Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

April 17, 2023

Mary Alice Evans, Director
State of Hawai'i Office of Planning and Sustainable Development
Environmental Review Program
235 South Beretania Street, Suite 702
Honolulu, HI 96813

Subject: Transmittal of Programmatic Draft Environmental Impact Statement
Addition of Wastewater Services for the Puna District

Dear Ms. Evans:

The County of Hawai'i Department of Environmental Management has determined that the proposed Addition of Wastewater Services for the Puna District may have a significant effect on the environment and, therefore, likely will require the preparation of a programmatic environmental impact statement (PEIS). Per Hawai'i Administrative Rules (HAR) Title 11 Chapter 200.1-14(d)(2), the county is choosing to prepare a PEIS in accordance with Subchapter 10, beginning with completion of a programmatic environmental impact statement preparation notice. We hereby transmit the accompanying programmatic draft environmental impact statement for the Proposed Action, located in the planning area for the Puna Community Development Plan on the Island of Hawai'i, for publication in the next edition of *The Environmental Notice* on April 23, 2023.

Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

From: webmaster@hawaii.gov
To: DBEDT OPSD Environmental Review Program
Subject: New online submission for The Environmental Notice
Date: Thursday, April 13, 2023 8:48:02 AM

Action Name

Addition of Wastewater Services for the Puna District

Type of Document/Determination

Draft environmental impact statement (DEIS)

HRS §343-5(a) Trigger(s)

- (1) Propose the use of state or county lands or the use of state or county funds
- (9)(A) Propose any wastewater treatment unit, except an individual wastewater system or a wastewater treatment unit serving fewer than fifty single-family dwellings or the equivalent

Judicial district

Puna, Hawai‘i

Tax Map Key(s) (TMK(s))

Numerous

Action type

Agency

Other required permits and approvals

Numerous (see document)

Proposing/determining agency

Department of Environmental Management, County of Hawai‘i

Agency contact name

Kelly Hartman

Agency contact email (for info about the action)

Kelly.Hartman@hawaiicounty.gov

Email address or URL for receiving comments

Kelly.Hartman@hawaiicounty.gov

Agency contact phone

(808) 961-8512

Agency address

345 Kekūanāo‘a Street, Suite 41
Hilo, HI 96720
United States
Map It

Accepting authority

Office of the Mayor, County of Hawai'i

Accepting authority contact name

Mitch Roth

Accepting authority contact email or URL

mitchd.roth@hawaiicounty.gov

Accepting authority contact phone

(808) 961-8211

Accepting authority address

25 Aupuni Street
Hilo, HI 96720
United States
Map It

Was this submittal prepared by a consultant?

Yes

Consultant

AECOM

Consultant contact name

Rae Loui

Consultant contact email

rae.loui@aecom.com

Consultant contact phone

(808) 529-7221

Consultant address

1001 Bishop Street, Suite 1600
Honolulu, HI 96813
United States
Map It

Action summary

The Proposed Action is the addition of wastewater collection, treatment, and disposal infrastructure and services for the Project Area. The action would provide efficient, technologically advanced, and resilient wastewater collection, treatment, and disposal infrastructure and services, primarily to town and village centers in the Project Area.

Attached documents (signed agency letter & EA/EIS)

- Puna-WW-Svcs-Final-PDEIS-_2023.04.12.pdf
- Transmittal-Letter-to-ERP_Puna-DEIS.pdf

Shapefile

- The location map for this Draft EIS is the same as the location map for the associated EIS Preparation Notice.

Action location map
• ProjectArea.zip
Authorized individual
Aaron Weieneth, AECOM
Authorization
• The above named authorized individual hereby certifies that he/she has the authority to make this submission.

PROGRAMMATIC DRAFT ENVIRONMENTAL IMPACT STATEMENT

ADDITION OF WASTEWATER SERVICES FOR THE PUNA DISTRICT

APRIL 2023

County of Hawai'i
Department of Environmental Management
345 Kekūanaō'a Street, Suite 41
Hilo, Hawai'i 96720

Delivering a better world

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PROGRAMMATIC DRAFT ENVIRONMENTAL IMPACT STATEMENT

ADDITION OF WASTEWATER SERVICES FOR THE PUNA DISTRICT

Prepared for:

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

Prepared by:

AECOM Technical Services, Inc.
1001 Bishop Street, Suite 1600
Honolulu, Hawai‘i 96813-3698

April 2023

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PROJECT SUMMARY

Project Name	Addition of Wastewater Services for the Puna District.
Project Location	The Project Area for the addition of wastewater services for the Hawai'i County Puna District is located on the windward side (east side) of the island of Hawai'i. The Pacific Ocean defines the area's eastern and southern borders. The Project Area is coterminous with the planning area for the Puna Community Development Plan (CDP). It encompasses Council District 4 and portions of Council Districts 3, 5, and 6. The Project Area is bordered by the Hawai'i County Hilo District to the northwest and generally by the Ka'ū District to the west, although the northwest corner of the area extends into that district.
Tax Map Keys	Numerous.
Community Plan	Puna Community Development Plan.
State Land Use	Agricultural, Conservation, Rural, and Urban Land Use Districts.
County Zoning	Agricultural, Neighborhood Commercial, Village Commercial, Family Agricultural, Forest Reserve, Industrial-Commercial Mixed, General Industrial, Limited Industrial, National Park, Open, Residential and Agricultural, Multiple-Family Residential, Single-Family Residential, Resort-Hotel Districts.
Special Management Area	Portions of Project Area are in the Special Management Area.
Flood Zone	Portions of the Project Area are in flood zone.
Proposed Action	The Proposed Action is the addition of wastewater collection, treatment, and disposal infrastructure and services for the Project Area. The action would provide efficient, technologically advanced, and resilient wastewater collection, treatment, and disposal infrastructure and services, primarily to town and village centers in the Project Area.
Alternatives Considered	Individual Wastewater Systems and Decentralized Treatment (no action) Decentralized Treatment Subregional Wastewater Treatment Plants Regional Wastewater Treatment Plant Conveyance to Hilo Wastewater Treatment Plant
Triggers for an Environmental Document under HRS 343-5(a)	(1) Use of County lands and use of County funds. (9)(A) Wastewater treatment unit.
Proposing Agency	Department of Environmental Management County of Hawai'i 345 Kekūanaō'a Street, Suite 41 Hilo, HI 96720 Phone: (808) 961-8083 Fax: (808) 961-8086
Agency Determination	The County of Hawai'i Department of Environmental Management, as the proposing agency, has determined through its judgement and experience that the Proposed Action may have a significant effect on the environment and, therefore, likely will require the preparation of a programmatic environmental impact statement (PEIS). Per Hawai'i Administrative Rules (HAR) Title 11, Chapter 200.1-14(d)(2), the County is choosing to prepare a PEIS in accordance with Subchapter 10, beginning with completion of a programmatic environmental impact statement preparation notice (PEISPN).

Accepting Authority	Mayor Mitchell D. Roth Office of the Mayor County of Hawai'i 25 Aupuni Street Hilo, HI 96720 Email: mitchd.roth@hawaiicounty.gov Phone: (808) 961-8211 Fax: (808) 961-6553

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ACRONYMS AND ABBREVIATIONS

AAQS	ambient air quality standards
ALICE	Asset Limited, Income Constrained, Employed
BMP	best management practice
CAA	Clean Air Act, Section
CCD	census county division
CDP	community development plan
CO	carbon monoxide
dBA	decibel (A-weighted level)
DBEDT	Department of Business, Economic Development and Tourism, State of Hawai‘i
DEM	Department of Environmental Management, County of Hawai‘i
DLNR	Department of Land and Natural Resources, State of Hawai‘i
DOFAW	Division of Forestry and Wildlife, DLNR
DOH	Department of Health, State of Hawai‘i
FEMA	Federal Emergency Management Agency
GHG	greenhouse gas
H_2S	hydrogen sulfide
HAR	Hawai‘i Administrative Rules
HDOT	Hawai‘i Department of Transportation
HELCO	Hawai‘i Electric Light Company, Inc.
HHW	household hazardous waste
HIBC	Hawai‘i Island Burial Council
HRS	Hawai‘i Revised Statutes
IPaC	Information for Planning and Consultation
IWS	individual wastewater system
mgd	million gallons per day
NAAQS	National Ambient Air Quality Standards
NOAA	National Oceanic and Atmospheric Administration
NO_2	nitrogen dioxide
O_3	ozone
Pb	lead
PDEIS	programmatic draft environmental impact statement
PEIS	programmatic environmental impact statement
PEISPN	programmatic environmental impact statement preparation notice
PFEIS	programmatic final environmental impact statement
$PM_{2.5}$	particulate matter with a diameter ≤ 2.5 micrometers
PM_{10}	particulate matter with a diameter ≤ 10 micrometers
PPV	peak particle velocity
SHPD	State Historic Preservation Division
SO_2	sulfur dioxide
TOD	transit-oriented development
USCB	United States Census Bureau
USEPA	United States Environmental Protection Agency

USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
vpd	vehicle(s) per day
WWTP	wastewater treatment plant

1.0 PURPOSE AND NEED

1.1 LOCATION

The Project Area for the addition of wastewater services for the Hawai‘i County Puna District is located on the windward side (east side) of the island of Hawai‘i, with the Pacific Ocean to the east and south. The Project Area is coterminous with the planning area for the Puna Community Development Plan (CDP) (County of Hawai‘i 2011). As illustrated by Figure 1-1, it encompasses essentially all of Council District 4 and portions of Council Districts 3, 5, and 6. The Project Area is bordered by the Hawai‘i County Hilo District to the northwest and generally by the Ka‘ū District to the west, although the northwest corner of the area extends into that district.

The County of Hawai‘i is evaluating the addition of wastewater services to the following town and village centers designated in the Project Area (County of Hawai‘i 2011), as shown in Figure 1-2:

- Regional Town Centers providing a wide range of services for the Project Area, comprising Kea‘au, Pāhoa, and Hawaiian Paradise Park.
- Community Village Centers providing a more limited range of services in smaller existing urban settlements and in large subdivisions that are experiencing the greatest rates of build-out, comprising ‘Āinaloa, Kurtistown, Maku‘u Homesteads, Mountain View, Volcano, and two or more locations in Hawaiian Paradise Park.
- Neighborhood Village Centers, being the smallest in scale and located in underserved remote communities and in subdivisions with relatively small lot sizes and significant rates of population growth, are projected for Glenwood, Orchidland Estates, Hawaiian Paradise Park, and Hawaiian Beaches.
- Future locations subject to community review are potential additional Neighborhood Village Centers that may be established. These include Kaimū, Poihikau, Kapoho, Leilani Estates, Nānāwale Estates, and near Volcano.

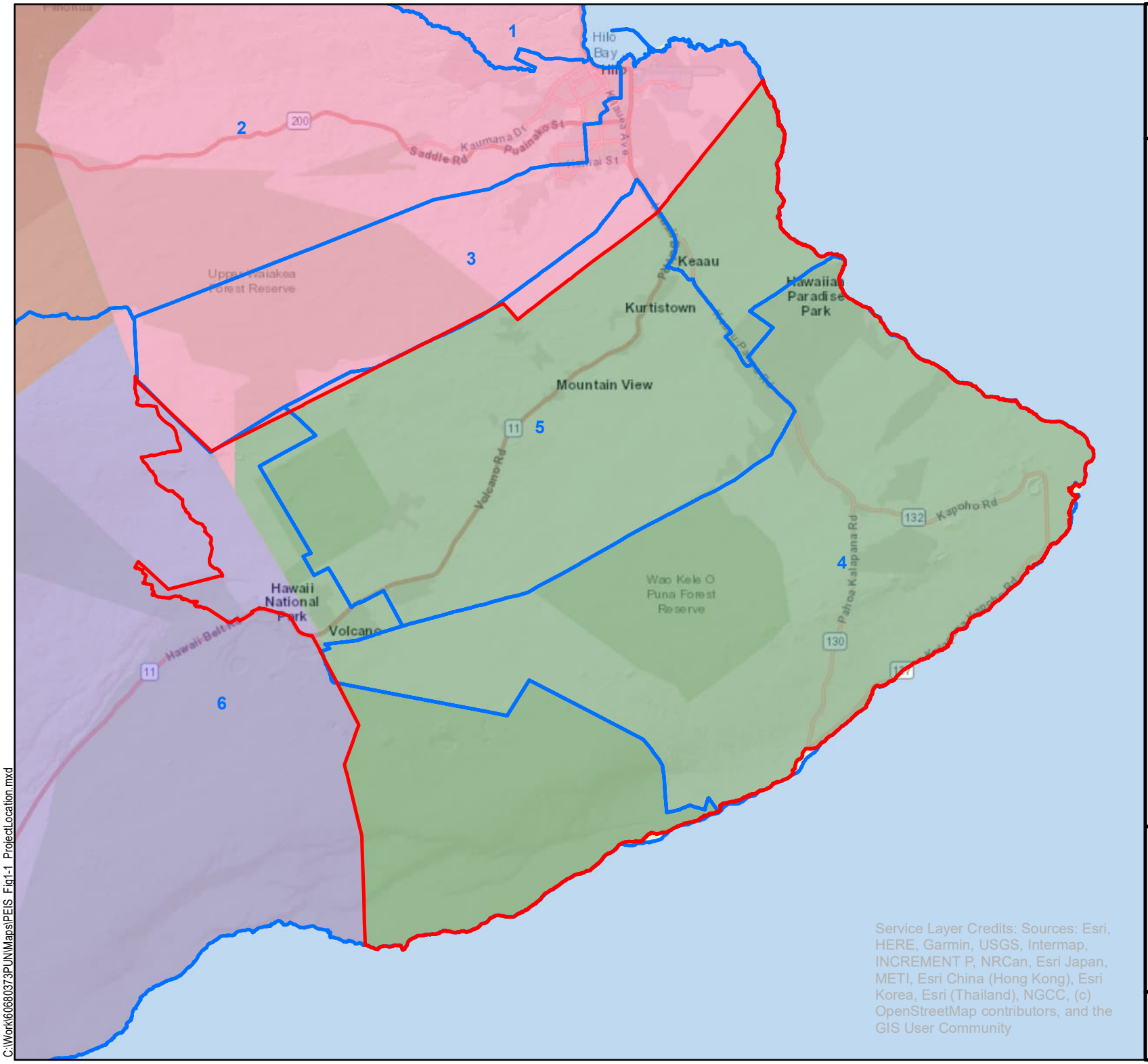

FIGURE 1-1

PROJECT LOCATION

Legend

- Project Area
- Council Districts

Hawai'i County Districts

- Ka'ū
- N. Hilo
- Puna
- S. Hilo

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, Hawai'i County Council District Boundaries, May 2022.

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Honolulu, HI 96813

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FIGURE 1-2

TOWN AND VILLAGE CENTERS

Legend

- Project Area
- Roads

Town and Village Centers

- Regional
- Community
- Neighborhood
- Future Neighborhood
- Location Subject to Community Review

Sources: County of Hawai'i, 2011 Puna Community Development Plan; 2011 Puna CDP, Proposed Town and Village Center Locations.

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1.2 PURPOSE AND NEED FOR THE PROPOSED ACTION

Kīlauea ranks among the world's most active volcanoes (United States Geological Survey [USGS] 2022a). During the 2018 eruption of Kīlauea, from May through August, large lava flows destroyed over 700 homes and devastated residential areas in the Project Area, partially or completely inundating multiple neighborhoods, destroying Kua O Ka Lā public charter school and Ahalanui Park, and resulting in the loss of historical and culturally sacred places (County of Hawai'i 2020c, National Park Service 2021).

The Kīlauea eruption, along with damage from Hurricane Lane, which brought torrential rainfall and strong winds during late August 2018, affected tourism and visitor services, disturbed supply chains, damaged infrastructure, directly impacted real estate, and shocked consumers island-wide (Institute for Sustainable Development 2020). The two events caused more than $974.9 million in impacts, including the destruction or damage to County-owned infrastructure assets preliminarily estimated at $236 million. More than 3,350 people lost their jobs over 12 months after the eruption began in May, as illustrated by Figure 1-3, and numerous small businesses closed or downsized (Institute for Sustainable Development 2020).

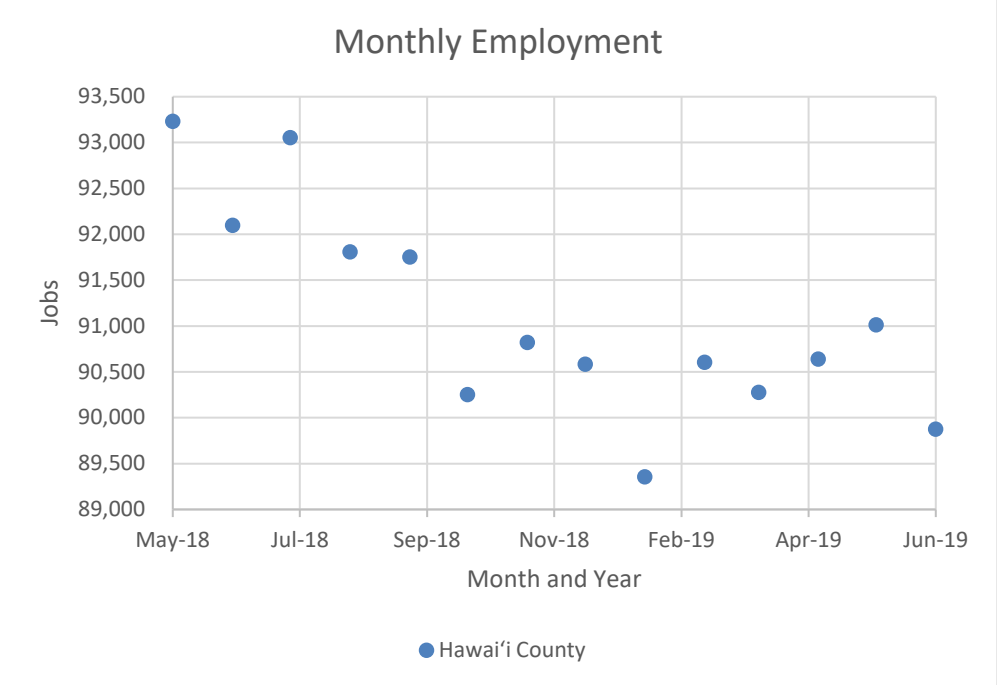

Figure 1-3. Hawai'i County Monthly Employment, May 2018 – June 2019

Source: United States Bureau of Labor Statistics 2022c, Local Area Unemployment Statistics, Customized Tables, Employment.

The economy and labor market in Hawai'i changed in response to the Kīlauea eruption and Hurricane Lane, the onset of the coronavirus disease 2019 (COVID-19) pandemic, and the attendant shutdown and restriction on travel to the State. The

first COVID-19 shutdown in March 2020 led to high statewide unemployment in April, and the second shutdown in late August to September 2020, after a partial recovery in employment, led to a second peak in unemployment in September (Liou 2021). As shown in Figure 1-4, the unemployment rates for Hawai'i County followed a similar trend, increasing from 2.5 percent in March to 21.9 percent in April 2020. The data also shows a comparatively minor, although substantive, increase of 1.4 percent in the County unemployment rate in June 2018; however, it would be speculative to attribute this to the Kīlauea eruption and the increase precedes Hurricane Lane by two months.

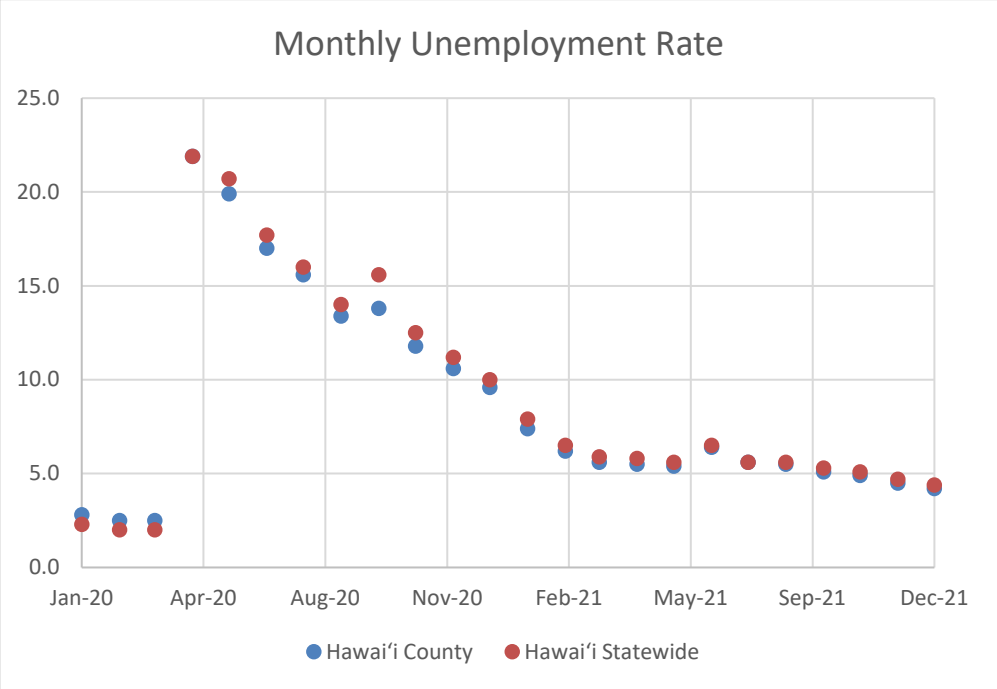

Figure 1-4. Monthly Unemployment Rate, 2020 – 2021

Source: United States Bureau of Labor Statistics 2022c, Local Area Unemployment Statistics, Customized Tables, Unemployment Rate.

The process to plan and implement immediate, near-term, and long-term recovery actions following the Kīlauea eruption has been ongoing since late 2018. The Puna CDP Action Committee lists four main goals from the Kīlauea Eruption Recovery planning process as priorities (County of Hawai'i 2022b):

- Village Town Centers – Create Village Town Centers that provide residents with greater access to goods, services, educational resources, and economic opportunities in a thoughtful and sustainable manner, including options for marketing locally produced products.
- Infrastructure – Develop essential infrastructure to provide livable spaces, including increased connectivity of roads to provide alternative routes for emergency situations and managed traffic flow and increased internet

connectivity to encourage employment, educational and economic opportunities for residents.

- Natural and Cultural Resource Management – Preserve native ecosystems, maintain pono [righteous] uses of natural resources, and protect increasingly threatened forests.
- Health and Well-Being – Promote the development of medical facilities and services, social services and programs, and family economic self-sufficiency services and programs to increase the mental, physical, emotional, and economic health and wellbeing of communities and residents, especially the most vulnerable in the community.

Under the Infrastructure goal are three objectives that address transportation, utilities, and gathering spaces, respectively. The Utilities objective is to "Restore, improve and expand adequate and affordable utilities (water, wastewater, energy, phone and internet services) where needed and infrastructure is lacking."

Similarly, Recommendation 5 of the *2018 Kīlauea Disaster Economic Recovery Plan* (Institute for Sustainable Development 2020) is to invest in critical infrastructure, as access to necessary infrastructure, including wastewater infrastructure, is one of the critical components for the success of businesses. Among the key elements of the recommendation is to invest in wastewater infrastructure, as well as water infrastructure, "to facilitate commercial development in Puna's town centers, which serve as economic anchors and assure natural resources are protected." Another key element of Recommendation 5 is to "Convert old, obsolete, or counter-productive infrastructure to more resilient, efficient, and technologically advanced solutions," to develop infrastructure that can withstand future extreme weather or geological events.

Presently, the County of Hawai'i does not provide any wastewater collection and treatment facilities in the Project Area. As of 2005, most residents in the district were served by individual wastewater systems including cesspools and household aerobic treatment units (County of Hawai'i 2005). There are an estimated 49,300 inventoried cesspools in the County of Hawai'i that discharge approximately 27.3 million gallons of raw sewage effluent into the County's groundwater and surface waters per day (State of Hawai'i Department of Health [DOH] 2017, 2021a). Figure 1-5 shows cesspool locations within the Project Area. Based on May 2017 data from DOH, as of 2010, there were approximately 16,000 cesspools on 15,400 properties in the Project

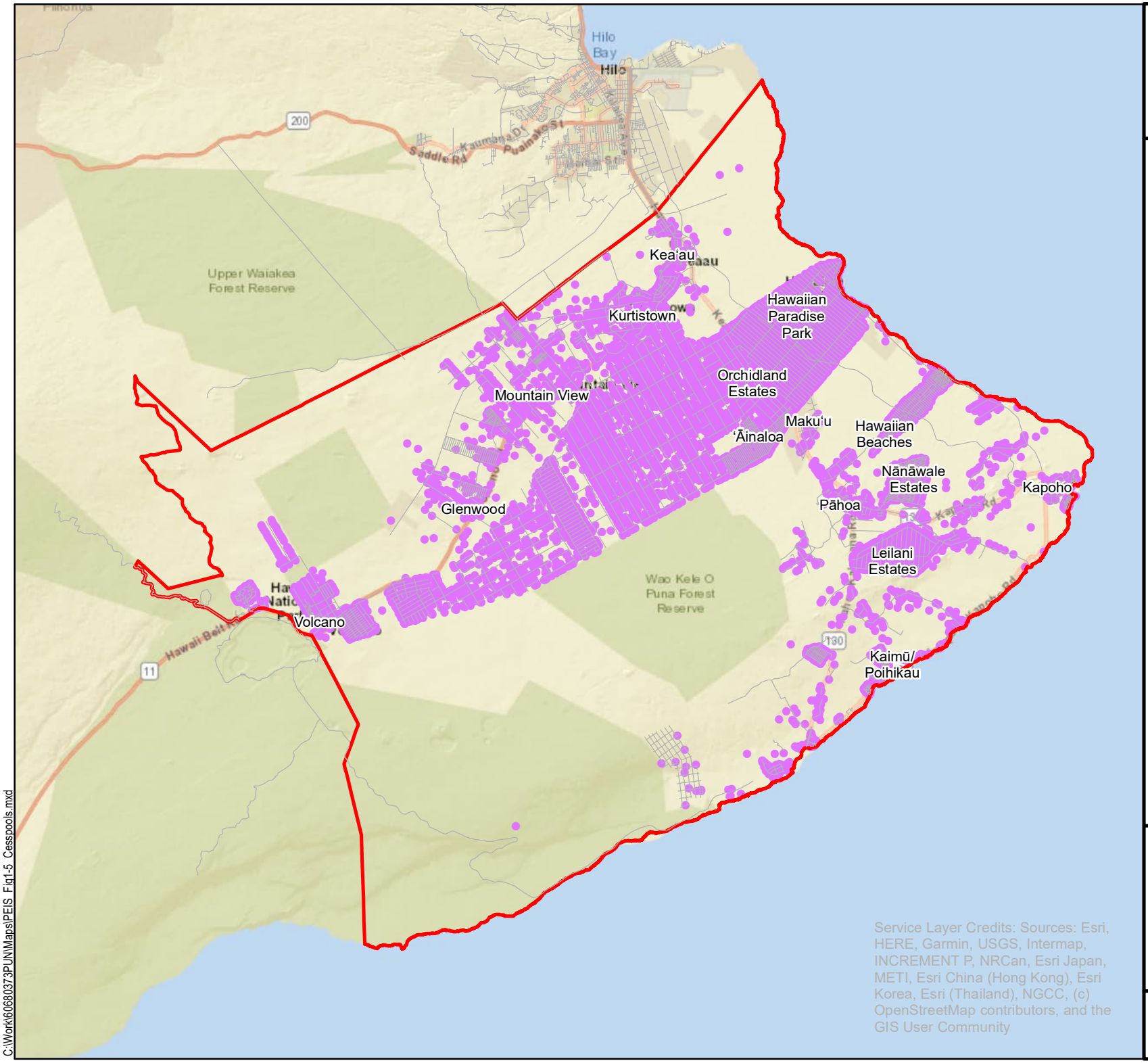

FIGURE 1-5

CESSPOOLS

Legend

- Project Area
- Roads
- Cesspools

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, On-site Sewage Disposal Systems for the island of Hawai'i, Oct. 2021.

N

0 12,500 25,000 Feet

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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Area discharging approximately 8.5 million gallons of raw sewage effluent per day (Hawai'i Statewide GIS Program 2021a)[1].

Cesspools are shallow, underground systems for disposing of sanitary wastewater. Typically unlined, with an open bottom and/or perforated sides, cesspools receive untreated wastewater but are not designed to treat sanitary waste. Rather, cesspools retain, or are designed to retain, the solids in wastewater discharged into them, while allowing the liquid to seep through their bottoms or sides. The pollutants in untreated wastewater from cesspools are released to the environment, discharged at depths below the ground surface that bypass the potential for natural remediation of wastewater contaminants (DOH 2017). The subsurface zone to which the liquid waste is discharged may be hydraulically connected to groundwater and surface water.

Cesspools are a dated, substandard sewage disposal method and their use, especially where many are located in close proximity, present a risk to human health and the environment (DOH 2017, 2021a; Mezzacapo and Shuler 2021). According to DOH (2017), the effluent from cesspools poses a significant risk:

> Cesspool wastewater is untreated and contains pathogens, bacteria and viruses that may spread disease. Additionally, cesspool effluent contains nutrients, like nitrogen and phosphorous, that can disrupt the sensitive ecosystems of Hawai'i, including harming nearshore coral reefs.

In 2017, the Hawai'i State Legislature passed Act 125, which required that by January 1, 2050 all cesspools in the State, unless granted exemption, shall upgrade or convert to a septic or aerobic treatment unit, or connect to a sewer system. In 2022, Act 125 was amended by Act 87, which expands the candidate individual wastewater systems (IWSs) to include any wastewater system approved by the DOH.

[1] According to Whittier and El-Kadi 2014, the discharge rate was estimated using residential dwelling characteristics and by the type of activity occurring at non-residential parcels. For residential units, guidance was provided by HAR Title 11, Chapter 62 that estimates an effluent rate of 200 gallons per day for each bedroom served by onsite sewage disposal systems. Non-residential activities included businesses, churches, schools, parks, and condominiums. The OSDS discharge rate for non-residential systems was based on estimates given in Metcalf and Eddy 1991.

The Proposed Action (defined in the next section) is needed to support the ongoing process of economic recovery in the Project Area, which has been impacted by the 2018 Kīlauea Eruption and Hurricane Lane, and the ongoing COVID-19 pandemic. It also is needed to reduce the risk to human health and the environment posed by reliance on dated, substandard sewage disposal methods for wastewater disposal in the Project Area. The purpose of the Proposed Action is to aid the economic recovery of the Project Area and Hawai'i County, and secondarily to contribute to the improvement of groundwater and surface water quality.

1.3 ENVIRONMENTAL SCOPE OF AUTHORITY AND PURPOSE OF THIS PDEIS

This programmatic draft environmental impact statement (PDEIS) was prepared by the County of Hawai'i Department of Environmental Management (DEM) in accordance with Hawai'i Revised Statutes (HRS) Chapter 343 and Hawai'i Administrative Rules (HAR) Title 11, Chapter 200.1. The Department's Proposed Action is an Agency Action subject to HRS Chapter 343 because it involves the following:

- Proposed use of County lands and the use of County funds, other than funds to be used for feasibility or planning studies for possible future programs or projects that the agency has not approved, adopted, or funded, or funds to be used for the acquisition of unimproved real property (HRS 343-5(a)(1)).
- Proposed wastewater unit, except an individual wastewater system or a wastewater treatment unit serving fewer than fifty single-family dwellings or the equivalent (HRS 343-5(a)(9)(A)).

Although the Proposed Action will be implemented in multiple component actions that, individually, may not have significant environmental impacts, HAR Section 11-200.1-10 requires that multiple actions of a "larger total program" be treated as a single action. Due to the collective scale of the Proposed Action, compliance with HRS Chapter 343 warrants the preparation and processing of a programmatic environmental impact statement (PEIS). It is anticipated that the PEIS will fulfill the intent and provisions of HRS Chapter 343, adequately disclose and describe all identifiable environmental impacts, and satisfactorily respond to review comments.

This PDEIS is intended to provide environmental considerations that may assist DEM in its decision-making. The alternative development and evaluation process, and development of the facility plan, is documented in this PDEIS for addition of wastewater services for the Puna District. The feedback obtained through public review and participation has informed the formulation of the facility plan for addition of wastewater services for the Puna District, as well as the range of actions, alternatives, impacts, and proposed mitigation measures considered and the significant issues analyzed in depth in the PDEIS.

With the planning level of information currently available (e.g., wastewater services facility plan being developed concurrently with the PEIS), the PDEIS evaluation is

considered programmatic. When sufficient design details are available, separate project-specific HRS Chapter 343 documents will be prepared as appropriate and compliance with special laws (e.g., HRS Chapter 6E, *Historic Preservation*) will be demonstrated.

The potential need for a Federal action is anticipated for project alternatives that involve work in water and the need for a United States Army Corps of Engineers (USACE) permit. These Federal actions would require National Environmental Policy Act compliance and compliance with other Federal special laws, and will be proposed by DEM as separate future actions, for the purpose of meeting Federal requirements.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 OBJECTIVES

As discussed in Section 1.2, the Proposed Action is needed to support the ongoing process of economic recovery in the Project Area and to reduce the risk to human health and the environment posed by reliance on dated, substandard sewage disposal methods for wastewater disposal. The purpose of the Proposed Action is to aid the economic recovery of the Project Area and Hawai‘i County, and secondarily to contribute to the improvement of groundwater and surface water quality.

The primary objectives of the Proposed Action are to:

- Establish wastewater collection, treatment, and disposal infrastructure and services in the Project Area, to which property owners and businesses in urban areas and clustered developments can connect
- Thereby, enable compliance with Act 125 of 2017 as amended by Act 87 of 2022, which requires that by January 1, 2050 all cesspools in the State, unless granted exemption, shall upgrade or convert to a wastewater system approved by the State of Hawai‘i Department of Health (DOH), or connect to a sewer system

2.2 HISTORIC PERSPECTIVE

Cesspools are used throughout the State of Hawai‘i, Hawai‘i County, and the Project Area for the disposal of untreated sanitary waste. The geology and terrain of the Island of Hawai‘i makes it expensive to build sewer connections and, within the Project Area, the County of Hawai‘i presently does not provide any wastewater collection and treatment facilities. Especially in rural areas due to the large distances between houses, sewer systems often are not feasible. Project Area communities, therefore, rely on cesspools.

Large-capacity cesspools are subject to the United States Environmental Protection Agency’s (USEPA’s) Underground Injection Control regulations, 40 Code of Federal Regulations Parts 144 through 148, which required all existing large-capacity cesspools to be closed by April 5, 2005. State of Hawai‘i Act 125 of 2017 as amended by Act 87 of 2022, and DOH regulations require that cesspools of any size, unless granted exemption, be upgraded or converted to a wastewater system approved by DOH, or connected to a sewer system by January 1, 2050.

Hawai‘i has been very slow in replacing cesspools with more advanced treatment techniques, which Calabretta (2022) attributes to the diverse rain and soil conditions across the islands, and the high cost to homeowners of addressing cesspools:

- Mountainous terrain on the islands creates microclimates where some parts of the island have much more rain than others, and soils that transition from porous and sandy to higher in clay and impenetrable, affecting the suitability of individual wastewater systems (IWSs) and decentralized wastewater infrastructure.
- Installation costs are high, as materials and equipment are imported and labor costs are high. Installation of a septic system in Hawai‘i costs $20,000 to $50,000, with enhanced systems costing $5,000 to $10,000 more.

Act 125 (2017) directed DOH to investigate the number, scope, location, and priority of cesspools Statewide that require upgrade, conversion, or connection based on each cesspool's impact on public health, and submit a report of its findings and recommendations to the legislature no later than twenty days prior to the convening of the regular session of 2018. In its 2017 *Report to the Twenty-Ninth Legislature*, DOH proposed that cesspool replacement efforts be focused by geographic area, rather than by identifying individual cesspools, using the following broad categories (DOH 2017):

- Priority 1: Significant Risk of Human Health Impacts, Drinking Water Impacts, or Draining to Sensitive Waters. Cesspools in these areas appear to contribute to documented impacts to drinking water or human health, and also appear to impact sensitive streams or coastal waters.
- Priority 2: Potential to Impact Drinking Water. Cesspools in these areas are within the area of influence of drinking water sources, and have a high potential to impact those sources.
- Priority 3: Potential Impacts on Sensitive Waters. Cesspools in these areas cumulatively represent an impact to an area that includes sensitive State waters or coastal ecosystems (coral reefs, impaired waterways, waters with endangered species, or other vulnerabilities).
- Priority 4: Impacts Not Identified. Comprehensive health and environmental risks have not yet been assessed, or the risk of affecting public or environmental health currently appears low.

No Priority 1 areas were identified on Hawai‘i Island (DOH 2017). Within the Project Area, DOH (2017) designated as Priority 2 the 91-square mile Kea‘au area, with an estimated 9,300 cesspools discharging approximately 4.9 million gallons per day (mgd) of raw sewage effluent. The Department noted that many residents in this area rely on privately owned wells for domestic water, 25 percent of which tested positive for wastewater indicator bacteria, and that there is little soil to mitigate the impact of the effluent discharge or slow drainage of cesspool effluent to the water table.

Additionally, DOH (2017) designated as Priority 3 the 1.4-square mile Kapoho area, with an estimated 220 cesspools discharging 0.12 mgd of effluent. The Kapoho area was fronted by tidepools in the Wai‘ōpae Tidepools Marine Life Conservation

District. According to the Department, as the tidepools had only limited connection to the ocean, they and the abundant, resident coral were susceptible to degradation due to land-based pollution.

Cesspools in the Project Area that are located outside both the Kea'au Priority 2 area and the Kapoho Priority 3 area were designated as Priority 4 (DOH 2017).

During the 2018 eruption, subsequent to submittal of the 2017 *Report to the Twenty-Ninth Legislature* (DOH 2017), the Kapoho area was inundated by an active lava flow, largely destroying the entire residential community. An active ocean entry of lava inundated Kapoho Bay, including the conservation district, and the Wai'ōpae Tidepools and their coral communities were destroyed. Kapoho currently is an uninhabited, unincorporated area.

During the 2018 regular session, the State of Hawai'i Legislature passed Act 132, which established a Cesspool Conversion Working Group within DOH, to develop a long-range, comprehensive plan for converting all cesspools in the State by 2050.

The *2021 Hawai'i Cesspool Hazard Assessment & Prioritization Tool: 2021 Report & Technical Appendices* (Mezzacapo and Shuler 2021) reevaluates the DOH 2017 Cesspool Prioritization Report. Although the 2017 and 2021 reports share some approaches to evaluating the hazards posed by cesspools, there are significant differences in methodology and results. Importantly, whereas the 2017 effort evaluated risk rankings of broad geographical areas with respect to sensitive resources, the 2021 effort treats all cesspools as nonpoint pollution sources and groups them into finer geographical areas. The later effort also incorporated additional differences in methodology aimed at decreasing bias towards places for which scientific and monitoring data are available and decreasing subjectivity in defining prioritization areas.

The 2021 report categorizes cesspools based on potential or realized harm to humans and the environment, calculating a single prioritization score for every cesspool in the State. It consolidates individual cesspool prioritization scores by census tracts into the following three prioritization categories:

- Priority Level 1: Greatest contamination hazard;
- Priority Level 2: Significant contamination hazard; and
- Priority Level 3: Pronounced contamination hazard.

The *2021 Report & Technical Appendices* (Mezzacapo and Shuler 2021) does not designate any census tracts within the Project Area as Priority Level 1 or 2. All Project Area census tracts are categorized as Priority Level 3, pronounced contamination hazard.

In its *Final Report to the 2023 Regular Session Legislature*, the Cesspool Conversion Working Group (DOH 2022) recommends adjusting the deadline by which cesspools must be upgraded, converted, or connected to a staggered timeline. The timeline

would accelerate the mandatory conversion date for cesspools that pose the highest risk, as determined by the Hawai‘i Cesspool Prioritization Tool (Mezzacapo and Shuler 2021) and supporting water quality data. Specifically, the working group recommends replacing the 2050 deadline mandated by Act 125 (2017) with the following deadlines:

- Priority Level 1 converted by 2030;
- Priority Level 2 converted by 2035; and
- Priority Level 3 converted by 2050.

The overall historic setting of the Project Area is presented in Section 3.7.1.

2.3 PROPOSED ACTION

The Proposed Action is the addition of wastewater collection, treatment, and disposal infrastructure and services for the Project Area. The action would provide efficient, technologically advanced, and resilient wastewater collection, treatment, and disposal infrastructure and services, primarily to town and village centers in the Project Area.

Options for wastewater systems comprise the following (USEPA 2005):

- Onsite – A system relying on natural processes and/or mechanical components to collect, treat, and disperse or reclaim wastewater from a single dwelling or building;
- Decentralized – A managed onsite system and/or cluster of systems used to collect, treat, and disperse or reclaim wastewater from a small community or service area; and
- Centralized – A managed system consisting of collection sewers and a single treatment plant used to collect and treat wastewater from an entire service area.

2.4 ALTERNATIVES CONSIDERED

The County of Hawai‘i currently is developing and evaluating wastewater system alternatives, comprising sets of collection, treatment, and disposal options, for the various town and village centers identified in Section 1.1 and shown on Figure 1-2. Alternatives are being evaluated in terms of engineering feasibility; compliance with regulatory requirements; construction, maintenance, and operation costs; and potential environmental and social impacts. In turn, the County is developing combinations, or suites, of alternatives for each town and village center to be incorporated into a wastewater facility plan for the district. In addition to alternatives fully within the Project Area, the County is evaluating conveying wastewater to the existing County of Hawai‘i Hilo Wastewater Treatment Plant (WWTP), which is located approximately 7 miles to the north. The existing permitted treatment and outfall capacity for the Hilo WWTP may need to be expanded to accept additional wastewater flow.

2.4.1 Alternative 1A – Individual Wastewater Systems and Decentralized Treatment

Alternative 1A comprises a combination of IWSs to treat and disperse or reclaim wastewater from individual dwellings or buildings, and decentralized treatment to collect, treat, and disperse or reclaim wastewater from small communities or service areas. Under this alternative, no County wastewater system would be constructed. Rather, individual property owners and businesses, and communities and developers would construct, operate, and maintain IWSs and decentralized wastewater systems, respectively.

Effectively, Alternative 1A is the no action alternative and is representative of the future no action condition. Under Alternative 1A, County wastewater collection, treatment, and disposal infrastructure and services for the Project Area would not be added. Act 125 of 2017 as amended by Act 87 of 2022 requires that by January 1, 2050 all cesspools in the State, unless granted exemption, shall upgrade or convert to a wastewater system approved by DOH, or connect to a sewer system. Alternative 1A would meet this requirement without the provision of County wastewater infrastructure and services. Although no County wastewater services or infrastructure would be added under the alternative, the County nonetheless may provide financial incentives to homeowners and businesses to enable cesspool conversions.

Figure 2-1 illustrates the progression of the IWS and decentralized treatment streams under Alternative 1A, and Table 2-1 summarizes the components of the alternative. Figure 2-2 depicts the anticipated locations of decentralized package treatment plants for this alternative, based on the locations of existing town center and proposed town center commercial areas and schools. Typically, decentralized plants would be constructed on approximately 1.8-acre sites. Properties not served by the decentralized plants would be served by IWSs.

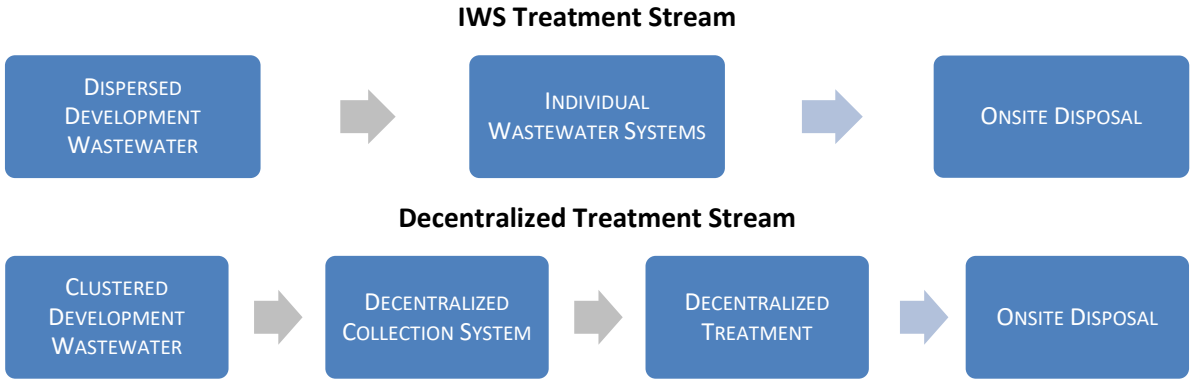

Figure 2-1. Flowchart of Alternative 1A Treatment Streams

Table 2-1. Alternative 1A Components

Component	IWS	Decentralized Treatment
Collection System	None	Decentralized collection system
Wastewater Treatment	Onsite	Onsite or clustered wastewater systems
Disposal	Effluent onsite and solids trucked to WWTP	Effluent onsite and solids trucked to WWTP

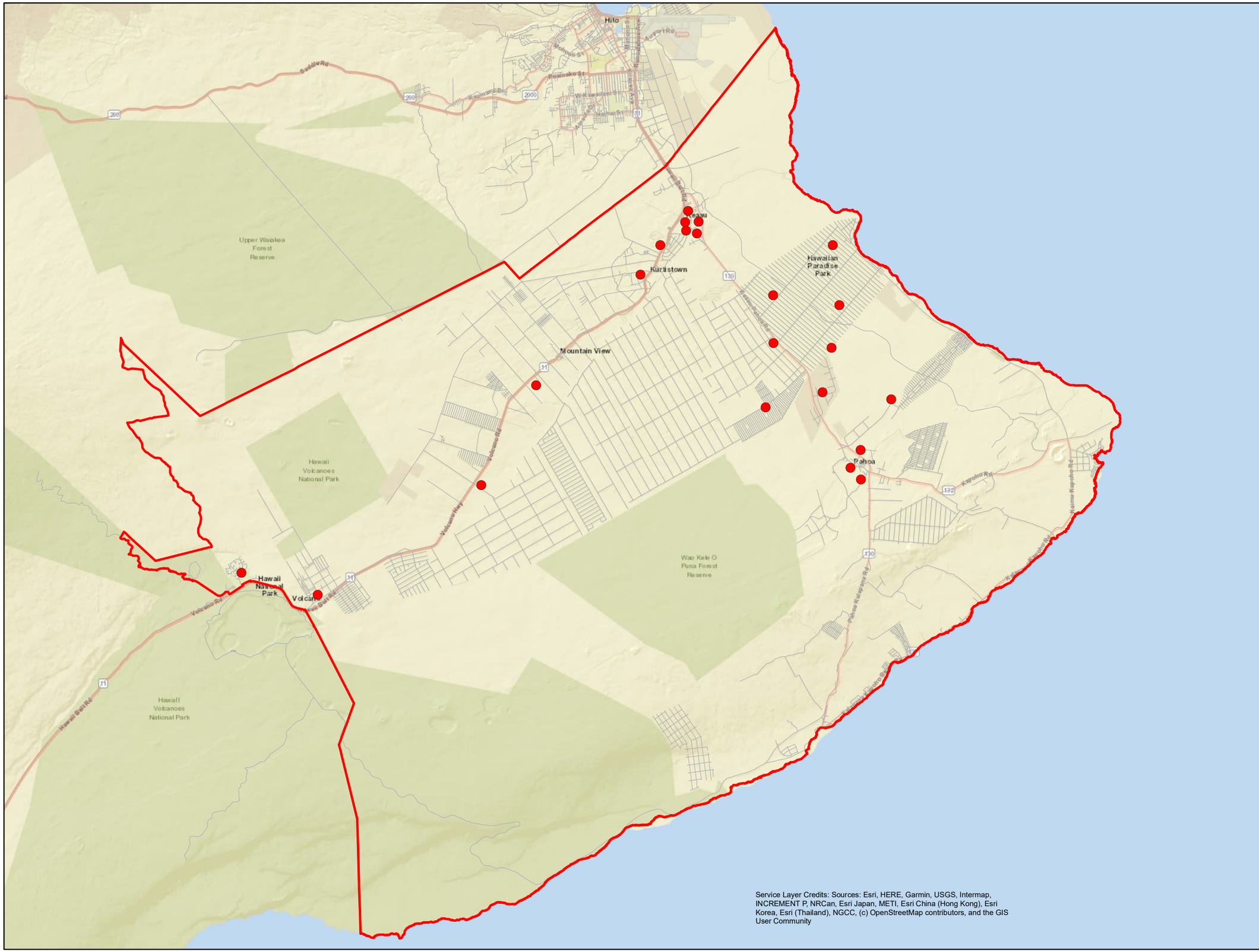

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FIGURE 2-2

ALTERNATIVE 1A

INDIVIDUAL WASTEWATER SYSTEMS AND DECENTRALIZED TREATMENT

Legend

Project Area

Roads

Anticipated Wastewater Infrastructure

Potential Decentralized Plant Location

Note:
Anticipated locations of decentralized package treatment plants are based on the locations of existing town center and proposed town center commercial areas and schools.

N

0 8,000 16,000 Feet

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2.4.2 Alternative 1B – Decentralized Treatment

Alternative 1B comprises decentralized treatment to collect, treat, and disperse or reclaim wastewater from individual dwellings or buildings, and small communities or service areas throughout the Project Area. Under this alternative, the County would construct, operate, and maintain the collection systems; whereas homeowners and other private entities would install, operate, and maintain the decentralized treatment facilities, as well as the connections on private property to the collection systems.

Figure 2-3 illustrates the progression of the decentralized treatment stream under Alternative 1B, and Table 2-2 summarizes the components of the alternative. Figure 2-4 depicts the anticipated locations of decentralized package treatment plants for this alternative, based on the estimated flow within each community and plant capacities ranging from 15,000 to 250,000 gallons per day. Low-pressure sewers would convey wastewater from residential and commercial properties to the decentralized plants, which typically would be constructed on approximately 1.8-acre sites. Hypothetically, all properties would be served by the decentralized plants.

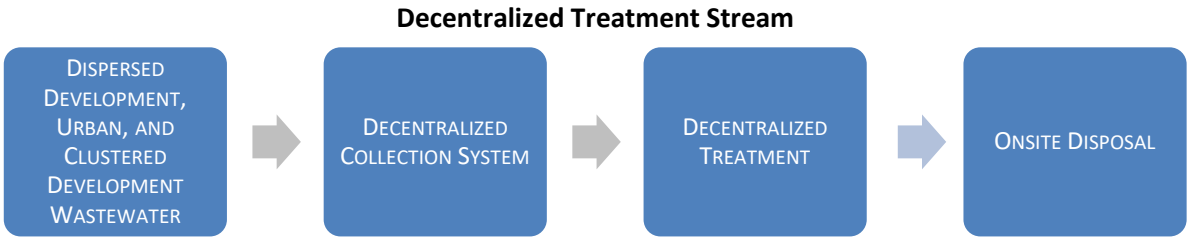

Figure 2-3. Flowchart of Alternative 1B Treatment Stream

Table 2-2. Alternative 1B Components

Component	Decentralized Treatment
Collection System	County decentralized collection system comprising low-pressure sewers with grinder pumps
Wastewater Treatment	Decentralized package treatment plants
Disposal	Effluent onsite and solids trucked to WWTP

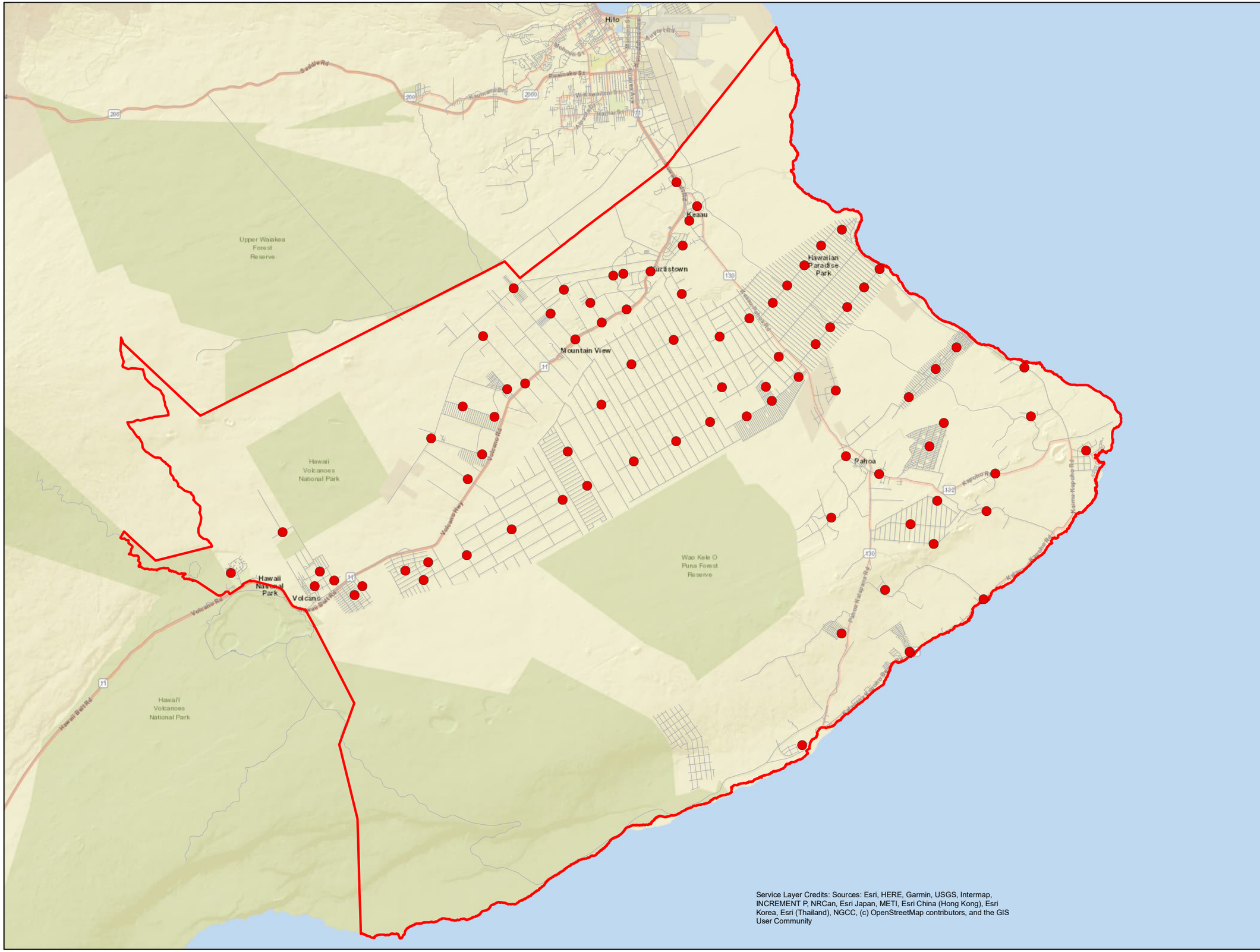

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FIGURE 2-4

ALTERNATIVE 1B

DECENTRALIZED TREATMENT

Legend

- Project Area
- Roads

Proposed Wastewater Infrastructure

- Potential Decentralized Plant Location

Note:
Anticipated locations of decentralized package treatment plants are based on the estimated flow within each community and plant capacities ranging from 15,000 to 250,000 gallons per day. Low-pressure sewers typically would be installed along neighborhood roadways, where properties would be sewered for conveyance of wastewater to package treatment plants.

N

0 8,000 16,000 Feet

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2.4.3 Alternative 2/3 – Subregional Wastewater Treatment Plants

Alternative 2/3 comprises a combination of subregional centralized WWTPs to collect and treat wastewater from three or four subregional service areas, and IWSs to treat and disperse or reclaim wastewater from individual dwellings or buildings not within the WWTP service areas. Under this alternative, the County would construct, operate, and maintain the subregional wastewater systems, and individual property owners and businesses would construct, operate, and maintain IWSs.

Subregional WWTPs would be located in Volcano, Kea'au, and Hawaiian Paradise Park (three service areas option), or in those three locations plus Pāhoa (four service areas option). For the three service areas option, the Pāhoa and Hawaiian Paradise Park service areas would be consolidated into a single service area, served by a subregional WWTP in Hawaiian Paradise Park. The subregional WWTPs would be constructed on approximately 5- to 12-acre sites, depending on wastewater flows, site characteristics, surrounding land use, and the resulting need for buffer zones around the plants. Land application of wastewater effluent that is not reused would require an additional 6 to 32 acres of land. Pump stations would be constructed on approximately 0.5-acre sites.

Figure 2-5 illustrates the progression of the subregional WWTP and IWS treatment streams under Alternative 2/3, and Table 2-3 summarizes the components of the alternative. Figures 2-6 and 2-7 depict the planned locations of the subregional WWTPs, extents of the subregional collection systems, locations of pump stations, and alignments and sizes of County sewers and force mains for the three service areas option and the four service areas option, respectively. Properties not served by the subregional plants would be served by IWSs.

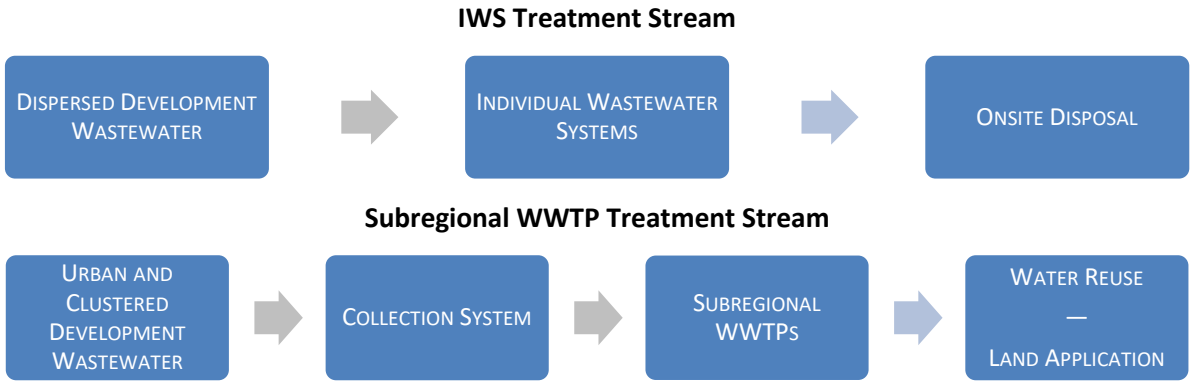

Figure 2-5. Flowchart of Alternative 2/3 Treatment Streams

Table 2-3. Alternative 2/3 Components

Component	IWS	Subregional WWTPs
Collection System	None	County collection systems comprising a mix of trenched or aboveground conventional gravity sewers in existing roadways and easements, subregional and neighborhood pump stations, and low-pressure sewers with grinder pumps
Wastewater Treatment	Onsite	3 or 4 County subregional WWTPs with a combined treatment capacity of approximately 6.0 mgd
Disposal	Effluent onsite and solids trucked to WWTP	Water reuse and land application of effluent, and landfill disposal of solids

2.4.4 Alternative 4/5 – Regional Wastewater Treatment Plant

Alternative 4/5 combines two Facility Plan regional plant alternatives:

- Alternative 4, a County regional wastewater system that does not accommodate wastewater from dispersed development[2] and rural areas, which would be served by IWSs.
- Alternative 5, a County regional wastewater system that hypothetically accommodates wastewater from all properties throughout the Project Area. Conceptually, all areas would be sewered.

Alternative 4/5 comprises a regional centralized WWTP to collect and treat wastewater from a single service area, and IWSs to treat and disperse or reclaim wastewater from individual dwellings or buildings not within the WWTP service area. Under this alternative, the County would construct, operate, and maintain the regional wastewater system, and individual property owners and businesses would construct, operate, and maintain IWSs. The regional WWTP would be located in Kea‘au on an approximately 18- to 20-acre site, depending on site characteristics, surrounding land use, and the resulting need for buffer zones around the plant. Land application of wastewater effluent that is not reused would require an additional 45 to 60 acres of land. Pump stations would be constructed on approximately 0.5-acre sites.

[2] Dispersed development, also referred to as urban growth or sprawl, is a pattern of low-density development spread over previously rural or wild landscapes. (Southerland 2004)

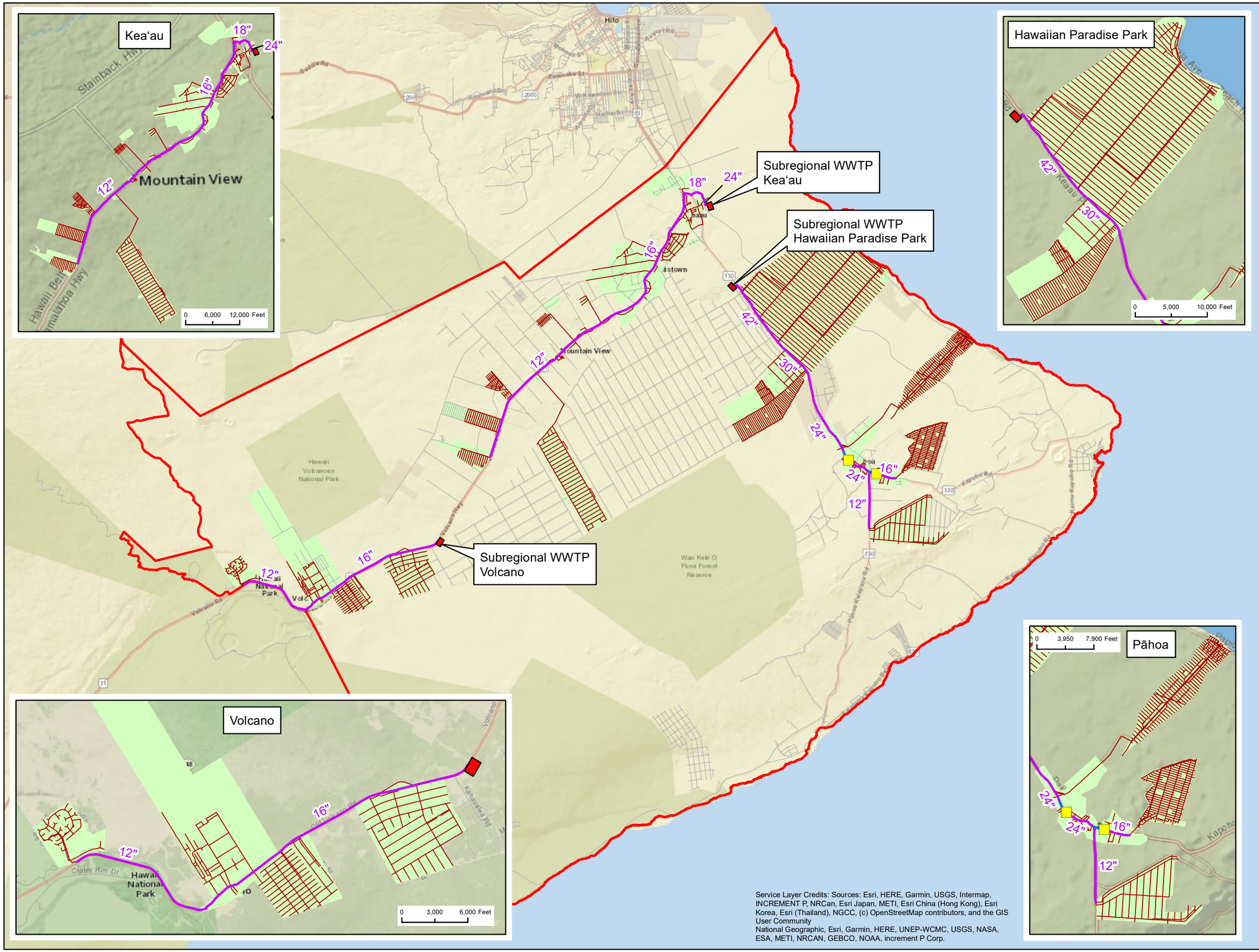

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FIGURE 2-6

ALTERNATIVE 2/3

SUBREGIONAL WASTEWATER TREATMENT PLANTS

THREE SERVICE AREAS

Legend

- Project Area
- Roads
- Areas Served by County Wastewater System

Proposed Wastewater Infrastructure

- Subregional WWTP
- 12" Trunk/Interceptor
- Force Main
- Pump Station
- Branch Sewer

N

0 8,000 16,000 Feet

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FIGURE 2-7

ALTERNATIVE 2/3

SUBREGIONAL WASTEWATER TREATMENT PLANTS

FOUR SERVICE AREAS

Subregional WWTP Kea'au

Subregional WWTP Hawaiian Paradise Park

Subregional WWTP Pāhoa

Subregional WWTP Volcano

Kea'au

Hawaiian Paradise Park

Pāhoa

Volcano

Legend

- Project Area
- Roads
- Areas Served by County Wastewater System

Proposed Wastewater Infrastructure

- Subregional WWTP
- 12" Trunk/Interceptor
- Force Main
- Pump Station
- Branch Sewer

N

0 8,000 16,000 Feet

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Figure 2-8 illustrates the progression of the regional WWTP and IWS treatment streams under Alternative 4/5, and Table 2-4 summarizes the components of the alternative. Figure 2-9 depicts the planned location of the regional WWTP, the extent of the regional collection system, locations of pump stations, and alignments and sizes of County sewers and force mains for this alternative. Properties not served by the regional plant would be served by IWSs. As depicted in Figure 2-10, Alternative 4/5 would accommodate wastewater from all properties throughout the Project Area and, therefore, is representative of Facility Plan Alternative 5.

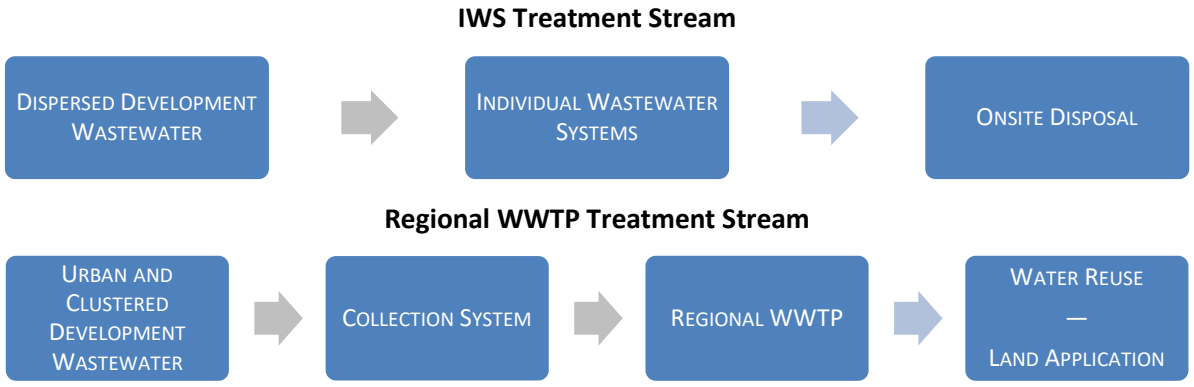

Figure 2-8. Flowchart of Alternative 4/5 Treatment Streams

Table 2-4. Alternative 4/5 Components

Component	IWS	Regional WWTP
Collection System	None	County collection system comprising a mix of trenched or aboveground conventional gravity sewers in existing roadways and easements, regional and neighborhood pump stations, and low-pressure sewers with grinder pumps.
Wastewater Treatment	Onsite	Regional WWTP with a treatment capacity ranging between approximately 6.0 and 8.6 mgd.
Disposal	Effluent onsite and solids trucked to WWTP	Water reuse and land application of effluent, and landfill disposal of solids. Injection wells and ocean discharge also are under consideration but likely will not be carried forward.

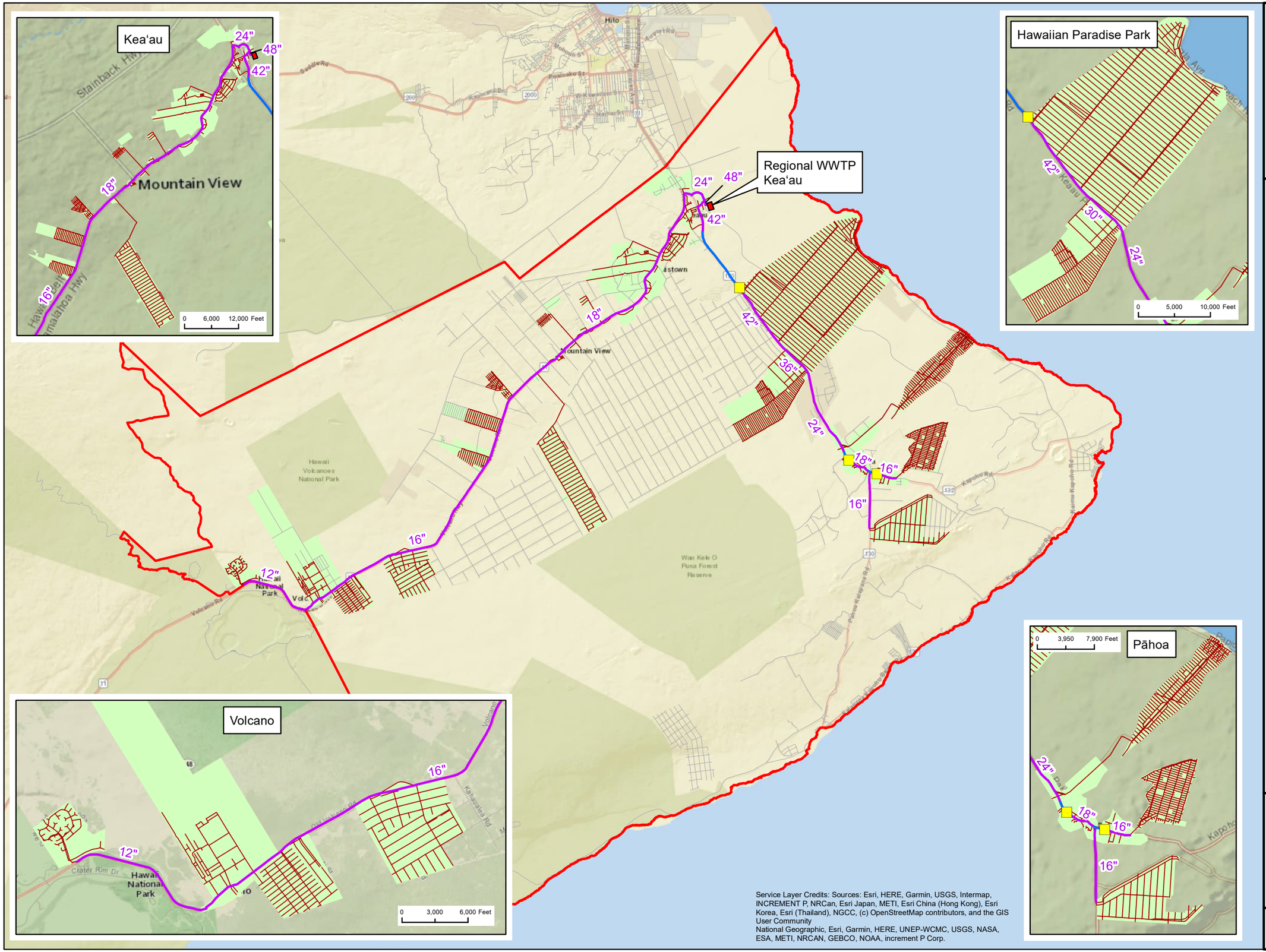

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FIGURE 2-9

ALTERNATIVE 4/5

REGIONAL WASTEWATER TREATMENT PLANT

URBAN AND CLUSTERED DEVELOPMENT SEWERING

Legend

- Project Area
- Roads
- Areas Served by County Wastewater System

Proposed Wastewater Infrastructure

- Regional WWTP
- 12" Trunk/Interceptor
- Force Main
- Pump Station
- Branch Sewer

N

0 8,000 16,000 Feet

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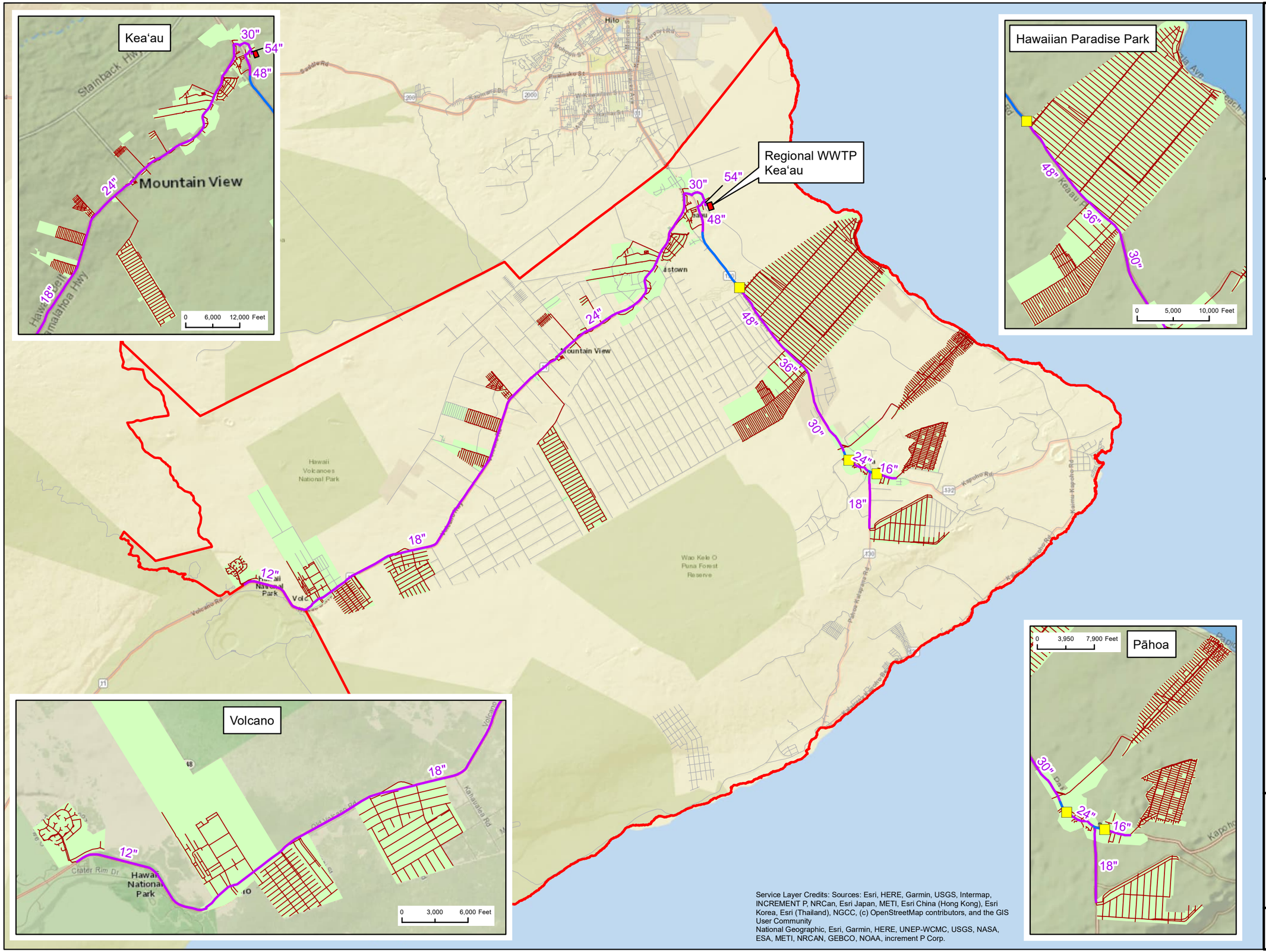

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FIGURE 2-10

ALTERNATIVE 4/5

REGIONAL WASTEWATER TREATMENT PLANT

FULL PROJECT AREA SEWERING

Legend

- Project Area
- Roads
- Areas Served by County Wastewater System

Proposed Wastewater Infrastructure

- Regional WWTP
- 12" Trunk/Interceptor
- Force Main
- Pump Station
- Branch Sewer

N

0 8,000 16,000 Feet

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2.4.5 Alternative 6/7 – Conveyance to Hilo Wastewater Treatment Plant

Alternative 6/7 combines two Facility Plan alternatives that entail conveying Project Area wastewater to the existing County of Hawai'i Hilo WWTP:

- Alternative 6, a County regional wastewater system that does not accommodate wastewater from dispersed development and rural areas, which would be served by IWSs.
- Alternative 7, a County regional wastewater system that hypothetically accommodates wastewater from all properties throughout the Project Area. Conceptually, all areas would be sewered.

Alternative 6/7 comprises collection of wastewater from a single service area and its conveyance to the Hilo WWTP for treatment, and IWSs to treat and disperse or reclaim wastewater from individual dwellings or buildings not within the WWTP service area. Under this alternative, the County would construct, operate, and maintain the regional wastewater system, and individual property owners and businesses would construct, operate, and maintain IWSs. The permitted capacity of the Hilo WWTP and potentially the capacity of the existing ocean outfall would need to be increased to accommodate wastewater from the Puna District, as well as additional wastewater from future population growth and cesspool closures within the current Hilo WWTP service area.

Potential environmental and social impacts outside the Project Area—e.g., impacts associated with conveyance of wastewater to the Hilo WWTP, expansion of the WWTP and the ocean outfall, and discharge of treated effluent to coastal marine waters—are not assessed in the Puna Programmatic Environmental Impact Statement (PEIS). Rather, if Alternative 6/7 is progressed, a separate project-specific Hawai'i Revised Statutes (HRS) Chapter 343 document would be prepared, when sufficient design details are available in the future.

Figure 2-11 illustrates the progression of the regional WWTP and IWS treatment streams under Alternative 6/7, and Table 2-5 summarizes the components of the alternative. Figure 2-12 depicts the location of the existing Hilo WWTP, the extent of the regional collection system within the Project Area, locations of pump stations, and alignments and sizes of County sewers and force mains for this alternative. Pump stations would be constructed on approximately 0.5-acre sites. Properties not served by the Hilo WWTP would be served by IWSs. As depicted in Figure 2-13, Alternative 6/7 would accommodate wastewater from all properties throughout the Project Area and, therefore, is representative of Facility Plan Alternative 6.

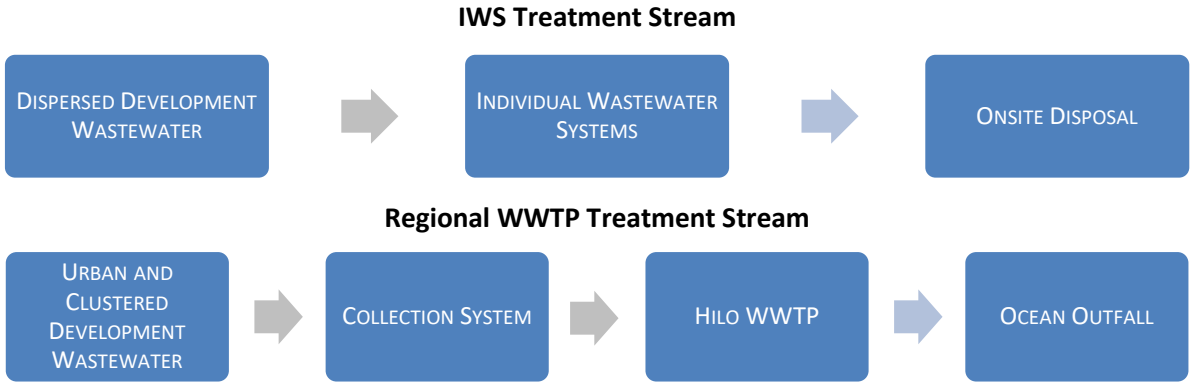

Figure 2-11. Flowchart of Alternative 6/7 Treatment Streams

Table 2-5. Alternative 6/7 Components

Component	IWS	Conveyance to Hilo WWTP
Collection System	None	County collection system comprising a mix of trenched or aboveground conventional gravity sewers in existing roadways and easements, regional and neighborhood pump stations, and low-pressure sewers with grinder pumps. Includes conveyance to Hilo WWTP.
Wastewater Treatment	Onsite	Treatment of between 6.0 and 8.6 mgd of Project Area wastewater at existing Hilo WWTP.
Disposal	Effluent onsite and solids trucked to WWTP	Existing ocean discharge.

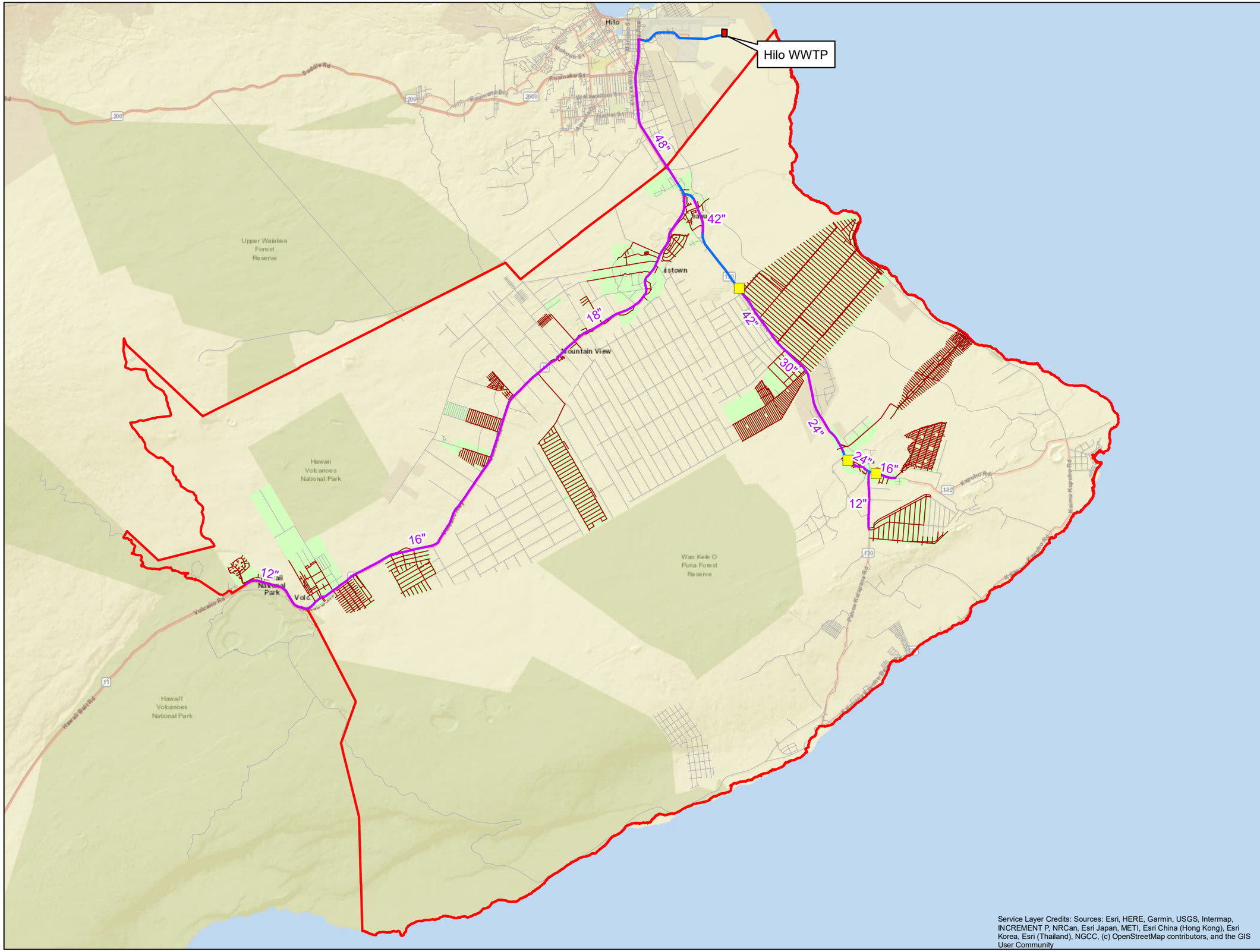

FIGURE 2-12

ALTERNATIVE 6/7

CONVEYANCE TO HILO WASTEWATER TREATMENT PLANT

URBAN AND CLUSTERED DEVELOPMENT SEWERING

Legend

- Project Area
- Hilo WWTP
- Roads
- Areas Served by County Wastewater System

Proposed Wastewater Infrastructure

- 12" Trunk/Interceptor
- Force Main
- Pump Station
- Branch Sewer

N

0 8,000 16,000 Feet

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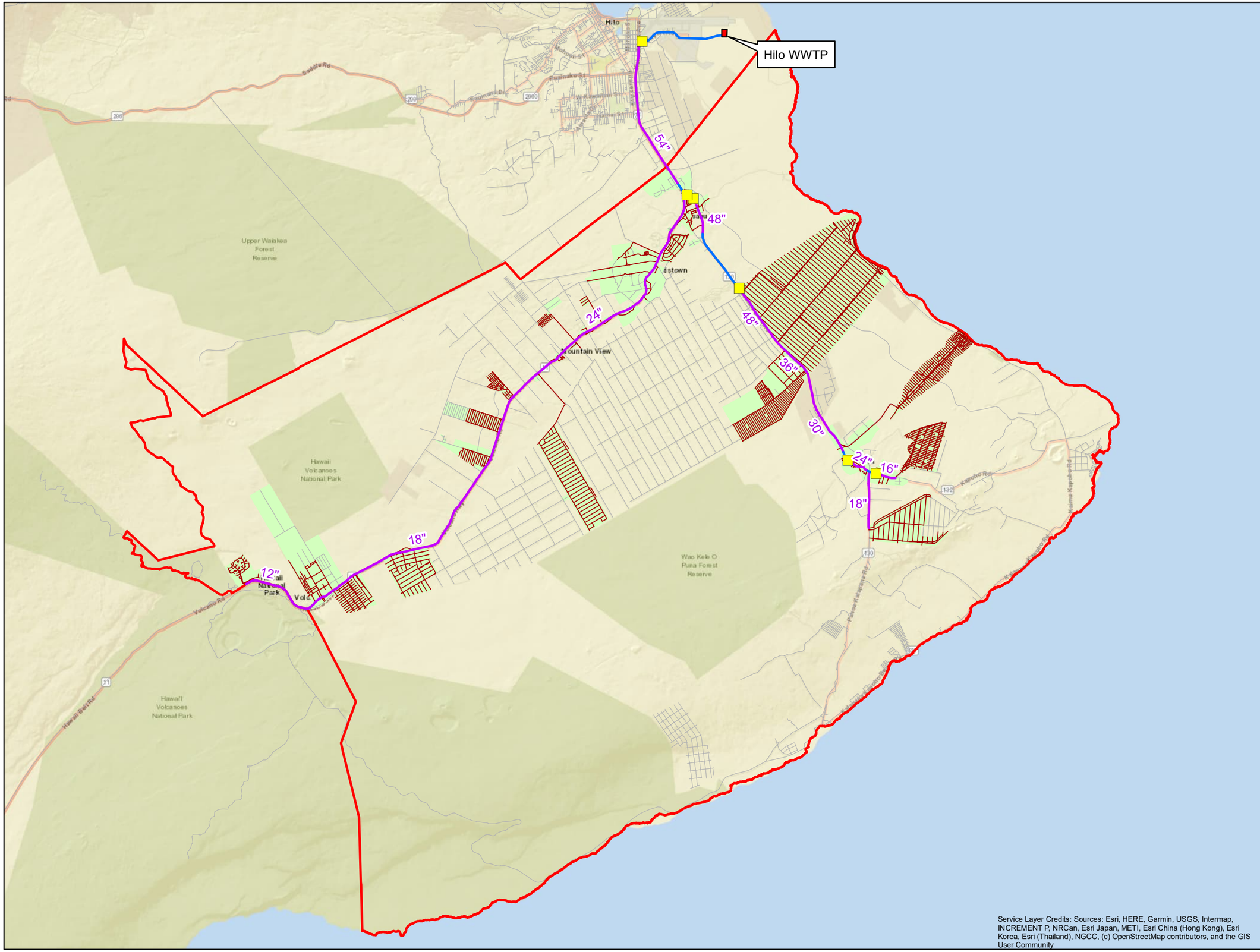

FIGURE 2-13

ALTERNATIVE 6/7

CONVEYANCE TO HILO WASTEWATER TREATMENT PLANT

FULL PROJECT AREA SEWERING

Legend

- Project Area
- Hilo WWTP
- Roads
- Areas Served by County Wastewater System

Proposed Wastewater Infrastructure

- 12" Trunk/Interceptor
- Force Main
- Pump Station
- Branch Sewer

N

0 8,000 16,000 Feet

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2.5 USE OF STATE OR COUNTY FUNDS OR LANDS

Implementation of Alternatives 1B, 2/3, 4/5, and 6/7 would entail use of County funds and County lands. Implementation of the Proposed Action is not expected to require the use of State funds or State lands.

2.6 PHASING AND TIMING

The final facility plan report for the addition of wastewater services for the Puna District is anticipated to be issued in August 2023, and the programmatic final environmental impact statement (PFEIS) is anticipated to be published in September 2023.

The facility plan is expected to detail the following implementation plan and schedule for a time horizon of 2052. Construction beyond January 1, 2050—when all cesspools in the State, unless granted exemption, shall upgrade or convert to a wastewater system approved by DOH, or connect to a sewer system—serves future growth at the end of the 30-year facility plan planning period.

The work related to all wastewater alternatives would need to be executed in the following steps:

- Preliminary Design;
- State and potentially Federal environmental review;
- Final Design and permitting;
- Bidding and Award;
- Construction of wastewater improvements; and
- Startup and Commissioning.

Preliminary design and environmental review would require approximately 2 years to complete. Final design and permitting would begin after the preliminary design is complete and require approximately 2 additional years to complete.

Alternative 1A implementation schedules would be managed by each individual property owner. The implementation schedules for Alternatives 1B through 6/7 would be managed in part by the County of Hawai‘i and may be impacted by the following:

- Time needed to procure, fabricate, and deliver major systems and equipment;
- Receipt of shop drawings from the construction contractor for the review and approval of major equipment;
- Demolition and renovation work required for the new facilities; and
- Number of projects and construction contracts needed to construct each alternative.

Assuming the first construction contracts start around 2027 and the last contracts are awarded around 2047, after 20 years, the County would need to bid and award six to eight contracts every year from 2027 through 2047 for all construction to be completed by the year 2052.

3.0 AFFECTED ENVIRONMENT, POTENTIAL IMPACTS, AND PROPOSED MITIGATION

This section describes the existing environmental conditions for each resource in the Project Area generally at the level of the Puna Community Development Plan (CDP), addressing localized resource elements and issues where appropriate. For any given resource, the extent of the potentially affected area may be the Project Area, neighboring council or Hawai'i County districts, Hawai'i County, or some combination thereof. The description of the affected environment in the programmatic environmental impact statement (PEIS), depending on the resource, also focuses on resource elements and issues at finer geographic scales, including those of the town and village centers identified in Section 1.1 and shown in Figure 1-2.

3.1 CLIMATE AND CLIMATE CHANGE

3.1.1 Affected Environment

The climate in Hawai'i is considered subtropical. Hawai'i County has a mild climate due in part to its location within the trade-wind zone. The climate has low variability with an annual variation in mean monthly temperature of about 9°F in locations at sea level. The mean monthly temperatures range from 71.2°F in February to 76.5°F in September (National Oceanic and Atmospheric Administration [NOAA] 2022c). Precipitation ranges from 30 inches in leeward areas to 300 inches annually in upper windward areas (Tetra Tech 2020). Precipitation averages around seven inches per month in May to over 14 inches per month in November (NOAA 2022c).

Climate change is defined by the Hawai'i Climate Change Mitigation and Adaptation Commission as "a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties that persist for an extended period, typically decades or longer" (Hawai'i Climate Change Mitigation and Adaptation Commission 2017).

The climate in Hawai'i is getting warmer. In areas at an elevation over 2,600 feet above sea level, temperature has increased by 0.48°F per decade over the last 30 years, which is faster than the global warming rate (Tetra Tech 2020). Some model projections for the late 21st century indicate that surface air temperature over land will increase 1.8° to 7.2°F with the greatest warming at the highest elevations and on leeward sides of the major islands (City and County of Honolulu Climate Change Commission 2018). Under continued strong greenhouse gas (GHG) emissions, high elevations above 9,800 feet are predicted to reach up to 7.2° to 9°F warmer temperatures by the late 21st century (City and County of Honolulu Climate Change Commission 2018).

Precipitation rates are also changing. Rainfall has declined significantly over the past 30 years, with increasing variation in rainfall patterns on each Hawaiian Island (State of Hawai‘i 2022). Hawai‘i is experiencing fewer but more intense rain events. Modeling results show an anticipated decrease in rainfall in response to climate change. This is in part due to a decrease of prevailing northeasterly trade winds, which drive precipitation landward (Tetra Tech 2022).

Sea level is rising at increasing rates due to global warming of the atmosphere and oceans as well as melting of the glaciers and ice sheets (Hawai‘i Climate Change Mitigation and Adaptation Commission 2017). Sea level in Hilo Bay has risen about 10 inches since 1950. The rate of sea level rise is now increasing about one inch every four years (State of Hawai‘i 2022).

Climate change is further discussed in Section 4.5.6.

3.1.2 Potential Environmental Consequences and Mitigation Measures

3.1.2.1 Construction

Transporting materials and fueling of equipment during construction activities for any of the alternatives would contribute to Hawai‘i’s GHG emissions. Additionally, climate change in Hawai‘i may have an impact on the construction of the proposed infrastructure. Although rainfall is declining, the rain events are more intense, and more intense events have the potential to cause delays to construction schedules and increase project costs.

Potential short-term impacts to climate change can be further assessed through impacts to air quality and sea level rise, which are discussed in Section 3.2.2 and Section 3.5.2, respectively.

3.1.2.2 Operation

Alternatives 1A and 1B would include multiple new package treatment plants. Alternative 2/3 and Alternative 4/5 would result in either new infrastructure including multiple pump stations and three to four subregional wastewater treatment plants (WWTPs) or multiple pump stations and one larger regional WWTP, respectively. Alternative 6/7 would also result in new pump stations to transport the wastewater to the existing Hilo WWTP. Each of these alternatives would require operation and maintenance that would result in additional GHG emissions.

Once construction is complete, climate change could impact the proposed infrastructure. More intense precipitation events, drought, flooding, or saltwater intrusion all have the potential to impact the performance or integrity of the wastewater collection, treatment, and disposal systems.

3.2 AIR QUALITY

Regional and local climate, together with the amount and type of human activity, generally dictate the air quality of a given location. Sources relevant to the Proposed Action include mobile sources, such as vehicles, aircraft, ships, and construction equipment, as well as stationary sources, such as emergency generators, prescribed fires, and natural processes (e.g., wildfires and volcanic activity) that results in the release of lead and other air pollutants.

To protect public health and welfare, the United States Environmental Protection Agency (USEPA), under the requirements of the 1970 Clean Air Act (CAA) as amended in 1977 and 1990, has established National Ambient Air Quality Standards (NAAQS) for six air pollutants known as criteria pollutants (40 CFR 50): carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10} [particulate matter with a diameter ≤ 10 micrometers], and $PM_{2.5}$ [particulate matter with a diameter ≤ 2.5 micrometers]), lead (Pb), and sulfur dioxide (SO_2). Under Hawai'i Administrative Rules (HAR) Title 11, Chapter 59, the State of Hawai'i has adopted more stringent air quality standards for CO and NO_2 than the Federal ambient air quality standards (AAQS) and also amended additional AAQS for PM_{10} and SO_2 (Table 3-1).

Areas where concentration levels are below the NAAQS for a criteria pollutant are designated as being in "attainment" per the CAA. Areas where a criteria pollutant level equals or exceeds the NAAQS are designated as being in "nonattainment." Based on the severity of the pollution problem, nonattainment areas are categorized as marginal, moderate, serious, severe, or extreme. A maintenance area is one that has been re-designated from nonattainment status and has an approved maintenance plan under Section 175 of the CAA. Where insufficient data exist to determine an area's attainment status, it is designated as either unclassifiable or in attainment.

In addition to establishing the NAAQS, the CAA also sets permit rules and emission standards for stationary pollution sources of certain sizes. The State of Hawai'i Department of Health (DOH) has adopted the USEPA-established stationary source regulations and acts as the administrator to enforce stationary source air pollution control regulations in Hawai'i (DOH, Title 11, Chapter 60.1, Air Pollution Control). DOH grants an air permit to applicable facilities for not only Federal enforceable major sources but also non-major sources in the State.

Table 3-1. State and Federal Ambient Air Quality Standards (AAQS)

Air Pollutant	Averaging Time	Hawai'i State Standard	Federal Primary Standard	Federal Secondary Standard
CO	1-hour	9 ppm	35 ppm	None
	8-hour	4.4 ppm	9ppm	
NO_2	1-hour	---	0.100 ppm	---
	Annual	0.04 ppm	0.053 ppm	0.053 ppm
PM_{10}	24-hour	150 µg/m^3	150 µg/m^3	---
	Annual	50 µg/m^3	---	---
$PM_{2.5}$	24-hour	---	35 µg/m^3	35 µg/m^3
	Annual		12 µg/m^3	15 µg/m^3
O_3	8-hour	0.08 ppm	0.070 ppm	0.070 ppm
SO_2	1-hour	---	0.075 ppm	---
	3-hour	0.5 ppm	---	0.5 ppm
	24-hour	0.14 ppm	---	---
	Annual	0.03 ppm	---	---
Pb	Rolling 3-month	1.5 µg/m^3	0.15 µg/m^3	0.15 µg/m^3
H_2S	1-hour	0.025 µg/m^3	None	None

Source: DOH 2021b.
H_2S hydrogen sulfide
µg/m^3 microgram per cubic meter
ppm part per million

With respect to the volcanic emissions, SO_2, one of the most common gases released in volcanic eruptions, released from active volcanoes would be of concern with respect to human activities as well as on the global scale due to its potential to influence climate.

In addition to the criteria pollutants, hydrogen sulfide (H_2S) is a toxic, colorless gas with a characteristic "rotten egg" odor detectable at very low levels even though it is not a criteria pollutant. It occurs naturally during the decomposition of organic matter, near geothermal sources and is also produced during certain industrial processes, including wastewater treatment facilities.

GHGs are gas emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities. Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in GHG emissions from human activities. The scientific community predicts the climate change associated with this global warming will produce negative economic and social consequences across the globe. Although there are currently no GHG emission limits for the WWTPs on the island, in 2007 the Hawai'i State Legislature passed Act 234, "Global Warming Solutions Act" which Governor Linda Lingle signed into law. Act 234 required the State of Hawai'i Department of Business, Economic Development and Tourism (DBEDT) and DOH to update their Inventory of GHG

Emissions Estimates for 1990 by December 31, 2008 and to reduce the amount of GHG emissions in Hawai‘i to levels at or below 1990 levels by 2020.

3.2.1 Affected Environment

To protect the State's air quality from degradation, the DOH's Clean Air Branch is responsible for regulating and monitoring pollution sources to ensure that the levels of criteria pollutants remain well below the State and Federal ambient air quality standards. The State of Hawai‘i operates air monitoring stations on Hawai‘i, four of which (Hilo, Kona, Mountain View, and Pāhala) are located in relative proximity to or within the Project Area. Monitoring data is gathered to inform the public about air quality conditions and to demonstrate compliance with national and State AAQS. Excluding the exceedances of SO_2 monitored at Mountain View and Pāhala Stations due to the Kīlauea eruption in the Lower East Rift Zone in 2018 and the eruption at Halema‘uma‘u crater on the summit of Kīlauea in December 2020, the State of Hawai‘i was in attainment with all NAAQS. Volcanic eruptions are natural events and, therefore, USEPA may exclude the exceedances of the SO_2 NAAQS from attainment determinations (DOH 2021b).

Since there are no wastewater collection and treatment facilities treating concentrated sources in the Project Area, the odor in terms of H_2S levels is anticipated to be low.

3.2.2 Potential Environmental Consequences and Mitigation Measures

3.2.2.1 CONSTRUCTION

Proposed construction under each alternative would result in short-term, intermittent air quality impacts within and beyond the Project Area due to the operation of construction equipment and vehicles, and privately-owned vehicles. Site clearing, grubbing, excavation, and grading would result in localized increases in fugitive dust during overall sewer system construction affecting all areas, with the most intensive impacts around the proposed new subregional or regional WWTPs. All construction activities would comply with the provisions of HAR 11-60.1-33, *Fugitive Dust*. Dust management best management practices (BMPs) such as regular watering would be implemented for construction activities. Therefore, temporary construction activities under each alternative are anticipated to have minor impacts to air quality.

Table 3-2 provides comparisons of potential air quality impacts amongst alternatives using extent and duration of changes in total emissions during construction periods as impact indicators.

Table 3-2. Construction Air Quality Effects under Proposed Action

Alternative	Type of Impact	Related Activities within Sensitive Land Uses	Temporary Impact Level
1A (No Action Alternative)	Short-term air emissions generated from the use of fuel-burning equipment; on-land transportation and management of materials and land surface disturbance that generates dust	Individual wastewater system (IWS) and decentralized wastewater system installation	Minor
1B	Same as above	Sewer system and decentralized wastewater system installation	Minor (slightly greater than Alternative 1A around low-pressure sewers and additional package plants)
2/3	Same as above	IWS installation, and sewer system and WWTP construction	Minor (slightly greater than Alternative 1A around subregional WWTP sites)
4/5	Same as above	IWS installation, and sewer system and WWTP construction	Minor (greatest around the regional WWTP site)
6/7	Same as above	IWS installation, and sewer system construction affecting greater areas including those extended to and around Hilo WWTP	Minor (affecting greater areas that extend beyond the regional WWTP site and outside Project Area)

3.2.2.2 OPERATION

Stationary sources and any new WWTP activities regulated under DOH Title V permit and noncovered source permit regulations (DOH Title 11, Chapter 60.1), including permit modification potentially required at the Hilo WWTP for equipment located at that WWTP, would be evaluated for each alternative as applicable.

It is anticipated that each WWTP could involve stationary source operation from sewer pumps, boilers, standby power generators, compressors, and digesters that would generate criteria and air toxic pollutant emissions.

Standby power generators provide power to a WWTP when the utility feed is interrupted. Given their emergency use, these generators are exempt from obtaining an air permit. The emissions standards for diesel generators are governed by USEPA as well as any state requirements only during a utility outage and for some testing purposes for a maximum of 500 hours per year intermittently with minor air quality impacts. However, if these generators would be used for peak power shaving purposes as compared to emergency use, they would have to comply with more stringent emissions requirements involving treatment of exhaust emissions and greater air quality impacts would occur. Under this circumstance, the future DOH air permitting process would ensure the compliance of the NAAQS as a result of

increasing stationary source operational emissions on site for each applicable WWTP.

Since these WWTPs would be new stationary sources, emissions would increase resulting in adverse air quality impacts on the local level. Because the operation of new WWTPs or modification of the Hilo WWTP under these alternatives is still being evaluated at a programmatic planning level without specific design plans, the potential air emissions from WWTPs under each alternative cannot be reasonably estimated. However, during the air permitting process, it is anticipated that an air quality impact modeling analysis would be conducted to demonstrate that potential air quality impacts from each WWTP would not be significant including a consideration of mitigation measures if required to be implemented in the design. Therefore, anticipated air quality impacts from operational activities within each WWTP for all action alternatives are not expected to interfere with the attainment of NAAQS in areas where sensitive receptors such as residences, schools, hospitals, community facilities, parks, churches, etc. are present around each WWTP.

In addition to the criteria and air toxic pollutant impacts discussed above, odor impacts specifically associated with the WWTP operations and affecting adjacent neighborhoods would occur particularly at newly constructed WWTPs. Reducing odor emissions from sludge dewatering and treatment process and impacts to WWTP workers and communities through odor control is evolving into an essential component of the wastewater treatment process.

Depending on the size of the WWTP, various systems in combination to control odor impacts would be considered under each applicable alternative. Odor treatment technologies can be classified into three categories: chemical (thermal oxidation, catalytic oxidation, ozonation), physical (condensation, adsorption, absorption), and biological (using biofilters, bioscrubbers, and other bioreactor types) treatment methods.

Current methods to control odor from sludge dewatering in a WWTP could involve primary treatment from collecting and treating odorous air from the influent sewers, influent screens, influent pump station wet well, aerated grit chambers, pre-aeration tanks, primary clarifier weirs, etc. and conveying the odorous air to activated carbon scrubbers. The secondary treatment could involve collecting and treating odorous air including the biotower pump station and trickling filter/solids contact process with the system also consisting of catalytic scrubbers. The sludge odor control system would consist of biofilter and carbon systems that collect and treat odorous air from the gravity thickeners and sludge blend tanks. If additional control is warranted, adding grit covers, primary clarifier covers, and primary effluent channel covers to further control odor containment would be evaluated. These covers keep odorous air contained within the headspace of process units. By ventilating the headspace, odorous air would be exhausted and treated resulting in improvements in the long-term air quality in the Project Area in terms of the nuisance odor that would result from each WWTP.

Many of the odor-causing compounds associated with WWTPs are sulfur-based compounds, such as H_2S, and mercaptans. Although there are many common odors associated with WWTPs, H_2S is the most prevalent malodorous gas associated with domestic wastewater collection and treatment. The conditions leading to H_2S formation usually favor the production of other odorous gases, such as ammonia and mercaptans, which may have considerably higher detectable odor thresholds, and consequently H_2S may be an indicator of their presence. H_2S is commonly used as a trace odor indicator. Therefore, an ambient odor monitoring program could be implemented, if necessary, after each new WWTP is under operation that would demonstrate the compliance of the DOH ambient odor standard in terms of H_2S concentration levels.

In addition to the new or modified stationary sources of air emissions, the operational workforce size is anticipated to increase as a result of construction of new WWTPs under Alternatives 2/3 and 4/5, or expansion of the Hilo WWTP under Alternative 6/7, resulting in a slight increase in commuter emissions with minor mobile source air quality impacts.

3.3 TOPOGRAPHY, GEOLOGY, AND SOILS

The County of Hawai‘i has varied landscapes and vegetation contributed by factors including topography, geology, and soils. The complexity of the island is related to the volcanoes in which it was formed. Two of these volcanoes, Kīlauea and Mauna Loa, are the main features of Hawai‘i Volcanoes National Park, which is partially located in the Puna District (Britannica 2022). Due to continued volcanic activity, the landscape continues to change, and in the Project Area, lava flows as recently as 2018 covered approximately 14 square miles and added 875 acres of new land from lava flows entering the ocean (United States Geological Survey [USGS] 2022b).

3.3.1 Affected Environment

3.3.1.1 TOPOGRAPHY

The Project Area is located in the central eastern portion of Hawai‘i Island. The topography consists of rocky shorelines on the northeast and southeast coasts which gradually rise to higher elevations and rainforests to the western side of the district. The elevation change from sea level along the coastline to the Hawai‘i Volcanoes National Park in the west is approximately 5,800 ft with the highest elevations in the northwestern corner (Figure 3-1). The residential areas are located in areas ranging from about 10 feet above mean sea level along coastal areas up to about 4,000 feet above mean sea level along the western boundaries of the Project Area. The Hawai‘i Volcanoes National Park, Ka‘ū Desert, Hōlei Pali, and Wao Kele o Puna Forest Reserve are among the major land features of the Project Area.

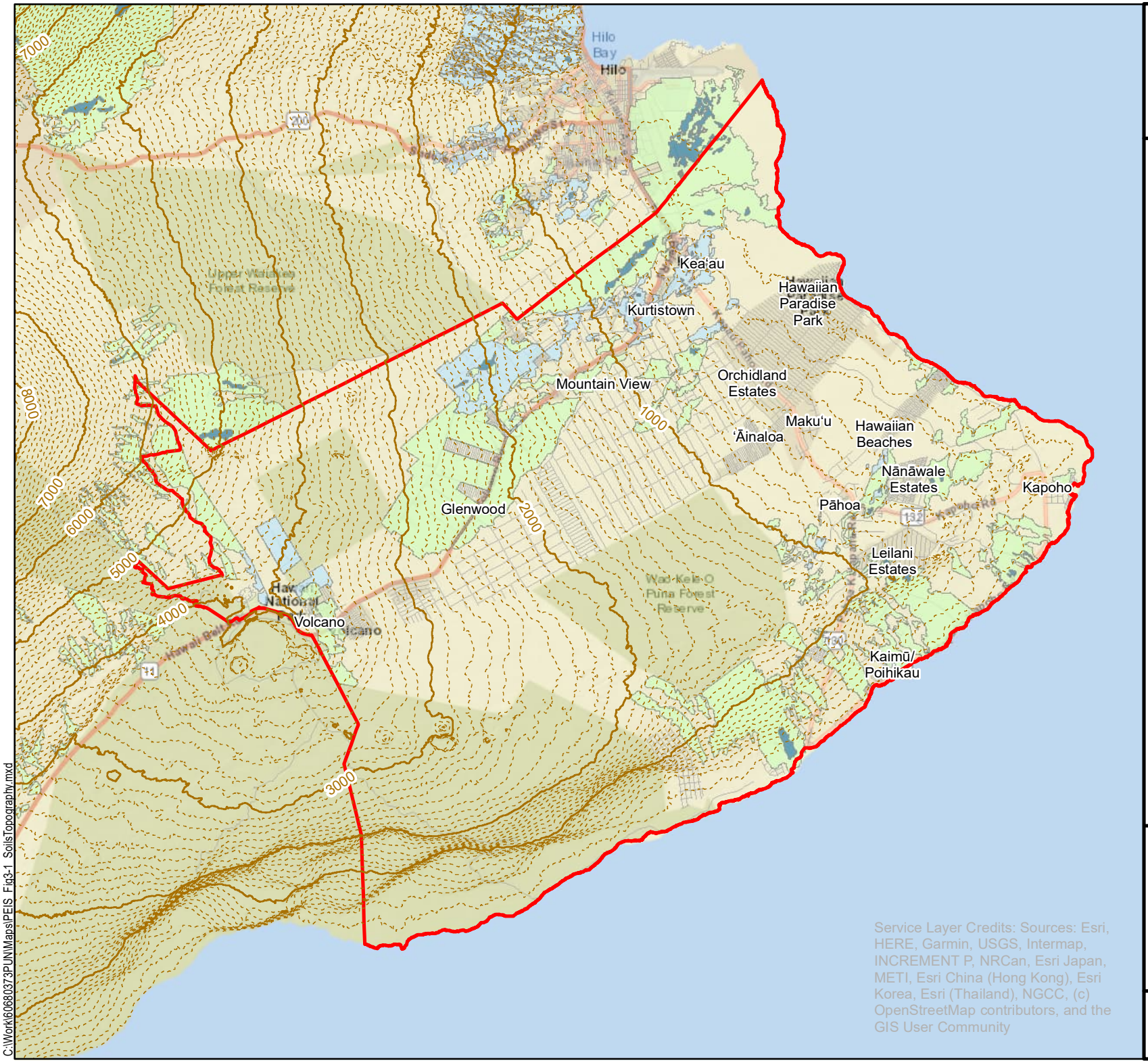

FIGURE 3-1

SOILS AND TOPOGRAPHY

Legend

- Project Area
- Roads

Elevation Contours (100 ft)

- Index
- Intermediate

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

- Unclassified
- Prime Lands
- Other Lands

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, 100 ft contours for Hawaii Island from USGS Digital Elevation Models (DEM), Nov. 2021; Agricultural Lands of Importance to the State of Hawai'ii for the islands of Kauai, Oahu, Maui, Molokai, Lanai and Hawai'i, Nov. 2021i\.

N

0 12,500 25,000 Feet

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3.3.1.2 GEOLOGY AND SOILS

The geology of the Project Area is complex as the age of soils varies due to volcanic activity. A majority of the Project Area is located in an area of recent lava flows (spanning from 1983 to 2018) and volcanic activity. As a result, there are typically only a few feet of soil covering the underlying volcanic deposits. As described in the Hawai‘i General Plan, the Puna coast from Kea‘au along Cape Kumukahi to Kalapana is partly low sea cliff and partly the constructional surface of recent lava flows. The irregularity of the coast a few miles to either side of Pohoiki is the result of several earthquakes and subsidence, and there are also black sand beaches on the coast created when hot molten lava reaches the ocean (County of Hawai‘i 2005).

The geology of the district is dominated by Holocene and Pleistocene Basalts associated with the Kīlauea and Mauna Loa volcanoes as shown in the Geologic Map of the State of Hawai‘i-Island of Hawai‘i (Sherrod et al. 2021).

The USDA web soil survey provides detailed soil maps and descriptions within the Project Area that provide useful information for projects at a larger scale. Within the Puna District there are two soil surveys that have been completed: Hawai‘i Volcanoes National Park, Hawai‘i (HI701) and Island of Hawai‘i area, Hawai‘i (HI801) (USDA 2022). Based on these two surveys, a range of soils within the Puna district include but are not limited to various lava flow complexes, cobbly hydrous loams, ashy silt loams, cinder land, decomposed plant material, Urban Land complexes, hydrous silty clay, hydrous silt loams, and hydrous highly organic loam. In general, volcanic soils are highly permeable and the barren landscapes and young age of soils leave certain areas non-productive. However, in contrast, the Puna District has many farms growing a variety of crops such as macadamia nuts, papayas, and formerly sugar cane. The Hawai‘i State Department classifies Agricultural Lands of Importance to the State of Hawai‘i that reflect the value of lands to support diversified agriculture. There are approximately 75,000 acres in the Puna District that are considered prime or other important agricultural land (Figure 3-1) (County of Hawai‘i 2011; State of Hawai‘i Office of Planning and Sustainable Development 2022).

Soil percolation is a measure of how quickly water moves through soil and is useful in determining the effectiveness of an onsite treatment system. Soil percolation is determined by soil hydraulic conductivity which has been mapped in the Project Area. Conductivities reach up to about 150 feet per day, with a majority of the Project Area ranging from 3 to 10 feet per day.

Subsurface geologic features located in the Project Area include lava tube caves. Areas have been designated as geothermal sub-zones for development of geothermal energy (County of Hawai‘i 2005). The geothermal resource area is mapped along the Kīlauea southwest Rift zone and the East Rift zone within the Puna district. In addition, the Mauna Loa Northeast rift zone high temperature resource area may also extend into the northwest portion of the Project Area (GeothermEx, Inc. 2000).

3.3.2 Potential Environmental Consequences and Mitigation Measures

3.3.2.1 CONSTRUCTION

During construction of IWSs, subregional treatment plants, or a regional treatment plant, soil disturbance would occur. Variations in topography and temporary disturbance would occur during open trench excavation for the installation of sewers and force mains and site preparation for pump stations and WWTPs. Once construction is complete, trenches would be backfilled and grade levels above the sewer lines would be restored, minimizing the potential impact on topography.

Due to the varied soil types, backfill may be required for the construction of WWTPs and pump stations. In addition, IWSs may require different soils or materials to be backfilled for the systems to be most effective.

Standard BMPs to preserve geologic structure, slope stability, and soil retention would be implemented such as silt fences and compost filter socks. Mitigation measures would be utilized to minimize potential impacts to the topography and soils. Construction equipment would be maintained in good working condition to reduce the potential of accidental spills. An erosion and sediment control plan would be developed and implemented to minimize any potential impact to soils and to specify control measures (e.g., silt fences, filter bags) to reduce impacts to the natural environment. Soil that is not immediately used for backfilling would be stockpiled and covered or otherwise protected (e.g., surrounded by silt fence) to prevent erosion or sedimentation.

3.3.2.2 OPERATION

Long-term impacts to topography would not result from any of the alternatives, as areas would be backfilled, graded, and stabilized after construction.

Soils in areas where new infrastructure would be constructed or installed may result in altered soil types due to compaction requirements to support the foundations of the infrastructure. Soil stability inspections near the proposed facilities would be conducted periodically to check the condition of these foundations. Improved wastewater treatment for the Project Area would minimize contamination of soils from the existing outdated and substandard disposal methods.

3.4 HYDROLOGY AND WATER QUALITY

3.4.1 Affected Environment

3.4.1.1 GROUNDWATER

Groundwater accumulates through the percolation of rain and surface water. When precipitation occurs, the rainwater seeps through the soil and then through porous volcanic rock, also known as the caprock (City and County of Honolulu Board of Water Supply 2022). Groundwater supply can also come from return irrigation

waters and seepage from other water bodies. Once the water percolates through the caprock, it remains semiconfined beneath the caprock, if present, and forms an aquifer.

The State of Hawai‘i Commission on Water Resource Management published a 2019 update to the Water Resource Protection Plan that describes the following types of groundwater (State of Hawai‘i Commission on Water Resource Management 2019):

- Basal water, confined or unconfined;
- Dike water, often called dike-impounded or high-level water;
- Perched water, also classified as high-level water;
- Caprock water;
- Brackish water; and
- Deep confined freshwater.

The freshwater lens in the basal aquifers are the most important sources of freshwater supply in Hawai‘i. According to the *Water Resource Protection Plan 2019 Update* aquifer coding system, which classifies and codes the aquifers in the State of Hawai‘i to consistently reference and describe groundwater resources, the Project Area is predominantly covered by the Kīlauea Aquifer Sector Area (Pāhoa and Kalapana aquifer systems) with smaller portions of the area covered by portions of the Northeast Mauna Loa (Kea‘au aquifer system) and Southeast Mauna Loa (‘Ōla‘a aquifer system) Aquifer Sector Areas (State of Hawai‘i Commission on Water Resource Management 2019).

The Pāhoa aquifer system has a sustainable yield of 432 million gallons per day (mgd) and contains groundwater as basal, perched, and high level (State of Hawai‘i Commission on Water Resource Management 2019). The Kalapana aquifer system has a sustainable yield of 158 mgd and contains groundwater as basal and high level. Both of these systems reported groundwater use is pumped from the basal zone. The Kea‘au aquifer system has a sustainable yield of 395 mgd and contains groundwater as basal, perched, and high level with a majority of the groundwater use pumped from basal zone, followed by perched. The ‘Ōla‘a aquifer system has a sustainable yield of 125 mgd of predominantly high-level groundwater with some perched. There is no reported groundwater use in the ‘Ōla‘a aquifer system.

The *Hawai‘i County Water Use and Development Plan Update* from 2010 indicates that within the Kīlauea Aquifer Sector Area, which predominantly covers the Project Area, there are 45 production wells comprised of 8 municipal, 8 irrigation, 19 domestic, and 10 other wells (County of Hawai‘i 2010). As reported in the 2010 plan update, there are also 19 wells drilled and marked as unused according to the State of Hawai‘i Commission on Water Resource Management database. However, the 2019 update of the Water Resource Protection Plan (State of Hawai‘i Commission on Water Resource Management 2019) indicates that there are several Federal, State, and County agencies that own and operate observation wells. In addition, many

private landowners and corporations have wells that are permitted for observation purposes but are not included in current monitoring programs with the Commission on Water Resource Management or USGS. The plan states that there is a need for a statewide plan to coordinate and implement monitoring activities.

Within the Project Area, the depth to groundwater ranges from 8 to 6,200 feet with a majority of the Project Area within the range of 8 to 3,000 feet (DOH 2014)

3.4.1.2 SURFACE WATER

The island of Hawai‘i has highly pervious and permeable land cover limiting the number of perennial streams. The Project Area spans about 20 different watersheds but does not contain any perennial streams. There are a few non-perennial streams mapped through the National Hydrography dataset and the Hawai‘i Streams data set from State of Hawai‘i Department of Land and Natural Resources, Division of Aquatic Resources. The non-perennial streams include ‘Ōla‘a located east of Kea‘au, Kea‘au located south of Mountain View and Kurtistown extending from the western side of Route 11, Volcano Highway, to the eastern side of Route 130, Kea‘au-Pāhoa Road, and Keonepoko stream located north of Pāhoa (Figure 3-2).

The State of Hawai‘i Water Quality Standards in HAR Chapter 11-54 classify State waters as either inland or marine. Inland waters are further classified into use categories. The three non-perennial streams—‘Ōla‘a, Kea‘au, and Keonepoko—are classified as Inland Class 2 waters. Class 2 waters are protected for their use for recreational purposes, the support and propagation of aquatic life, agricultural and industrial water supplies, shipping, and navigation. Additionally, the regulations state that these waters shall not act as receiving waters for any discharge which has not received the best degree of treatment or control compatible with Class 2 waters.

All of Puna’s coastal waters are classified as “AA” waters. AA waters are regulated as the most unspoiled in Hawai‘i. State law mandates that Class AA waters “remain in their natural pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality from any human-caused source of actions” (County of Hawai‘i 2011).

Conservation district includes submerged lands beneath coastal waters. DOH is responsible for monitoring and protecting quality of waters under the Federal Clean Water Act.

Existing and proposed stormwater infrastructure include diversion channels to intercept sheet flows and direct flow away from an area, and culverts to facilitate movement of water and minimize overtopping of roadways (County of Hawai‘i 2005). Stormwater has created localized flooding in areas of Volcano to Mountain View and Hawaiian Acres to Orchidland Estates. Lava landscapes lack natural surface drainage systems, making it difficult to develop drainage management (County of Hawai‘i 2011).

Wetland resources are further discussed in Section 3.6.1.3.

FIGURE 3-2

SURFACE WATER

Legend

- Project Area
- Roads

Streams

- Perennial
- Non-Perennial
- National Hydrography Dataset Waterbodies

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, Hawai' Streams from DLNR, Division of Aquatic Resources (DAR) Oct. 2020; National Hydrography Dataset (NHD) Waterbodies, Oct. 2020.

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0 12,500 25,000 Feet

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3.4.2 Potential Environmental Consequences and Mitigation Measures

3.4.2.1 CONSTRUCTION

Construction activities that include excavation and trenching would need to be designed to avoid adverse impacts to groundwater. These activities would be conducted in accordance with applicable regulations. In addition, appropriate mitigation methods (e.g., silt fences, proper storage and movement of spoils), monitoring of groundwater, and careful site preparation would be utilized to minimize adverse impacts.

It is not anticipated that surface water would be impacted by the Proposed Action during construction as there are no perennial streams in the Project Area. However, during construction, excavation and land disturbance could contribute to sedimentation and runoff. Erosion and sedimentation control measures would be implemented where necessary during construction activities to mitigate any potential nearby off-site surface waters impacted by stormwater during construction activities.

3.4.2.2 OPERATION

The Proposed Action is intended to improve groundwater and surface water quality within the Project Area. Centralized wastewater treatment systems and updated IWSs would replace the use of cesspools and other outdated, substandard wastewater disposal methods that pose a risk to human health and the surrounding environment. Additionally, the IWSs that would be installed under all the Proposed Action alternatives, except Alternative 1B, would provide upgraded treatment methods that minimize human health and environmental risks with onsite systems.

In addition, the Proposed Action would minimally increase impervious area at the locations of pump stations and WWTPs, so there would be some minor impacts to groundwater or surface water runoff. However, the improvements to wastewater treatment in the Project Area are anticipated to positively impact the community and surrounding area in terms of human health and the environment.

3.5 NATURAL HAZARDS

3.5.1 Affected Environment

3.5.1.1 VOLCANIC ACTIVITY

The island of Hawai‘i was formed by five volcanos, four of which – Mauna Kea, Hualālai, Mauna Loa, and Kīlauea – are considered active because they have erupted within the past 10,000 years and have the potential to erupt again (Tetra Tech 2020). Eruptions of Kīlauea and the nearby volcano Mauna Loa continue to shape the ecology of the region and the land itself (County of Hawai‘i 2011). As noted in Section 3.2, Kīlauea ranks among the world’s most active volcanoes (USGS 2022a) and caused significant damage to the Project Area in 2018 (County of Hawai‘i 2020c, National Park Service 2021).

The Project Area lies within the three highest risk volcano lava risk zones identified by USGS (2022a). Zone 1 transects the Project Area east to west. Zone 2 flanks this area and includes the southern coastal area. Zone 3 comprises the northern portion of the Project Area (Figure 3-3). These zones are described as follows:

Zone 1:

- Summits and rift zones of Kīlauea and Mauna Loa, where vents have been repeatedly active in historic time. Boundaries are defined by eruptive fissures, cinder cones, pit craters, and graben and caldera faults. Zone 1 is where lava flows originate. Communities including Kapoho and Leilani Estates are located in Zone 1.

Zone 2:

- Areas adjacent to and downslope from Zone 1. Fifteen to 25 percent of Zone 2 has been covered by lava since 1800, and 25-75 percent has been covered within the last 750 years. The relative hazard within Zone 2 decreases gradually as one moves away from Zone 1. Communities including Kaimū/Pohoiki, Kapoho, Nānāwale Estates, Pāhoa, Hawaiian Beaches Parks and Shores are located in Zone 2.

Zone 3:

- Areas gradationally less hazardous than Zone 2 because of greater distance from recently active vents and/or because the topography makes it less likely that flows will cover these areas. One to 5 percent of Zone 3 has been covered since 1800, and 15-75 percent has been covered within the last 750 years. Communities including Kea‘au/W.H. Shipman Business Park, Mountain View, Kurtistown, Glenwood, Hawaiian Paradise Park, Maku‘u, ‘Āinaloa, Orchidland Estates, Hawaiian Acres, and Volcano/Volcano Golf Course are located in Zone 3.

3.5.1.2 EARTHQUAKES

Earthquakes are not uncommon in Hawai‘i and are typically caused by volcanic activity on the island of Hawai‘i. Earthquakes pose a life safety hazard and a risk to infrastructure, buildings, and utilities. Strong earthquakes, such as those seen in 1868 and 1975, can cause coastal subsidence (Tetra Tech 2020). All of the Project Area lies within the three most hazardous geological risk zones: LF1, LF2, and LF3 (County of Hawai‘i 2011).

Figure 3-4 shows earthquake sources on the island of Hawai‘i, including: (1) locations of shallow Quaternary faults (solid lines, colors represent age of faulting), (2) locations of places where deep faults (décollements) are known (dashed lines), and (3) locations of volcanoes (triangles). Large earthquakes (magnitude greater than 6.0) with dates and magnitudes are shown in the table below the figure (USGS 2021).

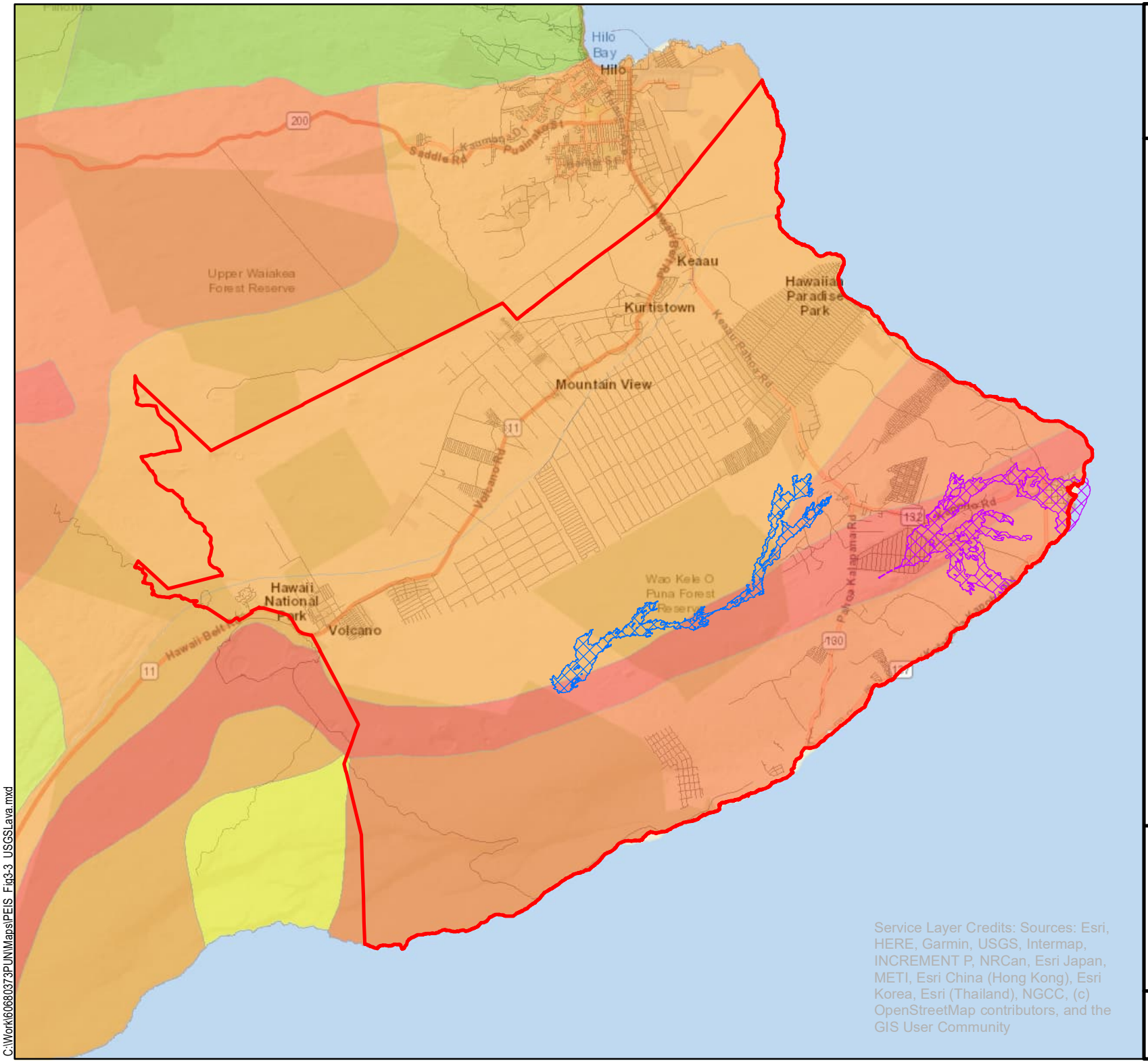

FIGURE 3-3

USGS LAVA HAZARD ZONES

Legend

- Project Area
- Roads
- 2018 Lava Flow
- 2014 Lava Flow

Volcano Lava Flow Hazard Zones

- 1 (highest risk)
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9 (lowest risk)

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, Volcano Lava Flow Hazard Zones, Source: USGS, 1991, updated Sep. 2021.

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Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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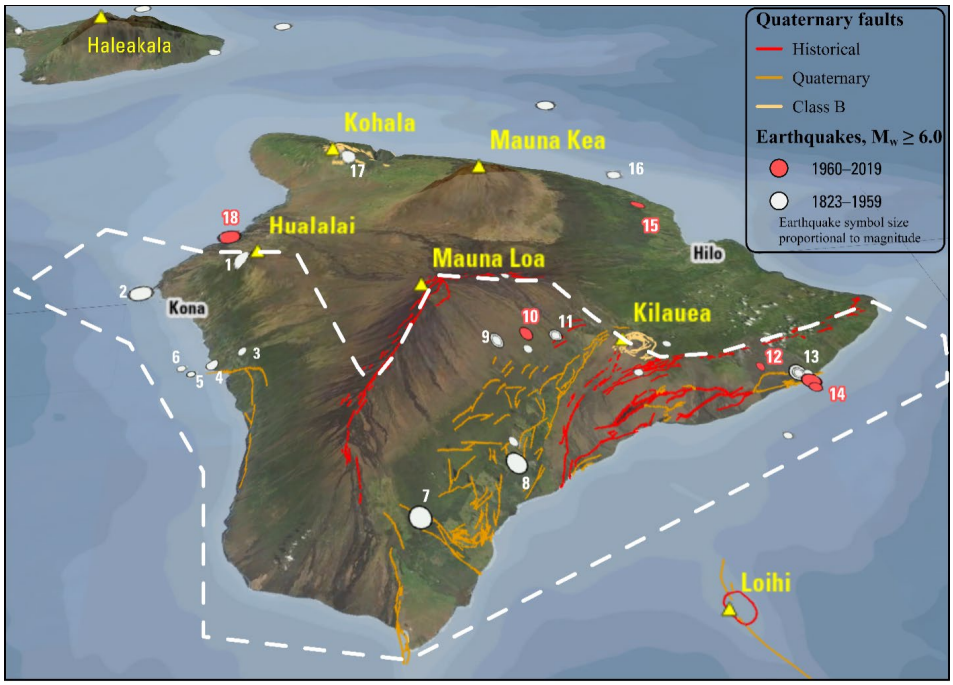

ID	Date	Mw	ID	Date	Mw	ID	Date	Mw	ID	Date	Mw	ID	Date	Mw
1	Sept. 26, 1929	6.2	5	May 23, 1952	6	10	Nov. 16, 1983	6.7	13	Sept. 21, 1908	6.7	17	Sept. 30, 1881	6.4
2	Oct. 6, 1929	6.5	6	May 30, 1950	6.3	11	Sept. 24, 1880	6.6	14	Nov. 29, 1975	7.7	17	Nov. 18, 1941	6.1
3	Jan. 7, 1825	6.2	7	March 28, 1868	7	12	June 6, 1989	6.2	14	May 4, 2018	6.9	18	Oct. 15, 2006	6.7
3	March 11, 1841	6.1	8	April 3, 1868	7.9	13	June 2, 1823	7	15	April 26, 1973	6.2			
4	Aug. 21, 1951	6.9	9	Jan. 24, 1887	6.5	13	April 8, 1841	6.5	16	Jan. 13, 1885	6.1			

Figure 3-4. Earthquakes on the Island of Hawai‘i (USGS 2021)

The Modified Mercalli Intensity Scale ranking for the southern third of Hawai‘i County and most of the Project Area is VIII. This intensity causes severe shaking that results in considerable damage in ordinary substantial buildings with partial collapse, great damage in poorly built structures, falling chimneys, factory stacks, columns, monuments, and walls, and overturning of heavy furniture (USGS 2022c).

The southeast part of Hawai‘i County has the greatest peak horizontal acceleration, (or largest increase in velocity during an earthquake) with a 2 percent probability of exceedance in 50 years in the County (Figure 3-5).

Of the thousands of earthquakes the island of Hawai‘i experiences annually, only a few are strong enough to be felt or cause minor or moderate damage. The stronger earthquakes are usually directly related to magma moving below the earth surface under Mauna Loa and Kīlauea (Tetra Tech 2020). Since 1959, 46 earthquakes with a magnitude of 5.0 or greater have occurred on or near the Big Island. Magnitude 6.0 or greater earthquakes strike every nine years on average (Tetra Tech 2020). In 2017, a magnitude 5.28 earthquake occurred southeast of Volcano, Hawai‘i. The 2018 Kīlauea caldera collapse events caused tens of thousands of earthquakes at the Kīlauea summit that resulted in large ground fractures and explosions and clouds of rock and debris (Tetra Tech 2020).

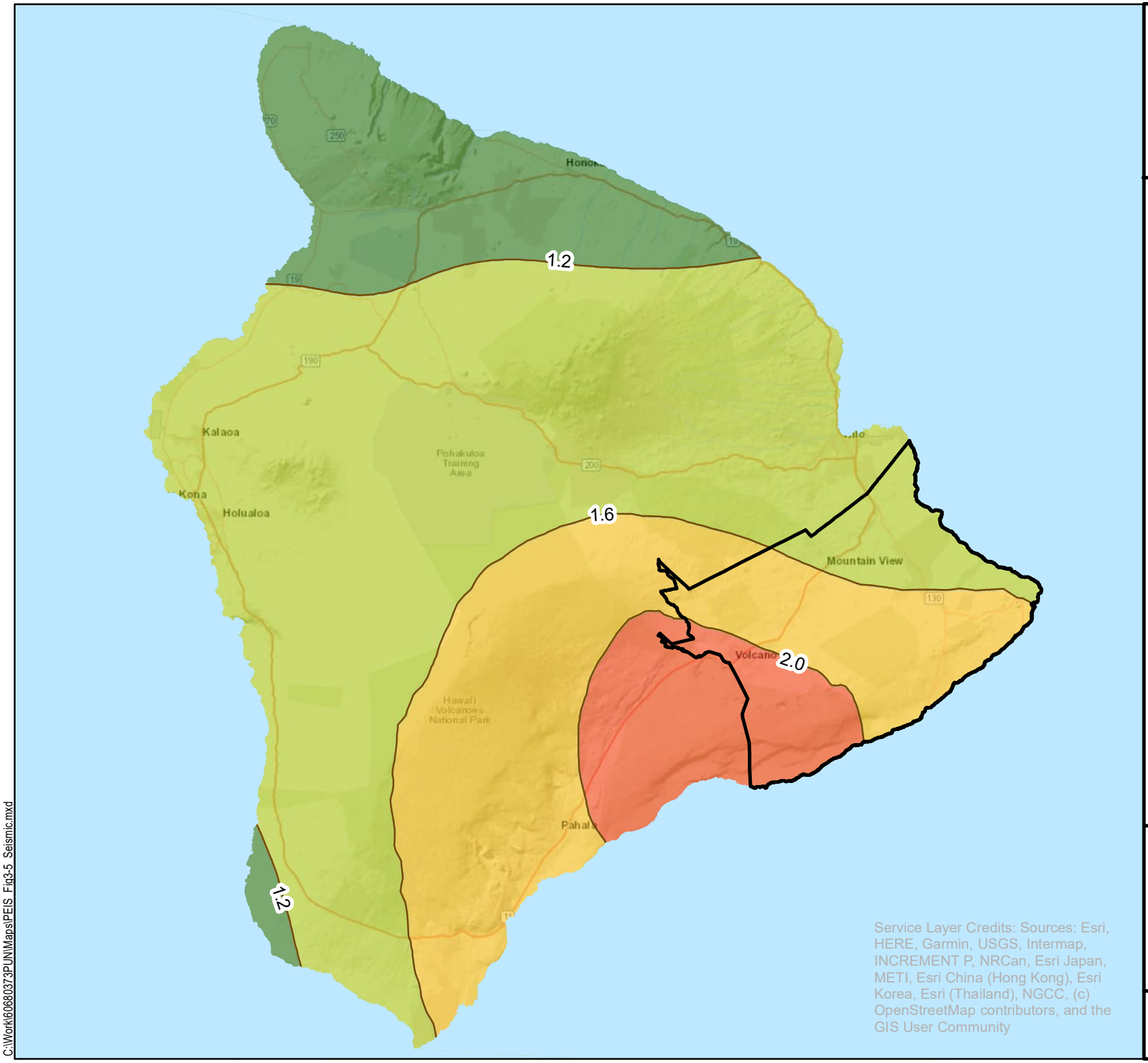

FIGURE 3-5

PEAK ACCELERATION WITH A 2% PROBABILITY OF EXCEEDANCE IN 50 YEARS

Legend

- Project Area

Peak Horizontal Acceleration (g)

- 0.8 - 1.2
- 1.2 - 1.6
- 1.6 - 2
- > 2

Source: County of Hawai'i, 2011 Puna Community Development Plan; USGS Uniform-hazard maps and GIS data for the 2021 update of the National Seismic Hazard Model for Hawai'i.

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3.5.1.3 HURRICANES

Tropical storm systems that have sustained winds exceeding 73 miles per hour, form in warm tropical waters near the equator, and strike in the Atlantic and Eastern Pacific Oceans are known as hurricanes. Similar tropical storm systems that strike in the Western Pacific Ocean, Indian Ocean, and Southern Pacific Oceans are called typhoons and cyclones, respectively. Due to the geographic location of Hawai'i within the Eastern Pacific Ocean, tropical storms that strike Hawai'i are referred to as hurricanes. Wind, precipitation, and landslides associated with hurricanes can cause damage to, and flooding of, roads and structures.

In Hawai'i, hurricane season runs from June 1 to November 30. The last major hurricane (Category 5) to impact Hawai'i was Lane, which produced significant flooding and across the Hawaiian Islands during August 2018. This hurricane also fanned a series of wildfires in western Maui.

Although conditions are ideal for hurricane formations, few have made landfall (Tetra Tech 2020). However, these storm events are occurring more frequently with more storms developing from Pacific storms between 1991 and 2010 than in the last century (Tetra Tech 2020). Several tropical storms have passed over or near the Big Island in recent decades (NOAA 2022a).

According to the NOAA National Storm Surge Hazard Maps, coastal areas of the Project Area are subject to hurricane storm surge. Areas surrounding Kapoho Bay and south of Kapoho Bay are vulnerable to storm surge further inland than other coastal areas (NOAA 2022b). Under future conditions with higher sea level, it is feasible that a strong hurricane could exceed the current projections for storm surge inundation.

3.5.1.4 TSUNAMIS

Tsunamis are a series of waves that are created by sea floor movements caused by earthquakes, landslides, or volcanic eruptions. The Hawaiian Islands are always at risk for tsunamis, as the islands are susceptible to tsunamis generated from earthquake and volcanic activity from the area bordering the Pacific Ocean (also known as the "Rim of Fire"). Since 1812, 25 tsunamis have adversely impacted the Big Island (Tetra Tech 2020). The most devastating tsunamis for Hawai'i County in the last century occurred in 1946 and 1960, with most damage occurring on the northeast side of the island.

Tsunamis can strike anywhere along the coast. Areas that are less than 25 feet above sea level and within one mile of the shoreline are at the greatest risk to tsunamis. The shoreline of the Project Area lies within the Tsunami Evacuation Zone (Figure 3-6); however, a majority of the Project Area is located at higher elevation and out of this risk zone. Table 3-3 displays recorded wave height of tsunamis in the vicinity of the Project Area.

Table 3-3. Tsunami Wave Height in the Project Vicinity

	Year				
Location	1946	1952	1957	1960	1964
North of Pāpaʻi	20	0	10	7	0
Near Keaʻau	24	0	8	12	0
Near Waiakahiula	19	0	0	14	0
East of Waiakahiula	16	0	0	0	0
Cape Kumukahi	19	0	12	0	0
Kapoho Point	0	0	3	3	0
Near Pohoiki	9	0	7	6	0
ʻOpihikao	10	0	0	6	0
Near Kaimū	20	0	10	13	0
Kalapana Park	18	3	7	7	0
Near Kalapana Park	12	0	0	0	0

Source: County of Hawaiʻi 2022a.

FIGURE 3-6

TSUNAMI EVACUATION ZONE

Legend

- Project Area
- Roads
- Tsunami Evacuation Zone

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, Tsunami Evacuation Zones for the islands of Niihau, Kauai, Oahu, Molokai, Lanai, Maui and Hawai', Sept. 2021.

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Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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3.5.1.5 FLOODING

According to the State of Hawai'i Department of Land and Natural Resources Flood Hazard Assessment Tool, most of the Project Area is located in Federal Emergency Management Agency (FEMA) Zone X, an area of minimal flood hazard outside of the Special Flood Hazard Area and at a higher elevation than the 0.2 percent annual chance flood, or Zone D, an area of undetermined flood hazard (Figure 3-7). A narrow strip of coastal land is located in the VE zone, which includes areas subject to inundation by the 1-percent-annual-chance flood event with additional hazards due to storm-induced velocity wave action. The Project Area intersects a total of 34 FIRM panels (Table 3-4).

Table 3-4. FEMA FIRM Panels within the Project Area

FEMA FIRM PANEL		
1551661100F	1551661425F	1551661435F
1551661375F	1551661650F	1551661445F
1551661105F	1551660917F	1551661201F
1551661115F	1551660919F	1551601203F
1551661400F	1551660940F	1551661211F
1551661625F	1551661180F	1551661213F
1551661108F	1551661190F	1551661202F
1551661120F	1551661430F	1551661204F
1551661109F	1551661440F	1551661212F
1551661107F	1551661655F	1551661214F
1551660915F	1551661185F	1551661210F
1551661175F	1551661195F	

Source: State of Hawai'i Department of Land and Natural Resources 2022a.

In the Project Area, high rainfall over 100 inches per year results in severe flooding. Overland sheet flow occurs in areas with undefined drainage ways during storm events. Flood hazard areas can be difficult to delineate due to the lack of defined drainage ways (Tetra Tech 2020).

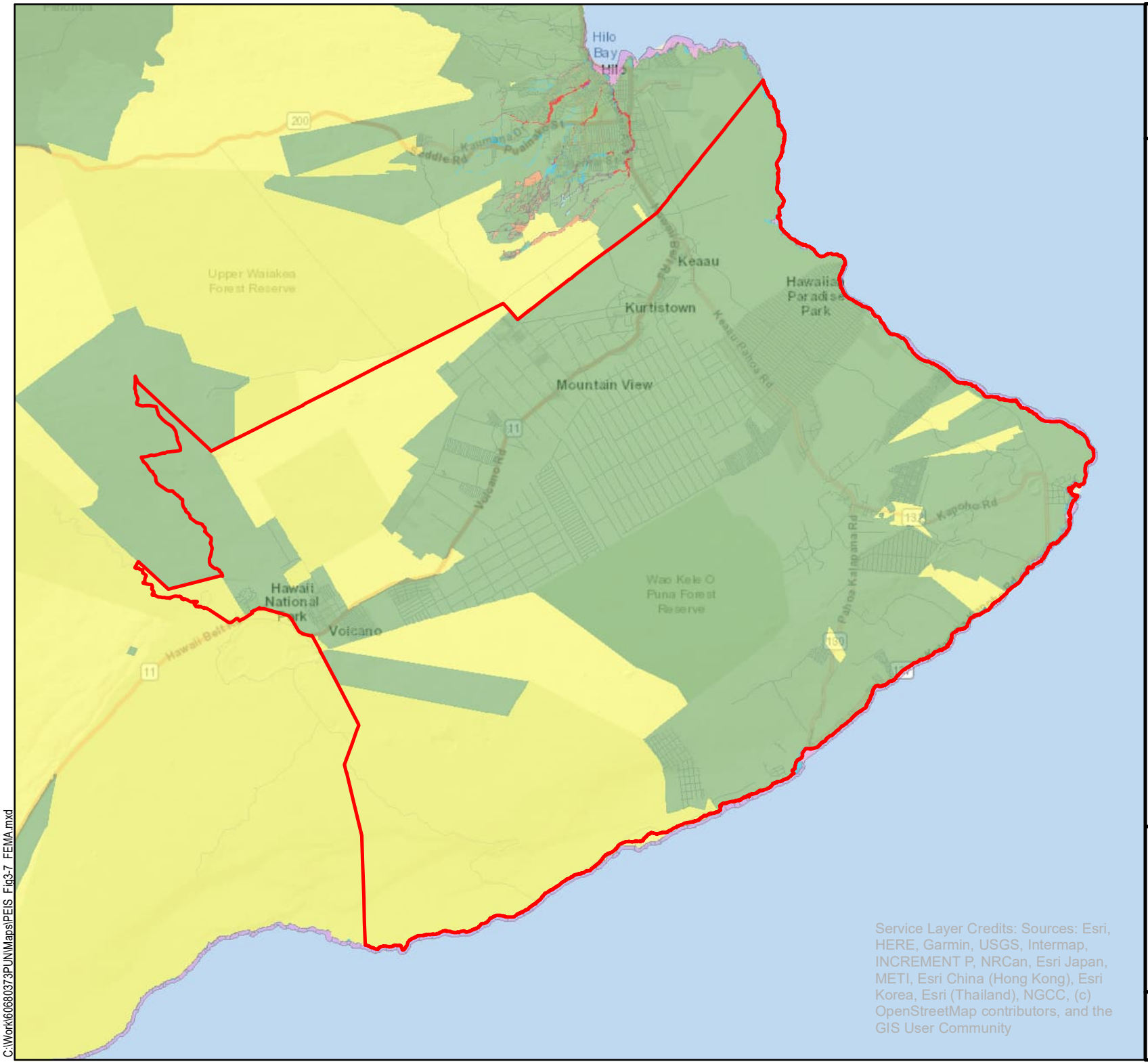

FIGURE 3-7

FEMA FLOOD MAP

Legend

- Project Area
- Roads

FEMA Flood Hazard Areas

- A: 1% Annual Chance of Flooding, no BFE
- AE: 1% Annual Chance of Flooding, with BFE
- AE: Regulatory Floodway
- AH: 1% Annual Chance of 1-3ft Ponding, with BFE
- AO: 1% Annual Chance of 1-3ft Sheet Flow Flooding, with Depth
- D: Possible But Undetermined Hazard
- VE: High Risk Coastal Area
- X: 0.2% Annual Chance of Flooding
- X: Area of Minimal Flood Hazard
- X: Reduced Flood Risk due to Levee

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program,. Flood Hazard Areas (DFIRM) - County of Hawai'i, May 2021.

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3.5.1.6 Climate Change and Sea Level Rise

Climate change refers to any significant change in the measures of climate lasting for an extended period of time (USEPA 2017). Climate change is defined by the Hawai‘i Climate Change Mitigation and Adaptation Commission as “a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties that persist for an extended period, typically decades or longer” (Hawai‘i Climate Change Mitigation and Adaptation Commission 2017). The risks of climate change include rising temperatures, increased frequency and severity of storm events, sea level rise, and sea level rise induced groundwater rise near the coast.

Temperature

Hotter temperatures create more intense, frequent, irregular weather patterns. Warming oceans cause more frequent and intense El Niño years (extreme weather events) (State of Hawai‘i 2022). Warming air temperatures lead to heat waves, expanded pathogen ranges and invasive species, thermal stress for native flora and fauna, increased electricity demand, increased wildfire, potential threats to human health, and increased evaporation, which both reduces water supply and increases demand. Rapid warming at highest elevations impedes precipitation, the source of Hawai‘i’s freshwater (City and County of Honolulu Climate Change Commission 2018).

Warming seas lead to more intense droughts and heavy tropical storms. The impacts of these storms include more landslides, runoff, algae blooms, erosion, and flooding.

Wind and Precipitation

Impacts of changing wind and precipitation include the following (City and County of Honolulu Climate Change Commission 2018):

- The frequency of gale-force winds is increasing in the western and south Pacific but decreasing in the central Pacific.
- Average daily wind speeds are slowly declining in Hilo, while remaining steady across western and south Pacific sites.
- Studies indicate there will be future changes to winds and waves due to climate change, which affects ecosystems, infrastructure, freshwater availability, and commerce.
- Hawai‘i has seen an overall decline in rainfall over the past 30 years, with widely varying precipitation patterns on each island. The period since 2008 has been particularly dry.
- Declining rainfall has occurred in both the wet and dry seasons and has affected all the major islands.
- Heavy rainfall events and droughts have become more common, as well as increasing runoff, erosion, flooding, and water shortages.
- Consecutive wet days and consecutive dry days are both increasing in Hawai‘i.

- There is disagreement regarding predicted precipitation at the end of the century. Model projections range from small increases to increases of up to 30 percent in wet areas, and from small decreases to decreases of up to 60 percent in dry areas.
- Generally, windward sides of the major islands will become cloudier and wetter. The dry leeward sides will generally have fewer clouds and less rainfall.
- Stream flow in Hawai‘i has declined over the past century, consistent with observed decreases in rainfall. This indicates declining groundwater levels.
- More frequent tropical cyclones are projected for the waters near Hawai‘i. This is not necessarily because there will be more storms forming in the east Pacific; rather, it is projected that storms will follow new tracks that bring them into the region of Hawai‘i more often.

Sea Level Rise

Sea level rise also threatens people, infrastructure, buildings, freshwater resources, and other natural resources. The 2017 Hawai‘i Sea Level Rise Vulnerability and Adaptation Report estimates that the County will lose $430 million due to infrastructure and land loss, not including public facilities (Hawai‘i Climate Change Mitigation and Adaptation Commission 2017).

Sea level in Hilo Bay has risen about 10 inches since 1950. Sea level is currently rising at a greater rate of about one inch every four years (State of Hawai‘i 2022).

As noted in the Hawai‘i County General Plan, the combination of subsidence and sea level rise impacts the County. Volcanoes, which increase the weight of the island, and large earthquakes contribute to coastal subsidence (County of Hawai‘i 2005).

Planning for Climate Change

Section 1: Natural Resources of the draft General Plan 2040 for the County of Hawai‘i includes the following goal:

> *Climate impacts are addressed in the built environment by efficient public investment in green development, increasing renewable energy production, reducing greenhouse gas emissions, fossil fuels, energy consumption, and waste, and by educating the community in adapting for climate change* (County of Hawai‘i 2019).

The climate change sustainability objectives in the draft General Plan 2040 are:

- Partner with community stewardship groups, local stakeholders and intergovernmental agencies to reduce island-wide greenhouse gas emissions by at least 80 percent from 2005 levels by 2050.
- Reduce vulnerability to sea level rise for all vulnerable communities and infrastructure (County of Hawai‘i 2019).

There are two areas of risk identified for Hawai‘i County in the Hazard Mitigation Plan based on the findings of the 2017 Hawai‘i Sea Level Rise Vulnerability and Adaptation Report:

- Chronic Sea Level Rise Exposure Area – area predicted to be inundated under ongoing normal conditions in the future for various scenarios of sea level rise. 3.2-foot exposure area.
- Event-based Sea Level Rise Inundation Area – 3.2 feet chronic sea level rise if a 1-percent annual chance coastal flood event occurs.

Figure 3-8 displays the extent of 3.2 feet of sea level rise, which is the level that the Hawai‘i Climate Change Adaptation and Mitigation Commission recommends planning for now.

3.5.2 Potential Environmental Consequences and Mitigation Measures

3.5.2.1 CONSTRUCTION

While construction would not increase the likelihood of natural hazards occurring, natural hazards may impact construction. All hazards have the potential to cause delays to the construction schedule and increase project cost.

An earthquake can cause structural damage, instability, liquefication, and potential injuries to personnel. Earthquakes may also cause tsunami and storm surge. Hurricanes and storm events may cause flooding and wind damage.

Construction activities could exacerbate the local impacts of these events. Disturbance of soil during construction could result in increased sedimentation and erosion. Increased precipitation associated with climate change could further exacerbate surface water runoff impacts during construction, resulting in potential delays and impacts to water quality.

High winds or extreme heat may create hazardous working conditions, which could also result in project delays. These high winds can introduce more particulate matter into the environment and could impair nearby waterbodies and air quality. Adherence to warnings, forecasts, and alerts about potential hazards and weather events would reduce the potential for impacts to the project, environment, and personnel. The impacts to construction associated with hurricanes could be minimized by scheduling the project outside of hurricane season, which runs from June 1 to November 30, to the extent practicable.

Sea level rise is not anticipated to have a direct impact on near-term construction activities as the proposed activities are not located within the extent of the 3.2 feet of sea level rise, which is the level that the Hawai‘i Climate Change Adaptation and Mitigation Commission recommends for planning purposes.

FIGURE 3-8

3.2-FOOT SEA LEVEL RISE EXPOSURE AREA

Legend

- Project Area
- Roads
- 3.2-Foot Sea Level Rise Exposure Area

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, 1% Coastal Flood Zone with 3.2 ft Sea Level Rise - Hawai'i Island, Oct. 2017.

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3.5.2.2 OPERATION

To mitigate the hazards associated with potential earthquakes, structures would be designed to meet Seismic Zone 2A requirements and applicable International Building Code, Federal, State, and County requirements. Furthermore, the proposed facilities would be designed and constructed to meet all applicable International Building Code, and Federal, State, and local requirements to protect against potential structural impacts resulting from tsunamis, hurricanes, flooding and other natural hazards.

The anticipated 3.2-foot sea level rise was compared to the map of the Proposed Action sites and their surrounding environs on the Hawai'i Sea Level Rise Viewer (Pacific Islands Ocean Observing System n.d.). More specifically, passive flooding, high wave flooding, and coastal erosion scenarios were simulated on the Hawai'i Sea Level Rise Viewer. The resultant maps identified no sea level rise exposure areas on the Proposed Action sites.

After construction, the Proposed Action would operate under the same level of risk of all natural hazards. However, the impact from natural hazards would be alleviated by the application of the building code, grading ordinance, revegetation plan, emergency management operations protocol, and adherence to applicable standard operating procedures and BMPs. The Proposed Action would not significantly increase or exacerbate risks to human health or property from natural hazards including potential 3.2-foot or 6-foot sea level rise, and the impacts would be less than significant.

3.6 BIOLOGICAL RESOURCES

3.6.1 Affected Environment

3.6.1.1 FLORA

Hawai'i's natural environmental resources, including its forests, exceptional trees, and unique ecosystems, contribute to the County's natural beauty and tourism industries. Several areas in the Project Area are protected as forest reserves or natural area reserves (Figure 3-9). Table 3-5 provides a list of the forest reserves and natural area reserves within the Project Area.

FIGURE 3-9

FOREST AND NATURAL AREA RESERVES

Legend

- Project Area
- Roads

Reserves

- Forest Reserve
- Game Management Area
- National Park
- Natural Area Reserve
- Office of Hawaiian Affairs
- Managed by DOFAW
- State Monument
- State Park
- State Recreation Area
- Nature Conservancy Preserve
- Various Other Sanctuary
- Wildlife Sanctuary

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, Reserves in the State of Hawai'i, May. 2022.

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Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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Table 3-5. Forest Reserves and Natural Area Reserves within the Project Area

Name	Managed by
ʻŌlaʻa Forest Reserve	Division of Forestry and Wildlife (DOFAW)
Puʻu Makaʻala Natural Area Reserve	DOFAW
Hawaiʻi Volcanoes National Park	United States National Park Service
Kahaualeʻa Natural Area Reserve	DOFAW
Wao Kele O Puna	Office of Hawaiian Affairs
Keauʻohana Forest Reserve	DOFAW
Malama-Kī Forest Reserve	DOFAW
Nānāwale Forest Reserve	DOFAW

The islands of Hawaiʻi are home to unique ecosystems and flora found nowhere else in the world. This includes some of the last remaining old growth ʻōhiʻa and koa forests. These forests are threatened by invasive plant species, invasive ungulates, and invasive pathogens, including Rapid ʻŌhiʻa Death (*Ceratocystis* sp.).

ʻŌhiʻa (*Metrosideros polymorpha*) is the most abundant native tree in the state of Hawaiʻi. On Hawaiʻi Island, hundreds of thousands of ʻōhiʻa have already died from the fungus called Rapid ʻŌhiʻa Death. The disease was first discovered on Hawaiʻi Island in 2014 and is repsonsible for killing ʻōhiʻa trees in all districts, especially within the Puna district. Based on recent and ongoing aerial surveys in 2019, more than 175,000 acres of forest contain ʻōhiʻa showing symptoms of Rapid ʻŌhiʻa Death disease on the island of Hawaiʻi. The fungus enters ʻōhiʻa plants through a wound and grows in the sapwood. Humans are thought to be a main vector because we move infected wood, or contaminated tools, gear and vehicles from one location to another. Other potential vectors include feral ungulates and beetles (UH Mānoa, College of Tropical Agriculture and Human Resources 2022).

In 1975, the Hawaiʻi State Legislature passed Hawaiʻi Revised Statutes (HRS) Chapter 58 to protect the State's exceptional trees. A tree, stand, or grove of trees can be designated as exceptional by a County Arborist if the tree has historic or cultural value, or based on its age, rarity, location, size, aesthetic quality, or endemic status. There are several exceptional trees within the Project Area. Exceptional trees in the Project Area include two groves of mangoes; one grove mapped along Pohoiki Road leading to the Isaac Kepoʻokalani Hale Memorial Park, and a second grove of mangoes mapped along Government Beach Road in Koaʻe, south of Nānāwale Park (Figure 3-10). There are also two exceptional ʻōhiʻa lehua trees in the Project Area, one near the intersection of Middle Road and North Road located east of Wao Kele O Puna Forest Reserve, and one in Volcano, on Volcano Road, near the Volcano Art Center.

FIGURE 3-10

EXCEPTIONAL TREES

Legend

- Project Area
- Roads
- Exceptional Tree

Sources: County of Hawai'i, Inventory of Exceptional Trees in Hawaii County.

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The United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool provided a list of 42 Federally endangered plant species that could potentially be within the Project Area (USFWS 2022a). The Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW) has provided a list of 6 additional State and Federally endangered plant species known to occur in the Project Area (Table 3-6).

Table 3-6. List of Federally and State Endangered Plant Species Potentially Occurring within the Puna District

Common Name	Latin Name	Status
Flowering Plants		
ʻAiea	*Nothocestrum breviflorum*	Federal and State Endangered
ʻAkūʻakū	*Cyanea platyphylla*	Federal and State Endangered
ʻAkū	*Cyanea tritomantha*	Federal and State Endangered
ʻĀnunu	*Sicyos albus*	Federal and State Endangered
ʻĀnunu	*Sicyos macrophyllus*	Federal and State Endangered
ʻŌhā wai	*Clermontia lindseyana*	Federal and State Endangered
ʻŌhā wai	*Clermontia peleana*	Federal and State Endangered
ʻŌhai	*Sesbania tomentosa*	Federal and State Endangered
ʻOhe	*Joinvillea ascendens ascendens*	Federal and State Endangered
Aʻe	*Zanthoxylum dipetalum* var. *tomentosum*	Federal and State Endangered
Aʻe	*Zanthoxylum hawaiiense*	Federal and State Endangered
Alani	*Melicope zahlbruckneri*	Federal and State Endangered
Haʻiwale	*Cyrtandra giffardii*	Federal and State Endangered
Haʻiwale	*Cyrtandra tintinnabula*	Federal and State Endangered
Hāhā	*Cyanea shipmanii*	Federal and State Endangered
Hāhā	*Cyanea copelandii* ssp. *copelandii*	Federal and State Endangered
Hāhā	*Cyanea stictophylla*	Federal and State Endangered
Haʻiwale	*Cyrtandra nanawaleensis*	Federal and State Endangered
Haʻiwale	*Cyrtandra wagneri*	Federal and State Endangered
Hala pepe	*Pleomele hawaiiensis*	Federal and State Endangered
Hau kuahiwi	*Hibiscadelphus giffardianus*	Federal and State Endangered
Hawaiian vetch	*Vicia menziesii*	Federal and State Endangered
Hilo ischaemum	*Ischaemum byrone*	Federal and State Endangered
Hōʻawa	*Pittosporum hawaiiense*	Federal and State Endangered
Hōlei	*Ochrosia haleakalae*	Federal and State Endangered
Hōlei	*Ochrosia kilaueaensis*	Federal and State Endangered
ʻIhi	*Portulaca villosa*	Federal and State Endangered

Common Name	Latin Name	Status
Kīponapona	*Phyllostegia racemosa*	Federal and State Endangered
Laukahi kuahiwi	*Plantago hawaiensis*	Federal and State Endangered
Loulu	*Pritchardia maideniana*	Federal and State Endangered
Makou	*Ranunculus hawaiensis*	Federal and State Endangered
Maui reedgrass	*Calamagrostis expansa*	Federal and State Endangered
Nānū	*Gardenia remyi*	Federal and State Endangered
Poʻe	*Portulaca sclerocarpa*	Federal and State Endangered
No common name	*Phyllostegia brevidens*	Federal and State Endangered
No common name	*Phyllostegia floribunda*	Federal and State Endangered
No common name	*Phyllostegia parviflora*	Federal and State Endangered
No common name	*Phyllostegia stachyoides*	Federal and State Endangered
No common name	*Phyllostegia velutina*	Federal and State Endangered
No common name	*Sanicula sandwicensis*	Federal and State Endangered
No common name	*Schiedea diffusa* ssp. *macraei*	Federal and State Endangered
No common name	*Schiedea diffusa* subsp. *diffusa*	Federal and State Endangered
No common name	*Spermolepis hawaiiensis*	Federal and State Endangered
No common name	*Stenogyne cranwelliae*	Federal and State Endangered
Ferns and Allies		
No common name	*Deparia kaalaana*	Federal and State Endangered
Hohiu	*Dryopteris glabra* var. *pusilla*	Federal and State Endangered
No common name	*Microlepia strigosa* var. *mauiensis*	Federal and State Endangered
Pendant kihi fern	*Adenophorus periens*	Federal and State Endangered

Within the Project Area, there is designated critical habitat for ʻānunu, haʻiwale, Hilo ischaemum, and the pendant kihi fern species (Figure 3-11).

ʻĀnunu is an annual vine that is part of the gourd family (Cucurbitaceae). The critical habitat in the Project Area is located north of Volcano, overlapping the Puʻu Makaʻala Natural Area Reserve and most of the ʻŌlaʻa Small Tract in Hawaiʻi Volcanoes National Park. Historically, this species occurred in the Mauna Kea, Kīlauea and Puʻu Makaʻala areas, but is currently found only in the Koa management unit in Hawaiʻi Volcanoes National Park (USFWS 2022b).

Haʻiwale is a shrubby tree that is a member of the Gesneriaceae (African violet) family. This species occurs in wet montane forest and lowland wet forest at approximately 2,150 to 4,725 feet. Historically this species occurred on the northeast slope of Mauna Kea near Kīlau Stream and south of the eastern slope of Mauna Loa. One individual plant of this species was found near ʻŌlaʻa Forest Reserve in 2015. The critical habitat in the Project Area is located north of Volcano, encompassing a large part of the Puʻu Makaʻala Natural Area Reserve, and slightly overlapping a portion of the ʻŌlaʻa Small Tract in Hawaiʻi Volcanoes National Park. (USFWS 2022c).

Hilo ischaemum is a grass in the Poaceae family currently found on Molokaʻi and east Maui with no occurrences on the island of Hawaiʻi reported since 2009. The typical habitat is in close proximity to the ocean, among rocks or frequently moist or wet basalt cliffs in windward coastal dry shrubland from sea level to 623 feet. The critical habitat within the Project Area is located on the southwestern shoreline within Hawaiʻi Volcanoes National Park (USFWS 2022d).

The pendant kihi fern is a small epiphytic fern that is a member of the Polypodiaceae family. Historically, this fern occurred in the Hilo and Waimea areas of the island of Hawaiʻi but most populations have not been observed since the 1990s. Critical habitat in the Project Area is located within the Kahaualeʻa Natural Reserve (USFWS 2022e).

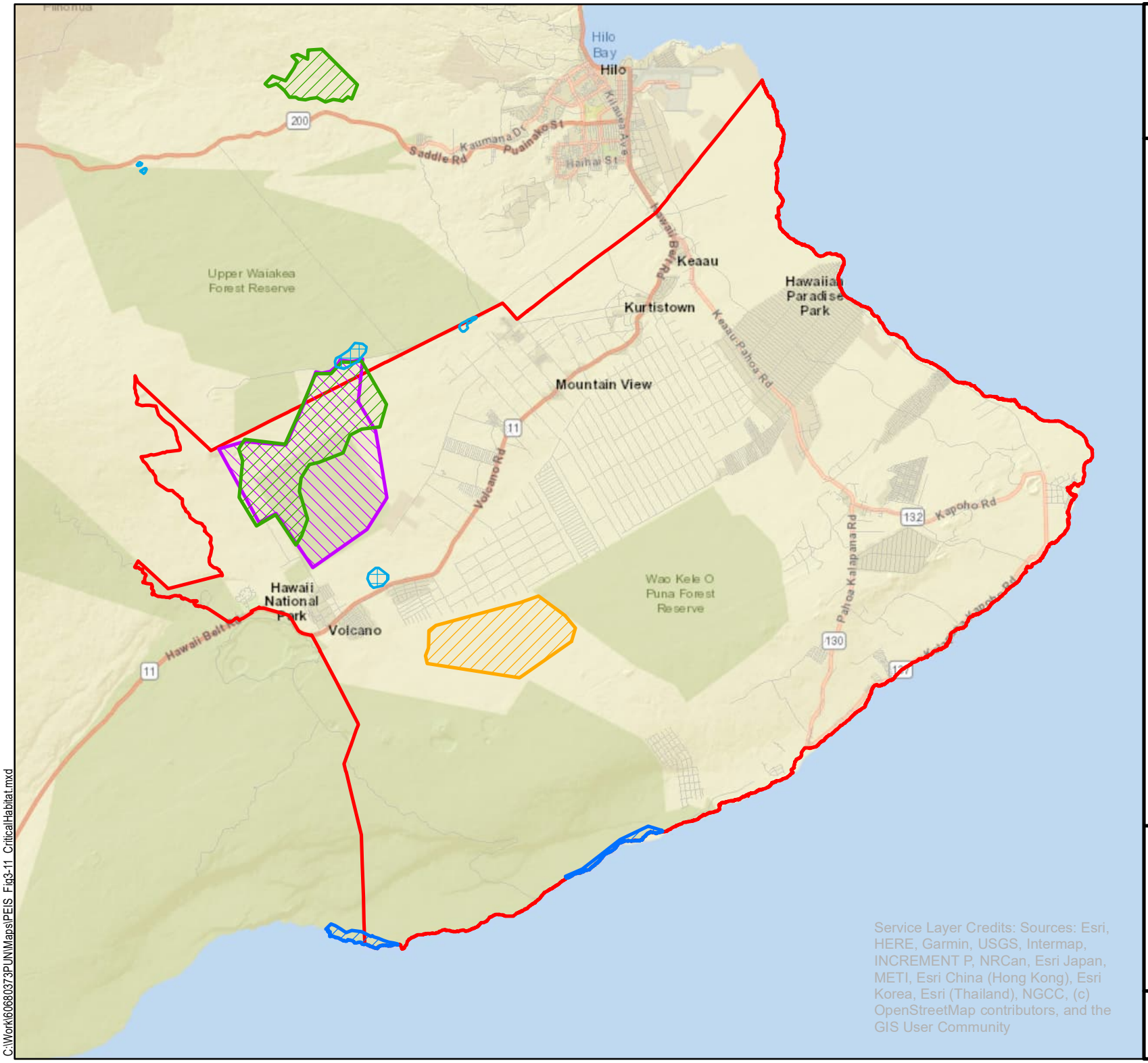

FIGURE 3-11

CRITICAL HABITAT

Legend

- Project Area
- Roads
- Picture-wing Fly
- Pendant Kihi Fern
- Ha'iwale
- Hilo Ischaemum
- 'Ānunu

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, State Critical Habitat - Picturewing, November, 2022; Big Island Critical Habitat - Plant, November, 2022.

N

0 12,500 25,000 Feet

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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3.6.1.2 FAUNA

Hawai'i's native wildlife includes a number of marine mammals, sea turtles, seabirds, waterbirds, and a host of endemic insects and forest bird species. Hawai'i has no native land mammals except for the diminutive Hawaiian hoary bat (DLNR 2022b).

The USFWS IPaC tool provided an unofficial list of Federally threatened and endangered species that could potentially be within the Project Area. In addition to the Federally listed species identified by USFWS, DOFAW has advised that the State-listed Hawaiian hawk or 'io (*Buteo solitarius*), the State and Federally listed anchialine shrimp species (*Vetericaris chaceorum* and *Procaris hawaiana*), the State and Federally listed Anthricinan yellow-faced bee (*Hylaeus anthracinus*), and the State and Federally listed Hawaiian monk seal (*Monachus schauinslandi*) may occur in the project vicinity (Table 3-7).

Hawaiian Hoary Bat

The endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) is the only native mammal to Hawai'i. The habitat requirements of the Hawaiian hoary bat are not well-understood and has been identified as one of the primary data needs for species recovery (USFWS 1998 and Gorresen et al. 2013). The species has been observed foraging in both open and forested habitats (USFWS 1998). The mobility of the species by flight results in all areas from the coast to the highest mountains being accessible to foraging by the Hawaiian hoary bat (Gorresen et al. 2013). Hawaiian hoary bats forage for insects as low as 3 feet above the ground in a variety of habitats; making entanglement in barbed wire fencing a threat for this species (USFWS 1998). The bats are solitary roosting in both native and non-native trees greater than 15 feet in height (Bonaccorso et al. 2015). During the Hawaiian hoary bat birthing and pup rearing season, from June 1 through September 15, bat pups that cannot yet fly may be present in roost trees.

Hawaiian Seabirds

The threatened and endangered Hawaiian seabirds include the endangered Hawaiian petrel (*Pterodroma sandwichensis*), the endangered band-rumped storm-petrel (*Oceanodroma castro*), and the threatened Newell's Townsend's shearwater (*Puffinus auricularis newelli*). These birds travel between their nesting colonies in the mountains and the ocean where they feed (Young and VanderWerf 2016). They take flight at night during their breeding, nesting, and fledging seasons from September 15 to December 15 (USFWS 2022g).

Table 3-7. Federally and State Listed Threatened and Endangered Species Potentially Occurring within the Project Area

Common Name	Latin Name	Status
Mammals		
Hawaiian Hoary Bat	*Lasiurus cinereus semotus*	Federal and State Endangered
Hawaiian Monk Seal	*Monachus schauinslandi*	Federal and State Endangered
Birds		
Band-rumped Storm-petrel	*Oceanodroma castro*	Federal and State Endangered
Hawai'i 'Ākepa	*Loxops coccineus*	Federal and State Endangered
Hawaiian (=koloa) Duck	*Anas wyvilliana*	Federal and State Endangered
Hawaiian Coot	*Fulica americana alai*	Federal and State Endangered
Hawaiian Goose	*Branta* (=*Nesochen*) *sandvicensis*	Federal and State Threatened
Hawaiian Hawk	*Buteo solitarius*	State Endangered
Hawaiian Petrel	*Pterodroma sandwichensis*	Federal and State Endangered
Hawaiian Stilt	*Himantopus mexicanus knudseni*	Federal and State Endangered
Newell's Townsend's Shearwater	*Puffinus auricularis newelli*	Federal and State Threatened
Short-tailed Albatross	*Phoebastria* (=*Diomedea*) *albatrus*	Federal and State Endangered
Reptiles		
Green Sea Turtle	*Chelonia mydas*	Federal and State Threatened
Insects		
Blackburn's Sphinx Moth	*Manduca blackburni*	Federal and State Endangered
Hawaiian Picture-wing Fly	*Drosophila digressa*	Federal and State Endangered
Mull's Hawaiian Picture-wing Fly	*Drosophila mulli*	Federal and State Threatened
Anthricinan yellow-faced bee	*Hylaeus anthracinus*	Federal and State Endangered
Orangeblack Hawaiian Damselfly	*Megalagrion xanthomelas*	Federal and State Endangered
Crustaceans		
Anchialine Pool Shrimp	*Vetericaris chaceorum*	Federal and State Endangered
Anchialine Pool Shrimp	*Procaris hawaiana*	Federal and State Endangered

Hawaiian Waterbirds

Endangered Hawaiian waterbirds, including the Hawaiian stilt (*Himantopus knudseni*) and Hawaiian coot (*Fulica alai*) can be found in a variety of wetland habitats including freshwater marshes, ponds, coastal estuaries, artificial reservoirs, taro loʻi, irrigation ditches, and sewage treatment ponds. Hawaiian stilts and Hawaiian coots, are highly mobile and may occupy newly, sometimes unintentionally, created habitat for foraging and even nesting, wherever ephemeral or persistent standing water is found. While not an ideal habitat, Hawaiian waterbirds may use existing cesspools and ponds for foraging, loafing, and nesting.

Hawaiian Goose (Nēnē)

The threatened Hawaiian goose or nēnē (*Branta sandvicensis*) can be found in a wide variety of habitats including coastal dune vegetation and nonnative grasslands, sparsely vegetated low- and high-elevation lava flows, mid-elevation native and nonnative shrubland, early successional cinderfall, cinder deserts, native alpine grasslands and shrublands, and open native and nonnative alpine shrubland-woodland community interfaces. Nēnē have an extended breeding season, and nesting may occur in all months except May, June, and July, although the majority of birds nest between October and March, and most clutches are laid between October and December (DLNR 2022c). They build bowl-shaped nests on the ground using a variety of habitat types and elevations, laying 2-5 eggs per nest (National Park Service 2018a).

Hawaiʻi ʻĀkepa

The endangered Hawaiʻi ʻākepa (*Loxops coccineus*) has been documented in five isolated populations above 4,000 feet elevation on the windward side of the island of Hawaiʻi, mainly in old-growth ʻōhiʻa and ʻōhiʻa/koa forests. Populations are known to occur mostly on the eastern slopes of Mauna Kea within the Hakalau Forest National Wildlife Reuge, the eastern and southern slopes of Mauna Loa within the upper forest areas of Kaʻū, and the northern slope of Hualālai (Lepson and Freed 1997). They feed mainly on ʻōhiʻa (*Metrosideros polymorpha*) leaf clusters, but also on koa (*Acacia koa*) leaves and seed pods. Hawaiʻi ʻākepa could be found in ʻōhiʻa and koa forests within the Project Area. ʻĀkepa breed in the spring and are obligatory cavity nesters, with most nests placed in natural cavities found in old-growth ʻōhiʻa and koa trees. Females build nests, incubate eggs, and brood chicks, and males deliver food to the female on and off the nest. Both parents feed the young, which remain with their parents for two to three months after flying (DLNR 2022c). Hawaiian forest birds including the ʻākepa are threatened by habitat loss and mosquito-borne diseases. None of the known populated forest sites where Hawaiʻi ʻākepa have been previously documented are in the Project Area.

Hawaiian Hawk

The Hawaiian hawk or ʻio (*Buteo solitarius*) is known to breed only on the island of Hawaiʻi and have nests in a wide variety of habitats. While they generally prefer dense native forests, they are also frequently seen in agricultural areas. ʻIo nests may

be present in trees during their breeding season from March to September. ʻIo mate for life and both parents help with incubating the egg for 38 days; but once the chick has hatched the male primarily hunts while the female broods. The ʻio is an opportunistic feeder and will hunt a wide variety of prey including rats, mice, mongoose, and various bird species (DLNR 2022c).

Short-tailed Albatross

The endangered short-tailed albatross (*Phoebastria albatrus*) spends most of its time at sea, foraging diurnally and possibly nocturnally, either alone or in groups and predominantly hunt for prey by surface-seizing, feeding primarilly on squid, crustaceans and various fishes (USFWS 2022i). They breed primarily on remote islands in the western Pacific during the month of October, beginning between 5 and 6 years of age. Short-tailed albatross nest on isolated, windswept, offshore islands, with restricted human access such as Midway Atoll and Kure Atoll in the Northwestern Hawaiian Islands. No Short-tailed albatross nesting has been documented on the Island of Hawaiʻi. The majority of short-tailed albatross nest on islands near Japan. (DLNR 2022c).

Green Sea Turtle and Hawaiian Monk Seal

The threatened green sea turtle (*Chelonia mydas*) may nest on any sandy beach in the Pacific Islands. In Hawaiʻi nesting occurs from May through September, peaking in June and July, with hatchlings emerging in November and December (USFWS 2022g).

Endangered Hawaiian monk seals (*Monachus schauinslandi*) come to shore mainly to birth, rest, and molt. Sandy protected beaches surrounded by shallow waters are preferred for pupping. Female seals haul-out on shore for up to seven weeks to give birth and nurse their pups. Though Hawaiian monk seals give birth year-round, pups are usually born during late March to early April. A newborn Hawaiian monk seal typically nurses with its mother for about one month (The Marine Mammal Center 2022).

Blackburn's Sphinx Moth

The endangered Blackburn's sphinx moth (*Manduca blackburni*) is currently found on the islands of Hawaiʻi, Maui, Kahoʻolawe, Molokaʻi, and Lānaʻi. Adult Blackburn's sphinx moths feed on nectar from native plants, including beach morning glory (*Ipomoea pes-caprae*), ʻilieʻe (*Plumbago zeylanica*), and maiapilo (*Capparis sandwichiana*). Blackburn's sphinx moth larvae feed on native ʻaiea (*Nothocestrum* sp.) and non-native tree tobacco (*Nicotiana glauca*). The larvae burrow into the soil and can remain in a dormant state for a year or more before emerging from the soil. Soil disturbance can result in death of the inactive immature insects (USFWS 2022g).

Hawaiian Picture-wing Flies

Hawaiʻi's endangered picture-wing flies (*Drosophila digressa and Drosophila mulli*) live in montane forests and are restricted to single islands. The only animal species with final critical habitat located in the Project Area is the Mull's picture-wing fly (*D. Mulli*). This species, restricted to the island of Hawaiʻi, was first discovered in ʻŌlaʻa

Forest Reserve. No recorded observations of this species have been reported since 2001. The final critical habitat for this species, within the Project Area, is located north of Route 11, near the community of Volcano, in the ʻŌlaʻa Forest Reserve and on the southern border of Upper Waiākea Forest Reserve (Figure 3-11) (USFWS 2022f). Populations of the Mull's picture-wing fly are closely associated with their breeding host plant, loulu (*Pritchardia beccariana*).

The picture-wing fly (*Drosophila digressa*) is found only on the island of Hawaiʻi at elevations ranging from approximately 2,000 to 4,500 feet above sea level in low land mesic, montane mesic, and montane wet ecosystems. This species lays its eggs on the decaying stems of *Charpentiera* and *Pisonia* plant species where the larvae develop. The most recently known areas to be occupied by this picture-wing fly are the ʻŌlaʻa Small Tract in Hawaiʻi Volcanoes National Park and the Manukā Natural Area Reserve (Figure 3-9) (DLNR 2022f).

Anthricinan Yellow-faced Bee

The endangered anthricinan yellow-faced bee (*Hylaeus anthracinus*) can be found along the coastline on the northwest coast of Hawaiʻi Island in South Kohala and North Kona in higher densities, and in lower densities near South Point. Due to a decline of native coastal vegetation, tree heliotrope (*Heliotropium foertherianum*) is now a critical floral resource. Other important plants visited for pollen and nectar include naupaka (*Scaevola taccada*), ʻilima (*Sida fallax*), ʻōhai (*Sesbania tomentosa*), naio (*Myoporum sandwicense*), and ʻakoko (*Euphorbia spp*.) (DLNR 2022e).

Orangeblack Hawaiian Damselfly

The endangered Orangeblack Hawaiian damselfly (*Megalagrion xanthomelas*) can be found in a variety of low elevation habitats, including anchialine pools, coastal wetlands, small streams, and artificial ponds (USFWS 2022g).

Anchialine Pool Shrimp

Anchialine pools are unique brackish water environments that form in lava fields near the ocean. They are landlocked pools fed by subsurface fresh groundwater and tidal seawater with no visible connection to the ocean (National Park Services 2018). Hawaiʻi is the only state with these unique pools that are home to Hawaiʻi's anchialine pool shrimp, also known as red shrimp or ʻōpaeʻula. The island of Hawaiʻi supports more pools than any of the other Hawaiian Islands; with more than 460 pools in about 80 sites identified on the ground, and an additional 54 sites (about 170 pools) viewed or photographed from the air (The Nature Conservancy 2021).

V. chaceorum is considered one of the most primitive shrimp species in the world (USFWS 2022h). Of the 700 known anchialine pools in the State of Hawaiʻi, *V. chaceorum* has only been documented in four pools at Manukā and the single pool at Lua O Palahemo (USFWS 2020a). None of the pool sites where *V. chaceorum* has been previously documented are in the Project Area.

P. hawaiana is found on the islands of Hawaiʻi and Maui. This species has been documented in two pools on the island of Maui and 26 pools on the island of Hawaiʻi (USFWS 2020b). None of the pool sites where *P. hawaiana* has been previously documented are in the Project Area.

Marine Ecosystems

The Puna shoreline includes rocky coastline, recent lava flows, tidepools, and black sand beaches. The shoreline, intertidal zone, and nearshore marine environment support a diversity of marine fauna including sea turtles, coral, sea urchins or wana, opihi, octopuses, sea cucumbers, crustaceans, and a wealth of other marine invertebrates and reef fish. In 2003, DLNR established the Waiʻōpae Tidepools, located east of Kapoho, as a Marine Life Conservation District. However, in 2018, this important fish nursery with rich coral growth, was covered by lava flows. DLNR also manages the Leleʻiwi Point Bottomfish Restricted Fishing Area. This marine managed area extends from Leleʻiwi Point, east of the Hilo Airport, to just south of Hawaiian Paradise Park. On February 25, 2022, the Board of Land and Natural Resources approved the reopening of all bottomfish restricted fishing areas which had been closed to fishing since 2007. The decision to open these areas is based in part on the 2021 update to the 2018 stock assessment which found these species to be fished at sustainable levels.

3.6.1.3 WETLANDS

Waters of the United States including adjacent wetlands are protected under Section 404 of the Clean Water Act, under the regulatory jurisdiction of the United States Army Corps of Engineers and USEPA. Per the Code of Federal Regulations Title 33 Part 328 waters of the United States (also referred to as jurisdictional waters) include:

- The territorial seas, and waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including waters which are subject to the ebb and flow of the tide;
- Tributaries to those waters;
- Lakes, ponds, and impoundments of jurisdictional waters; and
- Wetlands adjacent to jurisdictional waters.

The Code of Federal Regulations Title 33 Part 328 define wetlands as areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

The National Wetland Inventory was created in response to the Emergency Wetlands Resources Act of 1986, which mandated USFWS to map the wetlands of the United States. The purpose of the National Wetland Inventory is to support resource management decisions at the Federal, state, and local government levels, and promote the conservation and protection of fish and wildlife habitats.

Wetlands are mapped by the National Wetland Inventory through an analysis of high-altitude imagery and other data sources, including information provided by public and private entities. The term “wetland” is used to refer to a number of different aquatic habitats. These maps include wetlands and features that do not

meet the Code of Federal Regulations definition of a wetland and include wetlands and features that are not adjacent to jurisdictional waters.

The USFWS National Wetland Inventory dataset shows several freshwater emergent wetlands, freshwater ponds, and a few freshwater forested/shrub wetlands throughout the Puna District. There are a few relatively large wetlands located east of Kea‘au, and at the shoreline, near Hā‘ena Beach (aka., Shipman Beach). There are also several freshwater ponds located on either side of Route 11 between Mountain View and Volcano, such as near Glenwood Road and Lehuanani Street. A freshwater forested/shrub wetland is located southeast of Pāhoa at the southern end of Hīnalo Street, and a freshwater forested/shrub wetland and freshwater pond are located at the eastern end of route 132 (Kapoho Road) between Koa‘e and Pohoiki (Figure 3-12).

Any ponded water could provide potential habitat for wildlife, including endangered Hawaiian waterbirds. Some of the inland wetlands shown in the vicinity of Kea‘au Road may be relic features of the sugar plantation industry and may not be waters of the United States, protected under Section 404 of the Clean Water Act. The wetlands at the shoreline, near Hā’ena Beach are likely waters of the United States under the jurisdiction of the United States Army Corps of Engineers and USEPA.

3.6.2 Potential Environmental Consequences and Mitigation Measures

USFWS’s standard avoidance and minimization measures, and recommendations received from DOFAW for the protection of threatened and endangered species and Hawai‘i’s unique flora and fauna have been incorporated into the Proposed Action as described below.

3.6.2.1 CONSTRUCTION

FLORA

Most of the required trenching for construction of a County wastewater collection system would be within existing roadways and easements and would not affect native vegetation, forest habitat, or exceptional trees. The construction of new regional and subregional WWTPs and pump stations would require the clearing of vegetation and could have the potential to affect native vegetation, forest habitat, and exceptional trees.

FIGURE 3-12

WETLANDS

Legend

- Project Area
- Roads

Wetlands

- Estuarine/Marine Deepwater
- Wetland
- Pond or Lake
- Riverine

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, Wetlands in the State of Hawai' from USFWS, Aug., 2019

N

0 12,500 25,000 Feet

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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Under Alternatives 1B, 2/3, 4/5, and 6/7, a small portion of the proposed wastewater collection system in the town of Volcano would be located adjacent to the ʻŌlaʻa Small Tract in Hawaiʻi Volcano National Park and adjacent to the ʻŌlaʻa Forest Reserve (Figure 3-9). Alternative 2/3 also includes construction of a subregional WWTP adjacent to the ʻŌlaʻa Forest Reserve. The proposed wastewater collection system and several of the pump stations in the Pāhoa area, under Alternatives 1B, 2/3, 4/5, and 6/7, would be located adjacent to the Nānāwale Forest Reserve and the Malama-Kī Forest Reserve (Figure 3-9). The DLNR and the National Park Services will be consulted should the project involve work in any reserves under their respective jurisdictions.

There are four individual or groves of exceptional trees within the Project Area. One of the exceptional ʻōhiʻa lehua trees is located within a proposed service area for decentralized, regional, or subregional wastewater treatment in the town of Volcano, on Volcano Road, near the Volcano Art Center (Figure 3-10). One of the potential Alternative 1B package treatment plant locations is on Government Beach Road near one of the groves of exceptional mango trees. The locations of exceptional trees will be considered during the design of the project to avoid impacts to these protected resources.

There are 48 endangered plant species with the potential to be present in the Project Area. Therefore, the project activities may affect listed plant speices. To avoid and minimize potential adverse effects to listed plants, the Proposed Action would implement the following measures:

- Minimize distrubance outside existing developed areas or modified sites (e.g., site previouly used for agriculture), as practical;
- When construction is required outside existing developed areas or modified sites a botanical survey would be conducted;
- Botanical surveys would be conducted by a botanist with experience identfying native Hawaiian and listed plants;
- Botanical surveys would be conducted in the wettest part of the year (Ocotber to April), as practical;
- The boundary of any areas occupied by listed plants would be marked in the field and buffers zones listed in Table 3-8 would be established;
- DOFAW would be notified of any listed plant species identifed during the surveys;
- Any disturbed areas would be restored with native or non-invasive plants, as appropriate for the location; with a preference for native plants;
- Invasive plant species would not be used for site restoration or landscaping; and

- Hawai‘i-Pacific Weed Risk Assessment at www.plantpono.org would be reviewed to determine the invasiveness of plants proposed for site restoration or landscaping and for guidance on the selection and evaluation of landscaping plants.

Table 3-8. Buffer Distance to Avoid and Minimize Potential Impacts to Listed Plants

Action	Buffer Distance (feet)	
	Grasses/Herbs/Shrubs and Terrestrial Orchids	**Trees and Orchids Living in Trees**
Walking, Hiking, Surveys	3 feet	3 feet
Cutting and Removing Vegetation by Hand or Hand Tools (e.g., weeding)	3 feet	3 feet
Mechanical Removal of Individual Plants or Woody Vegetation (e.g., chainsaw, weed eater)	3 feet or up to height of removed vegetation (which ever greater)	3 feet or up to height of removed vegetation (which ever greater)
Removal of Vegetation with Heavy Equipment (e.g., bulldozer, tractor)	2x width equipment + height of vegetation	820 feet
Ground Disturbance/Outplanting/ Fencing with Hand Tools (e.g., shovel, auger)	20 feet	2x crown diameter
Ground Disturbance with Heavy Equipment	328 feet	820 feet
Surface Hardening/Soil Compaction (Roads, Utility Corridors, Buildings and Structures)	328 feet	820 feet

Within the Project Area there is designated critical habitat for four listed plant species: ‘ānunu, ha‘iwale, Hilo ischaemum, and the pendant kihi fern. None of the proposed wastewater system infrastructure or construction activities, under any of the alternatives, would be within designated critical habitat for listed plant species. The proposed branch sewer line on Wright Road in Volcano is less than 1,000 feet from designated critical habitat for ‘ānunu. With implementation of the measures listed in Table 3-8, impacts to listed plant speices and designated critical habitat for listed plant species would be avoided. If listed plants are present in or near proposed construction areas and buffer zones listed in Table 3-8 cannot be implemented, USFWS and DOFAW would be consulted.

The County of Hawai‘i Department of Environmental Management (DEM) would work with DOFAW and USFWS as needed to identify potential locations with threatened and endangered plant species that could be affected by the proposed addition of wastewater services and would perform surveys for these species as needed and recommended by DOFAW and USFWS. As individual projects are

developed, appropriate environmental documentation would be completed, including project-specific botanical surveys of habitats at or near the proposed construction. If a project is located entirely within a developed area or modified site, the need to conduct the biological survey would be evaluated.

Any location where vegetation is disturbed would be restored to existing conditions or better, using native or non-invasive plants, as appropriate for the location; with a preference for native plants. Where appropriate, native plant species would be selected for soil stabilization and replanting efforts.

To prevent the spread of Rapid ʻŌhiʻa Death, DEM would follow the information and guidance provided by the University of Hawaiʻi at Mānoa's College of Tropical Agriculture and Human Resources. This includes not moving ʻōhiʻa wood or ʻōhiʻa parts; not transporting ʻōhiʻa inter-island; avoiding injury to ʻōhiʻa; cleaning gear and tools, including shoes and clothes, before and after entering forests; and washing vehicles with a high pressure-hose or washer if they have been off-roading or have picked up mud from driving. These guidelines would be applied when ʻōhiʻa trees are present at a project site.

To prevent the spread of invasive fungal pathogens (e.g., Rapid ʻŌhiʻa Death), vertebrate and invertebrate pests (e.g., Little Fire Ants, Coqui Frogs), or invasive plant parts, the movement of plant and soil material between project sites would be minimized. As individual projects are developed, DEM would consult with the Big Island Invasive Species Committee for current information to help plan, design, and construct the project, learn of any high-risk invasive species in the area, and ways to mitigate and minimize the movement of plant or soil material between worksites. All equipment, materials, and personnel would be cleaned of excess soil and debris to minimize the risk of spreading invasive species. Additionally, importing soil or other plant material from off-island to Hawaiʻi Island would be avoided. DEM would consult with the Hawaiʻi Interagency Biosecurity Plan in planning, design, and construction of the project.

As the individual projects are developed, the Hawaiʻi Wildlife Management Organization would be consulted on measures to prevent and address wildfires in the project area.

FAUNA

Hawaiian Hoary Bat

To avoid inadvertent harm or mortality to young bats that cannot yet fly, trees and other woody plants greater than 15 feet in height would not be removed or trimmed during the Hawaiian hoary bat birthing and pup rearing season from June 1 to September 15. If this cannot be avoided, DOFAW and USFWS would be consulted. Bats can become entangled in barbed wire; therefore, the use of barbed wire fencing during construction would be avoided where possible. Where appropriate plain wire

may be used as an alternative to barbed wire. With the implementation of these mitigation measures, potential impacts to Hawaiian hoary bats from construction activities would be avoided.

Hawaiian Seabirds

Lighting from night construction can disorient seabirds, resulting in collision with manmade structures or grounding of seabirds. If nighttime construction work is required, all construction lighting would be downward facing and fully shielded to avoid and minimize impacts. In addition, nighttime construction work that requires outdoor lighting would be avoided, to the extent practical, during the seabird fledging season from September 15 through December 15. With the implementation of these mitigation measures, potential impacts to Hawaiian seabirds from construction activities would be avoided.

Hawaiian Waterbirds

Prior to undertaking construction activities or vegetation clearing within 100 feet of locations with habitat suitable for Hawaiian waterbirds (e.g., streams, wetlands, ponds, loʻi kalo) the area would be surveyed for Hawaiian waterbird nests. If a nest is discovered, DOFAW would be contacted, and a 100-foot buffer would be established and maintained around all active nests and/or chicks until the chicks have fledged. If a Hawaiian waterbird is observed in the project area, all work within 100 feet would cease and not resume until the birds leave the area of their own accord. Appropriate sediment and erosion control and spill prevention BMPs would be implemented to avoid water quality impacts that could affect Hawaiian waterbirds. With the implementation of these mitigation measures, potential impacts to Hawaiian waterbirds from construction activities would be avoided.

Hawaiian Goose (Nēnē)

Should construction activities take place between August and April, a wildlife biologist would be consulted and would survey the site for nesting nēnē prior to the start of construction activities. Should a Hawaiian goose be observed in the project area, all work within 100 feet should cease and the bird would not be approached. Work may continue after the bird or birds leave the area of their own accord. With the implementation of these mitigation measures, potential impacts to nēnē from construction activities would be avoided.

Hawai'i ʻĀkepa

As discussed above, several of the project alternatives involve construction in or near Hawaiʻi Volcano National Park, ʻŌlaʻa Forest Reserve, and Kahaualeʻa Natural Area Reserve. ʻŌhiʻa and ʻōhiʻa/koa forests within these reserves provide habitat for native forest birds including the Hawaiʻi ʻākepa. To avoid inadvertent harm or mortality to Hawaiʻi ʻākepa, the removal of tree cover in or near montane ʻōhiʻa and ʻōhiʻa/koa forests would be minimized, as practical. The removal of tree cover in or near montane ʻōhiʻa and ʻōhiʻa/koa forests over 2,000 feet in elevation would be avoided during the peak of the ʻākepa breeding season, from January 1 to June 30.

During construction, care would be taken to remove sources of standing water, including depressions where water may pool, to prevent the proliferation of mosquitos and mosquito-borne diseases that are a threat to native Hawaiian forest birds. As discussed above in the flora section, measures would be taken to prevent the spread of invasive species and wildfires that can impact Hawaiian forest bird habitat.

Hawaiian Hawk

Tree trimming and removal would be avoided, to the extent practical, during the Hawaiian hawk breading season from March to September. Should tree trimming or removal be scheduled during their breeding season, surveys for Hawaiian hawk nests would be performed. With the implementation of these mitigation measures, potential impacts to Hawaiian hawk from construction activities would be avoided.

Short-tailed Albatross

Short-tailed albatross are not known to use habitat within the Project Area; therefore, the proposed construction activities would have no effect on this species.

Green Sea Turtle and Hawaiian Monk Seal

The project does not include any construction activities in-water or on beaches or rocky shorelines, where green sea turtles or Hawaiian monk seals could be present. Alternatives 1B, 2/3, 4/5, and 6/7 could include construction activities within 100 meters of the shoreline. If a green sea turtle or Hawaiian monk seal is detected within 100 meters of the project area, all nearby construction operations would cease and not continue until the animal has departed the area on its own accord. With the implementation of these mitigation measures, potential impacts to green sea turtles and Hawaiian monk seals from construction activities would be avoided.

Blackburn's Sphinx Moth

As individual projects are developed, DEM would consult with the Hawai'i Island Branch of DOFAW for current information about where Blackburn's sphinx moth may be present. Based on recommendations from DOFAW, surveys for the moth and its host plants may be required prior to working in certain areas. These surveys would ideally be conducted during the wettest part of the year and within 4 to 6 weeks prior to construction. If moths, eggs, larvae, native 'aiea or tree tobacco over 3 feet tall are found during the survey, USFWS and DOFAW would be contacted. To avoid attracting Blackburn's sphinx moth at sites where construction activities are planned or ongoing, it is recommended that tree tobacco plants less than 3 feet tall be removed. If tree tobacco plants over three feet in height are present at a construction site, the plants would be inspected by a qualified biologist for the presence of Blackburn's sphinx moth eggs and larvae. With the implementation of these mitigation measures, potential impacts to Blackburn's sphinx moth from construction activities would be avoided.

Hawaiian Picture-wing Flies

Alternatives 1B, 2/3, 4/5, and 6/7 include trenching for construction of a wastewater collection system in the town of Volcano, on Volcano Highway, near, but outside designated critical habitat for the Mull's picture-wing fly (*D. mulli*). These alternatives also include trenching for construction of a wastewater collection system along Wright Road through a section of the ʻŌlaʻa Small Tract in Hawaiʻi Volcanoes National Park, one of the most recently known sites to be occupied by the picture-wing fly (*D. digressa*). The proposed trenching work is anticipated to be limited to the existing roadways. However, adjacent vegetation could be affected.

Vegetation surveys would be conducted at undeveloped project sites in the Volcano area (including potentially effected portions of the ʻŌlaʻa Small Tract in Hawaiʻi Volcanoes National Park) to determine the presence of loulu (*Pritchardia beccariana*), the breeding host plant for the Mull's picture-wing fly (*D. mulli*) and the presence of Charpentiera and Pisonia plant species, the breading host plant for the picture-wing fly (*D. digressa*). If loulu, Charpentiera or Pisonia plant species are present, buffer zones of 3 meters would be established to avoid disturbance and the plants would be inspected by a qualified entomologist for the presence of picture-wing fly eggs and larvae. If picture-wing flies are present, further consultation with DOFAW and USFWS may be required to determine avoidance and minimization measures to prevent impacts to the species.

Anthricinan Yellow-faced Bee

The project may include vegetation clearing in coastal areas, with important plant food for yellow-faced bees; including, tree heliotrope, naupaka (*Scaevola taccada*), ʻilima, ʻōhai, naio, and ʻakoko. Prior to vegetation clearing in these coastal areas, a qualified entomologist would perform a survey for yellow-faced bees. Ideally, yellow-faced bee surveys would be performed between the months of April to November. If yellow-faced bees are present, further consultation with DOFAW and USFWS may be required to determine avoidance and minimization measures to prevent impacts to the species.

Anchialine Pool Shrimp and Orangeblack Hawaiian Damselfly

While not yet identified, anchialine ponds may be present in the Project Area. Work occurring near anchialine pools could affect endangered anchialine shrimp species, including *Vetericaris chaceorum* and *Procaris hawaiana*, and the endangered orangeblack Hawaiian damselfly. Areas with anchialine ponds would be avoided to the extent practical. If anchialine pools are present near proposed project sites, surveys would be conducted by a qualified entomologist to determine if orangeblack Hawaiian damselfly are present and to assess any potential impacts. In addition, if anchialine pools are present DOFAW would also be consulted regarding measures that can be taken to avoid impacts to anchialine shrimp species.

Work near streams could also affect endangered Hawaiian damselflies. The project does not include any work in streams. It is anticipated that any sewer line stream crossings would be attached to existing bridges or other structures to span the stream and avoid impacts. If work is required at a stream, surveys would be conducted by a qualified entomologist to determine if damselflies are present and assess potential impacts.

As described above, project-specific biological surveys would be conducted for each phase of the project to avoid impacts to listed species and to support the environmental decision documents. These surveys would be tailored to the species likely to use habitat at a given project site. If a project is located entirely within a built/paved environment, the need to conduct the biological survey would be evaluated.

MARINE ECOSYSTEMS

Alternatives 1A, 1B, 2/3, and 4/5 do not include any construction activities in the marine environment. Appropriate sediment and erosion control, stormwater management, and spill prevention and control measures would be used during construction to prevent impacts to all surface waters, including the nearshore marine environment.

Alternative 6/7 would require expansion of the Hilo WWTP ocean outfall and the discharge of treated effluent to coastal marine waters. If Alternative 6/7 is progressed, a separate project-specific HRS Chapter 343 document would be prepared, when sufficient design details are available in the future.

WETLANDS

None of the proposed wastewater system improvements overlap with wetland features shown on National Wetland Inventory Maps. These maps show several isolated wetlands in the town of Kea‘au. Based on initial site visits and review of recent aerial imagery several of these wetland sites do not appear to be flooded, support vegetation adapted for life in saturated soil conditions, or show other apparent indicators of wetland hydrology. These may be relic features of the sugar plantation industry that have since been converted to other uses (e.g., paved parking lot, active agricultural field) and may not be waters of the United States, protected under Section 404 of the Clean Water Act.

If any project activities are proposed that have potential to affect wetland features shown on National Wetland Inventory Maps, a wetland delineation would be performed and an approved jurisdictional determination from the Army Corps of Engineers would be obtained. Construction activities in and adjacent to wetlands would be avoided to the extent practical. Should construction activities with the potential to affect wetlands be required, the Army Corps of Engineers would be consulted and required permits under Section 404 of the Clean Water Act secured.

As stated above, appropriate sediment and erosion control, stormwater management, and spill prevention and control measures would be used during construction to prevent impacts to all surface waters, including wetlands.

3.6.2.2 OPERATION

FLORA

The operation and maintenance of the proposed wastewater treatment systems is not anticipated to negatively affect flora, regardless of the alternative implemented. If maintenance activities include the use of construction equipment, trimming of trees, and or the clearing of vegetation, then appropriate mitigation measures including coordination with DOFAW and USFWS and plant surveys may be required. Any locations where vegetation is disturbed would be restored to existing conditions. Where appropriate, native plant species would be selected for soil stabilization and replanting efforts.

FAUNA

Hawaiian Hoary Bat

To avoid entanglement of Hawaiian hoary bats, the use of barbed wire at wastewater pump stations and treatment plants would be avoided where possible. Where appropriate, plain wire may be used as an alternative to barbed wire.

Hawaiian Seabirds

To avoid attraction and disorientation of seabirds, any outdoor lighting at wastewater pump stations or treatment plants would be downward facing and fully shielded. As practical, outdoor lighting would be turned off when not in use or equipped with automatic motion sensor switches.

Hawaiian Waterbirds

Natural wastewater treatment systems using plants and bacteria to break down and neutralize pollutants in wastewater, such as facultative lagoons, aerated lagoons, and constructed wetlands are likely to be attractive to and provide habitat for Hawaiian waterbirds.

The proposed subregional and regional WWTPs under Alternatives 2/3 and 4/5 would not include ponds, lagoons, or wetlands that would provide habitat for Hawaiian waterbirds. The subregional and regional WWTP may have open-air tanks that could be used by but are not anticipated to be attractive to Hawaiian waterbirds. If Hawaiian waterbirds are found to be present at WWTPs during operation, the County would coordinate with DOFAW and USFWS regarding measures that can be implemented to avoid impacts. This may include covering above ground tanks.

The IWSs and decentralized treatment systems under Alternatives 1A and 1B could include natural treatment systems that could provide habitat for Hawaiian

waterbirds. Owners and operators of these treatment systems may need to implement measures and coordinate with DOFAW and USFWS to ensure other activities at these sites do not impact endangered Hawaiian waterbirds.

The removal of cesspools under all alternatives is anticipated to improve water quality in streams, wetlands, ponds, and nearshore waters throughout the Puna District, thereby having a beneficial effect on Hawaiian waterbird habitat.

Hawai'i 'Ākepa

Mosquito-borne diseases are a threat to Hawaiian forest birds, including the Hawai'i 'ākepa. The removal of cesspools under all alternatives would have a beneficial effect for the Hawai'i 'ākepa by reducing stagnant water habitat and mosquito populations.

The operation and maintenance of the proposed wastewater treatment systems is not anticipated to negatively affect any of the wildlife species listed above, regardless of the alternative implemented. If maintenance activities include the use of construction equipment, trimming of trees, or the clearing of vegetation, the appropriate mitigation measures described above for potential construction impacts should be implemented. The removal of cesspools under all alternatives is anticipated to improve surface water quality to the benefit of all wildlife.

Marine Ecosystems

The operation and maintenance of the proposed wastewater treatment systems under Alternatives 1A, 1B, 2/3, and 4/5 would not result in any adverse effects to surface water habitats or marine ecosystems. Alternative 6/7 would require expansion of the Hilo WWTP ocean outfall and the discharge of treated effluent to coastal marine waters. If Alternative 6/7 is progressed, a separate project-specific HRS Chapter 343 document would be prepared, when sufficient design details are available in the future.

Cesspool effluent contains nutrients, like nitrogen and phosphorous, that can disrupt the sensitive ecosystems of Hawai'i, including harming nearshore coral reefs. The utilization of cesspools as a substandard sewage disposal method increases the potential for pollution of surface waters and resulting impacts to the species reliant on these habitats. The removal of cesspools under all alternatives would have a beneficial effect on water quality, fresh and brackish water habitats, and marine ecosystems.

WETLANDS

The operation and maintenance of the proposed wastewater treatment improvements would not result in any adverse effects to wetlands. The removal of cesspools under all alternatives would have a beneficial effect on all surface waters, including wetlands.

3.7 ARCHAEOLOGICAL, HISTORIC AND CULTURAL RESOURCES

3.7.1 Affected Environment

Archaeological and historic resources include a broad range of historic properties defined in HRS Chapter 6E-2 as "…any building, structure, object, district, area, or site, including heiau and underwater site, which is over fifty years old." Applicable HAR that implement HRS Chapter 6E require the identification and inventory of historic properties within a given project area. Once historic properties are identified an assessment of significance occurs. The effects or impacts of a project on significant historic properties is then determined and, if required, mitigation plans are submitted to the State of Hawai'i Department of Land and Natural Resources State Historic Preservation Division (SHPD) for review and approval.

HRS Chapter 6E requires that prehistoric and historic burial sites be preserved in place until the requirements of the statute are met. The Hawai'i Island Burial Council would determine whether the preservation in place or relocation of any previously identified burials sites within the project area is warranted.

3.7.1.1 ARCHAEOLOGICAL AND HISTORIC RESOURCES

Initial settlement of the Hawaiian Islands occurred along windward shorelines where rainfall was abundant to support agriculture and sheltered bays provided access to marine resources (Rechtman 2013:8). Over the course of several centuries, settlement was firmly established and was followed by expansion to other regions (ibid). Puna is on the windward side of Hawai'i Island but the effects of volcanic and other geologic phenomena may have delayed the establishment of permanent settlements until population demands made it necessary (Maly 1999:10).

A possible settlement and population pattern has been suggested for Puna. Kea'au and surrounding areas were settled by the 12th-13th centuries with near-residence agriculture and collection of marine resources providing subsistence. A growing population resulted in expansion inland to establish large agricultural systems by the 14th-16th centuries and population expansion further inland towards 'Ōla'a and southwest along the coastline by the 16th-18th centuries (ibid).

An Archaeological Literature Review (LR) was prepared for the Project Area by Cultural Surveys Hawai'i (Appendix A). The LR summarizes previous archaeological work that has been conducted in the Project Area, archival sources, maps, Land Commission Awards and other archaeological documentation (Figure 3-13).

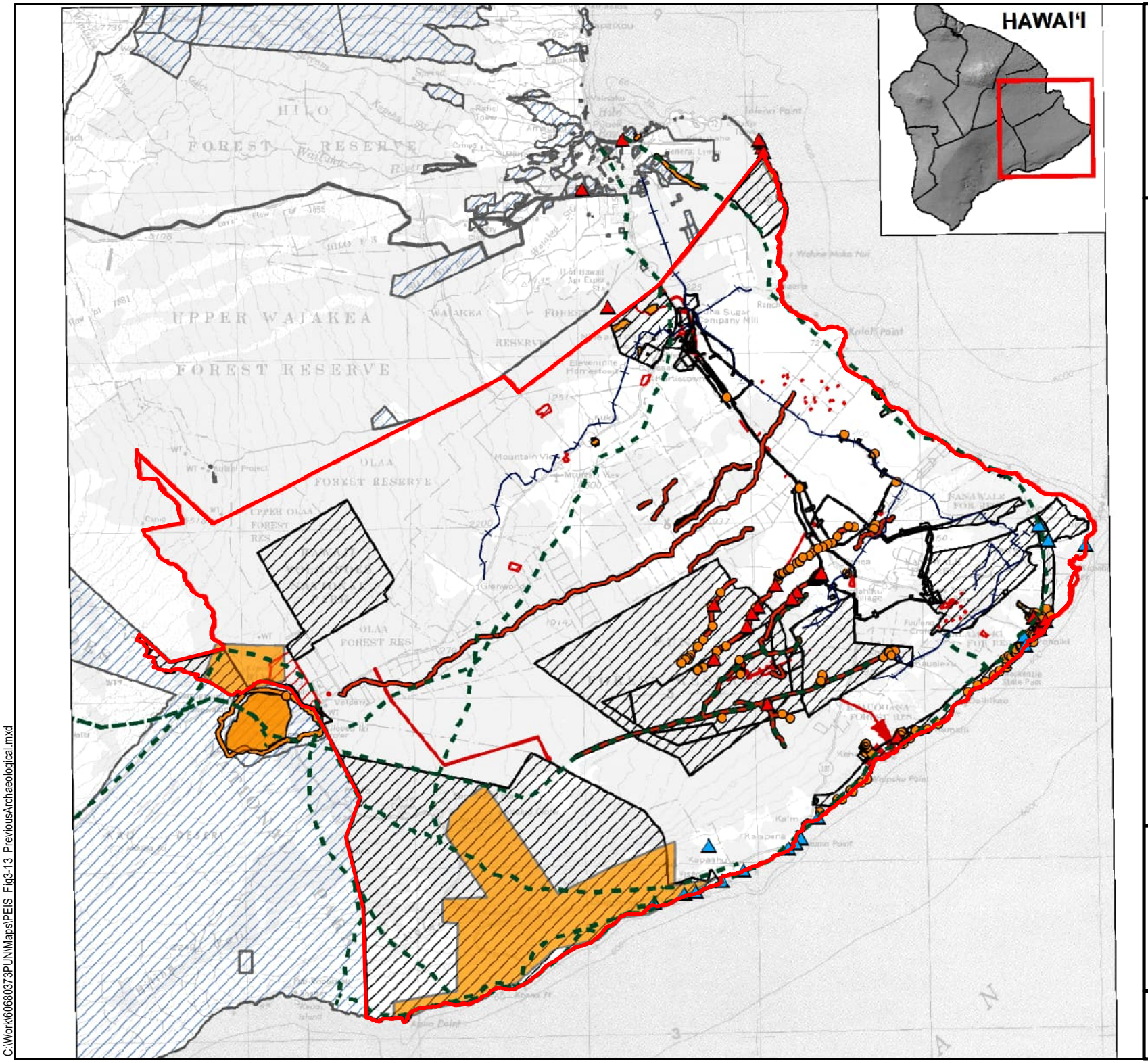

FIGURE 3-13

PREVIOUS ARCHAEOLOGICAL STUDIES AND DOCUMENTATION WITHIN THE PROJECT AREA

Legend

- Project Area
- Heiau
- Burial Site
- Historic Property
- Historic Trail
- Railroad
- Lava Tube
- Archaeological Sudy Areas (w/ sites)
- Archaeological Sudy Areas (w/ no sites)
- Archaeological Sudy Areas (outside PA)

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Cultural Surveys Hawai'i, 2022.

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The results of previously conducted archaeological research in the Project Area are consistent with suggested pre-contact land use patterns and indicate that the majority of permanent habitation and intensive land use was in close proximity to the coastline (Wilkinson 2011:16). In Keaʻau a coastal pond was modified into a loko iʻa (fishpond). Agricultural activities extended from the coast inland, where a broad range of crops were cultivated. Puna was especially famed for groves of pū hala (pandanus, *Pandanus tectorius*) and ʻawa (*Piper methysticum*). Forest areas in the uplands were accessed for ceremonial purposes, gathering of resources, and associated temporary habitation. A traditional trail system provided travelers access to specific resources and locations and passed through the entire Project Area (Maly 1999:5).

Lava tube systems extend throughout the Project Area and were used for temporary habitation, ceremony, and burial. The Puna—or Kazumura—Cave (Statewide Inventory of Historic Places # 50-10-46-10001) in particular is a well-known lava tube extending approximately 14 miles with multiple openings. This cave is generally orientated North-South and is approximately 20 feet below the surface where it underlies the Keaʻau-Pāhoa Road (State Highway 130) at its intersection with Orchid Land Drive (Wilkinson 2011:16-18). Archaeological, temporary habitation, ceremonial, and burial features have been documented within it.

Archaeological resources may have been destroyed by modern lava flows in this geologically active area (Figure 3-14), historic agricultural activities (such as cattle ranching and sugar cane cultivation), and the development of residential subdivisions. Intact surface and subsurface (within lava tubes/caves) archaeological resources, cultural deposits, and burials are situated within the Project Area. Previous archaeological research indicates that the probability of encountering pre-contact resources increases at the coastline.

A Historic Architectural Resources Supporting Study has been prepared to provide a preliminary desktop analysis of non-archaeological historic property types (buildings, structures, sites, objects, and districts) within the Project Area (Appendix B). Background research to support this study included a review of materials collected from online government sources and libraries, historical maps, and newspaper archives.

The early to mid-nineteenth century brought new methods of travel (horses/hoofed animals and eventually wheeled carts); the traditional trail system in Puna was modified and, in some cases, realigned (Maly 1999:5). In the 1840s the Hawaiian kingdom established a network of Government roads and the Puna Trail (Statewide Inventory of Historic Places # 50-10-36-21273, also known as the “Old Government Road”) became the main Government road in the Project Area (Ibid). As economic activities shifted further inland and travel between Hilo and Puna increased, the preference for a direct route to Hilo resulted in the construction of the Keaʻau-Pāhoa Highway (State Highway 130) beginning in 1895 (ibid).

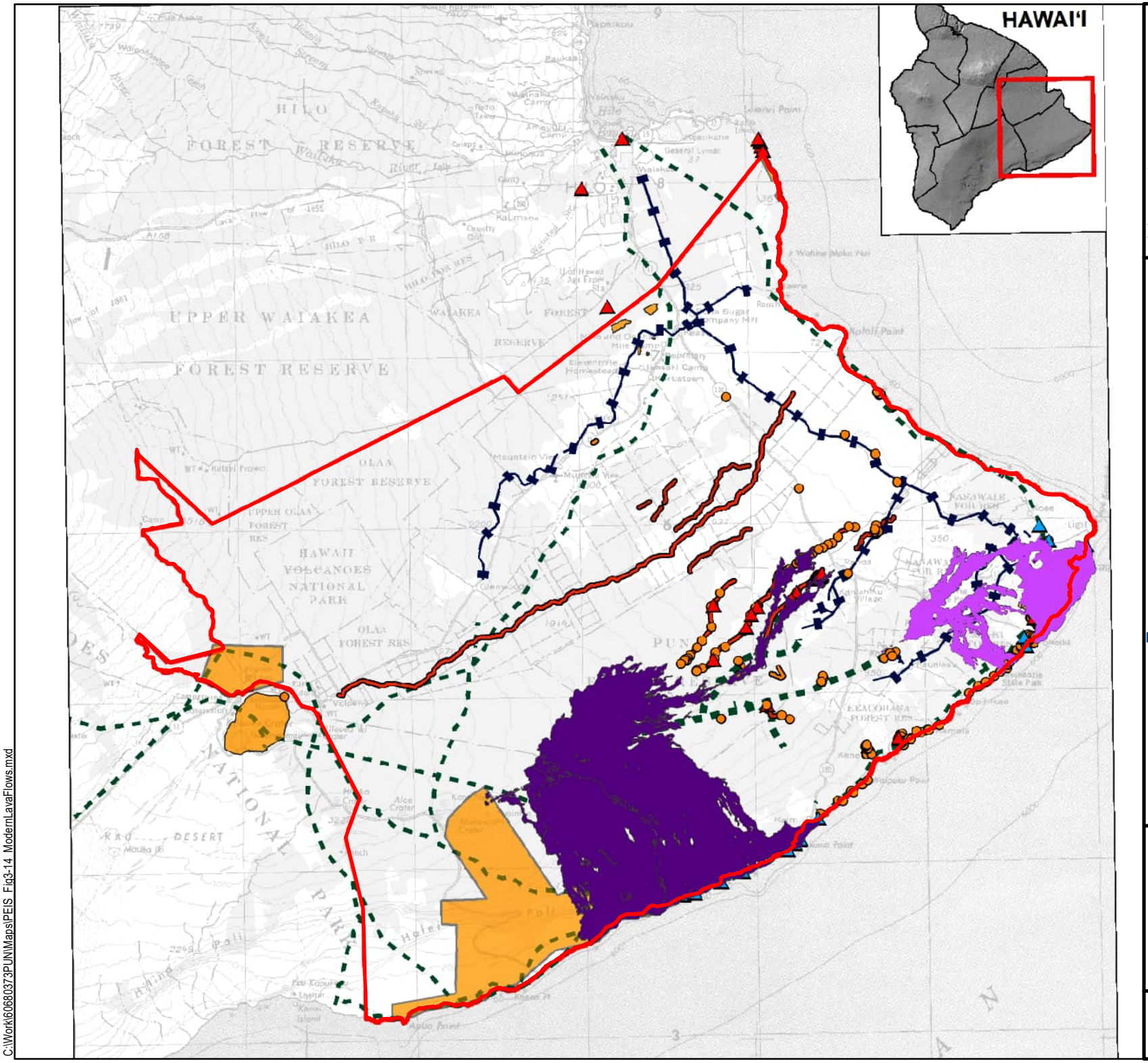

FIGURE 3-14

MODERN LAVA FLOWS FROM THE 1983-2018 PU'U 'Ō'Ō' ERUPTION AND THE 2018 LOWER EAST RIFT ZONE ERUPTION IN RELATION TO KNOWN HISTORIC PROPERTIES

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Commercial cattle ranching operations began in the Project Area in the 1870s with Keaʻau Ranch controlling nearly 50,000 acres at its peak (Maly 1999:42). Like in many other places in Hawaiʻi, the sugar industry would bring significant social, cultural, and economic changes to Puna. The first large sugar plantation was established in the Project Area in the late 1800s with the ʻŌlaʻa Sugar Company (later renamed Puna Sugar Company) leasing lands by 1899 (ibid:58). The Company acquired approximately 34,000 acres of land in Puna extending from Keaʻau to Pāhoa and Kapoho (Hawaiian Sugar Planters' Association 1992). Communities were established for a diverse labor force and grew with the economic success of ʻŌlaʻa Sugar Company. A segment of a larger railroad transportation system was constructed to serve the needs of the businesses and communities in Puna, extending approximately 25 miles from Hilo thru ʻŌlaʻa to Kapoho. A major tsunami struck Hawaiʻi Island in 1946, destroying critical system infrastructure in Hilo. The rail system operator, Hawaiʻi Consolidated Railway, went out of business and the system was never rebuilt (AECOM 2017). Puna Sugar Company continued operations until the early 1980s (Maly 1999:60).

Table 3-9 lists known non-archaeological historic properties that have been determined to be significant within the Project Area.

Appendix B, Section 2.12 provides specific discussion on the establishment and development of historic-era communities in the Project Area, highlights associated historic themes, and identifies potential historic properties in each community. The establishment of historic residential communities in the Project Area to support the sugar industry was followed by the re-zoning of large tracts of agricultural lands for residential developments. More than 52,500 residential lots were created in the Project Area between 1958 and 1973 (Appendix B, Table 2).

The remnants of U.S. military features, associated with the construction of fortifications for coastline defense during World War II, are still situated along the Old Government Road.

Lava flows from a series of eruptions from Kīlauea since 1955 have destroyed buildings and infrastructure in the Project Area, including historic communities and residential developments. The most recent eruption in 2018 began in the Leilani Estates subdivision and flows made it to the coast, completely filling Kapoho Bay and covering Pohoiki Boat Ramp.

The residences, schools, civic and commercial buildings, industrial facilities, recreational facilities, places of worship, cemeteries, and linear resources still found in the Project Area convey the identity, character, and significance of the Puna District over time. Appendix B provides a geospatial "hot spot" analysis of year-built data. This analysis identifies the areas with the highest statistically significant concentrations and clusters of historic-age properties among the tens of thousands of parcels identified in year-built data. Figure 3-15 depicts the findings of that analysis. Project Area "hot spots," or clusters of historic-age properties, are shown in red, and "cold spots," or clusters of non-historic-age properties, are shown in blue.

Table 3-9. Known Significant Non-Archaeological Historical Properties within the Project Area

TMK	Property Name (SIHP)	Location	Resource Type	Source
313004004	ʻOpihikao Evangelical Church Residence (50-10-55-07383)	6314 Kalapana Kapoho Beach Road	Building	HHF, HICRIS
313004018	Kahaloa House (50-10-55-07384)	Near ʻOpihikao	Building	HICRIS
312006081	Star of the Sea Church, Kalapana Painted Church (50-10-63-07380)	12-4815 Pāhoa Kalapana Road	Building	HHF, HICRIS
N/A	Crater Rim Drive (50-10-52-09059)	Hawaiʻi Volcanoes National Park, HI 96718	Road	HHF
399001001	Whitney Seismograph Vault #29 (50-10-52-05506)	99-165 Crater Rim Drive, Hawaiʻi Volcanoes National Park	Building	HHF
399001001	Old Volcano House #42 (50-10-52-05508)	99-165 Crater Rim Drive, Hawaiʻi Volcanoes National Park	Building	HHF
399001001	Tahara House Site (50-10-52-31200)	Crater Rim Drive, Hawaiʻi Volcanoes National Park	Site	HICRIS
313005012, 313005013, 313005019	Old Kudo Camp (50-10-55-07385)	Kaueleau	Building	HICRIS
311005019	Johnson Summer Residence (50-10-53-07519)	11-3968 Hale ʻOhiʻa Road, Volcano	Building	HHF, HICRIS
319004055	Kīlauea Lodge Complex (50-10-53-29502)	19-3948 Old Volcano Road, Volcano	Building	HHF
318002001	Mountain View Theater (50-10-44-07511)	18-1325 Old Volcano Road, Mountain View, HI 96771	Building	HHF
313008034	Pohoiki Mill Ruins (50-10-46-07386)	Pohoiki	Building	HICRIS
multiple	Pāhoa Town District (50-10-55-07388)	Pāhoa	District	HICRIS
multiple	Volcano Residential District (50-10-53-07414)	Volcano	District	HICRIS
multiple	Glenwood District (50-10-53-07453)	Glenwood	District	HICRIS
multiple	Hale ʻOhiʻa Tract Historic District (50-10-53-07521)	11-3991, 3992, 4000, and 4006 Hale ʻOhiʻa Road, Volcano	District	HHF, HICRIS
multiple	Puna-Kaʻu Historic District (50-10-62-09609)	Near Hawaiʻi Volcanos National Park, HI 96718	District	HICRIS, NPS

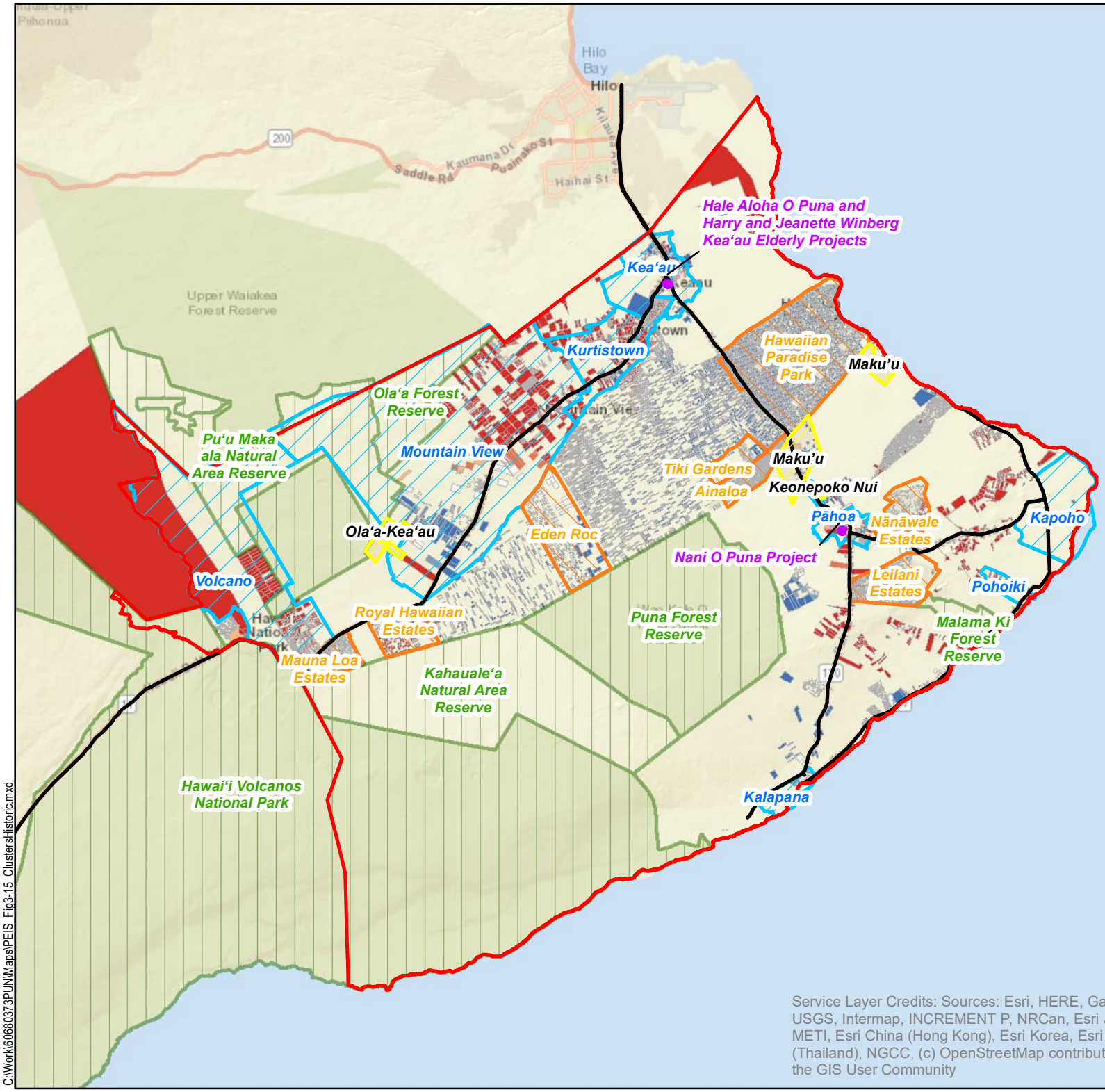

FIGURE 3-15

CLUSTERS OF HISTORIC AGE PROPERTIES

Legend

- Project Area
- Historic Roads
- Historic Subdivisions
- Historic Communities
- Hawiian Homelands
- HHA Development
- Recreation Areas and Reserves

Hot Spot Analysis

- Cluster of Historic-age Parcels
- No Clustering of Parcels
- Cluster of Non-historic age Parcels

Sources: County of Hawai'i, 2011 Puna Community Development Plan, Real Property Tax Office data extract Oct 2022; Hawai'i Statewide GIS Program, Reserves in the State of Hawai'i, May. 2022; 2020 Census Hawaiian Homelands, Nov. 2021; 2020 Census Designated Places, Nov. 2021.

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Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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Darker hues indicate higher percentages of statistical significance. Parcels shown in white indicate no statistically significant clustering of historic-age or non-historic-age parcels.

3.7.1.2 CULTURAL RESOURCES

Article XII, Section 7 of the Constitution of the State of Hawai'i protects the traditional and customary gathering rights of Native Hawaiians. In 1997, the State of Hawai'i Environmental Council adopted guidelines for assessing cultural impacts for actions that are subject to the HRS Chapter 343 process. These guidelines emphasize the importance of consultation with knowledgeable community members. A Hawai'i Supreme Court decision in September 2000 (*Ka Pa'akai O Ka 'Aina v Land Use Commission*) provides a three-part process (sometimes referred to as a "Ka Pa'akai Analysis") for addressing the preservation and protection of customary and traditional practices:

1. 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;
2. Identify the extent to which those resources and rights will be affected or impaired by the proposed action; and
3. Specify the feasible action, if any, to be taken by the regulatory body to reasonably protect Native Hawaiian rights if they are found to exist.

A cultural impact assessment has been prepared for the Project Area (Appendix C).

Puna is the eastern-most of six traditional districts on the island of Hawai'i. The district is further divided into ahupua'a (smaller land management districts). It is known for the arrival of the first sunlight in Hawai'i at Kumukahi. The presence of the volcano goddess Pele is resounding in the Project Area. Puna is also associated with the god Kāne, embodied by sunlight, fresh water, verdant growth, and forests (Maly 1999:9). Puna was especially famed for groves of pū hala and master weavers who utilized this important resource. The importance of hala is embodied in the saying:

Puna paia 'ala i ka hala (Puna, with walls fragrant with pandanus blossoms)

Puna, Hawai'i, is a place of hala and lehua forests. In olden days the people would stick the bracts of hala into the thatching of their houses to bring some of the fragrance indoors (Pukui 1983:301. Number 2749)

Ethnographic records in the collections of the Bernice Pauahi Bishop Museum describe the traditional practice of bird catching in the forested lands of Kea'au and 'Ōla'a for subsistence and the gathering of feathers (Maly 1999:28-29).

The shoreline of Kea'au Ahupua'a was the location of a famous event involving Kamehameha I, who landed and encountered a group fishing along the shoreline. The group fled and Kamehameha pursued them, but his foot became stuck. One of

the men in the group struck Kamehameha, breaking a paddle on his head. This event led to Kamehameha establishing a law—Kānāwai Māmalahoa (Law of the Splintered Paddle)—to provide for the safety of those traveling on trails in areas under his control. In pre-contact times trails provided connectivity to resources essential for survival and are an important feature of the Project Area's traditional cultural landscape.

In traditional Hawaiian thinking natural and cultural resources are one and the same. These resources exist in the Project Area and are essential to the continuation of traditional and customary practices. Historic and modern land uses have brought multiple groups to Puna and resources important to the cultures and practices of these groups also exist in the Project Area.

A Cultural Impact Assessment was prepared for the Project Area by Cultural Surveys Hawai'i, Inc. (Appendix C).

3.7.2 Potential Environmental Consequences and Mitigation Measures

3.7.2.1 CONSTRUCTION

Archaeological and Historic Resources

The alternatives under consideration have the potential to affect archaeological and historic resources that are defined by HRS Chapter 6E as historic properties.

HRS Chapter §6E-42(a) requires that:

> Before any agency or officer of the State or its political subdivisions approves any project involving a permit, license, certificate, land use change, subdivision, or other entitlement for use, which may affect historic property, aviation artifacts, or a burial site, the agency or office shall advise the department and prior to any approval allow the department an opportunity for review and comment on the effect of the proposed project on historic properties, aviation artifacts, or burial sites, consistent with section 6E-43, including those listed in the Hawai'i register of historic places.

When sufficient design details are available for each component action, compliance with HRS Chapter 6E would be demonstrated. DEM would provide SHPD with information to undergo the 6E review process on each specific action involving project-specific areas with identified land parcels and ancillary system routes (including any in County or State road/highway right-of-way).

Cultural Resources

The alternatives under consideration have the potential to impact cultural resources and associated constitutionally protected Native Hawaiian traditional and customary rights, and the cultural practices of other groups that may be currently exercised

within the Project Area. When sufficient design details are available, separate project-specific HRS Chapter 343 documents would be prepared as appropriate and evaluate impacts on cultural resources. Permits, land use approvals, or other entitlements to support project-specific actions may also require an evaluation of impacts on cultural resources.

Any evaluation would follow the three-part process established by a Hawai‘i Supreme Court decision in September 2000 (*Ka Pa‘akai O Ka ‘Aina v Land Use Commission*). Often referred to as a “Ka Pa‘akai Analysis” the evaluation would:

1. 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;
2. Identify the extent to which those resources and rights would be affected or impaired by the proposed action; and
3. Specify the feasible action, if any, to be taken by the regulatory body to reasonably protect Native Hawaiian rights if they are found to exist.

The mitigation of any identified impacts to cultural resources by the construction of any alternative under consideration would be developed and implemented as a component of the third part of any project-specific Ka Pa‘akai Analysis that is conducted.

3.7.2.2 OPERATION

Archaeological and Historic Resources

The operations of any wastewater treatment systems under consideration would not result in any direct impacts to historic properties and no mitigation would be required.

Cultural Resources

The impact of the operation of any wastewater treatment systems under consideration would be evaluated in any project-specific Ka Pa‘akai Analysis that is conducted and mitigation developed as appropriate.

3.8 AESTHETIC RESOURCES, TOURISM AND RECREATION

3.8.1 Affected Environment

Tourism is a vital industry for Hawai‘i and it is dependent upon the aesthetic and recreational resources available. As the General Plan states, “the island’s major visitor attraction, especially for tourists from large urban centers, is natural beauty accentuated by the quality of air, land, and water” (County of Hawai‘i 2005).

The Project Area attracts tourists to the State and national parks, as well as its historic villages such as Volcano Village and the historic town of Kalapana. The historical and cultural resources that attract tourists to the Project Area are

discussed in Section 3.7. Many of these resources can be experienced on the trails and scenic byways.

3.8.1.1 VISUAL RESOURCES

The County of Hawai‘i General Plan describes Hawai‘i’s natural and scenic beauty as one of the most significant and valuable assets of the island. The landscape, topography and vegetation which include lava fields, heavily vegetated valleys, kiawe deserts, native forests, rolling grasslands, and rocky coastlines contribute to the aesthetic resource (County of Hawai‘i 2005).

The Project Area includes the Kapoho and Pu‘u ‘Ō‘ō volcanic regions which are considered major areas of natural beauty in which the landscape has been altered by the force of nature (County of Hawai‘i 2005). A list of Natural Beauty sites, according to the Hawai‘i County General Plan are provided in Table 3-10. In addition, there are several areas that are categorized as forest reserves and natural area reserves throughout the district as described in Section 3.6.

3.8.1.2 RECREATION

There are a number of parks in the Project Area that provide space for recreation in multiple forms such as hiking, fishing, camping, and picnicking (Figure 3-16). With the exception of Hawai‘i Volcanoes National Park, many of the parks are State- or County-owned.

Hawai‘i Volcanoes National Park is a major attraction and includes Kīlauea volcano which is described as the one of the most active volcanos. Approximately 60,000 acres of the 229,176-acre park is located in the Project Area. The entrance to the park is located near Volcano Village. Park attractions include hikes, crater overlooks, scenic drives, and a 500-year-old lava cave.

State-owned parks include Mackenzie State Recreation Area and Lava Tree State Monument. Mackenzie State Recreation Area is approximately 13-acres in size and offers fishing, tent camping, and picnicking along the edge of the Malama-Kī Forest Reserve. Lava Tree State Monument, located near Kapoho Pohoiki junction, consists of 17 acres of lava trees and a large volcanic earth crack. The park includes a footpath, picnic facilities, parking area, and restrooms.

Shoreline parks include Isaac Kepo‘okalani Hale Beach Park, which was partially damaged in the 2018 Kīlauea eruption.

Table 3-10. Natural Beauty Sites in Puna District

Site	Tax Map Key	Region
Viewplane from Pāhoa-Kalapana Highway looking makai	1-2-04, 06, 07, 09	
Kehena Black Sand Beach	1-2-09:21	Kehena
Viewpoint-Shoreline	1-2-09:22	Kekeʻekeʻe
1955 Lava Flow (ʻĪʻīlewa Cone)	1-2-10:1	Kamāʻili
Ironwood Groves along Kapoho-Kalapana Road	1-3-03:5 ;1-3-07:6,26	Kauaea; Malama-Kī
Viewpoint-Shoreline	1-3-04:71	ʻOpihikao
MacKenzie Park	1-3-07:26	Malama-Kī
Mango Grove along Pohoiki Road	1-3-08:4,5	Pohoiki
Keahialaka Spring & Pond	1-3-08:15	Keahialaka
Shoreline	1-3-08:15	Keahialaka
Warm Springs	1-3-08:34	Pohoiki
Albizzia Grove along Pāhoa-Kapoho Road	1-4-01:4	Kaniahiku
1960 Lava Flow	1-4-02:1	Kapoho
Kapoho Tidal Ponds	1-4-02	Kapoho
Viewpoint (Puʻu Kukae)	1-4-02:2	Kapoho
Kapela Bay (Black Sand Beach)	1-4-03:13	Kahuwai
Viewpoint-Shoreline (Hilo & Puna)	1-4-03:13	Kahuwai
Viewpoint & Tidal pool (Makaʻukiu Pt.)	1-4-03:13	Kahuwai
Ironwood Grove at Nānāwale Park	1-4-03:18	Nānāwale
Viewpoint-Shoreline (Honolulu Landing)	1-4-03:19	Honolulu
Mango Grove along Kapoho-Honolulu Landing Road	1-4-03,04	Kahuwai & Halepuaʻa
View from Green Lake Hill	1-4-91:18	Kapoho
Viewpoint-Shoreline	1-5-63:1-4	Waiakahuila
Cove with Stone Beach	1-6-01:25	Keaʻau
Royal Palms fronting Keaʻau Intermediate School	1-6-02	Keaʻau
View of Mauna Kea and Mauna Loa from Pāhoa-Keaʻau, Volcano-Keaʻau Roads, and various Puna subdivisions	Various	Various
Puʻu ʻŌʻō Lava Flow Region	Various	Various

Source: County of Hawaiʻi 2005.

FIGURE 3-16
PARKS

Legend

- Project Area
- Roads
- Parks

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, Hawaii State Parks, Nov. 2021; Google Maps.

N

0 12,500 25,000 Feet

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

AECOM
1001 Bishop St. STE 1600
Honolulu, HI 96813

Document Path: C:\Work\60680373PUN\Maps\PEIS_Fig3-16_Parks.mxd

Hawai‘i County also provides opportunities for recreation at the community parks such as Herbert C. Shipman Park in Kea‘au which includes a playground, tennis courts and ball fields, a basketball court and the Kea‘au Community Center. Pāhoa Park is a large athletic and recreational complex that includes a pool, a neighborhood center for meetings, programs, the Pāhoa District gym and a skatepark. The County also maintains a gymnasium at Mountain View, outdoor basketball courts at Kurtistown and Hawaiian Beaches, and tennis courts at Kurtistown and Kea‘au (County of Hawai‘i 2011).

Leilani Estates Park is located on Moku Street near the center of the Leilani Estates neighborhood and is maintained by the community association. The park supports covered picnic tables, a large playground with numerous play structures, covered basketball courts, a softball/baseball field, and a community center, among other facilities.

The Nānāwale Estates community center, located on Kahau road, supports a playground and swimming pool, and the longhouse facility used for community events.

The Hawaiian Beaches neighborhood has several parks including Kahakai Park, and the nearby Papio Ocean Park located on government beach road. Kahakai Park is a small county park with open grass lawns, and access to the rocky cliff shoreline, Papio Ocean Park is a private park equipped with picnic tables, benches and artwork. The Hawaiian Beaches Park located on Manini Street supports picnic tables, a softball/baseball field, basketball courts, and a playground.

The ‘Āinaloa Community Association Park, located on ‘Āinaloa Boulevard supports covered picnic tables, a play structure, swings, and a basketball court. Adjacent is the ‘Āinaloa Longhouse.

Hawaiian Paradise Park community also has a community Center on the corner of Lokelani Avenue and Maku‘u Drive, as well as a privately-owned amusement park, Mini Wonderland, on 12th Avenue. Along the shoreline there are a few access points and trails to the cliffs adjacent to the ocean.

Hawaiian Acres Community Center supports a swing set and play structure, a picnic table, and a community center building.

In addition, the Volcano Golf and Country Club is located west of Volcano on Route 11, adjacent to Hawai‘i National Park and a small neighborhood off Pi‘i Mauna Drive.

3.8.2 Potential Environmental Consequences and Mitigation Measures

Significant impacts to recreation are any action that curtails the range of beneficial uses of recreational areas. This curtailment may result from actions directly impacting the size of or affecting user experience in the existing recreational areas. Examples of significant impacts to recreation could include development encroaching onto recreational sites, or construction or other project-related activities that create noise or visual impacts to users of recreational sites or create impacts to the accessibility of the recreational areas.

3.8.2.1 CONSTRUCTION

Construction of the wastewater infrastructure may have some short-term impact on the visual aesthetics and recreational areas nearby. Alternative 1A would include the installation of package treatment plants, Alternative 1B would include the installation of package plants and low-pressure sewers, and Alternatives 2/3, 4/5, and 6/7 would include the construction of a pump station, force main, trunk/interceptor sewer and branch sewers adjacent to Hawai‘i Volcanos National Park and the nearby Volcano Golf and Country Club. The trunk/interceptor sewers would also be constructed along stretches of Route 11 Volcano Highway through the communities of Volcano, Mountain View, Kurtistown, Kea‘au, as well as stretches of Route 130 Kea‘au-Pāhoa road through the communities of Pāhoa and Kaniahiku Village. In addition, open trenching and excavation may be required for construction of the pump stations, force mains, and branch sewers through subdivisions and neighborhoods including Nānāwale Estates, Leilani Estates, Hawaiian Beaches, Hawaiian Paradise Park, ‘Āinaloa, as well as other developments along Route 130 and Route 11.

Temporary viewshed impacts would result from the package treatment plants installed under Alternatives 1A and 1B. Alternative 1B would also include the construction of low-pressure sewers. Anticipated temporary viewshed impacts related to the construction of branch sewers and pump stations for each alternative are consistent. Viewshed impacts vary slightly under Alternative 2/3, Alternative 4/5, and Alternative 6/7 due to the proposed construction of subregional or regional WWTPs in the Project Area. Alternative 2/3 proposes three to four subregional WWTPs to be constructed in Volcano, Kea‘au, Hawaiian Paradise Park, and Pāhoa. Under Alternative 4/5, there are no subregional WWTP in Volcano, Hawaiian Paradise Park or Pāhoa, but a Regional WWTP is proposed in Kea‘au. Lastly, Alternative 6/7 does not include any subregional or regional WWTP within the Project Area as this option utilizes the existing Hilo WWTP for treatment and disposal.

These temporary viewshed impacts would primarily affect residential homes in the communities and subdivisions that the infrastructure is intended to service. Most of the community parks discussed in Section 3.8.1.2 would be temporarily impacted by the construction of the branch sewers under the proposed alternatives. Some other parks such as the Āinaloa Community Park, Shipman Park, and Hawai‘i Volcanoes National Park may be temporarily impacted by the construction of force mains,

interceptor sewers, and pump stations for each of the alternatives. During construction, fencing surrounding construction sites may be provided as needed to provide a visual screen to mitigate the potential impacts. Any construction impacts regarding visual aesthetics are expected to be short-term and would cease after construction.

At many of the parks and other recreational facilities within the Project Area, noise and potential road closures during construction may have temporary impacts. These noise and viewshed impacts may affect users of the community, State and County recreational facilities, and Volcano Golf Course and Country Club, which would all be adjacent to the proposed construction. These impacts are not anticipated to directly affect the use of any facilities. These impacts would be temporary, and the area restored upon completion of construction.

3.8.2.2 OPERATION

Above-grade infrastructure such as aboveground package plants, sewers, pump stations, and WWTPs would change the viewshed of the surrounding areas. However, landscaping around these facilities could mitigate any negative impact within a neighborhood or tourist area.

None of the proposed package plants, pump stations or WWTPs are located within the boundaries of a park or recreational facility, so long-term impacts are not anticipated as a result of the Proposed Action other than periodic inspection and/or maintenance of adjacent proposed facilities.

3.9 NOISE AND VIBRATION

Noise, in its simplest definition, is unwanted sound. In order to establish a uniform noise measurement that simulates people's perception of loudness and annoyance, the decibel measurement is weighted to account for those frequencies most audible to the human ear. This is known as the decibel A-weighted sound level, or "dBA," and it is the descriptor of noise levels most often used for community noise analyses. The threshold of human hearing is defined as 0 dBA; very quiet conditions (as in a library or rural area at night) are approximately 40 dBA; levels between 50 dBA and 70 dBA define the range of noise levels generated by normal daily activity; levels above 70 dBA would be considered noisy, and then loud, intrusive, and deafening as the scale approaches 130 dBA.

In considering these values, it is important to note that the dBA scale is logarithmic, meaning that each increase of 10 dBA describes a doubling of perceived loudness. Thus, the background noise in an office at 50 dBA is perceived as twice as loud as a library at 40 dBA. For most people to perceive an increase in noise, it must be at least 3 dBA. At 5 dBA, a change in noise level would be readily noticeable.

In accordance with HAR Title 11, DOH, Chapter 26 Community Noise Control, there is a classification of zoning districts which have defined maximum permissible sound levels in dBA applicable to stationary noise sources; and equipment related to agriculture, construction, and industrial activities. These levels are shown in Table 3-11.

Table 3-11. Maximum Permissible Sound Levels (dBA)

Zoning District*	Land Zoned	Daytime (7 a.m. – 10 p.m.)	Nighttime (10 p.m. – 7 a.m.)
Class A	Residential, public and open space, etc.	55	45
Class B	Apartment, commercial, hotel, etc.	60	50
Class C	Agriculture, industrial, etc.	70	70

Source: *Haw. Code R. § 11-46-4.*

Unlike noise, which travels in air, vibration typically travels along the surface of the ground. The geological properties of the surrounding terrain and the type of building structure exposed to vibration can affect the level of vibration propagation within the building. For example, buildings with a solid foundation set in bedrock experience relatively higher vibration levels than buildings located in sandier soil. Heavier buildings (such as masonry structures) are less susceptible to vibration than wood-frame buildings because they absorb more vibration energy.

To assess potential for building structural damage such as when construction or rock blasting occur in close proximity, the peak particle velocity (PPV) is used in monitoring of vibration since it is related to the stresses that are experienced by buildings rather than human annoyance. PPV is the maximum instantaneous positive or negative peak of the vibration signal and is expressed in inches per second.

3.9.1 Affected Environment

Given the limited human activities in most neighborhood areas within the Project Area, the existing ambient noise conditions would be relatively quiet and likely range from 40 to 50 dBA depending on the time of day. However, the ambient noise levels could approach 60 dBA during daytime hours in those areas around large or small urban centers.

3.9.2 Potential Environmental Consequences and Mitigation Measures

3.9.2.1 CONSTRUCTION

Construction noise would temporarily increase sound levels in the immediate vicinity of the construction activities. Noise at construction sites varies relative to the particular operation in progress. USEPA has published noise levels observed 50 feet from various types of construction equipment.[3] These levels range from 72 to 96 dBA for earth moving equipment, from 75 to 88 dBA for materials-handling equipment,

[3] *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances*. USEPA 1971.

and 68 to 87 dBA for stationary equipment such as pumps and compressors. Impact equipment may generate noise levels up to 105 dBA.

Distance rapidly diminishes noise from all sources with a 6-dBA reduction per doubling distance. For example, at a distance of 300 feet, the equipment noise would be reduced by 16 dBA as compared to the level observed at 50 feet. Therefore, several factors would affect temporary noise effects such as construction duration, construction site's geographic surroundings, related pedestrian and vehicular activities, the distance between general public/residences and noise sources, and construction intensity. Some of these factors were considered in evaluating relative noise impacts for each alternative as summarized in Table 3-12.

In general, construction activities would be short with less intensity at most sensitive receptors under IWSs, package treatment plants, or sewer systems associated with WWTP options proposed under each alternative. Longer with more intensity construction activity noise is anticipated to occur in the neighborhoods immediately adjacent to the subregional or regional WWTP sites under Alternative 2/3 and Alternative 4/5, respectively. A greater area beyond the Project Area would be affected under Alternative 6/7 as a result of sewer system construction that would convey wastewater to the Hilo WWTP. The Hilo WWTP upgrade would also likely involve certain construction activities affecting noise conditions to the neighborhood around the Hilo WWTP. It is anticipated that construction activities would meet the permissible sound levels summarized in Table 3-11 and would have a minor and temporary impact to noise sensitive land uses in the Project Area.

Table 3-12. Construction Noise Effects under Proposed Action

Alternative	Site Specific Construction Duration/Intensity	Related Activities within Sensitive Land Uses	Overall Temporary Impact
1A (No Action Alternative)	Short/Small	IWS and decentralized wastewater system installation	Minor
1B	Short/Small	Package treatment plant and decentralized wastewater system installation	Minor
2/3	Short in most neighborhoods and longer at subregional WWTP sites/small in most neighborhoods but more intense around subregional WWTP sites	IWS installation, and sewer system and WWTP construction	Minor in neighborhoods; greater but minor around subregional WWTP sites
4/5	Short in most neighborhoods and longer at the regional WWTP site/small in most neighborhoods but most intense around regional WWTP site	IWS installation, and sewer system and WWTP construction	Minor in neighborhoods; greatest but minor around the regional WWTP site

Alternative	Site Specific Construction Duration/Intensity	Related Activities within Sensitive Land Uses	Overall Temporary Impact
6/7	Short in all neighborhoods including those around Hilo WWTP	IWS installation, and sewer system construction affecting greater areas including those extended to and around Hilo WWTP	Minor

For purposes of assessing potential structural or architectural damage to nearby structures, the PPV level of 0.50 inches per second can be used as a conservative damage threshold per the Federal Transit Administration (September 2018). According to the Federal Transit Administration, impact pile driving would result in the greatest potential vibration impact to nearby structures and generate a PPV level approaching 0.50 inches per second damage threshold at a distance of 60 feet. To prevent potential significant vibration impacts, the construction activities under each proposed alternative would not utilize any impact driving equipment in a close distance to buildings/structures.

3.9.2.2 OPERATION

As compared to Alternative 1A (the no action alternative) and Alternative 1B, operational noise associated with each WWTP proposed, including the subregional WWTPs under Alternative 2/3, the regional WWTP under Alternative 4/5, and the Hilo WWTP upgrade under Alternative 6/7, would have adverse noise impacts to noise sensitive land uses immediately adjacent to each WWTP. However, since typical noise levels from pumps, boilers, generators, compressors, etc. inside each WWTP range from 68 to 87 dBA, the WWTP operational noise impacts are anticipated to be minor as most of these sources would be enclosed and/or placed away from sensitive land uses to ensure compliance with the permissible sound levels shown in Table 3-11.

3.10 TRANSPORTATION

3.10.1 Affected Environment

Primary access to the Project Area is limited due to the presence of numerous natural and protected areas that provide barriers to vehicle traffic. Access to/from the south and east is via Route 11 (Volcano Road or the Hawai‘i Belt Road), while access from the north is via Route 130/Route 11 south of Hilo.

3.10.1.1 ROADWAYS

The Project Area is served by a limited number of State-numbered routes providing access to residential areas and the numerous protected natural areas and connecting Puna with the commercial and employment centers outside the Project Area in Hilo.

Route 130 (Kea‘au-Pāhoa Road) is a four-lane facility serving, among other locations, the numbered residential street grid of Hawaiian Paradise Park, with annual average

daily traffic[4] volumes exceeding 28,000 vehicles per day (vpd) as it approaches Kea'au (Hawai'i Department of Transportation [HDOT], 2020). Further south near Pāhoa, traffic volumes on Route 130 reduce to approximately 12,000 vpd before dwindling to under 5,000 vpd on Pāhoa-Kalapana Road where the roadway is a two-lane facility.

Route 11 connects Hilo and Kailua Kona, travelling through and along the perimeter of Hawai'i Volcanoes National Park. Within the Project Area, Route 11 provides access to the national park. North of Kurtistown it widens from two to four lanes and carries over 17,000 vpd; while north of Kea'au past its intersection with Route 130, it carries over 39,000 vpd, the highest traffic volumes on the entire island.

Other State-numbered routes serving the Project Area include Route 138 (Kahakai Boulevard) with daily traffic volumes of 5,500 vpd, Route 132 (Kapoho Road) at 4,400 vpd, and Route 137 (Kalapana-Kapoho Road) at 1,600 vpd. Table 3-13 summarizes the reported Project Area traffic volumes.

Table 3-13. Traffic Volumes

State-Numbered Route	Number of Lanes	Annual Average Daily Traffic (vpd)
Route 130		
North of Kea'au Transfer Station	4	28,400 vpd
North of Kahakai Boulevard	2	11,800 vpd
South of Pāhoa-Kapoho Road	2	4,500 vpd
Route 11		
North of Route 130	4	39,400 vpd
South of Pa'ahana Street	2	17,400 vpd
South of S. Pszyk Road	2	5,600 vpd
Route 138	2	5,500 vpd
Route 132	2	4,400 vpd
Route 137	2	1,600 vpd

Source: HDOT 2020.

3.10.1.2 EMERGENCY/EVACUATION ROUTES

Several emergency management plans identify evacuation zones without identifying specific evacuation routes and acknowledge the limited route alternatives leading into and out of the Project Area. As a result of the 2018 eruption of Kīlauea and subsequent lava flows that blocked traditional access, immediate emergency

[4] The annual average daily traffic number represents a typical traffic volume number for any day of the year on the segment of interest.

detours were identified (HDOT 2018). A bill currently in the Hawai‘i legislature is requesting that the Hawai‘i Emergency Management Agency develop preliminary draft evacuation plans for the areas within lava zones 1, 2, and 3, each of which occurs in the Project Area.

The *County of Hawai’i Multi-Hazard Mitigation Plan* (Tetra Tech 2020) identifies potential natural hazards, including volcanic eruptions, and measures to address and prepare for hazard incidents. The plan lists several roadways in the Project Area that would be vulnerable to eruption and lava flows.

The establishment of emergency, hazard mitigation and evacuation routes within and adjacent to the Project Area is a dynamic occurrence that should be acknowledged and updated as the Proposed Action moves forward. As an example, a Traffic Hazard Mitigation Route was implemented by the County of Hawai’i in December 2022 to accommodate drivers who want to safely view the current Mauna Loa eruption. Via the route, drivers can enter the Old Saddle Road directly across from the Gilbert Kahele Recreation Area. From there, drivers can travel the 4.5-mile stretch of road until it rejoins with the Daniel K. Inouye Highway just before Pu‘uhuluhulu near the Mauna Kea Access Road.

The route is one-way only, and parking is only allowed on the right side of the road. Only passenger vehicles are permitted into the route.

3.10.1.3 Programmed Roadway Improvements in the Project Area

The HDOT Statewide Transportation Improvement Program (HDOT 2022) identifies Federal transportation funding programmed for Federal fiscal years 2022 through 2025. The program includes several general bridge and pavement improvement programs as well as guardrail and shoulder improvements throughout Hawai‘i County, including roadways within the Project Area. For informational purposes, it also identifies, in Federal fiscal year 2026, Kea‘au-Pāhoa Road (Route 130) improvements from the Kea‘au Bypass to Pāhoa-Kapoho Road.

3.10.1.4 Pedestrian and Bicycle Conditions

Bike Plan Hawai‘i 2003 is the latest State of Hawai‘i master plan for bicycle facilities. The plan includes recommendations for designation or construction of facilities within the Project Area on Volcano Highway, Railroad Avenue, and Kea‘au-Pāhoa Road. The plan identifies 29 separate projects in the Project Area, totaling over 150 miles. In 2020, HDOT initiated an update of the 2003 plan and is in the process of undertaking its Bike Plan Hawai‘i refresh.

The *2013 Statewide Pedestrian Master Plan* (HDOT 2013) is the latest State of Hawai‘i master plan for pedestrian facilities. The plan identifies concerns and recommendations for pedestrian facility improvements. None of those recommendations are at locations in the Project Area. HDOT is planning to install four raised sidewalks at mid-block locations and school crossings: three on Route 11 in Mountain View and one on Route 130 in Pāhoa.

3.10.1.5 PUBLIC TRANSIT CONDITIONS

The County of Hawai'i Mass Transit Agency provides island-wide transit through its Hele-On bus service. Hele-On serves the Project Area with seven different full- and flex-service bus routes of varying frequency through the day.

The 2018 *County of Hawai'i Transit and Multi-Modal Transportation Plan* (SSFM International, Inc. 2018) identifies numerous transit service and capital improvements within the Project Area. Expanded service recommended in the plan is being implemented and additional study to construct a new transit hub in Pāhoa is underway.

3.10.1.6 SAFETY ISSUES

The County of Hawai'i (2020b) has developed the *Hawai'i Island Vision Zero Action Plan* in response to data showing that the County had the highest percentage of traffic fatalities per capita in the State between 2003 and 2017. Vision Zero also looks at equity and communities of concern as an acknowledgement that street and highway investments have not always been multimodal and have had a disproportionate adverse effect on minority and low-income communities. The Project Area is identified as having areas with the highest socioeconomic need while exhibiting a high frequency of traffic fatalities. The plan identifies both Route 130 and Route 11 segments within the Project Area as "high fatality corridors."

3.10.2 Potential Environmental Consequences and Mitigation Measures

3.10.2.1 CONSTRUCTION

The upgrading or conversion of IWSs or construction of the small, decentralized package treatment plants identified as part of Alternative 1A would have negligible effect on the transportation system. Delivery of materials and construction worker trips to these dispersed private properties would not degrade traffic operations on nearby roadway networks. The Alternative 1B addition of low-pressure sewer lines connecting to more numerous small, decentralized package treatment plants would have similar negligible effects. Local roadway closures of one-lane or sidewalk would be frequent given the geographic breadth of the 30-year program but would be isolated events, during which residents would have access options and experience limited inconvenience.

The remaining alternatives involve construction activity that would include the installation of force mains, trunk/interceptor sewer lines, or branch sewer lines in public rights-of-way/travelled ways, or in easements. The anticipated construction lane closure requirements on Project Area roadways are summarized in Table 3-14. Table 3-15 summarizes the number of lanes and annual average daily traffic on roadway segments that would be affected by Alternative 2/3, as well as Alternatives 4/5 and 6/7.

Table 3-14. In-road Lane Closure Requirements on Project Area Roadways

In-road Lane Closure Requirements (shoulder-only, one-lane, two-lane) by Road	
Route 11	Shoulder and one- or two-lane closure
Route 130	Shoulder and one- or two-lane closure
Route 132	Shoulder and one- or two-lane closure
Local roads	one- or two-lane closure

Under Alternative 2/3, in-road lane closure requirements would impact Project Area roadway operations. The magnitude of impacts would be directly related to the number of lanes available to motorists, traffic volumes, and the ability to shift or detour traffic.

In most cases, the major roadways along which construction would occur are two-lane roadways with shoulders. The maximum road closure requirements would force these roadways to shut down. Limited detour options exist due to land use and geography, with few parallel or adjacent roadways suitable to accommodate the volume of traffic requiring detour. Detours onto local roads are not feasible for similar reasons. Single-lane road closures would result in vehicle delays as traffic control (police officer/flagman control or temporary traffic signals) alternate opposing traffic onto the single available lane. The magnitude of impact would also be affected by the timing and pace of construction (phasing and feet or miles per day of installation).

Affected roadways with more than two lanes would have greater flexibility under both single- and two-lane road closures, but they would still experience vehicle delays for the same reasons noted previously. The number of lanes available typically correlates to traffic volume, so these roadways can be expected to carry higher traffic volumes. The configuration of some of these facilities (median separation, widened shoulders) may provide options for lane shifting and other means not available on two-lane roadways.

Table 3-15. Selected Roadway Segments by Alternative and Subarea

Subarea	Roadway Segment	Number of Lanes	Annual Average Daily Traffic (vpd)	Road Closure Requirements
Alternative 2/3				
Volcano	Route 11 (S of Kahauale'a Rd.)	2	5,600 vpd	Shoulder and 1 or 2 lanes
	Route 11 (S of Lanihuli Rd.)	2	3,700 vpd	Shoulder and 1 or 2 lanes
	Route 11 (S of Crater Rim Dr.)	2	1,800 vpd	Shoulder and 1 or 2 lanes
Kea'au	Route 11 (Mountain View)	2	13,300 vpd	Shoulder and 1 or 2 lanes
	Route 11 (Kurtistown) S of Pa'ahana St.	2 to 3	17,400 vpd	Shoulder and 1 or 2 lanes
	Route 11 (Kurtistown) N of Pa'ahana St.	4	17,400 vpd	Shoulder and 1 or 2 lanes
	Route 11 (Kea'au) N of Route 130	5 to 6	39,400 vpd	Shoulder and 1 or 2 lanes
	Route 130 S of Route 11	4	21,600 vpd	Shoulder and 1 or 2 lanes
Hawaiian Paradise Park	Route 130 near Paradise Drive	3 to 4	28,400 vpd	Shoulder and 1 or 2 lanes
	Route 130 S of 'Āinaloa Blvd.	2	11,800 vpd	Shoulder and 1 or 2 lanes
Pāhoa	Route 130 N of Route 132	2	5,200 vpd	Shoulder and 1 or 2 lanes
	Route 130 S of Route 132	2	4,500 vpd	Shoulder and 1 or 2 lanes
	Route 132 E of Route 130	2	4,400 vpd	Shoulder and 1 or 2 lanes
	Route 134 (Pāhoa Village Rd.) W of Route 130/132	2	6,300 vpd	Shoulder and 1 or 2 lanes
Alternative 4/5 — all of Alternative 2/3 plus these segments				
Volcano	Route 11 N of Kahauale'a Rd.	2	5,600 vpd	Shoulder and 1 or 2 lanes
Kea'au/ Hawaiian Paradise Park	Route 130 between Paradise Dr. and Route 11	4	28,400 vpd	Shoulder and 1 or 2 lanes
Pāhoa	Route 130 S of Niaulani St.	2	11,800 vpd	Shoulder and 1 or 2 lanes
Alternative 6/7 — all of Alternatives 2/3 and 4/5 plus these segments				
Hilo	Route 11 N of Macadamia Rd.	4 to 6	28,200 vpd to 39,400 vpd	Shoulder and 1 or 2 lanes

The impact to local roadways would be similar to the major two-lane roadways, but with fewer vehicle delays. The Project Area land use patterns of residential street grids also lends itself to easier detour routes, unlike the major roadways.

Effectively, in terms of transportation impacts, Alternative 4/5 would merely connect additional roadway segments on Routes 11 and 130. Similar effects would occur at a greater magnitude corresponding to the length of the added roadway segments.

Alternative 6/7 extends the sewer line north on Route 130 from Kea'au to the Hilo WWTP. This segment has the greatest number of travel lanes but also carries the highest traffic volumes on the entire island. The number of available lanes provides the greatest flexibility for traffic control.

3.10.2.2 OPERATION

There are no anticipated consequences to the transportation network as a result of implementation and operation of the Proposed Action. Vehicle trips associated with maintenance of treatment system elements are expected to be minimal and would not affect Project Area roadway operations.

The implementation of Alternatives 2/3, 4/5, or 6/7 would act as a catalyst to support transit-oriented development in the Puna District by allowing greater development density. Aligning this development with the existing and planned transit service would provide residents with options to passenger vehicle travel, which in turn would reduce vehicle miles travelled on the Project Area roadway network.

3.10.2.3 MITIGATION

Mitigation measures are needed to address the temporary effects of in-road lane closures on the roadways where force mains and sewer lines would be installed. A well-designed lane closure and detour strategy (where feasible) would help to minimize vehicle delays and congestion. The following elements should be considered as part of the lane closure strategy:

- Single-lane-only closures on roadway segments with only two lanes;
- Overnight/off-peak construction and lane closures;
- Lane shifts to opposing lanes (with movable barriers) to account for peak hour traffic directional distribution; and
- Use of shoulders and median where feasible to reduce the effects of lane closures.

Where detour options are available, the following strategies should be considered:

- Avoid or limit high-volume detours on local roadways;
- Analyze the impacts of detours prior to implementation to confirm that impacts are not greater than those that would occur under lane closure options;

- Ensure that detour routes do not include roadways that exhibit existing high-crash incidence; and
- Ensure that local authorities are consulted during the establishment of any detour routes.

3.11 INFRASTRUCTURE AND UTILITIES

3.11.1 Affected Environment

This section summarizes and outlines utilities and public services in the Proposed Action's general vicinity. Potable water, power, and communications utilities are present in the Project Area.

3.11.1.1 UTILITIES

Potable Water

The Hawai'i General Plan outlines the four major water systems that distribute potable water throughout the Project Area (County of Hawai'i 2005). Each system's source water is obtained by groundwater wells. The 'Ōla'a-Mountain View water system, supplied 'Ōla'a-Station Number 3 well and 'Ōla'a-well Number 6, includes eleven service areas and extends along Volcano Road from the former Puna Sugar Company mill to 'Ōla'a Reservation Lots and along the Kea'au-Pāhoa Road to the vicinity of Kaloli Drive. The Pāhoa water system which uses Pāhoa Battery Well Nos. A and B and Keonepoko Nui well Nos. 1 and 2, extends from Keonepoko Homesteads down along portions of the Kapoho and Pohoiki Roads to Kapoho. The Kalapana Water system, supplied by the Keau'ohana Well Nos. 1 and 2, extends from the Keau'ohana Forest Reserve along Highway 13 down to Kaimū Beach intersection and continues in a southwesterly direction along Highway 13 ending in the vicinity of Kaimū. Water Quality reports for Pāhoa, Kalapana, and 'Ōla'a-Mountain View can be found on the County of Hawai'i Department of Water Supply website (County of Hawai'i 2022c).

A privately owned water system constructed by the developer serves the Hawaiian Beaches subdivision located in Waiakahiula, but many other areas, including the Glenwood and Volcano areas and farmers within the district, are presently not served by any public water system and still depend on roof catchment systems. Widespread individual wastewater collection systems and current DOH regulations limit the areas where municipal potable water wells can be sited, despite the abundance of groundwater (County of Hawai'i 2005, 2011).

Wastewater

There are six municipal wastewater treatment plants operated by the County of Hawai'i. None of these are located within the Project Area, but three of the closest ones are located in the southern Hilo District (Hilo, Pāpa'ikou, and Pepe'ekeo). Other communities are serviced by private wastewater treatment facilities or individual facilities such as cesspools or septic tanks. The Mauna Loa Macadamia Nut

Corporation operates a private wastewater treatment plant located in the northern tip of the Project Area (Figure 3-17) and used for process water only.

The Project Area is mostly served by individual wastewater systems including cesspools and household aerobic treatment units (County of Hawai‘i 2005). The onsite sewage disposal systems consist of any system utilizing soil as a treatment medium (Class I), a septic tank discharging to a seepage pit (Class II), an aerobic treatment system discharging to a seepage pit (Class III), or wastewater discharged directly to a seepage pit with no treatment (i.e., cesspool) (Class IV). The majority of these systems within the Project Area are Class IV onsite sewage disposal systems (Figure 1-5). Figure 3-17 shows all classes of onsite sewage disposal systems and wastewater treatment plants within the Project Area.

Electric

The Hawai‘i Electric Light Company, Inc. (HELCO) supplies electricity for the County of Hawai‘i. HELCO purchases power from three privately-owned companies – Hilo Coast power company, Hāmākua Energy Partners and Puna Geothermal Venture. In addition, HELCO-owned steam units, diesel units and gas turbines also provide power. In the Project Area, power plants are located at Keāhole in North Kona, Waimea in South Kohala, Waiākea Peninsula and Kanoelehua in South Hilo, and Kea‘au (County of Hawai‘i 2005).

Gas

Gas lines regulated by the Public Utilities Commission are mainly located in Hilo and many people are provided gas service by tank or cylinder. Often in rural areas, gas is the only source of power. Major liquid propane gas substations are located in Hilo, Kailua-Kona, Waimea, and Ka‘ū (County of Hawai‘i 2005).

Telecommunications

Every region on the island of Hawai‘i has access to phone service with single line service provided island-wide. Fiber-optic technology provides high-capacity broadband requirements and services through the Verizon Hawai‘i’s fiber optic network (County of Hawai‘i 2005). Within the Project Area, many households do not have internet access as telecommunications towers need clear line-of-sight. Active volcanoes, the rugged terrain, and low population density with long distances between homes introduce a real challenge to providing island-wide broadband infrastructure (DBEDT 2020).

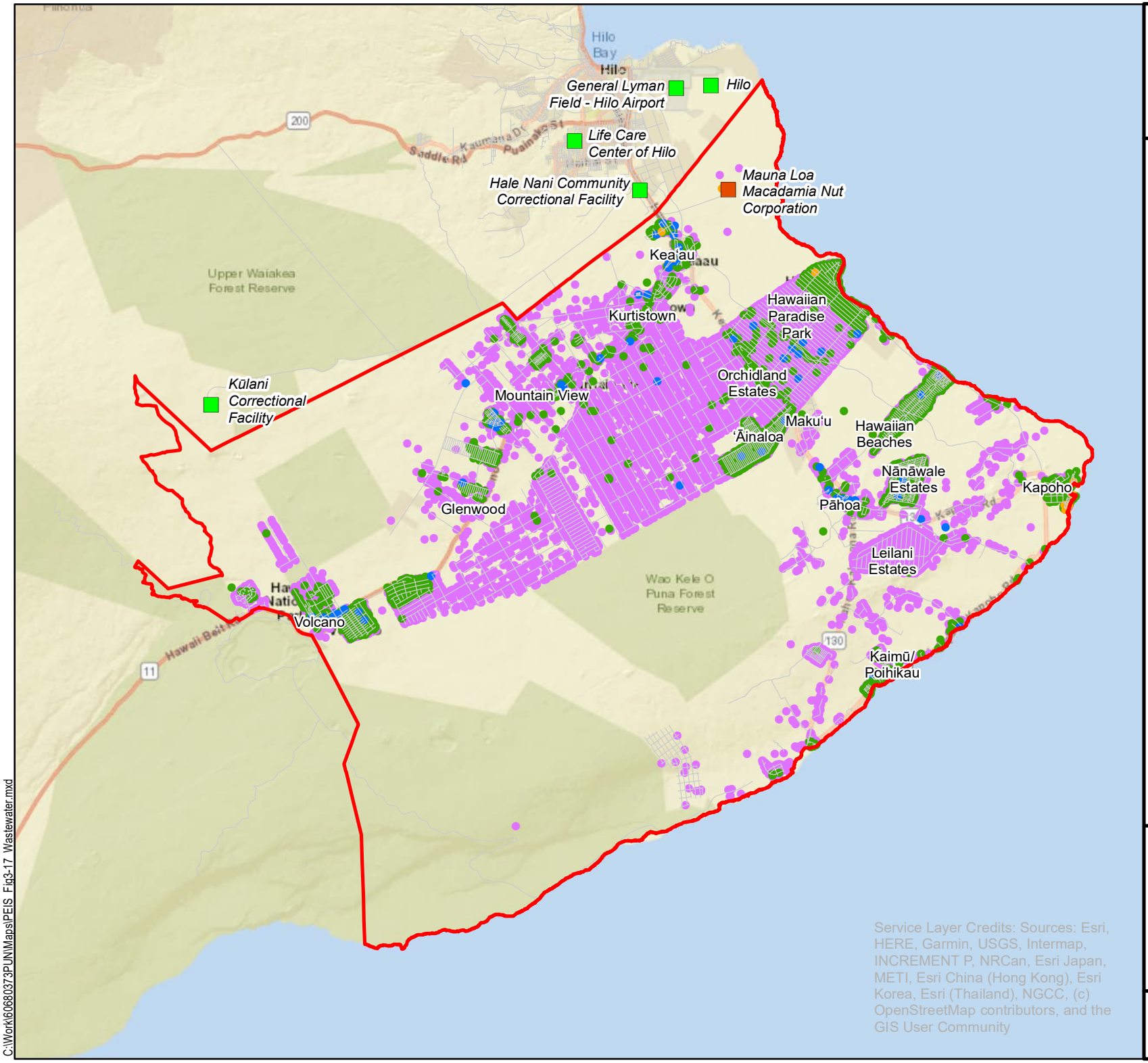

FIGURE 3-17

WASTEWATER SYSTEMS

Legend

- Project Area
- Roads

On-Site Sewage Disposal

- Class I
- Class II
- Class III
- Class IV

Wastewater Treatment Plants

- Private
- Public

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, On-site Sewage Disposal Systems for the island of Hawai'i, Oct. 2021; Wastewater Treatment Olants, Nov. 2021.

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3.11.1.2 Solid Waste and Hazardous Materials

Solid Waste

The County of Hawai‘i maintains solid waste management facilities on the island that include a sanitary landfill site and 22 solid waste transfer station sites (18 of which also accept recyclables). Within the Project Area, there is no municipal house-to-house collection of waste. Residents take their solid waste to any of the transfer stations. The waste previously was hauled to either the South Hilo Sanitary Landfill or West Hawai‘i Sanitary Landfill in Pu‘uanahulu (County of Hawai‘i 2005, 2020a); however, the South Hilo Sanitary Landfill closed in 2020. The solid waste transfer stations located in the Project Area include Pāhoa, Glenwood, Volcano, Kalapana, and Kea‘au. The recycling and transfer stations are only permitted to accept household waste and commercial and hazardous wastes are prohibited (County of Hawai‘i 2011, 2020a). Construction and demolition debris, including grading and grubbing materials (e.g., large stumps), are hauled to the West Hawai‘i Sanitary Landfill (County of Hawai‘i 2020a).

Potential Pollutants and Hazardous Materials

Proper management of household hazardous waste (HHW) is essential to protect the health and welfare of the public. The County of Hawai‘i household hazardous waste program, which is free to residents, offers collection events at four of the recycling and transfer stations in the County. The stations that hold the HHW collection events currently include Hilo, Kailua-Kona, Pāhoa and Waimea. Table 3-16 shows the types of materials collected based on data from collection events in 2015-2017 (County of Hawai‘i 2020a).

Table 3-16. Acceptable Materials for Collection at HHW Collection Events

Material Collected
Batteries (Automotive and Industrial)
Aerosol Cans
Poisons
Acids
Bases
Paints and Solvents (oil based)
Batteries (household)
Polychlorinated Biphenyls
Oil and Solvents (Halogenated)
Mercury
Fluorescent Lamps/Bulbs/Ballasts
Compressed Gas Cylinders
Miscellaneous
Oxidizing Material
Oil

The County of Hawai'i contracts for the collection of the hazardous products which are then shipped to the mainland for proper disposal or treatment. Hazardous waste storage, recycling and/or disposal for commercial entities is conducted through private contractors. Private contractors can also be contacted by residents that cannot attend one of the collection events or have items that are not accepted. Within the County, E-waste (discarded electrical or electronic devices) is collected in Hilo at Mr. K's recycle and redemption Center every Saturday, and on a rotating schedule at the Wai'ōhinu, Waimea, and Kealakehe stations (County of Hawai'i 2020a).

3.11.2 Potential Environmental Consequences and Mitigation Measures

3.11.2.1 CONSTRUCTION

All existing underground and above ground utilities would be confirmed and identified during the design process. During construction, safety procedures would be followed to avoid impacts to existing utilities. New underground utilities, which may include new sewer lines ranging from 2 inches to 48 inches in diameter, depending on the alternative, would be constructed under the Proposed Action.

Relocation, upgrade, or alteration of potable water, electrical, gas or communication utilities related to this project may include work located in State of Hawai'i ROWs, such as the Volcano Highway (Route 11) ROW, and Kea'au-Pāhoa Road (Route 130) ROW.

Wastes generated or introduced during construction activities, such as oil leaks from vehicles, would be handled and disposed of properly. BMPs would be put in place prior to any construction activities. Spill prevention and response procedures would be implemented to prevent and minimize the discharge of pollutants off the site during the construction phase. Coordination with local landfills and recycling centers for the disposal of construction debris and/or hazardous materials may be required. Disposal would be in accordance with appropriate regulations and standards. Impacts from the construction phase would be less than significant with implementation of these procedures and controls. The Proposed Action is not anticipated to generate hazardous waste that would enter the surrounding soil or groundwater.

3.11.2.2 OPERATION

The Proposed Action is planned to improve the wastewater disposal methods within the Project Area. The proposed infrastructure would increase the wastewater utilities and require additional electric or gas utilities for power to support the pump stations included in the proposed wastewater treatment and disposal systems. The improvements to the sewage treatment and disposal methods within the Project Area would replace outdated and substandard methods that pose a risk to human health and the surrounding environmental resources which would result in a positive impact to the service area.

The operation of the Proposed Action is not anticipated to impact any potable water utilities or alter any current procedures in place to manage solid or hazardous waste disposal. The Proposed Action is expected to have less than significant impacts on solid and hazardous waste and the potential for a positive impact on potable water as it would reduce the impacts to drinking water sources that cesspools have been documented to impact.

3.12 PUBLIC SERVICES AND FACILITIES

3.12.1 Affected Environment

There are three fire/EMS stations on the eastern side of the Project Area including Pāhoa Station, Hawaiian Paradise Park Station and Keaʻau Station. Volcano Station is located on the eastern edge of the District. Volunteer facilities operating 24 hours/day cover Hawaiian Beaches, Hawaiian Paradise Parks, Hawaiian Acres, Fern Acres, Fern Forest and Waʻa subdivisions and Volcano Village. (County of Hawaiʻi 2005, Hawaiʻi Statewide GIS Program 2021b). For example, the Hawaiian Beaches Volunteer Fire Station is located adjacent to the Hawaiian beaches park, to the south.

The two police stations within the Project Area are located in Keaʻau and Pāhoa. County services are supplemented with community policing programs and volunteer fire stations, usually with some degree of County assistance in the form of training, equipment and/or personnel (County of Hawaiʻi 2005, Hawaiʻi Statewide GIS Program 2021c).

There are no licensed hospitals located within the Project Area. The Hawaiian County Network consists of a total of six licensed hospitals (Hilo, Kona, Honokaa, North and South Kohala, and Kaʻū), Hilo being the closest to the Puna District. Health Services within Project Area are provided by privately operated clinics in Pāhoa and Keaʻau (County of Hawaiʻi 2005). The County contracts with DOH for emergency medical ambulance services. All fire department personnel who provide basic and advanced life support are licensed or certified as required by law (Hawaiʻi General Plan 2005).

The locations of public and private schools are shown in Figure 3-18. The Project Area includes public school complexes located in the Keaʻau, Mountain View and Pāhoa communities. The Keaʻau High School complex includes Keaʻau High School, Keaʻau Middle School, Keaʻau Elementary School and Mountain View Elementary School. The Pāhoa High School complex includes Pāhoa High School, Pāhoa Intermediate School, Pāhoa Elementary School, and Keonepoko Elementary School. Two charter schools are also located in the same general areas including Ke Kula ʻO Nāwahīokalaniʻōpuʻu Iki Laboratory PCS near Keaʻau, and Hawaiʻi Academy of Arts and Science PCS near Pāhoa. Three private schools are located in the Puna district including Christian Liberty Academy near Keaʻau, Kamehameha Schools of Hawaiʻi near Kurtistown, and the Waldorf school located on Makuʻu Drive within the Hawaiian Paradise Park subdivision.

Several preschools, early education and early childcare centers are located within the Puna District. These include Volcano School of Arts and Sciences located between Volcano and Glenwood, Parents and Children Together (PACT) Head Start Mountain

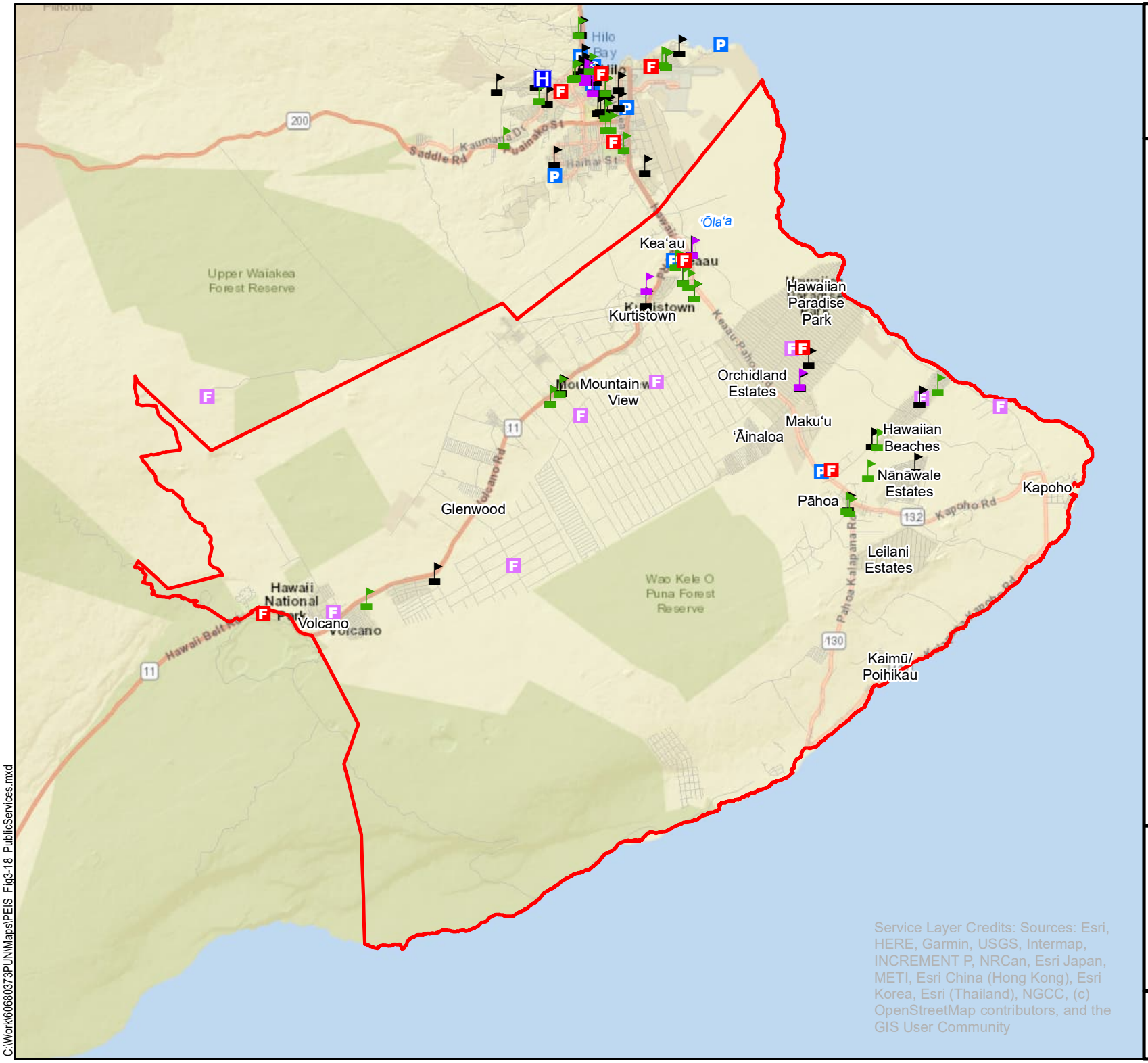

FIGURE 3-18

PUBLIC SERVICES

Legend

- Project Area
- Roads
- Hospital
- Public School
- Private School
- Preschools
- Police Station
- Fire Station
- Volunteer Fire Station

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, Hospitals, Nov. 2021; Fire Stations, Nov. 2021; Public Schools Jun. 2021; Private Schools, Nov. 2021; Police Stations Island of Hawai'i, Nov. 2021; Volunteer Fires Stations Island of Hawai'i, Nov. 2021; Locations of Preschools, Early Education and Early Childcare Centers in the State of Hawaii, Feb. 2022.

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View Pre-Plus in Mountain View, Aloha Keiki Preschool in Kurtistown, Pūnana Leo O Hilo located south of Kea‘au, Kamehameha Preschool in the Hawaiian Paradise Park subdivision, PACT Head Start Keonepoko Pre-Plus Inclusion, PACT Early Head Start Hawaiian Beaches ITC, and Kamehameha Preschool – Pāhoa all located northeast of Pāhoa (Hawai‘i Statewide GIS Program 2021d). Branch libraries which are joint community-school facilities are located in Kea‘au, Mountain View and Pāhoa (County of Hawai‘i 2005).

It should be noted that in some development areas, master plans have been developed to include plans for future public services and utilities. For example, W.H. Shipman, Ltd, a principal landowner within the Kea‘au Development Area, has prepared development plans to accommodate new police, fire, transit, and medical facilities.

3.12.2 Potential Environmental Consequences and Mitigation Measures

3.12.2.1 CONSTRUCTION

Temporary impacts during construction may impact traffic or roadway access. Coordination with public facilities such as Police, EMS, and Fire Departments would be needed during construction activities. In instances when traffic control cannot be provided by the construction contractor, an off-duty police officer would be scheduled and hired to provide those services.

During construction, there may be additional noise and traffic at or near the schools. State Department of Education and the individual schools in the area would be consulted to coordinate work when occurring in close proximity to these facilities. Construction related impacts would be short term and are not anticipated to have any significant impacts.

3.12.2.2 OPERATION

The Proposed Action would not result in the need for enhanced or altered police, fire, or medical resources. Also, no immediate population or employment increase would be directly associated with the Proposed Action. Therefore, no immediate increases in the demands for public services would be expected during the operational phase. The Proposed Action involves the provision of utilities and public services to adjacent land uses, and therefore impacts would be less than significant.

No operational effects to schools are anticipated, other than periodic inspection and/or maintenance of proposed wastewater management facilities located on or near school property.

3.13 LAND OWNERSHIP

3.13.1 Affected Environment

The Project Area landowners consist of predominantly Federal- and State-owned land with some County and private landowners. Figure 3-19 displays the Public lands, either Federally owned, State-owned or County-owned, and any large private landowners with properties larger than 1,000 acres. Within the Project Area approximately 50 percent (approximately 104,433 acres) of the land is State owned, 30 percent (approximately 63,197 acres) is Federally owned, 20 percent (approximately 42,643 acres) is privately owned with a 1,000 acre minimum, and less than 1 percent (486 acres) is County owned. In addition, there are approximately 7,000 additional acres owned privately throughout the district in smaller size parcels (Hawai‘i Statewide GIS Program 2021e).

Within the project area, there are 57,732 parcels of which 26,342 are greater than 1 acre and 31,390 are less than 1 acre. In general, wastewater services for a community are provided for commercial, industrial, and residential properties of one acre or less. Sewering is typically proposed in areas with lots sizes of 1 acre or less, or for institutions (i.e., schools, hospitals), commercial or industrial properties. IWSs are typically planned in less densely developed areas such as national parks, forest reserves, community/regional parks or Agricultural zones of 3 acres or larger.

Based on Land Use District Boundary information, the Project Area is primarily Conservation Land and Agricultural Land. HAR Title 13, Chapter 5 of the Department of Land and Natural Resources identifies and governs permissible land uses and permit requirements.

A policy of non-participation areas for the purpose of United States Department of Housing and Urban Development assistance in Lava Hazard Zones 1 and 2 was developed in 1971. This policy prohibits the use of Community Development Block Grant funds for permanent residential development, including infrastructure in service to this use, in these areas on the island of Hawai‘i. Lava Hazard Zones are discussed in Section 3.5.1 and are shown in Figure 3-3.

W.H. Shipman is a principal landowner in the Kea‘au community with a master plan developed with community participation. The master plan includes development of the area within the designated town center and extending to the Shipman lands.

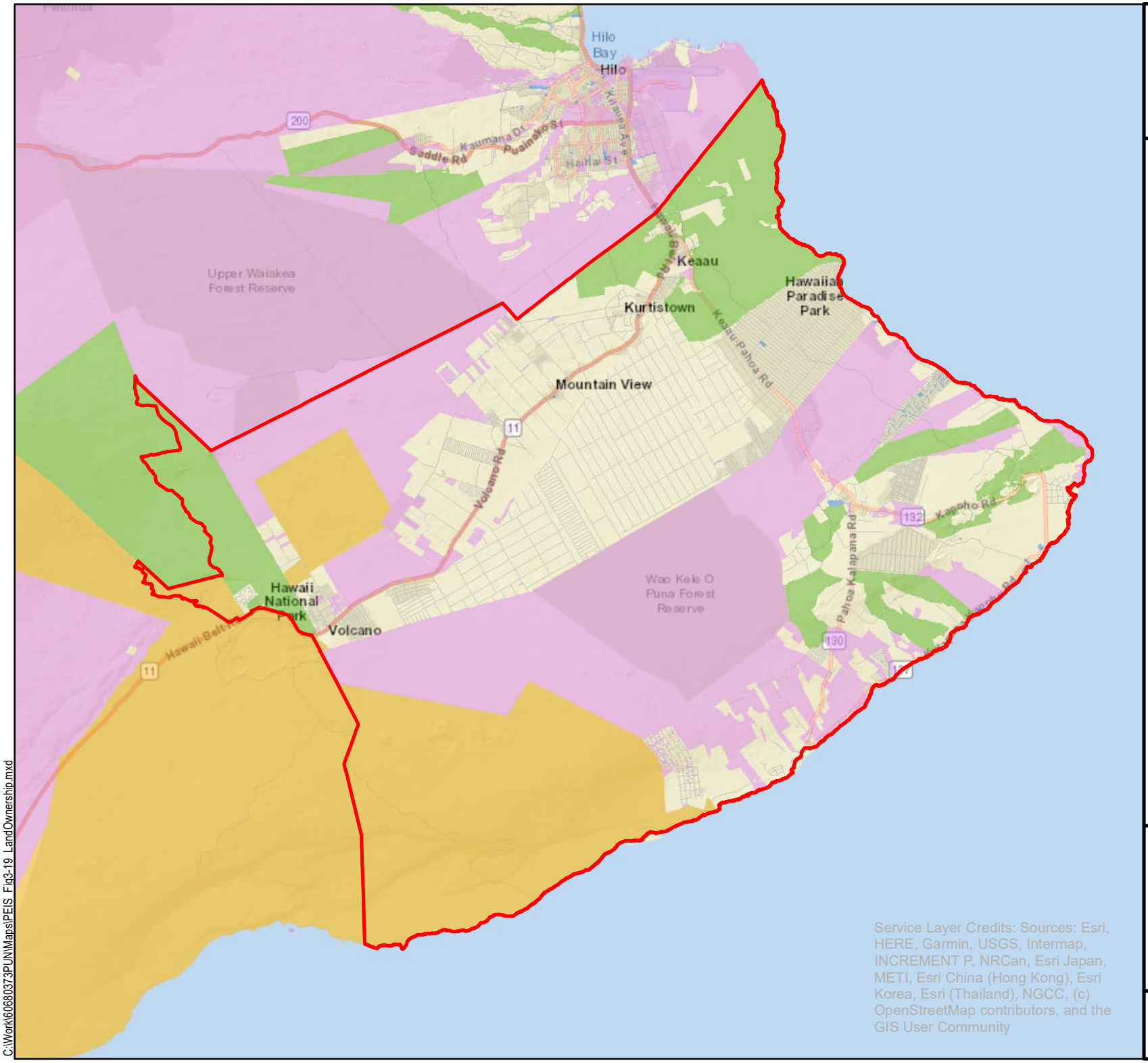

FIGURE 3-19

LAND OWNERSHIP

Legend

- Project Area
- Roads

Large Landowners - Statewide

- Private (1,000 acre minimum)
- Public - Federal
- Public - State
- Public - County

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, Statewide Large Landowners as of 2017.

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3.13.2 Potential Environmental Consequences and Mitigation Measures

3.13.2.1 CONSTRUCTION

A majority of the proposed construction would occur along or near existing roadway easements and utility corridors. However, temporary easements or right-of-entry may be required throughout the Project Area during construction. Temporary impacts related to trenching and excavation for sewer alignments would affect private landowners and public landowners including State and County owned property. It is not anticipated that any of the proposed work would occur within Federally owned land except for a portion of the work adjacent to Hawai'i Volcanoes National Park. This work would be along Route 11 east of the Village of Volcano.

3.13.2.2 OPERATION

The Proposed Action would primarily be located within existing ROWs and easements, although some pump stations and WWTPs may require permanent easements from private landowners and public lands owned by the State and County. It is not anticipated that any of the proposed work would occur within Federally owned land.

3.14 SOCIOECONOMIC FACTORS

For the purpose of characterizing socioeconomic conditions in the Project Area, the Kea'au-Mountain View census county division (CCD) and the Pāhoa-Kalapana CCD, subdivisions of Hawai'i County recognized by the United States Census Bureau (USCB) and shown in Figure 3-20, are considered representative of the Project Area due to the following:

- The combined area of the Kea'au-Mountain View and Pāhoa-Kalapana CCDs is generally coterminous with the Project Area.
- The portions of the Kea'au-Mountain View and Pāhoa-Kalapana CCDs that are outside the district, and portions of neighboring CCDs that are within the district support only low concentrations of population, and minimal development and infrastructure.
- The town and village centers to which the County of Hawai'i is evaluating the provision of wastewater services are within the Kea'au-Mountain View and Pāhoa-Kalapana CCDs.

3.14.1 Affected Environment

Kea'au-Mountain View CCD encompasses a land area of approximately 232.6 square miles and a water area of about 39.4 square miles; whereas Pāhoa-Kalapana CCD encompasses a land area of approximately 267.9 square miles and a water area of about 112.0 square miles (USCB 2021). The land area of the two CCDs combined represents approximately 12.4 percent of the land area of the County of Hawai'i.

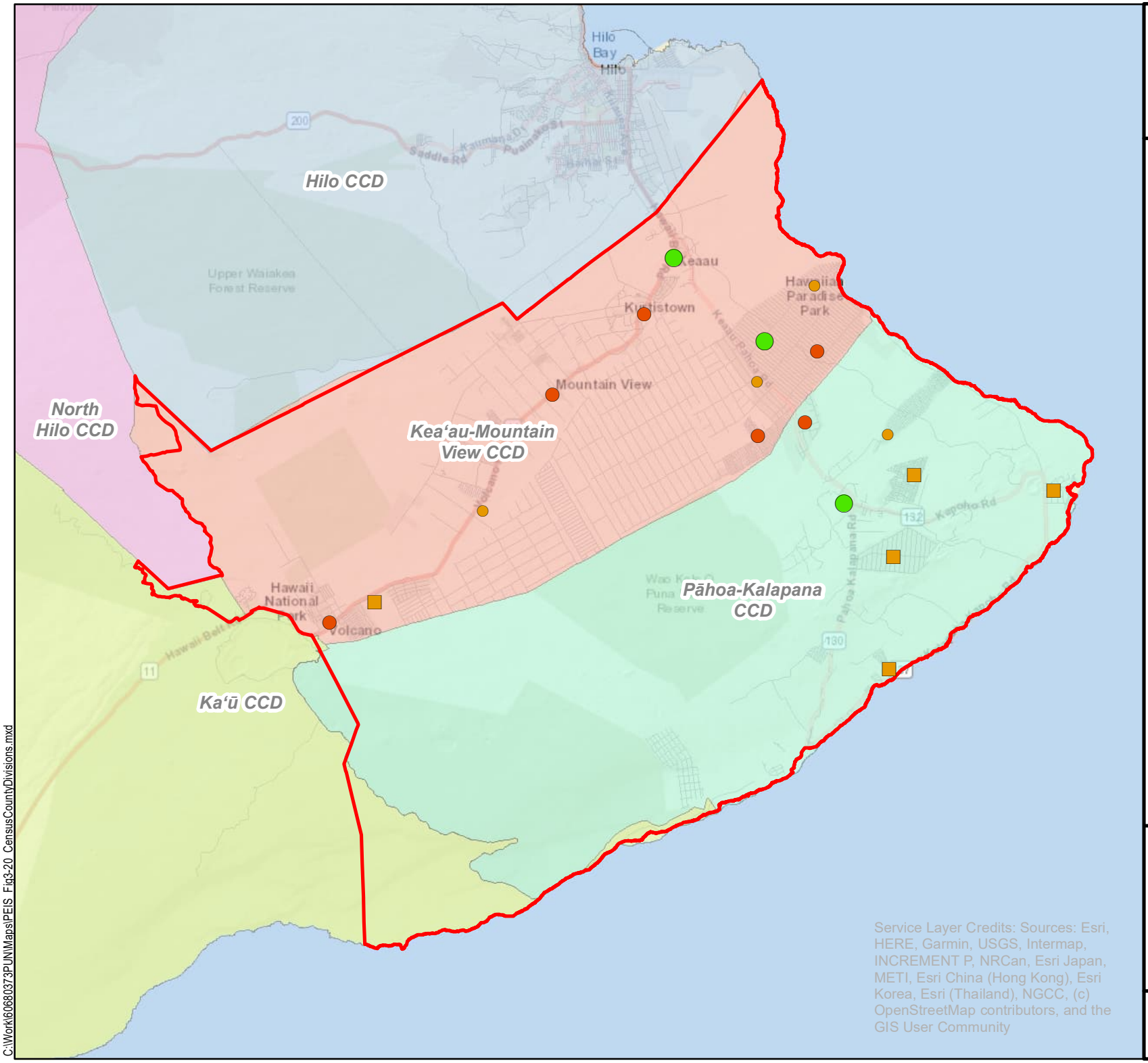

FIGURE 3-20

CENSUS COUNTY DIVISIONS

Legend

- Project Area
- Roads

Town and Village Centers

- Regional
- Community
- Neighborhood
- Future Location Subject to Community Review

2020 Census County Divisions

- Hilo CCD
- Ka'ū CCD
- Kea'au-Mountain View CCD
- North Hilo CCD
- Pāhoa-Kalapana CCD

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, 2020 Census County Division Boundaries (Districts) with Population; 2011 Puna CDP, Proposed Town and Village Center Locations.

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3.14.1.1 POPULATION

USCB conducts a census of the United States every 10 years, in years ending in zero, to count the population and housing units for the entire United States. The most recent completed decennial census is the 2020 Census. Table 3-17 presents population statistics for the Kea'au-Mountain View and Pāhoa-Kalapana CCDs. Population data are from the USCB 2010 and 2020 Censuses.

Table 3-17. Population, 2010 and 2020, and Population Density, 2020

Geographic Area	Land area (square miles)	Population			2020 Density (persons per square mile)[1]
		2010	2020	Percent Change 2010-2020[1]	
Kea'au-Mountain View CCD	232.6	34,266	41,210	20.3	177
Pāhoa-Kalapana CCD	267.9	11,060	10,494	-5.1	39
Hawai'i County	4,028.4	185,079	200,629	8.4	50
State of Hawai'i	6,422.5	1,360,301	1,455,271	7.0	226

Sources: USCB 2021; USCB 2022a, 2010 and 2020 Decennial Census Redistricting Data (PL 94-171), Table P1, Race.

[1] Values were calculated based on USCB gazetteer and census data.

Overall, the Project Area is a relatively lightly populated region undergoing robust population growth, although both the population and its growth are unevenly distributed across the Kea'au-Mountain View and Pāhoa-Kalapana CCDs. The two CCDs have a combined population density of approximately 100 persons per square mile. However, Kea'au-Mountain View CCD population density is about 180 persons per square mile; substantially higher than the approximately 50 persons per square mile population density of Hawai'i County, although lower than the approximately 230 persons per square mile density of the State of Hawai'i. The population density of Pāhoa-Kalapana CCD is about 40 persons per square mile; lower than the Hawai'i County population density and substantially lower than the State population density.

Figure 3-21 illustrates the distribution of population across the Project Area census tracts, as well as the Kea'au-Mountain View and Pāhoa-Kalapana CCDs. The three census tracts with the highest population densities in 2020 all are within the Kea'au-Mountain View CCD. Census Tracts 210.14 and 210.15 extend from Route 130 (Kea'au-Pāhoa Road) to the ocean and include Hawaiian Paradise Park, and both support population densities in the upper one-third of the range of tracts in the Project Area, with densities above 700 persons per square mile. Census Tract 201.03, on the west side of Route 130 and including Orchidland Estates and 'Āinaloa, supports a population density in the middle third of the range, with densities between 350 and 700 persons per square mile.

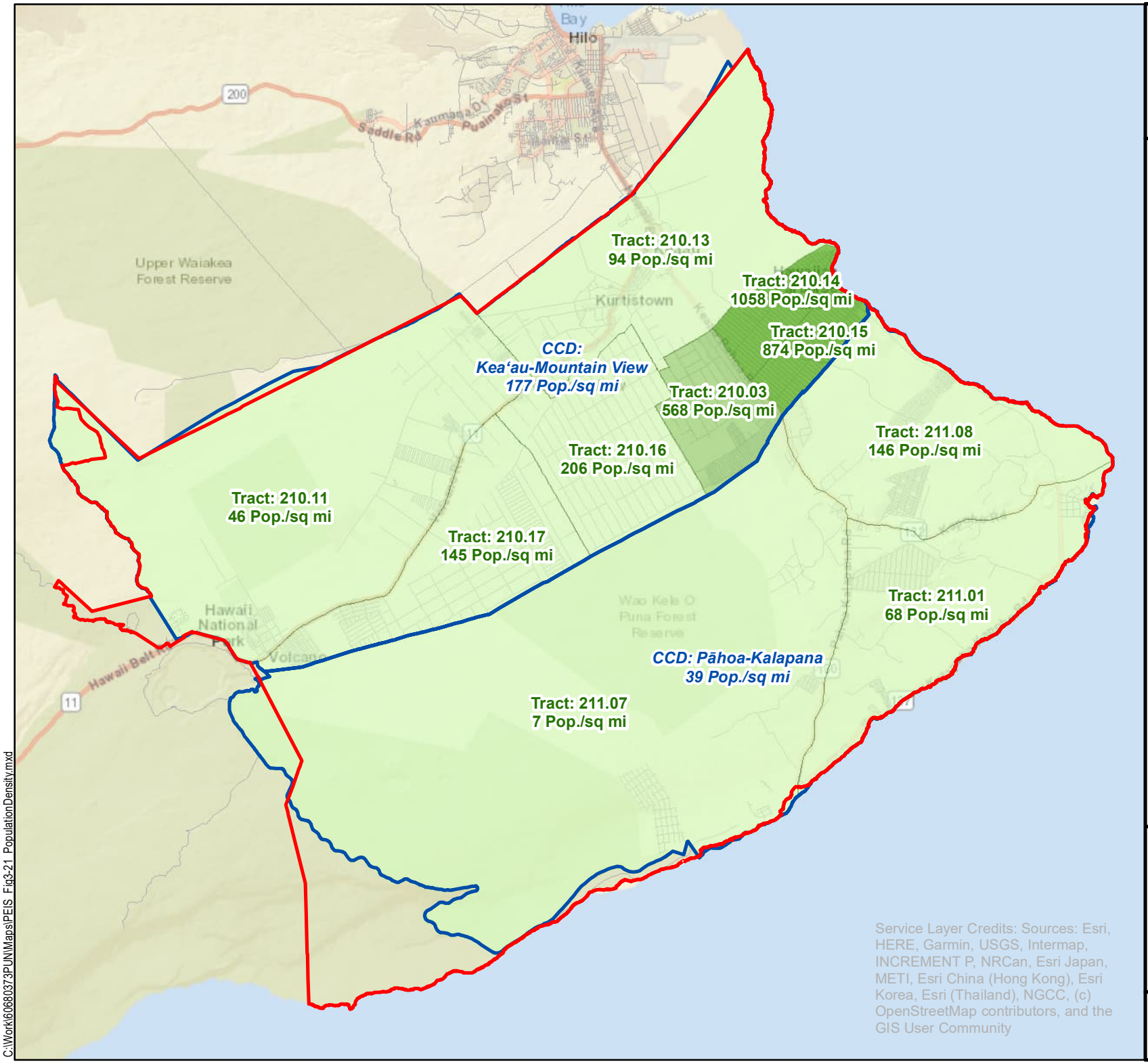

FIGURE 3-21

POPULATION DENSITY

Legend

- Project Area
- Roads
- 2020 Census County Divisions
- 2020 Census Tracts

Tract Population Density

- Greater than approximately 700 persons per square mile
- Between approximately 350 and 700 persons per square mile
- Less than approximately 350 persons per square mile

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, 2020 Census Tracts, Nov. 2021 and 2020 Census County Divisions, Nov. 2021.

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Population growth from 2010 to 2020 was faster in Hawai‘i County than the statewide average, as it has been for the past four decades since 1980 (DBEDT 2022, Table 1.09, De Facto Population, By County: 1980 to 2020). The population of Kea‘au-Mountain View CCD increased approximately 20.3 percent from 2010 to 2020; nearly three times higher than the 7.0 percent increase in population of the State of Hawai‘i during that time period and more than twice the 8.4 percent increase in population of Hawai‘i County. Conversely, the population of Pāhoa-Kalapana CCD decreased approximately 5.1 percent from 2010 to 2020. Based on USCB data (USCB 2022a, 2010 and 2020 Decennial Census Redistricting Data (PL 94-171), Table P1, Race), between 2010 and 2020, Kea‘au-Mountain View CCD was the fastest growing among the 12 CCDs in the County and Pāhoa-Kalapana CCD was the slowest.

Table 3-18 provides population projections for Hawai‘i County and the State of Hawai‘i prepared by the DBEDT (2018). Based on DBEDT population projections, the resident population of Hawai‘i County will be about 273,230 in 2045, an approximately 30.7 percent cumulative increase over the 25 years from 2020 or about 1.1 percent annually. For the State of Hawai‘i, DBEDT estimates an approximately 12.4 percent cumulative increase between 2020 and 2045, or about a 0.5 percent annual increase. This rate of increase for the State is substantially lower than the anticipated increase in Hawai‘i County. Similarly, the rate of increase of the de facto population of the State of Hawai‘i is substantially lower than that of the County.

Table 3-18. Population Projections, 2020-2045

Geographic Area	2020[1]	2025[2]	2035[2]	2045[2]
Hawai‘i County				
Resident Population[3]	209,000	222,396	248,486	273,232
De Facto Population[4]	236,684	252,073	282,588	311,869
State of Hawai‘i				
Resident Population[3]	1,466,632	1,514,723	1,592,684	1,648,609
De Facto Population[4]	1,638,617	1,695,167	1,792,080	1,866,457

Source: DBEDT 2018.

[1] 2016 vintage population estimates for July 1st by the USCB.

[2] DBEDT projections.

[3] Resident population includes active-duty military personnel and their dependents as well as other civilian population.

[4] De facto population includes those who are physically present in a given area at the given time, including visitors who stay in the area but excluding residents who are temporarily away.

Based on the USCB American Community Survey five-year estimates for 2016-2020, the number of housing units in the Keaʻau-Mountain View and Pāhoa-Kalapana CCDs totaled about 15,830 and 5,570, respectively, as shown in Table 3-19. The total number of units in Hawaiʻi County was about 88,620. Using USCB data for 1990 to 2018 and econometric models, the DBEDT (2019) forecasts that Hawaiʻi County will need approximately 7,800 to 13,500 additional housing units in the next ten years.

Table 3-19. Housing Units, 2016-2020

Geographic Area	Total Housing Units	Occupied Housing Units[1]	Vacant Housing Units[2]	Percent Vacant
Keaʻau-Mountain View CCD	15,829	13,445	2,384	15.1
Pāhoa-Kalapana CCD	5,574	4,566	1,008	18.1
Hawaiʻi County	88,624	71,747	16,877	19.0
State of Hawaiʻi	546,571	467,932	78,639	14.4

Source: USCB 2022a, 2016-2020 American Community Survey 5-Year Estimates, Table DP04, Selected Housing Characteristic; USCB 2022b.

[1] A housing unit is classified as occupied if it is the usual place of residence of the person or group of people living in it at the time of enumeration.

[2] A housing unit is vacant if no one is living in it at the time of enumeration, unless its occupants are only temporarily absent. Units temporarily occupied at the time of enumeration entirely by people who have a usual residence elsewhere are also classified as vacant.

Approximately 15.1 percent of the housing units in Keaʻau-Mountain View CCD and 18.1 percent of units in Pāhoa-Kalapana CCD were vacant. The vacancy rate for Hawaiʻi County was higher and that for the State of Hawaiʻi was lower. The high vacancy rates throughout these geographies are due in large part to the high proportion of housing units that are intended by the owner to be occupied during only certain seasons of the year. According to the DBEDT (2019), of the total residential homes sold in Hawaiʻi County between January 2008 and September 2019, 42.2 percent were sold to out-of-state residents and many of those homes were left vacant for most of the year, with the owner only staying during the holidays.

As shown in Table 3-20, a large proportion of vacant housing units in the State, the County, and the Project Area are held for seasonal, recreational, or occasional use and, as such, are unavailable to the resident housing market. Approximately 40.9 percent of the housing units in Keaʻau-Mountain View CCD and 46.8 percent of units in Pāhoa-Kalapana CCD are vacant for seasonal, recreational, or occasional use.

Table 3-20. Vacant Housing Units, 2016-2020

Geographic Area	Vacant Housing Units	For Seasonal[1], Recreational, or Occasional Use	
		Housing Units	Percent
Kea'au-Mountain View CCD	2,384	975	40.9
Pāhoa-Kalapana CCD	1,008	472	46.8
Hawai'i County	16,877	7,524	44.6
State of Hawai'i	78,639	32,027	40.7

Source: USCB 2022a, 2016-2020 American Community Survey 5-Year Estimates, Table B25004, Vacant Housing Units; USCB 2022b.

[1] Seasonal units are intended by the owner to be occupied during only certain seasons of the year. They are not anyone's usual residence.

[2] A housing unit is vacant if no one is living in it at the time of enumeration, unless its occupants are only temporarily absent. Units temporarily occupied at the time of enumeration entirely by people who have a usual residence elsewhere are also classified as vacant.

3.14.1.2 EMPLOYMENT AND INCOME

Based on estimates by the United States Bureau of Economic Analysis (2021), Figure 3-22 shows full- and part-time total employment in Hawai'i County and wage and salary, nonfarm proprietor, and farm proprietor employment for the period 2015 through 2020. From approximately 103,990 jobs in 2015, total employment in the County increased about 4.8 percent to 108,940 jobs three years later, in 2018. After 2018, the year of the 2018 Kīlauea eruption and Hurricane Lane, total employment decreased 11.0 percent to 96,950 jobs in 2020.

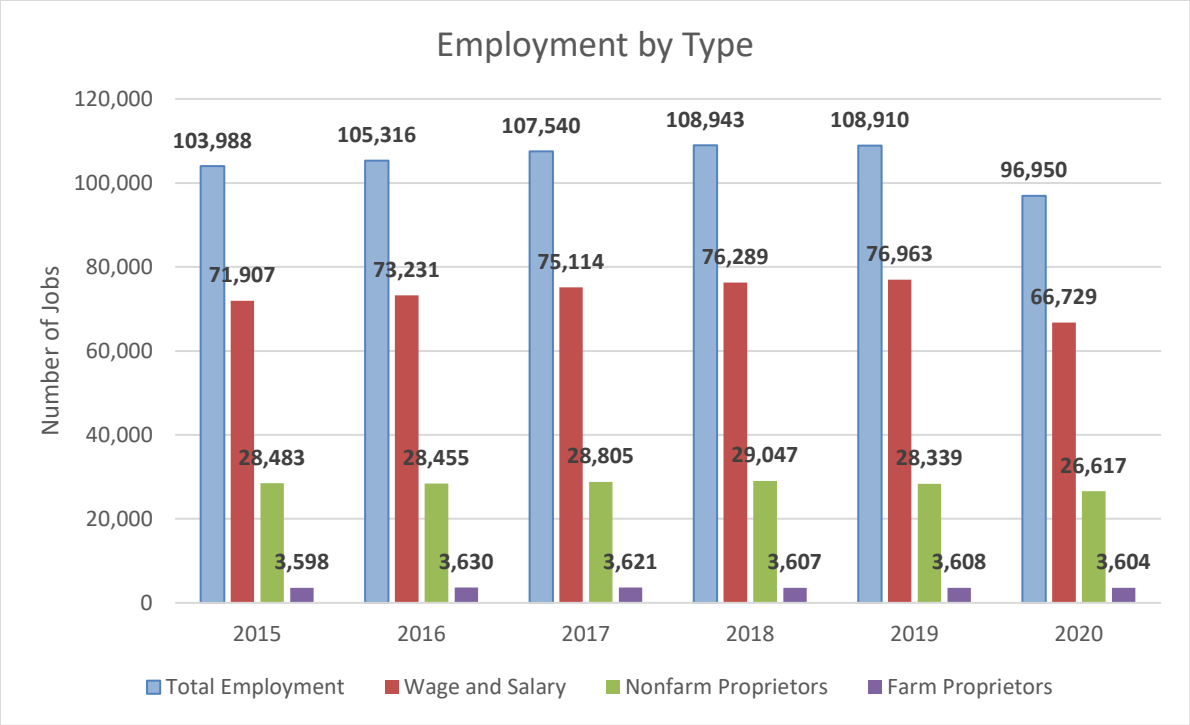

Figure 3-22. Full- and Part-Time Employment by Type, 2015 – 2020

Source: United States Bureau of Economic Analysis (2021), Regional Economic Accounts, Table CAEMP25N.

Full- and part-time employment by two of the three broad employment types that cumulatively comprise total employment generally conformed to similar patterns, whereas the number of jobs in the third broad type were decreasing since 2016. These patterns are described as follows:

- Wage and salary employment accounted for approximately 68.8 to 70.7 percent of total employment in Hawai'i County. From approximately 71,910 jobs in 2015, wage and salary employment increased about 7.0 percent to 76,960 jobs in 2019, and then decreased 13.3 percent to 66,730 jobs in 2020.
- Nonfarm proprietor employment accounted for approximately 26.0 to 27.5 percent of total employment. From approximately 28,480 jobs in 2015, nonfarm proprietor employment increased about 2.0 percent to 29,050 jobs in 2018, and then decreased 8.4 percent to 26,620 jobs in 2020.
- Farm proprietor employment accounted for approximately 3.3 to 3.7 percent of total employment. Unlike total employment, and the component employment types described in the preceding bullets, job numbers for this employment type were essentially unchanged during the 2015-2020 period, varying by only 32 jobs or 0.9 percent throughout.

Similar to the previous figure, Figure 3-23 is based on estimates by the United States Bureau of Economic Analysis (2021) and shows full- and part-time employment in Hawai'i County. For the 2015-2020 period, trends are illustrated for three select

industries—namely private nonfarm employment, government and government enterprise employment, and farm employment—as well as for total employment. The three broad industries cumulatively comprise total employment in the County.

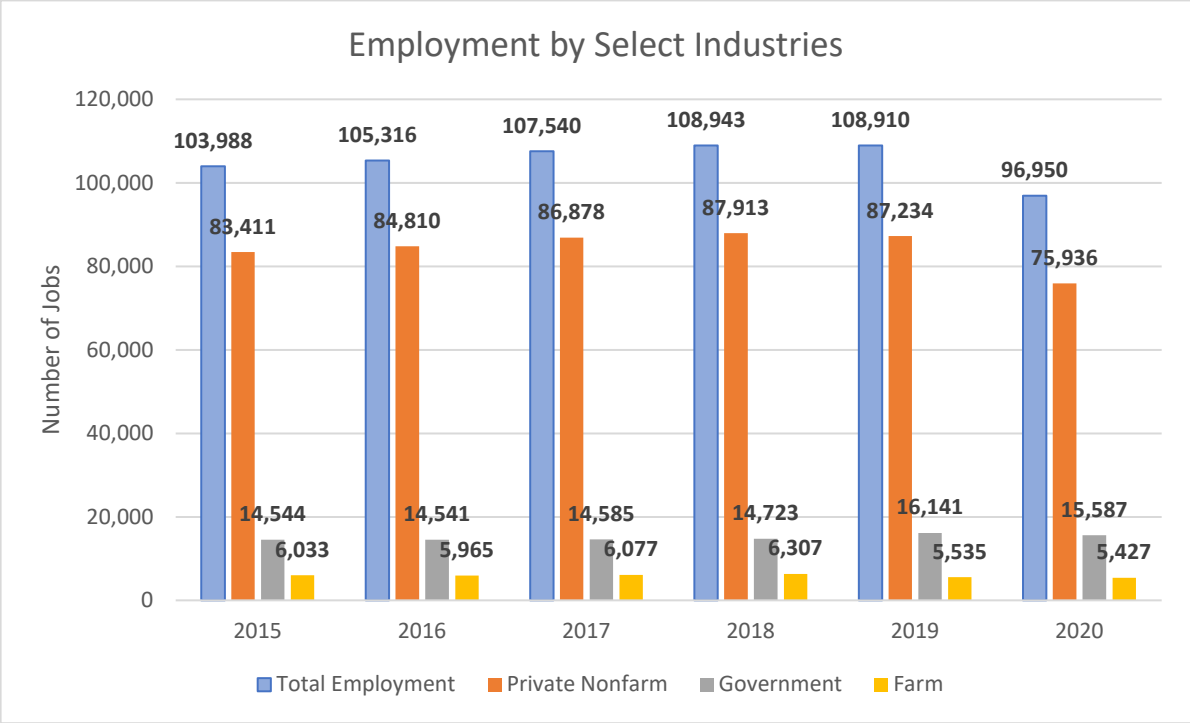

Figure 3-23. Full- and Part-Time Employment by Select Industries, 2015 – 2020

Source: United States Bureau of Economic Analysis (2021), Regional Economic Accounts, Table CAEMP25N.

Full- and part-time employment in the three broad industries generally conformed to similar patterns as previously described for total employment, as follows:

- Private nonfarm employment accounted for approximately 78.3 to 80.8 percent of total employment in Hawai'i County. From approximately 83,410 jobs in 2015, private nonfarm employment increased about 5.4 percent to 87,910 jobs in 2018, and then decreased 13.6 percent to 75,940 jobs in 2020.
- Government and government enterprise employment accounted for approximately 13.5 to 16.1 percent of total employment. From approximately 14,540 jobs in both 2015 and 2016, government and government enterprise employment increased about 11.0 percent to 16,140 jobs in 2019, and then decreased 3.4 percent to 15,590 jobs in 2020.
- Farm employment accounted for approximately 5.1 to 5.8 percent of total employment. From approximately 6,030 jobs in 2015, farm employment increased about 4.5 percent to 6,310 jobs in 2018, and then decreased 14.0 percent to 5,430 jobs in 2020.

Based on data from the United States Bureau of Labor Statistics (2022a), annual average unemployment rates in Hawai‘i County increased by 0.5 percent over the two years from 2017 to 2019 and then jumped by 8.6 percent to 11.7 percent in 2020, as shown in Table 3-21. The County unemployment rate then recovered partially, decreasing 6.2 percent to 5.5 percent in 2021. The unemployment rates for the State of Hawai‘i followed a similar trend over the five-year period, although the rates for the State were lower than the rates for Hawai‘i County from 2017 through 2019 but higher in 2020 and 2021.

Table 3-21. Annual Average Labor Force, 2017-2021

Geographic Area	2017	2018	2019	2020	2021
Hawai‘i County					
Labor Force	95,104	94,721	93,600	91,636	93,848
Employed	92,655	92,033	90,674	80,942	88,679
Unemployed	2,449	2,688	2,926	10,694	5,169
Unemployment Rate (%)	2.6	2.8	3.1	11.7	5.5
State of Hawai‘i					
Unemployment Rate (%)	2.2	2.4	2.5	12.0	5.7

Source: United States Bureau of Labor Statistics 2022a, Labor Force Data by County, Annual Averages; United States Bureau of Labor Statistics 2022b, Unemployment Rates for States, Annual Averages.

For the State of Hawai‘i, the annual average unemployment rate had reached a low in 2017 at 2.2 percent, the lowest state rate in the United States (United States Bureau of Labor Statistics 2022a). In the same year, however, Hawai‘i County had the highest annual average county unemployment rate in the State. Three years later, in 2020, the unemployment rate for the State of Hawai‘i reached a high at 12.0 percent, the second highest state rate in the country, surpassed only by the State of Nevada with an annual average unemployment rate of 13.5 percent. That year, the Hawai‘i County annual average unemployment rate, although high at 11.7 percent, was not the highest county rate in the State. The average annual unemployment rate for Honolulu County, at 10.5 percent, was lower than the Hawai‘i County rate, but both the Kaua‘i County and Maui County rates were higher, at 16.6 and 18.2 percent, respectively.

Table 3-22 presents income and poverty estimates for the Project Area from the 2016-2020 American Community Survey 5-Year Estimates. Median household incomes in the Kea‘au-Mountain View and Pāhoa-Kalapana CCDs were approximately 13.0 percent and 43.1 percent lower, respectively, than the median household in Hawai‘i County overall. Although the relative values differ, the overall pattern for both measures of median family income are the same as that described for median household income: Median family incomes in the Kea‘au-Mountain View and Pāhoa-Kalapana CCDs were lower than the median family incomes in the County

overall. Per capita income also was lower in the Project Area than in Hawai‘i County; about 16.0 percent lower in Kea‘au-Mountain View CCD and 27.5 percent lower in Pāhoa-Kalapana CCD.

Table 3-22. Income and Poverty, 2016-2020

Geographic Area	Median Income in 2020 Dollars			Per Capita Income in 2020 Dollars	Persons in Poverty (%)
	Household	Family	Married Couple Family		
Kea‘au-Mountain View CCD	56,895	65,758	81,282	26,762	16.1
Pāhoa-Kalapana CCD	37,200	52,232	65,500	23,085	24.2
Hawai‘i County	65,401	77,500	91,231	31,863	14.0
State of Hawai‘i	83,173	97,813	108,893	37,013	9.3

Sources: USCB 2022a, 2016-2020 American Community Survey 5-Year Estimates, Table S1901, Income in the Past 12 Months (in 2020 Inflation-Adjusted Dollars); Table S1902, Mean Income in the Past 12 Months (in 2020 Inflation-Adjusted Dollars); Table S1701, Poverty Status in the Past 12 Months.

Figure 3-24 and Figure 3-25 illustrate the distribution of median household incomes and median married-couple family incomes, respectively, in the census tracts in the Kea‘au-Mountain View and Pāhoa-Kalapana CCDs. The three census tracts with the highest median household incomes in 2020, with incomes in the upper one-third of the range of tracts in the Project Area, all are within the Kea‘au-Mountain View CCD, in the Kea‘au and Kurtistown area, and in the area of Hawaiian Paradise Park. For median married-couple family income, the one tract with incomes in the upper one-third of the range of tracts and all three tracks with incomes in the middle third also are within the Kea‘au-Mountain View CCD.

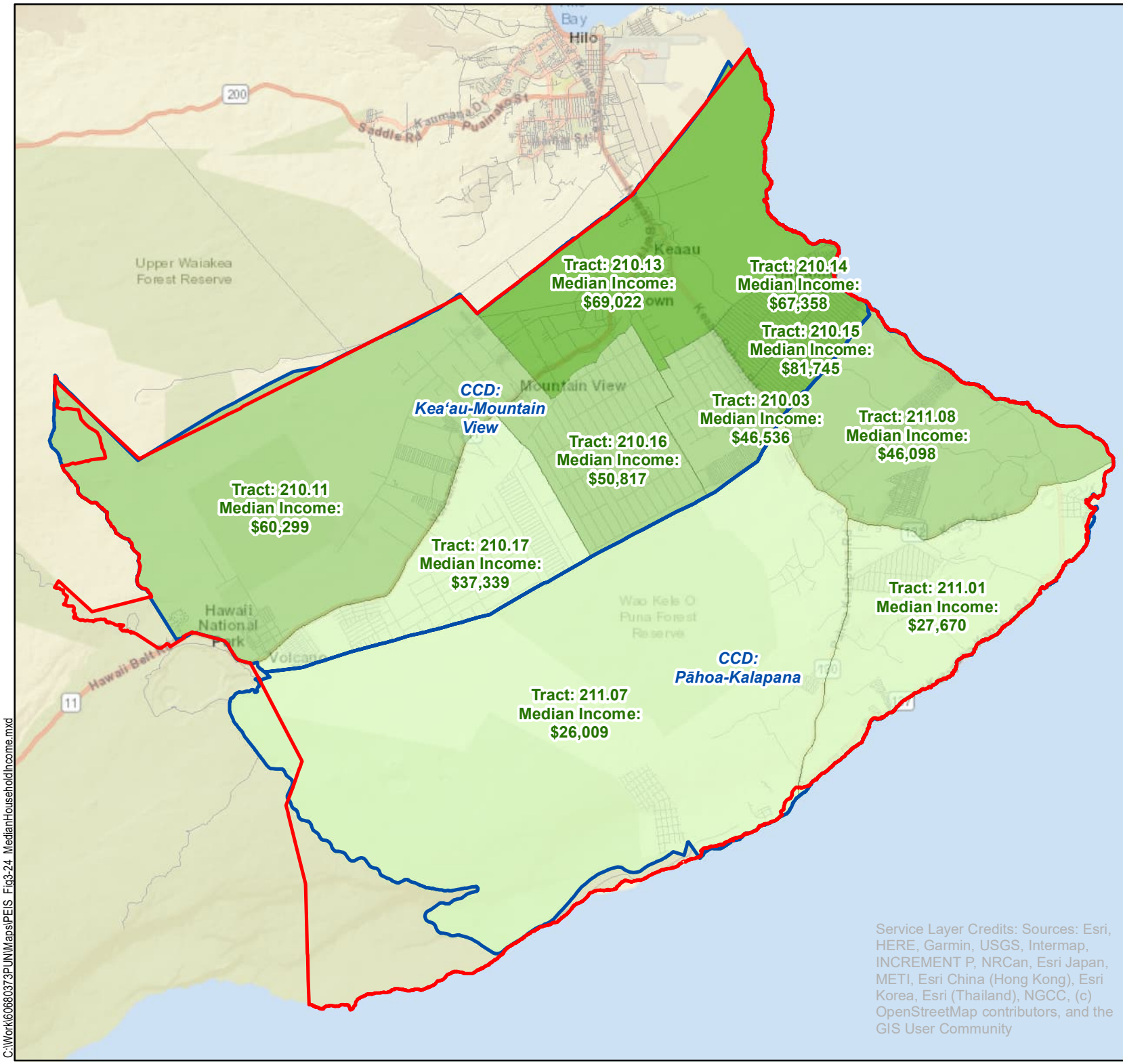

FIGURE 3-24

MEDIAN HOUSEHOLD INCOME

Legend

- Project Area
- Roads
- 2020 Census County Divisions

Tract Median Income

- Greater than $63,000
- Between $45,000 and $63,000
- Less than $45,000

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, 2020 Census Tracts, Nov. 2021 and 2020 Census County Divisions, Nov. 2021.

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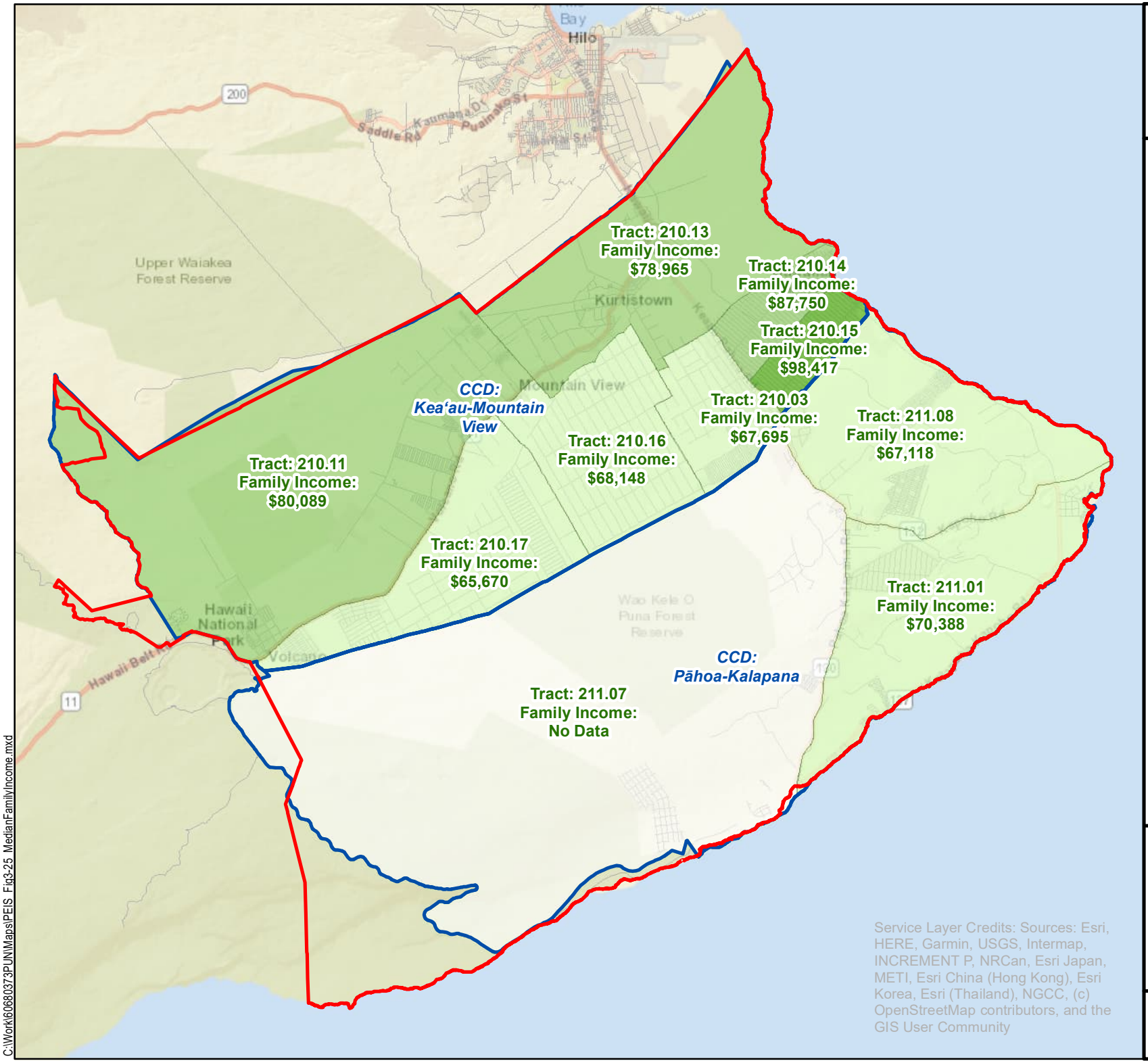

FIGURE 3-25

MEDIAN MARRIED-COUPLE FAMILY INCOME

Legend

- Project Area
- Roads
- 2020 Census County Divisions

Tract Family Income

- No Data
- Greater than $88,000
- Between $77,000 and $88,000
- Less than $77,000

Sources: County of Hawai'i, 2011 Puna Community Development Plan; Hawai'i Statewide GIS Program, 2020 Census Tracts, Nov. 2021 and 2020 Census County Divisions, Nov. 2021.

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Reflecting the lower incomes in the two CCDs, the proportion of persons in poverty in the Project Area was higher than in the County, which in turn was higher than the poverty rate in the State overall (Table 3-22). Across all measures of income—i.e., median household, median family, and per capita—incomes were lower in in Pāhoa-Kalapana CCD than in Kea'au-Mountain View CCD and, accordingly, poverty rates were higher. Importantly, poverty rates do not account for living costs beyond very basic food budgets, with the poverty threshold being three times the cost of a minimum food diet in 1963 (Creamer et al. 2022), and therefore do not adequately gauge the economic self-sufficiency of populations.

3.14.1.3 SELF-SUFFICIENCY

To evaluate the economic self-sufficiency of the Project Area population, the numbers of households with incomes below and the number with incomes above the United Way Asset Limited, Income Constrained, Employed (ALICE) Threshold were determined. ALICE represents households with income above the Federal poverty level but below the basic cost of living.

The ALICE Threshold is the average income that a household needs to afford the basic necessities defined by the Household Survival Budget (Aloha United Way 2020a). In turn, the Household Survival Budget estimates the actual bare-minimum costs of basic necessities, comprising housing, child care, food, transportation, health care, and a basic smartphone plan. For Hawai'i County, the 2018 Household Survival Budgets for households comprising people under age 65 and households comprising people age 65 or over are $60,000 and $50,000, respectively (Aloha United Way 2020b).

Table 3-23 compares, for the Project Area, the ALICE Thresholds and associated household data from USCB 2014-2018 American Community Survey 5-Year Estimates, as reported in the ALICE in Hawai'i Excel workbook (Aloha United Way 2020b). Approximately 36.6 percent of households in Kea'au-Mountain View CCD and 40.4 percent of households in Pāhoa-Kalapana CCD were ALICE households—i.e., households earning above the Federal poverty limit but not enough to afford basic household necessities. In the Kea'au-Mountain View and Pāhoa-Kalapana CCDs, the number of ALICE households exceeded the number of households in poverty by 81.9 percent and 58.6 percent, respectively.

Table 3-23. ALICE Households

Geographic Area	Total Households[1]	Households in Poverty[1]	ALICE Households	Above-ALICE Households
Kea'au-Mountain View CCD	12,532	2,524	4,590	5,418
Pāhoa-Kalapana CCD	4,495	1,146	1,818	1,531

Source: Aloha United Way 2020b.

[1] USCB 2014-2018 American Community Survey 5-Year Estimates, Aloha United Way 2020b.

Another benchmark of self-sufficiency is the Massachusetts Institute of Technology Living Wage Calculator. As a measure of basic needs, the living wage model draws upon geographically-specific expenditure data related to a family's likely minimum food, childcare, health insurance, housing, transportation, and other basic necessities costs, and the effects of income and payroll taxes (Glasmeier and the Massachusetts Institute of Technology 2022). The cost elements and tax measures are used to determine a minimum subsistence wage—the minimum employment earnings necessary to meet basic needs and maintain self-sufficiency.

The Living Wage Calculator estimates the living wage needed to support one-adult families, two-adult families in which one adult is in the workforce, and two-adult families in which both adults are in the workforce. To enable comparison with the USCB median married-couple family income presented in Table 3-22, Figure 3-26 provides living wage data for two-adult families with zero to three children, and the following adjustments were made to the living wages reported by Glasmeier and the Massachusetts Institute of Technology 2022 for Hawai'i County:

- The living wage was converted from the hourly rate to the annual rate that an individual in a household must earn to support his or herself and their family, assuming working full-time year-round, 40 hours per week for 52 weeks.
- In the case of households with two working adults, wages per working adult were converted to the combined wage for both working adults.

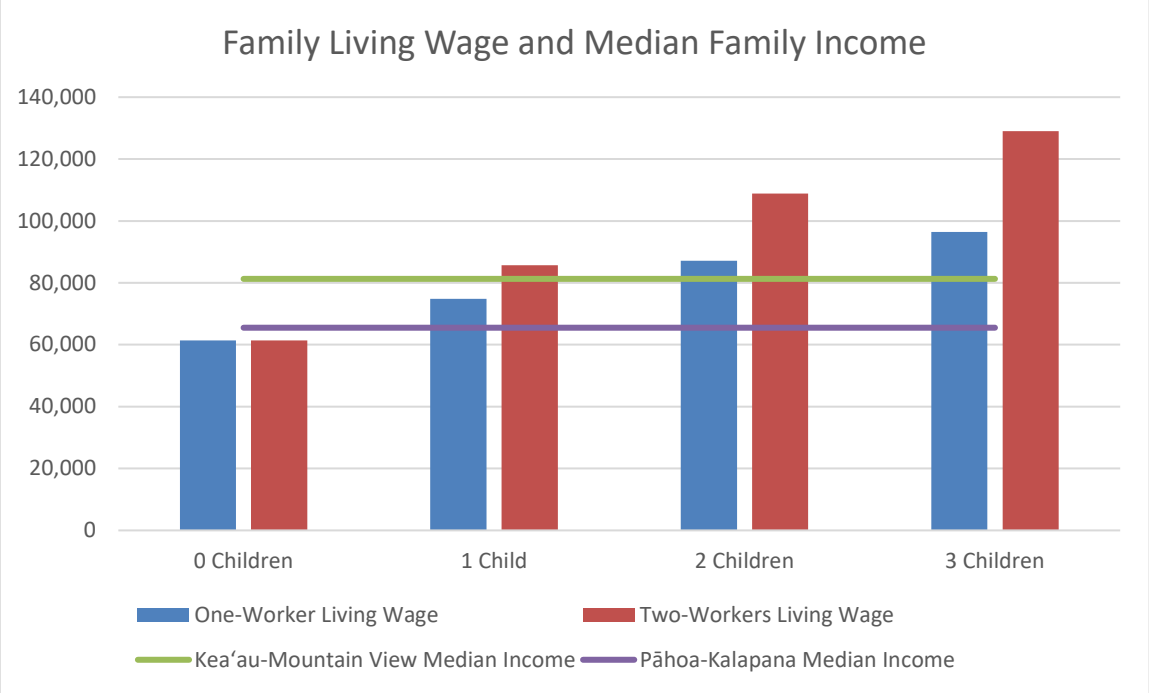


Figure 3-26. Two-Adult Family Living Wage and Median Married Couple Family Income

For two-adult families in which one adult is in the workforce with two or three children, and two-adult families in which both adults are in the workforce with one, two, or three children, the living wages presented in Figure 3-26 exceed the median married couple family income shown in Table 3-22 for both Kea'au-Mountain View CCD and Pāhoa-Kalapana CCD. The living wage for two-adult families in which one adult is in the workforce with one child also exceeds the median married couple family income for Pāhoa-Kalapana CCD.

The median married-couple family income presented in Table 3-22 divides the income distribution into two equal groups, one having incomes above the median and the other having incomes below the median (USCB 2022b). Therefore, the noted living wage exceedances of the median married couple family incomes indicate that at minimum half of the subject families in the respective CCDs are not earning the minimum necessary to meet basic needs and maintain self-sufficiency.

3.14.2 Potential Environmental Consequences and Mitigation Measures

Proposed Action Alternatives 1B, 2/3, 4/5, and 6/7 would construct and operate decentralized wastewater systems, subregional wastewater systems, or a regional wastewater system to accommodate flows through 2052, at an estimated capital cost of $3.9 billion to $11.5 billion. For comparison, the estimated capital cost of upgrading or converting all cesspools in the Project Area to wastewater systems approved by DOH, or connecting them to existing sewer systems, without the provision of County wastewater infrastructure and services—i.e., the cost of Alternative 1A—would be approximately $2.7 billion. The estimated costs of implementing the alternatives may be updated or further refined as the facility plan is finalized.

The capital cost estimates of the Proposed Action alternatives, as well as the estimate for Alternative 1A, are substantially higher than the earlier estimate of the total cesspool conversion cost for the entire State of Hawai'i. With respect to converting cesspools across the State, according to the *Cesspool Conversion Finance Research Summary Report* (Carollo 2021):

> Historical costs of cesspool upgrades to approved systems range widely from approximately $9,000 to $60,000 or more depending on the wastewater system capacity (based on bedroom count), technology, and location or site constraints.[5] Assuming an average conversion cost of $23,000, the potential magnitude of the financial burden to convert all 88,000 cesspools is over two billion dollars.[6]

[5] Based on cost data from DOH.

[6] Costs shown in 2020 dollars.

The higher cost estimates for the Proposed Action are attributed to the following factors:

- As noted in the quote above, the Statewide estimate assumes an average conversion cost within the range of historical costs and excludes location or site constraints. Due to the prevalence of underlying rock and high groundwater across most of the Project Area, and the need to transport gravel for use in construction, the Proposed Action estimates result in conversion costs more representative of the higher end of the range.
- The Statewide estimate only accounts for conversion of existing cesspools. The Proposed Action estimates also account for constructing and operating wastewater infrastructure to accommodate future growth to 2052, inflating the number of households and businesses served in the Project Area by approximately 56 percent.
- The Statewide estimate excludes engineering, permitting, and land acquisition (Carollo 2020). The Proposed Action estimates include a 20 percent allowance for project services (i.e., preliminary design, final design and permitting, construction engineering and inspection, and legal and fiscal expenses) and land acquisition costs, as well as a 20 percent contingency to account for uncertainties and undefined work as the project proceeds.

3.14.2.1 CONSTRUCTION

The cost and the economic impacts of Proposed Action construction would vary substantially depending on the alternative constructed and, for Alternatives 4/5 and 6/7, the extent to which the constructed wastewater system would accommodate wastewater from dispersed development and rural areas. Costs also would vary depending on the eventual timing and phasing of construction, and construction expenditures and therefore the resulting effects would vary from year to year.

The construction expenditures would result in one-time increases in economic output, employment, and earnings, and one-time increases in fiscal revenues of the State. The economic impacts of Proposed Action construction would include the impact of expenditures on construction materials, and on earnings of construction workers and professional service providers during the construction period, as well as the impacts of those changes on the overall economy of the Puna District and Hawai‘i County.

The construction industry in the Hawai‘i County is projected to grow, both on the short-term and on the long-term (Table 3-24), with the mining and construction sector projected to expand by an estimated 1,250 jobs between 2020 and 2045, at an annualized rate of approximately 0.7 percent. Nonetheless, the current and projected future County construction labor force might not be sufficient to fill the Proposed Action demand for construction workers, as well as ongoing and future regional demand. In its *Final Report to the 2023 Regular Session Legislature*, the Cesspool Conversion Working Group (DOH 2022) acknowledged uncertainty as to whether there will be an adequate engineering, materials supply chain, and construction contractor workforce available to meet cesspool conversion program

needs, especially if the number of conversions is more concentrated in the latter part of the compliance period. Although economic impacts likely would disproportionately benefit Hawai‘i County residents, impacts would accrue to local, County, and off-island residents to varying degrees, depending on the relative capacities of the Project Area, Hawai‘i County, and State of Hawai‘i construction labor forces.

Table 3-24. Hawai‘i County Civilian Mining and Construction Jobs, 2016-2045

Geographic Area	2016	2020	2025	2030	2035	2040	2045
Mining and construction	6,690	7,020	7,340	7,660	7,860	8,060	8,270

Source: DBEDT 2018, DBEDT 2045 Series Appendix Tables (spreadsheet).

Employment growth is beneficial to an economy, and expansion of the industry base results in economic benefits on the region. Socioeconomic concerns would materialize if expansion were to occur in a short time frame or if other aspects of the economy also undergo a rapid expansion during the same time period. Possible labor shortages could occur, resulting in a rise in labor costs and ultimately a rise in overall construction costs. However, the market would respond to a shortage with new workers entering the construction industry from other industries or new workers coming from outside the region to fill available jobs. If new workers were to enter the region in response to a construction labor shortage, the households that relocate to the Project Area would need a supply of housing, to which the local economies likely would respond by increasing the supply.

Overall, construction effects from the Proposed Action would be largely beneficial, providing short- and long-term regional economic benefits from construction spending and labor, as well as positive effects on employment and income in the region. However, upgrading or converting cesspools to a wastewater system approved by DOH, or connecting to a sewer system will be costly for homeowners and businesses.

According to the *Cesspool Conversion Finance Research Summary Report* (Carollo 2021), based on cost data from DOH, historical costs of cesspool upgrades to approved systems range widely from approximately $9,000 to $60,000 or more depending on the wastewater system capacity, technology, and location or site constraints. In Hawai‘i, installation of a septic system costs an estimated $20,000 to $50,000, and enhanced systems cost an addition $5,000 to $10,000 (Calabretta 2022). For many households, such costs would be prohibitive. Additionally, although the County would construct the wastewater collection system under Alternative 1B, and the County wastewater system under Alternatives 2/3, 4/5, and 6/7, the households and businesses that connect to the system ultimately would pay a major portion of the cost.

As shown in Table 3-23, approximately 2,520 households in Kea‘au-Mountain View CCD and 1,150 in Pāhoa-Kalapana CCD were households in poverty in 2018. An additional 4,590 households in Kea‘au-Mountain View and 1,820 in Pāhoa-Kalapana

were ALICE households. Similarly, as discussed in Section 3.14.1.3 and depicted in Figure 3-26, numerous families in both CCDs are earning incomes below the living wage for Hawai‘i County. These data indicate that large numbers of households and families in the Project Area purportedly are not earning the minimum necessary to meet basic needs and maintain self-sufficiency. Therefore, they likely will be financially burdened by the costs of upgrading or converting cesspools, or connecting to sewer systems under any of the alternatives evaluated in this programmatic draft environmental impact statement (PDEIS), including the no action alternative, Alternative 1A.

Act 125 (2017) directed DOH to work in collaboration with the State of Hawai‘i Department of Taxation to assess the feasibility of a grant program to assist low-income property owners with cesspool upgrade, conversion, or connection. Act 132 (2018) designated objectives for the Cesspool Conversion Working Group, including the following relating to the cost of cesspool conversion and of connecting existing cesspools to a sewer system:

- Examine financing issues and the feasibility of various mechanisms for accomplishing and funding cesspool conversion;
- Consider owners' ability to pay for cesspool conversion, and especially how assistance can be provided for lower-income homeowners;
- Consider the most cost-effective approach to cesspool conversion; and
- Identify physical, practical, and financial impediments that may be encountered by land owners who are required to connect pre-existing cesspools to a sewer system or convert cesspools to an individual waste treatment system, and recommend solutions to those impediments.

The Cesspool Conversion Working Group (DOH 2022) recommends developing robust funding and financing options to assist low- and moderate-income homeowners to finance conversions, as well as incentives for cesspool conversion for all homeowners. The working group likewise recommends maximizing the use of available Federal, State, and local funding to implement conversion, and providing tax credits and rebates for upgrade and connection costs.

3.14.2.2 OPERATION

With operation of Alternatives 2/3, 4/5, or 6/7, an increase in DEM personnel is anticipated, although the size of that increase would vary substantially depending on the alternative constructed and, for Alternatives 4/5 and 6/7, the extent to which the constructed wastewater system would accommodate wastewater from dispersed development and rural areas. The scale of the increase in personnel is undetermined at this time. In turn, however, the increase in personnel potentially would negligibly affect demographics and the demand for housing, and negligibly alter the housing inventory.

Annual expenditures from operations of the Proposed Action would result in ongoing increases in economic output, employment, and earnings, and ongoing increases in

fiscal revenues. Taken as a whole, operation effects from the Proposed Action would be largely beneficial, providing short- and long-term regional economic benefits from operation- and maintenance-related spending and labor, and positive effects on employment and income in the region. However, similar to upgrading or converting cesspools, or connecting to a sewer system, operating and maintaining septic systems will be costly for homeowners and businesses, as will be contributing, as bill payers, to the cost of operating and maintaining a County wastewater system. Although the County would operate the County wastewater system under Alternatives 2/3, 4/5, and 6/7, the households and businesses that connect to the system ultimately would pay a major portion of the cost.

The data detailed in Section 3.14.1.3 and briefly outlined in Section 3.14.2.1 indicate that large numbers of households and families in the Project Area purportedly are not earning the minimum necessary to meet basic needs and maintain self-sufficiency. Therefore, they likely will be financially burdened by the operation and maintenance costs associated with owning septic systems or being connected to sewer systems under any of the alternatives evaluated in this PDEIS, including the no action alternative, Alternative 1A.

4.0 CUMULATIVE AND SECONDARY IMPACTS

According to Hawai‘i Administrative Rules (HAR) Chapter 200.1, cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The Proposed Action, when considered in conjunction with past, present, and reasonably foreseeable future actions to the environment, may result in cumulative impacts. Below is a summary of known conceptual and underway development. A review of potential cumulative and secondary impacts of the Proposed Action and other development is also provided.

4.1 PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE PROJECTS

This section summarizes several larger-scale development projects in the Project Area that have the potential to contribute to cumulative impacts.

Kea‘au Village Master Plan

The Kea‘au Village Master Plan conforms to the existing Kea‘au Village area with a walkable, transit-friendly, regional town center concept. The master plan area infills lands adjacent to the existing Kea‘au Village, linking, Kea‘au Elementary, Kea‘au High School and Kea‘au Middle School. The master plan could eventually add 940± single-family dwelling units, village mixed-use commercial and residential areas, and approximately 14.9 acres of regional commercial land. The residential land use types would include Single Family Residential at 3 to 7 units per acre, Multifamily Residential of up to 25 units per acre, Village Mixed-Use at 7 units per acre for single family, and 35 units per acre for multifamily housing. Commercial use would be located on the west side of Volcano Highway and addresses the W.H. Shipman, Ltd longer-term vision for a regional commercial center that can expand as the community grows. The master plan includes multi-modal greenways, parks, road improvements, a wastewater treatment plant, water facilities, and other supporting infrastructure. Additionally, the master plan identifies a 3.6-acre Well/Tank Site south of the Master Plan Area that could be used for possible expansion of well and tank facilities around an existing County of Hawai‘i, Department of Water Supply well and reservoir. The Hawai‘i County General Plan and the Puna Community Development Plan both anticipated this build-out of Kea‘au Village, and the master plan proposal is now being reviewed through an environmental assessment process.

Pāhoa Transit Hub and Co-located Library

The Mass Transit Agency and Hawai‘i State Public Library System are in the process of site selection and conceptual design for a transit hub with a co-located library in Pāhoa, slated to be completed by early 2023. Hawai‘i Revised Statutes (HRS) Chapter 343 Environmental Assessment is scheduled to begin in February 2023. The initial concept for the library includes 8,000 square feet of enclosed air-conditioned space and 1,000 square feet for an indoor/outdoor activity area. A new design concept for the library hinges upon where the transit hub will be sited. The library will be located adjacent to a proposed transit hub that will connect low-income residents to jobs, amenities, and other opportunities that were not accessible in the past.

Pāhoa Waterline Improvements

The County of Hawai‘i Department of Water Supply is proposing to install new waterlines along Pāhoa Village Road and Post Office Road in Pāhoa. Planning, Design, and Environmental status are not started yet. HRS Chapter 343 Environmental Assessment has not started yet either.

Pāhoa Roadway Improvements

The Hawai‘i Department of Transportation (HDOT) has proposed intersection improvements along Kea‘au-Pāhoa Road (SR 130) to include the construction of a compact roundabout at Orchidland Drive and Mau‘u Drive. HDOT previously completed a compact roundabout at ‘Āinaloa Boulevard. Final design was completed in September 2020 with a National Environmental Policy Act Categorical Exclusion process (determined the proposed action does not individually or cumulatively have a significant effect on the human environment) completed in July 2021.

Transit-Oriented Development (TOD) Projects

The County of Hawai‘i has identified a goal for mass transit on Hawai‘i to make riding transit more desirable and easier, making it responsive to the needs of transit-dependent individuals, youth, seniors, individuals with disabilities, and low-income populations. This goal is consistent with developing the areas surrounding transit centers as TOD areas, consistent with the TOD goals of the State, with the transit hubs becoming significant influences on land use development.

The Hawai‘i island community is unified in understanding the need to:

- Direct growth and increase density towards urban and village centers, and to infill the underutilized areas between existing urban and village centers;
- Focus and prioritize future investments in new infrastructure that will facilitate the opportunity to direct growth to the designated urban areas;
- Discourage sprawl outside of designated urban centers;
- Provide Multimodal transportation to and within urban and village centers; and
- Encourage a mix of uses to build livable communities that provide residents with opportunities for employment near affordable housing, together with access to commercial and recreational opportunities.

4.2 POTENTIAL CUMULATIVE AND SECONDARY IMPACTS

4.2.1 Surface and Groundwater Quality and Ecology

The Proposed Action would underpin upgrading or converting cesspools to a wastewater system approved by the State of Hawai'i Department of Health (DOH), or connecting to a sewer system, as required by Act 125 of 2017 as amended by Act 87 of 2022. By replacing the use of cesspools and other outdated, substandard wastewater disposal methods with centralized water treatment systems and updated individual wastewater systems (IWSs), the Proposed Action is expected to improve groundwater and surface water quality within the Project Area, and reduce risks to human health and the environment. The discharge to the environment of untreated wastewater—containing pathogens, bacteria, and viruses that may spread disease, and nutrients that can disrupt sensitive aquatic ecosystems, including harming nearshore coral reefs—would be substantially reduced.

4.2.2 Infrastructure and Utilities

The Proposed Action may contribute cumulative and secondary impacts to water resources, water and wastewater infrastructure, and solid waste disposal. The additional wastewater infrastructure that the Proposed Action would provide would enable increased growth, which would increase the demand for water and the burden on drinking water infrastructure. However, the improvements to the sewage treatment and disposal methods within the Project Area would replace outdated and substandard methods that pose a risk to human health and the surrounding environmental resources, which would result in a positive impact to the service area. The proposed wastewater systems thereby would mitigate ongoing contamination and avoid future contamination of water resources and drinking water wells by cesspool discharge.

The Proposed Action would increase capacity of the wastewater conveyance system and result in increased discharge of wastewater effluent and generation of wastewater solids. During construction of the Proposed Action, the volume of construction waste would increase.

The expanded infrastructure would also potentially have greater maintenance, repair, and replacement costs.

More wastewater collection, treatment, and disposal infrastructure and capacity would require more power. Thus, the Proposed Action would likely increase greenhouse gas (GHG) emissions. GHG emissions associated with the Proposed Action would be analyzed when sufficient, project-specific design details are available.

4.2.3 Increased Development and Population

Increased population growth, population density, and development are anticipated long-term, and there could be cumulative impacts associated with increased wastewater capacity provided by the Proposed Action and increased future demand associated with planned and conceptual development.

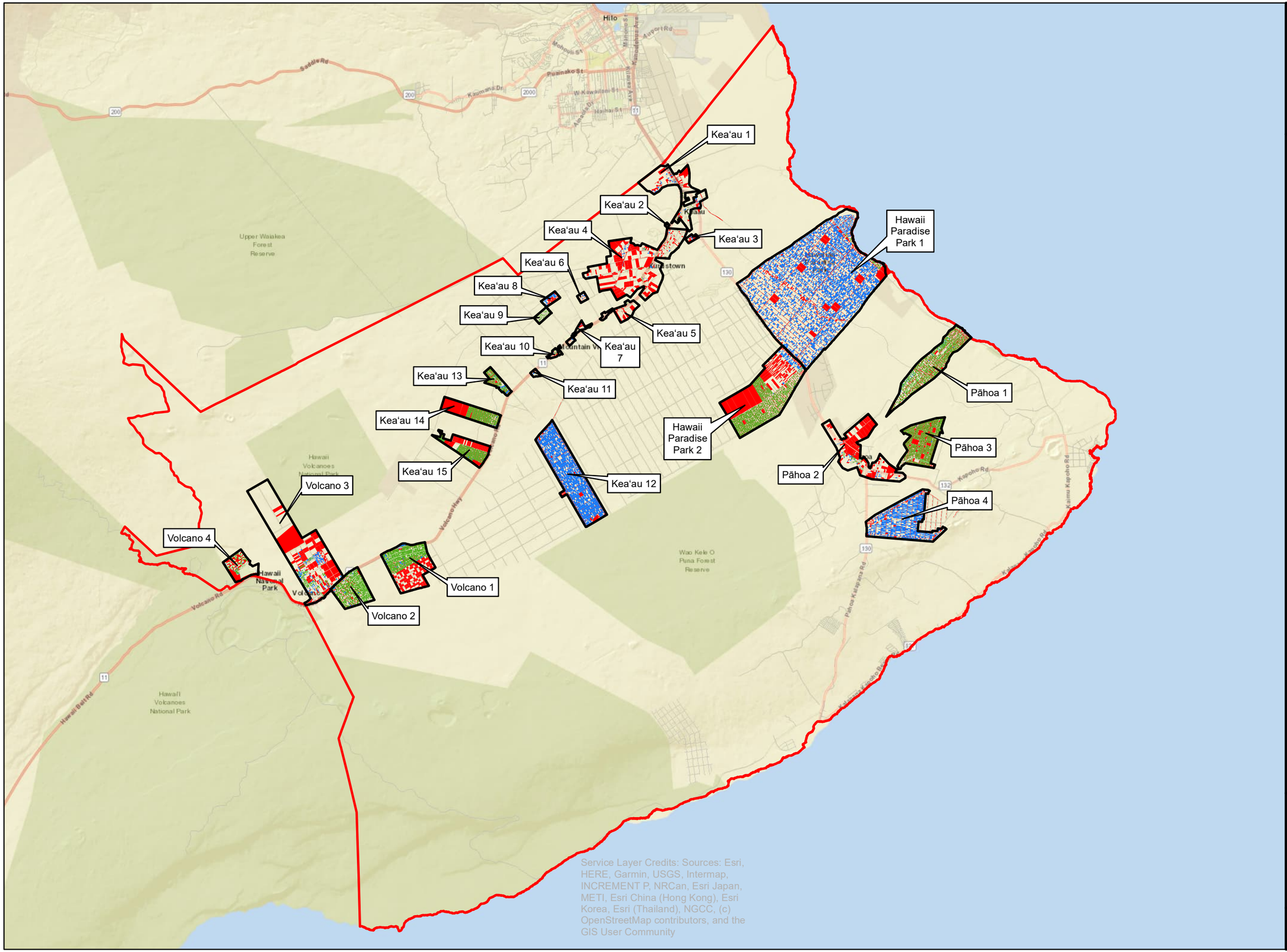
Increased development would result in increased impervious surfaces, which may increase nonpoint source pollution and stream temperature. Buildings and paved surfaces could also contribute to the urban heat island effect, impacting localized air temperature. The footprint of proposed subregional wastewater treatment plants (WWTPs), a regional WWTP, or expansion of the Hilo WWTP would create increased impervious areas and would require stormwater management. While the footprint of the wastewater pump stations would not create a substantial amount of increased impervious surface area, the pump stations likewise would require stormwater management. At a regional scale, the effect of supporting greater development and associated impervious surfaces may impact flood vulnerability in both coastal and inland areas.

Secondary impacts of greater population density and infrastructure include increased potential damage to property and risk of injury or death during an earthquake, tsunami, or other storm or extreme weather event. Increased coastal development in areas that are vulnerable to sea level rise and coastal hazards would likely result in an increase in economic impacts associated with flood damage to properties.

Increased development may have long-term, cumulative impacts to aesthetic and visual resources. Dense development may impact views of volcanoes and coastal vistas.

While increased population density and development would increase stress on natural systems by adversely impacting ecosystems and their biological components, the Proposed Action wastewater infrastructure would be located within and adjacent to areas that are already developed, thus limiting the pressure to expand development into forests and agricultural land. Furthermore, there are limited impacts to open space associated with the Proposed Action.

Based on visual observations during October 2022 and data illustrated in Figure 4-1 for Alternatives 1B, 2/3, 4/5, and 6/7, proposed private and County wastewater service areas have varying proportions of parcels that currently are not occupied by residential structures, especially in sections more distant from the State-numbered roads on which the service areas front. For the purposes of this analysis, these parcels currently not occupied by residential structures are assumed to be vacant and available for future residential development.



Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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FIGURE 4-1

SERVICE AREA UNOCCUPIED PARCELS

Legend

- Project Area
- Roads
- Service Areas

Parcels without Structures

Size in Acres

- Less than 0.5
- Between 0.5 and 1.0
- Greater than 1.0

Sources: County of Hawai'i, 2011 Puna Community Development Plan, Real Property Tax Office data extract Oct 2022.

N

0 8,000 16,000 Feet

AECOM
1001 Bishop St. STE 1600
Honolulu, HI 96813

A total of approximately 21,200 unoccupied parcels are present on the 25 service areas shown on Figure 4-1. The number of parcels ranges from 5 parcels in one of the service areas to approximately 3,620 parcels in another. The sizes of the unoccupied parcels vary greatly between service areas, with the mean sizes ranging from about 0.2 to 5.9 acres, and the median sizes ranging from about 0.2 to 1.6 acres. The sizes of the unoccupied parcels in each service area are represented graphically in the figure, categorized into three size classes, as follows:

- Less than 0.5 acres, comprising approximately 66 percent of the parcels;
- 0.5 to 1.0 acres, comprising approximately 28 percent; and
- Greater than 1.0 acre, comprising approximately 6 percent.

The presence and especially abundance of unoccupied parcels indicates that the service areas potentially will support future residential development. This potential would be bolstered by the proposed provision of County wastewater infrastructure and services in these locations, as well as the possible provision of other public services including County water and public transit. Residential development in these locations would favor low-density, dispersed development, or urban sprawl, where it occurs on large parcels on or beyond the urban margin. Conversely, provision of wastewater infrastructure and services to smaller parcels, in existing residential areas in more urban settings would favor urban, residential infilling and thereby potentially would slow urban sprawl.

4.2.4 Transportation

The impact of additional development would have implications for transportation infrastructure. Increased development would increase the number of trips, miles traveled on roadways, and demand for new transportation infrastructure. As a result, there could be increased transportation construction and maintenance needs and costs.

Implementation of Alternatives 1B, 2/3, 4/5 or 6/7 could act as a catalyst to support transit-oriented development in the Puna District by allowing greater development density. However, to the extent that the provision of County wastewater infrastructure and services occurs on larger parcels on or beyond the urban margin, and thereby favors urban sprawl, the Proposed Action could undermine the objectives of transit-oriented development. Focusing the provision of wastewater services on smaller lots, closer to major transportation routes and especially transit routes, and within or adjacent to existing, developing, and planned urban centers would bolster transit-oriented development, as well as urban infilling.

4.2.5 Socioeconomic Impacts

The Proposed Action would support development of new housing options, commercial and industrial space, transportation options, and recreational and cultural amenities. Thus, it is anticipated that the overall impact of the Proposed

Action and other proposed development would have a positive impact on local socioeconomic conditions.

Ongoing and future construction in the region would provide local jobs to construction workers. As discussed in Section 3.14.2.1, the existing labor force may not be sufficient to support all proposed development in the region. If new workers were to enter the region in response to a construction labor shortage, the households that relocate to the Project Area would need a supply of housing, to which the local economies likely would respond by increasing the supply.

Both construction and operation effects from the Proposed Action would be beneficial, providing regional economic benefits from construction spending and labor, as well as long-term positive effects on employment and income in the region.

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5.0 RELATIONSHIP TO PLANS, POLICIES, AND CONTROLS

5.1 STATE OF HAWAIʻI PLANS AND POLICIES

The State of Hawai'i maintains a statewide planning system that includes State and County land use plans, policies, and controls to provide standards and guidelines for development. At the State level, this programmatic draft environmental impact statement (PDEIS) assesses the Proposed Action's compliance and consistency with the Hawai'i Environmental Policy Act (HEPA), Coastal Zone Management (CZM) Program, State Land Use Classification, Hawai'i State Plan (HSP), Hawai'i 2050 Sustainability Plan, and State Functional Plans. Appropriate plans, policies, and controls to assist in evaluating the options to best meet future needs are referenced below.

5.1.1 Hawai´i Environmental Policy Act (HEPA)

The HEPA outlines the process of environmental review for the State and counties. HEPA is codified in Hawai'i Revised Statutes (HRS) Chapter 343 and implemented through Hawai'i Administrative Rules (HAR) Title 11, Chapter 200.1. The review ensures that environmental concerns are appropriately considered in decision-making. For the Proposed Action, an environmental review is required because the action involves the following:

> (1) Proposed use of county lands and use of county funds, other than funds to be used for feasibility or planning studies for possible future programs or projects that the agency has not approved, adopted, or funded, or funds to be used for the acquisition of unimproved real property (HRS 343-5(a)(1)).
>
> (9)(A) Proposed wastewater treatment unit, except an individual wastewater system or a wastewater treatment unit serving fewer than fifty single-family dwellings or the equivalent (HRS 343-5(a)(9)(A)).

This PDEIS was prepared in accordance with all applicable provisions from both HRS Chapter 343 and HAR Title 11, Chapter 200.1.

5.1.2 Coastal Zone Management Act

Per the National Coastal Zone Management Act of 1972, Hawai'i's CZM Program outlines objectives and policies to guide the effective management, beneficial use, protection, and development of the coastal zone. The entire State of Hawai'i is located within the jurisdiction of the CZM Program. Hawai'i's CZM Program was established through HRS Chapter 205A. The objectives and policies in HRS Chapter 205A-2 were reviewed, and it has been determined that the Proposed Action is consistent with the objectives and policies of Chapter 205A-2 to the maximum extent practicable.

Table 5-1 lists applicable objectives and policies of the HRS Chapter 205A-2, followed by a discussion of the consistency of the Proposed Action with them. Where an Objective and Policy section of HRS Chapter 205A-2 is not listed below, it has been analyzed and determined to be not applicable to the Proposed Action.

Table 5-1. Coastal Zone Management Act HRS Chapter 205A

C=Consistent; N/C=Not Consistent; N/A=Not Applicable

Recreational Resources			
Objective: (A) Provide coastal recreational opportunities accessible to the public.			
Policies:	**C**	**N/C**	**N/A**
(A) Improve coordination and funding of coastal recreational planning and management.			X
(B) Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:			
(i) Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;			X
(ii) Requiring replacement of coastal resources having significant recreational value including, but not limited to, surfing sites, fishponds, and sand beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the State for recreation when replacement is not feasible or desirable;			X
(iii) Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;			X
(iv) Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;	X		
(v) Ensuring public recreational uses of county, state, and federally owned or controlled shoreline lands and waters having recreational value consistent with public safety standards and conservation of natural resources;			X
(vi) Adopting water quality standards and regulating point and nonpoint sources of pollution to protect, and where feasible, restore the recreational value of coastal waters;			X
(vii) Developing new shoreline recreational opportunities, where appropriate, such as artificial lagoons, artificial beaches, and artificial reefs for surfing and fishing; and			X
(viii) Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the land use commission, board of land and natural resources, and county authorities; and crediting such dedication against the requirements of section 46-6.			X

Discussion: As discussed in Section 3.8.2, temporary impacts to recreational resources may include noise and viewshed impacts associated with temporary construction impacts of the branch sewers. Some parks such as ʻĀinaloa Community Park, Shipman Park, Hawaiʻi Volcanoes National Park may be impacted by the construction of low-pressure sewers, force mains, interceptor sewers, and pump stations for each of the alternatives, except Alternative 1A. Temporary noise and impacts to the viewshed of Volcano Golf course, and Country Club, community, state, and county recreational facilities that are adjacent to the project site may occur, however, direct impacts are not anticipated. A temporary easement from the Department of Parks and Recreation may be required during Construction for the installation of the temporary bypass pumping system and access for construction. Minimal impacts to public access may occur during construction. None of the proposed pump stations or wastewater treatment plants (WWTPs) are located within the boundaries of a park or recreational facility. Therefore, no long-term impacts to recreational resources, including those in coastal areas, are anticipated as a result of the Proposed Action.

Historic Resources

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

Policies:	**C**	**N/C**	**N/A**
(A) Identify and analyze significant archaeological resources;	X		
(B) Maximize information retention through preservation of remains and artifacts or salvage operations; and	X		
(C) Support state goals for protection, restoration, interpretation, and display of historic resources.	X		

Discussion: Discussion: Significant archaeological resources are identified in Section 3.7 of this PDEIS. An Archaeological Literature Review was prepared for the Project Area by Cultural Surveys Hawaiʻi, Inc. and is included in Appendix A. The Literature Review summarizes previous archaeological work that has been conducted in the Project Area, archival sources, maps, Land Commission Awards, and other archaeological documentation.

A Historic Architectural Resources Supporting Study has been prepared to provide a preliminary desktop analysis of non-archaeological historic property types (buildings, structures, sites, objects, and districts) within the Project Area (Appendix B). Background research to support this study included a review of materials collected from online government sources and libraries, historical maps, and newspaper archives. Additionally, a Cultural Impact Assessment was prepared by Cultural Surveys Hawaiʻi, Inc. (Appendix C).

As discussed in Section 3.7, County of Hawai'i Department of Environmental Management (DEM) would provide the State Historic Preservation Division (SHPD) with the opportunity to review and comment on specific actions and would determine whether historic properties are present in any project-specific area(s). Any historic properties would be inventoried. If DEM determines that significant historic properties would be affected and SHPD concurs, DEM would proceed to develop proposed mitigation commitments to be approved by SHPD in accordance with HAR §13-275-8(1).

In accordance with HRS Chapter 6E-43, prehistoric and historic burial sites would be preserved in place until the requirements of the statute are met.

An evaluation of cultural resources would follow the three-part process established by a Hawai'i Supreme Court decision in September 2000, *Ka Pa'akai O Ka 'Aina v Land Use Commission,* often referred to as a "Ka Pa'akai Analysis."

Scenic and Open Space Resources			
Objective: (A) Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.			
Policies:	**C**	**N/C**	**N/A**
(A) Identify valued scenic resources in the coastal zone management area;	X		
(B) Ensure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline;	X		
(C) Preserve, maintain, and, where desirable, improve and restore shoreline open space and scenic resources; and	X		
Policies:			
(D) Encourage those developments that are not coastal dependent to locate in inland areas.			X
Discussion: As discussed in Section 3.8, Hawai'i's natural and scenic beauty is identified as one of the most significant and valuable assets of the island. There are several natural beauty sites in the Puna District and two volcanic regions that are considered to be major areas of natural beauty: Kapoho and Pu'u 'Ō'ō volcanic regions. Construction of the wastewater treatment infrastructure may have short-term impacts on the visual aesthetics of the area. Temporary viewshed impacts associated with construction of branch sewers and pump stations may primarily impact residential homes in the communities and subdivisions that the infrastructure will serve. During construction, fencing surrounding construction sites may be provided as needed to provide a visual screen. Any construction impacts regarding visual aesthetics are expected to be short-term and would cease after construction. Above-grade infrastructure such as pump stations and WWTP would change the viewshed of the surrounding areas. However, landscaping around these facilities would mitigate any negative impact within a neighbourhood or tourist area.			

Coastal Ecosystems			
Objective: (A) Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.			
Policies:	**C**	**N/C**	**N/A**
(A) Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;	X		
(B) Improve the technical basis for natural resource management;			X
(C) Preserve valuable coastal ecosystems, including reefs, of significant biological or economic importance;	X		
(D) Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs; and			X
E) Promote water quantity and quality planning and management practices that reflect the tolerance of fresh water and marine ecosystems and maintain and enhance water quality through the development and implementation of point and nonpoint source water pollution control measures.	X		

Discussion: As discussed in Section 3.6 potential impacts to ecosystems would be reduced through mitigation measures. Two exceptional mango groves located within the Project Area would not be affected under any of the proposed alternatives. As individual projects are developed, appropriate environmental documentation will be completed, including project-specific biological surveys of habitats at or near the proposed construction. In addition, any construction mitigation requirements such as pre-clearing site surveys or limits on working hours to accommodate endangered or threatened species will be followed. If a project is located entirely within a built/paved environment, the need to conduct the biological survey will be evaluated. Any location where vegetation is disturbed would be restored to existing conditions or better, using native plant species for landscaping that are appropriate for the area.

Construction lighting should be shielded down and any night-time construction work that requires outdoor lighting should be avoided during the seabird fledgling season from September 15 through December 15 to mitigate any possible impacts. Locations that are suitable for Hawaiian waterbirds would be surveyed for nests prior to undertaking construction activities or vegetation clearing within 100 feet of these locations. Construction would be halted if a nest were found. If construction activities occur between August and April, the site should be surveyed for nesting nēnē. Green sea turtle and Hawaiian monk seal could potentially occur or haul out onshore within the vicinity of the proposed project site. If species are detected within 100 meters of the project area, all nearby construction operations would be stopped until the animal has departed the area on its own accord. Project-specific biological surveys will be conducted for each phase of the project to support the environmental impact statement. If a project is located entirely within a built/paved environment, the need to conduct the biological survey will be evaluated. Operation and maintenance are not anticipated to negatively affect flora or fauna.

The Proposed Action will reduce impacts to coastal ecosystems associated with nonpoint source pollution resulting from cesspools.

Economic Uses			
Objective: (A) Provide public or private facilities and improvements important to the State's economy in suitable locations.			
Policies:	**C**	**N/C**	**N/A**
(A) Concentrate coastal dependent development in appropriate areas;	X		
(B) Ensure that coastal dependent development and coastal related development are located, designed, and constructed to minimize exposure to coastal hazards and adverse social, visual, and environmental impacts in the coastal zone management area; and	X		
(C) Direct the location and expansion of coastal development to areas designated and used for that development and permit reasonable long-term growth at those areas, and permit coastal development outside of designated areas when: (i) Use of designated locations is not feasible; (ii) Adverse environmental effects and risks from coastal hazards are minimized; and (iii) The development is important to the State's economy.	X		
Discussion: The Proposed Action would provide efficient, technologically advanced, and resilient wastewater collection, treatment, and disposal infrastructure and services, primarily to town and village centers in the Project Area. The Proposed Action is needed to support the ongoing process of economic recovery in the Project Area, which has been impacted by the 2018 Kīlauea Eruption and Hurricane Lane, and the ongoing COVID-19 pandemic. It also is needed to reduce the risk to human health and the environment posed by reliance on dated, substandard sewage disposal methods for wastewater disposal in the Project Area. The purpose of the Proposed Action is to aid the economic recovery of the Project Area and Hawai'i County, and secondarily to contribute to the improvement of groundwater and surface water quality. Refer to Section 1.2 for a more detailed discussion.			

Coastal Hazards			
Objective: (A) Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.			
Policies:	**C**	**N/C**	**N/A**
(A) Develop and communicate adequate information about storm wave, tsunami, flood, erosion, subsidence, and point and nonpoint source pollution hazards;			X
(B) Control development in areas subject to storm wave, tsunami, flood, erosion, hurricane, wind, subsidence, and point and nonpoint source pollution hazards;	X		
(C) Ensure that developments comply with requirements of the Federal Flood Insurance Program; and	X		
(D) Prevent coastal flooding from inland projects.			X

Coastal Hazards
Discussion: As discussed in Section 3.5, construction of the Proposed Action would not increase the likelihood of natural hazards occurring. Appropriate mitigation measures, including designing to meet seismic, International Building Code, National Flood Insurance Program, and other federal, state, and County requirements would be implemented. After construction, the Proposed Action would operate under the same level of risk of all natural hazards. However, the impact from natural hazards would be alleviated by the application of the building code, grading ordinance, revegetation plan, emergency management operations protocol, and adherence to applicable standard operating procedures and best management practices (BMPs). The Proposed Action would not significantly increase or exacerbate risks to human health or property from natural hazards including potential 3.2-foot or 6-foot sea level rise.

Managing development			
Objective: (A) Improve the development review process, communication, and public participation in the management of coastal resources and hazards.			
Policies:	**C**	**N/C**	**N/A**
(A) Use, implement, and enforce existing law effectively to the maximum extent possible in managing the present and future coastal zone development;			X
(B) Facilitate timely processing of applications for development permits and resolve overlapping or conflicting permit requirements;			X
(C) Communicate the potential short and long-term impacts of proposed significant coastal developments earlier in their life cycle and in terms understandable to the public and facilitate public participation in the planning and review process.	X		
Discussion: As part of the development of this programmatic environmental impact statement (PEIS), an in-person public scoping meeting was held on October 12, 2022 and a virtual public scoping meeting was held on October 20, 2022. These meetings provided opportunities for agencies, citizens groups, and the general public to assist in determining the range of actions, alternatives, impacts and proposed mitigation measures to be considered and issues to be analyzed in the draft PEIS. Written comments on the programmatic environmental impact statement preparation notice (PEISPN) were accepted during the public comment period from September 23, 2022, through October 24, 2022. A final public comment period will be held in the spring of 2023 following the publication of the draft PEIS. Additional in-person engagement opportunities include Puna Community Development Plan Action Committee Meetings and the quarterly Revitalize Puna Community Activations.			

Beach and coastal dune protection			
Objective: (A) Protect beaches and coastal dunes for: (i) Public use and recreation; (ii) The benefit of coastal ecosystem			
(B) Coordinate and fund beach management and protection			
Policies:	**C**	**N/C**	**N/A**
(A) Locate new structures inland from the shoreline setback to conserve open space, minimize interference with natural shoreline processes, and minimize loss of improvements due to erosion;		X	
(B) Prohibit construction of private shoreline hardening structures, including seawalls and revetments, at sites having sand beaches and at sites where shoreline hardening structures interfere with existing recreational and waterline activities;			X
(C) Minimize the construction of public shoreline hardening structures, including seawalls and revetments, at sites having sand beaches and at sites where shoreline hardening structures interfere with existing recreational and waterline activities;	X		
(D) Minimize grading of and damage to coastal dunes;			X
(E) Prohibit private property owners from creating a public nuisance by inducing or cultivating the private property owner's vegetation in a beach transit corridor; and			X
(F) Prohibit private property owners from creating a public nuisance by allowing the private property owner's unmaintained vegetation to interfere or encroach upon a beach transit corridor.			X
Discussion: The specific locations of the proposed pump station footprints associated with Alternatives 2/3, 4/5, and 6/7 have not been determined. However, it is possible that the one of the proposed pump stations located in Hawaiian Paradise Park would be located within or in close proximity to the minimum 40-foot shoreline setback. The pump station would be located outside of the shoreline setback if feasible. Construction of shoreline hardening structures is minimized and limited to one potential pump station. This location does not coincide with sand beaches. The proposed pump station is nearby the Paradise Cliffs hiking trail and may have a limited impact on trails or views along the shoreline. Any impacts identified during the design phase would be mitigated through use of vegetation to screen the structure and re-routing any trails or walking paths.			

Based on the above discussion and as analyzed in the various chapters of this PEIS, is has been determined that the Proposed Action is consistent, to the maximum extent practicable, with the objectives and policies of the State CZM Program outlined in HRS 205A-2 and Revised Ordinances of Honolulu (ROH) Section 25.

5.1.3 State Land Use District

The Hawai‘i Land Use Commission administers the statewide zoning law under the authority granted by the State Land Use Law. The Land Use Commission regulates land use through land classification into one of four districts: Urban, Rural, Agriculture, and Conservation. The land classification system is intended to preserve,

protect, and encourage development and preservation of lands for those uses to which they are best suited in the interest of public health and welfare of the people (HAR Title 15, Chapter 15). Each district has specific land use objectives and development constraints.

The Project Area extends over portions of land within all of the four land use districts (Figure 5-1):

- Urban District – areas with "city-like" concentrations of people, structures and services and vacant areas for future development. Jurisdiction lies with the respective county through ordinances and rules.

  Uses that are permitted by the county are described in the Zoning Code (Section 5.2.4).

- Rural District – primarily small farms intermixed with low-density residential lots with a minimum size of one-half acre. Jurisdiction is shared by the Land Use Commission and county governments. Permitted uses include those relating or compatible to agricultural use and low-density residential lots. Variances can be obtained through the special use permitting process.

  Public, quasi-public, and public utility facilities are permitted within the Rural District.

- Agricultural District – land for the cultivation of crops, aquaculture, raising livestock, wind energy facility, timber cultivation, agriculture-support activities, and land with significant potential for agricultural uses. Uses permitted in the highest productivity agricultural categories (A, B) are governed by statute while those in lower productivity categories (C, D, E, U) are established by the Land Use Commission and include those allowed on A or B lands as well as those stated under HRS Section 205-4.5.

  Public, private, and quasi-public utility lines and appurtenant small buildings such as booster pumping stations are permitted within lands with productivity agricultural categories A, B, C, D, E, and U.

- Conservation District – primarily lands in existing forest and water reserve zones, including areas necessary for protecting watersheds and water sources, scenic and historic areas, parks, wilderness, open space, recreational areas, habitats of endemic plants, fish and wildlife, and all submerged lands seaward of the shoreline. Lands subject to flooding and soil erosion are also included. The district is administrated by the State Board of Land and Natural Resources and uses are governed by the State Department of Land and Natural Resources rules.

  Public Purposes, including water systems and other utilities, are permitted in the protective subzone, the limited subzone, and the resource subzone, of the Conservation District with a permit approved the by Board of Land and Natural Resources.

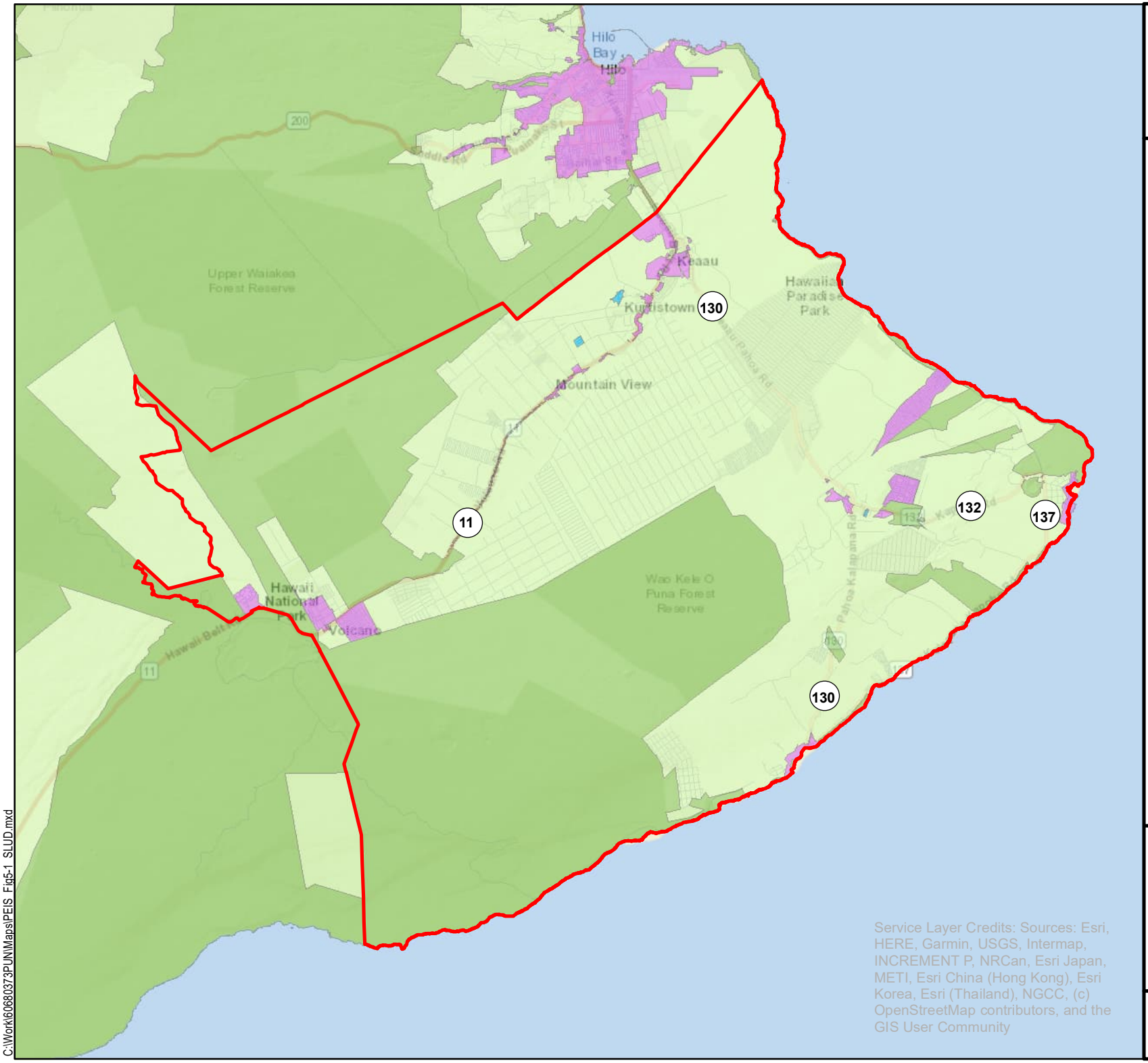

FIGURE 5-1

STATE LAND USE DESIGNATIONS

Legend

- Project Area
- Roads

State Land Use Designation

- Agricultural
- Conservation Land
- Rural
- Urban

Sources: State Land Use Designations, Hawai'i Statewide GIS Program, December 2020.

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AECOM
1001 Bishop St. STE 1600
Honolulu, HI 96813

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5.1.4 Hawai´i State Plan

The Hawai´i State Plan, as codified in Hawai'i Revised Statutes Chapter 226, provides guidance for future long-range development of the State by increasing coordination among different agencies and levels of government and providing a basis for determining priorities and allocation of resources.

The purpose of the Hawai'i State Plan, as defined in HRS Chapter 226, is to:

- Serve as a guide for the future long-range development of the State;
- Identify the goals, objectives, policies, and priorities for the State;
- Provide a basis for determining priorities and allocating limited resources, such as public funds, services, human resources, land, energy, water, and other resources;
- Improve coordination of Federal, State, and county plans, policies, programs, projects, and regulatory activities; and
- Establish a system for plan formulation and program coordination to provide for an integration of all major State, and county activities (HRS Title 13, Chapter 226).

The State plan outlines goals to achieve in order for present and future generations to obtain the elements of choice and mobility to ensure individuals and groups may approach their desired levels of self-reliance and self-determination. The goals include:

(1) A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawai'i's present and future generations.

(2) A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people.

(3) Physical, social, and economic well-being, for individuals and families in Hawai'i, that nourishes a sense of community responsibility, of caring, and participation in community life.

There are several objectives and policies of the Hawai'i State plan that include population, economy, physical environment, facility systems, socio-cultural advancement.

The object in planning for the State's population is to guide population growth with the following policies:

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

(2) Encourage an increase in economic activities and employment opportunities on the neighbor islands consistent with community needs and desires.

(3) Promote increased opportunities for Hawai‘i's people to pursue their socio-economic aspirations throughout the islands.

(4) Encourage research activities and public awareness programs to foster an understanding of Hawai‘i's limited capacity to accommodate population needs and to address concerns resulting from an increase in Hawai‘i's population.

(5) Encourage Federal actions and coordination among major governmental agencies to promote a more balanced distribution of immigrants among the states, provided that such actions do not prevent the reunion of immediate family members.

(6) Pursue an increase in Federal assistance for states with a greater proportion of foreign immigrants relative to their state's population.

(7) Plan the development and availability of land and water resources in a coordinated manner so as to provide for the desired levels of growth in each geographic area.

Discussion: The Proposed Action aligns with the goals and policies of the State plan. The Proposed Action is needed to support the ongoing process of economic recovery in the Project Area, which has been impacted by the 2018 Kīlauea Eruption and Hurricane Lane, and the ongoing COVID-19 pandemic. It also is needed to reduce the risk to human health and the environment posed by reliance on dated, substandard sewage disposal methods for wastewater disposal in the Project Area. The purpose of the Proposed Action is to aid the economic recovery of the Project Area and Hawai‘i County, and secondarily to contribute to the improvement of groundwater and surface water quality. The pollutants in untreated wastewater from cesspools are released to the environment, discharged at depths below the ground surface that bypass the potential for natural remediation of wastewater contaminants. In 2017, the Hawai‘i State Legislature passed Act 125, which required that by January 1, 2050 all cesspools in the State, unless granted exemption, shall upgrade or convert to a septic or aerobic treatment unit, or connect to a sewer system. In 2022, Act 125 was amended by Act 87, which expands the candidate individual wastewater systems (IWSs) to include any wastewater system approved by the State of Hawai‘i Department of Health (DOH). The Proposed Action will support both economic recovery and the requirement to upgrade from cesspool treatment, therefore improving wastewater management and mitigating contamination of water resources.

Refer to Section 1.2 for a more detailed discussion.

5.1.5 Hawai‘i State Functional Plans

State Functional Plans provide the framework for implementation of the Hawai‘i State Plan by establishing policies and guidelines for specific activities. State Functional Plans are developed by the agency responsible for the functional area,

with public input. Functional areas include agriculture, conservation lands, education, energy, higher education, health, historic preservation, housing, recreation, tourism, and transportation.

A review of the Functional Plans found that the plans are not applicable to the Proposed Action. While the Health Functional Plan does recognize that the disposal of wastewater and solid waste from urban areas is a problem, the plan does not have any policies or implementing actions that are applicable to the Proposed Action or to wastewater management in general.

5.1.6 Hawai‘i 2050 Sustainability Plan

Act 8 Special Session Laws of Hawai‘i 2005 established the Hawai‘i Sustainability Task Force and directed the Task Force to develop a Hawai‘i 2050 Sustainability Plan to address the vital needs of Hawai‘i through the year 2050 and beyond.

The Hawai‘i 2050 Sustainability Plan was published in 2008 by the State Auditor and the Hawai‘i 2050 Sustainability Task Force and served as a long-range plan for Hawai‘i to prepare for global warming, climate impact planning, and sustainability planning. The plan encourages the use of renewable energy, reducing Hawai‘i’s greenhouse gases, promoting water conservation and reuse, advocating for waste reduction, increasing Hawai‘i’s food security, supporting clean transportation, promoting pedestrian and bicycle accessibility, encouraging smart-growth, planning for sea level rise, stressing the need for affordable housing, encouraging a diversified economy, and supporting our indigenous Native Hawaiian culture.

Hawai‘i 2050 creates a long-term action agenda for achieving sustainability. The Plan defines a sustainable Hawai‘i as a Hawai‘i that:

- Respects the culture, character, beauty, and history of our state’s island communities;
- Strikes a balance among economic, social and community, and environmental priority; and
- Meets the needs of the present without compromising the ability of future generations to meet their own needs.

The plan has five goals:

- Living sustainably is part of our daily practice in Hawai‘i;
- Our diversified and globally competitive economy enables us to meaningfully live, work and play in Hawai‘i;
- Our natural resources are responsibly and respectfully used, replenished and preserved for future generations;
- Our community is strong, healthy, vibrant and nurturing, providing safety nets for those in need; and

- Our Kanaka Maoli and island cultures and values are thriving and perpetuated (Hawai‘i Sustainability Task Force 2008, Hawai‘i Office of Planning 2018).

Discussion: Hawai‘i 2050 recognizes that public infrastructure, including wastewater systems, is essential to building a strong economy, protecting the environment, and enhancing quality of life. The Proposed Action conforms to this objective by maintaining infrastructure and reducing infiltration of untreated or poorly treated wastewater into the groundwater, which threatens surface and groundwater resources. The Proposed Action will aid in economic recovery from the 2018 Kīlauea Eruption and Hurricane Lane, and the ongoing COVID-19 pandemic. Alternatives 2/3 and 4/5 align with the Plan's support of water reuse.

5.1.7 State Strategic Plan for Transit-Oriented Development

The State Strategic Plan for Transit-Oriented Development was prepared pursuant to Act 130, Session Laws of Hawai‘i 2016 by the Office of Planning and the Hawai‘i Housing Finance and Development Corporation in December 2017 and revised in August 2018. Act 130 established the Hawai‘i Interagency Council for Transit-Oriented Development (TOD) to coordinate TOD planning statewide. The Plan is an initial assessment of TOD opportunities and key initiatives that is intended to guide implementation of TOD projects.

The Plan identifies TOD opportunities in each county. Opportunities for TOD and smart growth collaboration in the County of Hawai‘i include:

- TOD and the potential for affordable housing on State lands; and
- Regional TOD opportunities in Puna, Hilo, and Kona.

The Kea‘au Public Wastewater Treatment Facility is a priority TOD project in Puna. The Plan notes that wastewater facilities are critical for future growth to be directed into mixed-use commercial cores and to support rural cores.

5.2 COUNTY OF HAWAI‘I PLANS AND POLICIES

5.2.1 Hawai‘i County General Plan

The County of Hawai‘i's General Plan, adopted in 2005, is the policy document for the long range comprehensive development of the island of Hawai‘i. The purposes of the general plan are to:

- Guide the pattern of future development in this County based on long-term goals;
- Identify the visions, values, and priorities important to the people of this 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 overarching goal of the plan is to guide future development in a way that fosters healthy community vison and values.

The plan contains 13 subject areas:

- Section 2: Economic;
- Section 3: Energy;
- Section 4: Environmental Quality;
- Section 5: Flooding and Other Natural Hazards;
- Section 6: Historic Sites;
- Section 7: Natural Beauty;
- Section 8: Natural Resources and Shoreline;
- Section 9: Housing;
- Section 10: Public Facilities;
- Section 11: Public Utilities;
- Section 12: Recreation;
- Section 13: Transportation; and
- Section 14: Land Use.

Of these, the subject areas that are applicable to the Proposed Action are:

- Section 2: Economy;
- Section 4: Environmental Quality; and
- Section 11: Public Utilities.

Below is a discussion of how the Proposed Action would be consistent with applicable themes, goals, policies, and standards of the General Plan.

5.2.1.1 SECTION 2: ECONOMY

Goals:

(a) Provide residents with opportunities to improve their quality of life through economic development that enhances the County's natural and social environments.

Policies:

(h) The land, water, air, sea, and people shall be considered as essential resources for present and future generations and should be protected and enhanced through the use of economic incentives.

Discussion:

The Proposed Action is the addition of wastewater collection, treatment, and disposal infrastructure and services for the Project Area. The action would provide efficient, technologically advanced, and resilient wastewater collection, treatment, and disposal infrastructure and services, primarily to town and village centers in the Project Area. The Proposed Action is needed to support the ongoing process of economic recovery in the Project Area, which has been impacted by the 2018 Kīlauea Eruption and Hurricane Lane, and the ongoing COVID-19 pandemic. It also is needed to reduce the risk to human health and the environment posed by reliance on dated, substandard sewage disposal methods for wastewater disposal in the Project Area. The purpose of the Proposed Action is to aid the economic recovery of the Project Area and Hawai'i County, and secondarily to contribute to the improvement of groundwater and surface water quality. The Proposed Action will result in the addition of wastewater collection and treatment facilities, or funds to individuals and businesses for IWSs, thereby enabling compliance with the requirement that all cesspools, unless granted exemption, shall upgrade or convert to a septic or aerobic treatment unit, or connect to a sewer system. The Proposed Action will support both economic recovery and the requirement to upgrade from cesspool treatment, therefore improving wastewater management and mitigating contamination of water resources. unless granted exemption, shall upgrade or convert to a septic or aerobic treatment unit, or connect to a sewer system.

5.2.1.2 SECTION 4: ENVIRONMENTAL QUALITY

Goals:

(b) Maintain, and if feasible, improve the existing environmental quality of the island.

(c) Control pollution

Policies:

(a) Take positive action to further maintain the quality of the environment.

(k) Require implementation of the management measures contained in Hawai'i's Coastal Nonpoint Pollution Control Program as a condition of land use permitting.

Standards:

(a) Pollution shall be prevented, abated, and controlled at levels that will protect and preserve the public health and well-being, through the enforcement of appropriate Federal, State and Country Standards.

(c) Federal and State environmental regulations shall be adhered to.

Discussion:

The Proposed Action is the addition of wastewater collection, treatment, and disposal infrastructure and services for the Project Area. The action would provide efficient, technologically advanced, and resilient wastewater collection, treatment, and disposal infrastructure and services, primarily to town and village centers in the Project Area. A key purpose of the Proposed Action also is to reduce the risk to human health and the environment posed by reliance on dated, substandard sewage disposal methods for wastewater disposal in the Project Area. Presently, the County of Hawai'i does not provide any wastewater collection and treatment facilities in the Project Area. As of 2005, most residents in the district were served by individual wastewater systems including cesspools and household aerobic treatment units (County of Hawai'i 2005). There are an estimated 49,300 inventoried cesspools in the County of Hawai'i that discharge approximately 27.3 million gallons of raw sewage effluent into the County's groundwater and surface waters per day (DOH 2017, 2021a).

In 2017, the Hawai'i State Legislature passed Act 125, which required that by January 1, 2050 all cesspools in the State, unless granted exemption, shall upgrade or convert to a septic or aerobic treatment unit, or connect to a sewer system. In 2022, Act 125 was amended by Act 87, which expands the candidate IWSs to include any wastewater system approved by DOH.

The Proposed Action would reduce a major source of water pollution identified by the Hawai'i County General Plan: sewage. The Proposed Action aligns with the Hawai'i County General Plan's recognition of the importance of controlling pollution and developing more effective sewer treatment programs.

5.2.1.3 SECTION 11: PUBLIC UTILITIES

Goals:

(a) Ensure that properly regulated, adequate, 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 be concealed from public view.

Policies:

(a) Public utility facilities shall be designed to complement adjacent land uses and shall be operated to minimize pollution or disturbance.

(c) Utility facilities shall be designed to minimize conflict with the natural environment and natural resources

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

Sewer

Policies:

(c) Immediate steps should be taken to designate treatment plant sites, sewerage pump station sites, and sewer easements according to the facility plans to facilitate their acquisition.

(d) Continue to seek State and Federal funds to finance the construction of proposed sewer systems and improve existing systems.

Standards:

(b) Sewerage systems shall be designed for a particular area, depending on topography, geology, density of population, costs, and other considerations of the specific area.

(c) There shall be a minimum of visual and odor pollution emanating from sewerage treatment facilities.

(e), (f), (g) Applicable standards and regulations of the State Department of Health, Chapters 54 "Water Quality Standards, 55 "Water Pollution Control", 62 Wastewater Systems"

(h) Applicable standards and regulations of Chapter 342, RS: Act 282, Session Laws of Hawaii 1985; and Act 302, Session Laws of Hawai'i 1986, Relating to Environmental Quality.

(i) All wastewater disposal systems shall conform to the applicable provisions of Chapter 11-62, Hawai'i Administrative Rules for the Department of Health to ensure proper treatment and disposal of wastewater and to prevent further contamination of waterways, underground water sources, and the coastal waters.

Courses of Action within the Puna District:

(a) The use of cesspools shall be discontinued in the coastal areas where cesspools do not function satisfactorily to meet water quality standards. Individual household aerobic treatment units approved by the State Health Department and the County of Hawai'i could be utilized in these areas. Future sewerage systems for the Puna area would then naturally commence with service to the lower coastal areas.

Discussion:

The Proposed Action is consistent with the goals and policies for utilities and sewer. The Hawai'i County General Plan notes that adequate sewer disposal systems are vital to safeguard public health and preserve the environment. An adequate system is one that minimizes contamination of both the ground water supply and the coastal waters, beaches and waterborne recreational areas and is not a visual and odor nuisance. The General Plan also recognizes that there is an increasing need to create a better system than individual cesspools, particularly in highly urbanized and shoreline areas due to the possible pollution of ground water and cesspool seepage into coastal waters. The Proposed Action will result in discontinuance of cesspools and improved sewer infrastructure. Sufficient buffers would be maintained to minimize any noise or odor effects on land uses that are adjacent to WWTPs proposed in Alternatives 2/3 and 4/5. All standards and regulations of the State Department of Health, Chapters 54, 55, and 62, as well as applicable provisions of Chapter 11-62 Hawai'i Administrative Rules for the Department of 11-62 would be adhered to.

5.2.2 Puna Community Development Plan

The Puna Community Development Plan (CPD) adopted in 2008 and subsequently amended, addresses elements in the County General Plan that are applicable to the District of Puna, including a combination of land-use amendments, policies, budgetary items, public-private partnership building, and community-based implementation activities that are needed to accomplish many kinds of goals. The plan is organized into three themes:

- **Mālama I Ka 'Āina** establishes how the contextual natural, historic and cultural features of Puna should be preserved and respected. The goals, objectives and implementing actions under this theme address cultural and historic sites and districts; forest lands and unique geological features; scenic resources; and drainage, aquifers, and coastal water quality.
- **Growth Management** addresses how the future pattern of human settlement and land use should be shaped to respect that context and support the desired quality of life for Puna's residents. The goals, objectives and implementing actions under this theme address the land use pattern; agricultural and economic development; public services, social services and housing; parks and recreation; and renewable energy and energy efficiency.

- **Transportation** focuses on sustainable approaches to transportation to support the goals of the two above themes. The goals, objectives, and implementing actions under this theme address mass transit and alternative travel modes, travel demand management, and roadway connectivity and safety.

Mālama I Ka ʻĀina includes goals, objectives, and actions that are pertinent to the Proposed Action.

5.2.2.1 MĀLAMA I KA ʻĀINA

Section 2.3 Aquifer, Coastal Waters and Stormwater

Goals:

(a) Aquifers that could be used for future community wells in high growth lower elevation areas are protected from pollution by untreated wastewater disposal systems.

Objectives:

(b) Improve wastewater treatment methods and standards in areas designated for future aquifer use and in coastal areas.

Actions:

(b) Seek State Department of Health acceptance of small-footprint septic wastewater treatment designs; for example, those using drip irrigation or low-pressure pipe and double-tank no-leach field designs. Also, seek acceptance of small, decentralized treatment systems and clustered septic systems for wastewater treatment in village/town centers, clustered residential development and other special circumstances.

(f) Based on the findings of the ongoing feasibility study for a wastewater treatment facility to service the Kapoho Beach Lots/Vacationland Hawai‘i area, the County shall support the funding of an Environmental Assessment or an Environmental Impact Statement for such facility.

Discussion: The plan recognizes that one of the potential threats is the cumulative impact of additional individual wastewater disposal systems, especially cesspools, in the subdivisions that overlie the makai portion of the aquifer. Establishing County wastewater collection, treatment, and disposal infrastructure and services in the Project Area, to which property owners and businesses in urban areas and clustered developments can connect, is a primary objective of the Proposed Action. Decentralized treatment (Alternatives 1A and 1B), subregional WWTP treatment systems (Alternative 2/3), regional WWTP treatment systems (Alternative 4/5), and conveyance of wastewater to the Hilo WWTP (Alternative 6/7) are proposed. These systems would result in improved wastewater treatment methods and eliminate cesspools in subdivisions overlying the aquifer, in areas designated for growth, as well as in coastal areas. State Department of Health acceptance would be sought for any new systems.

5.2.3 Special Management Area

Per the Federal Coastal Zone Management Act of 1972, Hawai'i's CZM Program outlines objectives and policies to guide the use of the State's coastal resources. The entire State of Hawai'i is included in the State's CZM Program Area.

As codified in HRS Chapter 205A, each county in the State of Hawai'i provides its own laws and regulations to implement the CZM Program within its respective jurisdiction through the Special Management Area (SMA) process. Portions of the area of the Proposed Action are located within the County-delineated SMA as designated in HRS Chapter 205A (Figure 5-2).

The County of Hawai'i Planning Commission Rules of Practice and Procedure, Rule 9 contains regulations that apply to all lands within the SMA. The objectives and policies of this chapter are contained in HRS Section 205 A-2, which are included in Section 5.1.2 of this PDEIS. The SMA guidelines set forth in Section 205A-26 are used for the review of developments proposed in the SMA. A discussion of consistency with these guidelines is included in Table 5-2.

FIGURE 5-2

SPECIAL MANAGEMENT AREAS

Legend

- Project Area
- Roads
- Special Management Areas

Sources: Special Management Arras, Hawai'i Statewide GIS Program, July 2022.

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0 12,000 24,000 Feet

AECOM
1001 Bishop St. STE 1600
Honolulu, HI 96813

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Table 5-2. Special Management Area, HRS Chapter 205A

C = Consistent; N/C = Not Consistent; N/A = Not Applicable.			
Review Guidelines (1) All development in the special management area shall be subject to reasonable terms and conditions set by the council to ensure:	**C**	**N/C**	**N/A**
A. Adequate access, by dedication or other means, to publicly owned or used beaches, recreation areas and natural reserves is provided to the extent consistent with sound conservation principles			X
B. Adequate and properly located public recreation areas and wildlife preserves are reserved			X
C. Provisions are made for solid and liquid waste treatment, disposition, and management which will minimize adverse effects upon special management area resources.	X		
D. Alterations to existing land forms and vegetation; except crops, and construction of structures shall cause minimum adverse effect to water resources and scenic and recreational amenities and minimum danger of floods, landslides, erosion, siltation, or failure in an earthquake	X		
Review Guidelines (2) No development shall be approved unless the council has first found that:	**C**	**N/C**	**N/A**
A. The development will not have any substantial adverse environmental or ecological effect except as such adverse effect is minimized to the extent practicable and clearly outweighed by public health and safety, or compelling public interest. Such adverse effect shall include, but not be limited to, the potential cumulative impact of individual developments, each one of which taken in itself might not have a substantial adverse effect and the elimination of planning options.	X		
B. The development is consistent with the objectives and policies, and special management area guidelines of this chapter and any guidelines enacted by the legislature.	X		
C. The development is consistent with the county general plan, development plans, and zoning. Such a finding of consistency does not preclude concurrent processing where a development plan amendment or zone change may also be required.	X		

Discussion: The Proposed Action will improve wastewater treatment and management and result in reduced existing potential impacts of septic systems and cesspools on special management area resources. As discussed in Section 3.3.2, standard BMPs, such as silt fences and compost filter socks, would be used to preserve geologic structure, slope stability, and soil retention as needed. A sediment and erosion plan would be implemented to minimize any potential impacts to the landscape. No long-term impacts to topography are anticipated. Improved wastewater treatment would minimize contamination of soils from the existing outdated and substandard disposal methods.

Three pump stations associated with Alternatives 2/3, 4/5, and 6/7 are proposed to be located within the SMA. Due to the small footprint and minimal height of these structures, it is not anticipated that they would substantially interfere with shoreline views.

The Proposed Action's consistency with the county general plan, development plans, and zoning is discussed in Section 5.2.

Alternative 6/7 would require expansion of the Hilo WWTP ocean outfall and the discharge of treated effluent to coastal marine waters. If Alternative 6/7 is progressed, a separate project-specific HRS Chapter 343 document would be prepared, when sufficient design details are available in the future. Ocean discharge is under consideration for Alternative 4/5 but likely will not be carried forward.

As described in Section 4.2.2, the Proposed Action would increase capacity of the wastewater conveyance system and result in increased discharge of wastewater effluent and generation of wastewater solids. Therefore, the Proposed Action may contribute cumulative and secondary impacts to water resources, water and wastewater infrastructure, and solid waste disposal. However, the Proposed Action is not anticipated to result in any substantial adverse environmental or ecological impacts that outweigh the public health and safety and environmental benefits of the project.

5.2.4 Zoning Code

Land uses within the jurisdiction of the County of Hawai‘i are regulated under Chapter 25, Zoning of the Hawai‘i County Code (Zoning Code). The purpose and intent of the Zoning Code is:

- Promoting health, safety, morals, or the general welfare of the County, this chapter regulates and restricts the height, size of buildings, and other structures, the percentage of a building site that may be occupied, off-street parking, setbacks, size of yards, courts, and other open spaces, the density of population, and the location and use of buildings, structures, and land for trade, industry, residence, or other purposes (Section 25-1-2).

  The Proposed Action meets the definition of "public use," "public building" and "public structure" as defined in Section 25-1-5:

- "Public use," "public building" and "public structure" mean a use conducted by or a structure or building owned or managed by the Federal government, the State of Hawai‘i or the County to fulfill a governmental function, activity or service for public benefit and in accordance with public policy. Excluded are uses which are not purely a function, activity or service of government and structures leased by government to private entrepreneurs or to nonprofit organizations.

Power lines, utility substations, and public buildings are subject to the following use regulations (Section 25-4-11):

(a) Communication, transmission, and power lines of public and private utilities and governmental agencies are permitted uses within any district.

(b) Any substation used by a public or private utility for the purpose of furnishing telephone, gas, electricity, water, sewer, radio, or television shall be a permitted use in any district provided that the use is not hazardous or dangerous to the surrounding area and the director has issued plan approval for such use.

(c) Public uses, structures and buildings and community buildings are permitted uses in any district, provided that the director has issued plan approval for such use.

The Proposed Action is located within several zoning districts, listed in Table 5-3 and shown in Figure 5-3. This table also provides a summary of certain applicable regulations. Plan approval is required for the Proposed Action in all districts.

Table 5-3. Summary of Zoning District Regulations

District	Proposed Action (Use) Permitted	Height	Minimum building site area
Agricultural (A)	Permitted, Special permit is required if the site is located within the State land use agricultural district	45 ft, or up to 100 ft as determined by director	5 acres
Neighborhood Commercial (CN)	Permitted	45 ft	7,500 square feet
Village Commercial (CV)	Permitted	35 ft	7,500 square feet
Family Agricultural (FA)	Permitted, Special permit is required if the site is located within the State land use agricultural district	45 ft	1 acre
Industrial-Commercial Mixed (MCX)	Permitted	45 ft	20,000square feet
General Industrial (MG)	Permitted	50 ft, up to 100 ft for industrial structures	20,000square feet
Limited Industrial (ML)	Permitted	45 ft	10,000square feet

District	Proposed Action (Use) Permitted	Height	Minimum building site area
Open (O)	Permitted	Determined as condition of approval for a permit or plan	Determined as condition of approval for a permit or plan
Residential and Agricultural (RA)	Permitted	35 ft	½ acre
Multiple-Family Residential (RM)	Permitted	Outside City of Hilo: 45 ft; in City of Hilo: 125 ft	7,500square feet
Single-Family Residential (RS)	Permitted	35 ft	7,500square feet
Resort-Hotel Districts (V)	Permitted	45 ft, in City of Hilo: 120 ft, in Keauhou Bay and Kahaluu Bay: 90 ft	15,000square feet

5.2.5 County of Hawai‘i Water Use and Development Plan Update (WUDP)

The County of Hawai‘i Department of Water Supply prepared the County of Hawai‘i Water Use and Development Plan (WUDP) in 1998 in compliance with the State Water Code. The WUDP serves as a continuing long-range guide for the water resources development in the County. The objective of the plan 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 plan examines several water resource enhancement measures to meet projected water demands, including alternative supply-side measures such as wastewater reclamation.

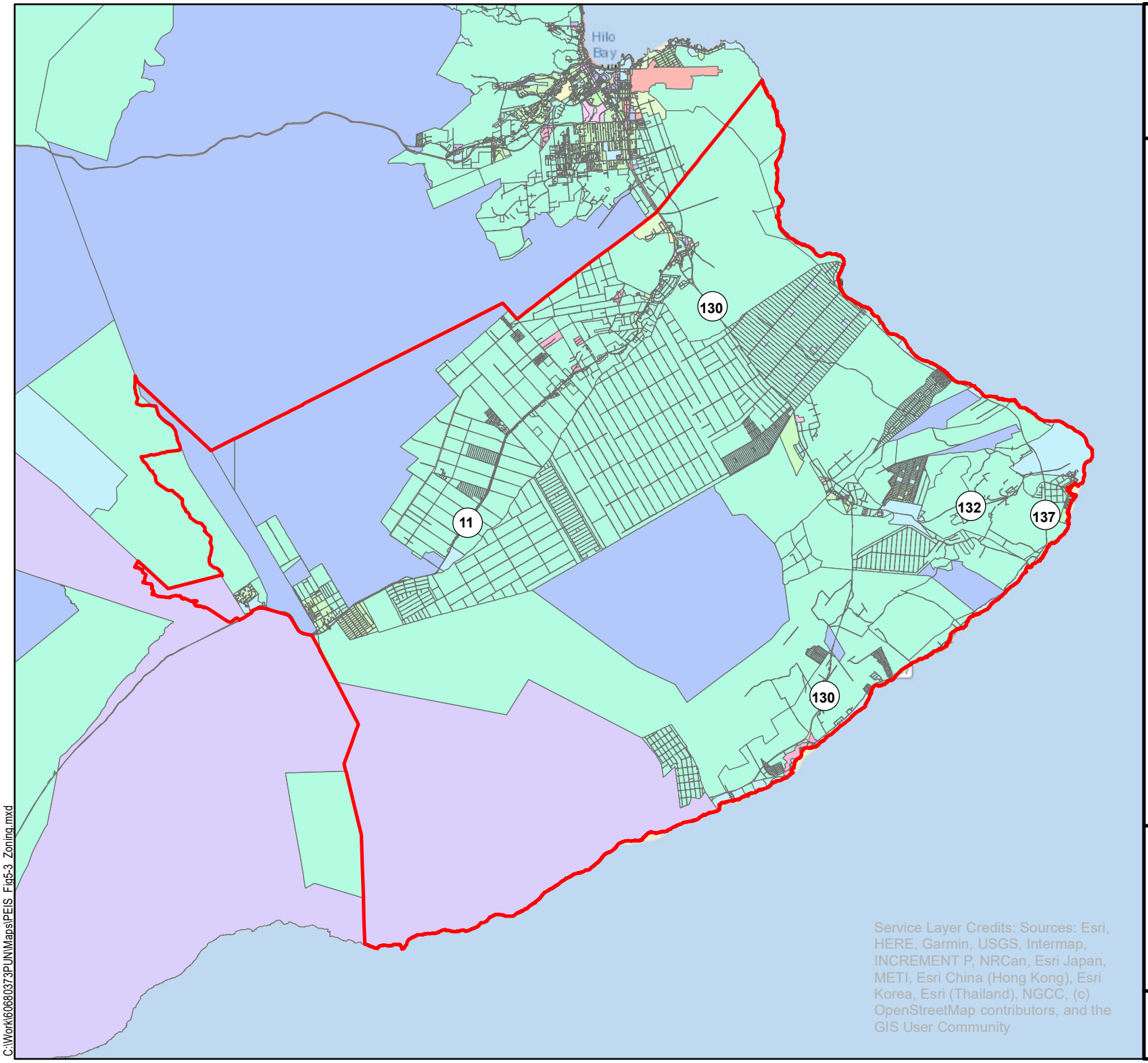

FIGURE 5-3

ZONING

Legend

Project Area

Zoning

- Agricultural
- Downtown Hilo Comercial
- General Commercial
- Neighborhood Commercial
- Village Commercial
- Family Agricultural
- Forest Reseve
- Industrial-Commercial Mixed
- General Commercial
- Limited Industrial
- National Park
- Open District
- Project District
- Residential and Agricultural
- ResidentialCommercial Mixed
- Double-Family Residential
- Multi-Family Residential
- Single-Family Residential
- University
- Resort-Hotel

Sources: Hawaii County Zoning, Hawai'i Statewide GIS Program, April 2022.

N

0 12,500 25,000 Feet

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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Honolulu, HI 96813

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The Hawai‘i Water Use and Development Plan Update promotes several common themes which are applicable island-wide:

- Reserve the highest quality of water for the most valuable end use;
- Promote water conservation; and
- Initiate more monitoring and studies.

The plan states that reclaimed wastewater, brackish groundwater, surface water; and other such lower quality sources should be used for landscaping and agriculture. In many areas, the supply of water makes wastewater reclamation unnecessary. The Proposed Action is located within three of the nine aquifers: Northeast Mauna Loa, Kīlauea, and Southeast Mauna Loa. For the Hilo Water System, located within the Northeast Mauna Loa aquifer, the need for a far-reaching nonpotable reclaimed water system would be contingent on development requiring a significant quantity of nonpotable water in the immediate vicinity that cannot be sustained by ambient rainfall. One wastewater reclamation facility, the Punalu‘u Sewage Treatment Plant is located within the Southeast Mauna Loa Aquifer and is used for golf course irrigation. There are no wastewater reclamation facilities within the Kīlauea aquifer and wastewater reclamation facilities are not considered a viable option due to the small service population of the municipal wastewater systems in the sector area. The plan states that the potential population of the Centra Puna area, with an estimated 30,000 lots, could justify a wastewater reclamation facility.

The plan’s general recommendations for wastewater reclamation are:

- *The existing wastewater reclamation facilities have the potential capacity to produce approximately 2 mgd of reclaimed wastewater for additional approved nonpotable uses. Effluent reuse is dependent upon viable users within close proximity to the wastewater reclamation facilities; otherwise, this is not a cost-effective alternative. Accordingly, smaller satellite facilities combining a wastewater treatment plant and reclamation facility could be implemented. This would require a carefully coordinated planning effort by several stakeholders, including community development groups, and County Planning, DWS* [Department of Water Supply]*, and Department of Environmental Management staff. Key factors to consider would include service area, proposed land use, costs, and public opinion. Such facilities would be more effective to implement in new communities rather than retrofitting or replacing existing systems; therefore, incorporating the analysis of this alternative at the planning level is desirable.*

Discussion: Wastewater reuse and land application are proposed for Alternative 2/3 and Alternative 4/5. For these alternatives, land application of wastewater effluent that is not reused would require an additional 6 to 32 acres of land or 45 to 60 acres of land, respectively. If either of these alternatives is advanced, coordination with community development groups, County Planning, County of Hawai‘i Department of Water Supply, and DEM staff would occur.

5.2.6 County of Hawai‘i Transit and Multi-Modal Transportation Master Plan

The County of Hawai‘i Transit and Multi-Modal Transportation Master Plan was completed in 2018 for the County of Hawai‘i Mass Transit Agency. The vision of the Plan is to:

> Create a high quality multi-modal transportation system that provides safe, reliable, convenient mobility choices that meet the commuting, social service, and other needs of our residents and visitors. The multi-modal system should be environmentally responsible and cost effective.

The Plan provides a 2-year program for multimodal transportation improvements. The Plan includes two planned hubs for Puna, including one in Kea‘au, that will support transit services, which was proposed by the Office of Planning, State TOD/TRD Strategic Plan. As discussed in Section 3.10, there are no anticipated consequences to the transportation network resulting from implementation or operation of the Proposed Action. The Proposed Action would act as a catalyst to support transit-oriented development within the Puna District by allowing greater development density. Aligning this development with the existing and planned transit service would provide residents with options to passenger vehicle travel.

5.2.7 Pāhoa Transit Hub and Co-located Library Work Plan

The Pāhoa Transit Hub and Co-located Library Work Plan was prepared in August 2022 for the County of Hawai‘i Mass Transit Agency and Hawai‘i State Public Library System. The Work Plan identifies potential locations for transit hubs in the Puna district. Eleven sites are evaluated. The potential to co-locate a public library on the same parcel as a transit hub was also considered. The Work Plan identified four primary components: work plan and schedule (July and August 2022), site selection report (September to December 2022), conceptual design (August 2022 to January 2023), and environmental assessment (December 2022 to November 2023).

As of November 2022, a location for the development had not been identified.

5.3 REQUIRED PERMITS AND APPROVALS

Table 5-4 outlines the permits and approvals that may be required to implement the Proposed Action. Required permits and approvals will be confirmed during the design phase of the project.

Table 5-4. Potential Required Permits and Approvals

Permit/Approval/Consultation	Agency
Federal	
Section 106, National Historic Preservation Act consultation	State Historic Preservation Officer
Use and Occupancy Agreement	Federal Highway Administration (authority delegated to State of Hawai'i Department of Transportation)
State	
HRS Chapter 343 Compliance	State of Hawai'i Department of Health
National Pollutant Discharge Elimination System General Permits	State of Hawai'i Department of Health
HRS Chapter 6E-8 Historic Preservation Review	State Historic Preservation Division
Community Noise Permit	State of Hawai'i Department of Health
Wastewater Permit	State of Hawai'i Department of Health
Use and Occupancy Agreement	State of Hawai'i Department of Transportation
Public Purpose (Public Utility) within Conservation District Permit	State Department of Land and Natural Resources
County of Hawai'i	
Plan Approval	Planning Department
Waiver of Minimum Building Site Area for Utilities	Planning Department
Variance from Provisions of the Zoning Ordinance	Planning Department
Land Use Permit	Planning Department
Special Management Area (Major) Use Permit	Planning Department
Building Permit	Department of Public Works
Permit to work within the County Right-of-Way	Department of Public Works
Non-Residential Floodproofing, Elevation Certificates in Special Flood Hazard Area	Department of Public Works
Sewage Works and Connections Permits	Department of Environmental Management

6.0 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

6.1 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Short-term uses associated with construction of the Proposed Action include use of water, energy, fuel, and other resources. The impact associated with use of these resources is anticipated to be minimal. Short-term uses and long-term productivity of water resources, flora and fauna, and health, safety, and well-being are summarized below.

Water Resources

Minimal consumption of surface or groundwater is required to construct the Proposed Action. By replacing the use of cesspools and other outdated, substandard wastewater disposal methods with centralized water treatment systems and updated individual wastewater systems (IWSs), the Proposed Action would improve long-term viability of surface and groundwater resources.

Temporary impacts to the floodplain are not anticipated during construction, as most of the Project Area is located in Federal Emergency Management Agency (FEMA) Zone X, an area of minimal flood hazard outside of the Special Flood Hazard Area and at a higher elevation than the 0.2 percent annual chance flood, or Zone D, an area of undetermined flood hazard.

The proposed construction activities are not expected to result in temporary or permanent loss of wetlands and other waters of the United States, because none of the proposed wastewater system improvements overlap with wetland features shown on National Wetland Inventory Maps. Operation and maintenance of the proposed facilities would not result in impacts to wetlands and would not require mitigation.

Flora and Fauna

Most of the required trenching for construction of a County wastewater collection system would be within existing roadways and easements and would not affect native vegetation, forest habitat, or exceptional trees. The construction of new regional and subregional wastewater treatment plants (WWTPs) and pump stations would require the clearing of vegetation and would have the potential to affect native vegetation, forest habitat, and exceptional trees, depending on the alternative implemented and the specific facility locations selected.

Table 3-7 lists Federally and State listed threatened and endangered species of fauna potentially occurring within the Project Area and that therefore could be affected by Proposed Action construction activities.

As individual projects are developed, appropriate environmental documentation would be completed, including project-specific biological surveys of habitats at or near the proposed construction for each phase of the projects. These surveys would be tailored to the plant and animal species likely to use habitat at a given project site. Any locations where vegetation is disturbed would be restored to existing conditions or better. Where appropriate, native plant species would be selected for soil stabilization and replanting efforts. To avoid and minimize potential adverse effects to listed plants and animals, the Proposed Action would implement the measures listed in Section 3.6.2.1 and Table 3-8.

Operation and maintenance of the proposed facilities is not anticipated to affect flora or wildlife, regardless of the alternative implemented. As a result, no significant loss of productivity is anticipated.

Health, Safety, and Well-being

During construction, surrounding and proximate neighborhoods may experience nuisances including noise, dust, and traffic. It is not anticipated that these impacts would present a significant threat to health, safety, and well-being. Operation of the wastewater systems would have a positive impact on health, safety, and well-being by substantially reducing the discharge to the environment of untreated wastewater.

Short-term impacts also include employment of construction workers and expenditures on materials, both of which are anticipated to have a positive impact.

6.2 FUTURE OPTIONS

It is not anticipated that the Proposed Action would result in foreclosure of future options or narrow the range of beneficial uses of the environment. The provision of wastewater services to town and village centers designated in the Project Area avoids loss of undisturbed, forest, and agricultural land. Mostly, wastewater infrastructure would not be constructed within proximity to the coast and coastal resources, and the addition of wastewater services and infrastructure avoids beaches and is not anticipated to cause erosion.

7.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible and irretrievable resource commitments are related to the use of non-renewable resources and the effects that the use of those resources have on future generations. Irretrievable resource commitments involve the loss in value of an affected resource (e.g., extinction of a threatened or endangered species or the disturbance of a cultural site). The Proposed Action would constitute an irreversible or irretrievable commitment of non-renewable or depletable resources for the materials, time, money, and energy expended during activities implementing the projects and for the land areas used for new proposed above-grade facilities.

In the short-term, construction activities would require the consumption of fossil fuel and energy, as construction requires equipment that would use fuel, either gasoline or diesel, to operate. Irreversible and irretrievable commitments to resources would be unavoidable (i.e., resulting emissions would contribute to overall air quality of the region) but would be minor and temporary.

The proposed clearing of trees and vegetation in the areas proposed for new above-grade facilities would constitute an irreversible and irretrievable loss of natural resources. However, any locations where vegetation is disturbed would be restored to existing conditions or better, and landscaping plans are recommended to include native vegetation plantings throughout the Project Area to minimize this loss.

Construction activities would require the manufacturing and use of materials. Following construction, unused materials would be reused or recycled whenever possible. Materials that cannot be recycled at the end of the project lifetime would become an irreversible and irretrievable commitment of resources. However, no supplies are considered scarce and thus would not limit other unrelated construction activities in the region. The packaging of construction materials that cannot be reused or recycled, as well as other waste generated during construction activities, would result in an irreversible and irretrievable allocation of landfill or other solid waste disposal capacity.

It is anticipated that the Proposed Action would have beneficial effects on both development and employment in the area. The Proposed Action would create demand for construction materials and services, and hence direct and indirect (mostly construction- and industrial-related) employment in the Project Area. The Proposed Action would also result in adequate sewerage facilities to support current and future economic activities and planned development and growth in the wastewater service areas.

In the long-term, fossil fuels would be required to operate back-up generators at the proposed wastewater pump stations. However, pump stations would be constructed with modern, efficient equipment. Therefore, although irreversible and irretrievable commitments of resources are unavoidable (i.e., using oil for energy production), these impacts are anticipated to be minimal.

8.0 PROBABLE ADVERSE EFFECTS THAT CANNOT BE AVOIDED

Adverse impacts can be defined as short- and long-term effects relative to the construction and implementation of a specific use. Short-term impacts are usually construction-related impacts that would occur during construction and cease upon completion of a project. Long-term impacts generally result from the implementation of a project.

8.1 SHORT-TERM EFFECTS

The Proposed Action would result in some unavoidable short-term impacts, as described below. These potential impacts are generally minor and would be further minimized through the implementation of best management practices (BMPs).

8.1.1 Air Quality

Regardless of the alternative selected, construction would result in short-term, intermittent air quality impacts within and beyond the Project Area due to the operation of construction equipment, vehicles, and privately-owned vehicles. Site clearing, grubbing, excavation, and grading would result in localized increases in fugitive dust during overall sewer system construction.

All construction activities would comply with the provisions of Hawai‘i Administrative Rules (HAR) 11-60.1-33, *Fugitive Dust*. Dust management BMPs such as regular watering would be implemented for construction activities. Overall, emission reduction measures are expected to minimize air pollutant emissions, resulting in minor adverse air quality impacts due to construction sources.

8.1.2 Soils

Trench excavation (i.e., force main, trunk/interceptor sewer, and branch sewer installation), constructing wastewater pump station, and wastewater treatment plants (WWTPs), and installing individual wastewater systems (IWSs) would result in unavoidable short-term soil disturbance and in soil loss during construction. Depending on the alternative selected, construction may include the removal of soils and excavation material in the area, and disposal of the excavation material. Disposal methods may include use as fill material for other projects, temporary stockpiling, or final disposal to a landfill. Construction activities could result in the accidental release of construction equipment fluids (e.g., oil and grease) that could contaminate soils.

To minimize the potential for impacts to soil, construction equipment would be maintained in good working condition to reduce the potential for accidental spills. An erosion and sediment control plan would be developed and implemented to minimize any potential impact to soils and to specify control measures to reduce impacts to the natural environment.

8.1.3 Groundwater

Construction activities could potentially impact groundwater if encountered during the proposed work. Also, dewatering may be necessary for construction below the groundwater table, which would be conducted in accordance with applicable regulations.

Construction activities would be designed to avoid adverse impacts to groundwater, including preventing the accidental release of construction equipment fluids that could contaminate groundwater. Mitigation measures would be implemented during construction activities to preserve the integrity of existing utility lines and keep construction equipment in good working condition to prevent accidental spills. In addition, appropriate BMPs (e.g., silt fences, proper storage and movement of spoil) and careful site preparation would be utilized to minimize adverse impacts.

8.1.4 Surface Water and Coastal Waters

Regardless of the alternative selected, excavation and land disturbance may contribute to sedimentation and runoff into nearby streams, and accidental release of construction equipment fluids also could contaminate surface and coastal waters. Construction controls required by National Pollutant Discharge Elimination System permits would reduce the risk of sediment and construction-related contaminants reaching surface and coastal waters. For construction using the conventional open trench method, shoring and dewatering techniques would be employed to mitigate potential impacts.

8.1.5 Flora and Fauna

Construction activities would temporarily disturb and for above-grade structures permanently displace existing vegetation and associated wildlife. Maintenance activities that include the use of construction equipment, trimming of trees, or the clearing of vegetation would temporarily disturb or permanently displace vegetation and wildlife.

Any locations where vegetation is disturbed would be restored to existing conditions or better. Where appropriate, native or other non-invasive plant species would be selected for soil stabilization and replanting efforts.

8.1.6 Visual and Aesthetic Resources

Regardless of the alternative selected, construction of the proposed wastewater systems may have short-term and local, adverse impacts on the visual aesthetics in the Project Area. During construction, fencing surrounding construction sites may be provided as needed to provide a visual screen to mitigate the potential impacts. Any construction impacts regarding visual aesthetics are expected to be short-term and would cease after construction.

8.1.7 Parks and Recreational Areas

During construction, there may be additional noise and traffic at or near parks and recreational areas, regardless of the alternative selected. These impacts would be temporary and are not anticipated to directly affect the use of any facilities.

8.1.8 Noise

Construction noise would be unavoidable during the duration of the project construction period. Short-term increases in noise levels would result from construction activities, vehicles, and equipment. However, it is anticipated that construction activities would meet permissible sound levels and would have a minor and temporary impact to noise sensitive land uses in the Project Area.

8.1.9 Transportation

The upgrading or conversion of IWSs or construction of the small, decentralized package treatment plants identified as part of Alternative 1A would have negligible effect on the transportation system. Delivery of materials and construction worker trips to these dispersed private properties would not degrade traffic operations on nearby roadway networks. Installation of low-pressure sewers connecting to small, decentralized package treatment plants as part of Alternative 1B would have similar negligible effects. Although local roadway closures of one-lane or sidewalk would be frequent given the geographic breadth of the 30-year program, these would be isolated events, during which residents would have access options and experience limited inconvenience.

The remaining alternatives involve construction activity that would include the installation of force mains, trunk/interceptor sewer lines, or branch sewer lines in public rights-of-way/travelled ways, or in easements. Thus, under Alternatives 2/3, 4/5, and 6/7, in-road lane closure requirements would impact Project Area roadway operations, although a well-designed lane closure and detour strategy (where feasible) would help to minimize vehicle delays and congestion.

8.1.10 Solid Waste Disposal

During construction, coordination with local landfills and recycling centers for the disposal of construction debris and/or hazardous materials may be required. Disposal would be in accordance with appropriate regulations and standards.

8.1.11 Public Schools

During construction, there may be additional noise and traffic at or near schools, regardless of the alternative selected. State Department of Education and the individual schools in the area would be consulted to coordinate work when occurring in close proximity to these facilities.

8.1.12 Socioeconomic Factors

Although the County of Hawai‘i would construct the wastewater collection system under Alternative 1B, and the County wastewater system under Alternatives 2/3, 4/5, and 6/7, the households and businesses that connect to the system ultimately would pay a major portion of the cost. Approximately 2,520 households in Kea‘au-Mountain View census county division (CCD) and 1,150 in Pāhoa-Kalapana CCD were households in poverty in 2018. An additional 4,590 households in Kea‘au-Mountain View and 1,820 in Pāhoa-Kalapana were Asset Limited, Income Constrained, Employed (ALICE) households. Similarly, numerous families in both CCDs are earning incomes below the living wage for Hawai‘i County. These data indicate that large numbers of households and families in the Project Area purportedly are not earning the minimum necessary to meet basic needs and maintain self-sufficiency. Therefore, they likely will be financially burdened by the costs of upgrading or converting cesspools, or connecting to sewer systems under any of the alternatives evaluated in this programmatic environmental impact statement (PEIS), including the no action alternative, Alternative 1A.

8.2 LONG-TERM EFFECTS

The following unavoidable long-term impacts may result from implementation of the Proposed Action.

8.2.1 Air Quality

Each WWTP under Alternatives 2/3, 4/5, and 6/7 could involve stationary source operation from sewer pumps, boilers, standby power generators, compressors, and digesters that would generate criteria and air toxic pollutant emissions. Since these WWTPs would be new stationary sources, or modified sources at the Hilo WWTP, emissions would increase resulting in adverse air quality impacts on the local level. Anticipated air quality impacts from operational activities within each WWTP for all action alternatives are not expected to interfere with the attainment of National Ambient Air Quality Standards (NAAQS) in areas where sensitive receptors such as residences, schools, hospitals, community facilities, parks, churches, etc. are present around each WWTP.

In addition to the new or modified stationary sources of air emissions, the operational workforce size is anticipated to increase as a result of construction of new WWTPs under Alternatives 2/3 and 4/5, or expansion of the Hilo WWTP under Alternative 6/7, resulting in a slight increase in commuter emissions with minor mobile source air quality impacts.

8.2.2 Groundwater

Regardless of the alternative selected, there is the potential for leakage and breakage in sewer lines and other wastewater management facilities that would result in impacts to groundwater. Mitigation measures for the operational impacts include proper operation and maintenance of the proposed facilities. Additionally, the Proposed Action is being implemented to reduce the risk to human health and

the environment posed by reliance on dated, substandard sewage disposal methods for wastewater disposal in the Project Area.

8.2.3 Visual and Aesthetic Resources

Regardless of the alternative selected, new above-grade facilities likely would be landscaped and are not expected to substantially affect the viewshed of the surrounding areas, although the addition of wastewater services is expected to result, over time, in a more urbanized look in the service areas.

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9.0 UNRESOLVED ISSUES

Unresolved issues are invariably associated with projects in the planning and conceptual design stages, as is the case for this Proposed Action. Consequently, the various planning processes being pursued by the County of Hawai‘i Department of Environmental Management (DEM), including the preparation of this programmatic draft environmental impact statement (PDEIS) and community outreach efforts, are based on the best available information and expertise of those knowledgeable in the design and construction of the proposed types of services and facilities. The unresolved issues for the Proposed Action at the time of this PDEIS submittal are summarized below along with a discussion of how the issues will be resolved prior to commencement of the project construction and/or operation.

9.1 SELECTION OF PREFERRED ALTERNATIVE

As discussed in Section 2.4, the County of Hawai‘i currently is developing and evaluating wastewater system alternatives, comprising sets of collection, treatment, and disposal options, for the various town and village centers in the Project Area. Alternatives are being evaluated in terms of engineering feasibility; compliance with regulatory requirements; construction, maintenance, and operation costs; and potential environmental and social impacts. In turn, the County is developing combinations, or suites, of alternatives for each town and village center to be incorporated into a wastewater facility plan for the district. In addition to alternatives fully within the Project Area, the County is evaluating conveying wastewater to the existing County of Hawai‘i Hilo Wastewater Treatment Plant (WWTP).

The final alternative has not yet been selected. Identification of a preferred alternative will be informed by the findings of this PDEIS and community outreach efforts.

9.2 PROJECT-SPECIFIC HRS CHAPTER 343 DOCUMENTS

This PDEIS is intended to provide environmental considerations that may assist the County of Hawai‘i in its decision-making. With the planning level of information currently available, the PDEIS evaluation is considered programmatic. When sufficient design details are available, separate project-specific Hawai‘i Revised Statutes (HRS) Chapter 343 documents will be prepared as appropriate and compliance with special laws (e.g., HRS Chapter 6E, *Historic Preservation*) will be demonstrated.

9.3 GREENHOUSE GAS EMISSIONS

Evaluations of greenhouse gas (GHG) impacts and mitigation measures are not included in this PDEIS. A study of whether the Proposed Action may emit substantial GHGs directly or as an indirect or cumulative impact will be conducted for individual projects as designs progress.

9.4 IMPACTS TO SPECIFIC SPECIES

Observation of nesting birds or other species at the time of construction would be necessary in order to verify that no endangered or threatened species are present.

10.0 CONSULTATION AND PUBLIC REVIEW

Pursuant to Hawai'i Administrative Rules (HAR) Section 11-200.1-23, consultation with agencies and other stakeholders during the preparation of the programmatic environmental impact statement (PEIS) is required to inform the affected community of the Proposed Action and solicit input in scoping the analyses to be conducted to evaluate potential impacts and identify required mitigation measures. A list of Federal, State, County, and other organizations that were consulted during the publication of the programmatic environmental impact statement notice of preparation (PEISPN) and that are being consulted during the publication of this programmatic draft environmental impact statement (PDEIS) is provided in Table 10-1. This list is not final, and additional stakeholders may be identified and consulted with as part of the review process.

The PEISPN was published in the Environmental Review Program's September 23, 2022 edition of *The Environmental Notice*. Comment letters, emails, and comments posted on the Proposed Action's SmartComment website were received from stakeholders during the PEISPN 30-day public comment period or shortly after the period ended. These stakeholders are designated in Table 10-1. Copies of these written comments and the respective response letters that were sent are included in Appendix D.

In addition, oral comments were received from stakeholders during an in-person Public Scoping Meeting held on October 12, 2022 and a virtual Public Scoping Meeting held on October 20, 2022. These comments and the respective responses are summarized in a comment response matrix that is included in Appendix E.

This PDEIS incorporates the public and agency review comments that were submitted during the PEISPN 30-day public comment period.

Table 10-1. Consulted Agencies and Stakeholders

	Comments Received?	
Agency/Organization	**Yes**	**No**
Federal		
Department of the Interior, Fish and Wildlife Service		X
Department of the Interior, National Park Service		X
Environmental Protection Agency		X
State of Hawai'i		
Business Action Center		X
Department of Accounting and General Services		X
Department of Business, Economic Development and Tourism		X
Department of Business, Economic Development and Tourism, Hawai'i Tourism Authority		X

	Comments Received?	
Agency/Organization	**Yes**	**No**
Department of Hawaiian Home Lands		X
Department of Health		X
Department of Health, Clean Air Branch	X	
Department of Land and Natural Resources, Commission on Water Resource Management		X
Department of Land and Natural Resources, Division of Aquatic Resources	X	
Department of Land and Natural Resources, Division of Forestry and Wildlife	X	
Department of Land and Natural Resources, Engineering Division	X	
Department of Land and Natural Resources, Land Division	X	
Department of Land and Natural Resources, Land Division – Hawai‘i District	X	
Department of Land and Natural Resources, Office of Conservation and Coastal Lands	X	
Department of Land and Natural Resources, State Historic Preservation Division		X
Department of Transportation, Highways Division		X
House of Representatives District 3, Hawai‘i State Legislature, Richard H.K. Onishi		X
House of Representatives District 4, Hawai‘i State Legislature, Greggor Ilagan		X
House of Representatives District 5, Hawai‘i State Legislature, Jeanne Kapela		X
Office of Hawaiian Affairs		X
Office of Planning and Sustainable Development	X	
Public Utilities Commission		X
Senate District 1, Hawai‘i State Legislature, Laura Acasio		X
Senate District 2, Hawai‘i State Legislature, Joy A. San Buenaventura		X
Senate District 3, Hawai‘i State Legislature, Dru Mamo Kanuha		X
County of Hawai‘i		
Civil Defense Agency		X
Council District 3, Susan L.K. Lee Loy		X
Council District 4, Ashley Lehualani Kierkeiwicz		X
Council District 5, Matt Kaneali‘i-Kleinfelder		X
Council District 6, Maile Medeiros David		X
County of Hawai‘i, Office of the Mayor		X
Department of Agriculture		X

	Comments Received?	
Agency/Organization	**Yes**	**No**
Department of Parks and Recreation		X
Department of Public Works		X
Environmental Management Commission		X
Hawai‘i County Fire Department	X	
Hawai‘i County Police Department	X	
Mass Transit Agency, Attn: Transportation Commission		X
Office of Housing and Community Development		X
Planning Department		X
Water Board of the County of Hawai‘i/Department of Water Supply		X
Private/Individuals		
‘Āinaloa Community Association		X
April Bullis		X
Charter Communications, Inc./Spectrum		X
Fern Acres Community Association		X
Fern Forest Community Association		X
Jared Gates		X
Wendy Grace		X
Cory Harden		X
Hawai‘i County Economic Opportunity Council		X
Hawai‘i Electric Light Company		X
Hawai‘i Gas		X
Hawai‘i Island Chamber of Commerce		X
Hawai‘i Island Economic Development Board		X
Hawai‘i Pacific Parks Association		X
Hawaiian Acres Community Association		X
Hawaiian Electric Company		X
Hawaiian Paradise Park Owners Association		X
Hawaiian Shores Community Association		X
Hawaiian Telcom		X
Historic Hawai‘i Foundation		X
Island of Hawai‘i Visitors Bureau		X
Susan Jamerson		X
Kamehameha Schools		X
Kalapana Seaview Estates Community Association		X
Kapoho Land and Development Company, Ltd.		X
The Kohala Center		X

	Comments Received?	
Agency/Organization	**Yes**	**No**
Kimo Lee		X
Leilani Community Association		X
Brennan Low	X	
Mainstreet Pāhoa Association		X
Maku'u Farmer's Market		X
Malama O Puna		X
Nānāwale Community Association, Inc.		X
National Trust for Historic Preservation		X
L. Peat O'Neil		X
Orchidland Community Association		X
Ridge to Reefs		X
Rotary Club of Pāhoa Sunset		X
Sierra Club Moku Loa Group		X
Maddie Tolbert		X
Volcano Community Association		X
Deborah Ward		X
Wastewater Alternatives & Innovations		X
WasteWater Education	X	
W.H. Shipman, Ltd.	X	

After a 45-day public comment period for this PDEIS, substantive comments will be responded to in writing with copies included in the programmatic final environmental impact statement (PFEIS) and addressed, as appropriate, in the PFEIS. If the Office of the Mayor, as the Accepting Authority, finds that the PEIS meets the criteria in HAR Section 11-200.1-28, the Office of the Mayor will issue acceptance of the PEIS in the Environmental Review Program's *The Environmental Notice*.

A description of the PEIS public engagement strategy is provided in Appendix E. The main elements include the Public Scoping Meetings that were conducted in October 2022, a StoryMap/project website (that includes links to recordings of the Public Scoping Meetings, a web-based comment platform linked to the StoryMap that can be used by the public, and other in-person engagement opportunities. The StoryMap website can be accessed at the following link:

https://storymaps.arcgis.com/stories/50e624065fa641598326febe6316327b

11.0 PREPARERS

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AECOM
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PDEIS Technical Studies/Support

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PBR Hawai‘i & Associates, Inc. (Stakeholder Outreach and Engagement)

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Appendix A:
Archaeological Literature Review

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Final

Archaeological Literature Review for the Puna Wastewater PEIS Project, Puna District; Keauhou and Kapāpala Ahupua‘a, Ka‘ū District, Hawai‘i Island TMKs: (3) 1-1-001 through 009, 9-9-001 (por.), and 9-9-002 through 010

Prepared for
AECOM
on behalf of the
County of Hawai‘i, Department of Environmental Management

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Management Summary

Reference	Archaeological Literature Review for the Puna Wastewater PEIS Project, Puna District; Keauhou and Kapāpala Ahupua‘a, Ka‘ū District, Hawai‘i Island, TMKs: (3) 1-1-001 through 009, 9-9-001 (por.), and 9-9-002 through 010 (Wilkinson et al. 2023)
Date	March 2023
Project Number(s)	Cultural Surveys Hawai‘i, Inc. (CSH) Job Code: HAWAII 14
Agencies	County of Hawai‘i, Department of Environmental Management (DEM)
Land Jurisdiction	Federal, State of Hawai‘i, County of Hawai‘i, private
Project Funding	County of Hawai‘i
Project Proponent	County of Hawai‘i DEM 345 Kekūanāo‘a Street, Suite 41 Hilo, HI 96720 Phone: (808) 961-8083 Fax: (808) 961-8086
Planning Consultant for the Project	Courtney Cacace Environmental Planner/Biologist AECOM Technical Services, Inc. 1001 Bishop Street, Suite 1600 Honolulu, HI 96813 Mobile: (650) 520-3254 Office: (808) 529-7297 Email: courtney.cacace@aecom.com
Project Location	The project area comprises the entire Puna District on Hawai‘i Island, as well as a small portion of the Ka‘ū District in the vicinity of Volcano Village near the summit of Kīlauea. The project area is shown on a portion of the 1975 U.S. Geological Survey (USGS) 1:250,000-scale topographic map of Hawai‘i Island (Figure 1), tax zone maps (Figure 2 and Figure 3), a 2017 aerial photograph (Figure 4), and a client-provided map (Figure 5).
Project Description	The County of Hawai’i (COH) DEM is preparing the required planning document— including a Programmatic Environmental Impact Statement (PEIS)—for establishing wastewater services for the Puna District through an anticipated 30-year planning period (the “proposed action’). The PEIS will analyze at a programmatic level potential environmental impacts (including impacts to historic properties) of the COH proposed action to install wastewater collection and treatment facilities in the project area. Broad proposals and/or planning-level decisions will be

	evaluated in the PEIS to allow informed choice among planning-level alternatives and the development of broad mitigation strategies. The PEIS will not address project-level issues such as precise footprints or specific design details that are not yet ready for decision at the planning level.
Document Purpose and Historic Preservation Regulatory Context	This investigation was conducted—through historical, cultural, and archaeological background research and a field inspection of the project area—to determine the likelihood that archaeological historic properties may be affected by the project. This document is intended to facilitate the project's planning and support the project's historic preservation review compliance. This investigation does not fulfill the requirements of an archaeological inventory survey (AIS) investigation, per Hawai‘i Administrative Rules (HAR) §13-276. This information may also be used to support the consultation with the State Historic Preservation Division (SHPD) regarding the project's necessary historic preservation review steps pursuant to HAR §13-275.

Sensitivity Model (Potential for Project Effect on Historic Properties)	Research indicates variable levels of archaeological sensitivity throughout the project area, dependent on factors including but not limited to pre-Contact and historic settlement patterns, proximity to the coast, extent of prior historic and modern development and related archaeological study, and geology (particularly lava flow areas).
	
	Archaeological sensitivity throughout the district of Puna and the Volcano Village portion of Ka‘ū District can be broadly characterized as follows:
	
	• Past archaeological research in the project area identifies the predominance of traditional Hawaiian archaeological sites within areas adjacent to the coast
	  o Traditional settlement patterns included permanent habitation at small coastal villages
	  o Upland areas used for scattered agriculture with related habitation and collection of forest resources
	• Upland areas in the project area may contain historic-era features associated with sugarcane agriculture or other commercial land use and related settlement
	  o Wide-scale disturbance for agriculture likely obliterated any traditional sites once present
	  o Historic-era features are usually considered less sensitive than traditional pre-Contact features
	  o Current town centers including Pāhoa and Kea‘au have origins associated with sugarcane plantations and timber harvesting

	○ The Volcano Village area developed in association with nearby activities at the Kīlauea summit and small-scale farming and ranching • Traditional site types documented in upland areas can include burials and other features within lava tubes ○ A number of major lava tube systems have been documented throughout Puna • Historic maps identify trails and roads throughout the project area ○ Some historic transportation routes had earlier pre-Contact origins ○ Trails are generally considered to have high cultural significance • The geographical area of Hawai‘i Volcanoes National Park contains a multitude of sensitive archaeological sites, and as federal land will pose hurdles to development • Volcanic activity from Kīlauea Volcano has impacted portions of Puna District and the archaeological sites present there ○ These flows are predominately along the east rift zone of Kīlauea ○ Large portions of Hawai‘i Volcanoes National Park have been impacted ○ The 2014 and 2018 lava flows impacted areas around and between the communities of Pāhoa in the uplands and Kapoho at the coast ○ “Young”’ lava flow areas have low archaeological sensitivity
Recommendations	General recommendations for establishing wastewater plants, pumping stations, and pipelines are as follows: • Placement away from the coast; • Avoidance of lava tubes of which some parts almost certainly contain cultural deposits or modifications; • Placement of new facilities on new lava flows might be considered; • Topography relative to potential future lava flow incursion is an important consideration. Following refinement of each individual project location and scope, the County shall determine if additional archaeological investigation is necessary and seek SHPD’s concurrence.

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Section 1 Introduction

1.1 Project Background

On behalf of the County of Hawai‘i, Department of Environmental Management (DEM) and at the request of AECOM, Cultural Surveys Hawai‘i, Inc. (CSH) has prepared this literature review report (LR) for the Puna Wastewater PEIS Project. The project area comprises the entire Puna District on Hawai‘i Island, as well as a small portion of the Ka‘ū District in the vicinity of Volcano Village near the summit of Kīlauea. The project area is depicted on a portion of the 1975 U.S. Geological Survey (USGS) 1:250,000-scale topographic map (Figure 1), tax zone maps (Figure 2 and Figure 3), a 2017 aerial photograph (Figure 4), and a client-provided map (Figure 5).

The County of Hawai'i DEM is preparing the required planning documents—including a Programmatic Environmental Impact Statement (PEIS)—for establishing wastewater services for the Puna District through an anticipated 30-year planning period (the "proposed action").

The PEIS will analyze at a programmatic level potential environmental impacts (including impacts to historic properties) of the COH proposed action to install wastewater collection and treatment facilities in the project area. Broad proposals and/or planning-level decisions will be evaluated in the PEIS to allow informed choice among planning-level alternatives and the development of broad mitigation strategies.

The PEIS will not address project-level issues such as precise footprints or specific design details that are not yet ready for decision at the planning level.

1.2 Document Purpose

This investigation was conducted—through historical, cultural, and archaeological background research and a field inspection of the project area—to determine the likelihood that archaeological historic properties may be affected by the project. This document is intended to facilitate the project's planning and support the project's historic preservation review compliance. This investigation does not fulfill the requirements of an archaeological inventory survey (AIS) investigation, per Hawai‘i Administrative Rules (HAR) §13-276.

This information may also be used to support consultation with the State Historic Preservation Division (SHPD) regarding the project's necessary historic preservation review steps pursuant to HAR §13-275.

1.3 Environmental Setting

1.3.1 Natural Environment

The project area is located in the Puna District and a small, upland portion of Ka‘ū District on windward side of Hawai‘i Island. The project area ranges from sea level to approximately 1,906 m (6,253 feet [ft]) above mean sea level (amsl). Annual rainfall in the project area is generally dependent on elevation, generally ranging from 1,500–2,500 mm (59–98 inches) along the coast to over 6,000 mm (236 inches) in the dense rainforests in the northeastern portion of Puna (Figure 6). Large portions of the project area have been set aside as forest reserve (see Figure 1).

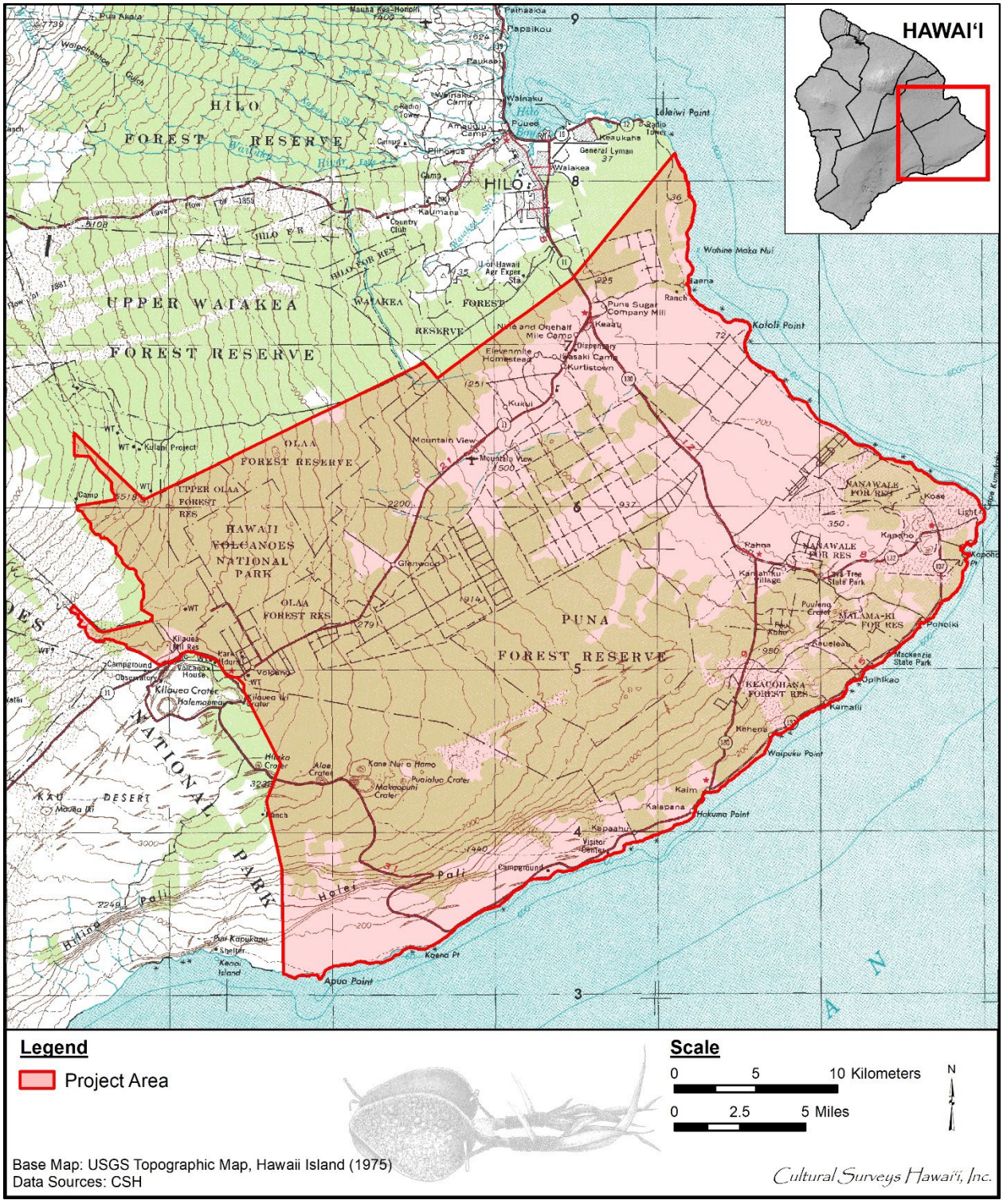

Figure 1. Portion of the 1975 USGS 1:250,000-scale topographic map of Hawai‘i Island showing the location of the project area

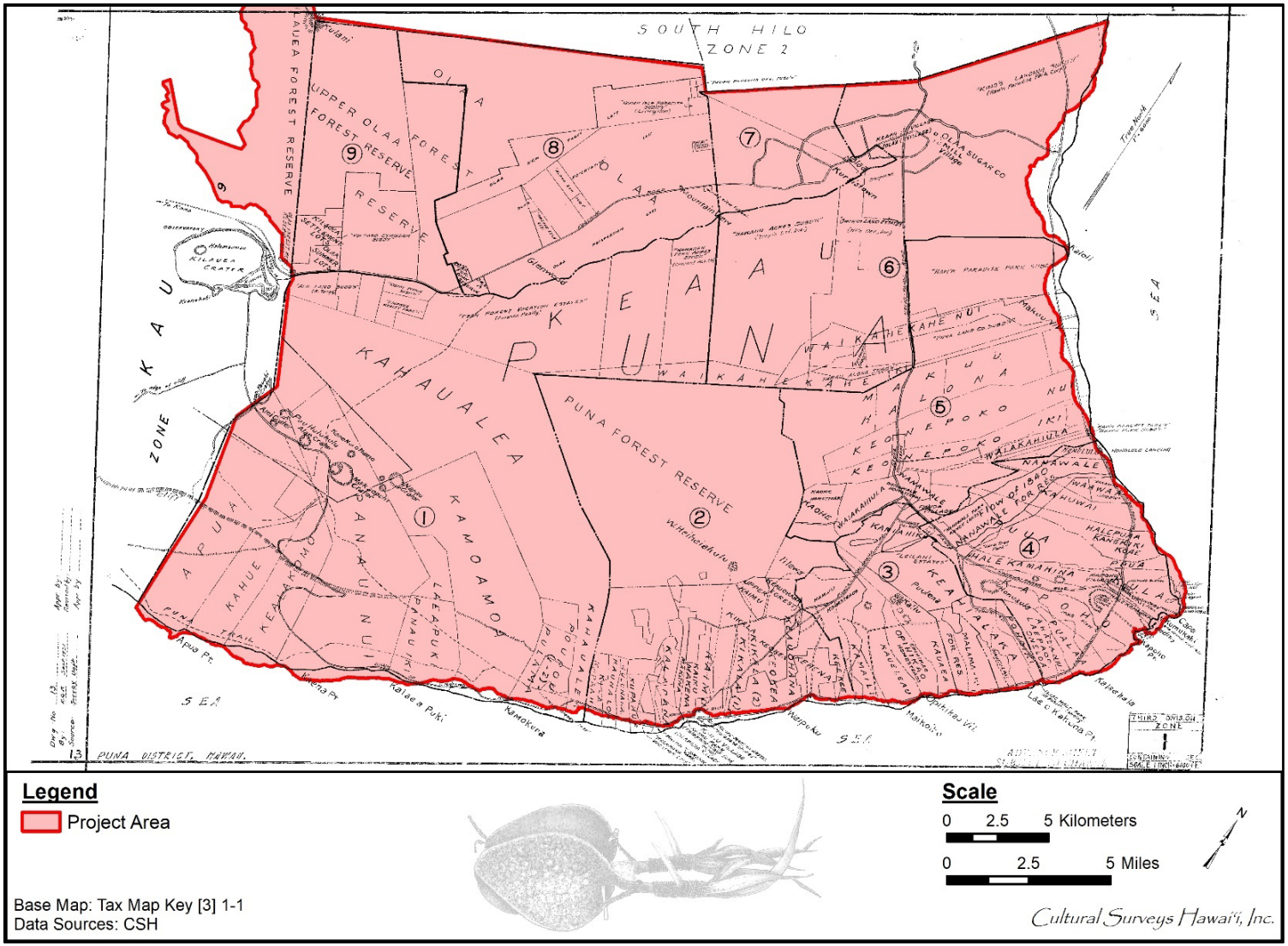

Figure 2. Tax Map Key (TMK) (3) 1-1 showing the project area in Puna District (Hawai‘i TMK Service 2014)

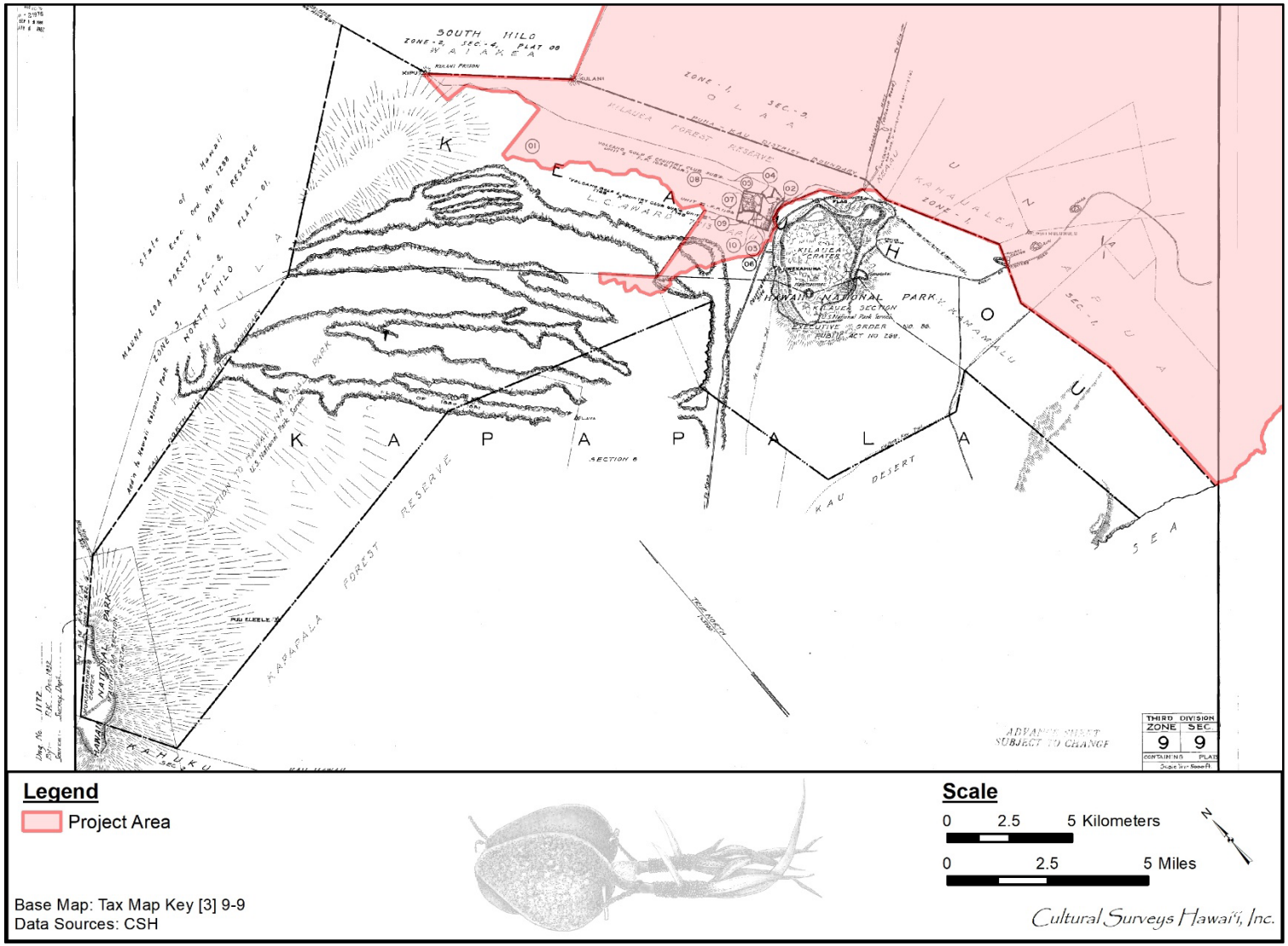

Figure 3. TMK: (3) 9-9 showing the project area in Ka‘ū District (Hawai‘i TMK Service 2014)

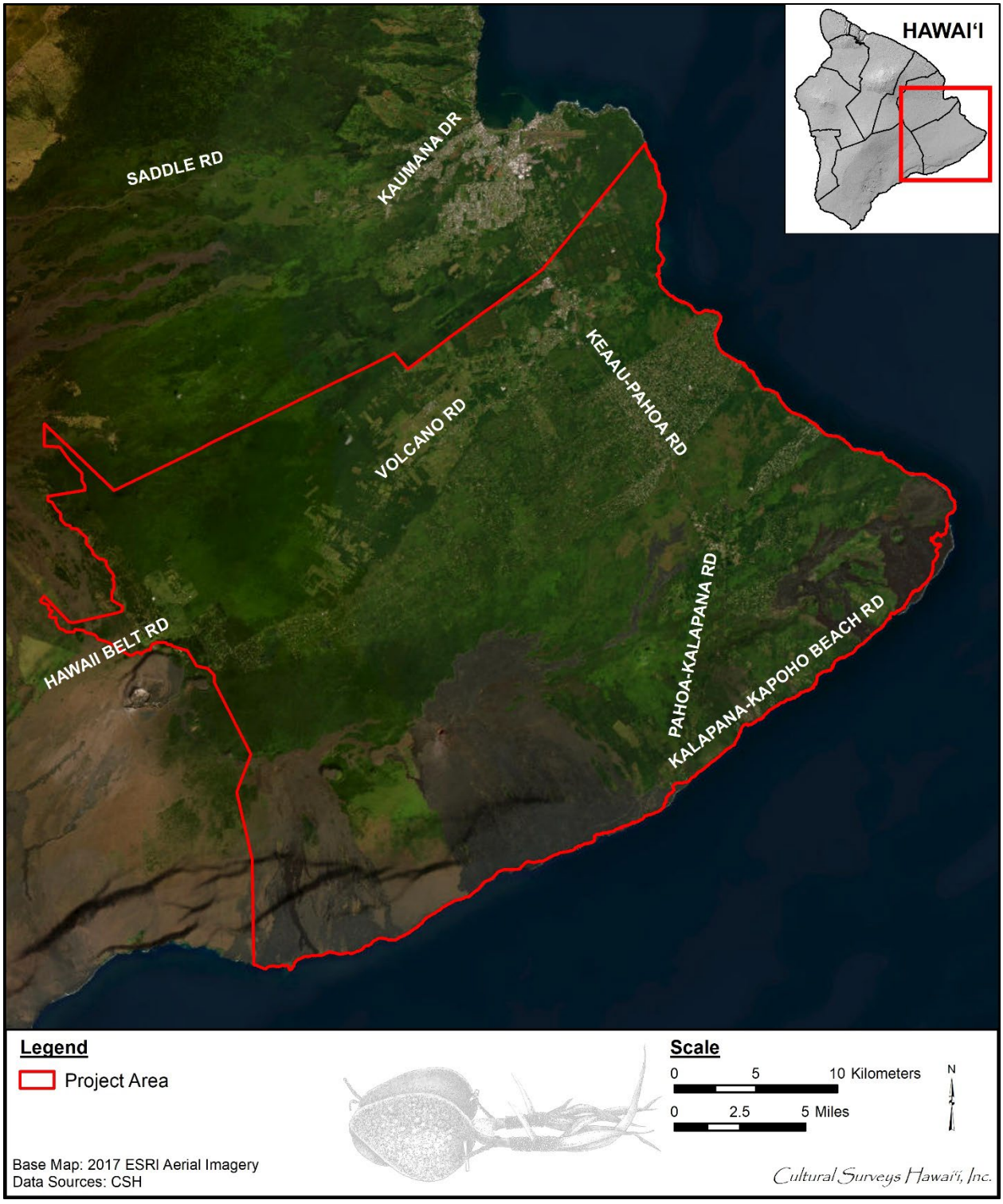

Figure 4. Aerial photograph of the project area (ESRI 2017)

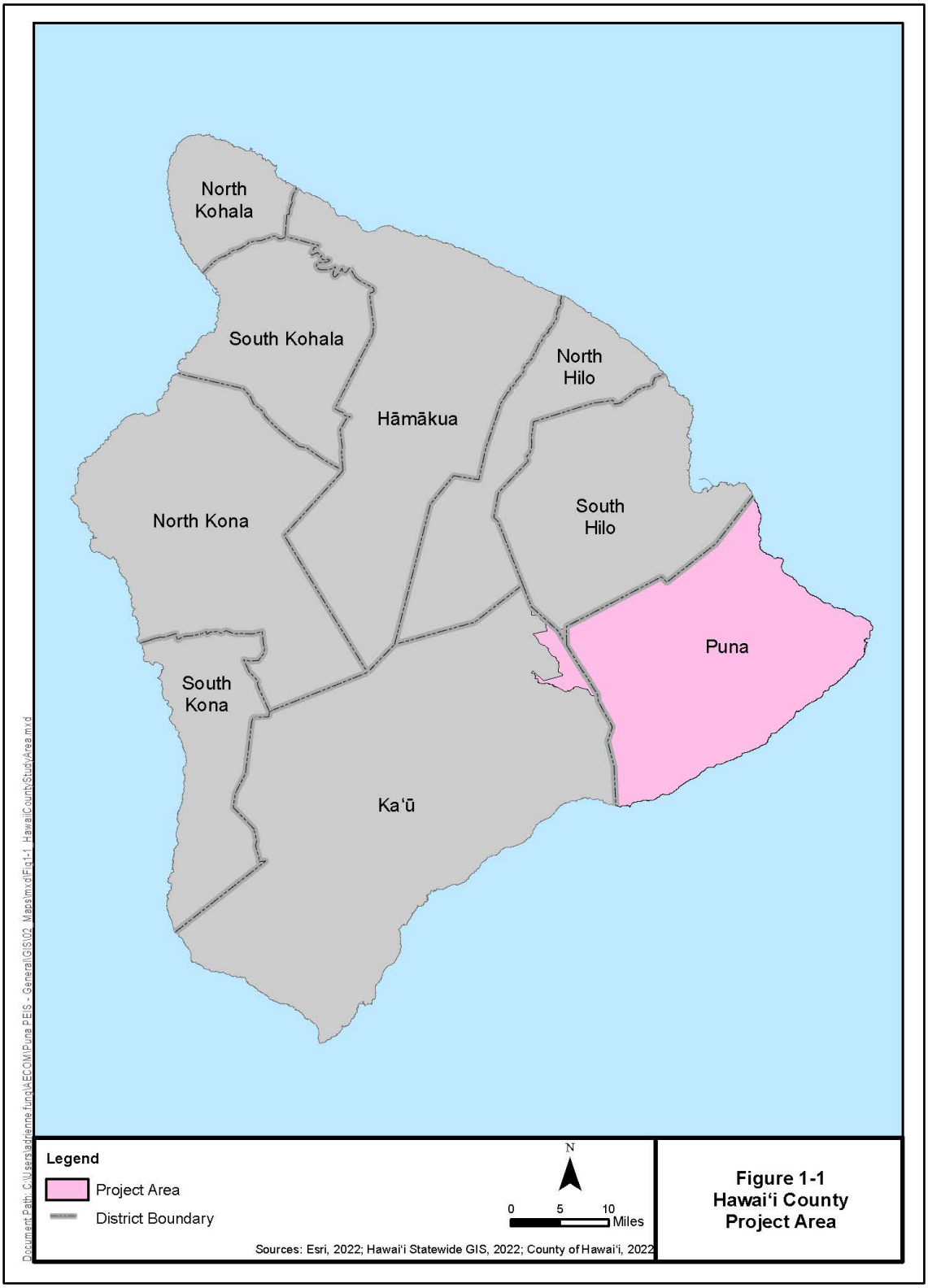

Figure 5. Map showing the project area extent in pink (courtesy of client)

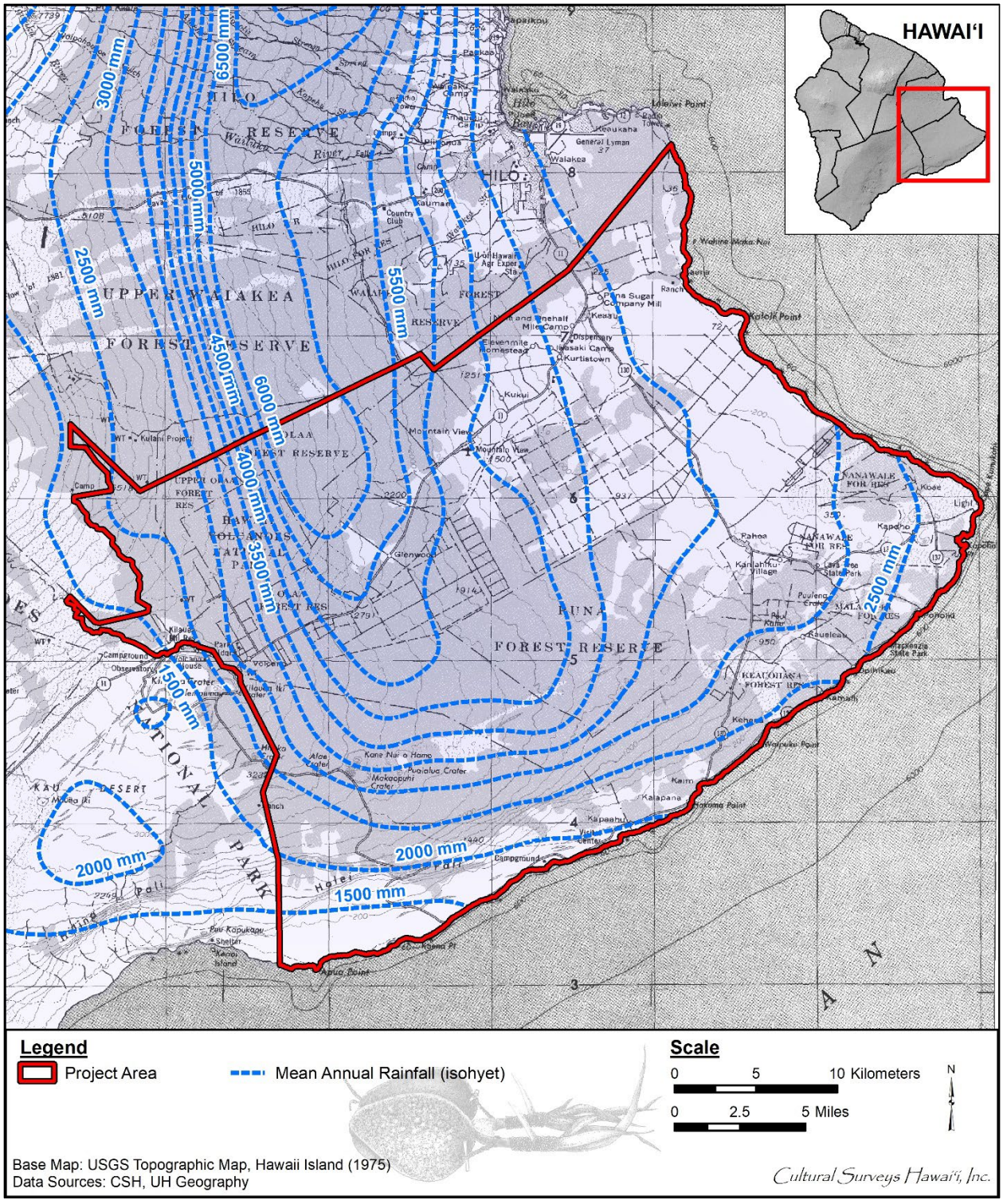

Figure 6. Portion of the 1975 USGS 1:250,000-scale topographic map of Hawai‘i Island showing main annual rainfall throughout the project area (“isohyet” is defined as a smooth line joining points of equal rainfall on a map)

Temperatures in the coastal portions of the Puna District are usually 60–80 degrees Fahrenheit, while the upper portions near and above the Kīlauea Summit are significantly cooler. As expected, the cooler temperatures and heavier rainfall occur in the winter months (October through April) and warmer temperatures and lighter rainfall occur during the summer months (May-September).

Only one notable stream is within the project area: a series of upslope drainages converge to form the intermittent Waipāhoehoe Stream, which is crossed by Highway 130 in Kea‘au. Two other relatively short intermittent streams are identified by USGS in Puna, including one located east of the old Olaa Sugar Mill in Kea‘au, and another in Keonepoko northwest of Pāhoa Village. A single freshwater lake, Ka Wai O Pele (also known as Green Lake), used to be present at Kapoho Crater in lower Puna, but this feature was destroyed by the 2018 Lower East Rift Zone eruption of Kīlauea. Abundant subsurface water flows throughout Puna, exiting usually at or near the ocean via springs. These underground sources of water are known to be quite pristine, having been filtered through miles of lava rock.

Figure 7 illustrates general ages of lava flows from Mauna Loa and Kīlauea throughout the project area. The majority of Puna District lies along the eastern and southern slopes of Kīlauea. Numerous eruptions over the past two centuries along Kīlauea’s East Rift Zone have inundated substantial portions of the district, including large swaths of the southern Puna coastline. The “seam” between the Mauna Loa and Kīlauea volcanoes roughly parallels the Highway 11 alignment, heading downslope from the Kīlauea summit and ending near Ha‘ena at the coast of Kea‘au. The Mauna Loa lava flows located north of this line in the project area are generally much older than the Kīlauea flows to the south. Lava tubes associated with past lava flows are common throughout the Puna district. Geothermal vents are also known to be present in the project area, focused along the rift zones and caldera of Kīlauea Volcano.

Soils throughout the project area are generally patterned after its geology (see Figure 7 and Figure 8). The most substantial soils in the project area are silty clay loams generally found within the areas of oldest Mauna Loa flows, though some small pockets of this soil type are also present in the eastern-central portions of the project area near the Highway 130 corridor. Soils and land types found in the Kīlauea portion of the project area are almost entirely characterized as *pāhoehoe* or *ʻaʻā* lava flows or cinder lands with little to no soil cover, or muck or loam soils containing high proportions of gravels, stones, or rocks.

1.3.2 Built Environment

Development in the project area is generally within the town centers and along the major transportation routes of Highways 11, 130, 132, and 137. Many of the towns in the project area such as Kea‘au, Pāhoa, Mountain View, and Glenwood were established in association with the sugar plantations and other historic-era land use. Remnants of these historic activities are still present and include the former Olaa Sugar Mill, plantation homes and shops, churches, schools, railroad berms and tracks, and other plantation-related features. The extent of the numerous residential subdivisions in the project area are visible in Figure 1. Most of these subdivisions were established in the 1950s and 1960s in agriculturally zoned lands. In the past few decades, the populations within these subdivisions have increased dramatically, straining the limited infrastructure in Puna. Many of the privately held lands outside the residential areas are under lease for commercial agriculture.

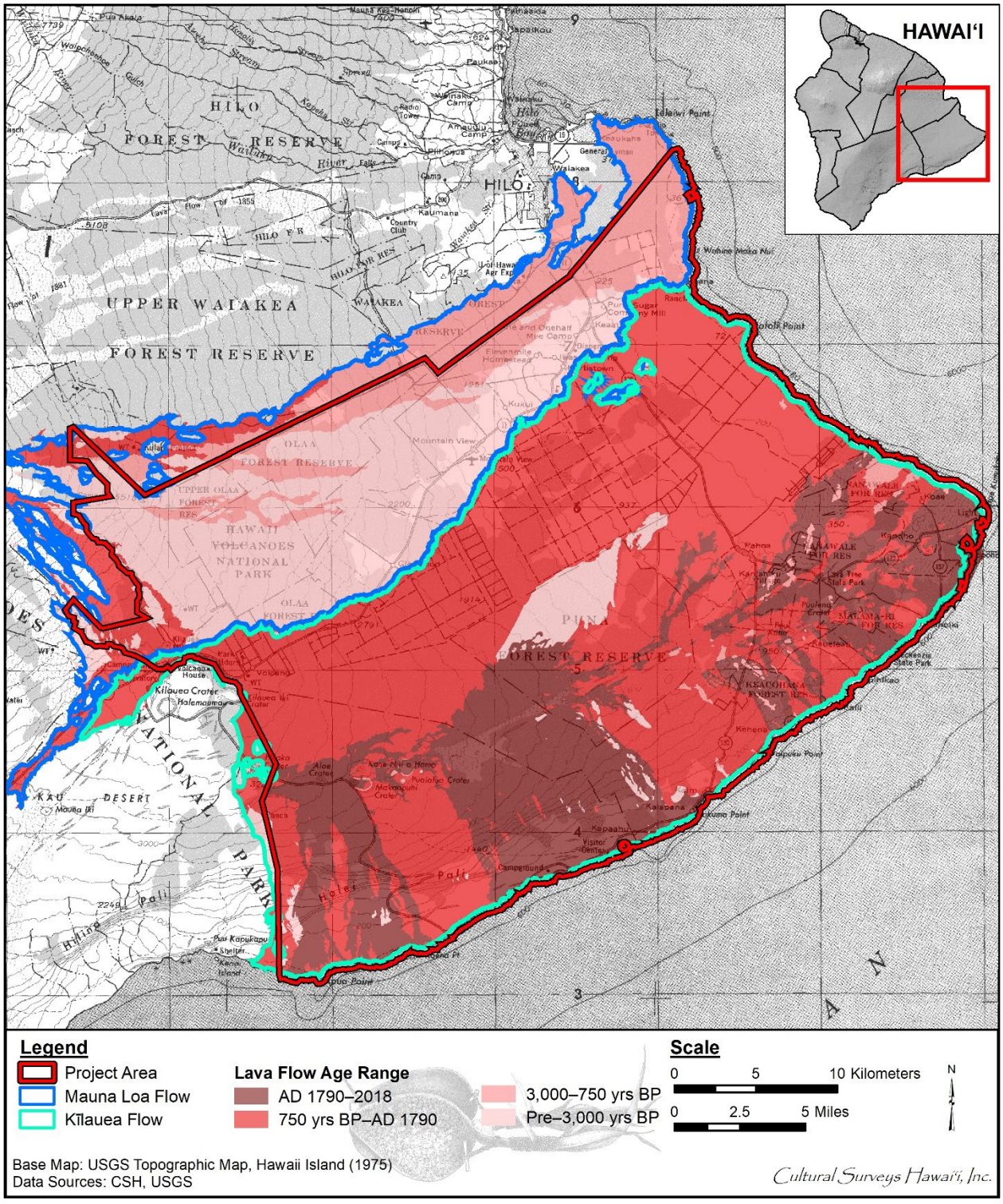

Figure 7. Portion of the 1975 USGS 1:250,000-scale topographic map of Hawai‘i Island overlain with geological data (Sherrod et al. 2008), indicating ages of general lava flow from Mauna Loa and Kīlauea volcanoes throughout the project area

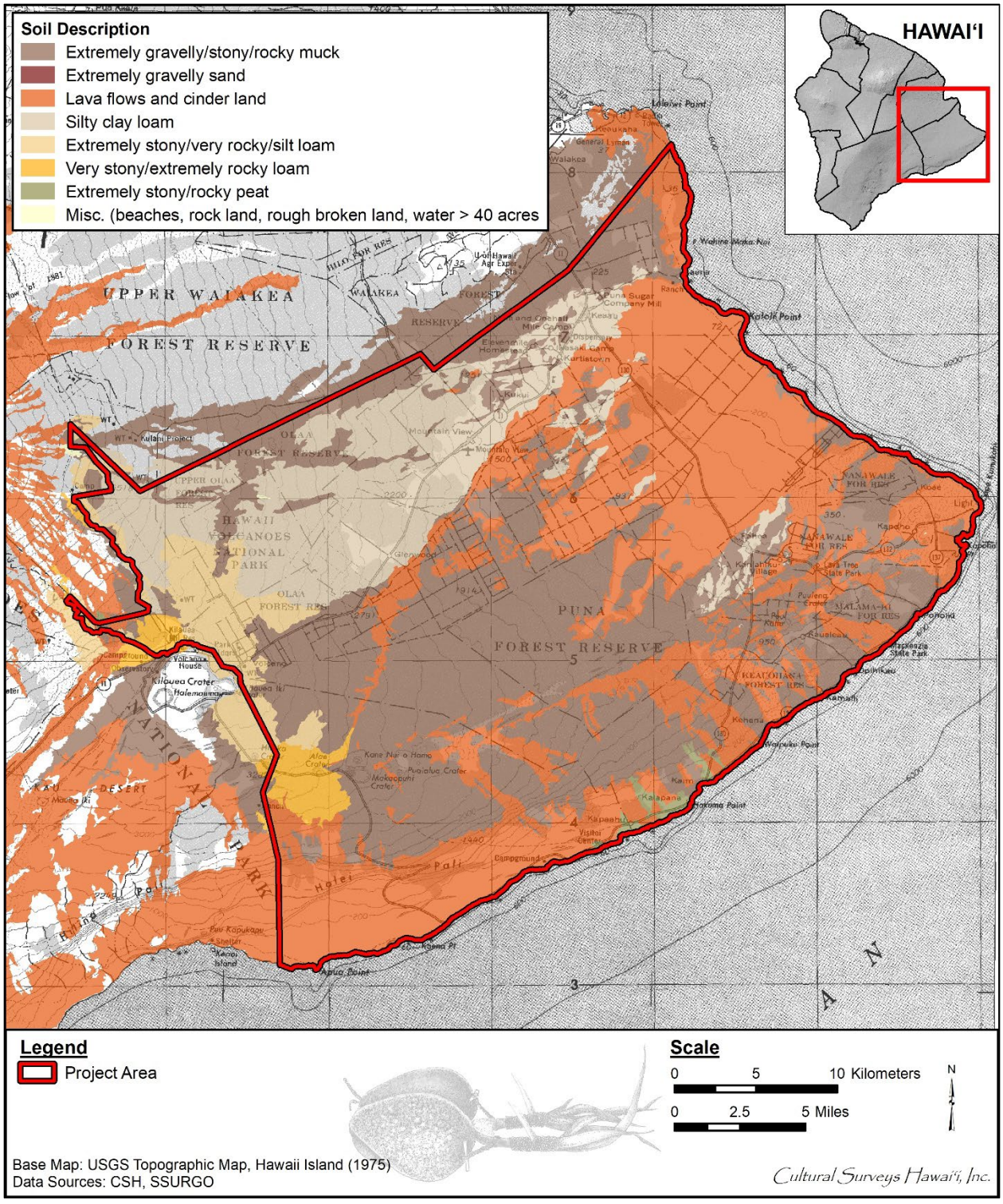

Figure 8. Overlay of *Soil Survey of the Island of Hawaii* (Sato et al. 1973), indicating generalized soil types within and surrounding the project area (U.S. Department of Agriculture Soils Survey Geographic Database [USDA SSURGO] 2001)

Section 2 Methods

2.1 Research Methods

Background research included a review of previous archaeological studies on file at the SHPD; review of documents at Hamilton Library of the University of Hawai‘i, the Hawai‘i State Archives, the Hawaiian Mission Children’s Society Library and Archives, the Hawai‘i Public Library, and the Bishop Museum Archives; study of historic photographs at the Hawai‘i State Archives and the Bishop Museum Archives; and study of historic maps at the Survey Office of the Department of Land and Natural Resources. Historic maps and photographs from the CSH library were also consulted. In addition, Māhele records were examined from the Waihona ‘Aina database (Waihona ‘Aina 2022).

This research provided the environmental, cultural, historic, and archaeological background for the project area.

Section 3 Traditional and Historical Background

This section contains a summary of the traditional and historical background associated with the project area. The project area includes the entire district of Puna and two *ahupua‘a* (traditional land divisions) in Ka‘ū District. According to cultural researcher Kepā Maly (1999:12), the Puna District is comprised of approximately 50 *ahupua‘a*. For general reference these *ahupua‘a* are listed in Appendix A along with corresponding acreages. The project area also overlaps small, upland portions of the two easternmost *ahupua‘a* in Ka‘ū District: Keauhou and Kapāpala.

Each subject heading below is broken into two subheadings, addressing the background of the Puna and Ka‘ū districts separately. Background for the district of Puna is discussed generally, as it covers a wide geographical area and numerous individual *ahupua‘a*. Background for the Ka‘ū District more specifically addresses Keauhou and Kapāpala.

3.1 Traditional Background

3.1.1 Puna District

According to Handy and Handy (1972), myths and legends provide an understanding of an early time when the district of Puna was famous for its long stretch of sand, fertile plains, and its *hala* (*pandanus*) trees and *‘awa* (*Piper methysticum*). Many *‘ōlelo no‘eau* (poetical sayings) and legends also describe Pele’s devouring of land by causing lava to cover either large areas of the region or more limited sections of it. Traditions imply Puna was one of Hawai‘i’s wealthiest agricultural regions. It is only in recent times that volcanic eruptions have destroyed much of Puna’s best land. The *mo‘olelo* or narrative stories of Puna also emphasize the area’s familial, genealogical, and political connections to the neighboring districts of Ka‘ū and Hilo. This connection is demonstrated by the mention of certain key place names both as places and as people. These *mo‘olelo* are not included herein but can be found in the companion *Cultural Sensitivity Map* study.

Barrère (1971:11) has speculated that the reason for the relatively small amount of traditional literature about Puna was the “remarkably successful” conversion of the natives to Christianity. This effort began when the Reverend William Ellis’ missionary party visited the district in 1823 and was continued and strengthened under Rev. Titus Coan’s management of the mission district beginning in 1835. In 1841, Wilkes noted, “Almost all the hills or craters of any note [in Puna] have some tradition connected with them; but I found that the natives were now generally unwilling to narrate these tales, calling them ‘foolishness’” (Wilkes 1845:[4]186).

In the early history of Hawai‘i there were many chiefs, each ruling one or several *ahupua‘a*, entire districts, or several districts. Emory et al. (1959) provide an explanation as to why there is a comparative lack of traditional political history surrounding Puna:

> We find that Puna, as a political unit, played an insignificant part in shaping the course of the history of Hawai‘i island. Unlike the other districts of Hawai‘i, no great family arose upon whose support one or another of the chiefs seeking power had to depend for his success. Puna lands were desirable, and were eagerly sought, but their control did not rest upon the conquering of Puna itself, but rather upon control of the adjacent districts, Ka‘ū and Hilo. An attempt to follow in detail the

> course of Puna’s history is bound up with the fortunes of the ruling families on either side of her. [Emory et al. 1959:15]

In the late 1500s, the government was united under the rule of Līloa, who became the *ali‘i nui* (high chief) over the entire island. He was a descendant of Pili, probably a high chief in the AD 1200-1300s period (Cordy 2000:160), who was said to be a voyager from the ancestral land of Kahiki. Līloa proclaimed an elder son, Hākau to be his heir, but gave to a younger son, ‘Umi (Umi-a-Līloa), the care of the god Kūkā‘ilimoku and his *heiau* (pre-Christian place of worship). After Līloa’s death, his younger son ‘Umi rebelled against the rightful heir, his older brother Hākau. The district chiefs refused to acknowledge his island-wide rights, and each chief went back to rule their respective district (or districts). ‘Umi fought endless battles and finally triumphed over all of these chiefs, including a chief of Puna named Hua‘a, and Imaikalani, “the powerful blind chief of Kau and parts of Puna” (Fornander 1996:99). Ultimately ‘Umi united the island once again under one *ali‘i nui* (Kamakau 1961:17–19).

The period following the death of Umi-a-Līloa was characterized by cycles of strife and peace (Fornander 1996:111–115). Puna does not seem to have had a district chief of its own; instead, it was at various times under the domination of the Hilo chiefs (descendants of ‘Umi and his wife Pi‘ikea) and the Kona chiefs (descendants of ‘Umi and his wife Kapukini).

In 1754 the chief Kalani‘ōpu‘u became the *ali‘i nui* of Hawai‘i Island (Kamakau 1992:78). Kalani‘ōpu‘u sent for his son, Kiwala‘o, and his favored nephew, Kamehameha. In an act reminiscent of Līloa and his two sons (Hākau and ‘Umi), Kalani‘ōpu‘u made the son his heir, with the right to perform the ritual to dedicate a *heiau*, but gave his god, Kūkā‘ilimoku, into the care of Kamehameha (Kamakau 1992:107).

One warrior who had originally fought on Kalani‘ōpu‘u’s side was a chief of Puna named ‘Īmakakoloa, “the dark ‘awa among the hala blossoms of Puna” (Kamakau 1992:86). This warrior rebelled against the rule of Kalani‘ōpu‘u:

> It was I-maka-koloa, a chief of Puna, who rebelled, I-maka-koloa the choice young ‘awa [favorite son] of Puna. He seized the valuable products of this district, which consisted of hogs, gray tapa cloth (*‘eleuli*), tapas made of *mamaki* bark, fine mats made of young pandanus blossoms (*‘ahu hinalo*), mats made of young pandanus leaves (*‘ahuao*), and feathers of the *‘o‘o* and *mamo* birds of Puna. [Kamakau 1992:106]

Kalani‘ōpu‘u moved with his court to Hilo and sent a war party into Puna to find ‘Īmakakoloa, but he escaped and hid with his people for almost a year. The court then moved to Ka‘ū and under the direction of a *kahu* (guardian or advisor), men began to burn the villages of Puna, until they found ‘Īmakakoloa, hidden on an islet off the Puna coast. ‘Īmakakaloa was taken to Ka‘ū, where his body was to be presented as a sacrifice at the dedication of Hālauwilua Heiau near South Point by Kiwala‘o, son of Kalani‘ōpu‘u (Kamakau 1992:108).

It was here that Kamehameha, like ‘Umi before him, made his bid for ascendancy over his cousin, the rightful heir, by seizing the body of ‘Īmakakoloa during the dedication ceremony and offering it to the gods himself, thus completing the dedication of the *heiau*, a duty that Kalani‘ōpu‘u had reserved for his son (Kamakau 1992:109). Kiwala‘o was later killed during a battle with Kamehameha’s forces, who went on to conquer all of Hawai‘i by 1791 and unified all

of the Hawaiian Islands under his rule by 1810 (Barrère 1971:7; Cordy 2000:191–208; Fornander 1996:72-78; Malo 1951:258).

During Kamehameha's conquest to gain control over Hawai‘i Island, he battled against many *ali‘i* on Hawai‘i Island. During one of his battles with Keawema‘uhili and Keōua, the infamous event of the "Law of Māmalahoe" took place in Puna. Kamakau (1992) recalls how this law came about:

> Since Keawe-ma‘u-hili and Keoua had joined forces against Kamehameha there was no place for him in Hilo; he camped his men at Laupahoehoe in Hilo Paliku (Hilo by the cliff). Afterwards Kamehameha and Ka-haku‘i paddled to Papa‘i and on to Kea‘au in Puna where some men and women were fishing, and a little child sat on the back of one of the men. Seeing them about to go away, Kamehameha leaped from his canoe intending to catch and kill the men, but they all escaped with the women except two men who stayed to protect the man with the child. During the struggle Kamehameha caught his foot in a crevice of the rock and was stuck fast; and the fishermen beat him over the head with a paddle. Had it not been that one of the men was hampered with the child and their ignorance that this was Kamehameha with whom they were struggling; Kamehameha would have been killed that day. This quarrel was named Ka-lele-iki, and from the striking of Kamehameha's head with a paddle came the law of Mamala-hoe (Broken paddle) for Kamehameha. [Kamakau 1992:125–126]
>
> At the time when he became ruling chief over all Hawaii, there were brought to him those men who had struck him with a paddle, together with their wives and children. All the chiefs said, 'Let them be stoned to death!' Kamehameha replied, 'The law of the broken paddle is declared: no chief or officer of execution is to take their lives. It is I who should by right be stoned.' What a wonderful thing for a chief thus to mete out justice toward those who had injured him! [Kamakau 1992:181]

3.1.2 Ka‘ū District

Keauhou is traditionally considered an *‘ili* (subdivision or land parcel within an *ahupua‘a*) of Kapāpala (Maly and Maly 205:ii). The land division of Keauhou can be described as

> […] among the most significant land areas in the Hawaiian Islands, as it is the home of Kīlauea, and abode of the goddess Pele. Because of the active volcanic nature of Kīlauea, and its manifestations of Pele and her family, as witnessed the geologic phenomena, the lua o Pele (volcano of Pele) has been a focal point of native traditions and religion; and since western contact, it has been the most frequently visited and written of landscape in the Hawaiian Islands. [Maly and Maly 2005:ii]

The portion of upland Keauhou in the vicinity of the project area would have been too wet and cold for cultivation or permanent habitation, and instead would have been used for capture of birds for their feathers and collection of *‘ōhi‘a* and *koa* woods for numerous uses (Kawachi 2003:4). The Keauhou Trail, connecting the Kīlauea Summit area with the coast some 10 miles away, generally followed the Ka‘ū-Puna District boundary (Kawachi 2003:4).

An archaeological study conducted at a cave in Hilina Pali in Kapāpala found evidence of Hawaiian occupation by AD 1600, and documented sites including shelters and trails used for

seasonal sweet potato cultivation, harvesting of *māmaki* (*Pipturus albidus*) for *tapa* (barkcloth) manufacture, collection of fresh water, and transportation to settlements along the coast (Cleghorn 1980:30).

3.2 **Early Historic Period**

3.2.1 Puna District

3.2.1.1 Early Accounts by Foreigners

The first foreigners to see the Puna coast were crew members of Captain Cook's third voyage to the Pacific in 1779. They were the first to note the differences in population and cultivation between the southwestern section of Puna and the more easterly area:

> The East part of Opoona [Puna] is flat, covered with Coco nut trees, and the land far back is of a Moderate height. As well as we could judge this is a very fine part of the Island, perhaps the best.
>
> On the SW extremity of Opoona the hills rise abruptly from the Sea side, leaving but a narrow border, and although the sides of the hills have a fine verdure, yet they do not seem Cultivated and when we sailed pretty near and along this end of Opoona, we did not observe that it was equally populous with the eastern parts. [Beaglehole 1967:606]

In 1823, British missionary William Ellis and members of the American Board of Commissioners for Foreign Missions (ABCFM)—Asa Thurston and Artemas Bishop—toured the island of Hawai‘i. After touring Ka‘ū District, they made a side trip inland to the Kīlauea crater (see Section 3.2.2), then returned back to shore near the Ka‘ū/Puna border. Mr. Ellis kept a detailed journal of his travels and was the second foreigner to note the differences in population and cultivation of the various areas of Puna.

T. Stell Newman (1971) reviewed the journal of William Ellis for his 1823 tour of Hawai‘i Island to reconstruct the environmental characteristics of aboriginal agricultural lands on different parts of the island. Based on Ellis' early observations, there were two main types of dryland farming in Hawai‘i, either in field systems or in scattered fields. As seen on the map provided in Newman (1971) (Figure 9), Ellis recorded only scattered fields on the northern coast of Puna, as opposed to the more organized field systems of the southern Puna coast.

> Within the western beginning of this field system, around Kaimū, Ellis approved of the 'extent of cultivation in the neighbourhood [*sic*], together with the decent and orderly appearance of the people,' and contemplated making Kaimū the location of a new mission. The next day, the party traveled on to Keouohana to preach, then to the villages of Kehena and Kamā‘ili, where they rested. They next traveled to ‘Opihikao (also written ‘Opihikāō [Pukui et al 1976:171]), not making any mention of the ahupua‘a of Kaueleau, suggesting there was not a large enough population in that area to stop for a sermon. They gave a sermon at ‘Opihikao, which Ellis describes as a 'populous village, situated within a short distance of the sea' (Ellis 1963:200). They continued east along the coastal trail:

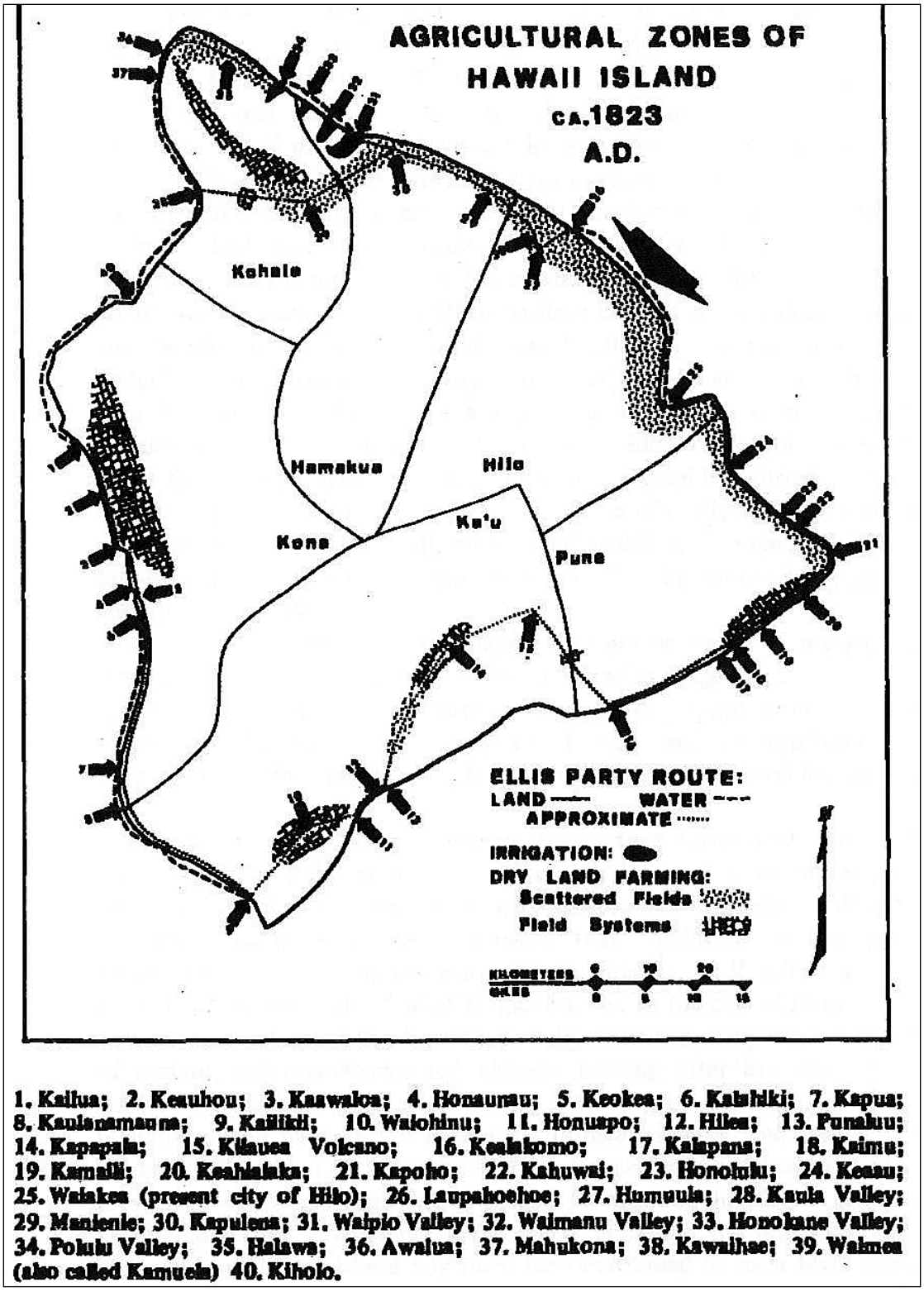

Figure 9. Newman’s (1971) map of the Ellis party route

> We then proceeded about two miles, principally through cultivated grounds, to Kauaea. About 300 people, excited by curiosity, soon collected around us, to whom Mr. Thurston preached. [Ellis 1963:201]

Their stay in the *ahupua‘a* of Kauaea was brief, so there is little description of the area. The group next traveled to the *ahupua‘a* of Malama and then to Keahialaka, the residence of Kinao, the governor of the Puna District. The party split up at Keahialaka, with Ellis remaining with the sick chief of Puna, Kinao, and the rest of the party continuing north to the village of Pū‘āla‘a.

> When they reached Pualaa, the above-mentioned village, they were kindly welcomed by the head man, who soon had the people of the place collected at their request, and to them Mr. Thurston proclaimed the news of salvation through Jesus Christ. The chief furnished the travelers with a hospitable supper and comfortable lodgings. […]
>
> About half-past eleven we took leave of them, and directed our way across the eastern point. A most beautiful and romantic landscape presented itself on our left, as we traveled out of Pualaa. The lava covered with a tolerably thick layer of soil, and the verdant plain, extending several miles toward the foot of the mountains, was agreeable diversified by groups of picturesque hills, originally craters, but now clothed with grass, and ornamented with clumps of trees. [Ellis 1963:205]

Barrère (1971:10) believes there may have been less than 100 people in the crowd that came to hear the missionaries at Pū‘āla‘a, since Ellis always gave an estimate of the audience when it was greater than 100 people. The chief of Puna, Kinao, visited by Ellis, may be Kinau, a son of Kamehameha, who was at one time considered his principal heir. Kamehameha instead selected a younger son, Liholiho, to be next *ali‘i nui* of the islands (‘Ī‘ī 1959:33, 37).

The missionary groups traveled to Kapoho and then past Kula, sometimes traveling “on the top of a wall four feet high and about three feet wide, formed of fragments of lava that had been collected from the surface of the enclosures which these walls surrounded” (Ellis 1963:211). They reached Kahuwai in the afternoon where they met with an assembled group of about 150 people, then traveling up the coast to Honolulu Landing to spend the night and continuing to Waiakahiula in the morning. Bishop left the group to continue the tour traveling along the coast to Kea‘au, and Ellis and Thurston followed the next day:

> Being somewhat recovered by noon, I was able to proceed with Mr. Thurston. The country was populous, but the houses stood singly, or in small clusters, generally on the plantations, which were scattered over the whole country. Grass and herbage were abundant, vegetation in many places luxuriant, and the soil, though shallow, was light and fertile.
>
> Soon after five p.m. we reached Kaau [Kea‘au], the last village in the division of Puna. It was extensive and populous, abounding with well-cultivated plantations of taro. Sweet potatoes, and sugar-cane; and probably owes its fertility to a fine rapid stream of water, which, descending from the mountains, runs through it into the sea. It was the second stream we had seen on the island […] [Ellis 1963:212]

Later in 1823, a mission station opened in Hilo, which was responsible for the districts of Hilo, Puna, and part of Ka‘ū. In 1833, two churches were dedicated, one in Hilo, and one in Kuolo, on

the eastern boundary in Puna (Hilo Station Report 1833:3). The missionary Titus Coan became head of the Hilo Station in 1835 and took his first tours through Hilo and Puna with his fellow preacher Mr. Lyman in the same year. Mr. Coan reported the following:

> Soon after, I made a tour with him into Puna, one wing of our field, and then through the district of Hilo, in an opposite direction. These tours introduced me to the people for whom I was to labor, and with whom I had a burning desire to communicate freely, and helped me greatly in acquiring the language. […]
>
> For many years after our arrival there were no roads, no bridges, and no horses in Hilo, and all my tours were made on foot. These were three or four annually through Hilo, and as many in Puna; the time occupied in making them was usually ten to twenty days for each trip. [Coan 1882:20]

In describing the district of Puna, Coan emphasized the abundant rainfall and evidence of volcanic activity, and the fields of vegetables and fruits grown in those regions with both deep soils and access to water.

> Its [Puna's] shore line, including its bends and flexures, is more than seventy miles in extent. For three miles inland from the sea it is almost a dead level, with a surface of pahoehoe or field lava, and a-a or scoriaceous lava, interspersed with more or less rich volcanic soil and tropical verdure, and sprinkled with sand-dunes and a few cone and pit-craters. […] The rains are abundant, and subterranean fountains and streams are numerous, carrying the waters down to the sea level, and filling caverns, and bursting up along the shore in springs and rills, even far out under the sea. […]
>
> Puna has many beautiful groves of the cocoa-palm, also breadfruit, pandanus, and ohia, and where there is soil it produces under cultivation, besides common vegetables, arrowroot, sugar-cane, coffee, cotton, oranges, citrons, limes, grapes, and other fruits. On the highlands, grow wild strawberries, cape gooseberries, and the ohelo, a delicious berry resembling our whortleberry. [Coan 1882:26]

In 1840 J.J. Jarves, editor of the *Polynesian*, documented a trip around the island. In addition to noting a village at ‘Ōla‘a, Jarves described taking an inland "middle Puna road" to view an eruption occurring in Nānāwale (Jarves 1840 cited in Maly 1999:33–34).

The Wilkes Expedition made a trip to the summit of the Kīlauea Crater in 1841, then returned along the Puna coast, descending from the crater to Kapoho. The route the Wilkes Expedition took extended through Waiakahiula downslope to the Puna coast. Nordhoff (1874:41), in his guide to the Hawaiian Islands, suggests "your pleasantest plan is to ride from Hilo by the direct road to the crater, and return by way of Puna" over the 70 miles back along the coastal path to Hilo, likely similar to the route Wilkes took in the 1840s:

> Almost the whole of it [Puna] is a land of desolation. A narrow trail across unceasing beds of lava, a trail which in spots was actually hammered down to make it smooth enough for horses' feet, and outside of whose limits in most places your horse will refuse to go, because he knows it is too rough for beast or man; this is your road. [Nordhoff 1874:41]

Most of these early visitors followed an ancient coastal foot trail; in the late nineteenth century this became a horse trail called the “Old Government Road” (Lass 1997:15). To improve these paths for horses, the variously spaced paving stones that marked the foot trail were removed and curb stones were added to mark the edges of the trail and guide the horses. It is uncertain exactly when the foot trail was altered into an “improved road.” Alfred Hudson thought it was constructed right before the Wilkes Expedition of 1840-1841, since Wilkes (1845) states, “In some places they have taken great pains to secure a good road or walking path; thus, there is a part of the road from Nanavalie [Nānāwale] to Hilo which is built of pieces of lava. […]” However, Lass does not believe this was a horse trail, since Wilkes also states, “[T]he road is exceedingly fatiguing to the stranger, as the lumps are so arranged that he is obliged to take a long and a short step alternatively, but this the natives do not seem to mind, and they pass over the road with great facility […]” (Wilkes 1845:191). This suggests the trail was made of variously spaced paving stones. During a tour of Puna in 1848 by the missionaries Henry Lyman and Titus Coan, no mention is made of an improved road. Lass (1997:17) believes the present form of the Old Government Road was constructed around the early 1870s.

3.2.1.2 Land Use

The U.S. Army Engineer Division contracted for an archaeological and historical literature search as part of the Lava Flow Control Study for Hilo, Hawai‘i (McEldowney 1979). The search included Kea‘au and surrounding *ahupua‘a* in the Hilo and Puna districts, encompassing the northern approximate half of the Puna district. Significant to the current project are the geographic and ecological zone classifications for early historic-period land use, which are presented in the report. These five zone classifications (McEldowney 1979:64) are listed below, and are pictured in Figure 10:

I: Coastal Settlement
II: Upland Agricultural
III: Lower Forest
IV: Rainforest
V: Subalpine or Montane

The coastal settlement land extends from the shore to about a half-mile inland (at 20-50 ft in elevation). The upland agricultural zone was once an open grassland band extending up to 3 miles inland and 1,500 ft in elevation; this zone contained scattered agricultural features and some temporary residence. The lower forest, beginning at elevations of 1,500 ft to 2,500 ft, was used to gather resources such as wood, bird feathers, fiber, and some food crops. The upland rainforest, at elevations from 2,500 ft to 5,500 ft, was used mainly by bird catchers to collect feathers and to gather other resources not available at the lower elevations. In the post-Contact era, the forest areas were also used for the collection of resources that could be sold as trade items to foreigners, such as sandalwood and *pulu* (McEldowney 1979). *Pulu* is the soft substance at the base of *hāpu‘u* ferns, which was shipped to California to be used for furniture and mattress stuffing (Baxley 1865:596; see also Section 3.4.1.2). The sub-alpine zone was located at elevations above 5,500 ft. Trails from one district to another are the major features found in this subzone.

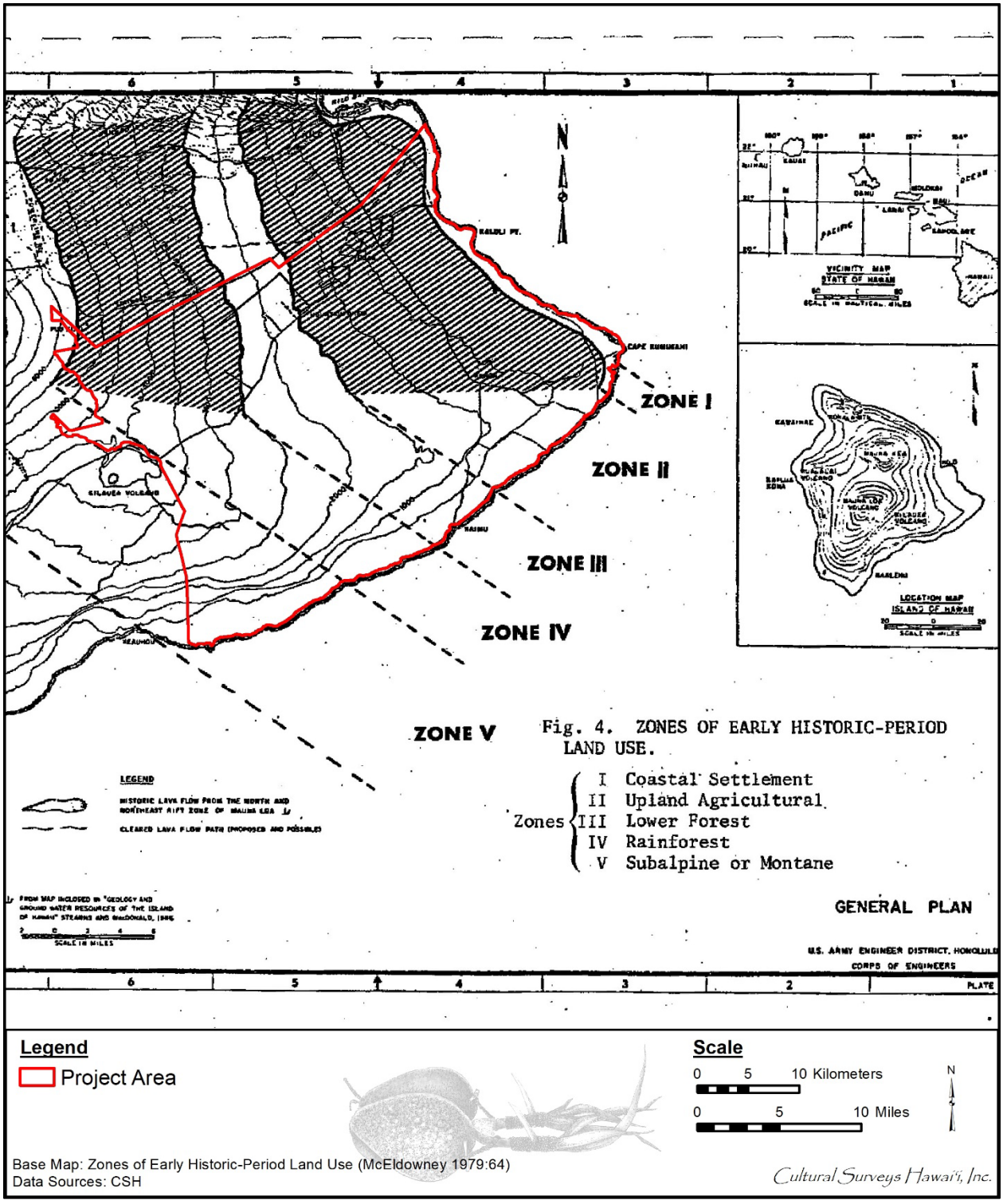

Figure 10. Map showing Zones of Early Historic-Period Land Use as described by McEldowney (1979:64) in relation to the northern half of the project area

The missionary Titus Coan described the forested lowlands of Puna, which at the time were still lightly inhabited and used for agriculture:

> The inhabited belt is one to three miles wide and in a few places there were hamlets and scattered villages five to ten miles inland. Beyond this narrow shore belt there is a zone of forest trees with a tropical jungle from ten to twenty-five miles wide, almost impenetrable by man or beast. [Coan 1882:29]

In Puna, historic accounts relate the cultivation of taro in cleared forest areas, dryland taro and sweet potatoes from the lower forest edge, and breadfruit and coconut trees near the coast. E.S. Craighill Handy related several methods of cultivation common and unique to Puna:

> In the wet, lowland forests of Puna, taro used to be planted under the pandanus trees, which were felled and cleared to let in the sun after the taro had rooted and put forth the first grown of leaves. It is said that here the cutting was planted wrapped in a roll of dry pandanus leaf to keep it moist and give it nourishment in the stony ground of the lava-covered lowlands. [Handy 1940:53]

> Despite the fact that sweet potatoes were planted almost universally and many patches are still maintained [as of 1931-1932], the Puna natives seem to regard this vegetable with little interest, probably because Puna people prided themselves upon and relished their breadfruit, and also because potato was nowhere and at no time the staple for this rainswept district. [Handy 1940:165]

Charles Wilkes and others described the myriad methods of sweet potato cultivation in Puna:

> [Potatoes] […] are seen to be growing literally among heaps of stones and pieces of lava, with scarcely soil enough to cover them; yet they are, I am informed the finest on the island. [Wilkes 1845:4:188]

> [Potatoes are planted] […] by digging holes in the lava where it was a little decayed, carrying a handful of earth to each of these holes, and planting there in a wet season, he got a very satisfactory crop. [Nordhoff 1874:94]

> The natives pick out the stones to the depth often of from 2 to 4 feet, and in the bottom plant the potato—how it can expand in such a place is a wonder. [Lyman 1846, July 7]

> [Potatoes are planted in] […] the holes dug among the stones to receive the potatoes where some of them 6 feet in depth—thus securing a degree of moisture and shelter from the sun though no more soil than at the surface. [Lyman 1846, July 13]

Titus Coan (1882:40) noted arrowroot, cotton, coffee, oranges, citrons, limes grapes, and other fruits and vegetables were grown in Puna. Handy and Handy (1972) also mention the unusual cultivation of breadfruit in Puna: “Except in Puna, Hawaii, breadfruit was wholly secondary to taro and sweet potato as a staple. We are told that in Puna in a good year, breadfruit may be eaten for eight months of the year, beginning with May” (Handy and Handy 1972:152).

3.2.2 Ka‘ū District

Missionary William Ellis visited Kīlauea during his 1923 tour, providing the first known written account of the volcano:

> The volcano of Kirauea, the largest of which we have any account, and which was, until visited by us, unknown to the civilized parts of the world, is situated in the district of Kapapala, nearly on the boundary line between the divisions of Kau and Puna, twenty miles from the sea-shore. [Ellis 1963:179]

Ellis' party approached Kīlauea from the Kā‘u side, crossing the Ponahohoa Chasm in Kapāpala which was associated with a recent eruptive event (Ellis 1963:141). Ellis' guide was a resident of Kapāpala, who "owned a small garden near." Ellis generally described this area of Kapāpala, situated between the sea and the foot of Mauna Loa, as fertile land, noting "The road by which we returned lay through a number of fields of mountain taro, which appears to be cultivated here more extensively than the sweet potato" (Ellis 1963:152). He also noted the use of caves in the area, both for residence and collection of water (Ellis 1963:154, 157).

A 1953 National Park Service publication describes how accommodations for early tourists to the volcano began to develop over the years following Ellis' visit:

> In the short span between Ellis' visit in 1823 and the early 1840's, Kilauea began coming into its own and more and more visitors came to marvel at it. Shelters improvised from boughs, grass, fern fronds, and other readily available materials were constructed one after another to protect visitors from the damp climate of the region, but these lasted only briefly. The *Polynesian* for July 20, 1844, reported that visitors to Kilauea would be gratified to learn that an enterprising Hawaiian had erected a comfortable thatched house on the brink of the crater, provided food, and in other ways added to the comforts and conveniences of travellers [*sic*].
>
> This first business enterprise at Kilauea apparently did not receive much patronage, for it was out of business in 1846 when Benjamin Pitman, Sr., a Hilo businessman, built a grass hut on the northeastern side of the crater and appropriately called it the Volcano House, a name which was to last for a long time. James J. Jarves, Editor of the *Polynesian*, visited Kilauea in the fall of 1847 and reported to his readers on the rates at the Volcano House: 37-1/2 cents for a fowl, 62-1/2 for a hen turkey, 25 for a small calabash of potatoes, and $1 a head for lodging.
>
> Pitman's enterprise apparently did not prove lucrative either, for Charles Hitchcock, an 1856 visitor, found the grass house but no sign of life in it, not even the manager. The primitive Volcano House of the day consisted of one room about fourteen by twenty feet in size. A mat covered the earthen floor. An 1860 visitor claims that twenty-three persons slept in that small space one night, another that it was capable of accommodating forty! [National Park Service 2006]

Aside from the ongoing activities at the summit, land use in the vicinity of the project area during this time would have likely represented a continuation of traditional activities, predominately the collection of forest resources.

3.3 The Māhele and the Kuleana Act

In the mid-nineteenth century, during the time of Kamehameha III, a series of legal and legislative changes were brought about in the name of land reform (see the works of Jon Chinen 1958, 1971 for a thorough and well-written explanation). Before the Māhele, all land belonged to the *akua* (gods), held in trust for them by the paramount chief, and managed by subordinate chiefs.

Following the enactment of a series of new laws from the mid-1840s to mid-1850s, Kamehameha III divided the land into four categories: Crown Lands reserved for himself and the royal house; Government Lands for the government; Konohiki Lands claimed by *ali‘i* and their *konohiki* (supervisors); and *kuleana*, small plots claimed by the *maka‘āinana* (commoners) (Chinen 1958:8–15). These claims are described in Land Commission Award (LCA) testimony from the claimants and witnesses. A Royal Patent (RP), which quit-claimed the government's interest in the land, was issued on most Land Commission Awards (Chinen 1958:14). In some cases, more than one RP number was issued for an LCA, especially in cases where there were several widely separated *‘āpana* (lots), such as an award with agricultural land in one *ahupua‘a* and a house lot in another.

Ali‘i were required to pay a commutation fee to the government for their confirmed Konohiki Land titles; this payment could be in cash or in the return of land to the government or crown. Many *ali‘i* elected to return substantial portions of their awarded lands to avoid the one-third commutation cash fee. The Kuleana Act of 1850 allowed *maka‘āinana*, in principle, to own land parcels where they were currently and actively cultivating and/or residing. In 1851, certain Government Lands became available for purchase in lots of 1 to 50 acres in fee simple; this new category of land ownership became known as Royal Patent Grants or Land Grants.

Although many Hawaiians did not submit or follow through on claims for their lands, the distribution of LCAs can provide insight into patterns of residence and agriculture. Many of these patterns probably had existed for centuries past. Examining the patterns of *kuleana* LCA parcels in the vicinity of the project area provides insight into the likely intensity and nature of Hawaiian activity in the area.

3.3.1 Puna District

The Māhele disposition of each *ahupua‘a* in Puna (i.e., classified as belonging to the Crown, Konohiki, or Government) is listed in Table 2 in Appendix A.

Very few *kuleana* awards were granted in all of Puna. One *kuleana* comprising 13.64 acres was awarded in Kea‘au, to Hewahewa (LCA 8081, Royal Patent 4360). The claim indicated the land was unfenced with no house, and that coffee was being grown (Hurst 1994:12–13, 17). This parcel was sold to the Roman Catholic Church in 1865. According to Lyman (1924, 10 July 1846) "one [*kuleana* award] for 13+ acres in Kahaualea, was to Baranaba an early convert to Christianity, and Rev. Titus Coan […] the other, for 7+ acres in Kehena was to one Haka." Other *kuleana* may have been awarded but the general takeaway from the current research is that these awards are few and far between in Puna.

The general absence of *kuleana* awards throughout the Puna district may indicate the paucity of habitation in the region during the mid-1800s. The absence of *kuleana* awards along the coast, where numerous villages were documented by travelers in the early part of the century, may be

due to a tsunami devastating the coast of East Hawai‘i sometime before 1846, or may be more related to political and/or other social factors than a total absence of inhabitants. Unfortunately, *kuleana* data cannot be utilized to reconstruct mid-1800s settlement patterns for Puna.

3.3.2 Ka‘ū District

In the Māhele the *‘ili* of Keauhou was awarded to and retained by Victoria Kamāmalu. Kapāpala was claimed by Kamake‘e Pi‘ikoi who relinquished it in commutation for lands elsewhere, and it was subsequently retained as Crown Lands. Regarding LCA in these land divisions, Maly and Maly (2005) note,

> Unfortunately, our review of all records submitted to the Commissioner to Quiet Land Titles, revealed no applications from native tenants for *kuleana* in the *‘ili* of Keauhou, or the larger *ahupua‘a* of Kapāpala. And only one claim was made for the neighboring land of ‘Āpua [in Puna] by Kumauna (*Helu* 11091), which was not awarded. The absence of claims is unexplained in any records reviewed, though we know from traditional and historical accounts, both pre- and post-dating the Māhele, that individuals were living at [the village of] Keauhou (and in the larger area of Kapāpala), and working the lands from sea level to the forest and mountain zones […] [Maly and Maly 2005:210]

3.4 Mid- to Late 1800s

3.4.1 Puna District

3.4.1.1 Population Changes

The mid-1800s were marked by a decline in population throughout Hawai‘i. Cordy (2000:49–50) estimates there may have been 12,000–15,000 people in Puna (29,000 for Puna and Hilo combined) at the time of first Western Contact (AD 1778). Population for each *ahupua‘a* may have ranged from 50 to 100 residents, based on the size of the *ahupua‘a* and the availability of food resources. By the time of the first missionary census, the combined population of the districts of Hilo and Puna was 12,500, a decline of over 50% for Puna. Soon after Contact, people began to move to port cities or other trading areas. Since Puna has no good harbor, it lost a large portion of its population to out-migration.

The missionary Rev. Titus Coan estimated the population of Puna was 4,371 in the year 1841, which stayed constant until at least 1846, when Chester Lyman visited the area. However, in a second journey to the area in 1871, Lyman (1924:103) noted a rapid depopulation: “There are but few people in this region […] miserably poor and for some time past have been almost in a state of famine.” Decreasing population was also the result of the introduction of many foreign diseases, to which the Native Hawaiians had no natural immunity. Four epidemics occurred in 1848 and 1849, killing at least 1,000 people in the Hilo and Puna Districts (Coan 1882:260; Crozier and Barrère 1971:7; Lyman 1906:168–169). Furthermore, destructive earthquakes in the spring of 1868 caused a 75-mile stretch of the Puna-Ka‘ū coastline to subside and a tsunami destroyed numerous coastal homes and villages (Coan 1882:314–316).

By 1860, the population of Puna was only 2,200 people, and by 1890, it had decreased to only 800 people (Schmitt 1968:71). Titus Coan wrote in 1882, “Our people are now greatly diminished by death, and by being drawn away to the numerous plantations of the islands, upon ranches, in

various industries with foreigners, and by hundreds into Honolulu, and on board vessels […]" (Coan 1882:121). Also visiting in the 1880s, Captain Dutton noted, "The native population is somewhat scanty and has undergone a great decrease within the present century, as in all other parts of the island" (Dutton 1884:147).

3.4.1.2 Advent of Commercial Enterprise

One of the earliest commercial endeavors in Puna was the harvesting of *pulu*, the soft yellow wool from the base of the tree fern used for stuffing mattresses and pillows. Shipments were first sent to California in 1847. That year 14,327 pounds, valued at $573.08, shipped out. By 1860, the *pulu* industry had peaked with 650,000 pounds exported. By 1884, only 500 pounds were shipped to the States (Thrum 1911:10). A Mission Station Report of 1860 relates the ruinous effect upon the native population of participation in the *pulu* trade:

> The effect—on them—is not good; not that the pulu is not a source from which they might secure comfort to themselves and families, but the actual result is the reverse. They are offered goods to almost any amount, to be paid for in pulu; this to a native is a strong temptation to go into debt. Consequently many of them are deeply in debt and almost all to some extent. The policy of the traders is to get them in debt and to keep them there so long as possible […] [T]hey are almost entirely under the control of their creditors, and are compelled to live in the pulu regions, at the peril of losing their houses and lots, and whatever other property they may possess. Thus their homes are almost in reality deserted, ground uncultivated. [W.C. Shipman 1860]

Coffee cultivation was first attempted in Puna by the 1890s. According to McEldowney (1979:40) "[i]n 1898 government land in Ola‘a was divided into homesteads to foster a projected coffee industry which, due to drops in the international price of coffee, a severe blight, and a poor choice of farm plots, barely lasted two years." Around 1894 a man named Robert Rycroft also grew coffee on about 35 acres in Pohoiki and developed a mill downslope near Pohoiki Bay (Cordy 1977:4). The fledgling coffee industry of Puna could not compete with similar growers in the Kona region, and coffee operations in Puna declined after 1905 and disappeared completely by 1927 (University of Hawai‘i 1927 in Cordy 1977:4). Coffee trees continued to grow in scattered clumps in the area, but local informants who lived in the area in the mid-twentieth century said the beans were not harvested (Kennedy et al. 1991:20).

Meanwhile, ranching was also being attempted in Puna. In 1860 the estate of Lunalilo (including the lands of Kea‘au) was mortgaged to Mr. Charles R. Bishop. The lease for Kea‘au subsequently passed to a series of holders including Rufus A. Lyman among others (Maly 1999:69, 77, 80, 83). Lyman also secured leases during this time to the lands of other Puna *ahupua‘a* (Maly 1999:79–80). According to Henke (1929:33), Keaau Ranch was established about 1875 by Lyman, Bishop, and partners including P.C. Jones, John Paty, and others, but in 1877 the lease and business interests in Kea‘au including the ranch were purchased by William H. Shipman and J.E. Eldarts (Maly 1999:84). A few years later in 1882 all of Kea‘au and Waikahekahehenui to the south were sold to W.H. Shipman, Samuel Damon, and J. Elderts (Maly 1999:91–92). Shipman later purchased the interest of his other partners to become the sole owner (W.H. Shipman Ltd. 2022).

During this time travel was conducted over a few well-established cart roads and smaller lateral foot or horse trails. An 1886 map (Figure 11) depicts the "Hilo and Volcano Road" extending from

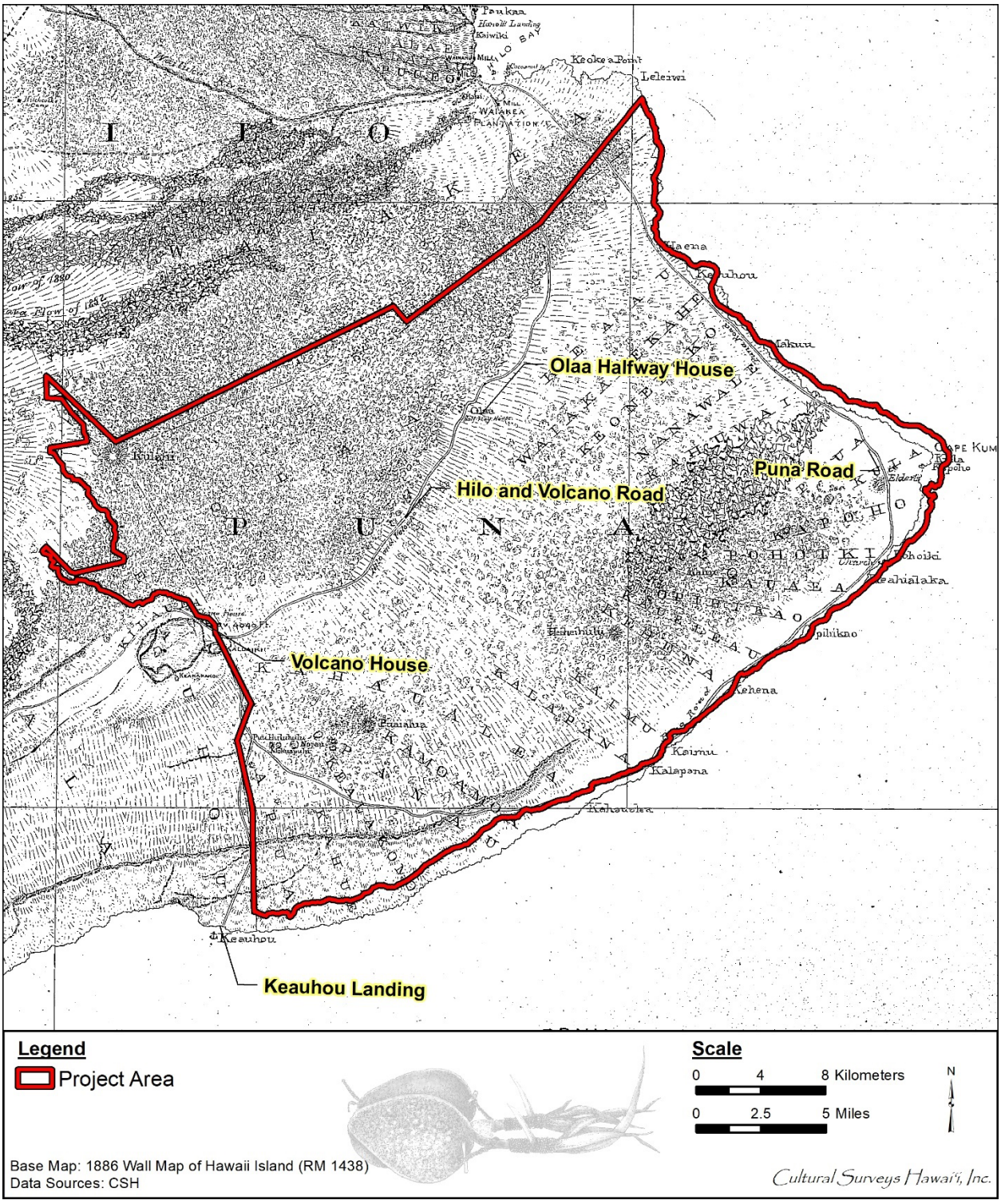

Figure 11. Portion of the 1886 Wall map of Hawaii Island showing the various roadways and places of lodging and the landing at Keauhou in Ka‘ū

Waiākea in Hilo through ‘Ōla‘a and Kea‘au to the Kīlauea Summit; the “Puna Road” running from Hilo along the Puna coast to Kahaualea where it then turned upslope and back up to the summit; and a branch from this latter road accessing a landing at Keauhou in Ka‘ū. An 1893 map of Puna (Figure 12) shows similar access routes and very limited development throughout the project area, aside from a large new area of homestead lots within ‘Ōla‘a. The establishment of homesteads and improved access in Puna toward the end of the nineteenth century also provided economic opportunity for small-scale farmers:

> In the 1890s, the Government was also opening up large tracts of Homestead lands throughout Puna, which were sold for residential and agricultural use. Because the rich agricultural parcels were generally situated three or more miles inland, above the 400 foot elevation Homestead lands could be better accessed, and their produce better transported by a new and more direct inland route between Puna and Hilo. [Maly 1999:6]

This new transportation route through inland Puna was first surveyed by A.B. Loebenstein in 1892. Thus, “the basic alignment of the Kea‘au-Pāhoa Highway (now Highway 130) was established and construction underway in 1895” (Maly 1999:6). This new route, as well as the extent of homestead tracts in relation to other land use areas, is depicted in a 1906 map of Hawai‘i Island (Figure 13).

A newly improved Volcano Road was completed in 1894, extending from Hilo through Shipman lands in Kea‘au to the summit of Kīlauea. This road provided an improved access route for visitors to the volcano, accommodating four-horse stagecoaches and “reducing the travel time from Hilo from two days to six and one-half hours” (National Park Service 2006). This significant reduction in travel time would have meant fewer and/or shorter stops at places of rest along the way, including the “Olaa Halfway House” shown on Figure 11; this specific location was mentioned in many of the early historic accounts of travelers to the volcano. Hilo became the principal departure point for Kīlauea, rather than other places in Ka‘ū. An 1893 article in a Hawaiian language newspaper describes how development of the route was transforming the surrounding landscape:

> The sections of Crown Land, adjoining the road have been leased. There are twelve miles of road that pass these lands, and the people are now working hard to cultivate the land. There are also many good houses that are being built, though those who travel along the road do not even see half of the areas worked, and they are hidden by the forest. This is because the forest has been protected from planting and from taking wood from along the road side […] The land of Olaa, which has been left from ancient times as wilderness (*nahelehele*), is now being planted in gardens since the making of this good road. [*Ku Okoa*, 26 August 1893:3, translated in Maly and Maly 2005:270]

3.4.1.3 Bernice Pauahi Bishop Estate

Another significant development during the late 1800s was the establishment of Bishop Estate. Lands retained by the *ali‘i* Victoria Kamāmalu in the Māhele and passed down through the royal family to Bernice Pauahi Bishop formed the basis of the Bishop Estate following her death in 1884.

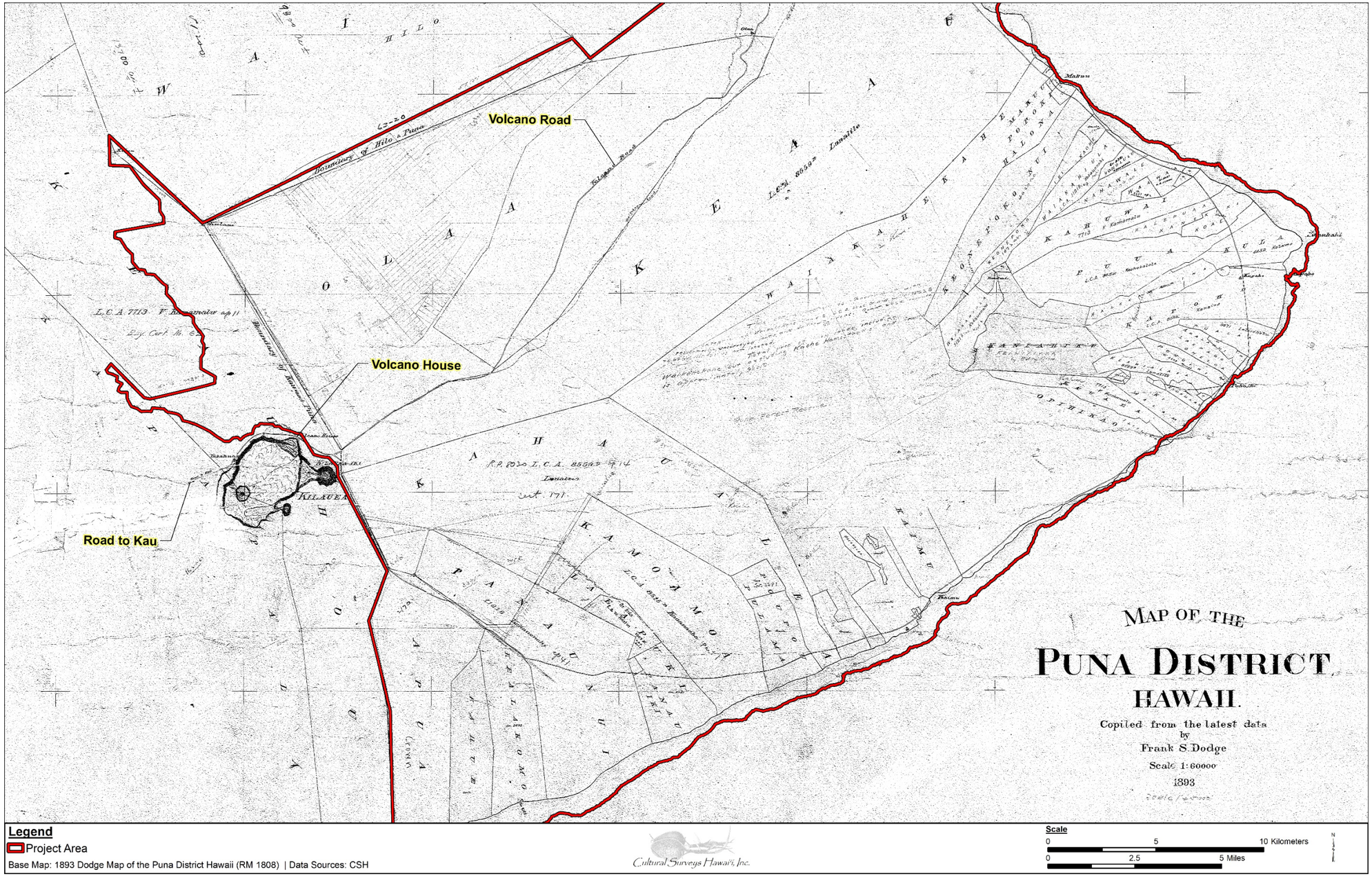

Figure 12. Portion of the 1893 Dodge map of Puna District showing roadways, Volcano House, and the grid-like homestead lots in upper ‘Ōla‘a

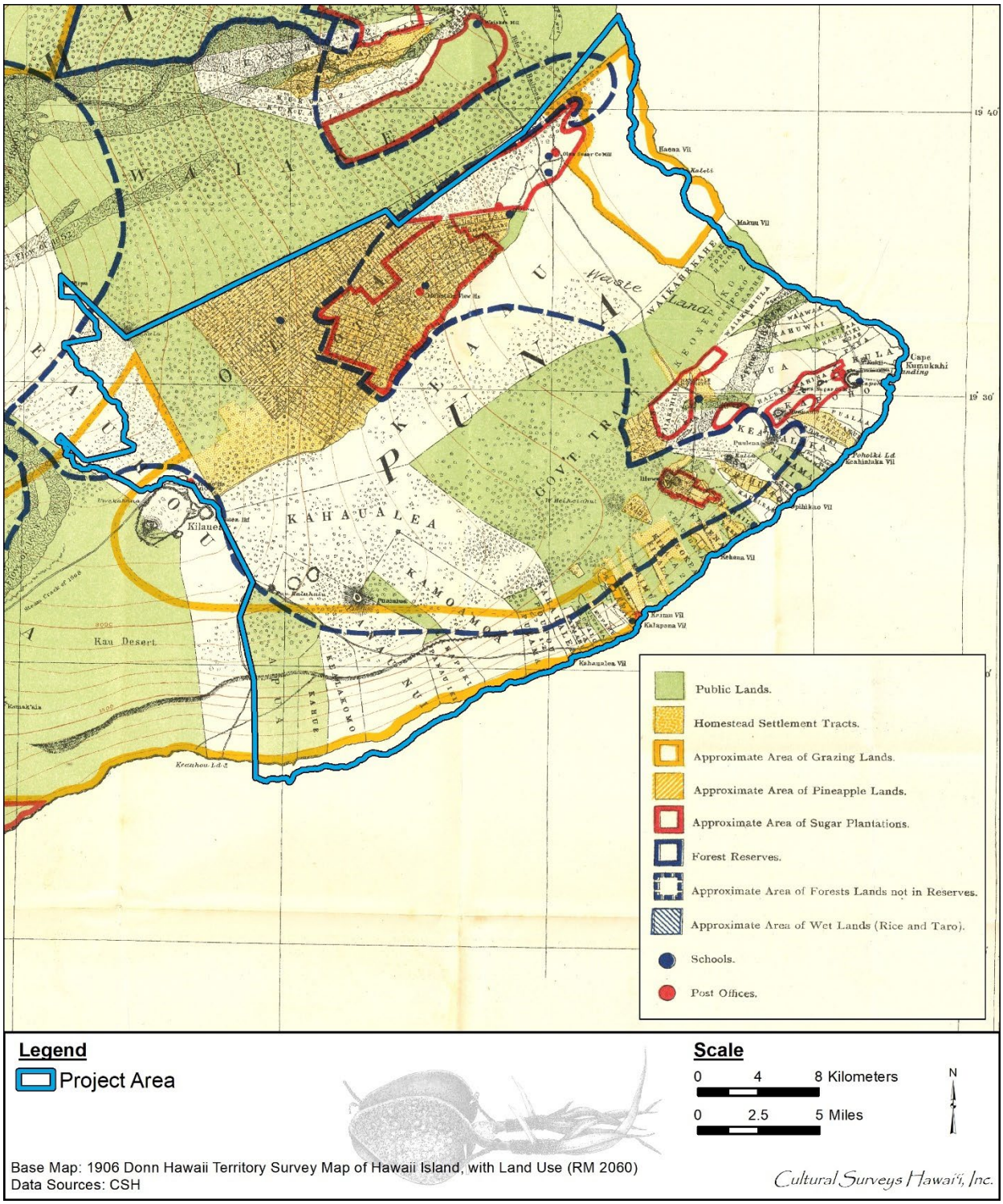

Figure 13. Portion of the 1906 Donn Hawaii Territory Survey map of Hawaii Island showing the new upslope road, various areas of different land use, villages along the coast, post office and school locations, the railroad, and other features; note the area labeled as “Waste Land” crossing upland Kea‘au to Keonepoko

According to researcher Peter Young (2022), “her combined lands were dedicated to the establishment of the trust forming the Bishop Estate and the subsequent forming of Kamehameha Schools.” As a result, Bishop Estate was situated to lease large acreages in Puna and elsewhere for agricultural purposes.

3.4.2 Ka‘ū District

During the latter 1800s the vicinity of the project area in Ka‘ū was largely influenced by the establishment of ranching and ongoing activity around the Kīlauea Summit. In 1863 Chiefess Kamāmalu and her father M. Kekūanao‘a formally leased lands in Keauhou for the development of goat and cattle ranching, *pulu* and timber harvesting businesses, the Keauhou boat landing at the coast, and a new Volcano House (Maly and Maly 2005:275; Young 2022). In 1866 the Volcano House was reconstructed offering more comfortable quarters and amenities to guests. A new, larger building was completed in 1877, which was expanded again in 1891 (National Park Service 2006); the location of Volcano House is depicted on both Figure 11 and Figure 12.

Mark Twain was among those who visited Kīlauea during this time period. During his visit in 1866, he noted the trail markers (*ahu*) or “pyramids of stones painted white, […] set up at intervals to mark the path to the lookout house and guard unaccustomed feet from wandering into the abundant chasms that line the way” (Twain 1866 in Day 1966:293). Kawachi (2003:6) remarks that modern roads were often build over older trails, likely obliterating “trail markers and other cultural resources such as those seen by Twain in 1866.”

Twain also remarked the “the whole country is given up to cattle ranching” (Day 1966:289). This activity was occurring on both a subsistence scale and larger commercial scale during this time period. Kapapala Ranch was a commercial venture established in Kapāpala Ahupua‘a ca. 1860, with headquarters “located *mauka* of the government road about six miles on the Hilo side of Pahala” (Henke 1929:35).

The deadly 2 April 1868 earthquake—considered the largest recorded earthquake in the history of Hawai‘i Island—caused a landslide and tsunami that washed away the ancient village of Keauhou (Pukui et al. 1976:104), among other coastal villages through Ka‘ū and Puna.

In the late 1880s Captain Peter Lee oversaw completion of a carriage road between Pāhala and the Kīlauea Summit. This road, depicted on Figure 12 as the “Road to Kau,” served as a primary access for those visiting the summit until the Volcano Road through Puna was completed in 1894 (National Park Service 2006).

3.5 Early to Mid-1900s

3.5.1 Puna District

3.5.1.1 Sugar Industry

In May 1899 Olaa Sugar Company leased 3,812 acres of land in ‘Ōla‘a (Pāhoa up to Mountain View) from W.H. Shipman for a term of 40 years (Maly 1999:59). Several more land exchanges were made the same year. The lands were allowed to be cleared (by horse and mule) for the cane fields, preserving only certain fruit trees, and by 1901 the Olaa Sugar Company held 4,000 acres of land under cane cultivation, employing 1,100 men (Hurst 1994:14–17). Development of the plantation between 1900 and 1905 “included construction of the railroad, Ola‘a Sugar Mill, shops and stores, public and Japanese language schools, churches, a cemetery, and labor camp housing”

(Hurst 1994:15). Many of these new features are shown on Figure 13 in relation to the extent of plantation lands and homestead tracts as of 1906. This industrial expansion in Kea‘au marks the beginning of massive landscape alterations and clearing operations which would have obliterated most, if not all, above-ground archaeological features present on the plantation lands. Notably, Figure 13 describes the upland portion of Kea‘au to Keonepoko below the forest reserve as “Waste Land” not being used for even grazing.

The sugarcane fields eventually stretched from the south Hilo border to Cape Kumukahi, then west to inland areas of south Puna. The plantation employed share laborers and ethnic workers including Japanese and, later, Filipinos, living in plantation camps (Hawaii Sugar Planters’ Association 1992; Takaki 1983:27). In 1936, the Olaa Sugar Company made the merger official and took over the Puna Sugar Company, which was based in Pāhoa and only operated for six years (Condé and Best 1973:93). Prior to that, the Puna Sugar Company operated as a division of the Olaa Sugar Company (Dorrance and Morgan 2000:107).

3.5.1.2 The Hilo Railway Company and the Timber Industry

A 40-ft right-of-way from Kea‘au to Hilo was granted to the Hilo Railway Company in December 1899; the right-of-way was to revert to Shipman when the railway was no longer in use (Hurst 1994:15). In 1900, a 17-mile coastal extension was constructed to the sugarcane fields near Kapoho. Spurs were built inland to additional fields in Pāhoa and Kama‘ili. The rail transportation occurred primarily from the ‘Ōla‘a, Pāhoa, and Kapoho fields and was used to haul sugar to the mill in ‘Ōla‘a. In 1901, the railway was extended from 8 ½ mile camp south to the Mountain View/Glenwood vicinity, at the 17-mile mark of Volcano Road (Condé and Best 1973:99, 211, 388). The extended railway was also used by tourists visiting the Kīlauea Summit:

> Visitors transferred from the railroad coaches to horse-drawn carriages at Glenwood and later to motor buses for the remainder of the trip to Kilauea. Increasing acceptability of the horseless carriage and improvement of the Volcano Road caused the Hilo Railroad to discontinue its Glenwood run in 1926. By this time, surfacing of the Volcano Road to the park boundary had been almost completed. [National Park Service 2006]

In 1907, the Hawaiian Mahogany Lumber Company (later called the Pāhoa Lumber Company) was founded, initially for the purpose of making *‘ōhi‘a* wood rails for the railroad. Much woodland was cleared in ‘Ōla‘a, but the woodcutting was also conducted in other areas of Puna:

> Most of the ties for this contract will be cut in the Puna District on homestead lots above Olaa on lands of the Puna plantation that are being cleared for cane, and on other lands in Puna on which rubber will be planted. The ties will be shipped from Hilo by steamers and sailing vessels, the first shipment being sometime in the spring of 1908. [Board of Commissioners of Agriculture and Forestry 4th report in Condé and Best 1973:101]

Figure 13 shows clearly how extensive the homesteads were in ‘Ōla‘a. McEldowney (1979:41) notes, “Many people who had come from the U.S. Mainland to farm the unsuccessful Ola‘a homesteads eventually moved to Hilo and contributed to its increasing diversity.”

In 1914, the Hilo Railway Company went into receivership and was reorganized as the Hawai‘i Consolidated Railway. Portable tracks were used in the cane fields until 1945. Figure 14 shows

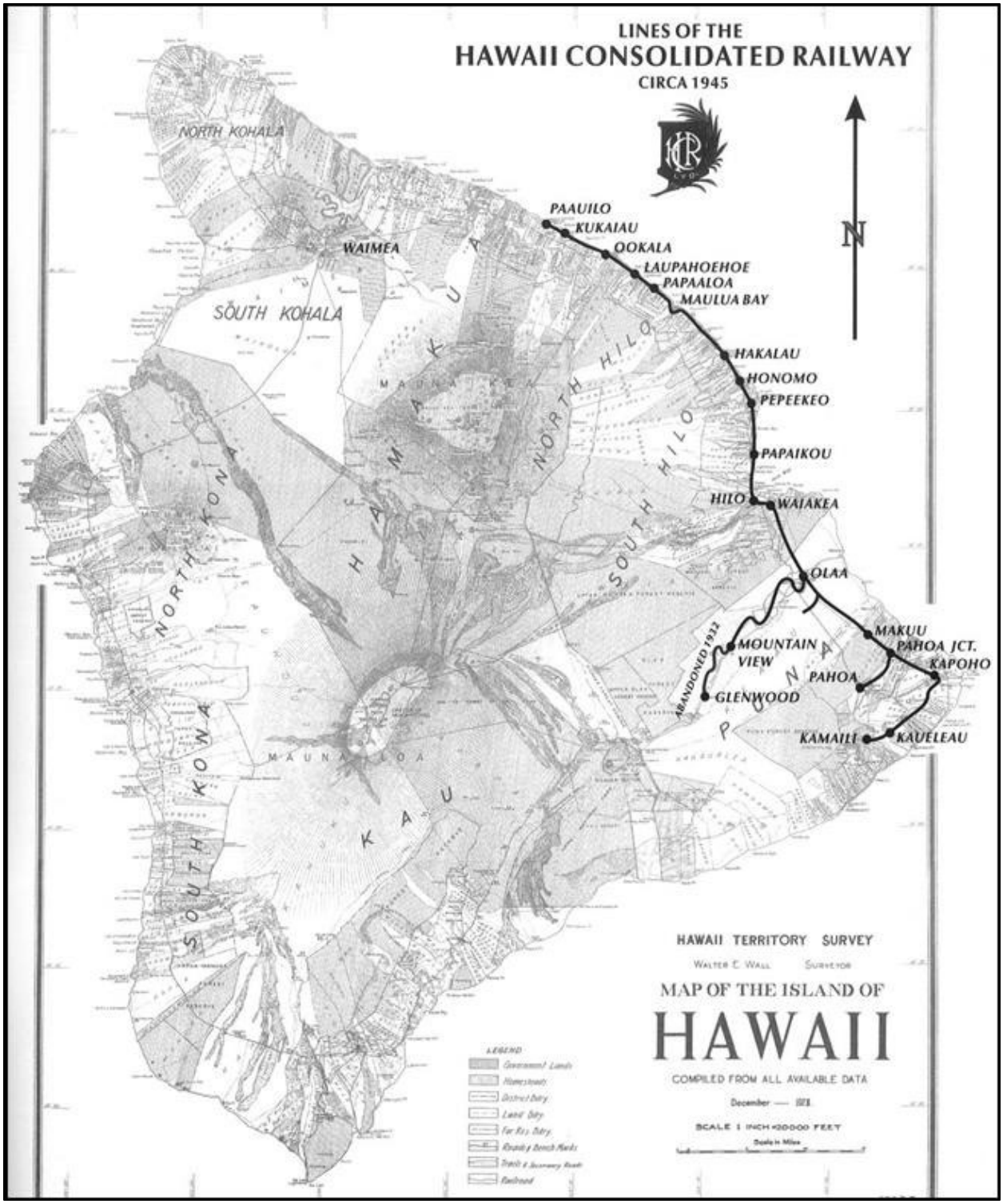

Figure 14. 1928 Territory Survey map of Hawai‘i Island by Walter E. Wall, overlain with the route of the Hawai‘i Consolidated Railway ca. 1945 (figure from Treiber 2005)

the extent of the railway at that time. Prior to using the portable tracks, loaded carts were pulled by mule to the main line. On 1 April 1946 a tsunami inundated the railway on the Hāmākua Coast and in Hilo, forcing the Hawai‘i Consolidated Railway Company out of business (Condé and Best 1973:99, 211, 388). However, portions of the Puna Division continued to be operated by the Olaa Sugar Company until 1948, when trucks took over the transportation of the sugarcane (Treiber 2005:59).

3.5.1.1 Ranching

By the 1920s the Kea‘au Ranch consisted of 50,000 acres, extending from the coast to elevations of 1800 ft amsl (Henke 1929:32). The ranch stretched from ‘Ōla‘a in the north to Pāhoa in the south. In his survey of cattle ranches on Hawai‘i Island, Henke (1929) provides the following additional information:

> The ranch formerly included lands in the Waiakea and Keaau sections now planted to sugar cane.
>
> Much of this land is pahoehoe and aa lava (undated flows) sufficiently decomposed and covered with thin soil in many places to afford mediocre pasturage. Fruit trees do particularly well in these partially decomposed aa flows.
>
> The ranch carries about 4,000 grade Herefords with about 100 bulls, 25 purebred and the other high grade. All cows except those kept for breeding cows are spayed. The rough character of many parts of the ranch necessitates more bulls than would otherwise be needed.
>
> The ranch has about 70 miles of fences, both stone and wire. Holes for posts have to be blasted in the lava. The region has a rather heavy rainfall, 106 inches in 1925, 85 inches in 1926 and 196 in 1927 at the ranch headquarters on the sea at Haena and this provides sufficient streams and pools of water for the cattle.
>
> Cattle from Keaau ranch are often sent to a higher ranch, Puu Oo [located on Mauna Kea above Hilo], belonging to the same owner, when about one year old and only about 150 are marketed annually direct from Keaau. The combined ranches with about 8,000 head market about 1,200 a year when 2 to 2½ years old, when they dress out at about 550 pounds. About 300 head a year are shipped to Honolulu, often driving them over the slopes of Mauna Kea to Kawaihae, where they are loaded on the steamers. The balance are slaughtered at the slaughter house of the Hilo Meat Company in Keaau. [Henke 1929:32]

Ranching was never a very lucrative business in the area since the soil was too poor for good pasturage (United States Army Corps of Engineers 1979:88).

3.5.1.1 Forest Reserves

In 1911 the territorial government set apart 19,850 acres of forest in Puna as the Puna Forest Reserve, on the recommendation that such action would allow for collection of revenue from the ongoing timber operations (Uyeoka et al. 2014:286–7). An additional 5,888 acres were added to the Forest Reserve in 1928.

According to Maly and Maly (2005:325), between 1913 and 1923 the Upper Waiakea and Upper Olaa forest reserves had also been established on 51,800 acres and 9,280 acres, respectively, both adjoining upper Keauhou in Ka‘ū where the Bishop Estate held forest in private reserve.

In 1918 approximately 20,000 acres in ‘Ōla‘a were recommended to be set apart as the Olaa Forest Reserve. A report from Forester C.S. Judd describes a “heavy forest of native trees […] which is impenetrable except for the roads and trails which have been cut though it,” and notes the prior attempts to farm coffee and raise cattle that had been unsuccessful due to the wet, cool, weather and poor, rocky soil (C.S. Judd 1918 cited in Maly and Maly 2005:328). The report also states,

> Sufficient land has been left out of the area recommended to be set aside to provide for the need of additional homesteads at the *makai* or lower end where soil conditions are more favorable, and a sufficient area at the high elevation near the upper end, not far from the Volcano House, has been reserved for additional summer lots. [C.S. Judd 1918 in Maly and Maly 2005:328]

Establishment of the “Olaa Summer Lots” appears to be the precursor to development of what is now known as Volcano Village. The 1930 USGS topographic map (Figure 15) depicts the extent of the summer lots, a “Volcano School” close to Volcano Road, and another area labeled “Olaa Settlement Lots” to the north.

Additional reserves were also established during the early 1900s in lower elevations of Puna, including the Keauohana, Malama-Ki, and Nanawale forest reserves. Some of these forest reserves in Lower Puna are visible on a 1927 map in relation to homestead areas (Figure 16).

3.5.1.2 Hawai‘i Volcanoes National Park and the Kilauea Military Camp

In 1916 the United States Congress established the National Park Service, and Hawai‘i National Park (later renamed as Hawai‘i Volcanoes National Park or HVNP) was established that same year. The Kīlauea area was by that time already a “popular destination for adventurers, scientists, entrepreneurs, and tourists” (Nakamura 2016:1). Proponents of establishment of the park in the years prior included Lorrin A. Thurston, son of missionary Asa Thurston, and Thomas Jagger, a geologist from the Massachusetts Institute of Technology (MIT) who had served as director of the Hawaiian Volcano Observatory at Kīlauea since 1912 (Nakamura 2016:9–12).

In 1916 the Kilauea Military Camp (KMC) was also established at the Kīlauea Summit within the bounds of the National Park (see Figure 15). Like the National Park, this installation was heavily promoted by L.A. Thurston (Nakamura 2016:14). The KMC website provides the following brief history for the approximately 50-acre camp:

> What once began as an idea by Hilo Board of Trade members for a training ground for the National Guard and an Army ‘vacation and health recruiting station’ has become one of Hawaii’s most unique resorts for the military […]
>
> In its one hundred years of existence, KMC had served as a training facility, housed a Navy camp, hosted numerous dignitaries including General Dwight D. Eisenhower who later became the president of the United States, and briefly served as an internment camp and later as a prisoner-of-war camp during World War II. [Kilauea Military Camp 2020]

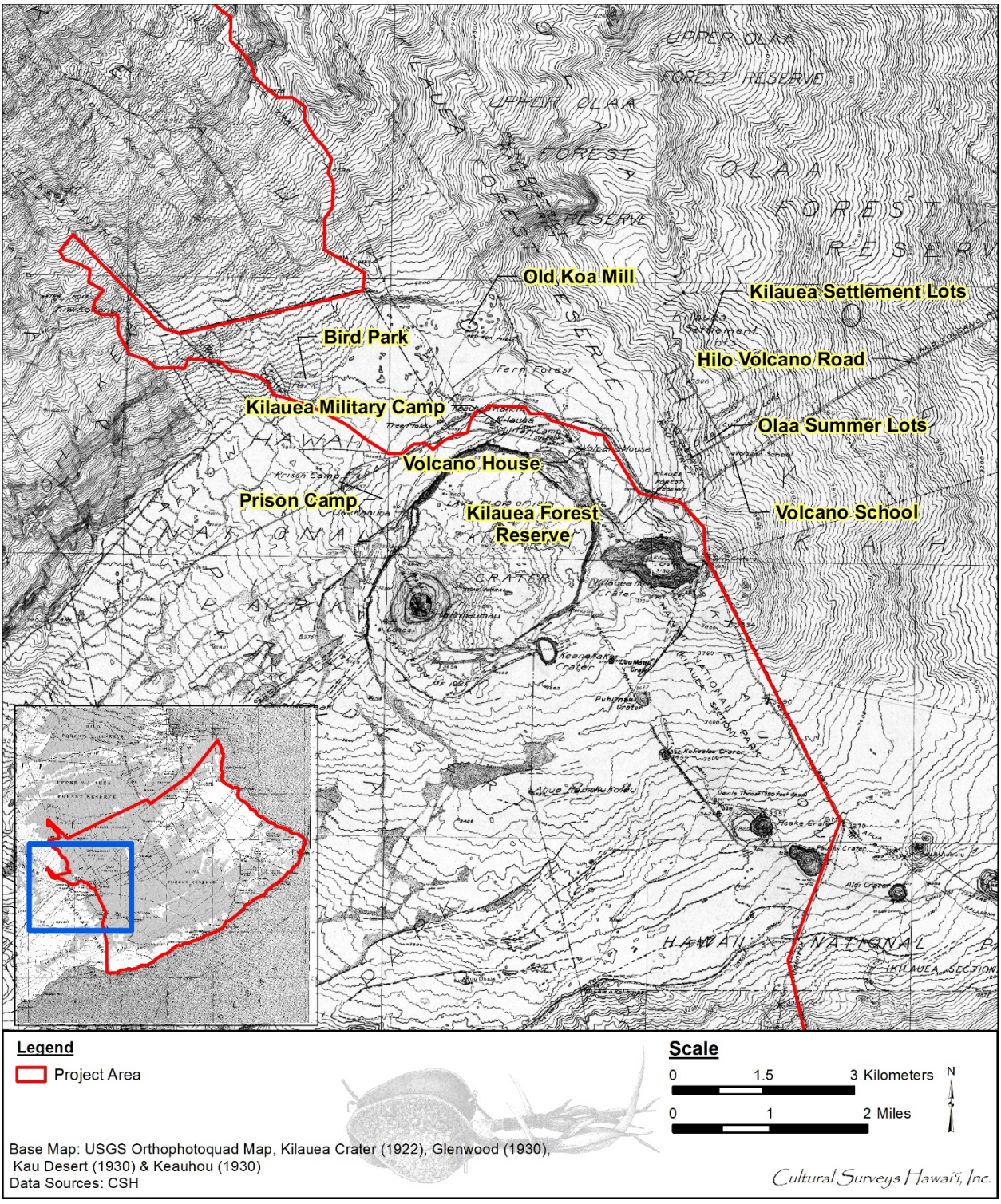

Figure 15. Portions of the 1922 Kilauea Crater and 1930 Glenwood, Kau Desert, and Keauhou USGS topographic quadrangles showing the new Olaa Summer Lots, Kilauea Settlement Lots, Volcano School, and key locations around the Kīlauea Summit

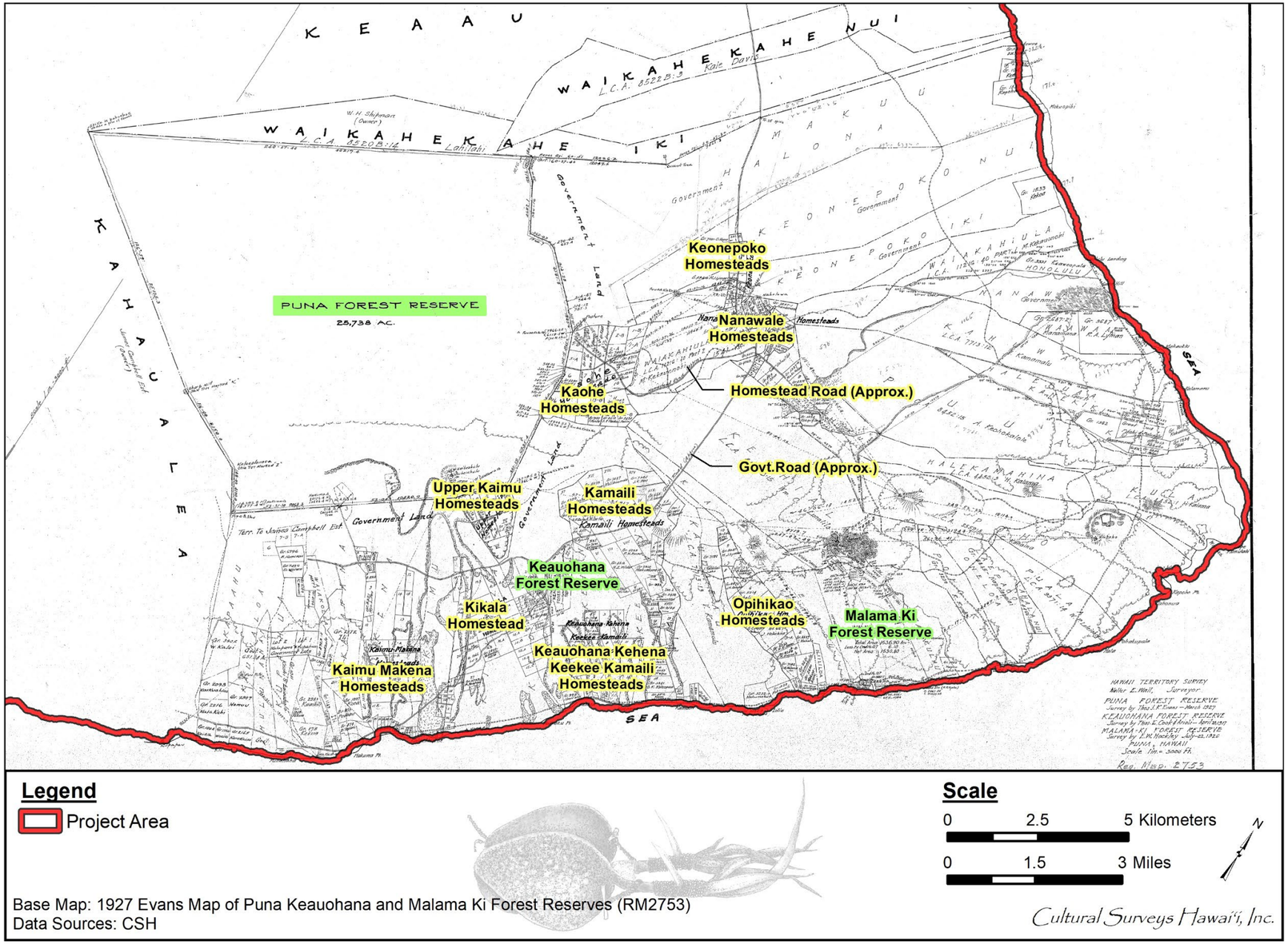

Figure 16. Portion of the 1927 Evans map of Puna Keauohana and Malama Ki Forest Reserves showing forest reserve locations, homestead areas, and roadways

While the Kīlauea Summit and KMC are located outside the project area, a large portion of the Kīlauea section of HVNP is within the project area in Puna, and the establishments at the summit are a major draw to the vicinity of Volcano Village and areas north of the summit located within the project area (in Ka‘ū). Many of the features at the summit, as well as major roadways and the extent of the Volcano Village area, are depicted on a 1944 NPS map (Figure 17).

3.5.1.3 Hawaiian Homelands and Residential Developments

The Hawaiian Homes Commission Act of 1920 created a Hawaiian Homes Commission to administer certain public lands, called Hawaiian Home Lands, for homesteads (Department of Hawaiian Homelands 2022). The homestead lots were (and continue to be) leased for a long-term period at a very low rate to be used for residential, agricultural, or pastoral purposes. In Puna, Hawaiian Home Lands lots were established in both coastal and uplands portions of Maku‘u, and the Kā‘ohe-‘Ōla‘a Homesteads were established in upper ‘Ōla‘a upslope near Glenwood.

Starting in the 1950s, various residential subdivisions throughout Puna were incorporated for residential and agricultural use. A brief history of this development found on the website for Orchidlands Estates, one of several residential subdivisions within agricultural-zoned lands in Puna, fairly well sums up life in the district during this time:

> In the early 1900’s the Puna lands were used primarily for raising cattle. The land was marginal at best for farming and ranching, so in the late 1950’s the property owners decided to subdivide and sell off most of this land. The developer’s permits were issued for Orchidland Estates, Hawaiian Paradise Park, Hawaiian Acres, and several other subdivisions all at the same time. It should be noted that this ‘time’ was before Hawaii became a state. By getting the permits under the rules of the Territory of Hawaii, the developers were able to avoid the more strict requirements of the U.S. Federal Government. We ended up with some huge subdivisions of ¼ to 3 acre parcels, agriculturally zoned, with private roads, and no utilities or services provided.
>
> Priced at under 500 dollars, the parcels sold rather quickly, however, very few people became residents. Only those with a strong pioneering spirit were able to overcome the absence of phones, electricity, County water, road maintenance, and other services. We had catchment systems for water, generator, and solar systems for electricity, and phones, well, back then it didn’t seem like such a big deal to not have a phone. It should be noted that Hawaiian Tel[com] was first to provide a utility service to the people of Orchidland. Road maintenance became the biggest issue. The developers had made beautiful red cinder roads, which, in the Puna rains, lasted just about long enough to take the picture. If you lived in Orchidland in the 60’s or 70’s, you were on your own and you knew it. The roads that weren’t used became overgrown, the roads that were used became washed out.
>
> The biggest appeal of this area back then, and to a certain extent now, was the price. This land has always been the cheapest in Hawaii, and the only option for many folks who wanted to own a piece of the rock. Commonly, people would live in tents or shacks until the land was paid off, building their house a stick at a time or in a series of additions. The rustic nature was endearing. People were very proud to say, ‘It’s humble, but it’s mine’. [Orchidland Estates 2014]

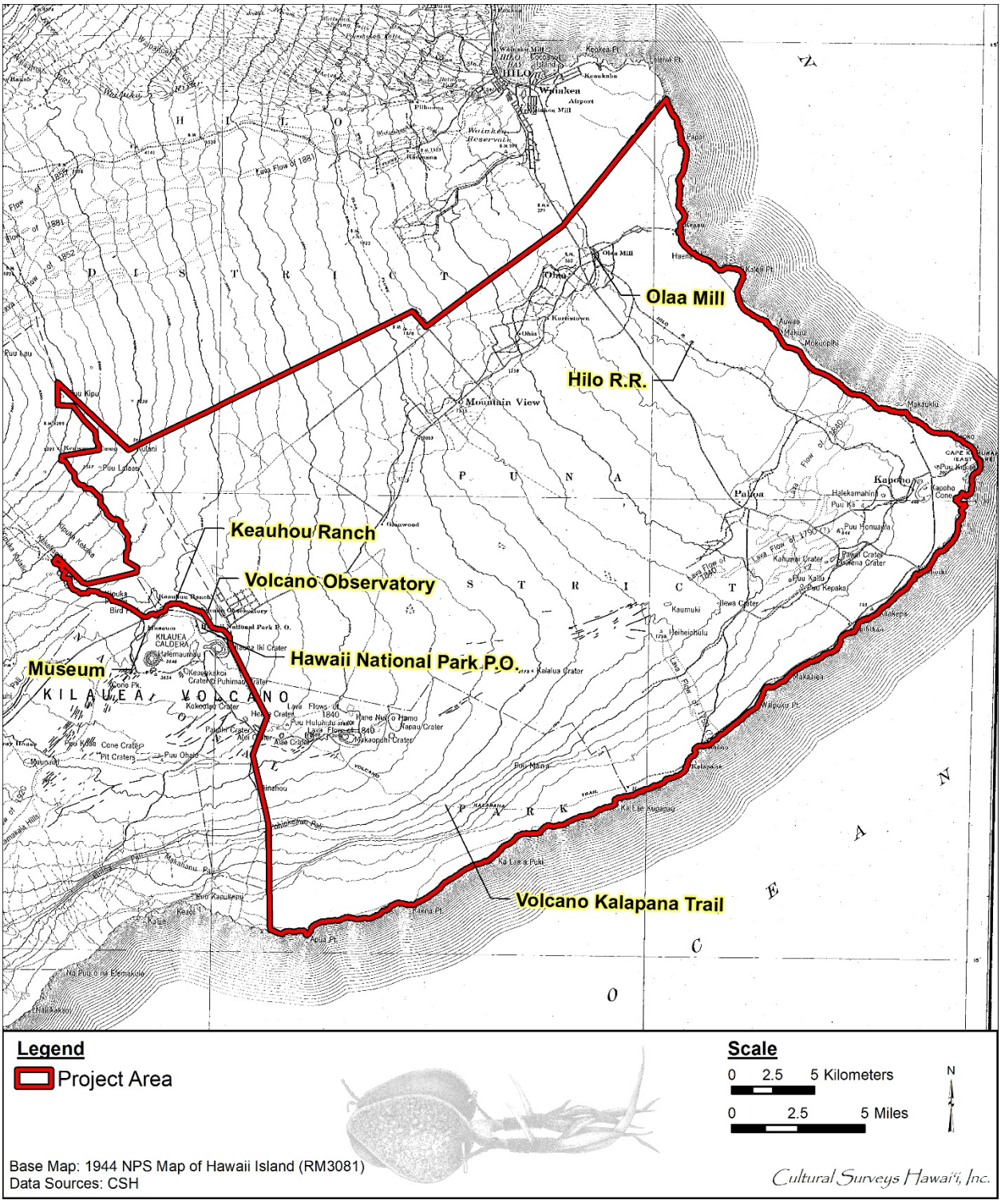

Figure 17. Portion of the 1944 NPS map of Hawai‘i Island showing roadways, the railroad, Keauhou Ranch, Olaa Sugar Mill, and key locations around the Kīlauea Summit

The various residential subdivisions throughout Puna are visible as grid-like patterns on aerial images from the 1970s (Figure 18 and Figure 19).

3.5.2 Ka‘ū District

3.5.2.1 Ranching

Ranching was a key land use in both Kapāpala and Keauhou during the early 1900s. By this time Kapāpala Ranch encompassed about 75,000 acres, extending from sea level to about 6,500 ft elevation. According to Henke (1929:35), these lands were mostly under lease from the government, and only about 40,000 acres had "good to fair grazing."

The Keauhou Ranch was established at the turn of the century by D.T. Shipman. It was managed by W.H. Shipman from about 1913 to 1923, when it was purchased by A.M. Brown W.H. Shipman purchased the ranch in 1937 following Brown's death (Henke 1929:32; Maly and Maly 2005:291). The ranch and its association with other activity at the Kīlauea Summit are described as follows:

> Keauhou Ranch, with its headquarters near the Military Camp, one mile from the Volcano House, has an area of 35,000 acres, all leased from private owners, about 20,000 of which have fair to good grazing value. The ranch extends from sea level to about 7,800 feet elevation.
>
> Water for the cattle must be caught from roofs and held in tanks. The tanks have a life of about ten years, the iron rods holding the staves together being the first to break. The storage capacity of these tanks is sufficient to carry the cattle through an eight months' drought period.
>
> The ranch has six large paddocks, four being used for fattening and two for weaning. About 30 miles of wire fence are found on the ranch […]
>
> The ranch has 55 saddle horses for ranch use and horses are rented to guests at the Volcano House and Military Camp. Horses and pack mules and guides are furnished for parties who desire to go to the top of Mauna Loa […]
>
> The ranch markets about 225 cattle per year, weighing about 450 pounds dressed weight at two years of age. All are marketed on Hawaii and three-fourths of them are slaughtered on the ranch for the Military Camp and the Volcano House.
>
> The ranch has about 250 pigs, using a purebred Chester White boar. The sows are rather mixed as to breed but Chester White blood predominates. One hog feed unique to this place is steamed tree ferns, which are steamed for one week over natural steam rifts found in the ground of this volcanic region. The only cost for these cooked tree ferns is the labor cost of cutting and bringing them in, which amounts to about $5 a ton.
>
> Garbage is also used as a hog feed, this being obtained from the military camp […]
>
> No cattle have been kept on the lower land for some years, efforts having been made to first eliminate the goats. This has been fairly well accomplished and some fifty head are being put there now. [Henke 1929:31]

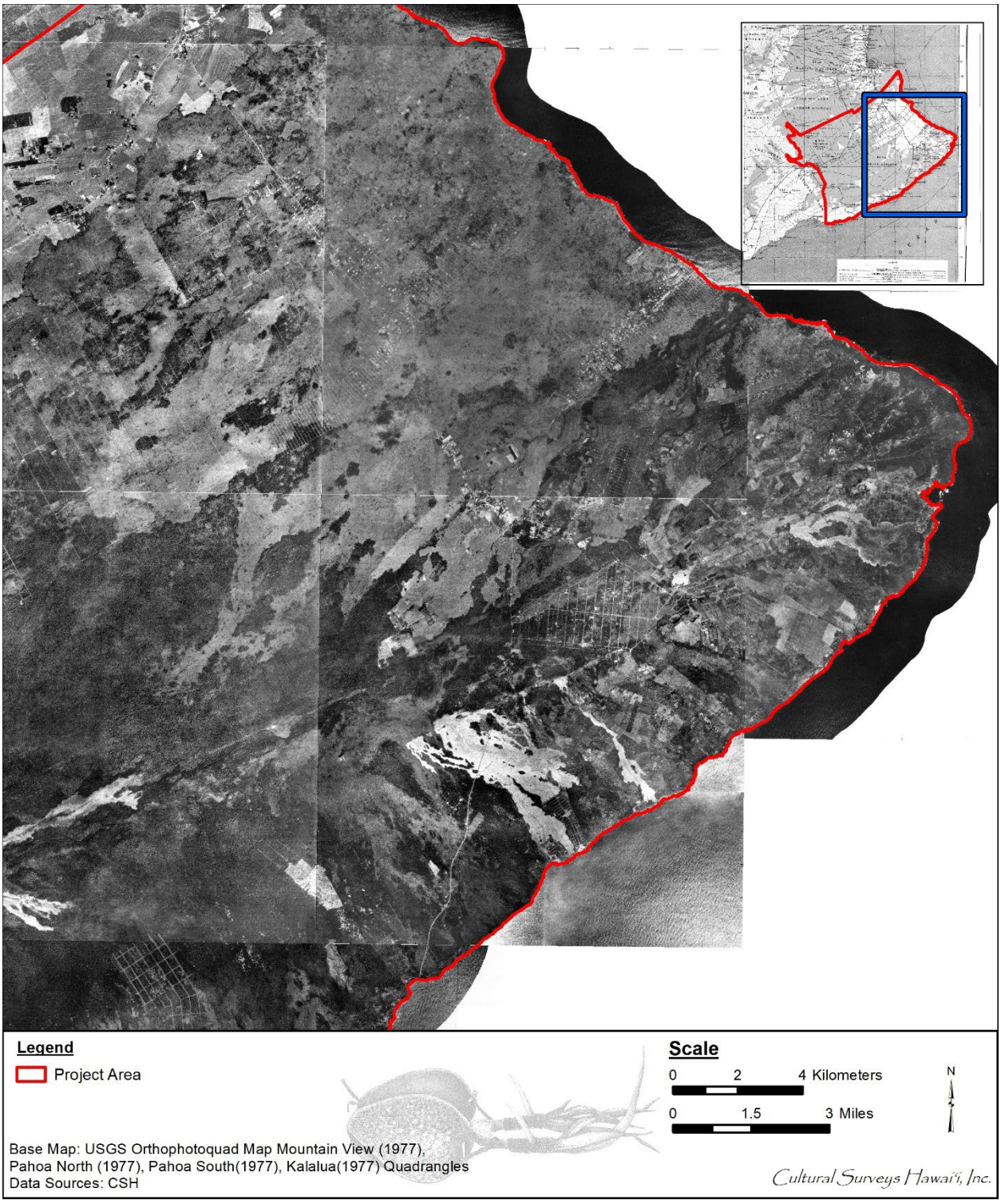

Figure 18. Portion of the 1977 USGS orthophotoquad aerial photo (Kalalua, Mountain View, Pahoa North, and Pahoa South quadrangles), showing the extent of residential and agricultural development in the eastern portion of the project area

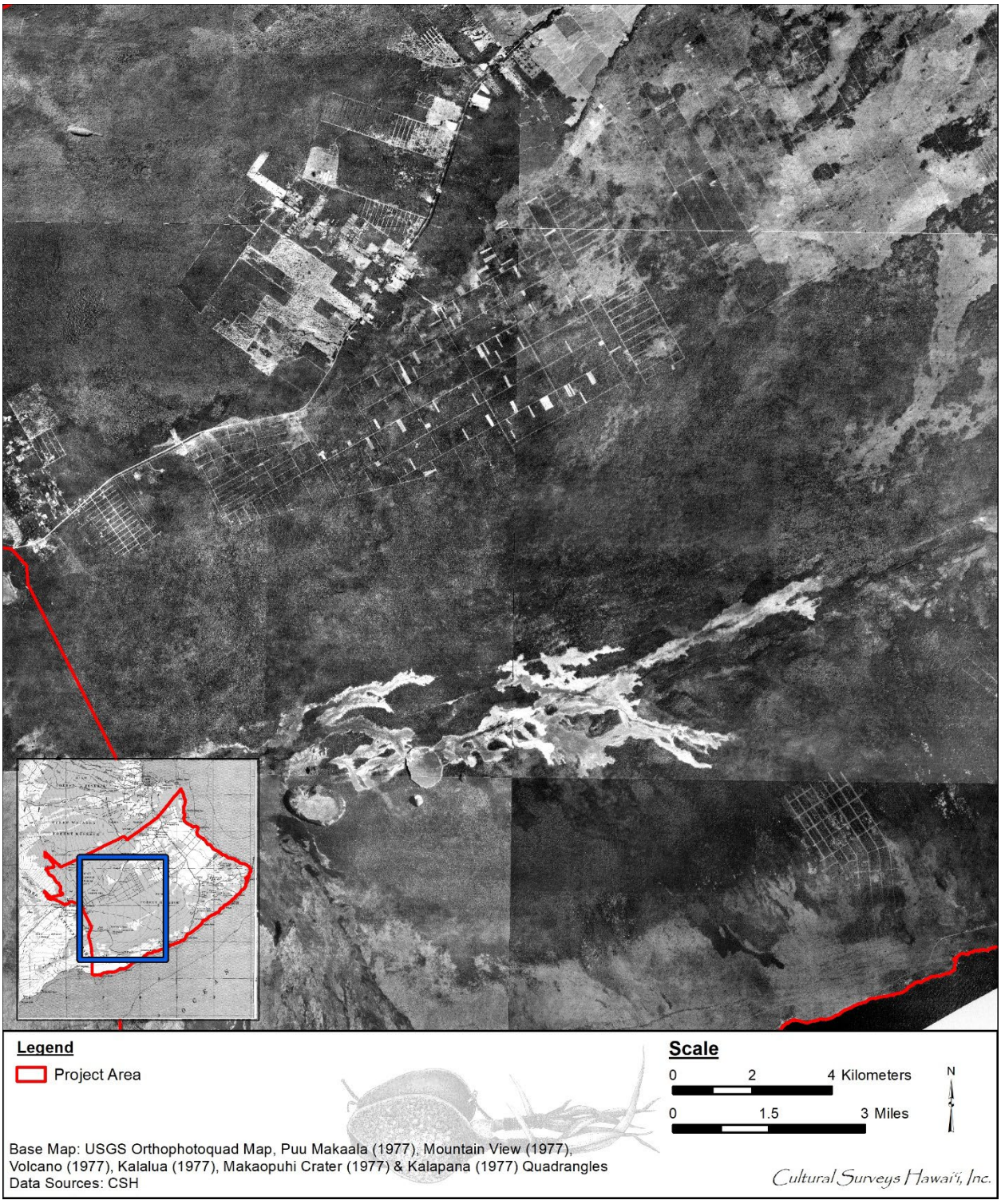

Figure 19. Portion of the 1977 USGS orthophotoquad aerial photo (Kalalua, Kalapana, Makaopuhi Crater, Mountain View, Puu Makaala, and Volcano quadrangles), showing the extent of residential and agricultural development in the western portion of the project area

3.5.2.2 Developments in and around the National Park

Maly and Maly (2005:273) note, “From the early 1900s, prisoners at Namakanipaio worked on rebuilding the ‘Peter Lee Road’ into Ka‘ū, and on roads and trails around Kīlauea, and towards Puna. The prison site was closed shortly after 1915.” Nāmakanipaio is located west of the Volcano House, just beyond the limits of the project area in Keauhou.

In 1907 George Lycurgus, owner of Volcano House at the time, formed a company with others to log *‘ōhi‘a* from within Keauhou Ranch lands:

> The lumbermen erected a sawmill on the site where they rough-milled the ohia and shipped it by rail to the present 29-Mile community where Peter Lee finished the milling of the wood into railroad ties. From there the ties were hauled by wagon to the rail terminal at Glenwood and shipped to Hilo for further consignment to the mainland. The enterprise proved profitable for a time, but after two years the demand for Hawaiian railroad ties lessened and the business started going downhill. Lycurgus and his partners then began to log the *koa* (an indigenous mahogany used in the manufacture of furniture) forests in the area, but found the cores of the tree trunks rotten and the wood useless. Lycurgus lost $10,000 in his lumbering venture. Sections of the railbed laid by the lumbermen remain in evidence in the Land of Pele in the half century that has passed. [National Park Service 2006]

Hilo resident H.W. Kinney in 1913 published a visitor’s guide titled *The Island of Hawaii* in which he described his travels throughout the island. Of interest to the current project area is Kinney’s explorations of the areas north of Kīlauea Crater in which he observed trails and ranching and logging features:

> Northwest of the Volcano House is another interesting region. The first east side road from the main road leading to Kau, goes into the famous fern forest, with its magnificent growth of gigantic tree ferns. The second east trail leads to the gate of the Shipman ranch. Just beyond this a trail, turning sharply to the left, leads to the tree moulds, formed where the lava surrounded trees, and, burning them out, left holes as casts of the trees. The main trail leads to the ranch house, and through the paddocks into the splendid forest of gigantic *koa* trees, beyond the old lumber mill, whence leads a railroad track, used for hauling the logs to a point close to the Volcano House, whence they are taken by wagon to Glenwood. It affords a good walk through *koa* and fern forest, emerging near the hotel. Both *koa* and fern forests are traversed by good trails, made by the loggers. From the ranch house a trail leads west to a small peach and fig orchard. Another trail leads from the ranch house to Puu Oo ranch on the mountain slope. A trail follows the N.W. side of the crater to the Uwekahuna bluff, whence a good view is had of the crater, pit and surrounding country. [Kinney 1913 in Maly and Maly 2005:207]

A land exchange in 1920 between Bishop Estate (owner of Keauhou Ahupua‘a) and the Territorial Government helped establish additional portions of the Kīlauea section of Hawai‘i National Park (Young 2022). Other Bishop Estate lands under lease to Keauhou Ranch were developed in 1921 by the Volcano House Hotel as the Volcano Golf Course. The course initially opened with three holes, but by 1922 was developed into a 9-hole course; later in 1946 the course was expanded to a full 18 holes (Young 2022). In 1932, the Volcano House was expanded to offer

115 rooms, but burned down in 1940; a new hotel was constructed the following year and expanded in 1953 (National Park Service 2006).

In 1928 the Kilauea Forest Reserve was established in the portion of upper Keauhou adjoining the Upper Waiakea and Olaa forest reserves. This land was “originally a part of the private forest reserve established by Trustees of the B.P. Bishop Estate” (Maly and Maly 2005:331).

3.6 **Contemporary Land Use**

3.6.1 Puna District

In the modern era Puna has been significantly impacted by geological activity. Eruptions in 1955 and 1960 along Kīlauea’s Lower East Rift Zone (LERZ) impacted communities, infrastructure, and prime agricultural lands (USGS). A 1975 earthquake off the coast of Kalapana caused widespread subsidence along the southern Puna coastline and triggered a large tsunami. A 1983–2018 eruption from the Pu‘u ‘Ō‘ō‘ vent along the Middle East Rift Zone covered a large swath of the southern Puna coastline, impacting communities around Kalapana and other areas to the south within HVNP. In May 2018 the eruption moved down-rift from Pu‘u ‘Ō‘ō‘ to a series of fissures in and below the Leilani Estates subdivision within the LERZ. The 2018 eruption inundated many residential and agricultural areas, major roadways, and several miles of coastline between Kapoho and Pohoiki.

Private efforts to explore development of geothermal power generation in Puna were undertaken by Richard Lyman at Kapoho during the 1960s (Schroeder 2015). Over the following decades interest and research expanded to larger areas of Kīlauea’s East Rift Zone. Soon community opposition began to build based on cultural, safety, and environmental concerns (Boyd et al. 2002:17–18). In 1993 the Puna Geothermal Venture (PGV) plant became operational and was acquired by Ormat Technologies in 2004 (Hunt 2015). The plant continues to operate despite operational issues and incidents, continued opposition from the community, and a brief closure following impacts from the 2018 LERZ eruption.

The majority of the lands in Puna are currently privately owned lots under 5 acres each, private lands under lease for commercial agriculture, and state or federal lands (including large areas of forest reserve and HVNP). The largest commercial crops include macadamia, papaya, orchids, and other cut flowers. The bottled-water industry has grown immensely in and around Kea‘au in recent years, tapping into the pristine underground waters flowing through the area. The population of Puna has increased dramatically in recent years, and some commercial expansion has occurred particularly in and around the towns of Kea‘au and Pāhoa.

3.6.2 Ka‘ū District

In 1968 the Volcano Golf Course was acquired by C. Brewer and renovated (Young 2022). Koa logging was allowed in the privately held section of Keauhou into the early 1990s (Maly and Maly 2005:334). Tourism remains the economic mainstay for the volcano area, and Volcano Village offers a number of amenities to tourists visiting HVNP or travelling between Kona and Hilo. The population of the Volcano Village area has continued to increase, with many residents commuting elsewhere (such as Hilo) for work.

Section 4 Previous Archaeological Research

This section contains a high-level overview of previous archaeological research in the project area. Table 1 is a summary of the available prior archaeological studies within the project area; for each study it lists the abbreviated citation (full citations are found in the References Cited in Section 6) and the study type, location, and findings. These study areas are depicted generally on Figure 20. Another map (Figure 21) illustrates the locations of historic properties identified during these prior archaeological investigations, including culturally modified lava tubes, *heiau*, burials, and other archaeological features.

The earliest archaeological studies in the project area were island-wide surveys of *heiau* (Thrum 1908, Stokes 1919). These were followed by surveys conducted by the Bishop Museum (e.g., Hudson 1932; Hansen 1956–68; Crozier and Barrère 1971). The studies covering the largest geographical extents have generally been conducted in association with the following:

- Hawai‘i Volcanoes National Park (Tuggle and Tomori-Tuggle 2008);
- Geothermal development (Haun et al. 1985; Holmes 1985; Hammatt and Borthwick 1988; Kennedy 1991; Sweeny and Burtchard 1994)
- W.H. Shipman lands (Hunt 1993);
- Forest reserve related projects (Yent and Ota 1982; Uyeoka et al. 2014, Bautista et al. 2017);
- Roadway or other infrastructure developments (Bevaqua and Dye 1972; Komori 1987; Major and Dixon 1992; Borthwick and Hammatt 1995; Haun and Henry 2004a; Clark and Rechtman 2005; Wilkinson et al 2010);
- Other proposed developments (Hammatt 1978; Rosendahl 1982; McGerty and Spear 2000; Haun and Henry 2013a); and
- Lava tube systems in Puna (Emory 1945; Kam 1982; Yent 1983; Olsen 1984; Stone and Teshima 1989; McEldowney and Stone 1991; Allred et al. 1997; Allred et al. 2002). The archaeological contents within the cluster of tubes located in the Pāhoa vicinity have been documented in greater detail than those within the tube systems to the north (including the lengthy Kazumura Cave); this explains the lack of “historic property” data points along the northern tube systems.

Numerous smaller studies have been undertaken for private landowners, particularly within the Special Management Area along the coastline. Notably, only two of the studies listed in Table 1 are within the Ka‘ū portion of the project area (Kawachi 2003; Tuggle and Tomonori-Tuggle 2008); the remainder are all within Puna District.

Previous archaeological studies in the project area have yielded general patterns of findings. Pre-Contact sites have been documented predominately along the coastal strip or in subsurface lava tubes, or within HVNP which has been largely protected from historic and modern development. The nature of surface pre-Contact sites throughout most of the upland areas was generally more transient or involved construction using natural materials; even if left undisturbed these sites would have decomposed or been overcome by the forest over time.

Historic-era sites are also found along the coast, and in upland areas where historic land use was occurring. These historic land uses were often highly ground disturbing (e.g., preparation of

cane fields for planting, clearing of pasture for cattle, development of roadways and residential camps, tourist attractions, or town centers) and would have likely destroyed any older pre-Contact features once present. Historic-era sites include but are not limited to plantation clearing mounds, flumes, roadways, and residential camps; railroad berms, tracks, and other related remnants; cattle enclosures or other ranching features; historic buildings, shops, and residences within and around camps, homesteads, or villages and along transportation routes; and historic trails and roadways.

Regarding State Inventory of Historic Places (SIHP) designations in Table 1, it wasn't until the 1970s or later that reports began to include standardized SIHP numbers for documented sites. In cases where SIHP numbers are listed in association with earlier studies, this information has likely been correlated from other reports during prior research. Each SIHP number begins with the designation for Hawai‘i State ("50"), then Hawai‘i Island ("10"), then the applicable USGS quadrangle number (e.g., "46" for Kapoho Quadrangle or "55" for Pahoa South Quadrangle), and finally the individual 5-digit site number.

Table 1. Previous archaeological studies in the project area

Reference	Type of Study	Location	Results
Thrum 1908	Survey of *heiau*	Island-wide	Describes 18 *heiau* in Puna District, identified as Wahaula in Pulama; Makaiwa; Waiaka; Makaoiki; Punaluu; Niukukahi; Napalua; Kikoa; Kumakaula; Mahinaakaka; Oolo; Kalepa; Kue; Haliipalala; Wahaula in Kamaili; Pulena; Kukii; and Kekaloa
Stokes 1919 (see Stokes and Dye 1991)	Survey of *heiau*	Island-wide	Documented 12 *heiau* in Puna, many previously identified by Thrum (1908), identified as Haliipalala; Kekaloa; Kikoa; Kue; Kukii; Kumakaula; Mahinaakaaka; Makaoiki; Niukukahi; Punaluu,Wahaula; and Waiaka
Baker 1931	Petroglyph study	Kalapana to ‘Āpua Ahupua‘a, Puna	Discusses and photo documents various petroglyphs in Puna District; also notes short-constructed bit of ancient trail and desert village (p.64), possible village of Kamoamoa
Hudson 1932	Archaeological survey	Coastal zone between Kapoho and Pohoiki Ahupua‘a, Puna	Identified several sites including SIHP # 50-10-36-00109, a *hōlua* slide in Pū‘āla‘a; SIHP #s -00110 and -00111, two agricultural sites near the slide; SIHP # -00145, a possible house site; and SIHP # -00147, possible habitation platforms
Emory 1945	Archaeological exploration	Shipman Cave, Kea‘au Ahupua‘a, Puna, TMK: (3) 1-6	SIHP # 50-10-36-20678 (“Shipman Cave”), a lava tube containing evidence of habitation, refuge, and burial; findings of food and tools
Hansen 1956–1968	Archaeological survey	Puna District	Extensive documentation of archaeological sites in Puna District by Bishop Museum
Orr 1968	Documentation of Kahuwai Village	Kahuwai Village, Kahuwai Ahupua‘a, Puna	Mapping of Kahuwai Village, SIHP # 50-10-46-04278, and findings of excavations with depths
Ladd 1969	Reconnaissance, data recovery, preservation	Chain of Craters Rd right-of-way in Hawai‘i Volcanoes National Park, Puna	Discussion of archaeological sites in Puna District selected for data recovery (salvage) and/or stabilization and restoration in Hawai‘i Volcanoes National Park area
Orr 1968	Reconnaissance	Kahuwai Ahupua‘a, Puna	Discusses elevated Hawaiian trails specifically in *ahupua‘a* of Kahuwai

Reference	Type of Study	Location	Results
Loo and Bonk 1970	Archaeological inventory	Puna	Description and evaluation of 32 archaeological sites in Puna District
Newman 1970	Multi-discipline synthesis of cultural practices	Island-wide	Synthesis of Hawai‘i Island’s fishing and farming practices using data from multi-disciplines (archeology, historical sources, general ecology, botany, geophysics, and marine biology); mentions a field system in Puna based on Ellis’s account in 1823, southwest of Kapoho, and scattered fields along Puna coastal strip from Kapoho to Hilo
Barrera and Barrère 1971	Archaeological and historical survey	Coastal zone of Kupahua (Kalapana) Ahupua‘a	Survey area divided into three zones: A, B, and C; observed numerous sites, however, only documented examples of each general site type
Crozier and Barrère 1971	Archaeological and historical survey	Pū‘āla‘a Ahupua‘a, Puna	Described remnants of Pū‘āla‘a Village (SIHP # 50-10-46-04294) and several platforms (SIHP #s -03946 through -03950)
Bevacqua and Dye 1972	Archaeological reconnaissance	Kapoho-Kalapana Hwy Corridor, Kaimū-Kapoho Ahupua‘a, Puna	Documented 48 archaeological sites including Pū‘āla‘a Village (SIHP # 50-10-46/55-02502, later assigned as SIHP # -04294); four platforms (-02504, -02514, -02523, -02532); six enclosures (-02506, -02508, -02509, -02512, -02513, -02521); five cemeteries (-02519, Hale Family; -02534, Pua‘akanu; -02538; -02539; -02547, Kaipuuelelu); three trails (-02530, King’s Highway; -02535; -02540, Kehena Beach Trail); 14 site complexes (-02503, -02505, -02507, -02515, -02516, -02520, -02522, -02524, -02533, -02536, -02537, -02542, -02543); two ponds (-02510, Pohoiki Warm Spring; -02518, Keahialaka Pond); a mound (-02531); a lava tube (-02526); a coffee mill (-02511); two *heiau* (-02500, Kuki‘i; -02517, Mahinaakaka); eight clusters of petroglyphs (-02501 or Kapoho petroglyphs, and -02525, -02527, -02528, -02529, -02544, -02545, -02546); and C-shape (-02541)
Barrera 1973	Archaeological reconnaissance	Pū‘āla‘a Ahupua‘a, Puna	Documented 150 archaeological sites including enclosures, mounds, agricultural and habitation sites, platforms, and caves; test pits excavated at two cave sites
Kikuchi 1973	Survey of prehistoric Hawaiian aquacultural systems (fishponds)	Statewide	Classified two fishponds in Kapoho Ahupua‘a: *pu‘uone* (site 18) and *loko kuapā* (site 26/26A)

Reference	Type of Study	Location	Results
Ching et al. 1974	Archaeological surface survey	Kaimū and Kalapana Ahupua‘a, Puna	Documented 25 archaeological sites assigned as SIHP # 50-10-63-06199 through -06223; sites include habitation and agricultural features, *heiau,* cisterns, walls, and trails; noted SIHP #s -06228 (Hudson site 163), -06229 (Hudson site 164), and -06230 (Hudson site 165) destroyed
Ewart and Luscomb 1974	Archaeological reconnaissance	Coastal zone of Kea‘au, Waikahekahe, Maku‘u, Keonepoko, and Waiakahiula Ahupua‘a, Puna	Documented 138 archaeological sites, including 30 sites in Kea‘au; three sites in Waikahekahe; 17 sites in Maku‘u; 79 sites in Keonepoko; and nine sites in Waiakahiula (text reads 118 total sites but table in report lists 138 total sites)
Palama 1976	Surface survey	Kaimū-Kalapana Beach Park, Puna	Documented three sites: SIHP #s 50-10-63-06277 (walls); -06278 (house platform); and -06279 (possible ag. enclosure)
Bordner 1977	Archaeological reconnaissance	Pāhoa (Maku‘u Ahupua‘a), Puna, TMK: (3) 1-5-010:017	Documented SIHP # 50-10-45-06417, an *ahu* (cairn)
Cordy 1977	Archaeological inventory survey	Pohoiki Bay, Pohoiki Ahupua‘a, Puna	No significant findings; previous archaeological research indicated nearby presence of SIHP #s 50-10-46-02509 through -02511; two metal poles located in water near existing boat ramp
Palama and Bordner 1977	Archaeological inventory survey	Kaimū and Kalapana Ahupua‘a, Puna	Documented 20 archaeological sites: SIHP #s 50-10-64-06280 through -06299; sites included agricultural and habitation complexes; walls; enclosures; Poluki Heiau; house sites; and a legendary stone
Hammatt 1978	Archaeological reconnaissance	Kea‘au Ahupua‘a, Puna	Documented 27 archaeological sites, six previously identified by Ewart and Luscomb (1974); sites assigned as SIHP #s 50-10-36-01845, -01846, and -06461 through -06476; sites included walls; possible burials; cultural deposits; platforms; lava sink; house foundation; *pohaku* (stone) pike; and a mound
McEldowney 1979	Archaeological and historical literature review	Hilo and Puna	By analyzing literature from early historic period and archaeological data, proposed a zonal settlement pattern described in terms of elevation
Bonk 1980a	Archaeological survey	2 acres in Keahialaka Ahupua‘a, Puna, TMK (3) 1-3-009:007 (por.)	Surveyed “easement #5,” one of six proposed easements; no significant findings

Reference	Type of Study	Location	Results
Bonk 1980b	Archaeological survey	Five, 2-acre sections of land for proposed drilling site in Keahialaka and Pohoiki Ahupua‘a, Puna	Surveyed 5 “easements” (#1, #2, #3, #4, and #6); easement #5 previously surveyed (Bonk 1980a); a cave identified in easement #2’s location, with native cultigens observed at cave site
Ladd 1981	Archaeological field survey	28 acres surrounding Cape Kumukahi Lighthouse, Kula Ahupua‘a, Puna	Surveyed four lighthouses on three islands: Kaua‘i (Makahuena Point); Maui (Hawea Point); and Hawai‘i (Cape Kumukahi and Kawaihae); historic features included stone outcrop platform, *ahu* and shelter cave, and historic name glyphs
Hommon 1982	Archaeological reconnaissance	2 areas in Kahauale‘a Ahupua‘a, Puna, TMKs: (3) 1-1-00:001 and 1-2-008:001	No significant findings; did note an old jeep road and a ginger plant as evidence of human activity
Kam 1982	Archaeological reconnaissance	Pāhoa Cave, Keonepokoiki, Ahupua‘a, Puna, TMK: (3) 1-5-009:009	Examined Pāhoa Cave; documented 20 burials; based on presence of ceramic and glass beads at one burial concluded cave used during late pre-Contact to early post-Contact period
Rosendahl 1982	Archaeological reconnaissance	490 acres for proposed W.H. Shipman Industrial Park, Kea‘au Ahupua‘a, Puna, TMK: (3) 1-6-003:012 por.	No significant findings
Yent and Ota 1982	Archaeological reconnaissance	Nānāwale Forest Reserve, Halepua‘a Section, Halepua‘a Ahupua‘a, Puna, TMKs: (3) 1-4-003:008 and 010	Documented five types of archaeological sites: enclosures, mounds, pits or depressions, walls, and *ahu*; no SIHP #s assigned
Cox 1983	Archaeological reconnaissance	Cape Kumukahi, Kula Ahupua‘a, Puna	Documented SIHP # 50-10-46-10002, comprising nine “clusters” of platforms and other features
Yent 1983	Archaeological survey	Lava tube in Pāhoa, Puna, TMK: (3) 1-5-008:001	Documented SIHP # 50-10-45-14900, part of Pāhoa cave system; in northeast tube identified terraces, walls and five burials; in southwest tube identified platforms, walls, walkways, scatter of cultural materials of midden, charcoal, animal bones, human teeth, and an *ahu*

Reference	Type of Study	Location	Results
Bonk 1984	Archaeological survey	74.9 acres near Kapoho Crater, Kapoho and Kula Ahupua‘a, Puana, TMK: (3) 1-4-002:016 por.	No significant findings
Carse et al. 1984	Compilation and Ethnographic study	Kahuwai Ahupua‘a, Puna	Describes Kahuwai Village (SIHP # 50-10-46-04278) including history, cultural resources, and oral interviews of Kahuwai residents
Olson 1984	Multi-discipline research investigation	Puna, TMK: (3) 1-6-009:376	Documents extensive Puna Cave complex (also known a Shipman Cave or Kazumura Cave), SIHP # 50-10-44, 45, 53, 54-10001; examines correlation of mythology with archaeological evidence regarding Pele
Rogers-Jourdane and Nakamura 1984	Archaeological reconnaissance	12 acres in Kapoho Ahupua‘a, Puna, TMKs: (3) 1-4-001:001, 002, 019	No significant findings
Haun et al. 1985	Archaeological reconnaissance	Wao Kele ‘O Puna Natural Area Reserve; Waiakahiula Ahupua‘a, Puna	Documented five to six cairns and mounds on southeast summit of Pu‘u Heiheiahulu (Transect five), assessed as possible burials; also noted two concrete foundations and a small cairn, all most likely used for surveyor’s markers
Holmes 1985	Literature review	Puna Forest Reserve/Wao Kele ‘O Puna Natural Area Reserve; Waikahiula Ahupua‘a, Puna	Documented a trail (Kaimū Trail) and possible bird catching shelters
Cordy 1987a	Archaeological reconnaissance	Keauohana Ahupua‘a, Puna, TMK: (3) 1-2-009:003 por.	Documented 15 sites, 14 assigned as SIHP #s 50-10-55-10922 through -10936; sites included trails, walls, platforms, agricultural areas and complexes, cemeteries, and burials
Cordy 1987b	Documentation of Kahuwai Village	Kahuwai Village, Kahuwai Ahupua‘a, Puna	Recordation of Kahuwai Village (SIHP # 50-10-46-04278) to support a preservation plan

Reference	Type of Study	Location	Results
Komori 1987	Cultural and biological resources survey	Pohoiki to Puna- Substation 69KV Transmission Corridor, Kapoho to Kea‘au Ahupua‘a, Puna, TMKs: (3) 1-4, 1-5, and 1-6	Identified 14 archaeological sites within sample transect, three of historic age; sites included mostly agricultural features with associated habitation areas; feature types consisted of irrigation ditches, terraces, platforms, modified outcrops, refuge and burial caves, petroglyphs, and a historic cement and stone foundation
Bonk 1988	Archaeological reconnaissance	James Campbell Estate property, upper Kaimū and Makena Ahupua‘a, Puna, TMK: (3) 1-2-010:003	No significant findings
Cordy 1988	Archaeological field inspection	Kahuwai Village, Kahuwai Ahupua‘a, Puna	Discusses previous archaeological work, history, and preservation recommendations for Kahuwai Village (SIHP # 50-10-46-04278)
Hammatt and Borthwick 1988	Archaeological assessment and historical research	Kīlauea East Rift Zone, Puna	Review of archaeological and historical documents including maps to assess potential adverse effects of geothermal development of three separate subzones to archaeological resources; based on data, recommended mitigation of impact on potential site areas should be concerned only with specific potentially sensitive areas to be affected by well sites, power lines, and roads on a project-by-project basis
Rosendahl 1988	Archaeological reconnaissance	Keonepokonui and Keonepokoiki Ahupua‘a, Puna, TMKs: (3) l-5:010:003 por., 1-5-009:009 por., l-5-008:001 por., 006 por.	No significant findings
Bonk 1989	Archaeological reconnaissance	Uplands of Kamā‘ili, Kehena, and Kīkala Ahupua‘a, Puna	No significant findings
Cordy 1989	Archaeological survey	Kahuwai Village, Kahuwai Ahupua‘a, Puna	Defined the boundaries of Kahuwai Village, SIHP # 50-10-46-04278

Reference	Type of Study	Location	Results
Rosendahl 1989	Archaeological field inspection	3.5 acres in Maku‘u, Pōpoki, and Hālona Ahupua‘a, Puna, TMK: (3) 1-5-010:028	No significant findings
Stone and Tashima 1989	Archaeological survey	Pāhoa Cave, Keonepokoiki and Keonepokonui Ahupua‘a, Puna, TMKs: (3) 1-5-010:3 and 1-5-116:030, 031, 049–057	Documented 8 sites within Pāhoa Cave system/network, including platforms, alignments, midden scatter, and burials
Barrera and Lerer 1990	Archaeological inventory survey	14 acres in Maku‘u Ahupua‘a, Puna, TMK: (3) 1-5-010:033	Documented six sites and associated features (SIHP #s 50-10-45-14675 and -14981 through -14985), including habitation and agricultural complexes; stone walls, a midden deposit, freshwater springs, platforms, and alignments observed but not documented in portion of study area planned for conservation
Bonk 1990	Archaeological reconnaissance	Upper Kaimū, Maku‘u, Ka‘ohe, Kehena, Ka‘apahu, and Kamā‘ili Ahupua‘a, Puna	No significant findings
Carter and Somers 1990	Field surveys and data recovery	Puna to Ka‘ū Historic District (Kalapana-Wahaula area)	Preliminary report of findings of five projects from 1987 to 1989; total of 15,000 archaeological features and components covering an area of 390 acres identified and documented; areas examined included vicinity of Waha‘ula Heiau in Poupou-Kauka area and Ka‘ili‘ili Village
Kennedy 1990	Archaeological reconnaissance	12 acres in Kapoho Ahupua‘a, Puna, TMKs: (3) 1-4-001:002 por. and 019 por.	No significant findings
Kirkendall and Hunt 1990	Archaeological reconnaissance	Two parcels in Wa‘awa‘a Ahupua‘a, Puna, TMKs: (3) 1-4-028:041 and 042	Documented one archaeological site comprising 14 features, not assigned an SIHP #

Reference	Type of Study	Location	Results
Kennedy 1991a	Archaeological inventory survey	Wao Kele ‘O Puna, Waiakahiula-Ka‘ohe Ahupua‘a, Puna, TMK: (3) 1-2-010:001 por.	Documented two sections of railroad tracks and 4-ft high earthen berm, likely associated with railroad; no SIHP #s assigned
Kennedy 1991b	Archaeological inventory survey	Kīlauea Middle East Rift Zone, Waiakahiula-Ka‘ohe Ahupua‘a, Puna, TMK: (3) 1-2-010:003	No significant findings
Kennedy et al. 1991; Dunn et al. 1995	Archaeological inventory survey	Pū‘āla‘a Village, Ahalanui, Oneloa, and Laepao‘o Ahupua‘a, TMKs: (3) 1-4-002:013, 014, 024, 069, and 070	Documented 48 sites (SIHP #s 50-10-46-11565, -11574, -11899, -11926, -12007, -12124 through -12141, -12143 through -12147, -12153, -12154, -12156 through -12162, -12185, -12188, -12572, -12668, -12699, -12704, -12724, -12726, -12774, and -16178) comprising 26 complexes and 22 single feature sites; site types included alignment, cave, C-shape, enclosure, hearth, indeterminate agriculture, modified outcrop, mound, platform, terrace, trail and wall; functional categories identified include agricultural, habitation, ancillary habitation, temporary habitation, boundary wall, burial, animal husbandry, and transportation
McEldowney and Stone 1991	Cave survey	Former Puna Forest Reserve/Wao Kele O Puna, Waiakahiula-Kaohe Ahupua‘a, Puna, TMKs: (3) 1-2-010:002 and 003	Identified three lava tube systems (Northern, Middle, and Southern) extending from former Puna Forest Reserve to Pāhoa area: SIHP # 50-10-55-14899 (Northern tube system) contained three burials and a structurally modified collapsed rock pile; SIHP # 50-10-55-14901 (lower segment), and SIHP # 50-10-55-14902 (upper segment), part of Southern lava tube system, and both contain extensive burials; SIHP # 50-10-45-14900 (Middle lava tube system) contained walls, burials, scattering of shell and bone midden, modified collapse rock piles, fire hearth, and rock arrangements
Franklin et al. 1992	Archaeological inventory survey	Waikahekahenui and Waikahekahe Ahupua‘a, TMKs: (3) 1-6-004:021, 057	Documented two sites: SIHP # 50-10-44-17848, a rock alignment; and -17849, stacked terrace; both agricultural features

Reference	Type of Study	Location	Results
Major and Dixon 1992	Archaeological inventory survey	Pohoiki No. 2 Transmission Line Corridor between Puna and Pohoiki substations, Puna	Documented six archaeological sites including SIHP #s 50-10-44-17967 (double-faced, core-filled wall), -17962 and -17963 (two burial caves), -17964 (terraces, wall, and a platform/mound), -17965 (burial cave with walls, a ramp, and terraces), and -17966 (walls, terraces, paving, platforms, cupboard, a cairn, and enclosures)
Rosendahl 1992a	Archaeological field inspection	Three areas within A&O golf course in Ahalanui and Oneloa Ahupua‘a, Puna	No significant findings
Rosendahl 1992b	Archaeological field inspection	45.945 acres in ‘Ōla‘a Ahupua‘a, Puna, TMK: (3) 1-7-017:003	No significant findings
Spear 1992	Archaeological assessment	3 parcels in Ahalanui Ahupua‘a, Puna, TMKs: (3) 1-4-002:005, 006, and 061	No significant findings
Barrera 1993	Archaeological reconnaissance	66 acres in Keauohana Ahupua‘a, Puna, TMKs: (3) 1-2-009:006 and 008	Documented 18 archaeological features including SIHP #s -19031, -10932, and -10933) previously documented by Cordy (1987a); sites included an agricultural complex, and both possible and confirmed graves
Chaffee and Spear 1993	Archaeological survey	Maku‘u Aquafarms in Maku‘u Ahupua‘a, Puna TMK: (3) 1-5-010:033	Documented SIHP #s 50-10-45-14675 Fea. J (irregular-shaped mound) and -14985 Fea. C (platform), Fea. L (platform), and Fea. M (platform); human remains discovered in SIHP # -14985 Feas. L and M
Charvet-Pond and Rosendahl 1993	Archaeological inventory survey	3.6 acres in Maku‘u, Pōpōkī, and Hālona Ahupua‘a, Puna, TMK: (3) 1-5-010:029	Documented five sites: SIHP #s 50-10-45-18418, trail; -18419, cattle walls; -18420, terrace complex; -18421, bait cups; and -18422, a horticultural complex
Franklin and Maly 1993	Archaeological inventory survey	3 acres in Kaimū and Makena Ahupua‘a, Puna, TMK: (3) 1-2-006:033 por.	Documented two archaeological sites: SIHP # 50-10-55-19060, a trail; and -19061, a boundary wall

Reference	Type of Study	Location	Results
Hunt 1993	Archaeological reconnaissance	600 acres of Shipman Lands in Kea‘au Ahupua‘a, Puna, TMKs: (3) 1-6-003:003, 007, 008, 011, 012, 027, 029, 058, 073, 075, 084, 086, and 090	Identified 50 archaeological features (not assigned SIHP numbers), likely clearance mounds associated with plantation activities; features concentrated near Kea‘au town
Major 1993	Archaeological monitoring	Pohoiki No. 2 Tramission Line Corridor between Puna and Pohoiki substations, Puna	Revisited and remapped SIHP #s 50-10-45-17962 and -17963 (cave sites) prior to construction; no new sites identified; no impacts to SIHP #s -17962 and -17963; concluded based on data recovery excavations at breach of -17967, wall built between 1907 and 1916
Conte et al. 1994	Archaeological inventory survey	735 acres of DHHL Maku‘u farm and ag. lands in Maku‘u, Pōpōkī, and Hālona Ahupua‘a, Puna, TMKs: (3) 1-5-010:004 and 1-5-008:003	No significant findings
Farrell and Wells 1994	Archaeological inventory survey	3.23-acre parcel in Keonepokoiki, Puna, TMK: (3) 1-5-009:042	Documented two archaeological sites: SIHP # 50-10-45-18758 and -18759; a later study (Farrell and Dega 2013) re-identified both sites and preservation was requested by SHPD; preservation plan prepared (Farrell et al. 2014)
Hurst and Schilz 1994	Archaeological survey	Kea‘au-Pāhoa Road, Kea‘au Town Section, Puna, TMK: (3) 1-6-003	No significant findings
Sweeney and Burtchard 1994 (see also Burtchard and Moblo 1994)	Archaeological survey	Kīlauea East Rift Zone, Puna	Documented 16 sites (archaeological and/or cultigen areas) including previously documented Kūki‘i Heiau (SIHP # 50-10-46-02500) and *hōlua* slide area (-05245), and 14 newly identified features assigned temporary sites numbers including the Pu‘u Kūka‘e mounds, Kūki‘i Cyst, cultigens at Halekamahina Crater, rock mounds and linear stacked rock features; Pu‘ulena and Kahuwai craters with evidence of observed cultigens; lava tubes with human remains or other modifications; four *‘awa* patches; abandoned road; bunker; mounds on Heiheiahulu crater; Pu‘u Kauka *kipuka*; and sections of Pahoa Lumber Company Railroad Grade

Reference	Type of Study	Location	Results
Barrera 1995	Archaeological data recovery	Kaueleau Ahupua‘a, Puna, TMK: (3) 1-3-004:013	Documented SIHP # 50-10-55-15312, complex comprising a platform, wall, fireplace, and paved area; two test units and a trench excavated
Borthwick and Hammatt 1995	Archaeological assessment	Kamā‘ili, Ke‘eke‘e, and Kehena and Keauohana Ahupua‘a, Puna, TMKs: (3) 1-2-009:003 por., 1-2-030; 1-2-031	No significant findings
Spear et al. 1995	Data recovery	Maku‘u Aquafarms, Maku‘u Ahupua‘a, TMK: (3) 1-5-010:033	Documented SIHP # 50-10-45-14675 Features B (enclosure), C (terrace), R (lava blister), Y (mound), AP (enclosure), # -14985 Features C (platform), J (terrace), L (mound), and M (platform); radiocarbon dating sample resulted in dates ranging from AD 1660 to 1950
Hunt 1996	Archaeological inventory survey	4.54 acres in Keahialaka Ahupua‘a, Puna, TMK: (3) 1-3-008:003	No significant findings
Allred et al. 1997	Speleological investigation	Herbert C. Shipman Cave, Puna	Re-visited Shipman’s Cave and analyzed Kenneth Emory’s (1945) study; located other entrances into cave as described by Emory and concluded “Shipman Cave” actually comprises two separate caves: Kazumura Cave and Keala Cave
Latinis et al. 1997	Archaeological inventory survey with subsurface testing	94-acre parcel in Ke‘eke‘e Ahupua‘a, Puna, TMK: (3) l-2-009:029	Documented six archaeological sites: SIHP #s 50-10-55-02539, cemetery, previously documented by Bevacqua and Dye (1972); -21139, an agricultural complex with 32 features; -21140, enclosure; -21141, enclosure; -21142, adjacent enclosures; and -21143, platform (possible *heiau*)
Lass 1997	Archaeological reconnaissance	Old Government Rd in Kea‘au Ahupua‘a, Puna	Documented 15 sites: SIHP #s 50-10-36-21273 (Old Government Rd) and -21259 through -212272 (walls, enclosures, a WWII bunker, and two trenches)
Walker et al. 1997	Archaeological inventory survey	75 acres for Kea‘au High School site, Kea‘au Ahupua‘a, TMKs: (3) 1-6-	Documented SIHP # 50-10-44-21191, Hilo Railway Co. right-of-way

Reference	Type of Study	Location	Results
		003:portions 003, 015, and 084	
Devereux et al. 1998	Archaeological inventory survey	Ahalanui Park and Pohoiki (Isaac Hale) Park, Pohoiki, Ahalanui, and Laepao‘o Ahupua‘a, Puna, TMKs: (3) 1-4-002:005, 006, and 061; 1-3-008:016 and 013; and 1-4-002:008	Documented two sites: SIHP #s 50-10-46-02507, remnants of former permanent habitation site complex previously documented by Bevacqua and Dye (1972); and -21352, a well
Masterson and Hammatt 1998	Archaeological inventory survey	2.46 acres for Kea‘au Elderly Housing Project, Kea‘au Ahupua‘a, Puna, TMKs: (3) 1-6-143: portions 018 and 039	No significant findings; modern Filipino Camp observed
Rechtman and Henry 1998	Site inspection and limited subsurface testing	Two parcels at Hawaiian Beaches Estates in Waiakahiula Ahupua‘a, Puna, TMKs: (3) 1-5-003:042 and 043	Documented two sites: SIHP #s 50-10-45-19013, an agricultural complex of four features (depressions and terraces); and -19014, burial platform; both sites previously documented by Ewart and Luscomb (1974); SIHP # -19014 tested and a chamber revealed that confirmed site type and function
Maly 1999	Ethnographical study	Kea‘au section of Historic Puna Trail/Old Government Rd, Kea‘au Ahupua‘a, TMK: (3) 1-6-001	Documented SIHP # 50-10-36-21273, Puna Trail/Old Government Rd
Stasack and Stasack 1999	Petroglyph survey	‘Āinahou Ranch Cave System in ‘Āpua Ahupua‘a, Puna	Documentation of ‘Āinahou Petroglyph Cave, SIHP # 50-10-62-21751; total of 123 petroglyphs identified

Reference	Type of Study	Location	Results
Corbin 2000	Archaeological inventory survey	Kauaea, Kaueleau, and Kamā‘ili Ahupua‘a, Puna, TMKs: (3) 1-3-002:portions 006, 054, 055, 058, 068, 076, 077, 078, 090, 108; 1-3-003:006 por.; and 1-3-004:013 por.	Documented SIHP # 50-10-55-22500, an agricultural complex comprising of 41 features
McGerty and Spear 2000	Archaeological inventory survey	300 acres for proposed KSBE East Hawai‘i Campus in Kea‘au Ahupua‘a, Puna, TMK: (3) 1-6-003:012 por.	Re-identified ten previously discovered features (Hunt 1993); only six determined to be archaeological features; one new feature identified; seven features of SIHP # 50-10-44-21823 documented, all related to sugarcane clearing activities
Rechtman 2000	Archaeological survey	32-acre parcel in Kapoho Ahupua‘a, Puna, TMK: (3) l-4-017:003	No significant findings
Clark et al. 2001	Archaeological inventory survey	Waiakahiula Ahupua‘a, Puna, TMK: (3) 1-5-002:024	Documented SIHP # 50-10-55-22966, railroad turntable; and -22967, a bulldozed earthen railroad bed with associated cement slab feature
Ritchey 2001	Petroglyph discussion	Cape Kumukahi, Kula Ahupua‘a, Puna	Discusses documentation of Cape Kumukahi petroglyphs including numbering, type, location, and characteristics, methodology of data collection, and its relationship with previous archaeological studies
Allred et al. 2002	Survey and documentation	Kazumura Cave, Kea‘au and Waiakahekahenui Ahupua‘a, Puna	Survey, data compilation, and cartography of Kazumura Cave; mostly describes natural features, but some maps include area of charcoal, an *ahu*, and a “stone altar” near a tube opening (p63)
Haun and Henry 2002a	Archaeological inventory survey	7-acre parcel in Kaueleau Ahupua‘a, Puna, TMK: (3) 1-3-002:071	No significant findings
Haun and Henry 2002b	Archaeological inventory survey	2-acre parcel in Wa‘awa‘a, Puna, TMK: (3) 1-4-028:038	Documented five sites comprising 37 features including a habitation terrace (SIHP # 50-10-46-23392), three agricultural complexes (-23390, -23391 and -23393), and a wall (-23389)
Elmore and Kennedy 2003	Archaeological assessment	412.5 acres in Keahialaka Ahupua‘a, Puna, TMK: (3) 1-3-008:004 por.	No significant findings; documented remnants of old *koa* mill but determined not to be 50 years or greater in age

Reference	Type of Study	Location	Results
Kawachi 2003	Literature review and field inspection	10,20.5 acres in Keauhou, Ka‘ū, TMK: (3) 9-9-001:017	No significant findings
Rechtman 2003	Archaeological and limited cultural assessment	DHHL lands in Hālona and Maku‘u Ahupua‘a, Puna, TMK: (3) 1-5-008:001	No significant findings
Desilets and Rechtman 2004	Archaeological inventory survey	Maku‘u, Pōpōkī, and Hālona, Puna, TMK: (3) 1-5-008:003	Documented two historic properties: SIHP # 50-10-45-24231, an enclosure complex of three features; and -24232, a terrace; five test units excavated among -24231; due to insufficient number of cultural materials, functionality of both sites unknown
Haun and Henry 2004a	Archaeological assessment	Along northeast side of Hwy 130 in Kea‘au, Puna, portions of TMKs: (3) 1-5-036:117-122; 1-6-001:015, 021; 1-6-003:002, 065, 068, 074; 1-6-004:011, 045, 047-051, 053-056; 1-6-064:269, 283–289	No significant findings
Haun and Henry 2004b	Archaeological inventory survey	4.099-acre parcel in Wa‘awa‘a, Puna, TMK: (3) 1-4-028:033–034	Documented six archaeological sites comprising 42 features (SIHP #s 50-10-46-23997 through -24002); feature types included excavated pits, enclosures, modified outcrops, terraces, and a platform; sites associated with habitation, agriculture, animal husbandry, and a burial
Kasberg and Rechtman 2004	Archaeological monitoring	DHHL lands in Hālona and Maku‘u Ahupua‘a, Puna, TMK: (3) 1-5-008:001	No significant findings
Rechtman 2004	Archaeological reconnaissance	Approx. 19.5-acre parcel in Keonepokonui and Keonepokoiki Ahupua‘a, TMK: (3) 1-5-007:017	No significant findings; a lava tube encountered but found to contain only modern trash, most likely carried by rainfall runoff

Reference	Type of Study	Location	Results
Clark and Rechtman 2005	Archaeological reconnaissance	Pohoiki Road Realignment in Oneloa Ahupua‘a, Puna, TMKs: (3) 1-4-002:009, 013 and 1-3-008:016	Within project area documented five features of previously identified SIHP # 50-10-46-12157 (agricultural and habitation complexes); also documented locations of two other previously identified sites located outside but near project area, including SIHP # -12153 (burial platform), and -12156 (lava blister with burials)
Rechtman 2005	Archaeological monitoring	DHHL residential subdivision in Hālona and Maku‘u Ahupua‘a, TMK: (3) 1-5-008:003	No significant findings
Clark and Rechtman 2006	Archaeological inventory survey	2.282-acre parcel in Wa‘awa‘a Ahupua‘a, Puna, TMK: (3) 1-4-028:041	One site with 14 features first identified by Kirkendall and Hunt (1990) re-located and reassigned site and feature designations; documented sites included SIHP #s 50-10-46-22516, agricultural complex; -25517, core-filled wall; -25518, raised trail; -25519, habitation complex; and -25520, agricultural complex; one test unit excavated in -25519 Feature A, and a preservation plan later written for SIHP #s - 25516, -25518, and -25519 (Berrigan et al. 2008); parcel is in portion of former Land Grant 1363 to Pakaka in 1854
Hammatt and Shideler 2006	Archaeological reconnaissance	Keakealani Outdoor Education Center, Mountain View Elementary School, and Pāhoa Elementary, Intermediate and High Schools, ‘Ōla‘a and Waiakahiula Ahupua‘a, Puna District	No further work recommended for proposed cesspool upgrade project at any of four schools
Haun and Henry 2006	Archaeological assessment	52.2-acre parcel in ‘Ōla‘a, Puna, TMK: (3) 1-8-008:007	No significant findings
Monahan et al. 2006	Archaeological inventory survey	2.8 acres in Kapoho Ahupua‘a, Puna, TMK: (3) 1-4-002:036 por.	Documented remains of a *loko kuapa* fishpond (unnamed) at Kapoho Bay, not assigned an SIHP #

Reference	Type of Study	Location	Results
Clark et al. 2007	Archaeological inventory survey	Kulia Farm, 38-acre parcel in Pōpōkī Ahupua‘a, Puna, TMK: (3) 1-5-010:023	Documented five archaeological sites: SIHP # 50-10-45-26165 (possible agricultural shrine/*heiau*); -26166 (historic trail/roadway); -26167 (habitation complex with three features); -26168 (remnant agricultural complex with four features); -26169 (agricultural complex with 54 features); two test units excavated at -26169; parcel includes portion of Land Grant 1537 issued to Kapohana in 1855
Haun and Henry 2007	Archaeological inventory survey	1-acre parcel in Kamā‘ili Ahupua‘a, Puna, TMK: (3) 1-3-002:050	Documented 58.4-m segment of King’s Trail/Old Government Rd (SIHP # 50-10-46-02530), first recorded by Bevacqua and Dye (1972)
Clark et al. 2008	Archaeological inventory survey	5.586-acre parcel in Maku‘u, Puna, TMK: (3) 1-5-010:032	Documented nine sites: SIHP # 50-10-45-26658 (portion of Old Government Rd), -26659 (historic habitation enclosure/pavement), -26660 (historic habitation complex with five features), -26661 (modified bedrock), -26662 through -26664 (three overhangs with historic burial features), -26665 (burial platform), and -26666 (an agricultural complex with 55 features); six test units excavated; preservation plan written for SIHP # -26660 (Pestana et al. 2009); parcel is portion of former Land Grant 1013:1 to Maiau in 1852
Corbin 2008	Archaeological inventory survey	0.88-acre coastal parcel in Wa‘awa‘a, Puna, TMK: (3) 1-4-028:009	Documented one archaeological site with three features: SIHP # 50-10-46-26465 consists of a platform (Feature A), clearing mound (Feature B), and a C-shaped wall (Feature C)
Escott 2008	Field inspection	64.48 acres in ‘Ōla‘a Ahupua‘a, Puna, TMK: (3) 1-7-017:170	No significant findings
Haun and Henry 2008a	Archaeological inventory survey	8 acres in Kea‘au, TMKs: (3) 1-6-004:011, 047-053, 055, 056; and 1-6-064:266-269, 283–286	Documented SIHP # 50-10-44-26874, Waipāhoehoe Bridge and associated roadway
Haun and Henry 2008b	Archaeological monitoring	Mountain View Elementary School, ‘Ōla‘a Ahupua‘a, TMK: (3) 1-8-001:007	No significant findings
Runyon et al. 2008	Archaeological monitoring	Pāhoa Elementary School, Waiakahiula 2 Ahupua‘a, TMKs: (3) 1-5-114:002, 025	No significant findings

Reference	Type of Study	Location	Results
Tuggle and Tomonari-Tuggle 2008	Archaeological overview, assessment, and research design	Hawai‘i Volcanoes National Park, Puna and Ka‘ū	Discusses Hawaiian archaeology through lens of volcanic action; parts of Puna District discussed
Wilkinson et al. 2008a	Archaeological monitoring	Kea‘au Middle School, Kea‘au Ahupua‘a, Puna District	No significant findings
Wilkinson et al. 2008b	Archaeological monitoring	Pāhoa Intermediate and High School, Waiakahiula Ahupua‘a, Puna District	No significant findings
Rechtman and Clark 2009	Archaeological and limited cultural assessment	1.287 acres in ‘Ōla‘a Ahupua‘a, Puna, TMKs: (3) 1-8-001:045 and 050	No significant findings
Wilkinson et al. 2009	Archaeological monitoring	Keakealani Outdoor Education Center, ‘Ōla‘a Ahupua‘a, Puna, TMK: (3) 1-9-004:019	No significant findings
Wilkinson et al. 2010	Archaeological inventory survey	Kea‘au-Pāhoa Rd, Kea‘au to Waiakahiula Ahupua‘a, TMKs: (3) 1-5 and 1-6	Documented one previously identified historic property: SIHP # 50-10-44-26874, abandoned concrete bridge (Waipāhoehoe Bridge) and associated roadway
Clark and Rechtman 2011	Archaeological assessment	0.415-acre conservation parcel in Wa‘awa‘a, Puna, TMK: (3) 1-4-028:007	No significant findings; some previously identified features and two additional features determined to be modern
Dye 2011	Archaeological reconnaissance	18 acres at Pū‘āla‘a Ahupua‘a, Puna, TMK: (3) 1–4–002:015 por.	Northern portion of 18-acre project covered by 1955 lava flow; southern portion partially mapped by Bishop Museum (Crozier and Barrère 1971) as part of *mauka* portion of Pū‘āla‘a Village (SIHP # 50-10-46-04294); additional archaeological sites north and south of village identified and described, including six possible burials; features of Pū‘āla‘a Village recommended for preservation

Reference	Type of Study	Location	Results
Haun and Henry 2011	Archaeological inventory survey	1.97-acre parcel in Wa‘awa‘a Ahupua‘a, Puna, TMK: (3) 1-4-028:023	Documented two archaeological sites: SIHP #s 50-10-46-28138, platform; and -28139, an agricultural complex with 18 features consisting of pits, retaining walls, modified outcrops, and mounds; one test unit excavated in SIHP # -28138
Uyeoka et al. 2011	Archaeological investigation	7.6-acres in Kahuwai Village, Kahuwai Ahupua‘a, Puna, TMK: (3) 1-4-003	Documented six archaeological complexes comprising 230 features; sites included habitation, agricultural, and ceremonial functions
Rechtman 2012	Archaeological assessment	2.1-acre parcel in Keonepokoiki Ahupua‘a, Puna, TMK: (3) 1-5-009:035	No significant findings
Ah Sam and Rechtman 2013	Archaeological inventory survey	3.5-acre parcel in Pōpōkī Ahupua‘a, Puna, TMK: (3) 1-5-010:028	Documented two archaeological sites previously recorded by Charvet-Pond and Rosendahl (1993): SIHP # 50-10-45-18418, portion of Feature A, trail section; and -18419 Feature A, wall; SIHP # -18418 Feature A recommended for preservation (Rechtman 2014)
Escott 2013	Archaeological inventory survey	0.217607-acre parcel on Pāpi‘o St in Hawaiian Beaches, Waiakahiula Ahupua‘a, Puna	Documented two previously identified archaeological sites: SIHP #s 50-10-45-19012, an agricultural complex of four features (two depressions and two terraces) and -19014, burial platform; nine shovel probes conducted at Feature A of -19012
Haun and Henry 2013a	Archaeological inventory survey	309 acres in Kauea Ahupua‘a, Puna, TMK: (3) 1-3-009:005 por.	Documented six archaeological sites: SIHP #s 50-10-55-29723, trail; -29724, transportation complex with four features; -29725, enclosure; -29726, transportation complex with two features; -29727, concrete slab; and -29728, railroad grade; the trail, SIHP # -29723 recommended for preservation (Haun and Henry 2013b)
Haun and Henry 2013c	Archaeological assessment	Ten 1-acre parcels in Kea‘au Ahupua‘a, Puna, TMKs: (3) 1-5-041:016–018; 1-5-043:005; 1-5-044:132; 1-5-046:080; 1-5-046:098; 1-5-047:068; 1-5-048:140; and 1-5-048:222	No significant findings

Reference	Type of Study	Location	Results
Haun and Henry 2013d	Archaeological assessment	Ten 1-acre parcels in Kea‘au and Waikahekahe Ahupua‘a, Puna, TMKs: (3) 1-5-026:021 and 129; 1-5-28:097, 098 and 165; 1-5-048:157; 1-5-049:033, 121 and 122; and 1-5-050:078	No significant findings
Haun and Henry 2013e	Archaeological assessment	1-acre parcel in Waikahekahenui Ahupua‘a, Puna, TMK: (3) 1-5-041:046	No significant findings
Rechtman and Zenobi 2013	Archaeological assessment	4.92-acre parcel in Keonepokonui Ahupua‘a, Puna, TMK: (3) 1-5-008:005	No significant findings
Clark et al. 2014	Archaeological inventory survey	35.5-acre parcel at Pohoiki Bay, Pohoiki and Keahialaka Ahupua‘a, Puna	Documented five previously identified archaeological sites (SIHP #s 50-10-46-02510, Pohoiki Warm Spring; -02511, historic Rycroft coffee mill complex; -02515, habitation complex; -02516, agricultural complex; and -02530, a section of old coastal Government Rd); and 22 newly identified archaeological sites assigned as SIHP # -30129 through -30150, associated primarily with agriculture and historic-era activity
Escott 2014	Archaeological inventory survey	23.334-acre parcel in Mountain View, ‘Ōla‘a Ahupua‘a, Puna	Documented one archaeological site: SIHP # 50-10-44-29815, historic drainage ditch
Haun and Henry 2014a	Archaeological inventory survey	120.02-acre property in Ke‘eke‘e Ahupua‘a, Puna, TMKs: (3) 1-2-009:028, 029, and 036	Documented 19 archaeological sites comprising 608 individual features; included five previously documented sites (SIHP #s 50-10-55-02539, -21139 through -21142 [found to be destroyed], and -21142) and 15 newly identified sites (SIHP #s 50-10-55-30024 through -30037) comprising 11 single sites and nine complexes; feature types included lava tubes; walls; platforms; pits, walkways; terraces; a lava blister; a U-shape; a C-shape; burials; soil swales; modified gullies and depressions; and enclosures

Reference	Type of Study	Location	Results
Haun and Henry 2014b	Archaeological inventory survey	Waiākea Timber Management area, Waiākea and ‘Ōla‘a Ahupua‘a, South Hilo and Puna, TMKs: (3) 1-8-012:001 por.; 2-4-008:portions 001, 006, 010 and 022	Documented three archaeological sites including two sites in ‘Ōla‘a, (SIHP #s 50-10-34-20870, disturbed remnant historic flume; and SIHP # 50-10-43-30088, historic ‘Ōla‘a Back Rd/Ihope Rd); and one site in Waiākea, South Hilo (SIHP # 50-10-35-18697, a previously identified cave with human remains)
Haun and Henry 2014c	Archaeological assessment	7.34-acre parcel in Kaueleau Ahupua‘a, Puna, TMK: (3) 1-3-002:070	No significant findings
Reeve 2014a	Archaeological field inspection	Kamehameha School property, Kahuwai Ahupua‘a, Puna, TMK: (3) 1-5-009:007	Documented two historic properties previously identified by Major and Dixon (1992): SIHP #s 50-10-45-17962, lava tube containing human remains; and -17967, a historic wall
Reeve 2014b	Archaeological field inspection	Kamehameha School properties in Kahuwai and Kauaea Ahupua‘a, Puna	Inspected two emergency evacuation routes: in Kahuwai Ahupua‘a no significant findings, noted proposed route previously disturbed by cane/papaya cultivation, and a lava flow ca. 1840 might have covered traces of archaeological evidence; in Kauaea Ahupua‘a two archaeological sites previously recorded by Haun and Henry (2013) documented (SIHP #s 50-10-55-29726, historic road; and -29728, a railroad grade)
Uyeoka et al. 2014	Ethnohistorical study with archaeological aerial survey	Wao Kele O Puna	Relocated four of seven mounds features previously identified as Site 94-6 by Sweeney and Burtchard (1994); also documented Kaimū cave and noted four *pu‘u* with evidence of native cultigens
Barna and Rechtman 2015	Archaeological inventory survey	Two parcels in Hawaiian Shores Subdivision, Waiakahiula Ahupua‘a, Puna, TMKs: (3) 1-5-088:042 and 043	Documented one site with five features: SIHP # 50-10-45-30226, an agricultural complex consisting of three modified depressions (Features A, C, and E), wall (Feature B), and a mound (Feature D)
Crowell and Higelmire 2015a	Archaeological inventory survey	Kea‘au Ahupua‘a, Puna, TMK: (3) 1-5-053:093	No significant findings

Reference	Type of Study	Location	Results
Crowell and Higelmire 2015b	Archaeological inventory survey	Kea‘au Ahupua‘a, Puna, TMK: (3) 1-1-020:085	No significant findings
Crowell and Higelmire 2015c	Archaeological inventory survey	Kea‘au Ahupua‘a, Puna, TMK: (3) 1-6-143:023	No significant findings
Crowell and Higelmire 2015d	Archaeological inventory survey	Waikahekahe Ahupua‘a, Puna, TMK: (3) 1-5-017:118	No significant findings
Haun and Henry 2015	Archaeological assessment	1.0 acre in Kea‘au, Puna, TMK: (3) 1-5-046:107	No significant findings
Wheeler et al. 2015	Archaeological field inspection	Kea‘au Middle School, Kea‘au Ahupua‘a, Puna, TMKs: (3) 1-6-002:001 and 1-6-003:059	School Buildings B, C, D, and E, found to be greater than 50 years old; portion of an *‘auwai* (irrigation ditch) documented adjacent to Buildings D and G; consultation with SHPD Architecture Branch recommended
Bautista, Wilkinson, Hammatt 2017a	Archaeological inventory survey	Kua O Ka Lā Public Charter School, Pū‘āla‘a Ahupua‘a, Puna, TMK: (3) 1-4-002:015 por.	Documented one historic property: SIHP # 50-10-46-30573, pre-Contact complex comprising two features, a lava tube (Feature A) and associated cairn (Feature B)
Bautista, Wildey, Hammatt 2017	Archaeological assessment	1.526-acre area in Kea‘au Ahupua‘a, Puna, TMKs: (3) 1-6-151:002, 003, 006, and 999	No significant findings

Reference	Type of Study	Location	Results
Bautista, Wilkinson, Hammatt 2017b	Archaeological condition assessment	Wao Kele O Puna, Waiakahiula and Ka‘ohe Ahupua‘a, Puna, TMKs: (3) 1-2-010:002, 003	Identified five previously documented sites within Wao Kele O Puna: SIHP #s 50-10-54-14899, northern portion of Northern Lava Tube documented by McEldowney and Stone (1991); -14900, Middle Lava Tube system/Pāhoa Cave documented by McEldowney and Stone (1991) and Yent (1983), respectively; -19849, Pahoa Lumber Co. railroad grade documented by Kennedy (1991b) and Sweeny and Burtchard (1995); -19853, five or more cairns or mounds on south summit of Pu‘u Heiheiahulu documented by Haun et al. (1985) and Sweeney and Burtchard (1995); and -19854, pre-Contact/historic agricultural and native cultigen site documented by Sweeney and Burtchard (1995); determined 27 June 2014 lava flow likely impacted portions of SIHP #s -19849 and -14900
Wilkinson et al. 2017	Archaeological field inspection	Kea‘au High School, Kea‘au Ahupua‘a, Puna, TMKs: (3) 1-6-003:110 por., 111, 112 por., and 118	No significant findings; research indicated at one time portion of SIHP # 50-10-45-21191 (a section of Hilo Railroad Co./Hawai‘i Consolidated ROW) present within or immediately adjacent to project area, but no evidence of this historic property identified during field inspection due to prior land disturbance
Barna and Bibby 2018	Archaeological assessment	6.9-acre parcel in Keonepokoiki Ahupu‘a, Puna, TMK: (3) 1-5-009:053	No significant findings
Clark 2018	Archaeological field inspection	1.460-acre parcel in Wa‘awa‘a Ahupua‘a, Puna, TMK: (3) 1-4-028:012	No significant findings
Rechtman and Tam Sing 2018	Archaeological inventory survey	6.7-acre parcel in Kea‘au Ahupua‘a, Puna, TMK: (3) 1-6-003:103	Documented two archaeological sites, including one site previously identified by Walker et al. 1997 (SIHP # 50-10-44-21191, a section of Hilo Railroad Co./Hawai‘i Consolidated ROW) and one newly identified site (SIHP # -30766, remnants of a historic wall)
Folk 2020	Archaeological field inspection	0.63-acre parcel in Wa‘awa‘a Ahpua‘a, Puna, TMK: (3) 1-4-028:121	No significant findings
Kepa‘a and Clark 2020	Archaeological assessment	Wa‘awa‘a Ahupua‘a, Puna, TMK: (3) 1-4-028:008	No significant findings

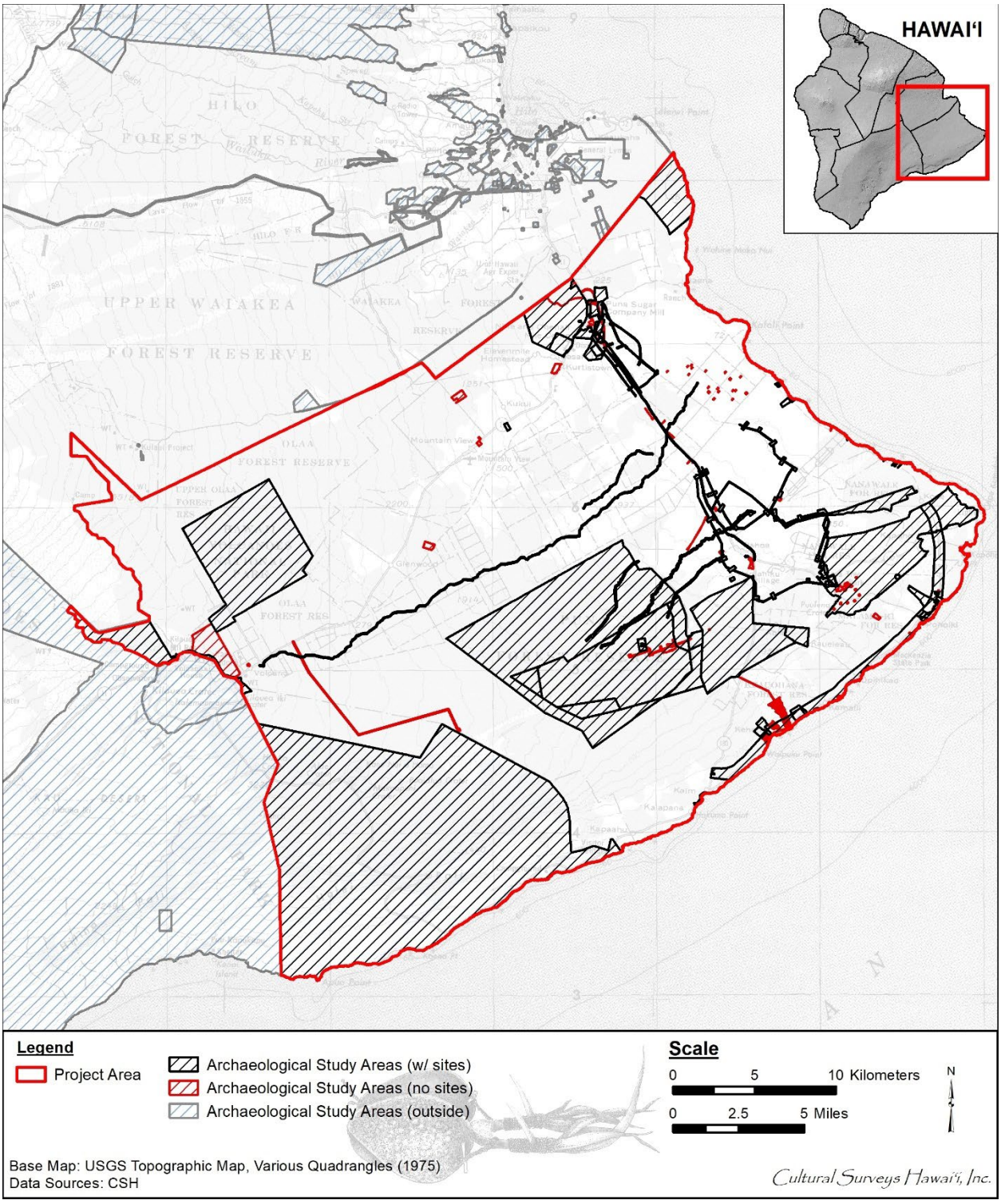

Figure 20. Portion of the 1975 USGS 1:250,000-scale topographic map of Hawai‘i Island showing the locations of prior archaeological studies within the project area

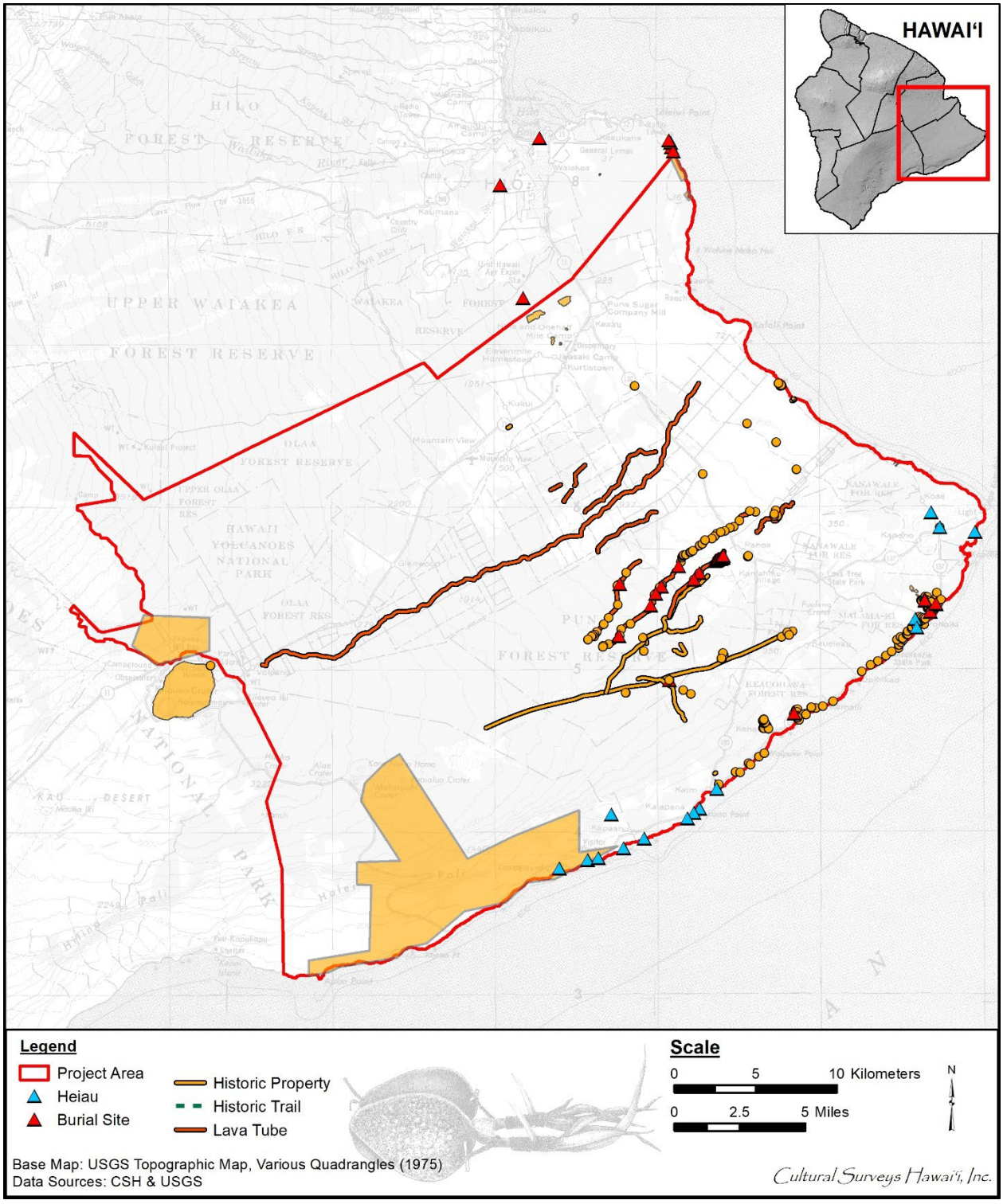

Figure 21. Portion of the 1975 USGS 1:250,000-scale topographic map of Hawai‘i Island showing the locations of historic properties (including lava tube systems) previously documented within the project area

Section 5 Sensitivity Model

Archaeological sensitivity for the proposed Puna Wastewater project is expressed by its potential to affect significant historic properties. Research indicates variable levels of archaeological sensitivity throughout the project area, dependent on factors including but not limited to pre-Contact and historic settlement patterns, proximity to the coast, extent of prior historic and modern development and related archaeological study, and geology (particularly lava flow areas).

Archaeological sensitivity throughout the district of Puna and the Volcano Village portion of Ka‘ū District can be broadly characterized as follows:

- Past archaeological research in the project area identifies the predominance of traditional Hawaiian archaeological sites within areas adjacent to the coast
    - Traditional settlement patterns included permanent habitation at small coastal villages
    - Upland areas used for scattered agriculture with related habitation and collection of forest resources
- Upland areas in the project area may contain historic-era features associated with sugarcane agriculture or other commercial land use and related settlement
    - Wide-scale disturbance for agriculture likely obliterated any traditional sites once present
    - Historic-era features are usually considered less sensitive than traditional pre-Contact features
    - Current town centers including Pāhoa and Kea‘au have origins associated with sugarcane plantations and timber harvesting
    - The Volcano Village area developed in association with nearby activities at the Kīlauea summit and small-scale farming and ranching
- Traditional site types documented in upland areas can include burials and other features within lava tubes
    - A number of major lava tube systems have been documented throughout Puna
- Historic maps identify trails and roads throughout the project area
    - Some historic transportation routes had earlier pre-Contact origins
    - Trails are generally considered to have high cultural significance
- The geographical area of Hawai‘i Volcanoes National Park contains a multitude of sensitive archaeological sites, and as federal land will pose hurdles to development
- Volcanic activity from Kīlauea Volcano has impacted portions of Puna district and the archaeological sites present there
    - These flows are predominately along the east rift zone of Kīlauea
    - Large portions of Hawai‘i Volcanoes National Park have been impacted
    - The 2014 and 2018 lava flows impacted areas around and between the communities of Pāhoa in the uplands and Kapoho at the coast

- “Young” (i.e., modern era) lava flow areas have low archaeological sensitivity

Two “sensitivity maps” (Figure 22 and Figure 23) seek to combine various types of available information and data to provide a high-level view of archaeological sensitivity throughout the project area, in support of the broad characterizations listed above. While these maps represent a good faith effort to include all known information and data, additional archaeological features and/or prior study areas may be present that were unavailable to CSH at the time of writing.

Sensitivity Map 1 (see Figure 22) illustrates the locations of prior archaeological studies throughout the project area (including studies that both do and no not report any findings) in relation to historic trails/roadways and railroad routes traced from historic maps, documented lava tube systems, *heiau*, known burials, and other historic properties. This map generally indicates the predominance of *heiau* along the coast. Burials are also generally found along the coast or within lava tubes. Concentrations of other types of historic properties are also much denser along the coast. This pattern would also be expected along the northern Puna coastline; fewer studies have been conducted along this portion of the coastline and therefore less site data appears on the map in this area. Similarly, the nature and extent of prior archaeological studies is the cause for a lack of existing historic property data within the lava tubes located in the northern portion of the project area. The longest tube shown (Kazumura Cave) is commonly known to contain archaeological features including burials, and similar features may also be present within the adjacent lava tube systems. Finally, Figure 22 indicates large complexes of sites have been documented within the bounds of the National Park, including along the southern Puna coastline and around the Kīlauea Summit area.

Note, the historic properties shown in orange in Figure 22 represent all types of sites recorded during prior archaeological studies that are not categorized as *heiau*, burials, or lava tubes; therefore, the significance of the individual data points within this particular category, as assessed per the criteria outlined in HAR §13-275-6(b), is variable. For example, an agricultural planting pit feature may be of more limited significance than an intact house site.

Sensitivity Map 2 (see Figure 23) overlays the site data from Figure 22 with modern-era lava flows of Kīlauea—specifically the flows of the 1983–2018 Pu‘u ‘Ō‘ō‘ Eruption and the 2018 LERZ eruption. The purpose of this graphic is to illustrate how the ongoing eruptions of Kīlauea have impacted many of the previously recorded sites in the project area. These modern flow areas are devoid of archaeological sites; however, volcanic impacts will continue to occur in areas along the East Rift Zone which could endanger facilities or infrastructure.

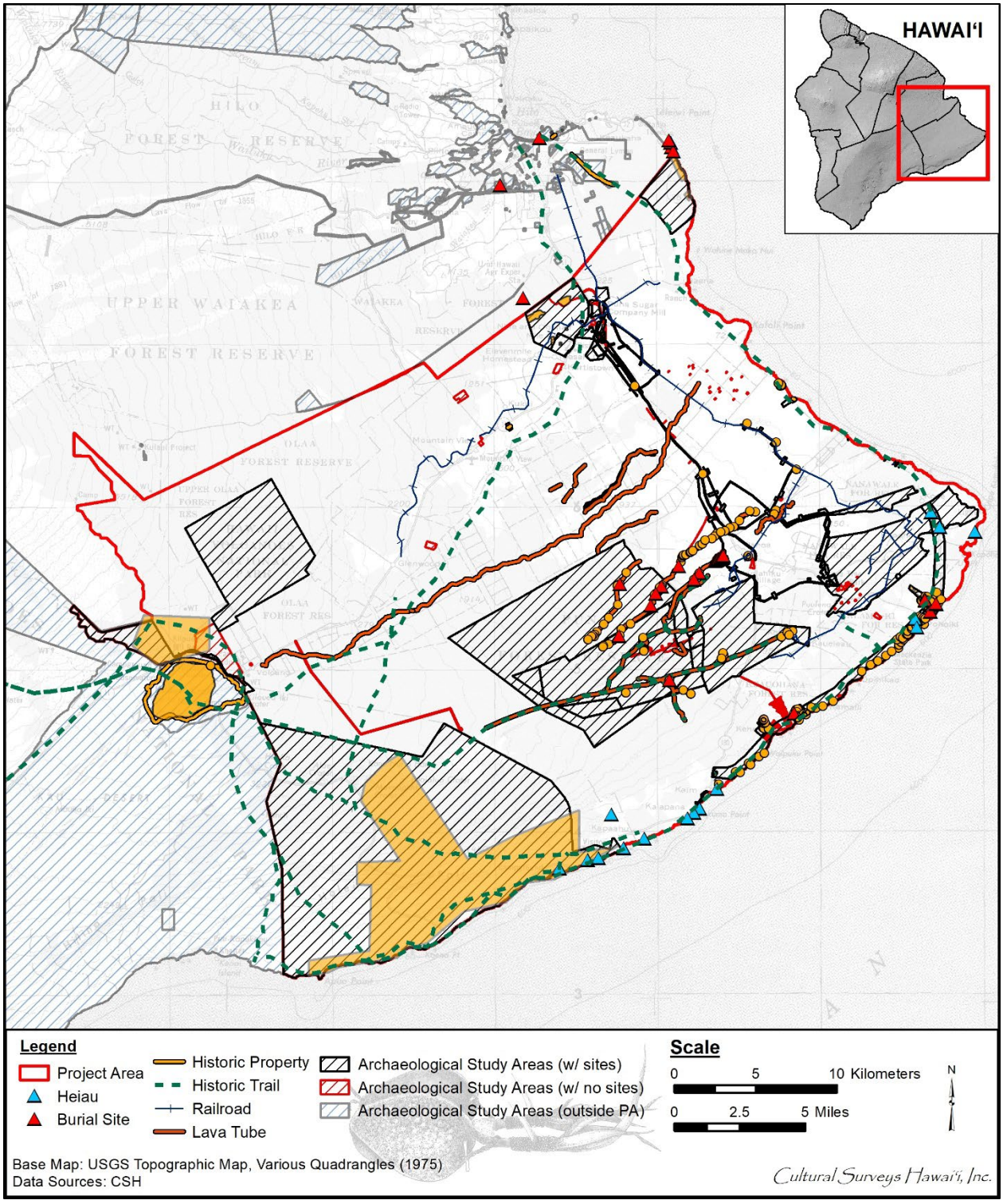

Figure 22. Sensitivity Map 1 showing previous archaeological study areas in relation to site data including historic trails and railways, lava tubes, *heiau*, burial sites, and other historic properties

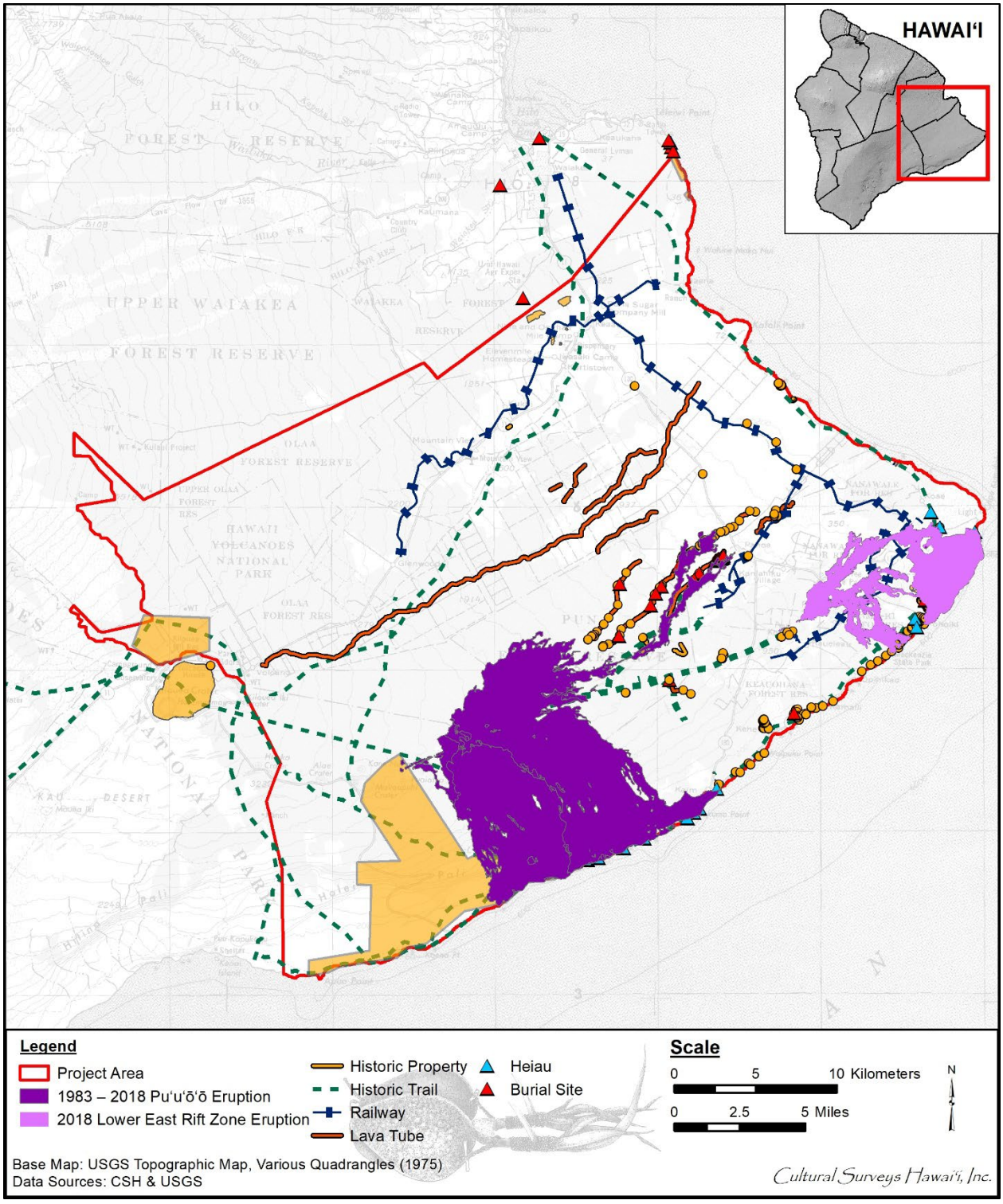

Figure 23. Sensitivity Map 2 showing site data in relation to modern lava flows from the 1983–2018 Pu‘u ‘Ō‘ō‘ Eruption and the 2018 LERZ eruption

Section 6 Recommendations

General recommendations for establishing wastewater plants, pumping stations, and pipelines are as follows:

- Development should occur away from the coast where higher concentrations of archaeological sites (including sensitive pre-Contact sites) are present.
- Lava tubes should be avoided, as these frequently contain cultural deposits or modifications, including but not limited to sensitive sites such as burials.
- Placing new facilities upon new/modern lava flows might be considered, to facilitate avoidance of historic properties.
- Topography relative to potential future lava flow incursion is an important consideration.

Following refinement of each individual project location and scope, the County shall determine if additional archaeological investigation is necessary and seek SHPD’s concurrence.

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Appendix A *Ahupua‘a* of Puna

The following table of *ahupua‘a* in Puna District uses unit and acreage data from the USGS. Units are listed in alphabetical order. Lexicology/spelling information and the Māhele disposition for each individual *ahupua‘a* are taken from Lloyd Soehren's *Hawaiian Place Names* database (Soehren 2019).

Note, spelling and names for some *ahupua‘a* differ amongst databases and historical records. The information presented in this table is for general reference purposes only, and is not intended to present a comprehensive or authoritative accounting of the *ahupua‘a* of Puna.

Table 2. *Ahupua‘a* of Puna with Acreages and Māhele Disposition

Ahupua‘a	**Acreage (approx.)**	**Disposition of land after the Māhele (Crown, Government, or Konohiki)**
Ahalanui, Laepao‘o, Oneloa	1,338	Government, Government, Government
‘Āpua	10,488	Crown
Halepua‘a, Kānekīkī	1,659	Government, Government
Honolulu	368	Government
Hulunanai	443	Not named in Māhele Book
‘Ili‘ililoa	76	Not named in Māhele Book
Kahauale‘a	27,323	Konohiki
Kahue	4,627	Not named in Māhele Book
Kahuwai	3,084	Konohiki
Kaimū, Mākena	4,867	Crown, Government
Kalapana, Kupahua	6,811	Government, Government
Kamoamoa	10,660	Konohiki
Kapoho	4,204	Konohiki
Kauaea	1,651	Konohiki
Kaueleau	2,288	Government/Konohiki
Kaukulau	463	Government
Kea‘au	65,460	Konohiki
Keahialaka	5,677	Konohiki
Kealakomo	4,677	Government
Keauohana, Kehena, Ke‘eke‘e	2,730	Government, Konohiki, Not named in Māhele Book
Keonepoko 1	4,661	Government

Ahupua‘a	Acreage (approx.)	Disposition of land after the Māhele (Crown, Government, or Konohiki)
Keonepoko 2	3,102	Government
Kīkala, Kēōkea	3,111	Government/Konohiki, Government
Kukuihala, Kamā‘ili	2,776	Not named in Māhele Book, Government
Kula	3,326	Konohiki
Laeāpuki	3,634	Government
Maku‘u, Pōpōkī, Hālona	8,431	Government, Government, Government
Malama, Kī (boundary of these lands never surveyed, so they are always written “Malama-Kī”)	1,888	Government
Nānāwale	1,280	Government
‘Ōla‘a	60,464	Crown
‘Opihikao	1,164	Government
Pānau	14,463	Konohiki/Government
Pohoiki	666	Government
Poupou, Pūlama	3,083	Government, Government
Pū‘āla‘a	1,021	Konohiki
Pu‘ua	4,875	Konohiki
Wa‘awa‘a	850	Government
Waiakahiula, Ka‘ohe	32,271	Konohiki, Government
Waikahekahe	2,909	[see below]
Waikahekaheiki	3,848	Konohiki
Waikakekahenui	4,166	Konohiki

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Appendix B:
Historic Architectural Resources Supporting Study

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AECOM

Puna Wastewater Programmatic Environmental Impact Statement

Historic Resources Supporting Study

December 16, 2022

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List of Acronyms and Abbreviations

AECOM	AECOM Technical Services Inc.
CMP	Comprehensive Management Plan
COMDAT	commercial property data
DHHL	Department of Hawaiian Home Lands
DLNR	Department of Land and Natural Resources
DOFAW	Division of Forestry and Wildlife
DWELDAT	residential property data
FRS	Forest Reserve System
HCR	Hawai‘i Consolidated Railway
HHA	Hawaiian Housing Authority
HHCA	Hawaiian Homes Commission Act
HRHP	Hawai‘i Register of Historic Places
HRS	Hawai‘i Revised Statute
NAR	Natural Area Reserves
NETR	National Environmental Title Research
NPS	National Park Service
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
OHA	Office of Hawaiian Affairs
PCDPSC	Puna Community Development Plan Steering Committee
PEIS	programmatic environmental impact statement
SHPD	State of Hawai‘i Historic Preservation Division
TMK	Tax Map Key
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USGS	United States Geological Survey

1.0 Introduction

The County of Hawai‘i, Department of Environmental Management, is evaluating the feasibility of and potential locations for the addition of wastewater services and facilities for the Puna District in the context of the Kīlauea Eruption Recovery planning process (Proposed Action). Per Hawai‘i Administrative Rules Title 11 Chapter 200.1-14(d)(2), the county is preparing a programmatic environmental impact statement (PEIS) to assess effects of the Proposed Action on the environment within the project area.

The Proposed Action is subject to Hawai‘i Revised Statute (HRS) 6E-8 and would require consultation with the State Historic Preservation Department (SHPD) regarding the impact of the project on historic properties, aviation artifacts, or burial sites, especially those listed on the Hawai‘i Register of Historic Places (HRHP). For the purposes of HRS Chapter 6E, a historic property is any building, structure, object, district, area, or site that is over 50 years old.

Additionally, if the project involves a federal undertaking, Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to take into account the effects of their undertakings on historic properties. Federal undertakings include projects, activities, or programs funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those carried out by or on behalf of a federal agency; those carried out with federal financial assistance; and those requiring a federal permit, license, or approval. For the purposes of the NHPA, a historic property is any property that is included in, or eligible for inclusion in, the National Register of Historic Places (NRHP).

This historic resources supporting study provides a preliminary desktop analysis of potential aboveground historic properties (buildings, structures, sites, objects, and districts) in the project area and recommendations for future phases of the Proposed Action. This supporting study did not include fieldwork and does not analyze archaeological resources, burials, or traditional cultural properties.

1.1 Report Organization

The sections of this report are organized as follows:

- Section 1.0 Introduction
- Section 2.0 Historical Context
- Section 3.0 Analysis and Findings
- Section 4.0 Recommendations
- Section 5.0 References
- Appendices

An introduction to the project, including the location and general overview of the property and the research and analysis methodology, are provided in Section 1.0. An overview of the historical context is provided in Section 2.0. The analysis and findings of this survey, including a description of previously and newly identified historic resources in Puna District, are provided in Section 3.0. Recommendations for further work, including field survey of potentially significant historic resources and/or districts with high concentrations of historic-age resources, are provided in Section 4.0. A list of the references used in this report is provided in Section 5.0. Appendices include select historical US Geological Survey (USGS) maps used in the historic topographic map analysis (Appendix A) and a historic resources analysis mapset that

overlays parcel construction dates with geographic areas identified in the historical context (Appendix B).

1.2 Project Area and General Project Overview

The project area for the addition of wastewater services for the Hawai'i County Puna District is located on the windward side (east side) of the island of Hawai'i (Figure 1). The Pacific Ocean defines the area's eastern and southern borders. The project area is coterminous with the planning area for the Puna Community Development Plan (PCDPSC 2008).

The County of Hawai'i is evaluating the provision of wastewater services to town and village centers in urban and remote communities, many of which are likely to contain resources older than 50 years of age at the time the Proposed Action is constructed. The Proposed Action would provide efficient, technologically advanced, and resilient wastewater collection, treatment, and disposal infrastructure and services in the project area.

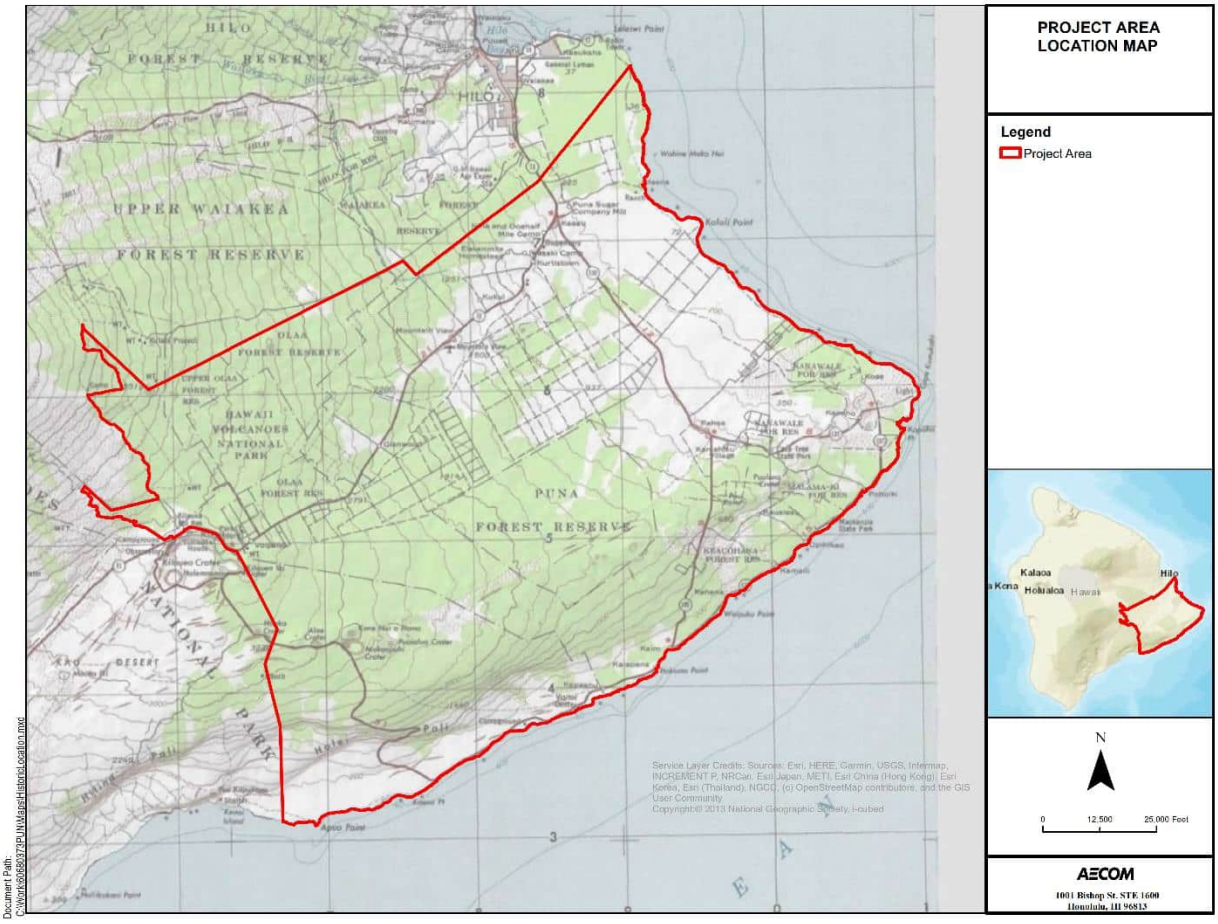

Figure 1. Project area

1.3 Methodology

The historic resources study was overseen and executed by qualified cultural resource professionals who meet the Secretary of the Interior's Professional Qualifications Standards (48 Federal Register 44738). Analysis methods included the research and development of a historical context, comparative review of

historic-age USGS and aerial maps, and GIS mapping of county assessor year built data for Tax Map Keys (TMKs).

1.3.1 Historical Context Development

AECOM Technical Services Inc. (AECOM) conducted research to develop a historical context to support the analysis of the built environment within the project area. Background research included review of materials collected from online government sources and libraries, historical maps, and newspaper archives.

Hawai‘i’s history is well documented in historical overviews and contexts. For the purposes of this report, historical research and context development provides summaries of the historic development eras and themes specific to the Puna District between 1894-1982. This historic period begins with the establishment of the Republic of Hawai‘i in 1894 and ends in 1982 to include resources that may be 50 years in age within 10 years of the report’s preparation.

1.3.2 Historical USGS Topographic Map Analysis

AECOM reviewed historical maps as part of the research and context development and as a preliminary analysis of historic resources that may exist in the project area. AECOM conducted an analysis of USGS topographic maps at scales of 1:24,000 or 1:62,500 produced during the historic period to identify potential aboveground historic resources, clusters of historic-age resources, and historic development trends in the project area. Within each map name/geography, the most recent map still produced within the historic period was selected for further analysis. Of that refined map set, only maps at scales 1:24,000 or 1:62,500 were analyzed, because maps at smaller scales did not show the level of detail necessary to identify built environment resources. AECOM used the USGS “topoView” digital interface to overlay the georeferenced historical USGS maps onto contemporary satellite images to identify which buildings, structures, and trends visible in the historic period maps may be extant today. The USGS historical topographic map analysis is presented in Section 3.2.1, and the analyzed USGS maps are provided in Appendix A.

1.3.3 Tax Map Key Year-Built Data Geospatial Statistical Analysis

A review of TMK data in Puna District identified tens of thousands of historic-age residential and commercial parcels in the project area. In an effort to identify potential clusters of historic-age resources (which could indicate potential historic districts), a geospatial hot spot analysis was performed to identify areas with the highest statistically significant concentrations of historic properties among the tens of thousands of identified parcels.

Hot spot analysis is a spatial statistical analysis and mapping technique interested in the identification of clustering of spatial phenomena. These spatial phenomena are depicted as points or polygons in a map and refer to locations of events or objects. There are different methods for analyzing spatial patterns and detecting hot spots, including spatial autocorrelation and cluster analysis. This hot spot analysis used the Getis-Ord Gi* statistic, which works by looking at each feature within the context of neighboring features. A hot spot can be defined as an area that has higher concentration of events or objects compared to the expected number, given a random distribution of events, in this case, concentrations of historic-age properties. A cold spot is defined as an area that has a lower concentration of events or objects compared to the expected number, given a random distribution of events. Cold spots in this analysis reveal clusters of non-historic-age parcels.

2.0 Historical Context

The Puna District has experienced a multi-faceted history since it was established during the division of the island into districts, or *moku*, by Native Hawaiian rulers long before the first European contact in 1778. Each *moku* is made up of smaller divisions of land called *ahupua'a*, shaped to include portions of mountain regions extending down to the ocean (University of Hawai'i n.d.). The Puna District contains approximately 60 *ahupua'a* (University of Hawai'i at Hilo 2018) (Figure 2).

Key events that have impacted Puna's built environment include government changes, homestead acts, road construction, agricultural and industrial development, establishment of parks and recreation areas, and notable volcanic eruptions. Table 1 provides a brief timeline of important events in Puna's history, including both statewide events affecting Puna and local events within the district. Subsections follow with brief historical overviews that summarize important themes in Puna's history including Homesteading, Community Planning and Development, Statehood, Suburban Housing, Transportation, Education, Religion, Industrial Development, and Recreation and Park Development.

Table 1. Puna District Historical Timeline

Year	Event
1840	The construction of the Puna Trail (or Puna Road), incorporating parts of the *ala loa* or *ala hele* (early trail system), became the main Government Road for Puna District and better-connected residents to both resources within the district and to neighboring districts (Kumu Pono Associates 1999).
1877	Development of the landing at Pohoiki, providing access to the eastern portion of Hawai'i. This landing was later used by the Olaa Sugar Company to first transport materials into Puna.
1893	Hawaiian Monarchy overthrown.
1894	Establishment of the Republic of Hawai'i.
1895	Homesteading is established under the Land Act of 1985 after the establishment of the Republic of Hawai'i in 1894. The land conversion increased small-scale farming in Puna, largely of coffee (Matsuoka et al. 1997:56).
1899	The founding of Olaa Sugar Company (renamed Puna Sugar Company in 1960) began with 34,000 acres of sugar cane, one of the largest sugar plantations in Hawai'i at the time (Hawaiian Sugar Planters' Association 1992). The development of sugar cane farming in Puna also brought railroad connection to the district and attracted migrant workers from Japan and the Philippines, who established communities like Pāhoa and Kea'au.
1911	The territorial government designated 19,850 acres of forest as the Puna Forest Reserve (Matsuoka et al. 1997:57). The reserve has since been expanded to 25,856 acres and was acquired by the Office of Hawaiian Affairs in 2006, which seeks to protect the natural and cultural resources located within the reserve (OHA 2022).
1932	Hawai'i Volcanoes National Park was expanded into Puna District (Matsuoka et al. 1997:61).
1938	US Congress passed the Kalapana Extension Act, which protected Native Hawaiian fishing traditions within the Kalapana area and alleviated the impacts of the National Park extension (Matsuoka et al. 1997:61).
1942	Hawai'i becomes an important training and transit area for American troops in the Pacific Theater, with the US military controlling one tenth of Hawai'i's land.
1955	Kīlauea erupts, and lava covers 3,900 acres within Puna.
1959	Hawai'i becomes a state. Land in Puna District is parceled into subdivisions post-statehood, encouraging population growth within the district.

Year	Event
1960	A major lava flow from the Kīlauea eruption originally destroyed the village of Kapoho. Rebuilding started that same year.
1970	Natural Area Reserves program is established by the state to preserve and protect native Hawaiian flora and fauna, as well as unique geological and vulcanological resources. Two natural area reserves are within the Puna District: Pu'u Maka Ala and Kahauale'a.
2018	Lava flow from Kīlauea covers Kapoho and part of Pohoiki in eastern Puna.

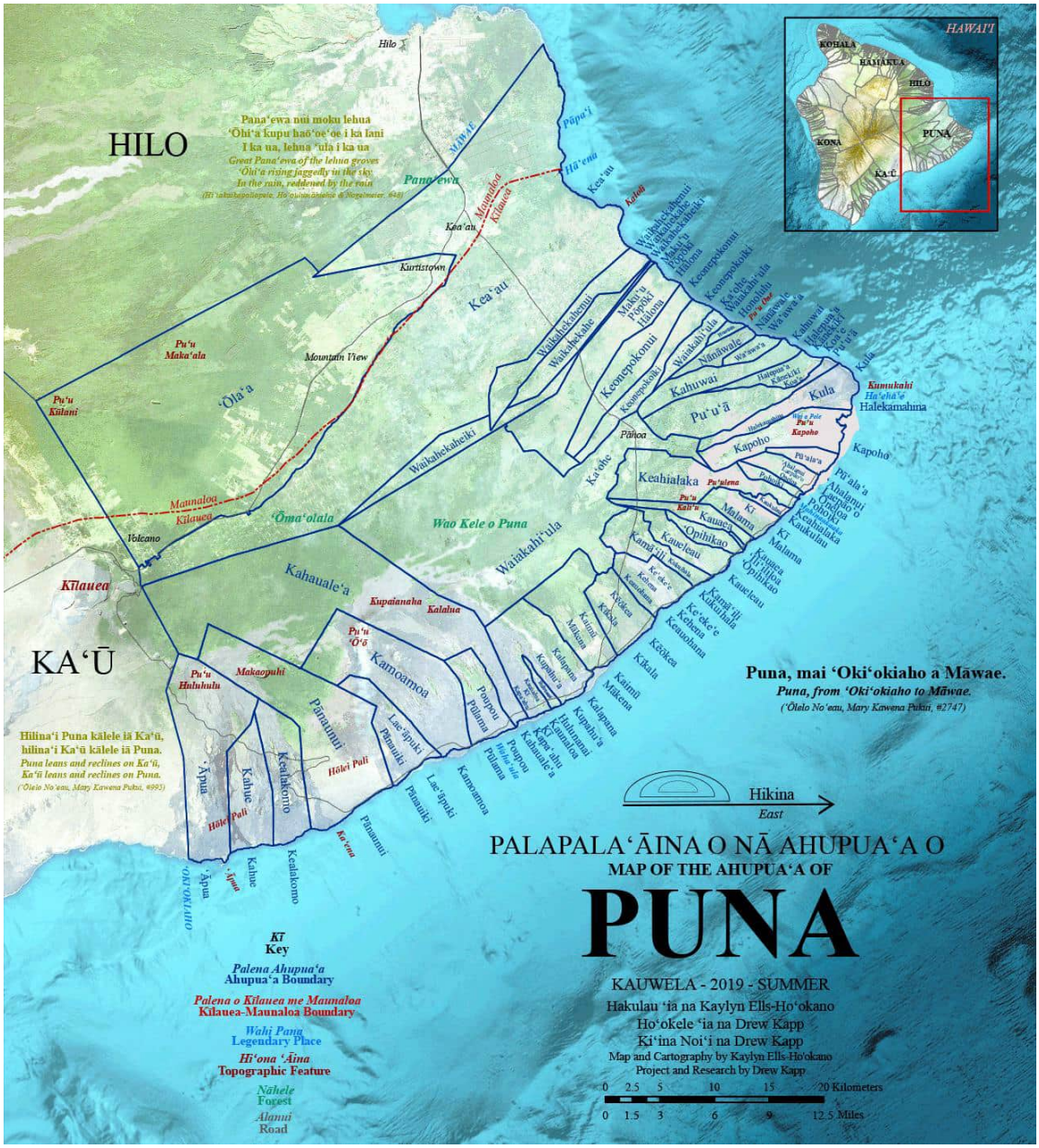

Figure 2. Map of the ahupua'a of Puna (Ells-Ho'okano 2018)

2.1 Republic of Hawai‘i and the Land Act of 1895

The overthrow of the Hawaiian Monarchy in 1893 marked a significant turning point in executive power and land organization throughout the Hawaiian Islands. The queen's proposal of a new constitution to restore power to the monarchy and extend voting rights for Native Hawaiians angered elite American plantation owners and businessmen. As a result, an armed group of 13 men organized the "Committee of Safety" and forced the queen to abdicate, violating existing treaties and conventions between the Kingdom of Hawai‘i and the United States (University of Hawai‘i at Manoa 2022). Half a year later, on July 4, 1894, those involved in the coup formed a white-minority provisional government, leading to the Republic of Hawai‘i. The Republic seized about 1.75 million acres of Hawaiian crown and government lands (Kauanui 1999:125-126). Four years later, the United States formally annexed Hawai‘i under the terms of the Joint Resolution of Annexation of July 7, 1898. The formal transfer of sovereignty from the Republic of Hawai‘i to the United States occurred on August 12, 1898 (Lee 1993:5; AECOM 2017).

With support from the U.S. Marines and the passage of the Land Act of 1895, the Republic of Hawai‘i seized Hawaiian lands to convert into homesteads for small farmers. In the Kingdom of Hawai‘i, land was categorized as either "Crown Land," which was owned and managed by the monarch on the island of Oahu, or "Government Land," which was transferred to the government for public purposes (RE3 LLC Real Estate Services 2004). Former Government Land was primarily used for homesteading across the islands, while Crown Land remained somewhat intact until U.S. President William McKinley signed the Annexation of Hawai‘i in July 1898 (National Archives n.d.).

2.2 Territorial Period Development

The territorial period is characterized by the decades following the US Annexation of Hawai‘i in 1898 to statehood in 1959. One of the most important developments during the territorial period was the significant expansion of the federal government's landholdings. The early years of the territorial period are marked by the Hawaiian Homes Commission Act of 1921 (HHCA) (Section 2.4), while the later years revolve around World War II in the Pacific Theater (Section 2.5).

The early territorial period was also characterized by the acquisition of native lands by the National Park Service (NPS) (Section 2.11). Authorized by Congress and strongly supported by the territorial government, a large part of the Puna District was purchased in the 1920s and 1930s (Young 2022a). The NPS aimed to preserve native grazing practices and Hawaiian structures. Puna was especially regarded as an area well preserved by the government for Hawaiian farming and fishing villages.

2.3 Sugar Plantation Development

The establishment of plantations, with their associated mills, camps, and other supporting infrastructure, forever changed the culture, economy, and landscape of Hawai‘i. Sugar, pineapple, and rice were mainstays of Hawai‘i's economy for much of the late nineteenth and early twentieth century; however, sugar's impact on Hawai‘i was unparalleled. By the 1860s, Hawai‘i's sugar industry was booming. Hawai‘i Island had eight sugar plantations and was producing 3,400 tons of sugar, about one-third of the islands' total production (MacLennan 1997:98, 104). By 1880, Hawai‘i Island had become the islands' major sugar producer, with 24 plantations and nearly 20,000 tons of production. Attracted by the region's rich volcanic soil, the Olaa Sugar Company (now the Puna Sugar Company) established itself in Puna in 1899 and proceeded to have substantial influence on economic, transportation, and community planning and development in the project area.

On May 3, 1899, Benjamin Dillingham, a businessman with railroad and plantation interests, incorporated the Olaa Sugar Company. Through investments, stock, and fees, the company acquired approximately 34,000 acres of land reaching from Pāhoa to Kapoho and Kea‘au (Hawaiian Sugar Planters’ Association 1992). The plantation fields occupied four widely separated sugarcane fields isolated from each other by stretches of barren lava, forming several communities in Puna and establishing a diverse labor force. The sugar company implemented a housing program to build new houses and relocate existing residences to the surrounding communities. The communities continued to grow with the economic success of the Olaa Sugar Company, and schools, churches, and commercial corridors began to emerge.

The company’s operations were intertwined with the Hilo Railway (later renamed Hawai‘i Consolidated Railway [HCR]), given Dillingham’s ownership interests in both organizations. The Olaa Sugar Company operated 72 miles of flumes to convey sugar to the mills in a practice typical to the island, but it lacked a dependable source of water to support their function. The company turned to rail instead, transporting sugarcane in its own Hilo Railway cars from distant fields to the processing plants. Between 1899 and 1946, the HCR transported and delivered up to 60 percent of the Olaa Sugar Company’s sugarcane (Hawaiian Sugar Planters’ Association 1992).

2.4 Hawaiian Homes Commission Act – Homesteads and Hawaiian Home Lands

The continuous arrival of foreigners during the territorial period led to deadly diseases among the native population, as well as loss of native land, resources, and culture. The HHCA of 1921 was passed with the intention to “rehabilitate” native Hawaiians by providing 230,000 acres of land dedicated to a government-sponsored homesteading program for homes, farms, and ranches (Dinstell 2000:29). The HHCA defined eligible Native Hawaiians as “descendants with at least one-half blood quantum of individuals inhabiting the Hawaiian Islands prior to 1778” (Kauanui 1999:123). Designation of public lands for homesteading by only native Hawaiians protected the territory’s most valuable farmlands and cane fields from land speculators (Dinstell 2000:29). As a federal condition allowing Hawai‘i to become a state in 1959, the HHCA became the state’s responsibility. The State Legislature created the Department of Hawaiian Home Lands (DHHL) in 1960 to manage the Hawaiian Home Lands and administer the provisions of the HHCA, which include 99-year homestead leases at an annual rental of $1, as well as financial assistance through direct loans or loan guarantees for home construction, replacement, or repair, and for the development of farms and ranches; technical assistance to farmers and ranchers; and the operation of water systems (DHHL 2022).

Three Hawaiian Home Lands were established in 1921 in the project area: Maku‘u, ‘Ōla‘a, and Keonepoko Nui (Figure 3). Maku‘u includes a total area of approximately 2,203 acres; ‘Ōla‘a encompasses approximately 682 acres; and Keonepoko Nui comprises approximately 100 acres (PBR Hawai‘i 2002; State of Hawai‘i 2021).

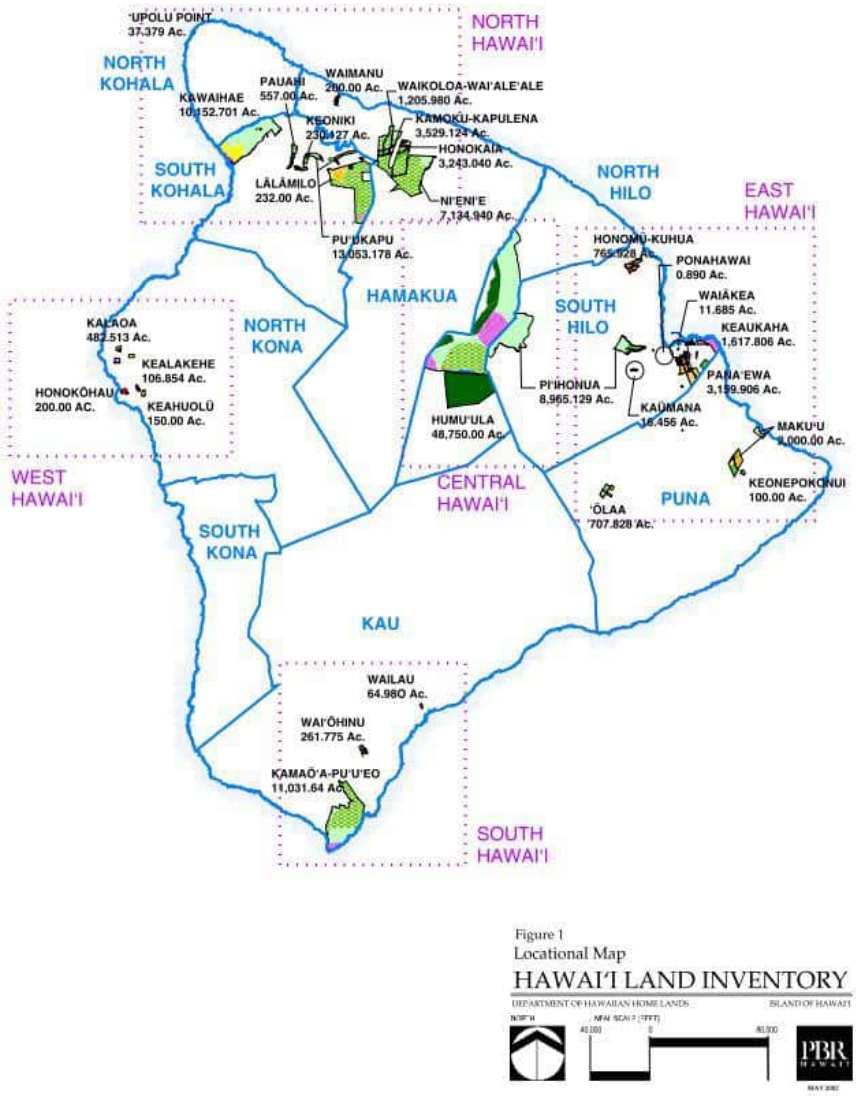

Figure 3. Hawaiian Home Lands parcels on Hawai'i (PBR Hawai'i 2002)

2.5 World War II Development

Efforts to rejuvenate the Native Hawaiian population were halted during World War II, and especially, after the Japanese attack on Pearl Harbor in December of 1941. As a result, Hawai'i quickly became an important training and transit area for American troops in the Pacific Theater. Hundreds and thousands of US officers were stationed in Hawai'i, nearly equalizing the population of military personnel to civilians. The overall service population increased from 28,000 in 1940 to 378,000 in 1944 (Chapman 2014).

In turn, territorial lands, including areas once ceded to Hawaiians, were leased to the military. Rural sugar fields, such as those in the Puna District, were filled with temporary military housing and facilities (Fung Associates Inc. 2011: 3-7). The military controlled nearly 400,000 of Hawai'i's 4 million acres, which served as US special bases, radar installations, air bases, landing strips, and bombing targets (Chapman 2014). The prioritization of military development strained resources for Hawaiians. A lack of

building materials and laborers brought residential construction to a virtual halt, causing a premium on housing throughout the islands for locals. Only 137 building permits were issued during 1942 for houses. New roads and expanded highways served increased military needs, transforming the landscape and placing further strains on traditional practices.

2.6 Hawaiian Statehood

Upon statehood, accelerated change occurred in every aspect of life throughout the Hawaiian Islands. Hawai‘i was admitted as the fiftieth state on August 21, 1959, by President Eisenhower, and just 3 days later, Pan American became the first airline to provide jet service to the islands. The ease of travel began to reshape the landscape of Hawai‘i. Within 10 years of statehood, the number of hotel rooms more than tripled, and five times the number of tourists were travelling to the islands (Fung Associates, Inc. 2011:B-2). Not only did the economy shift from agriculture to tourism at this time, but residents from the continental US also began to purchase land and become permanent residents of Hawai‘i. The state’s population has grown substantially from the beginning of statehood to today, from 620,000 residents to over 1.4 million (Hawaiian Encyclopedia n.d.). The influx of new residents is largely attributed to prime agricultural lands being transformed into residential subdivisions, condominium complexes, and resorts. Former plantation workers displaced by this economic shift often settled for lower-paying jobs in the tourist industry (McGregor 2007:46).

The district of Puna, however, experienced a delay in the rapid transformation of living conditions and land use in the state. Subdivision activities following statehood generated tens of thousands of small land parcels that were being purchased (DHHL 2010). These lots were often purchased with investment intentions, but owners opted not to construct due to lack of infrastructure and poor property conditions. As result, subdivision communities were only sparsely developed and occupied.

2.7 Housing Developments in Puna District

From the late 1940s through the 1950s, large agricultural landholdings across the Territory of Hawai‘i were transformed into suburban residential communities. In 1950, the City and County Department of Public Works reported that, “48 subdivisions were completed; 19 were under construction, and 34 had preliminary plans approved and authorized” (Fung Associates Inc. 2011: 4-67). With activity reaching a high of 71 subdivisions completed in 1956, this tremendous residential growth resulted in scattered and disconnected subdivisions that reduced access to public services and compounded already high levels of poverty (Fung Associates Inc. 2011:4-67).

In an effort to better regulate the islands’ growth, the Legislature in 1961 developed a comprehensive statewide system of zoning, making Hawai‘i the first state in the union to adapt such a strategy (Fung Associates Inc. 2011:4-67). The Omnibus Housing Act of 1961 was the first of many similar housing acts to follow on the mainland in the coming years. On Hawai‘i, it provided funding to improve low- and moderate-income housing and stimulate additional building activity, with an aim to revitalize the home construction industry (Stanley and Dewa 1967: 19).

2.7.1 Private Subdivision Developments

Following statehood, there was an explosion of housing activity. According to Fung and Associates in their research for the Hawaiian Modernism Context Study:

> The Public Works annual report for 1961-1962 noted, “Large new subdivisions continued to extend up into the valleys and ridges and out onto available plains and ponds.” In the opening

years of the 1960s, the number of subdivisions under construction ranged from 66 in 1963 to 107 in 1966. The pace slackened during the 1970s, but between 24 and 47 applications a year were reviewed and given final approvals.

In Puna alone, over 52,500 subdivision lots were created between 1958 and 1973, with a vast majority (43,413) of lots planned between 1958 and 1961 (Table 2). Lot sizes were larger in this earlier development period, with sizes ranging from 0.5 acres to over 3 acres in subdivisions before 1961, decreasing dramatically to an average of 0.25 acres per lot after the 1961 zoning changes (Table 2). Puna District currently contains 45 percent of the island's subdivided lots; however, a low (25 percent) build-out rate has kept the subdivided land from being utilized for other purposes (PCDPSC 2008:3-11).

The planned subdivisions in Hawai'i were in many ways speculative in nature; investors both from the mainland and from local Hawaiian investors sought to take advantage of the newly formed state's recreational lure to wealthy homeowners on the mainland. Most lots were sold as "investment" or "retirement" properties to mainlanders sight-unseen (McNarie 2018). As investors had no plans for local residents to live and work in these subdivisions, most Puna subdivisions were designed with unpaved roads and no lighting or sidewalks, and fall behind Hawai'i County standards for road width, drainage, and sewer and water systems (PCDPSC 2008). The homes that were built are largely one-story, rectangular-plan, front-gable Plantation Style buildings. The 1950s and 1960s homes are smaller and simpler in decoration than the homes in the 1970s subdivision, which more often have a second story, more elaborate decoration, and larger garages (Google Maps 2022).

Table 2. Suburban Residential Subdivisions in Puna District 1954-1974

Subdivision Name	Development Year	Number of Lots	Lot Size	Total Area (acres)
Pre-Statewide Zoning System Subdivision Developments				
Kapoho Beach Lots	1954	185	0.25-1.2 acres	50
Hawaiian Acres	1958	3944	1.8-6 acres	12,141
Fern Forest	1958	2579	3 acres	9,000
Orchid Land	1958	2491	0.5-1.3 acres	5,670
Fern Acres	1958	2021	2 acres	4,000
Hawaiian Orchid Isle	1958	205	+/-3 acres	700
Wa'a Wa'a	1958	177	0.3-3.5 acres	527
Hilo Acres	1958	48	N/A	N/A
Hawaiian Paradise Park	1959	8843	+/- 1 acres	9,469
Ainaloa	1959	3637	0.2-0.5 acres	1,160
Royal Hawaiian	1959	1640	0.25-0.5 acres	630
Hawaiian Holiday Estates	1959	94	3.89 acres	366
Nanawale Farm Ranch	1959	450	N/A	1,359
Kaohe Homesteads	1959	96	3 acres	1,325
Leilani Estates	1960	2266	1 acre	2,400
Eden Roc	1960	1809	1 acre	2,000
Nanawale Estates	1960	4289	0.25-0.4 acres	1,134
Mauna Loa Estates	1960	893	20,000 sf	550

Subdivision Name	Development Year	Number of Lots	Lot Size	Total Area (acres)
Ohia Estates	1960	756	0.25-0.3 acres	280
Hawai‘i Island Paradise	1960	449	0.2 acres	100
Kaniahiku Village	1960	36	0.5-3 acres	28
Hawaiian Beaches, Parks and Shores	1961	3522	0.2-0.5 acres	1,416
Aloha Estates	1961	1846	0.25-0.3 acres	593
Orchid Isle Estate	1961	845	0.25-0.3 acres	292
Pacific Paradise Development	1961	209	0.2 acres	49
Orchid Isle Estate II	1961	83	N/A	N/A
Post-Statewide Zoning System Suburban Developments				
Black Sand Beach	1962	918	7,750 sf	202
Tiki Gardens	1962	481	0.2-0.25 acres	120
Glenwood	1962	152	0.25-0.3 acres	53
Vacationland Hawai‘i	1963	489	0.2-3.2 acres	557
Tangerine Acres	1963	71	0.5 acres	71
Kehena Beach	1964	199	0.25-0.3 acres	52
Kapoho Papaya Farms	1964	40	3+ acres	130
Mauna Lani Lots	1965	98	1 acre	101
Kopua Farm Lots	1966	115	N/A	N/A
Ho‘onanea	1966	52	0.2 acres	12
Kea‘au Ag Lots	1966	331	N/A	N/A
Volcano Village	1968	1064	N/A	N/A
Kalapana Sea View Estates	1971	693	<0.25 acres	166
Pacific Paradise Mountain View Manor	1971	606	0.25-0.3 acres	145
Lanipuna Gardens	1973	118	1 acre	130
Pacific Paradise Gardens	1973	423	0.2 acres	95
Puna Beach Palisades	1973	72	20,000 sf	36
Olaa Scenic Lands (aka Pacific Paradise Gardens)	1973	442	N/A	N/A
Pāhoa Agricultural Park	1974	63	N/A	N/A

Sources: *Hawai‘i Tribune-Herald* 1972; PCDPSC 2008.
Notes: sf = square feet; N/A = not applicable.

2.7.2 Hawaiian Housing Authority Developments

During the Great Depression, the Public Works Administration, in an effort to stimulate employment and improve living conditions of low-income families, developed and operated housing projects in selected localities throughout the nation. In response to this federal program, the Territorial Legislature established the Hawai‘i Housing Authority (HHA) through Act 190, State Law 1935. With the passage of the federal Housing Act of 1937 (Public Law 412 – 75th Congress), public housing projects began to be developed in Hawai‘i, with the two pre-World War II projects being the Kalakaua Homes (1941), designed by Ray Morris, and C. W. Dickey’s red-tile roofed Kamehameha Homes (1940). Two other

projects, Mayor Wright Homes in Honolulu and Lanakila Homes in Hilo, were deferred because of the outbreak of World War II (Fung and Associates 2011:4-26). At the end of the 1960s, HHA was also given the responsibility for public teacher housing and constructed eight teacher cottages on Molokai (1968) and two at Weliweli in Koloa on Kauai (1969). No HHA public teacher housing has been recorded in Puna District.

Forty-seven federal housing projects were constructed in the state of Hawai'i between 1952-1979, including three separate projects designed by master architects C. W. Dickey, John Warnecke, and Cesar Pelli. Of this number, 9 were built in the 1950s, 20 during the 1960s, and 18 in the 1970s. No pre-World War II project remains standing (Fung and Associates Inc. 2011:4-24).

According to the State of Hawai'i Affordable Housing Inventory, two HHA-funded historic-age housing projects were constructed in Puna District during this period—the Hale Aloha O Puna Project in Kea'au and the Nani O Puna Project in Pāhoa, both constructed in 1976. A third, non-historic, HHA-funded project, the Harry and Jeanette Weinberg Kea'au Elderly Project was constructed in 2004 (State of Hawai'i 2018).

2.8 Transportation Development

The following section provides context on the development of transportation in the Puna District between the early settlement period of Hawai'i and 1946. Topics include roads in Puna, including information on the *ala loa* and *ala hele* trail systems, the Puna Trail and the Government Roads, in addition to a brief context on modern roads and highways. The development of historic rail lines, primarily the HCR in relation to the sugar plantations, is also discussed.

Typical settlement patterns in Hawai'i placed people along the shoreline, on the windward sides of the islands. However, in Puna, the shorelines featured thin soils and lacked deep water harbors; the ocean along the Puna coast was also rough and windblown. As a result, Puna settlement patterns became dispersed and without major population centers. Villages developed over large inland areas that included better soil for agricultural purposes. The dispersed settlement patterns, therefore, manifested the Puna Trail, known after the 1840s as the main Government Road. The Puna Trail, which included segments of the *ala loa*, or *ala hele*, trail system, operated as the main thoroughfare throughout the Puna District (Young 2014). By the turn of the twentieth century, Puna's transportation infrastructure also introduced commercial and industrial rail lines that supplemented travel between major trade centers, like Hilo.

2.8.1 Roads

The following context is largely excerpted and adapted from the Historic Puna Trail-Old Government Road (Kea'au Section) report authored in 1999 by Kumu Pono Associates. Edits have been made for clarity and the purpose of this report.

The development of modern road and highway systems in Puna evolved from a system of trails called the *ala loa* or *ala hele*. The *ala loa* operated from the early settlement period of Hawai'i until the late eighteenth century (Kumu Pono Associates 1999). The *ala loa* provided a link between individual residences, resource collection sites, agricultural field systems, and larger communities. These trail systems also demonstrated several methods of historical construction. Examples included ancient methods, like worn paths or cobble stepping-stone pavement, to more modern methods, like curbstone-lined roads with elevated stone filled "bridges" that leveled the contour of the roadway (Kumu Pono

Associates 1999). The *ala loa* and *ala hele* trail system, therefore, provided a standardized method of travel in Puna and was, and remains, a significant feature of the district's historical and cultural landscape.

Western contact in the early nineteenth century further influenced and developed the *ala loa* due to travel by horse and other hoofed animals, as well as wheeled carts. As a result, white settlers realigned, widened, and smoothed former *ala loa* roads; other *ala loa* roads were abandoned in favor of more direct routes (Kumu Pono Associates 1999). Portions of older routes were also moved further inland to make direct routes, compared to those that historically followed the coastline. By the 1840s, modified *ala loa* trail alignments became part of a system of "roads" called the *Ala Nui Aupuni*, or Government Roads.

Labor and/or financial contributions from local residents, as well as government appropriations, primarily funded the work and maintenance of the Government Roads. After 1840, the Puna Trail quickly became the main Government Road. The Puna Trail was the main Government Road that operated as a system of connected trails that meandered throughout the Puna District with a web-like fashion; Figure 4 illustrates the Puna Trail with darkened trails that extended across the district with an east to west orientation. The Puna Trail provided residents and travelers with access to resources within a given *ahupuaʻa*, a term used to describe a traditional Hawaiian land unit, as well as meandered through the entire district and connected itself to other districts around the island. The Keaʻau section of the Puna Trail connected small coastal settlements located at Keaʻau Beach, Paki Bay, and Keauhou Bay. Additional details of the Puna Trail included access to schools and churches, as well as access for those that resided in the neighboring Hilo District, directly north of Puna (Kumu Pono Associates 1999). Figure 4 shows the Puna Trail in 1841, as mapped by Charles Wilkes and the United States Exploring Expedition.

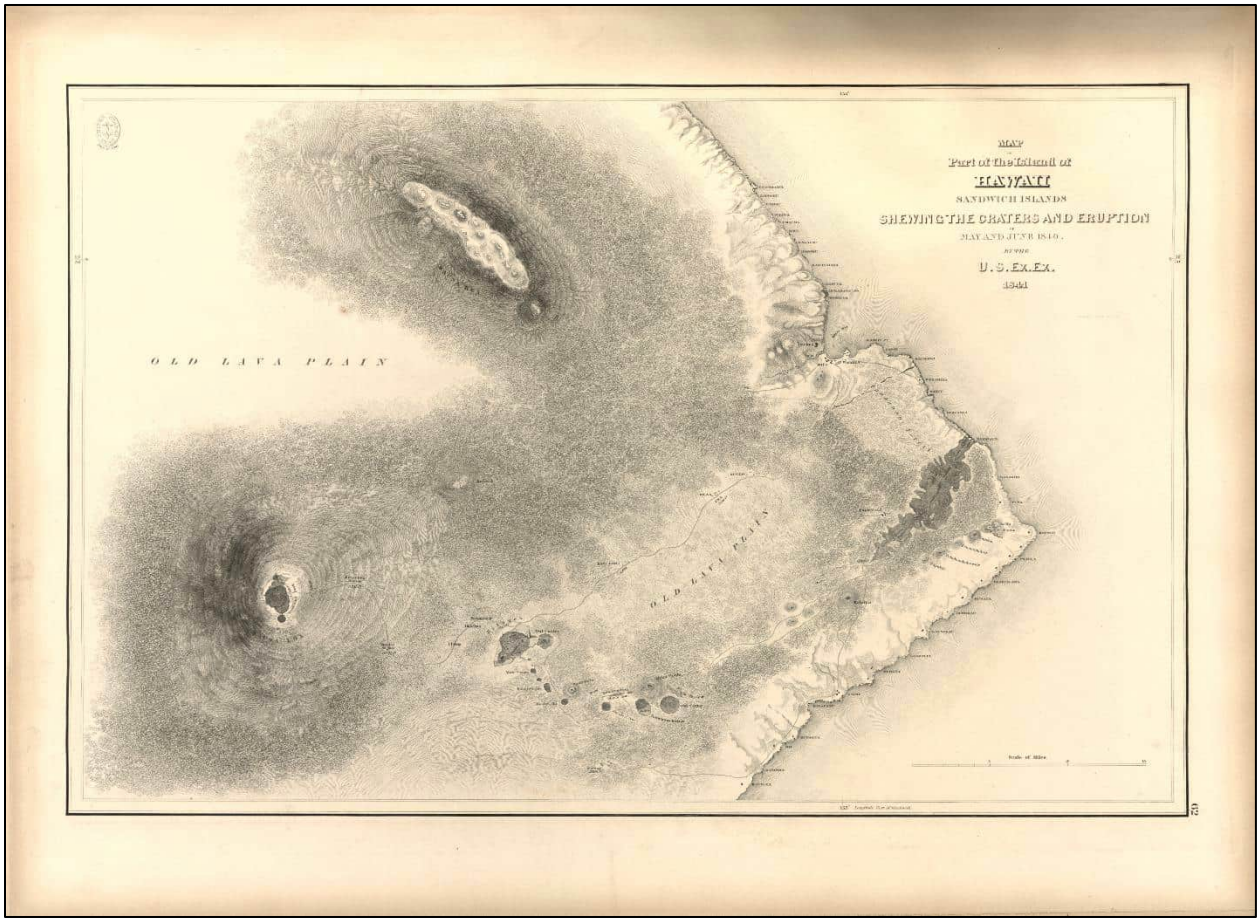

Figure 4. Map of the Puna District from the Charles Wilkes' United States Exploring Expedition of 1841. Depicted on the map are the historical road and trail alignments of the former Puna Trail, also known as the main Government Road (Wilkes 1841).

The mid- to late nineteenth century introduced Puna's infrastructure to a rapidly changing social and economic system of Hawai'i. This included increased travel between the communities of Puna and the town of Hilo, an important trade center. Residents of Puna regularly traveled along the Government Roads to trade and sell produce and handcrafts at the markets in Hilo. By the 1870s, Puna generated additional commercial activity that included cattle ranching, the cultivation of *'awa* and coffee, woods, and *pulu*. As a result, in 1875, government officials completed further modifications and alignment work to the Puna Trail (Kumu Pono Associates 1999).

In the 1890s, the State of Hawai'i sold large tracts of land in Puna for both residential and agricultural use. The location of the new land, about 3 to 4 miles inland and about 400 feet above sea level, resulted in the need for a new direct route between Puna and Hilo. In 1895, officials designed and constructed the basic alignment of the Kea'au-Pāhoa Highway, presently known as the Puna Road (Highway 130) (Kumu Pono Associates 1999). After 1895, research indicated that no major development to the alignment of the Government Roads occurred until 1941, when the United States entered World War II.

During World War II, the United States military operated the Puna Trail from the Waikahekahe-uni boundary to Ha'ena. The military smoothed the alignment for four-wheel military vehicles. While

alterations to road alignments occurred over a 4-year period, original stone and pebble material, bridge work, and curbstone alignments remained extant along the Puna Trail (Kumu Pono Associates 1999).

The State of Hawai'i has realigned and developed much of the original Puna Trail and Government Roads system to serve modern vehicular traffic and transportation needs. However, historical period roads remain extant throughout the Puna District. The following table provides general context on several road alignments extant in Puna (Table 3).

Table 3. Brief **C**ontext and **D**escriptions of **Select Historic Roads** in the Puna District

Road	Description	Date
Volcano Road (Highway 11)	Access to and from Hilo; serves the upper Puna region; connects Puna to Ka'u	Original alignment formed in 1783
Puna Road (Highway 130)	Runs from Kea'au to Kalapana-Kaimu; provides access from northern to southern Puna	1895
Kapoho Road (Highway 132)	Spans between Pāhoa and Kapoho	Unknown; likely historical alignments from the Puna Trail
Puna Coast Road (Highway 137)	Links Kapoho to Kalapana-Kaimu.	Unknown; likely historical alignments from the Puna Trail
Puna Trail/Old Government Road	Main Government Road system that meanders throughout the Puna District.	Circa 1840
Old Kalapana Road	A narrow road with a north-to-south orientation; runs parallel to Pāhoa Kalapana Road; located in southern Puna.	Unknown; likely historical alignments from the Puna Trail

2.8.2 Historic Rail Lines

Historic rail line development in Puna primarily revolves around the 1899 establishment of the Olaa Sugar Company plantation and its partnership with the HCR. The HCR operated from March 1899 to April 1946, when its rail lines experienced a fatal blow from a tsunami caused by Aleutian Islands earthquake (Figure 5).

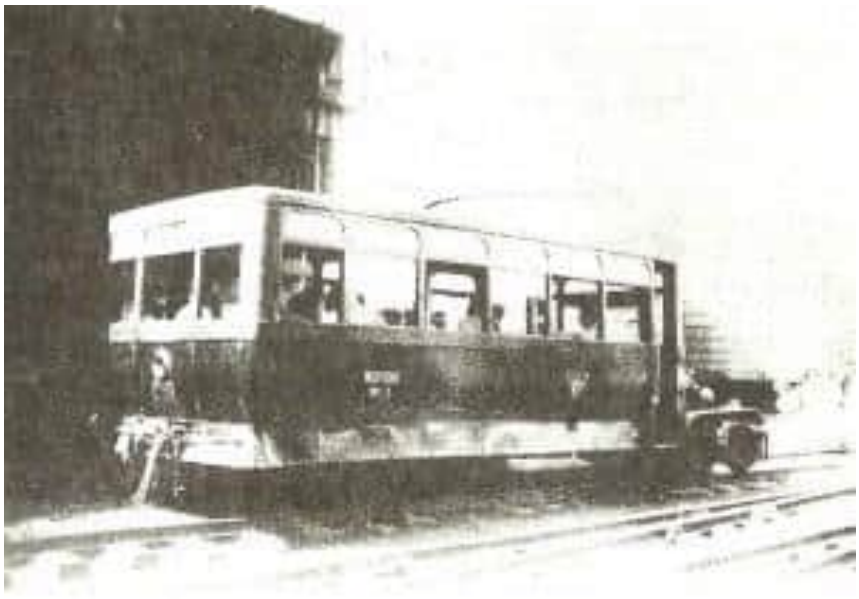

Figure 5. Early 1900s photo of a passenger car traveling from Pāhoa to Hilo along the Hawai‘i Consolidated Railway (Sato 2015)

2.8.2.1 Hawai‘i Consolidated Railway

Benjamin Dillingham, a businessman responsible for the Oahu Railway and Land Company in 1865, founded the Hilo Railway in 1899 as a solution to transportation needs for his newly established Olaa Sugar Company plantation. As a result, the Hilo Railway, a standard gauge common carrier railroad that served the east coast of the island of Hawai‘i, manifested out of the necessity for reliable transportation at the turn of the twentieth century.

On March 28, 1899, Dillingham received a charter to construct the first 8 miles of the Hilo Railway that connected the Olaa Sugar Company’s sugar mill to Waiākea, which later became Hilo’s deep-water port (Hamakua 2019). Shortly after construction, the railway constructed junctions to Pāhoa and Kamaili; the line was also extended into the town of Hilo (Figures 6 and 7). The railway also adapted the rail line to transport tourists from Glenwood to the Kīlauea Volcano (Hamakua 2019). By the end of 1910, the Hilo Railway owned six locomotives, three passenger cars, two combined passenger cars, mail and baggage cars, 60 flat freight cars, three material cars, a coal car, a tanker, an office car, and eight work cars. Between 1909 and 1910 alone, the HCR transported 77,074 passengers and 158,525 tons of goods, including approximately 60 percent of the Olaa Sugar Company’s sugarcane (Hamakua 2019). By 1916, the Hilo Railway reorganized itself as the HCR.

On April 1, 1946, a tsunami caused by Aleutian Islands earthquake destroyed significant portions of the HCR’s tracks and bridges. The HCR ceased its operations and closed all of its tracks. The Olaa Sugar Company was forced to convert to trucks in order to transport sugar and molasses to the Hilo wharf (Hawaiian Sugar Planters’ Association 1992). The HCR removed and disassembled much of its original rail line. However, the Hawai‘i Consolidated Railroad Roundhouse, constructed in 1921 in Hilo, appears to remain as the only extant evidence of the former HCR.

Figure 6. Undated historical photo of a railroad through the Puna Forest to the Pahoa Lumber Mill (Young 2016).

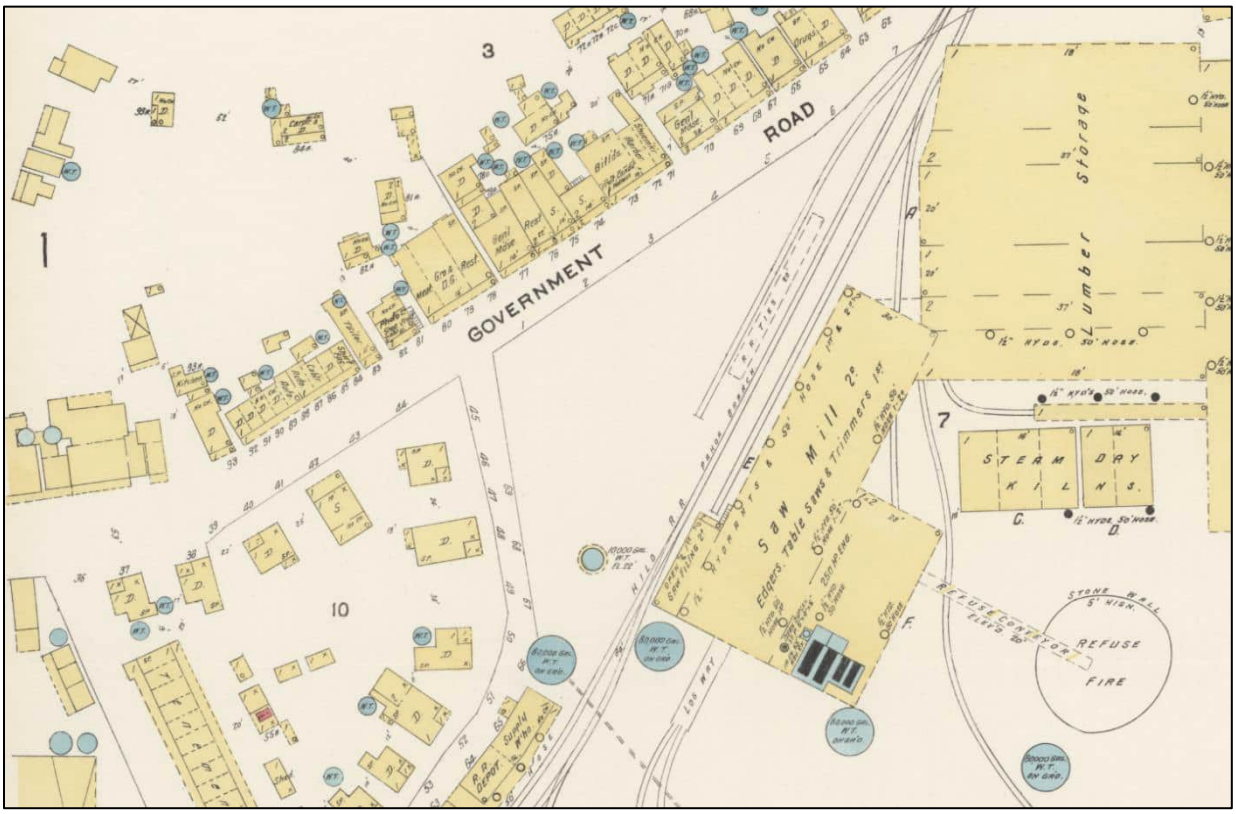

Figure 7. Sanborn Fire Insurance Map from Pāhoa, Hawai'i County, Hawai'i (1914). Depicted is the "Hilo R.R. Pāhoa Branch," later known as the HCR, bisecting the town of Pāhoa with a north-to-south orientation.

2.9 Education

The education system in Hawai‘i has its roots with the American missionaries who arrived in the islands in the early nineteenth century. By 1828, over 37,000 men, women, and children attended mission schools in Hawai‘i, with nearly half of those on the Big Island. Common Schools, institutions led by missionaries or more often, Native Hawaiian men who had previously received a mission school education, followed the first wave of mission schools. By the late 1830s, there were about 100 Common Schools in Hilo and Puna (Elliot-Kashima 2020). Early missionary and common schools were typically constructed of wood and other local materials. No extant schools from this period remain in Puna District.

The public school system in Hawai‘i was established in 1840 by King Kamehameha III, making it the oldest educational system west of the Mississippi. Instruction was taught in Hawaiian until it was banned in 1896, following the overthrowing of the Hawaiian Kingdom in 1893 (hawaiianpublicschools.org n.d.). By 1900, 92 percent of children in Hawai‘i County attended school (Moy n.d.). In Puna District, sugar plantation development around the turn of the twentieth century led to increased population growth in rural areas and subsequent development of rural public schools to serve plantation families. Pāhoa High and Intermediate School, originally Pāhoa School, established in 1910, and Kau High and Pahala Elementary School, completed in 1939, are examples of extant rural public schools in the Puna District.

A robust private school system developed concurrently with the public school system in Hawai‘i, largely the result of class and ethnic divisions on plantations, in suburbs, and in urban areas. Wealthy white settlers almost exclusively sent their children to private schools. Middle class immigrants, particularly Chinese and Japanese parents, also paid for private education, but most often at schools affiliated with churches, notably the Catholic Church (Fung Associates Inc. 2011:B-8).

Another wave of public school construction followed statehood in 1959. Reorganized as the Department of Education in 1962, Hawai‘i’s school system initiated an ambitious program of school expansion to educate the growing population. The program included major alterations to both rural and urban schools and the construction of many new schools and school buildings (Fung Associates Inc. 2011:B-20).

2.10 Religion

Prior to the arrival of Christian missionaries in Hawai‘i in the early nineteenth century, Native Hawaiians largely practiced polytheistic religions. Heiaus, or ancient Hawaiian temples and sacred sites, like the engulfed Waha‘ula Heiau near Kaimu Beach, embody these early religious practices of the Hawaiian Islands.

The first missionaries to arrive to Hawai‘i sailed from Boston, Massachusetts, aboard the *Thaddeus* and arrived at port in Kailua-Kona in 1820. That original missionary party comprised seven couples and included Presbyterians, Congregationalists, and Dutch Reformists (Derrick 2022). Catholic missionaries followed shortly thereafter, arriving to Honolulu in July 1827 (*Hawai‘i Catholic Herald* 2018). The Church of Hawai‘i was the state church and national church of the Hawaiian Kingdom from 1862-1893 (Portuguese Family History Collections of Hawai‘i 2021).

With the arrival of large Portuguese, Japanese, Filipino, and Chinese communities to the Hawaiian Islands in the late nineteenth and early twentieth centuries, new church facilities, including cemeteries, were established to support these growing communities. In Puna District, this included the

establishment of Holy Rosary Catholic Church in Pahala, Holy Rosary Mission Chapel in Kea‘au, Sacred Heart Church in Pāhoa, St. Theresa Catholic Church in Mountain View, and Star of the Sea Painted Church in Kalapana, all of which were associated with the Portuguese community (Portuguese Family History Collections of Hawai‘i 2021). The Puna Covenant Church, established in 1912, was originally associated with Japanese and Filipino plantation communities in the Puna region. The Puna Hongwanji Mission, a Buddhist temple founded in 1902 and built in Kea‘au in 1937, provided spiritual support for first generation Japanese immigrants in the area (Puna Hongwanji Mission 2022).

2.11 Recreation and Park Development

The following section outlines recreational and park development in Hawai‘i and, more specifically, in the Puna District. Topics include general recreational development, Hawai‘i Volcanoes National Park, the Pu‘u Maka Ala and Kahauale‘a Natural Area Reserves (NAR), and the ‘Ōla‘a, Malama Kī, and Wao Kele O Puna Forest Reserves.

2.11.1 General Recreation Development in Puna District

Recreational development in Hawai‘i began as early as 1870, when faster and more structurally sound steamships replaced obsolete sailing vessels in trans-Pacific travel. By 1900, Hawai‘i became a United States territory, and more Americans began to recreationally visit the tropical, Polynesian island. As a result, international, national, and local governments shaped Hawaiian tourism with mail subsidies to steamship companies, local funding for tourism promotion, and protective legislation on domestic shipping. Geographically, Hawai‘i also existed at the crossroads of major trade routes in the Pacific region (Mak 2015). As a result, by the 1920s and 1930s, Hawai‘i positioned itself as a destination for national, and international, tourism that offered an array of recreational indoor and outdoor activities for visiting parties.

In the 1920s and 1930s, Hawai‘i experienced major on-going development that included cruise ship lines and the establishment of visitor activities. Cruise ship lines arrived each year and docked in Hawai‘i for 2 to 3 days while tourists explored the island; destinations commonly included Honolulu, Hilo, and the Kīlauea Volcano in the Puna District. The introduction of cruise ship lines also encouraged the development of visitor activities. In 1929, the Aloha Festivals offered tourists “a season of colorful sports, festivals, school pageants, floral and other features of Hawaiian life” in the spring and fall (Mak 2015). In the 1930s, Boat Day celebrated the welcome and send off of passenger liners at Aloha Tower in Honolulu. In 1935, *Hawai‘i Calls*, a radio station created by Webley Edwards, began to broadcast Hawaiian music from the ballroom of the Royal Hawaiian Hotel and the Alexander Young Hotel Roof Garden. In 1937, Fritz Herman, vice-president and manager of Kodak Hawai‘i, staged the first Kodak Hula Show with five dancers at the Sans Souci Beach (Mak 2015). Cruise ship lines, coupled with the increase of recreational activities like annual festivals and hula shows, dramatically increased Hawai‘i’s position in the tourist industry. Between 1922 and 1930 alone, tourist arrivals grew at an average rate of 9.2 percent, with an additional growth of 5.7 percent between 1933 and 1940 (Mak 2015). By the end of 1920 and into the early 1930s, Hawai‘i earned sufficient recognition as a recreational destination to be called an “industry,” a title that maintains its global reputation in the present day (Mak 2015).

While Hawai‘i offered commercialized tourist activities, the island also became recognized for its natural landscape protected as national parks, forest reserves, and natural area reserves. Puna, the district located on the eastern coastline of Hawai‘i, includes several recreational locations identified as the Hawai‘i Volcanoes National Park, the Pu‘u Maka Ala and Kahauale‘a NAR, and the ‘Ōla‘a, Upper

Waiākea, Malama Kī, and Wao Kele O Puna Forest Reserves (Figure 8). Many of these natural reserves became protected by both federal and state recognition as early as the 1910s. In 1913, the Governor's Proclamation designated the Upper Waiākea Forest Reserve as a 53,241-acre reserve located on the eastern coastline in Puna. In 1916, President Woodrow Wilson designated the Kīlauea and Mauna Loa volcanoes, located toward the western boundary of Puna, as the Hawai'i Volcanoes National Park. Though both volcanoes lie largely outside Puna, they do touch the district boundary and are therefore included. Previously and newly identified historic resources associated with the Hawai'i Volcanoes National Park include the Crater Rim Drive, the Whitney Seismograph Vault #29, the Old Volcano House #42, and the Tahara House Site. Overall, a combination of natural and built environment resources significantly influenced and defined the recreational landscape that developed in Puna, Hawai'i, throughout the early to mid-twentieth century.

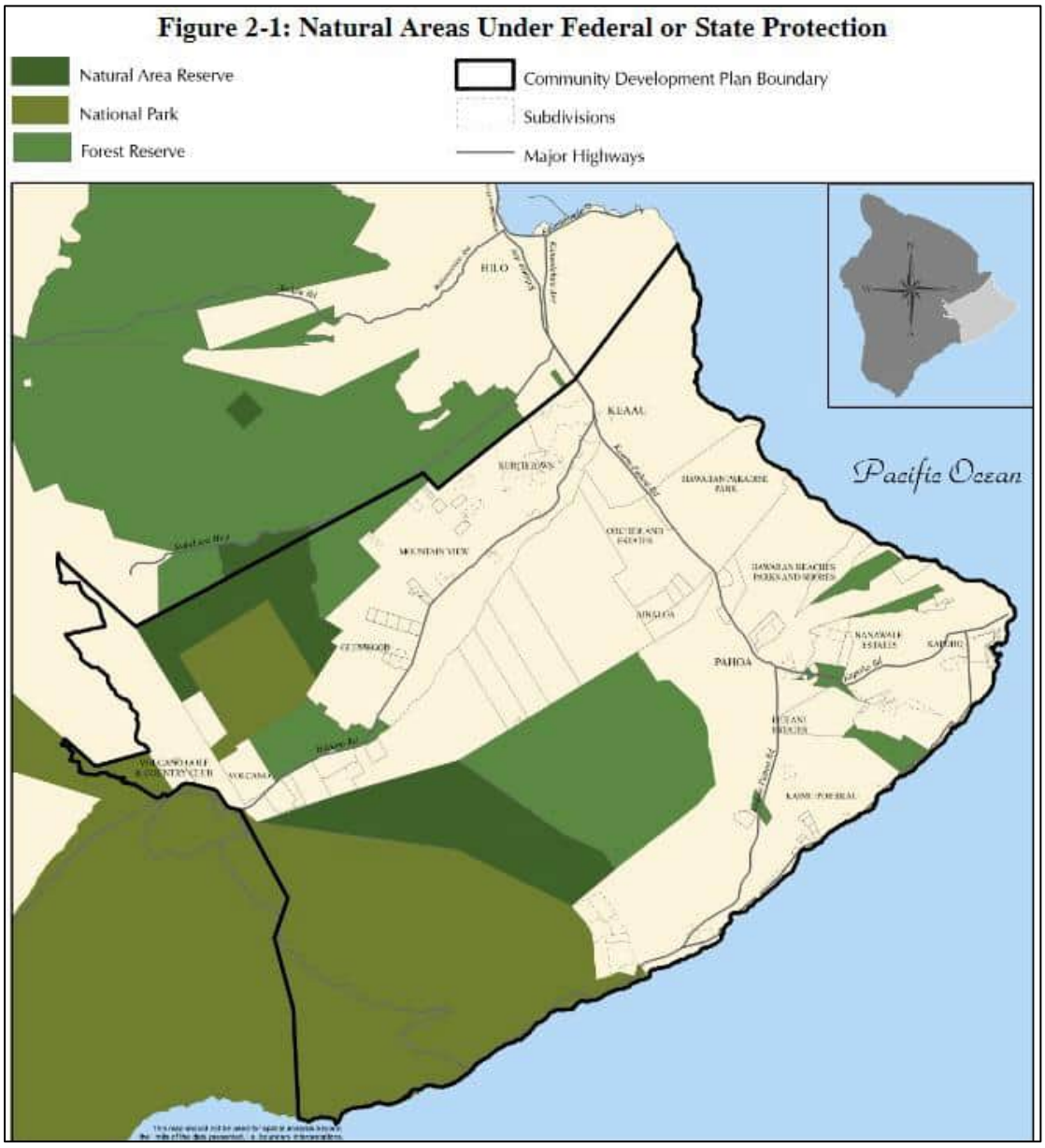

Figure 8. Map detailing natural areas within Puna that are under federal or state protection (PCDPSC 2008)

2.11.2 Hawai‘i Volcanoes National Park

In 1916, the National Park Service designated the Hawai‘i Volcanoes National Park under the authority of former President Woodrow Wilson. The park, partially located in the Puna District on 323,431 acres of land, protects both the Kīlauea and Mauna Loa volcanoes, in addition to other native plant and wildlife species. Mauna Loa, the world's largest active volcano, rises more than 2.5 miles above sea level and 10.5 miles above its base (USGS n.d.-a). The Hawai‘i Volcanoes National Park also includes additional NRHP-listed cultural resources and districts, including the Ainahou Ranch, an NRHP-listed ranch and house; the Kīlauea Administrative District, which includes park buildings and the Kīlauea Visitor Center built by Civilian Conservation Corps in the 1930s; and the Crater Rim Drive Historic District, a 5,000-acre district that meanders in and around the Kīlauea Caldera. Additional resources in the Hawai‘i Volcanoes National Park include the Whitney Seismograph Vault #29, the Old Volcano House #42, and the Tahara House Site. In 1980, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) designated the Hawai‘i Volcanoes National Park as an International Biosphere Reserve, reflecting its value for research and protection of evolutionary resources. In 1987, the national park became a World Heritage Site, citing its geological resources (PCDPSC 2008:2-1).

The Hawai‘i Volcanoes National Park undoubtably reflects themes of scientific, environmental, and geological importance. However, between the 1920s and 1930s, local tourist industries advertised the national park for its natural beauty and promoted the park for its recreational activities. As stated earlier, this period also became defined by commercial-minded activities that included elaborate swimming pools, golf courses, and surf boarding, as well as excursions to sugar plantations and mills. To some extent, "the wealth of the island is in these enterprises" (*The Honolulu Advertiser* 1935). Though commercialized activities attracted thousands of visitors each year and significantly supported the local economies, public opinion believed it falsely portrayed Hawai‘i's true identity: its natural landscape.

In the 1920s and 1930s, the Hawai‘i Volcanoes National Park became a location for the chance to witness a volcanic explosion. While the Kīlauea Volcano emitted, and continues to emit, a constant stream of lava, visitors attended for a chance to witness an eruption of its larger sibling, the Mauna Loa Volcano. The Mauna Loa Volcano erupted in 1926, 1933, and 1935. In 1935, *The Honolulu Advertiser* described an eruption day:

> Everyone wears a smile and seems unusually busy about something. The papers carry screamers across the top, "Mauna Loa Erupts; Dr. Jagger and Park Officials on Way to Scene," or "Kīlauea Again Active; Pele Returns to Hawai‘i," and such like. Steamer excursions are organized and space booked withing a few hours. On the island of Hawai‘i, the roads are crowded with every sort of conveyance, and at the hotels even floor space is in demand. Everyone who can, and numbers who cannot, spare the time are fleeing not from, but to the scene of activity (*The Honolulu Advertiser* 1935).

The Mauna Loa Volcano erupted several more times in the 1940s, 1950s, and 1970s. The last recorded eruption occurred in November of 2022. Throughout the second half of the twentieth century, Hawai‘i Volcanoes National Park drew in millions of visitors who sought a chance to experience an eruption but also enjoy the scenic beauty of Puna and its national park. In 1963, the national park experienced a 17.4 percent increase in travel. This record counted 494,708 visitors, compared to the 421,555 visitors in 1962. Throughout the 1960s, the Hawai‘i Volcanoes National Park counted an increase in travel for every 12-month period. August 1963 recorded a 14.1 percent increase, while September 1963 recorded

an 8.2 percent increase (*Hawai'i Tribune-Herald* 1964a). Currently, the Hawai'i Volcanoes National Park welcomes an average of 2.5 million visitors a year.

2.11.3 Pu'u Maka Ala and Kahauale'a Natural Area Reserves

The Puna District includes several Natural Area Reserves (NAR) managed by a state program. The State of Hawai'i created the NAR program "to preserve and protect representative samples of Hawaiian biological ecosystems and geological formations" (DLNR n.d.-a). The State initiated plans for the NAR program in 1970 because prior scientific records indicate that more native Hawaiian plants and animals had been declared endangered and/or extinct compared to all other states combined. Environmentalists and scientists developed three categories of recommendations to be considered in the development of an NAR program: terrestrial, aquatic, and educational (*Honolulu Star-Bulletin* 1970a). In response, state legislation quickly passed Act 139 that established the NAR program (*Honolulu Star-Bulletin* 1970b). The NAR program currently consists of 19 reserves on five islands that total 109,165 acres (DLNR n.d.-a). Of these 19 reserves, the island of Hawai'i includes eight reserves that encompass about 95,000 acres; only 12,000 of these acres include a fenced perimeter. The Puna District includes the Pu'u Maka Ala and Kahauale'a NAR.

The NAR program designated the Pu'u Maka Ala Natural Area Reserve in 1981, with an additional expansion of its boundary in 2010. In 1981, the Pu'u Maka Ala Natural Area Reserve encompassed 18,730 acres and protected native rain forests and natural watersheds. Long-term management plans included protection of the island's water resources, undeveloped open spaces, and culturally significant areas. The reserve also provided a safe and protected habitat for rare native plants and animal species. In 2010, an additional 6,600 acres of the Kūlani Forest were added to the Pu'u Maka Ala Natural Area Reserve. The koa and 'ōhi'a forest trees in this area include three critically endangered forest birds and numerous rare plants (DLNR n.d.-b).

Research and cultural documents indicate that native Hawaiians historically used the Pu'u Maka Ala Natural Area Reserve land for bird hunting, timber harvest, and medicinal plant gathering. In the modern period, the reserve has partially been used for logging and ranching. In the lower elevation, the military previously used the land to test chemical and biological weapons (NEON Science n.d.). As of 2005, the NAR program dedicated the entirety of reserve solely to conservation. The NAR program constructed and implemented ungulate fencing, predator control, and noxious weed treatment to protect the reserve from outside invaders and predators. The NAR program also regularly conducts outplanting of koa and 'ōhi'a trees in areas previously used for cattle ranching. Lastly, the reserve partners with adjacent landowners, like the Three Mountain Alliance, Kamehameha Schools, and NPS, who help strengthen and protect the land's natural and cultural resources (NEON Science n.d.). Currently, the reserve does not feature any obvious built environment, with exception of likely hiking trails, dirt bike paths, interpretive signage, and camping grounds.

South of the Pu'u Maka Ala Natural Area Reserve is the Kahauale'a Natural Area Reserve. In 1987, the NAR program designated the reserve, which originally included 16,725.738 acres. In 2010, the NAR program added an additional 5,794.88 acres to the reserve (DLNR n.d.-c). The reserve features pioneer vegetation on lava flows, lowland rainforests, and mesic forest. The reserve also includes the largest known populations of the *Adenophorus periens*, a federally endangered fern, as well as active flows of the Pu'u O'o vent, a volcanic cone (DLNR n.d.-c).

The Kahauale‘a Natural Area Reserve is primarily located on the Kīlauea Volcano. Research did not reveal significant context on past and present land use. A review of aerial photographs indicates that the reserve includes no obvious built environment with exception of designated hiking and walking trails constructed of wood planks, as well as gravel paths.

2.11.4 ‘Ōla‘a, Malama Kī, and Wao Kele o Puna Forest Reserves

The State of Hawai‘i manages 55 forest reserves across four islands (Table 4). Of these 55 forest reserves, 20 exist on Hawai‘i and encompass 479,097 acres of land (DLNR n.d.-d). In Puna, the state manages several forest reserves that encompass 131,659 acres of land, like the ‘Ōla‘a Forest Reserve (Mountain View Section), the Malama Ki Forest Reserve, and the Wao Kele O Puna Forest Reserve (PCDPSC 2008:2-1). Other forest reserves in Puna include the Nanawale Forest Reserve, and the Keau‘ohana Forest Reserve; however, research did not reveal significant information about these reserves.

Table 4. Forest Reserves Located across the State of Hawai‘i

Location	Forest Reserve	Approximate Area in Acres
Kaua‘i	9	86,174
O‘ahu	17	39,242
Maui Nui	9	79,451
Hawai‘i Island	20	479,097
Total	55	683,964

Source: DLNR n.d.-d.

The Territorial Government of Hawai‘i created the Forest Reserve System (FRS), Act 44, on April 25, 1903. Early territorial foresters recognized the for protecting upland forests to meet the rising demand for water resulting from the increase in population, expanding ranching industry, and extensive agricultural production of sugarcane and, later, pineapple (DLNR n.d.-e). In its early age, the FRS represented a public-private partnership that protected and enhanced upland forests for their abundance of public benefit and value. Currently, the FRS is partnered and managed by the Department of Land and Natural Resources (DLNR) and the Division of Forestry and Wildlife (DOFAW) (DLNR n.d.-e).

The DLNR and DOFAW focus their resources to protect, manage, restore, and monitor the natural resources of designated forest reserves. Both entities also provide recreational and hunting opportunities, as well as aesthetic benefits; watershed restoration; habitat protection for native, threatened, and endangered species; protection of cultural resources; and fire protection (DLNR n.d.-e). In general, visitors are welcome into any forest reserve for recreational purposes, provided their actions are not dangerous or detrimental to human life or the surrounding sensitive natural and cultural resources.

In 1913, Earnest A. Mott-Smith, former governor of Hawai‘i, designated the Olaÿa Forest, also known as the Upper ‘Ōla‘a Forest, as a forest reserve in the Puna District (*Hilo Daily Tribune* 1913). The Olaÿa Forest Reserve includes about 9,000 acres of undisturbed rain forest dominated by ’ohi’a canopy and a tree-fern understory (Department of Botany, University of Hawai‘i 2000). While recreation is welcomed at the Olaÿa Forest Reserve, it is not recommended nor popular. The designated land is not well developed for tourism and is wet, muddy, and thick with forested land. However, some trails do extend a short distance into the forested area, and the forest reserve includes a fence line with native plant species for visitors to observe and investigate in a safe environment. Species of interest include *Pisonia*

brunoniana, a common understory tree that harbors flowers with ripe, sticky capsules historically used by native Hawaiians as glue (Department of Botany, University of Hawai'i 2000) and *Cibotium glaucum*, an endemic tree fern with orange hairs along the base of its fronds. Other species deeper into the Olaÿa Forest Reserve include liverwort, hornwort, and *Vaccinium calycinum*, a deciduous shrub with brightly colored berries (Department of Botany, University of Hawai'i 2000).

The Malama-Ki Forest Reserve, located toward the eastern coastline of the Puna District, encompasses about 1,514 acres of land and is home to a young 'ohi'a-dominated forest that has served as habitat to sub-populations of native forest birds, like the Hawaiian honeycreepers. Other bird species present in the forest reserves include the Hawai'i 'Amakihi and 'Apapane. The Hawai'i 'Amakihi make up 24-50 percent of the bird community and is uniquely tolerant to avian malaria and avipox virus (DLNR n.d.-f).

Circa 1937, the State of Hawai'i created MacKenzie Park in a portion of the Malama-Ki Forest Reserve. The state designated the park as a memorial to a ranger who lost his life in the area while on duty. In 1952, the territorial board of agriculture and forestry proposed to create a territorial park within the Malama-Ki Forest Reserve. The commissioner of public lands asked for 65 acres of unassigned government land along the coastline of Puna and proposed to add it to the existing 12 acres of MacKenzie Park. During this period, MacKenzie Park provided space for campers and picnickers, as well as a pavilion and picnic tables in a fine grove of ironwood trees (*Hawai'i Tribune-Herald* 1952). Research did not indicate if the additional 65 acres were ever developed as a territorial park; however, MacKenzie Park is currently 13 acres, suggesting the commissioner's plans were never executed.

About 6 miles east of the Malama-Ki Forest Reserve is the Wao Kele O Puna Forest Reserve. In 2006, the Office of Hawaiian Affairs (OHA) acquired the forest reserve, which encompasses 25,856 acres of protected natural and cultural resources, as well as protected traditional and customary rights of Native Hawaiians on select parcels (DLNR n.d.-g). Wao Kele O Puna Forest Reserve also features one of the few remaining tracts of lowland rainforest in the State of Hawai'i. The reserve provides additional benefits to the surrounding lands and communities in Puna, including watershed recharge, native plant seed bank for the Kīlauea Volcano, endangered species habitat, and forest resources for gathering and cultural practices (DLNR n.d.-g).

Since 2016, the OHA, partnered with Forest Solutions Inc., as well as various other subcontractors, drafted a Comprehensive Management Plan (CMP) for the Wao Kele O Puna Forest Reserve. The draft CMP included significant focus on community engagement conducted through ethnohistorical interviews, a community advisory council, called the 'Aha Kūkākūkā, and two public meetings (DLNR n.d.-g). On July 6, 2017, the OHA held a public meeting at the Kamehameha Schools Kea'au campus to present the draft CMP. The OHA's Board of Trustees approved the CMP in August 2017, and the OHA has since begun implementation (DLNR n.d.-g).

2.12 Community Development

Communities have existed in the Puna region for thousands of years before colonization and western-form land ownership. The purpose of this report is not to rewrite the history of those millennia, but to focus on the development histories of the extant built environment resources in Puna district communities, including Pāhoa, Kea'au, Kurtistown, Mountain View, Volcano, Kalapana and Kaimu, Kapoho, and Pohoiki. The subsections below highlight associated historical development themes and

identify known and potential historic resources in each community beginning with the establishment of the Republic of Hawai‘i in the end of the 19th century and ending in the mid-20th century.

Puna is a traditional Wahi Pana, or Sacred Place, and is one of the most sacred areas in all of Hawai‘i (Matsuoka et al. 1997). Native Hawaiians have lived in what is now known as the Puna District since at least 300 A.D., first settling along the shoreline (Matsuoka et al. 1997). Communities would have had access to fertile lands, fresh water springs, and direct connection to the ocean (Matsuoka et al. 1997). Lava flow within the Puna District has historically destroyed and molded communities, from at least circa 1600 A.D. to present day. Agriculture has also played a large role in Puna's community development. Puna's connection to the ocean, as well as its rich soil and climate, has drawn various types of agricultural production, including fishing and harvesting of coffee, sugar, and various fruits and nuts.

After the first missionary visited Puna in 1823, immigration and agricultural production expanded. European colonizers developed sugar and coffee plantations in Puna beginning approximately 1877, with the largest sugar plantation, ‘Ōla‘a Sugar Company, forming in 1899. The establishment of the plantations drew large numbers of immigrants from Japan and the Philippines, who established multiple small communities near the plantation throughout Puna. As sugar production transitioned into automation in the 1940s, World War II implemented further changes to Hawai‘i, with several Army hospitals established in the Puna District. In 1959, statehood again brought waves of change, and many communities experienced the establishment of planned suburban housing developments and the influx of thousands of mainlanders (McGregor n.d.) (Figure 9). Statehood also saw the development of municipal buildings in communities, including post offices, government buildings, and libraries. Puna's communities have been greatly impacted by lava flow, which destroyed several communities in 1955, 1960, and more recently in 2018.

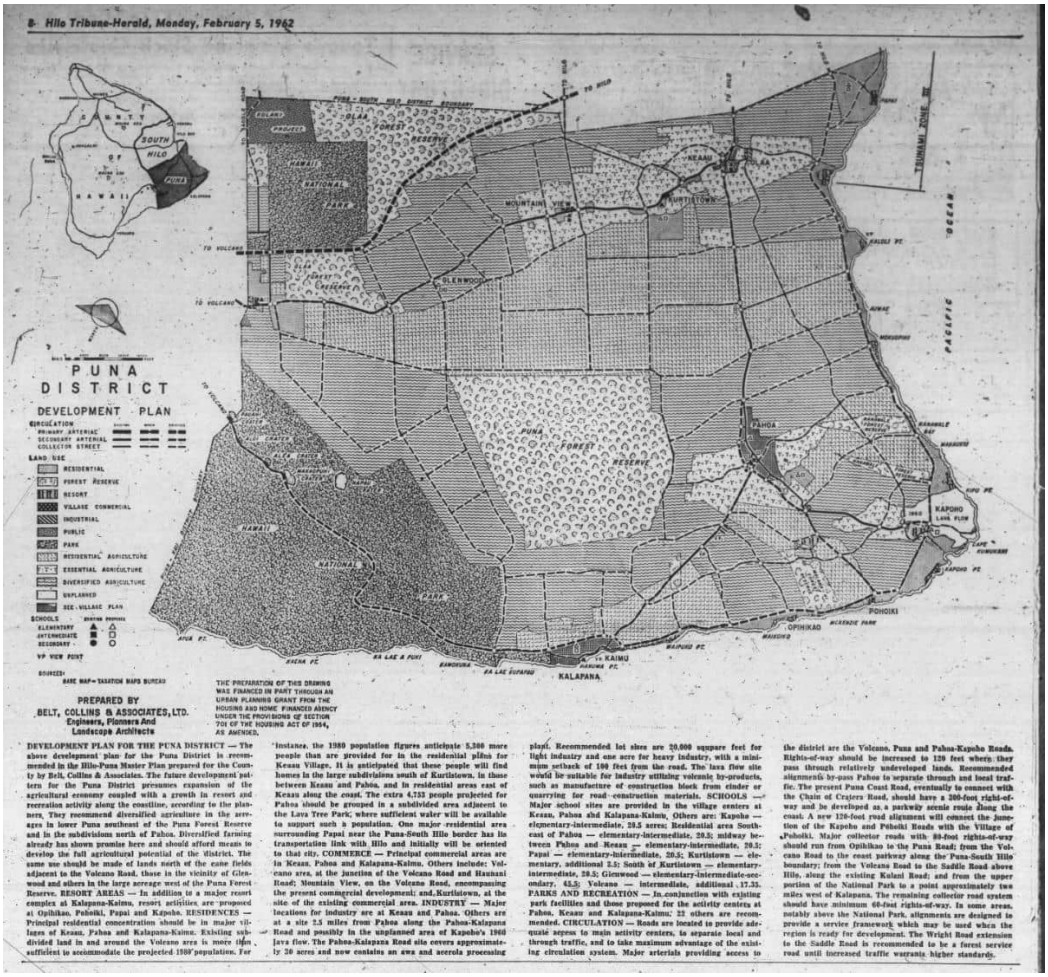

Figure 9. Puna District Development Plan (*Hawai'i Tribune-Herald* 1962)

2.12.1 Pāhoa

Pāhoa is a community of approximately 1,200 people located at the intersection of Hawai'i Route 130 and Hawai'i Route 132. The community lies northeast of the Wao Kele o Puna Forest Reserve, within Lava Zone 2 in the East Rift Zone of Kīlauea, an active volcano. Pāhoa's modern commercial and community development expanded circa 1899 with the establishment of the 'Ōla'a Sugar Company and Pahoa Lumber Mill. The Olaa Sugar Company recruited Japanese laborers to the area to assist with production, influencing a lasting prominent Japanese presence in the community. Local businesses established a commercial corridor (now Highway 130), including a hotel, barbershop, drug store, tombstone shop, and shoe shop, most with Japanese surnames (Hunt 2018) (Figures 10 and 11). The historic Pāhoa Japanese Cemetery, dating from the early 1900s, was partially enveloped in a 2014 lava flow (Sato 2014).

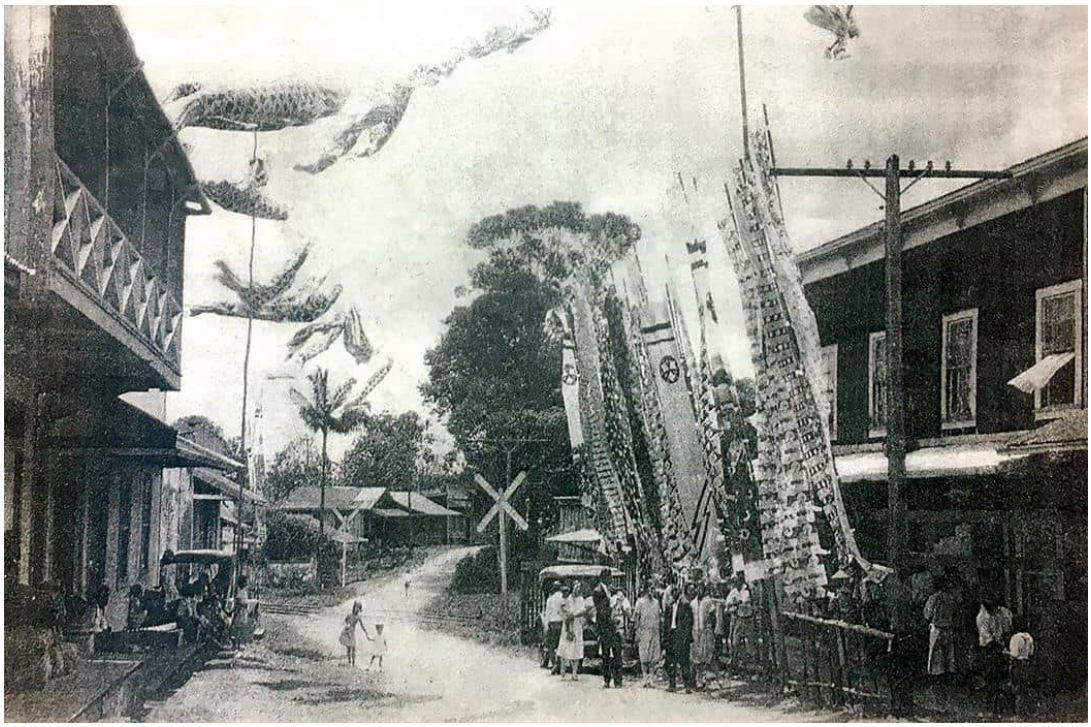

Figure 10. Undated photo of Pāhoa showing Japanese residents and railroad tracks with a railroad crossing sign (Hunt 2018)

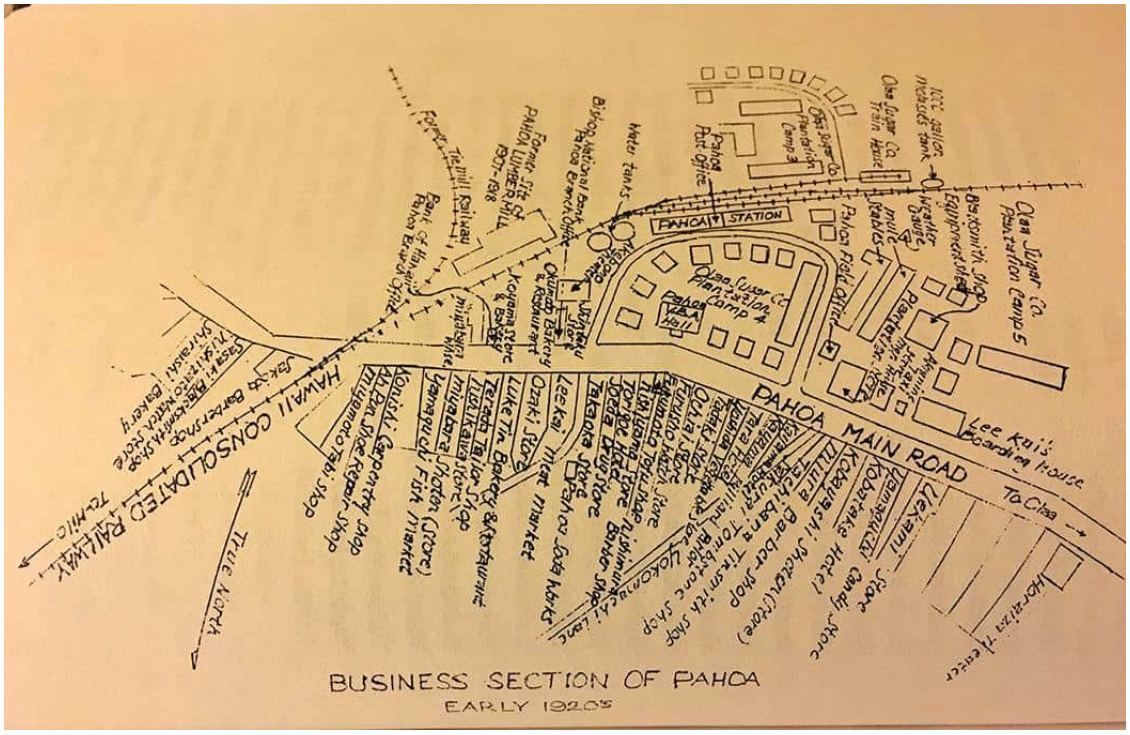

Figure 11. 1920 map of the "Business Section of Pāhoa." Note the many Japanese surnames on local businesses, the "Plantation Camp" south of Pāhoa Station, and the Hawai'i Consolidated Railway bisecting the map (Sato 2015).

The establishment of the Pahoa Lumber Mill in 1907 brought additional immigrants to the area, including Filipino laborers who produced railroad ties from 1907 to 1918 (Hunt 2018). The mill, also called the Hawaiian Mahogany Lumber Company, was responsible for the lumber production of Hawai‘i’s ‘ōhi‘a lehua tree (*Metrosideros polymorpha*) and its exportation to the continental United States for use as railroad ties (Young 2016) (Figure 12). A railroad line was built as part of the mill’s construction contract, connecting from an existing line in Pāhoa and running 4 miles through ‘ōhi‘a forest in Puna (Young 2016). The lumber mill was near the center of Pāhoa, further solidifying the community as a growing town. Just west of the lumber mill, the Akebono Theater, built in 1917, served the diverse community and played English, Japanese, and Filipino films until World War II (Figure 13). The theater, referred to as the “heart of Pāhoa” by residents, was destroyed in a fire in 2017 (*Hawai‘i News Now* 2017). Much of the surrounding plantation-era commercial corridor near the demolished theater remains.

Figure 12. Historical undated photograph of the Pahoa Lumber Mill (Young 2016)

Figure 13. 1914 Sanborn map of Pāhoa, including "Government Road," now Highway 130 (Sanborn Map Company 2014). The Akebono Theater is visible in the left center of the map.

A historical map from 1920 shows many Japanese-owned businesses along Pāhoa's commercial corridor (Figure 11). Today multiple buildings remain, particularly along Pāhoa Village Road (formerly Pāhoa Main Road). The railroad is also visible on the historical map and ran from the Olaa Sugar Company to Hilo, with an offshoot to the Pahoa Lumber Mill. The main line passed through the business section of Pāhoa and served as a vital transportation link for residents (Sato 2015).

Hawaiian statehood in 1959 and the ensuing decade brought a new wave of growth and development to Pāhoa. The *Hawai'i Tribune-Herald* attributed Pāhoa's booming development in the mid-1960s to the installation of a new water system that extended 2 miles along the highway on either side of town. The system cost approximately $500,000 to construct and served nearly 400 people within the first 5 years of its construction (*Hawai'i Tribune-Herald* 1964b). The establishment of several suburban housing developments around Pāhoa followed, including Nanawale Estates to the east and Leilani Estates to the south. Recent lava flow and an aging population have ultimately caused population loss in the community; however, much of Pāhoa's historic commercial corridor remains. Previously evaluated historic properties associated with Pāhoa include the Pāhoa Town District and the Sacred Heart Church. Additional potentially significant historic resources in this community may include schools like Pāhoa High & Intermediate School, libraries, religious facilities, and civic buildings.

2.12.2 Kea'au

Kea'au is a community of approximately 1,200 people located at the intersection of two main thoroughfares, Highway 11 and Highway 130. The community lies south of Hilo in the northern region of the Puna District. Kea'au's community development began circa 1889 with the establishment of coffee and sugar plantations and the construction of Highway 11.

Name discrepancies within the community indicate that much of present-day Kea'au was traditionally referred to as 'Ōla'a. Several historical documents recount that traditionally "'Ōla'a was on the Hilo [north] side of the road and Kea'au on the Puna [south] side" (Young and Garcia 2019). Originally called 'Ōla'a, the name was changed to Kea'au circa 1950. Several local businesses followed suit, including the 'Ōla'a Christian Church (now Kea'au Congregational Church) and 'Ōla'a Elementary School (now Kea'au Middle School) (Young and Garcia 2019).

Similar to Pāhoa and other nearby communities within the Puna District, Kea'au possessed rich soil and was heavily forested, attracting sugar and coffee growers. Part of the forest in Kea'au is now protected as the Waiākea Forest Reserve. Prior to 1900, over 6,000 acres of coffee trees were harvested in Kea'au, and the community was known as a budding hub for coffee farming (Young and Garcia 2019). After the establishment of the 'Ōla'a Sugar Company in 1899, sugar soon overtook coffee as the lead agricultural product and operation in the region. Kea'au grew with the success of the 'Ōla'a Sugar Company, and schools, churches, and commercial corridors began to emerge. Similar to Pāhoa, Kea'au was historically diverse. A historical map from the early 1900s shows a Filipino grocery store, Japanese school, and Hawaiian residence all within several blocks of Kea'au (then labelled 'Ōla'a; Figure 14). Several buildings seen on the historical map are still in existence, including several churches, and the roads are retained in their original orientation.

Highway 11 opened in 1898, connecting the town of Hilo to Kīlauea, one of the world's most active volcanoes (USGS n.d.-b). Highway 11 passed through Kea'au, making it a natural stopping point between Hilo and recreation activities and other communities throughout Puna. The 'Ōla'a Sugar Company contracted the Hilo Railroad Company in 1899 to lay tracks between 'Ōla'a and Hilo for the exportation of sugar (Young 2015). These tracks passed through Kea'au, further establishing a transportation link within the community.

In addition to the initial development of the community and transportation links circa 1900, the Olaa Sugar Company continued to influence the built environment of Kea'au for the next 40 years. The sugar

plantation provided land for community use, which led to the establishment of several educational and religious institutions, including the Puna Hongwanji Mission (a Buddhist temple, formerly ʻŌlaʻa Hongwanji), founded in 1902, and the ʻŌlaʻa School, built in 1939 (Puna Hongwanji Mission 2022).

As with other communities in Puna, statehood in 1959 ushered in new suburban development for Keaʻau. One of the largest subdivisions, Hawaiian Paradise Park, was built southeast of Keaʻau's commercial district. The subdivision occupied 15 square miles and brought in over 2,500 new occupants to the area, predominately from Los Angeles (*Hawaiʻi Tribune-Herald* 1959).

Newly identified historic resources associated with Keaʻau include the Keaʻau Elementary School and Keaʻau Middle School, W.H. Shipman Business Park, Puna Hongwanji Mission, and the Holy Rosary Mission Chapel. Additional potentially significant historic resources in this community may include churches, recreation facilities, and commercial buildings.

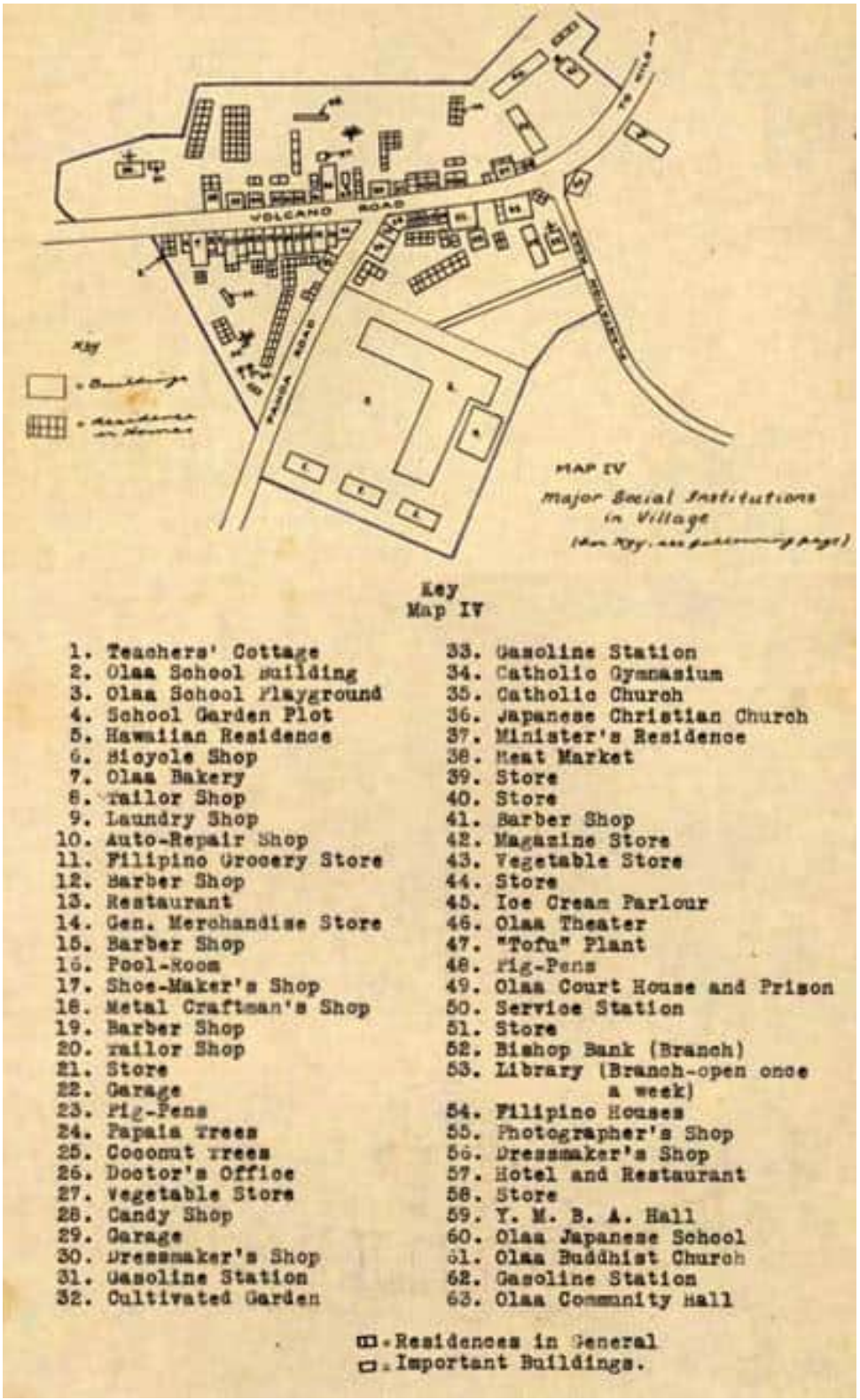

Figure 14. Undated historical map of Kea'au (then named 'Ōla'a) showing diverse businesses, schools, housing, and main roads in the area (Young and Garcia 2019)

2.12.3 Kurtistown

Kurtistown is a community of approximately 1,300 residents located immediately southwest of Kea‘au along Highway 11. Similar to Pāhoa and Kea‘au, Kurtistown was largely established as a result of the Olaa Sugar Company. AG Curtis, an early homesteader in Puna, grew sugar cane for Olaa Sugar Company and later harvested rubber trees (Young 2015). Establishing his namesake town, Curtis started a general store that housed a post office (Young 2015). Curtis returned to the mainland circa 1917 after selling his store but retaining many of his sugar cane fields.

Newly identified historic resources associated with Kurtistown include the Kamehameha Schools Hawai‘i Campus and many historic cemeteries including ‘Ōla‘a First Hawaiian Church Cemetery and Kurtistown Japanese Cemetery. Additional resource types associated with this community may include churches, recreation facilities, and commercial buildings.

2.12.4 Mountain View

Mountain View is located 8 miles southwest of Kurtistown along Highway 11 and has approximately 4,200 residents. Mountain View and Kurtistown are geographically similar and thus share historical similarities regarding their community development. Like most communities in Puna, Mountain View’s built history begins with the establishment of sugar plantations like the Olaa Sugar Company in the late 1890s. Laborers from Japan, Puerto Rico, the Philippines, and a small number of workers from Ukraine all settled in Mountain View (Young 2015). Pszyk Road in Mountain View is named after Ukrainian immigrants, although little documentation of their history remains (Yamane 2022). Similar to Kurtistown and Kea‘au, Mountain View’s location along Highway 11 (historically named Volcano Road) allowed for the transportation of goods to and from Hilo, and brought in visitors traveling from Hilo to Kīlauea.

Mountain View was home to a movie theater that played both Japanese and Filipino movies (Figure 15). Mountain View Theater opened in 1932 by Kamekichi Yamada, an immigrant from Japan who previously worked as a blacksmith for the Olaa Sugar Company (Yamada 1995). Yamada also owned several other stores in the Mountain View area, including a blacksmith shop, general store, and billiard parlor (Yamada 1995). World War II had a massive impact on the Mountain View community. A US Army medical center opened in Mountain View in the early 1940s, bringing an influx of wounded and recovering servicemen to the community (Chapman 2014). Soldiers and patients frequented the Mountain View Theater, receiving discounted rates and even jobs as ushers and projectionists. The theater also allowed the Army to show military training films for soldiers at the facilities (Yamada 1995). Post-World War II up until the mid-1950s, Mountain View continued to be home for many sugar plantation workers. The mechanization of sugar production circa 1955 led to many community members having to relocate elsewhere for work (Yamada 1995). After statehood, several large housing developments were built in the outskirts of Mountain View, including Eden Roc Estates and Hawaiian Acres. After the decline of sugar production, Mountain View saw an increase in coffee production, and today the community hosts several coffee mills.

Previously and newly identified historic resources associated with Mountain View include the Mountain View Theater, Mountain View Cemetery, and Mountain View Elementary School. Additional potentially significant historic resources in this community may include churches, recreation facilities, and commercial buildings.

Figure 15. Mountain View Theater and surrounding commercial district, circa 1940 (Yamada 1995)

2.12.5 Volcano

Volcano is a community of approximately 2,500 residents located along the eastern edge of Kīlauea Crater. The community covers 58.6 square miles of land, with the ʻŌlaʻa Forest Reserve encompassing most of the northern half of the area. Volcano contains two platted Republic of Hawaiʻi-period homestead lots and two mid-century subdivisions, as well as a historic golf course, Civilian Conservation Corps-era lodge, and small commercial downtown. The community borders Hawaiʻi Volcanoes National Park and the Kīlauea Military Camp, both of which are historically significant, but are outside the modern community boundary.

Volcano was first subdivided into homestead tracts after the 1893 overthrow in January 1902 (Lowell 1903a). The tracts were grouped in several blocks along the north side of Volcano Road near the Hawaiʻi Volcanoes National Park Entrance. These blocks included the ʻŌlaʻa Summer Lots closest to Volcano Road, the Kīlauea Settlement Lots, and the 27 ½ Mile Track, all subdivided into 50-acre parcels (Podmore 1910). The final block, the Rose Settlement Association, consisted of eight 200-acre lots located northeast of the 27 ½ mile tract (Lowell 1903b).

The following two paragraphs are excerpted and adapted from the Kīlauea Lodge National Register Nomination (White 2012) and describe subsequent early twentieth-century development in Volcano. Edits have been made for relevance and clarity.

Subdivision in Volcano progressed slowly due to limited road construction. Albert Mackenzie sold his Manolani Ranch lots in 1911 for the development of Mariner Tract, a modest subdivision. William M. Gifford constructed the first house in the Mariner Tract, which required him to personally finance the construction of Kalanikoa Road. As the number of individuals able to personally pay for road construction remained limited, most of the lots within Volcano remained undeveloped, despite the

"carrot" of potential land ownership. It wasn't until 1913 when C.E. Wright won a contract to construct a road on the mauka (mountain) side of Blocks A and B of Olaa Summer Lots that additional access granted to the owners of the ʻŌlaʻa lots sold between 1907 and 1913. This access would become Kīlauea Road 11.

Development was limited by both the lack of roads and the location of forest reserves surrounding the Olaa Summer Lots and Mariner Tract. Two of these forest reserves—among several set aside by Governor Lucius Pinkham in 1914—are labeled "Government Reservation" and "Koa Grove Reservation" on a 1911 survey map. In the 1940s, a decision to preserve forested land along Old Volcano Road prompted the withdrawal of three of these tracts, including the Koa Grove Reservation. Despite the withdrawal of these parcels, the ʻŌlaʻa subdivision remains bounded by state preserve land, which limited expansion of the area below 29-mile marker (White 2012).

The 1924 topographic map for Volcano depicts the forest reserves, as well as the Kīlauea Settlement Lots, Kīlauea Ranger Station, and the Keauhou Ranch, which appears to no longer be extant but is in the location of a golf course established in 1920 (NETR 2022). The opening of Volcano National Park in 1916 brought tourists to the area, and the park's hotel management established an informal three-hole golf course, the first golf course on the island of Hawaiʻi, to provide additional entertainment to visitors. The golf course was upgraded to a nine-hole golf course in 1922 and was redesigned in 1969 by master golf course landscape architect Arthur Jack Snyder (Young 2022b). Snyder designed 47 golf courses, six of which are in Hawaiʻi, and received a lifetime achievement award in 2006 for his contributions to golf (American Society of Golf Course Architects 2022). The clubhouse associated with Snyder's 1969 design succumbed to a fire in 2019, which has resulted in the building's demolition (Brestovansky 2022).

A 10-acre YMCA camping facility, the Kīlauea Lodge, was opened in Volcano in 1938. The lodge brought YMCA campers from across the islands to stay, as well as provided a gathering place for the local community. The Kīlauea Lodge was determined eligible for the NRHP for its association with the Hawaiʻi chapter of the YMCA from 1933-1964 and as a significant example of the Craftsman architectural style (White 2012).

Mid-century development in Volcano included the planned subdivisions of the 1959 Royal Hawaiian Estates and the 1960 Mauna Loa Estates, both located along Highway 11 south and east of the early 1900s homesteads (Table 2). The lots, approximately 0.25-0.5 acres in size, were sparsely developed, with one-story, Plantation-style homes. Volcano is currently experiencing one of the highest growth rates in Puna District due to its cooler climate and proximity to the national park (PCDPSC 2008).

Previously identified historic resources associated with Volcano include the Johnson Summer House, Kīlauea Lodge Complex, and the Volcano Residential District. Newly identified historic resources include the Volcano Golf Course and Country Club, the ʻŌlaʻa Forest Reserve, the Royal Hawaiian Estates and Mauna Loa Estates subdivisions, and the Volcano School of Arts and Sciences. Additional potentially significant historic resources in this community may include mid-century residential and commercial buildings, trailheads, and parks.

2.12.6 Kapoho

Kapoho, located on the eastern-most tip of Puna at the intersections of Highway 137 and Highway 132, was destroyed by lava flow in 1960 and again in 2018. Prior to 1960, Kapoho, like many Puna communities, centered on sugar production and developed to include schools, homes, and churches.

One building, the Cape Kumukahi Lighthouse, survived the 1960 lava flow (LighthouseFriends.com n.d.). After 1960, Kapoho began to rebuild, eventually becoming one of Puna's most expensive areas in regard to real estate. Agricultural production returned, and Kapoho was known as the largest papaya-producing district in Hawai'i, with approximately 97 percent of the state's fruit grown in the area (Young and Garcia 2019). However, a 2018 eruption again demolished all structures, farms, and residences, except for the Cape Kumukahi Lighthouse. There are remnants of the Kapoho Cemetery that are still visible, but most headstones and burial sites have largely been covered by lava.

The Cape Kumukahi Lighthouse is located on the eastern-most point of the Hawaiian Islands (Figure 16). The Lighthouse Board requested a lighthouse at Cape Kumukahi in 1907, stating "it is estimated that a light at this point can be established for not exceeding $75,000" (LighthouseFriends.com n.d.). Twenty-one years after the initial request for the lighthouse, 58 acres of Cape Kumukahi was purchased from the Hawaiian Trust Company on December 31, 1928 (LighthouseFriends.com n.d.). In 1929, a 32-foot wood tower with an acetylene automatic light was built. In 1933, keeper dwellings and additional structural support were added. In 1960, the two keeper dwellings were engulfed in lava, but the lighthouse remained. Today, the lighthouse is fully automated and is the only remaining historic building in Kapoho (LighthouseFriends.com n.d.). No additional potentially significant historic resources exist in Kapoho.

Figure 16. Historical undated photo of Cape Kumukahi Lighthouse and several outbuildings (LighthouseFriends.com n.d.)

2.12.7 Pohoiki

Pohoiki is a small oceanside community 3 miles south of Kapoho, accessed by Pohoiki Road and Highway 137. The 2018 lava flow in Puna stopped 500 feet from Pohoiki, saving the community but displacing many in the surrounding area (Timboy 2019). Historically, the 1,000-foot-long Pohoiki Bay was

considered the best landing spot in southeastern Hawai‘i (Timboy 2019) (Figure 17). Fishing has been a deeply rooted cultural practice in Pohoiki since pre-contact times, a tradition that has continued to shape the built environment and cultural activities in the community (Maly and Maly 2003). The “red house” at 13-105 Pohoiki Road across from the bay and hot springs was built in the mid-1800s and is one of the oldest remaining structures in the Pohoiki community (Timboy 2019). Built by Robert Rycroft, an agricultural businessman from Leeds, the house has been home to the Hale family for several generations, who have extensive cultural ties to the fishing activities in Pohoiki and presently host yearly fishing tournaments (Timboy 2019).

Rycroft contributed to Pohoiki’s built environment in other ways from 1877 to 1899, including improving the landing at Pohoiki in the late 1870s (Young 2017). The landing was rebuilt after 1885, and was the only means of transportation used by the Olaa Sugar Company to transport sugar cane to Kapoho and the surrounding communities circa 1898 (Young 2017). Rycroft also oversaw livestock ranching and the construction of a coffee mill, guava harvesting facility, and a sawmill (State of Hawai‘i 2014; Young 2017) (Figure 18).

The next developments in Pohoiki occurred in the 1930s, with the construction of a boat ramp, allowing motorized vessels to access the bay. The 1940s saw the decline of commercial activity in Pohoiki Bay, as well as the onslaught of World War II (State of Hawai‘i 2014). The 2018 lava flow brought immense change to Pohoiki Bay. The former boat ramp is now enclosed by a black sand beach, and access to the bay has changed dramatically due to lava covering several roadways. Previously identified historic resources associated with Pohoiki include the Pohoiki Mill Ruins (also called the Rycroft Mill). Newly identified historic resources include the Isaac Kepo‘okalani Hale Beach Park and the “red house.” Additional potentially historic resources associated with Pohoiki would be limited but may include residential buildings, the sand-covered boat ramp, and other resources associated with cultural fishing practices.

Figure 17. Undated historical photo of Pohoiki village (Timboy 2019)

Figure 18. The NRHP-eligible Rycroft Mill in an undated historical photograph, circa 1877-1899 (Young 2016)

2.12.8 Kalapana and Kaimu

The two communities of Kalapana and Kaimu together have an undetermined, but very small, local population. Both communities were covered by several Kīlauea lava flows, first in 1955, again in 1986 and 1990, and finally in 2018. Little remains of the historic fishing villages that can be seen on the 1924 topographic map of the area. Clusters of buildings surround small coves, and "Kalapana Park" is the only named feature (USGS 1924). The Kalapana Oral Histories Project conducted out of the University of Hawai'i Hilo in 1990 further documents the ways of life of early Kalapana residents (Matsuoka et al. 1997:59).

World War II saw Kalapana host "100 to 150 soldiers" in 3-month rotations to observe and protect the Hawaiian coastline from invasion (Matsuoka et al. 1997:63). Temporary structures were erected to house the soldiers, and any remains of those structures were destroyed in the lava flows. Much of the late nineteenth- and early twentieth-century settlement at both Kalapana and Kaimu was engulfed by the 1955 lava flow (Figure 19). The NRHP-listed Star of the Sea Church, built in 1931, was moved from its original location in 1990 as a result of the encroaching lava flow (Laitinen 2014).

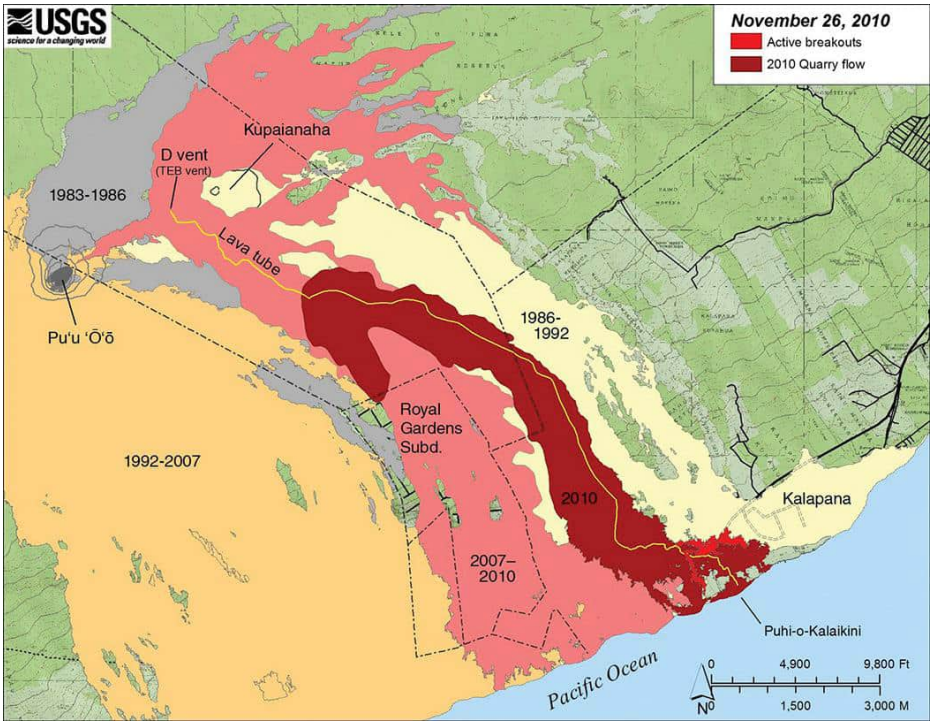

Figure 19**. Lava flows in and near Kalapana and Kaimu up to the 2010 flow (Verbano 2018). Does not include 2018 lava flow.**

In addition to the loss of the early and mid twentieth-century settlement, the 1990 lava flow also engulfed two 1950s subdivisions that were subsequently built atop the 1955 flow: the Kalapana Gardens and the Royal Hawaiian Gardens (Earth Observatory 2011). Construction atop the flows continued into the 1970s, with the Kalapana Seaview Estates development in 1971 (Zerkel 2018). The subdivision of 30+ homes was constructed north of the 1986, 1990, and 2018 lava flows and thus remains extant. Today the area mainly draws tourists for lava flow viewing.

Due to the lava flow, historic districts or clusters are unlikely but individual resources remain. Previously identified historic resources associated with Kalapana and Kaimu include the Opihikao Evangelical church residence, the Kahaloa House, and the Star of the Sea Church (also known as the Kalapana Painted Church), all located northeast of Kalapana, and newly identified historic resources include the Kalapana Trail. Additional potentially significant historic resource types associated with Kalapana and Kaimu may include scattered residential and commercial buildings (possibly in ruin), additional churches and gravesites, and parks.

3.0 Analysis and Findings

3.1 Real Property Tax Office Year-Built Data Analysis

The County of Hawai‘i Real Property Tax Office maintains property tax assessment records for parcels across the county, including those in the project area (County of Hawai‘i 2019). Although these records do not account for parcels that do not pay taxes, such as churches, schools, government buildings, and other tax-exempt properties, they do include two data sets that detail property data for commercial (COMDAT) and residential (DWELDAT) properties, including construction dates for buildings and structures on each parcel. The provided data was last updated in 2019.

There are a total of 85,846 commercial and residential parcels in the project area, including 33,287 with buildings or structures built 1982 or earlier (Figure 20).

The COMDAT files show a total of 4,900 commercial parcels in the project area, including 2,249 with buildings or structures built 1982 or earlier.

The DWELDAT files show a total of 80,946 residential parcels in the project area, including 31,038 with buildings or structures built 1982 or earlier.

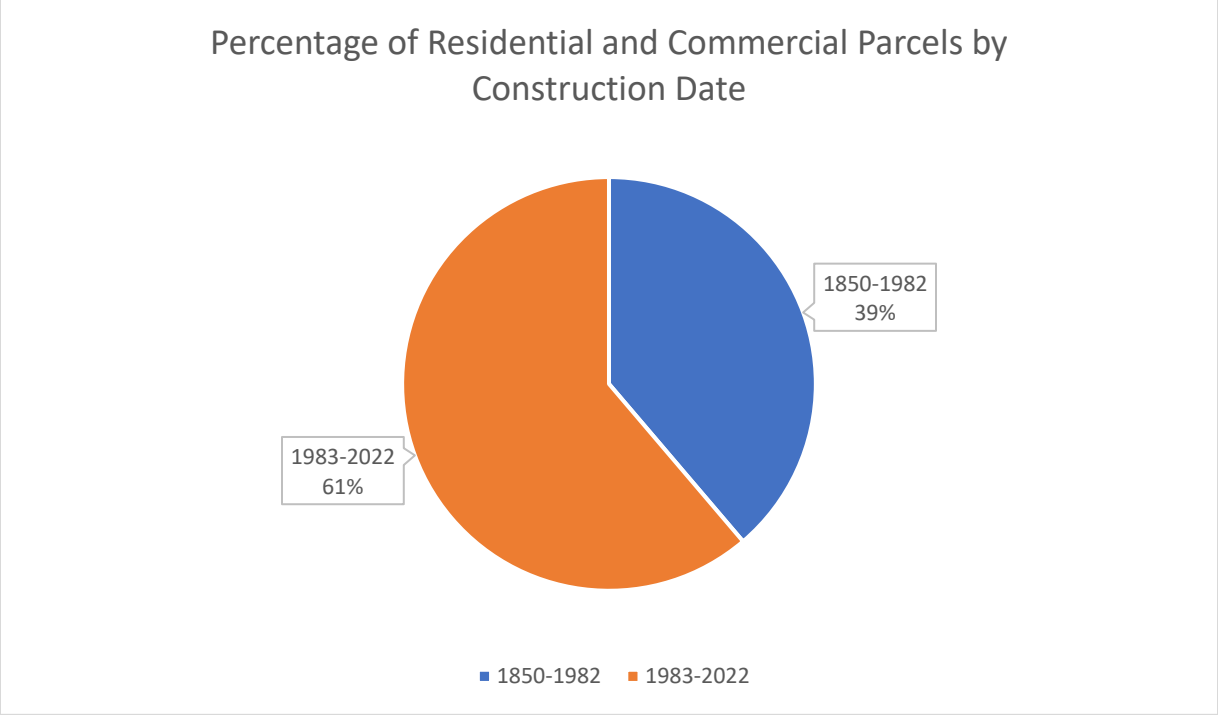

Figure 20. Real Property Tax Office data showing the percentage of residential and commercial parcels in the project area by construction date.

When analyzed by decade, the Real Property Tax Office data also shows that the majority of historic-age construction for both residential and commercial properties peaked in the 1960s and 1970s (Figure 21).

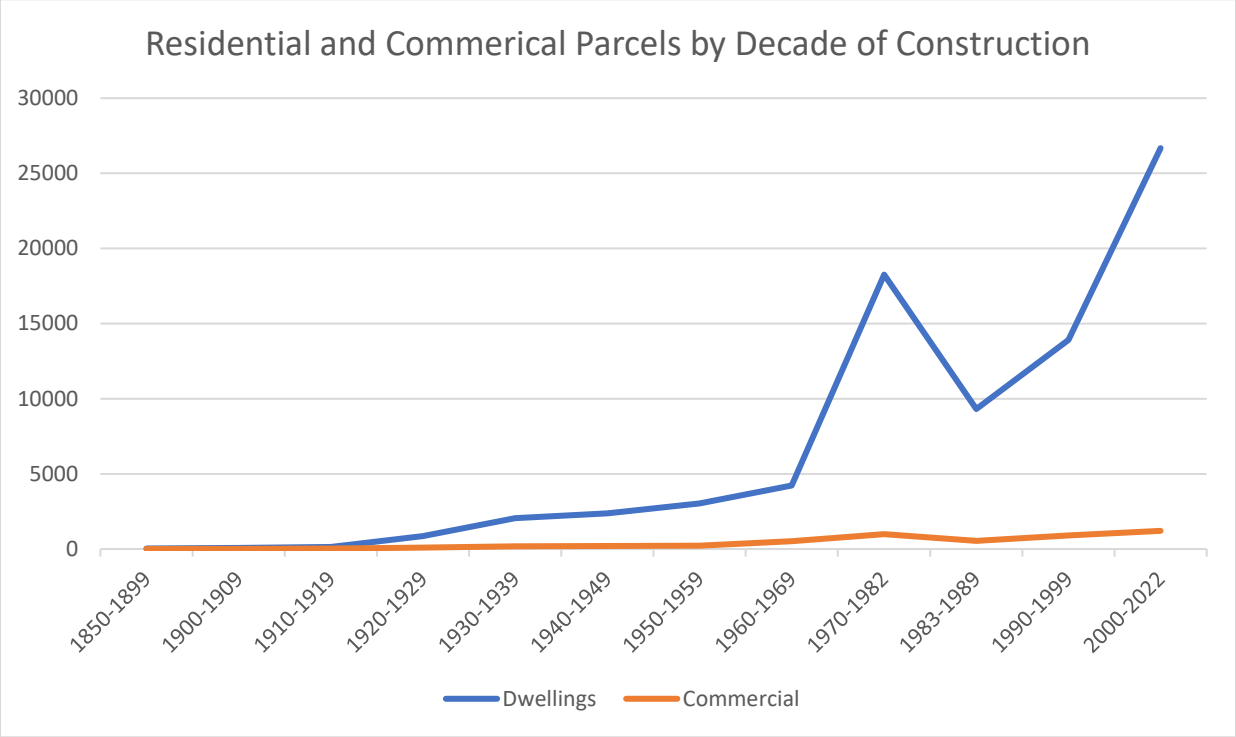

Figure 21. Chart of Real Property Tax Office TMK year-built data

3.2 Known (Previously Evaluated) NRHP- or HRHP-Eligible Historic Properties

Previously evaluated historic properties—buildings, structures, sites, objects, and districts listed or eligible for listing in the NRHP—and resources eligible for the HRHP were identified through a variety of sources, including NRHP Digital Assets Library, the Hawai'i Cultural Resources Information System, and the Historic Hawaiian Foundation database. Statewide historic resource inventories were also reviewed, including State Historic Bridge Inventory and Evaluation (MKE Associates LLC and Fung Associated, Inc. 2013), Hawai'i Modernism Context Study (Fung Associates Inc. 2011), Public Schools of the Island of Hawai'i Multiple Property Documentation Form (Moy n.d.), and the Hawai'i State Historic Preservation Plan (State of Hawai'i 2012). Table 5 lists known historic properties in the project area, including their TMKs, property name and State Inventory of Historic Places number, location, resource type, and source. Figure 22 depicts these historic properties on a map.

Table 5. Known Historic Properties in the Project Area

TMK	Property Name (SIHP)	Location	Resource Type	Source
313004004	Opihikao Evangelical Church Residence (50-10-55-07383)	6314 Kalapana Kapoho Beach Road	Building	HHF, HCRIS
313004018	Kahaloa House (50-10-55-07384)	Near Opihikao	Building	HCRIS
312006081	Star of the Sea Church, Kalapana Painted Church (50-10-63-07380)	12-4815 Pāhoa Kalapana Road	Building	HHF, HICRIS
N/A	Crater Rim Drive (50-10-52-09059)	Hawai'i Volcanoes National Park, HI 96718	Road	HHF

TMK	Property Name (SIHP)	Location	Resource Type	Source
399001001	Whitney Seismograph Vault #29 (50-10-52-05506)	99-165 Crater Rim Drive, Hawai‘i Volcanoes National Park	Building	HHF
399001001	Old Volcano House #42 (50-10-52-05508)	99-165 Crater Rim Drive, Hawai‘i Volcanoes National Park	Building	HHF
399001001	Tahara House Site (50-10-52-31200)	Crater Rim Drive, Hawai‘i Volcanoes National Park	Site	HICRIS
313005012, 313005013, 313005019	Old Kudo Camp (50-10-55-07385)	Kaueleau	Building	HICRIS
311005019	Johnson Summer Residence (50-10-53-07519)	11-3968 Hale Ohia Road, Volcano	Building	HHF, HICRIS
319004055	Kīlauea Lodge Complex (50-10-53-29502)	19-3948 Old Volcano Road, Volcano	Building	HHF
318002001	Mountain View Theater (50-10-44-07511)	18-1325 Old Volcano Road, Mountain View, HI 96771	Building	HHF
313008034	Pohoiki Mill Ruins (50-10-46-07386)	Pohoiki	Building	HICRIS
multiple	Pāhoa Town District (50-10-55-07388)	Pāhoa	District	HICRIS
multiple	Volcano Residential District (50-10-53-07414)	Volcano	District	HICRIS
multiple	Glenwood District (50-10-53-07453)	Glenwood	District	HICRIS
multiple	Hale ‘Ohi‘a Tract Historic District (50-10-53-07521)	11-3991, 3992, 4000, and 4006 Hale ‘Ohi‘a Road, Volcano	District	HHF, HICRIS
multiple	Puna-Ka‘u Historic District (50-10-62-09609)	Near Hawai‘i Volcanoes National Park, HI 96718	District	HICRIS, NPS

Notes: HICRIS = Hawai‘i Cultural Resources Information System; HHF = Historic Hawaiian Foundation; SIHP = State Inventory of Historic Places; TMK = Tax Map Key.

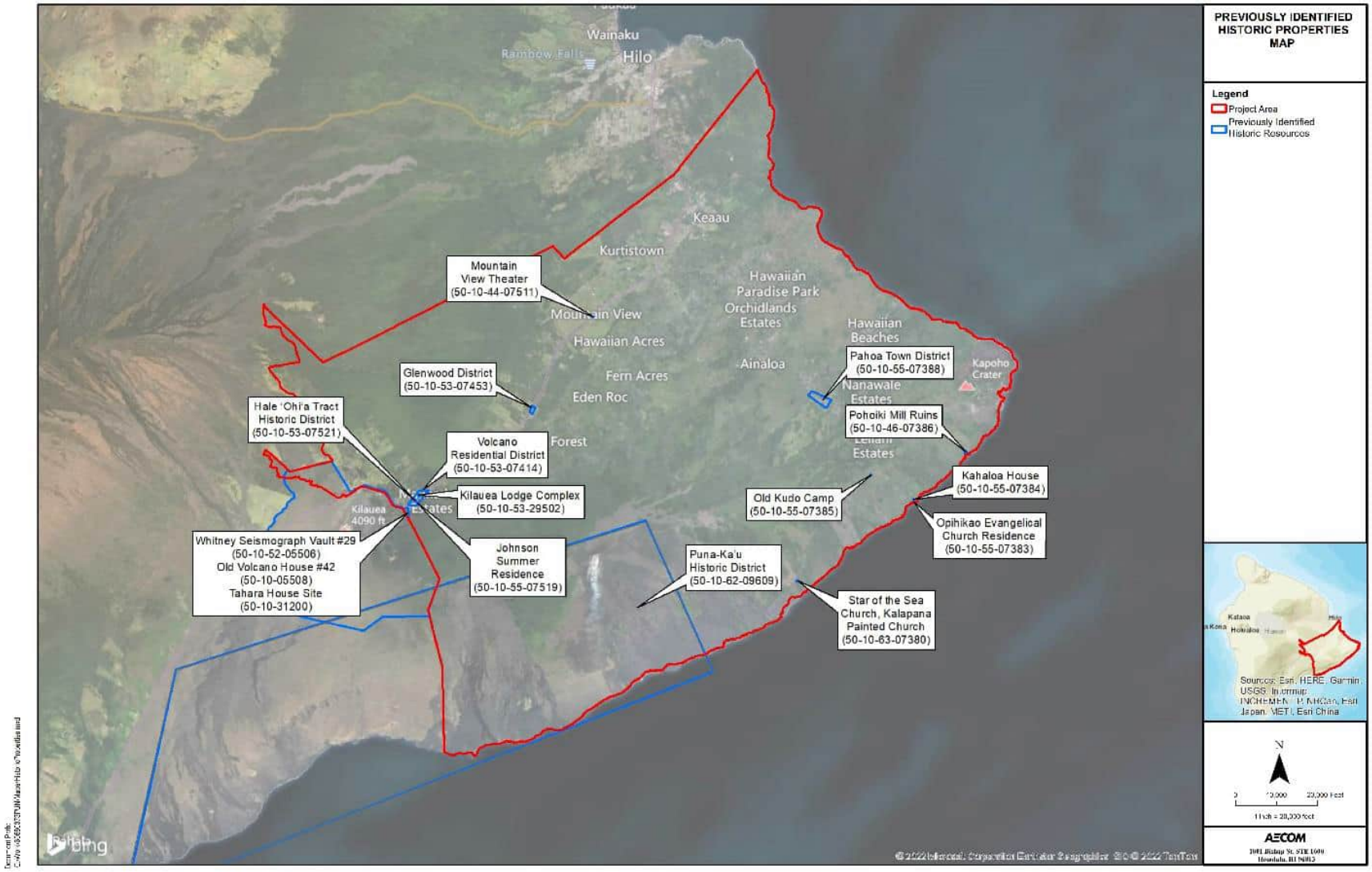

Figure 22. Previously identified historic properties in project area

3.2.1 Historical USGS Map Analysis

The historical USGS map analysis focused on the most recent historic-age USGS map in each region to show what resources lasted through the end of historic period and were most likely to remain extant. The analysis, presented in Table 6, shows key features identified on each of the analyzed maps (Appendix A); Table 7 presents a list of 35 individual extant historic-age resources identified through this analysis, organized by resource type. The map analysis also identified the following historic community development trends:

- Land use types include residential, commercial, industrial, agricultural, and recreational.
- Roads typically follow one of two patterns: aligned with the topography or laid out on a suburban residential grid.
- Typical building types include residences, commercial buildings, civic buildings including schools and post offices, industrial facilities, recreation facilities, and religious facilities.
- Residences are the most numerous type of historic building in the project area.
- Typical structure and site types include roads, cemeteries, and parks/reserves.
- Commercial development is largely located within the rights-of-way of main roads and their intersecting artery streets.
- Residential development is typically seen either in large suburban developments or along artery streets to main roads.
- The densest concentrations of historic buildings and structures are located in and around the communities of Volcano, Pāhoa, and Kea‘au.

Table 6. USGS Historical Map Analysis Findings

Map Name	Scale	Date, Revisions	Key Features
Hilo, HI	1:62,500	1981	The north half of the town of Kea‘au; dense concentrations of buildings along Volcano Road, Old Volcano Road, Ohe Street, Haa Street, Milo Street, Hoawa Street, and Preciado Lane; less dense concentrations of smaller buildings along Shipman Road; a cluster of buildings on the SE corner of Railroad Avenue and Milo Street; a cemetery just west of the current site of the Kea‘au Shipman Park; a quarry where current development is along Kipimana Street; Puna Sugar Company Mill facilities and Tropical Hawaiian Products facilities on Railroad Avenue; "8 1/2 mile Camp" at the residential development on Preciado Lane; Puna Hongwanji Mission on Old Volcano Road; Christian Liberty Academy on Milo Street
Kalapana, HI	1:24,000	1981	Hawai‘i Volcanoes National Park; Chain of Craters Road, Puna Coast Trail and Kalapana Trail; a campground near Kamoamoa Site; the towns of Laeapuki, Puu Manawalea, Kamokuna, Kapaahu, Kalapana and Kaimu; marked graves and burial sites on the north side of Pillani Street; several residential buildings along Pillani Street and Lokelani Street; several scattered buildings along the old Kapoho-Kalapana Road west of Kalapana town center (now covered in lava flow); a visitors‘ center west of Kupapau Point (now covered in lava flow); Star of the Sea Church;

Map Name	Scale	Date, Revisions	Key Features
			a series of buildings just north of Kaimu Beach Park; several residential buildings just east of Kaimu Beach Park
Kalalua, HI	1:24,000	1982, 1983	Hawai‘i Volcanoes National Park; Wao Kele O Puna Natural Area Reserve; Puna Forest Reserve; a gridded network of residential suburban streets without buildings developed on them encompassing portions of Kopua Farm Lots, Eden Roc, and Fern Forest subdivisions
Kapoho,HI	1:24,000	1981	Note: most of the built resources in this 1981 map have since been consumed by lava. The following features remain: Malama-Kī and Nanawale Forest Reserves; MacKenzie State Park; Cape Kumukahi Lighthouse; Kapoho Cemetery; Isaac Hale Park and adjacent recreation buildings; Highway 132 and Highway 137; a few scattered residences northwest of Highway 132 and southwest of Kapoho Crater; a few scattered buildings along Papaya Farms Road, Pakaka Road, and Waa Waa Road
Makaopuhi Crater, HI	1:24,000	1981	Hawai‘i Volcanoes National Park; Kahauale‘a Natural Area Reserve; Chain of Craters Road
Maku‘u, HI	1:62,500	1924, 1943	Parts of northern Pāhoa; Highway 130 and Highway 132; Puna Trail; a few scattered residences northwest of Highway 132 and southwest of Kapoho Crater; a few residential properties on Pāhoa Village Road; a couple of residential buildings off the northeast side of Highway 130 north of Pāhoa; scattered residential buildings on either side of Government Beach Road between Hawaiian Paradise Park subdivision and Cinder Road; several residences on either side of Cinder Road; Cape Kumukahi Lighthouse
Mountain View, HI	1:24,000	1981	The north half of the town of Kea‘au; Kurtistown; Mountain View; Highway 130 (Kea‘au Pāhoa Road); Highway 11 (Volcano Road); Old Volcano Road; ‘Ōla‘a Forest Park Reserve; Puna Forest Reserve; dense residential development at Iwasaki Camp northwest of Kurtistown and at Nine and Onehalf Mile Camp, Kea‘au Camp and Ninemile Camp, all southwest of Kea‘au; platted housing developments but with few buildings for suburbs including Kopua Farm Lots, Fern Acres, Hawaiian Acres, Orchidlands Estates, and Ainaloa; several residential buildings along Pikake Street, Plumeria Street, 1 Road, 8 Road, and 9 Road, all south of Mountain View and Kurtistown; dense residential development along Pohaku Drive on either side of Kea‘au Pāhoa Road; dense residential development in the Hawaiian Paradise Park subdivision and along Pohaku Cir; Kea‘au Elementary School; Kea‘au Middle School; large historic residence at 16-730 Kea‘au Pāhoa Road; Mountain View Elementary; Mountain View Community Cemetery; Saint Theresa Catholic Church; dense residential and commercial development along Volcano Road and Old Volcano Road in Mountain View; moderate to dense residential development along Nichols Road, Ekeku Street, Kulani Road, Kukui Camp Road, Ala Loop and Hale Puu Pueo Place, Papapa Street, Palula Street, Puko Street, and Aka‘Akai Street; US Post Office in Mountain View; cemetery at the northeast corner of Volcano Road and Kukui Camp Road; Filipino Cemetery on

Map Name	Scale	Date, Revisions	Key Features
			Volcano Road; unknown historic church at 17-604 Volcano Road; Kurtistown Samoan Seventh Day Adventist Church on Volcano Road; ʻŌlaʻa First Hawaiian Church on Hale Pule Loop; Kurtistown Jodo Mission; Kurtistown Jodo Cemetery; Holy Rosary Mission Keaʻau
Pāhoa South, HI	1:24,000	1980, 1981	Puna, Malama-Kī, and Nanawale Forest Reserves; Leilani Estates, Nanawale Estates, and Kaniahiku Village subdivisions; Highway 130, Highway 132, and Highway 137; a southern portion of Pāhoa; dense residential and commercial development in Pāhoa including along Post Office Road, Nani Place, Japanese Camp Road, Highway 130, Highway 132, Pāhoa Village Road, Akeakamai Loop, Homestead Road, Kaohe Homestead Road, and Kekauonhi Place; moderate to dense residential development along Nako Way, Halelo Place, Naele Road, Tangerine Road, Ho Opili Street, Lehualani Place, Pualaa Road, Kauilani Road, and Kaululaau Street, as well as in Nanawale Estates from Mayzee Road to Road A, especially along Nanawale Blvd; Pāhoa Elementary, Pāhoa High & Intermediate School and Pāhoa Public Library; Sacred Heart Church Pāhoa and Cemetery; US Post Office, Pāhoa; Lava Tree State Monument; Lava Tree Tropic Inn; scattered residences along Lava Tree Road; moderate to low development within Leilani Estates concentrated along Malama Street, Alapai Street, Leilani Avenue, Maile Street, Kula Street, and Kahukai Road; scattered residences along S Road, Kama Ili Uka Road, Kauelea Road, Oihakao Drive, Kamaili Road, and Highway 137 west of Opihikao; Opihikao Congregational Church and Residence; an unknown cemetery off Highway 137 southwest of Kalani Honua Road; the platted street network of Kalapana Seaview Estates subdivision but with no buildings developed yet; moderate residential development near Kehena Black Sand Beach along the artery streets on either side of Highway 137 and along Aloha Road and Diamond Head Drive; scattered farmsteads and residences along Highway 130 south of One Ele Ele Road
Puna, HI	1:62,500	1922, 1957	Hawaiʻi Volcanoes National Park; ʻŌlaʻa and Puna Forest Reserves; Volcano; Highway 11 and Chain of Craters Road; dense residential and commercial development along Volcano Road, Kiluea Road, Keonelehua Avenue, Kalanikoa Road, Haunani Road, and Kalani Honua Road; US Post Office, Volcano; Kiluea Lodge and Restaurant; scattered residential development along either side of Highway 11 between Volcano and Glenwood Road
Puu Makaala, HI	1:24,000	1981	ʻŌlaʻa Forest Reserves; Highway 11; a northern portion of Glenwood; a western portion of Mountain View; a northern portion of Hawaiʻi Volcanoes National Park; scattered residential development along either side of N Glenwood Road and along Lehuanani Street as well as the artery streets south of Lehuanani Street numbered 1st Road-14th Road, between Mauna Kea Drive and Mauna Loa Drive along artery streets numbered 1st Road-8th Road, along Peck Road, Hope Road, N OsHiroo Road, Kumo Street, Haumalu Street, Hulana Street, and along Highway 11 between N OsHiroo Road, and Peck Road

Map Name	Scale	Date, Revisions	Key Features
Volcano, HI	1:24,000	1981	Hawai'i Volcanoes National Park; ʻŌlaʻa Forest Reserve; Highway 11, Chain of Craters Road, and Crater Rim Drive; the towns of Volcano and Glenwood; scattered residential development along Highway 11 on the outskirts of both Volcano and Glenwood; platted suburban neighborhoods with minimal to moderate development at Fern Forest, Royal Hawaiian Estates, and Mauna Loa Estates subdivisions; scattered residential development along either side of Highway 11 between Volcano and Glenwood Road and along N Glenwood Road and Kahauale'a Road; dense residential and commercial development along Volcano Road, Old Volcano Road, Kiluea Road, Keonelehua Avenue, Kalanikoa Road, Haunani Road, Hale Ohia Road, Liwi Road, Maile Avenue, Wright Road, Elepaio Road, Liko Lehua Road, Laukapu Avenue, Kalani Honua Loop and Kalani Honua Road; US Post Office, Volcano; Kiluea Lodge and Restaurant; Japanese School Building on Kalani Honua Road in Volcano; Volcano School of Arts and Sciences on Haunani Road; Volcano Art Center; Glenwood County Park

Notes: USGS = US Geological Survey.

Table 7. Potentially Significant Historic Resources Identified in Historical USGS Map Analysis

Associated USGS Map Name(s)	Resource Name/Description
Industrial Properties	
Hilo, HI 1981	Tropical Hawaiian Products facilities on Railroad Avenue
Hilo, HI 1981	Puna Sugar Company Mill facilities on Railroad Avenue
Religious Facilities and Cemeteries	
Hilo, HI 1981	Puna Hongwanji Mission on Old Volcano Road
Kalapana, HI 1981	Star of the Sea Church
Mountain View, HI 1981	Mountain View Community Cemetery
Mountain View, HI 1981	Saint Theresa Catholic Church
Mountain View, HI 1981	Unknown Cemetery at the northeast corner of Volcano Road and Kukui Camp Road
Mountain View, HI 1981	Filipino Cemetery on Volcano Road
Mountain View, HI 1981	Church at 17-604 Volcano Road
Mountain View, HI 1981	Kurtistown Samoan Seventh Day Adventist Church on Volcano Road
Mountain View, HI 1981	ʻŌlaʻa First Hawaiian Church on Hale Pule Loop
Mountain View, HI 1981	Kurtistown Jodo Mission
Mountain View, HI 1981	Kurtistown Jodo Cemetery
Mountain View, HI 1981	Holy Rosary Mission Keaʻau
Pāhoa South, HI 1980, 1981	Sacred Heart Church Pāhoa and Cemetery
Pāhoa South, HI 1980, 1981	Opihikao Congregational Church and Residence
Pāhoa South, HI 1980, 1981	Unknown cemetery off Highway 137 southwest of Kalani Honua Road

Associated USGS Map Name(s)	Resource Name/Description
Schools	
Hilo, HI 1981	Christian Liberty Academy on Milo Street
Mountain View, HI 1981	Kea‘au Elementary School
Mountain View, HI 1981	Kea‘au Middle School
Mountain View, HI 1981	Mountain View Elementary
Pāhoa South, HI 1980, 1981	Pāhoa Elementary
Pāhoa South, HI 1980, 1981	Pāhoa High & Intermediate School
Volcano, HI 1981	Japanese School Building on Kalani Honua Road in Volcano
Volcano, HI 1981	Volcano School of Arts and Sciences on Haunani Road
Civic and Commercial Properties	
Maku‘u, HI 1924, 1943; Kapoho, HI 1981	Cape Kumukahi Lighthouse
Mountain View, HI 1981	US Post Office in Mountain View
Volcano, HI 1981	US Post Office in Volcano
Pāhoa South, HI 1980, 1981	US Post Office in Pāhoa
Pāhoa South, HI 1980, 1981	Pāhoa Public Library
Volcano, HI 1981	Kiluea Lodge and Restaurant*
Pāhoa South, HI 1980, 1981	Lava Tree Tropic Inn*
Volcano, HI 1981	Volcano Art Center
Recreation Properties	
Pāhoa South, HI 1980, 1981	Lava Tree State Monument
Volcano, HI 1981	Glenwood County Park
Puu Makaala, HI 1981; Volcano, HI 1981; Puna, HI 1957; Makaopuhi Crater, HI 1981	Hawai‘i Volcanoes National Park
Linear Resources	
Puu Makaala, HI 1981; Volcano, HI 1981; Puna, HI 1957; Makaopuhi Crater, HI 1981; Mountain View, HI 1981	Highway 11
Maku‘u, HI 1924, 1943; Mountain View, HI 1981; Pāhoa South, HI 1980, 1981	Highway 130
Maku‘u, HI 1924, 1943; Pāhoa South, HI 1980, 1981; Kapoho, HI 1981	Highway 132
Pāhoa South, HI 1980, 1981; Kapoho, HI 1981	Highway 137

Notes: *These properties could also be identified as Recreation Properties. USGS = US Geological Survey.

3.2.2 Historic Resource Types

The research and analysis identified the following historic resource types: residences, schools, civic and commercial buildings, industrial facilities, recreation facilities, religious facilities and cemeteries, and linear resources. Summary findings for each resource type are provided in the subsections below.

3.2.2.1 Residences

Residences may be locally significant in the themes of Architecture, Settlement, Community Planning and Development, or Social History. Individual residences and multi-family complexes may be historically significant for their association with settlement, agriculture, or architecture. These

residences may include auxiliary resources, such as auxiliary dwelling units, garages, pools, clubhouses, maintenance facilities, and other buildings constructed during the same period of significance as the property's main building. Some residences may include farmsteads or ranches associated with Puna's agricultural development. Less distinctive residences are more likely to be significant when clustered with other similar types in historic properties, such as a historic subdivision where the district possesses a significant concentration, linkage, or continuity that historically unites the associated resources. Previously evaluated residential historic properties include Kahaloa House, Tahara House Site, Pāhoa Town District, Volcano Residential District, Glenwood District, Hale Ohia Tract Historic District, and Puna-Kau Historic District. Additional survey and research is needed to indicate if additional potentially significant residences or residential historic districts are in the project area.

3.2.2.2 Schools

Schools may be locally significant in the themes of Architecture, Education, Community Planning and Development, or Politics/Government. In addition to school buildings, property types within this category may include administrative buildings, gymnasia, and teacher housing. No historic schools in the project area have been previously evaluated as historic properties, but the historical context and USGS map analysis indicate that several potentially significant historic-age schools may exist in the Project Area, including the following:

- Kea'ua Elementary
- Kea'ua Middle School
- Kea'ua High School
- Mountain View Elementary School
- Pāhoa Elementary School
- Pāhoa High and Intermediate School
- Keonepoko Elementary School
- Kua a ka La
- Waters of Life
- Volcano School of Arts and Sciences
- Hawai'i Academy of Art and Sciences
- Ke Kula Nawahi Okalaniopu'u Iki Lab
- Kamehameha Schools
- Malamalama Waldorf School
- Christian Liberty School

3.2.2.3 Civic and Commercial Buildings

Civic and commercial buildings may be locally significant in the themes of Architecture, Community Planning and Development, Transportation, Politics/Government, or Commerce. Property types within this category may include post offices, fire and police stations, courthouses, city or town halls, libraries, gas stations, office buildings, theatres, or stores. In addition to their potential significance on an individual basis, these resources may also contribute to potential historic districts. No civic or

commercial buildings have been previously evaluated as historic properties, but the historical context and USGS map analysis indicate that the Cape Kumukahi Lighthouse, as well as civic and commercial buildings in Mountain View, Volcano, Pāhoa, and Volcano, may be historically significant.

3.2.2.4 Industrial Facilities

Industrial facilities may be locally significant in the themes of Architecture, Industry, and Community Planning and Development. Property types within this category may include production plants, warehouses, processing facilities, mills, and other industrial buildings and structures. No industrial facilities in the project area have been previously evaluated as historic properties, but the historical context and USGS map analysis indicate that the Tropical Hawaiian Products facilities and the Puna Sugar Mill, both in Kea‘au, may be historically significant.

3.2.2.5 Recreation Facilities

Recreation facilities may be locally significant in the themes of Architecture, Landscape Architecture, Entertainment/Recreation, and Community Planning and Development. Property types within this category may include hotels, resort properties, golf courses, and park facilities. Previously evaluated recreational historic properties include resources associated with Volcano National Park, as well as Kīlauea Lodge Complex, Old Volcano House No. 42, and Mountain View Theater. The historical context and USGS map analysis indicate that the Lava Tree Tropic Inn, Lava Tree State Monument, and Glenwood County Park may be historically significant.

3.2.2.6 Religious Facilities and Cemeteries

Religious facilities and cemeteries may be locally significant in the themes of Architecture, Religion, Community Planning and Development, Ethnic History, or Education. Under NRHP Criterion Consideration A (Religious Properties) “a religious property is only eligible if it derives its primary significance from architectural or artistic distinction or historical importance” (NPS 197:26). Cemeteries may be locally significant in the themes of Landscape Architecture, Ethnic History, and Community Planning and Development or may be associated with a historically significant church or other religious facility. Under NRHP Criteria Consideration D (Cemeteries) “a cemetery is eligible if it derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events.”

Previously evaluated religious historic properties include Star of the Sea Church, Opihikao Evangelical Church Residence and Puna-Ka‘u Historic District. Previously evaluated cemeteries in the project area include Sacred Heart Catholic Church Cemetery and Opihikao Congregational Church Cemetery. The historical context and USGS map analysis indicate that several potentially significant religious facilities and cemeteries exist in the project area in Kapoho, Kea‘au, Kurtistown, Mountain View, Pāhoa, Volcano, and other communities, including the following:

- Puna Hongwanji Mission, Kea‘au
- Holy Rosary Mission Chapel, Kea‘au
- Saint Theresa Catholic Church, Mountain View
- Catholic Cemetery, Kurtistown
- Filipino Cemetery, Kurtistown
- Judo Cemetery, Kurtistown

- ʻŌlaʻa First Hawaiian Church Cemetery, Kurtistown
- Old Catholic Cemetery, Kurtistown
- Old Japanese Cemetery, Kurtistown
- Kapoho Cemetery, Kapoho
- Mountain View Community Cemetery, Mountain View
- Nikkei Cemetery, Pāhoa

3.2.2.7 Linear Resources

Linear resources may be locally significant in the themes of Engineering, Community Planning and Development, Transportation, Commerce, or Industry. Property types within this category may include roads, trails, rail lines, or transmission lines. In addition to individually eligible linear resources, a road, rail, or infrastructure network may be a character-defining feature or contributing resource for a district. For example, a network of cul-de-sacs and suburban landscaped streets could be a character-defining feature of the setting and landscape architecture of a potential residential district. Previously evaluated linear historic properties include Crater Rim Drive in Hawaiʻi Volcanoes National Park and the Historic Puna Trail–Old Government Road (Kumu Pono Associates 1999). The historical context and USGS map analysis indicate that Highway 11, Highway 130, Highway 132, Highway 137, and Old Kalapana Road may also be historically significant.

3.3 Potential Historic Districts and Clusters of Historic-Age Resources

The historical context and USGS map analysis identified several geographic areas that may contain historic significance associated with Puna's community development. Based on their historical contexts, these areas may contain potentially significant historic districts. Figure 23 illustrates the different geographic areas and historic themes, including historic roads, suburban subdivisions, communities, Hawaiian Home Lands, Hawaiʻi Housing Authority developments, and reserves and recreational areas.

Although many of these areas may have been planned or platted during the historic period, an analysis of construction dates pulled from the County of Hawaiʻi Real Property Tax Office indicates that the built environment does not necessarily reflect an area's historic significance (County of Hawaiʻi 2022). Therefore, not every geographic area is likely to contain a potential historic district. However, where large numbers of historic-age properties overlap with areas identified in the historical contexts, the probability of a historic district increases. Appendix B depicts the findings of the construction date analysis and illustrates where historic properties are located within historic road corridors, communities, subdivisions, Hawaiian Home Lands, and recreation areas and reserves.

A geospatial hot spot analysis of year-built data was conducted to hone in further on the areas with the highest statistically significant concentrations and clusters of historic-age properties among the tens of thousands of identified parcels identified in the year-built data analysis and shown in Appendix B. Figure 24 depicts the findings of that analysis. Project area hot spots, or clusters of historic-age properties, are shown in red, and cold spots, or clusters of non-historic-age properties, are shown in blue. Darker hues indicate higher percentages of statistical significance. Parcels shown in white indicate no statistically significant clustering of historic-age or non-historic-age parcels.

The hot spot analysis shows clustering of historic-age properties in the following areas:

- Along historic road corridors including Highway 11, Highway 130, Highway 132 and Highway 137
- In the historic communities of Volcano, Pāhoa, Mountain View, Kurtistown, Pohoiki (and an area south of Pohoiki), the northern side of Kea‘au, and an area northwest of Kapoho
- In the historic subdivisions of Mauna Loa Estates, Royal Hawaiian Estates, Nanawale Estates, and Leilani Estates
- In pockets of the historic subdivision of Hawaiian Beaches

The hot spot analysis shows clustering of non-historic-age properties in the following areas:

- In the historic community of Kalapana and most areas within Kea‘au
- In the historic subdivisions of Fern Forest, Eden Roc, Hawaiian Acres, Tiki Gardens, Ainaloa, Hawaiian Paradise Park, and most of Hawaiian Beaches

The hot spot analysis shows there are no statistically significant clusters of historic-age or non-historic-age properties in the following areas:

- In Hawaiian Home Lands
- In the forest reserves or natural area reserves

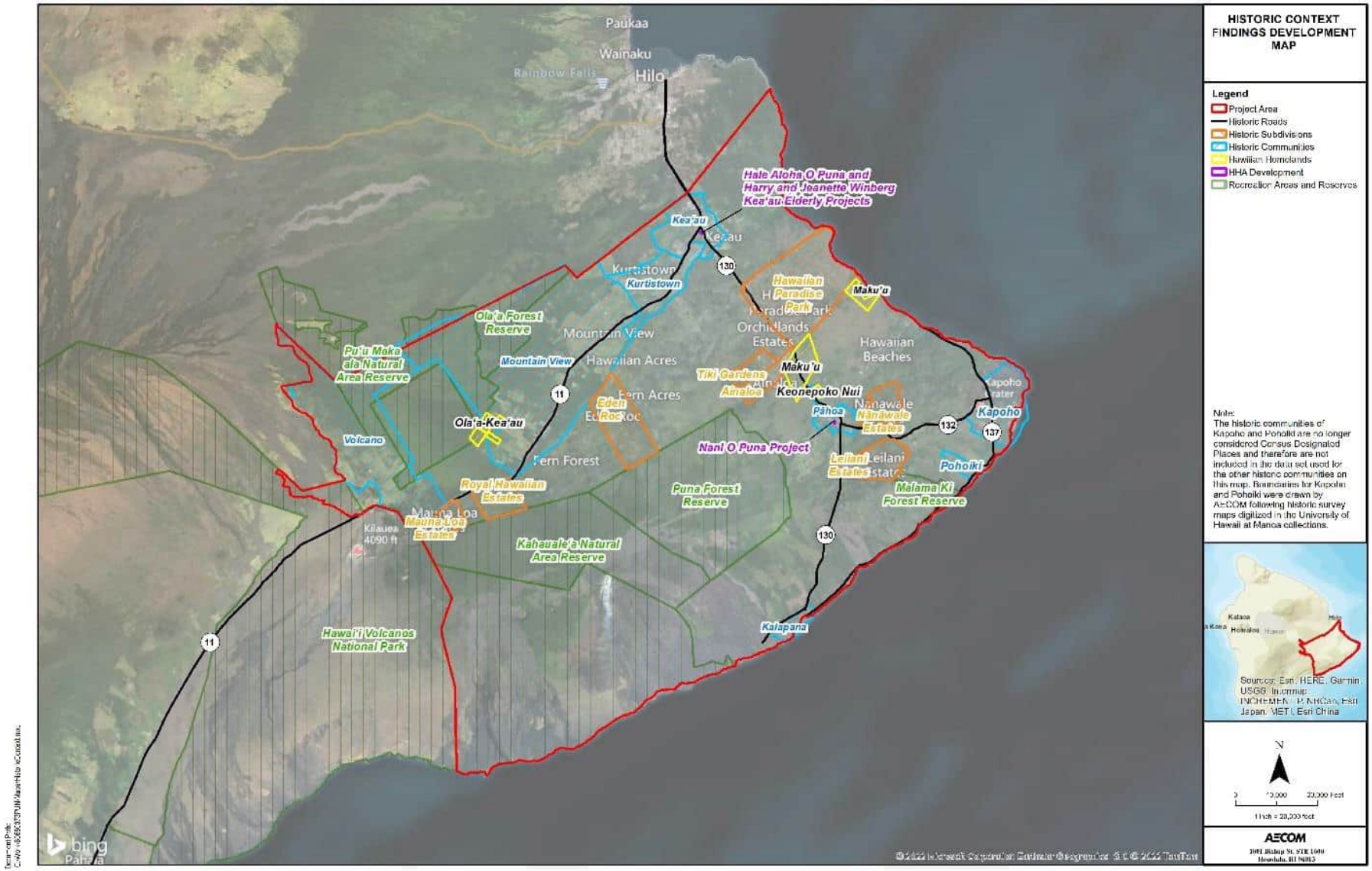

Figure 23. Historical context development findings

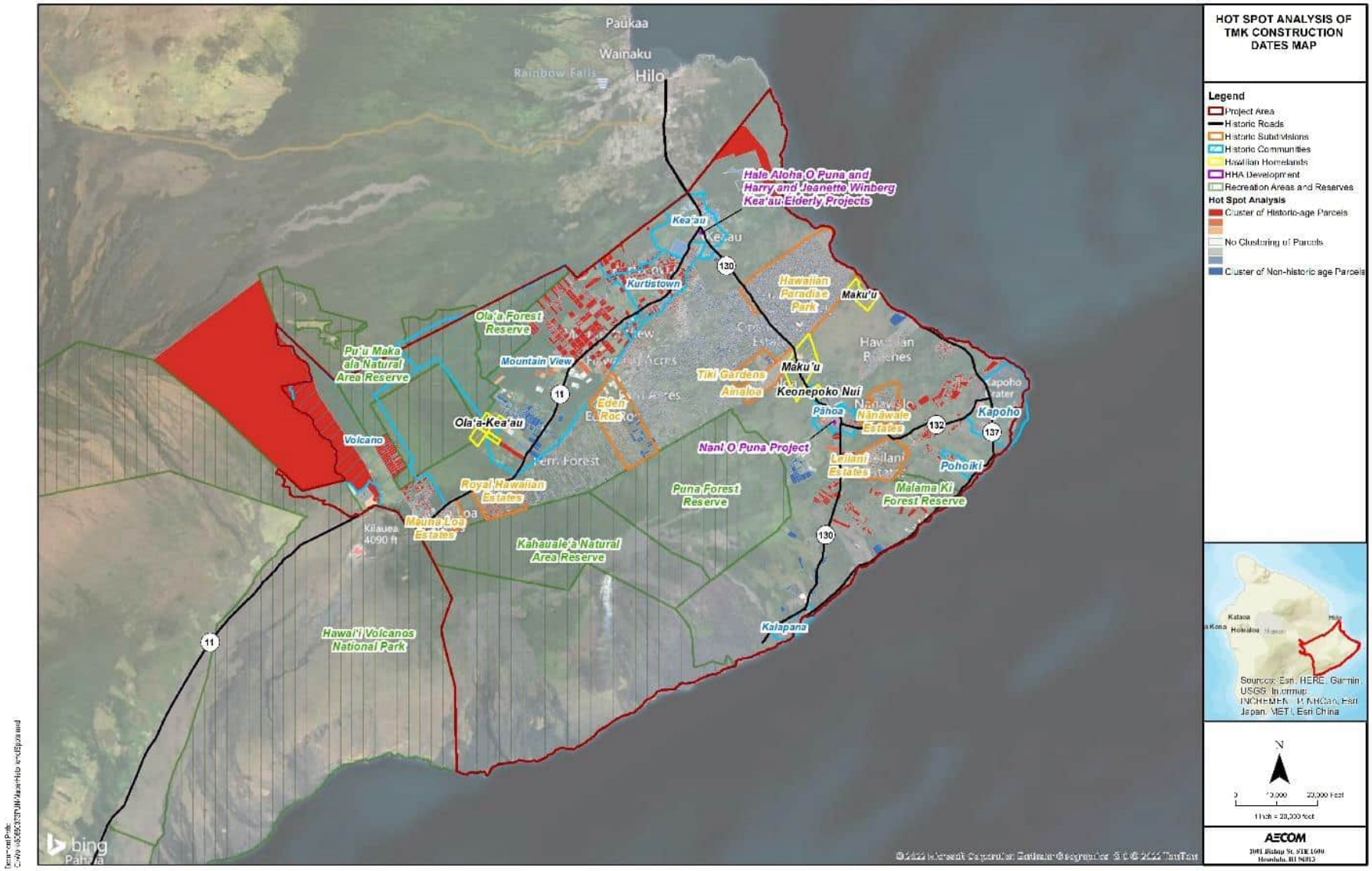

Figure 24. Hot spot analysis of TMK construction dates

4.0 Recommendations

Based on the research and desktop analysis of the historic resources supporting study, AECOM offers several recommendations for survey and evaluation of historic properties for future phases of the Puna Wastewater program. HRS Chapter 6E requires SHPD consultation on impacts to historic properties over 50 years in age. A comprehensive historic resources analysis of the project area would include survey of over 33,300 properties that contain buildings constructed in or before 1982. The scope of such a survey would be massive and unattainable for this project. The recommendations below provide a more manageable scope that includes intensive-level survey, reconnaissance-level survey, and windshield survey of historic resources in the project area and can be further refined to correspond with the selected PEIS project alternative. These three types of survey are described in SHPD's Guidelines for Architectural Historic Resource Surveys and Documentation (SHPD 2018).

Prioritize intensive-level survey and evaluation of the following known historic properties and potentially significant historic-age resources:

1. Previously evaluated known historic properties.
2. Potentially significant historic-age resources identified in the USGS historical map analysis and historical context.
3. Potentially significant resource types within each community, including residences, schools, civic and commercial buildings, industrial facilities, recreation facilities, religious facilities and cemeteries, and linear resources.

Prioritize reconnaissance-level survey and evaluation of the following resources:

1. Properties with resources 50 years in age or older located in PEIS priority areas with a selected action alternative. HRS Chapter 6E requires this level of analysis for actions that may impact historic properties.
2. Clusters of TMKs with high concentrations of historic-age resources identified in hot spot analysis:
    a. Along historic road corridors including Highway 11, Highway 130, Highway 132 and Highway 137
    b. In the historic communities of Volcano, Pāhoa, Mountain View, Kurtistown, Pohoiki (and an area south of Pohoiki), the northern side of Kea'au, and the area northwest of Kapoho
    c. In the historic subdivisions of Mauna Loa Estates, Royal Hawaiian Estates, Nanawale Estates, and Leilani Estates
    d. In pockets of the historic subdivision of Hawaiian Beaches

Prioritize windshield historic resources survey of the following areas and resource types in areas selected for project:

1. Main artery streets and transportation corridors. USGS maps and the hot spot analysis show that development historically occurred along transportation corridors, which are likely to include historic resources, such as civic and commercial buildings, religious facilities, schools, and combined clusters of these resources.
2. Resources that are not identified in TMK data due to their tax exempt status, such as schools, civic buildings, recreation facilities, and religious institutions.

For additional consideration:

1. The historical USGS map analysis focused on most recent historic-age maps to show what resources lasted through the end of the historic period and were most likely to remain extant. Additional analysis of earlier maps in these areas would provide additional information and context about these resources.
2. Volcano National Park, although not a historic property in its entirety, does contain historic resources that are eligible for and/or listed in the NRHP and HRHP. In addition, it is a UNESCO World Heritage Site and is subject to additional regulations beyond Section 106 of the NHPA and HRS 6(e).
3. There are acknowledged research gaps within the ninetieth and twentieth century in Hawai‘i, particularly since some cultural and ethnic groups are likely to be less documented in the historical record compared to more dominant groups.
4. Although not directly associated with specific historic resources, historic buildings, structures, sites, and districts may be located on Hawaiian Home Lands tracts and could have additional significance in the areas of Community Planning and Development and/or Government/Politics for their association to the HHCA of 1921 and the DHHL.
5. Coordination of cultural resources management for aboveground and archaeological resources may provide additional context and may streamline the County’s consultation efforts with SHPD and other consulting parties.

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APPENDIX A: SELECT US GEOLOGICAL SURVEY MAPS

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

HILO QUADRANGLE
HAWAII—ISLAND AND COUNTY OF HAWAII
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 HILO 15' QUADRANGLE

Mapped, edited, and published by the Geological Survey
Revised in cooperation with Hawaii Dept. of Transportation

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1961. Field checked 1966. Revised from aerial photographs taken 1977. Limited field checked 1980. Map edited 1981

Selected hydrographic data compiled from USC&GS Chart 4103 (1958). This information is not intended for navigational purposes.

Projection and 10,000-foot grid ticks: Hawaii coordinate system, zone 1 (transverse Mercator) Clarke spheroid 1866. Old Hawaii Datum 1000-meter Universal Transverse Mercator grid ticks, zone 5 shown in blue. International spheroid. To place on the predicted North American Datum 1983 move the projection lines 339 meters north and 291 meters west as shown by dashed corner ticks

Red tint indicates areas in which only landmark buildings are shown

There may be private inholdings within the boundaries of the National or State reservations shown on this map

SCALE 1:24000

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOWER LOW WATER
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 2 FEET

APPROXIMATE MEAN DECLINATION, 1981

FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

ROAD CLASSIFICATION
Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
Interstate Route
U. S. Route
State Route

HAWAIIAN ISLANDS
HAWAII
QUADRANGLE LOCATION

HILO, HAWAII
N1937.5—W15500/7.5
1981

NOV 5 1981
1900

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

KALALUA QUADRANGLE
HAWAII-HAWAII CO
ISLAND OF HAWAII-PUNA DISTRICT
7.5 MINUTE SERIES (TOPOGRAPHIC)

155°07'30" 278000m.E. 5' 2'30" 670 000 FEET 155°00'
19°30' 2157000m.N. 27'30" 25' 200 000 FEET 19°22'30" 630 000 FEET 289000m.E. 2144000m.N.

(PUU MAKAALAI) (PAHOA NORTH) (VOLCANO) (PAHOA SOUTH) (IMAKAOPUHI CRATER) (KALAPANA) (KALAPANA) POUPOU

MOUNTAIN VIEW 4.7 MI. 3.7 MI. TO HAWAII 11
(MOUNTAIN VIEW) 5 MI. TO HAWAII 11
3.5 MI. TO HAWAII 11
4.5 MI. TO HAWAII 13

KEAAU
AIKAHEKAHEIKI
MAKUU
PUNA FOREST RESERVE
WAO KELE O PUNA
NATURAL AREA RESERVE
KAHAUALEA
HAWAII VOLCANOES NATIONAL PARK
KAMOAMOA
KAIMU MAKENA
KALAPANA
KAUNALOA
KAPAAHU
KUPAHUA

LAVA FLOW OF 1963
LAVA FLOW OF 1965
LAVA FLOW OF 1969
LAVA FLOW OF 1977
LAVA FLOW OF 1961
Puu Kamoamoa
Puu Kahaualea
Kalalua
Puu Kauka
KAUKA HOMESTEADS
KAIMU MAKENA HOMESTEADS
KUPAHUA HOMESTEADS
CRACK
CRACKS
RIFT ZONE
BOUNDARY
RESERVE
NATURAL AREA
FOREST RESERVE BOUNDARY

Mapped, edited, and published by the Geological Survey
Revised in cooperation with Hawaii Dept. of Transportation

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1954 and 1961. Field checked 1966. Revised from aerial photographs taken 1977. Limited field check 1980. Map edited 1982

Projection and 10,000-foot grid ticks: Hawaii coordinate system, zone 1 (transverse Mercator) Clarke spheroid 1866. Old Hawaiian Datum 1000-meter Universal Transverse Mercator grid ticks, zone 5 shown in blue. International spheroid. To place on the predicted North American Datum 1983 move the projection lines 338 meters north and 291 meters west as shown by dashed corner ticks

There may be private inholdings within the boundaries of the National or State reservations shown on this map

11° TRUE NORTH MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1982

SCALE 1:24000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

HAWAIIAN ISLANDS HAWAII
QUADRANGLE LOCATION

ROAD CLASSIFICATION
Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
State Route

KALALUA, HAWAII
N1922.5—W15500/7.5
1982

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

KALAPANA QUADRANGLE
HAWAII—HAWAII CO.
ISLAND OF HAWAII—PUNA DISTRICT
7.5 MINUTE SERIES (TOPOGRAPHIC)

Mapped, edited, and published by the Geological Survey
Revised in cooperation with Hawaii Dept. of Transportation

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1954. Field checked 1966. Revised from aerial photographs taken 1977. Limited field check 1980. Map edited 1981

Projection and 10,000-foot grid ticks: Hawaii coordinate system, zone 1(transverse Mercator) Clarke spheroid 1866. Old Hawaiian Datum 1000-meter Universal Transverse Mercator grid ticks, zone 5, shown in blue. International spheroid. To place on the predicted North American Datum 1983 move the projection lines 337 meters north and 291 meters west as shown by dashed corner ticks

This map lies within an unstable volcanic area

There may be private inholdings within the boundaries of the National or State reservations shown on this map

APPROXIMATE MEAN DECLINATION, 1981

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 1 FOOT

FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

HAWAIIAN ISLANDS
QUADRANGLE LOCATION

ROAD CLASSIFICATION
Medium-duty — Light-duty
Unimproved dirt
State Route

KALAPANA, HAWAII
N1916.5—W15457.5/6X10

1981

NOV 24 1981

22 75

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

KAPOHO QUADRANGLE

HAWAII—HAWAII CO.
ISLAND OF HAWAII—PUNA DISTRICT
7.5 MINUTE SERIES (TOPOGRAPHIC)

154°52'30" 304 000m E. 50' 47'30" 750 000 FEET 154°45'
19°33'30" 19°33'30"
2163 000m N. 260 000 FEET
31' 31'
28'30" 28'30"
220 000 FEET 19°26'
154°52'30" 720 000 FEET 50' 47'30" 315 000m E. 154°45'
19°26'
2150 000m N.

NANAWALE PARK
Nanawale Bay
Lava Flow of 1840 (?)
NANAWALE FOREST RES.
Makaukiu Point
Old Hawaiian Canoe Sheds
Kalamanu
Kokoolau
BM 106
WAAWAA
KAHUWAI
Kipu Point
RESERVE
NANAWALE FOREST
HALEPUAA
KANEKIKI
Koae (Site)
BM 107
Cinder Pit
PUUA KULA ZONE
LAVA FLOW OF 1960
Kukii Heiau
Kukii Cinder Pit
Puu Kukae
U S COAST GUARD RESERVATION
U S COAST GUARD RESERVATION
Light
Kings Pillars
Cape Kumukahi
BM 110
HALEKAMAHINA 1
Cinder Pit
Grave
Puukea
Kapoho
BM 166
Green Lake
Kapoho Crater
Well
BM 80
BM 144
Halekamahina
EAST HALEKAMAHINA RIFT
Fishpond
BM 39
Kapoho Point
Kahonua
Kahoiea O Kahawali Crater
BM 205
KAPOHO
KII LAVA FLOW OF 1955
Waiopae
BM 57
BM 64
PUALAA
Pohoiki
BM 22
Pohakupala
AHALANUI
LAEPAOO
ONELOA
Hala Point
Pualaa
Kalea
BM 364
PAHOA
POHOIKI ROAD
POHOIKI
BM 198
KEAHIALAKA
Kahinihiniula
BM 37
Pohoiki
Isaac Hale Park
Lae O Kahuna
Cem
Mahinaakaka Heiau
KAUKULAU
MALAMA KI
MALAMA-KI FOREST RES
Malama Ki
BM 97
BM 78
STATE PARK
Lilioa
Cinder Pit
Kaakepa
MACKERITE
Paakikii
PACIFIC OCEAN
PAHOA 5 MI.
PAHOA NORTH
PAHOA SOUTH

Mapped, edited, and published by the Geological Survey
Revised in cooperation with Hawaii Dept. of Transportation

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1960. Field checked 1965. Revised from aerial photographs taken 1977. Limited field check 1980. Map edited 1981

Projection and 10,000-foot grid ticks: Hawaii coordinate system, zone 1 (transverse Mercator) Clark spheroid 1866. Old Hawaiian Datum 1000-meter Universal Transverse Mercator grid ticks, zone 5 shown in blue. International spheroid. To place on the predicted North American Datum 1963 move the projection lines 338 meters north and 291 meters west as shown by dashed corner ticks

This map lies within an unstable volcanic area

There may be private inholdings within the boundaries of the National or State reservations shown on this map

11° APPROXIMATE MEAN DECLINATION, 1981
TRUE NORTH
MAGNETIC NORTH

SCALE 1:24 000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 1 FOOT

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

HAWAIIAN ISLANDS HAWAII
QUADRANGLE LOCATION

ROAD CLASSIFICATION
Primary highway, hard surface
Light-duty road, hard or improved surface
Secondary highway, hard surface
Unimproved road
Interstate Route U. S. Route State Route

● INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1981

KAPOHO, HAWAII
N1926—W15445/7.5
1981

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

MAKAOPUHI CRATER QUADRANGLE

HAWAII–HAWAII CO
ISLAND OF HAWAII
7.5 MINUTE SERIES (TOPOGRAPHIC)

Mapped, edited, and published by the Geoloical Survey
Revised in cooperation with Hawaii Dept. of Transportation

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1954. Field checked 1963. Revised from aerial photographs taken 1977. Limited field check 1980. Map edited 1981

Projection and 10,000-foot grid ticks: Hawaii coordinate system, zone 1 (transverse Mercator) Clarke spheroid 1866. Old Hawaiian Datum 1000-meter Universal Transverse Mercator grid ticks, zone 5 shown in blue. International spheroid. To place on the predicted North American Datum 1983 move the projection line 337 meters north and 291 meters west as shown by dashed corner ticks

This map lies within an unstable volcanic area

There may be private inholdings within the boundaries of the National or State reservations shown on this map

APPROXIMATE MEAN DECLINATION, 1981

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 2 FEET

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

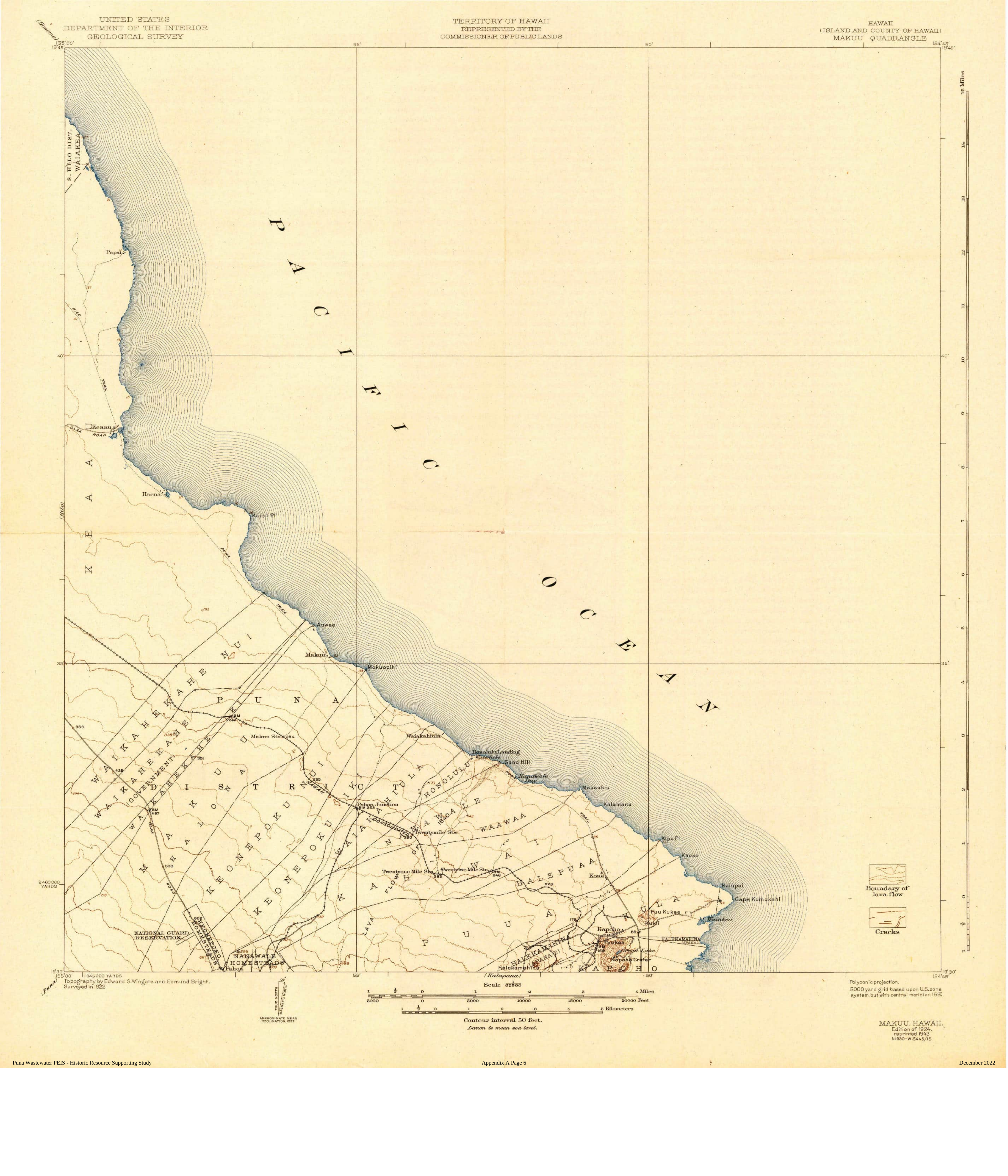
HAWAIIAN ISLANDS — HAWAII
QUADRANGLE LOCATION

ROAD CLASSIFICATION
Medium-duty — Light-duty
Unimproved dirt

MAKAOPUHI CRATER, HAWAII
N1915–W15507.5/7.5
1981

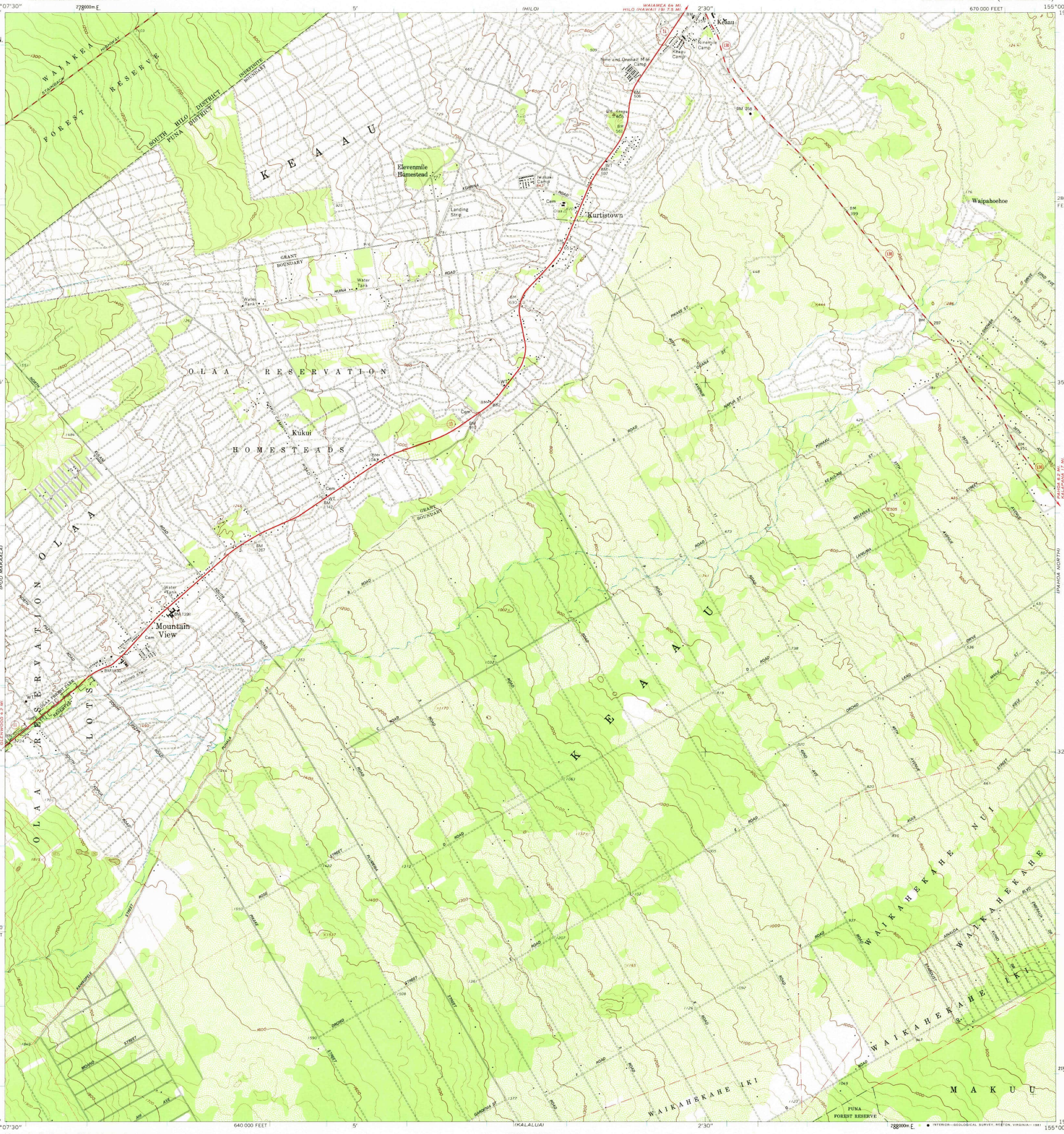
INTER-OR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1981

NOV 5 1981
2132


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
TERRITORY OF HAWAII
REPRESENTED BY THE
COMMISSIONER OF PUBLIC LANDS
HAWAII
(ISLAND AND COUNTY OF HAWAII)
MAKUU QUADRANGLE
PACIFIC OCEAN
S. HILO DIST.
WAIAKEA
Papai
Keaau
OLAA ROAD
Haena
Kaloli Pt
KEAAU
PUNA TRAIL
Auwae
Makuu
Mokuopihi
PUNA DISTRICT
Makuu Sta
Waiakahiula
Honolulu Landing
Waterhole
Sand Hill
Nanawale Bay
Makaukiu
Kalamanu
Kipu Pt
Kaoko
Kalupai
Cape Kumukahi
Waiakea
Puu Kukae
Kukii
Kapoho
Puukea
Green Lake
Kapoho Crater
HALEKAMAHINA (APANA 1)
HALEKAMAHINA (APANA 2)
Halekamahina
KAPOHO
HALEPUAA
Koae
WAAWAA
HONOLULU
Pahoa Junction
Twentymile Sta
Twentyone Mile Sta
Twentytwo Mile Sta
LAVA FLOW OF 1840
KEONEPOKUIKI
KEONEPOKUNUI
KEONEPOKO
KEONEPOKO HOMESTEADS
NANAWALE HOMESTEADS
NATIONAL GUARD RESERVATION
Pahoa
WAIKAHEKAHE (GOVERNMENT)
(Kalapana)
(Hilo)
(Puna)
Topography by Edward G. Wingate and Edmund Bright.
Surveyed in 1922
APPROXIMATE MEAN DECLINATION, 1922
Scale 1/62500
Contour interval 50 feet.
Datum is mean sea level.
Boundary of lava flow
Cracks
Polyconic projection.
5000 yard grid based upon U.S. zone system, but with central meridian 158°.
MAKUU, HAWAII.
Edition of 1924.
reprinted 1943
N1930-W15445/15

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

MOUNTAIN VIEW QUADRANGLE
HAWAII–HAWAII CO.
ISLAND OF HAWAII–PUNA DISTRICT
7.5 MINUTE SERIES (TOPOGRAPHIC)



Mapped, edited, and published by the Geological Survey
Revised in cooperation with Hawaii Dept. of Transportation

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1954. Field checked 1963. Revised from aerial photographs taken 1977. Limited field checked 1980. Map edited 1981

Projection and 10,000-foot grid ticks: Hawaii coordinate system zone 1 (transverse Mercator) Clarke spheroid 1866. Old Hawaiian Datum 1000-meter Universal Transverse Mercator grid ticks, zone 5, shown in blue. International spheroid. To place on the predicted North American Datum 1983 move the projection lines 338 meters north and 291 meters west as shown by dashed corner ticks

Fine red dashed lines indicate selected fence lines

There may be private inholdings within the boundaries of the National or State reservations shown on this map

11°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1981

SCALE 1:24000
1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0 1 KILOMETER
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

HAWAIIAN ISLANDS
HAWAII
QUADRANGLE LOCATION

ROAD CLASSIFICATION
Primary highway, hard surface — Light-duty road, hard or improved surface
Secondary highway, hard surface — Unimproved road
Interstate Route U. S. Route State Route

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

MOUNTAIN VIEW, HAWAII
N1930–W15500/7.5
1981
2250
OCT 21 1981

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PAHOA SOUTH QUADRANGLE

HAWAII–HAWAII CO.
ISLAND OF HAWAII–PUNA DISTRICT
7.5 MINUTE SERIES (TOPOGRAPHIC)

Mapped, edited, and published by the Geological Survey
Revised in cooperation with the Hawaii Dept. of Transportation

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1961. Field checked 1966. Revised from aerial photographs taken 1977. Limited field checked 1980. Map edited 1980

Projection and 10,000-foot grid ticks: Hawaii coordinate system, zone 1 (transverse Mercator) Clark spheroid 1866. Old Hawaii Datum 1000-meter Universal Transverse Mercator grid ticks, zone 5 shown in blue. International spheroid. To place on the predicted North American Datum 1983 move the projection lines 338 meters north and 291 meters west as shown by dashed corner ticks

This map lies within an unstable volcanic area

There may be private inholdings within the boundaries of the National or State reservations shown on this map

APPROXIMATE MEAN DECLINATION, 1980

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 1 FOOT

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

HAWAIIAN ISLANDS
QUADRANGLE LOCATION

ROAD CLASSIFICATION
Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
Interstate Route
U. S. Route
State Route

AUG 11 1982

PAHOA SOUTH, HAWAII
N1922.5–W15452.5/7.5
1980

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TERRITORY OF HAWAII
COMMISSIONER OF PUBLIC LANDS

HAWAII
(ISLAND AND COUNTY OF HAWAII)
PUNA QUADRANGLE

PUNA, HAWAII

N1915—W15500/15

1922

Topography by C. H. Birdseye, A. O. Burkland, Kostka Mudd, Edward G. Wingate, Edmund Bright and K. Simeona.
Control in part by Hawaiian Territorial Survey and U. S. Coast and Geodetic Survey.
Surveyed in 1912 and 1922.

Polyconic projection. Hawaiian datum.
5000 yard grid based upon U.S. zone system, but with central meridian 158°

SCALE 1:62500

CONTOUR INTERVAL 50 FEET
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION
Heavy-duty — 4 LANE | 6 LANE — Light-duty
Medium-duty — 4 LANE | 6 LANE — Unimproved dirt
U. S. Route — State Route

Boundary of lava flow
Cracks

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PUU MAKAALA QUADRANGLE

HAWAII–HAWAII CO.
ISLAND OF HAWAII
7.5 MINUTE SERIES (TOPOGRAPHIC)

Mapped, edited, and published by the Geological Survey
Revised in cooperation with Hawaii Dept. of Transportation

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1954. Field checked 1963. Revised from aerial photographs taken 1977. Limited field check 1980. Map edited 1981

Projection and 10,000-foot grid ticks: Hawaii coordinate system, zone 1 (transverse Mercator) Clarke spheroid 1866. Old Hawaii Datum 1000-meter Universal Transverse Mercator grid ticks, zone 5 shown in blue. International spheroid. To place on the predicted North American Datum 1983 move the projection lines 339 meters north and 291 meters west as shown by dashed corner ticks

There may be private inholdings within the boundaries of the National or State reservations shown on this map

11° TRUE NORTH MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1981

SCALE 1:24 000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 5 0 1 KILOMETER
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

HAWAIIAN ISLANDS HAWAII
QUADRANGLE LOCATION

ROAD CLASSIFICATION
Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
Interstate Route U. S. Route State Route

PUU MAKAALA, HAWAII
N1930–W15507.5/7.5
1981

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

VOLCANO QUADRANGLE
HAWAII–HAWAII CO
ISLAND OF HAWAII
7.5 MINUTE SERIES (TOPOGRAPHIC)

155°15' 264000m E. | 12'30" | (PUU MAKAALA) | 10' | 620 000 FEET | 155°07'30"
19°30' | 19°30'
2157000m N.

HILO 20 MI.
MOUNTAIN VIEW 4.5 MI.

HAWAII VOLCANOES NATIONAL PARK
OLAA FOREST RESERVE
OLAA RESERVATION LOTS
OLAA FOREST RESERVES PARK
OLAA FOREST PARK RESERVE
KEAAU FOREST RESERVE
KILAUEA SETTLEMENT LOTS
OLAA SUMMER LOTS
KAHAUALEA
KEAUHOU RIFT ZONE
EAST RIFT ZONE
PANAU NUI LAVA FLOW OF 1974
PUNA KAU DISTRICT
KAU DISTRICT
CHAIN OF CRATERS ROAD 0.4 MI.
PARK HOURS 4.5 MI.
NAALEHU 34 MI.
PARK HEADQUARTERS 0.9 MI. (KILAUEA CRATER)
MAKAOPUHI CRATER 4.1 MI.
(KILAUEA)
(MTN VIEW)
(KALAPANA)
(KAU DESERT)

Glenwood
Volcano
Kilauea Iki Crater
Thurston Lava Tube
Twin Craters
Kokoolau Crater
Hiiaka Crater
Devils Throat
Cinder and Spatter Cones
Kane Nui o Hamo
Napau Crater
Puu Huluhulu
Quarry
Lava Flow of 1959
LAVA FLOW OF 1969
LAVA FLOW OF 1972
LAVA FLOW OF 1973
LAVA FLOW OF 1970
LAVA FLOW OF 1968
LAVA FLOW OF 1840
CRACK
Japanese Sch
Kenkealani Sch
PO
Water Tank
County Park

27'30" | 27'30"
25' | 25'
200 000 FEET
590 000 FEET
19°22'30" | 19°22'30"
155°15' | 155°07'30"
2144000m N.
276000m E.

Mapped, edited, and published by the Geological Survey
Revised in cooperation with Hawaii Dept. of Transportation

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1954. Field checked 1963. Revised from aerial photographs taken 1977. Limited field checked 1960. Map edited 1981

Projection and 10,000-foot grid ticks: Hawaii coordinate system zone 1 (transverse Mercator) Clarke spheroid 1866. Old Hawaiian Datum 1000-meter Universal Transverse Mercator grid ticks, zone 5, shown in blue. International spheroid. To place on the predicted North American Datum 1983 move the projection lines 338 meters north and 291 meters west as shown by dashed corner ticks

Fine red dashed lines indicate selected fence lines
This map lies within an unstable volcanic area
There may be private inholdings within the boundaries of the National or State reservations shown on this map

APPROXIMATE MEAN DECLINATION, 1981

SCALE 1:24 000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

HAWAIIAN ISLANDS
QUADRANGLE LOCATION

ROAD CLASSIFICATION
Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
State Route

VOLCANO, HAWAII
N1922.5–W15507.5/7.5
1981

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1981

APPENDIX B: HISTORIC RESOURCES ANALYSIS MAP SET

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area

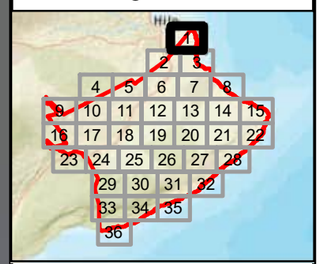
Residential Parcels

- Parcels without Buildings
- 1850-1899
- 1900-1909
- 1910-1919
- 1920-1929
- 1930-1939
- 1940-1949
- 1950-1959
- 1960-1969
- 1970-1982
- 1983-1989
- 1990-1999
- 2000-2021

Commercial Parcels

- 1850 - 1899
- 1990 - 1909
- 1910 - 1919
- 1920 - 1929
- 1930 - 1939
- 1940 - 1949
- 1950 - 1959
- 1960 - 1969
- 1970 - 1982
- 1983 - 1989
- 1990 - 1999
- 2000 - 2022

Page 1 of 36



LOCATOR MAP

N

0 1,000 2,000 Feet

1 inch = 2,000 feet

AECOM
1001 Bishop St. STE 1600
Honolulu, HI 96813

Document Path:
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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

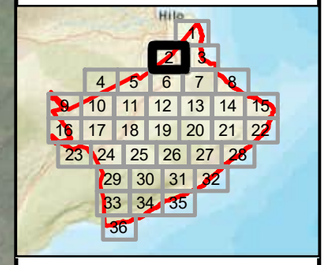
- Project Area
- Historic Communities
- HHA Development
- Recreation Areas and Reserves
- Historic Road Corridors

Residential Parcels

- Parcels without Buildings
- 1850-1899
- 1900-1909
- 1910-1919
- 1920-1929
- 1930-1939
- 1940-1949
- 1950-1959
- 1960-1969
- 1970-1982
- 1983-1989
- 1990-1999
- 2000-2021

Commercial Parcels

- 1850 - 1899
- 1990 - 1909
- 1910 - 1919
- 1920 - 1929
- 1930 - 1939
- 1940 - 1949
- 1950 - 1959
- 1960 - 1969
- 1970 - 1982
- 1983 - 1989
- 1990 - 1999
- 2000 - 2022



LOCATOR MAP

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1 inch = 2,000 feet

AECOM
1001 Bishop St. STE 1600
Honolulu, HI 96813

Document Path:
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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

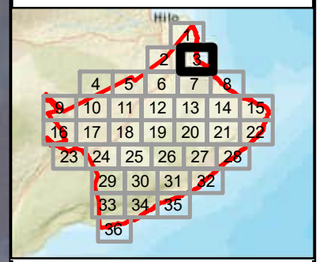
- Project Area
- Historic Subdivisions

Residential Parcels

- Parcels without Buildings
- 1850-1899
- 1900-1909
- 1910-1919
- 1920-1929
- 1930-1939
- 1940-1949
- 1950-1959
- 1960-1969
- 1970-1982
- 1983-1989
- 1990-1999
- 2000-2021

Commercial Parcels

- 1850 - 1899
- 1990 - 1909
- 1910 - 1919
- 1920 - 1929
- 1930 - 1939
- 1940 - 1949
- 1950 - 1959
- 1960 - 1969
- 1970 - 1982
- 1983 - 1989
- 1990 - 1999
- 2000 - 2022



LOCATOR MAP

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1 inch = 2,000 feet

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1001 Bishop St. STE 1600
Honolulu, HI 96813

Document Path:
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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Communities
- Recreation Areas and Reserves

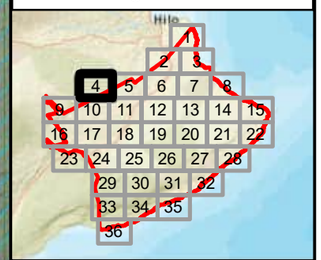
Residential Parcels

- Parcels without Buildings
- 1850-1899
- 1900-1909
- 1910-1919
- 1920-1929
- 1930-1939
- 1940-1949
- 1950-1959
- 1960-1969
- 1970-1982
- 1983-1989
- 1990-1999
- 2000-2021

Commercial Parcels

- 1850 - 1899
- 1990 - 1909
- 1910 - 1919
- 1920 - 1929
- 1930 - 1939
- 1940 - 1949
- 1950 - 1959
- 1960 - 1969
- 1970 - 1982
- 1983 - 1989
- 1990 - 1999
- 2000 - 2022

Page 4 of 36



LOCATOR MAP

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1 inch = 2,000 feet

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1001 Bishop St. STE 1600
Honolulu, HI 96813

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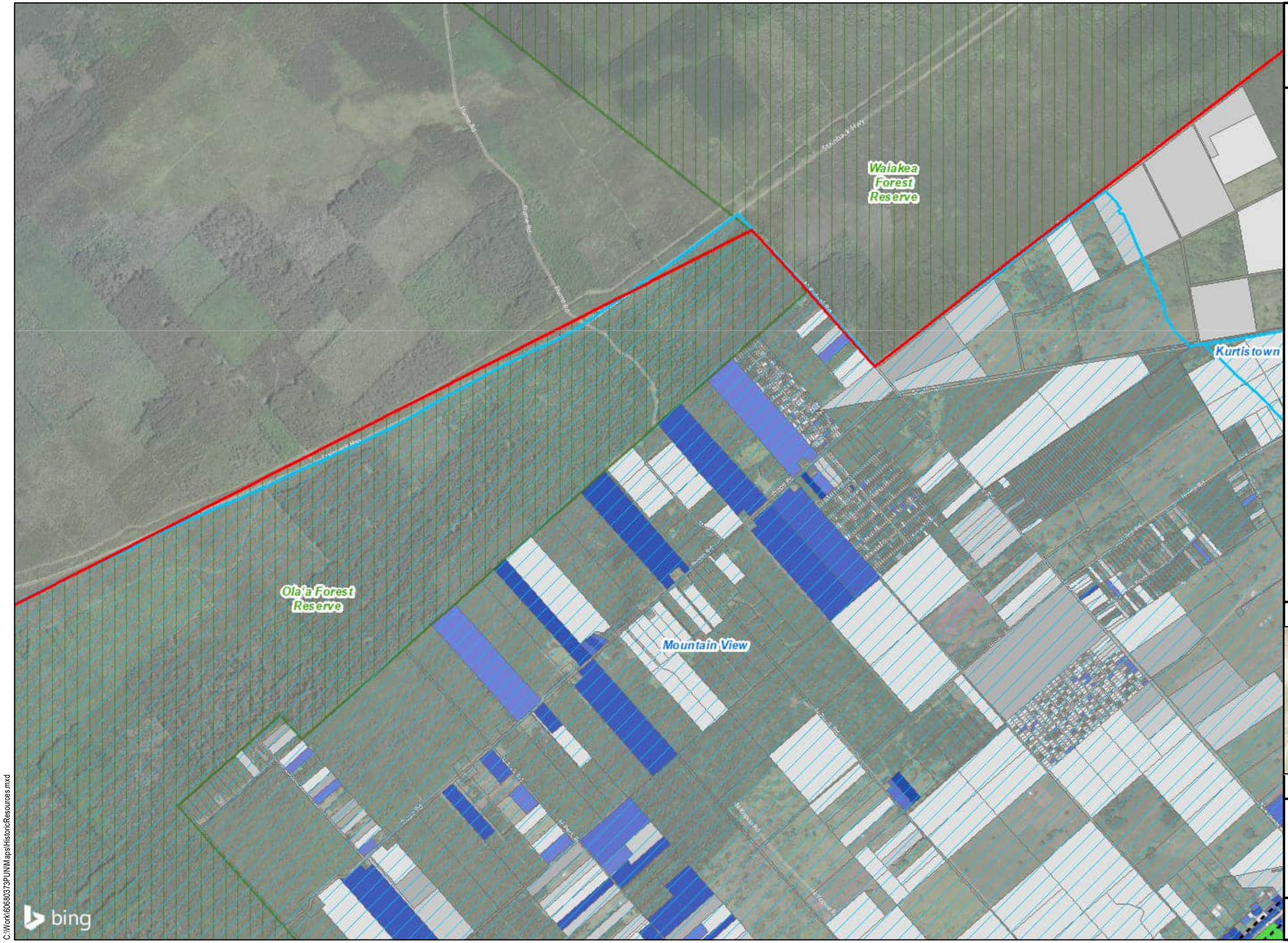

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Communities
- Recreation Areas and Reserves
- Historic Road Corridors

Residential Parcels

- Parcels without Buildings
- 1850-1899
- 1900-1909
- 1910-1919
- 1920-1929
- 1930-1939
- 1940-1949
- 1950-1959
- 1960-1969
- 1970-1982
- 1983-1989
- 1990-1999
- 2000-2021

Commercial Parcels

- 1850 - 1899
- 1990 - 1909
- 1910 - 1919
- 1920 - 1929
- 1930 - 1939
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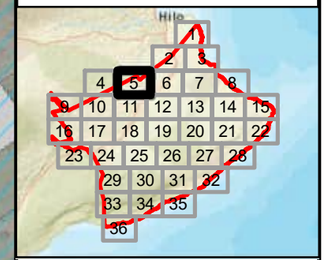
- 1950 - 1959
- 1960 - 1969
- 1970 - 1982
- 1983 - 1989
- 1990 - 1999
- 2000 - 2022



LOCATOR MAP

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1 inch = 2,000 feet

AECOM
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Honolulu, HI 96813

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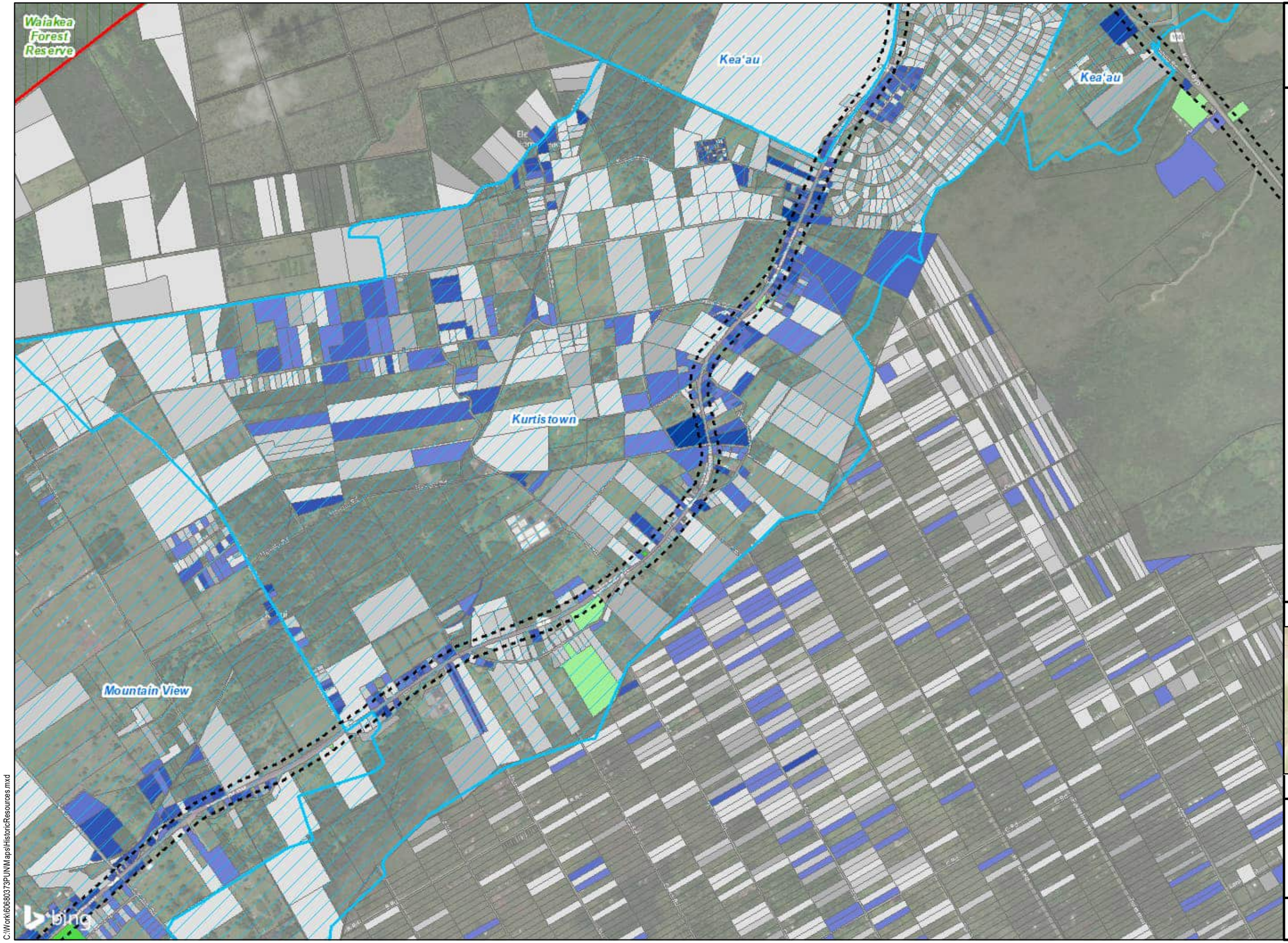

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Communities
- Recreation Areas and Reserves
- Historic Road Corridors

Residential Parcels

- Parcels without Buildings
- 1850-1899
- 1900-1909
- 1910-1919
- 1920-1929
- 1930-1939
- 1940-1949
- 1950-1959
- 1960-1969
- 1970-1982
- 1983-1989
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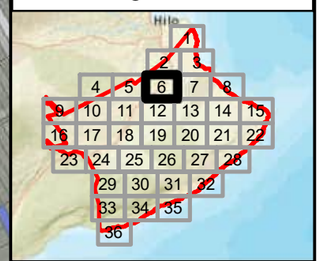
- 2000-2021

Commercial Parcels

- 1850 - 1899
- 1990 - 1909
- 1910 - 1919
- 1920 - 1929
- 1930 - 1939
- 1940 - 1949
- 1950 - 1959
- 1960 - 1969
- 1970 - 1982
- 1983 - 1989
- 1990 - 1999
- 2000 - 2022

Page 6 of 36



LOCATOR MAP

N

0 1,000 2,000 Feet

1 inch = 2,000 feet

AECOM
1001 Bishop St. STE 1600
Honolulu, HI 96813

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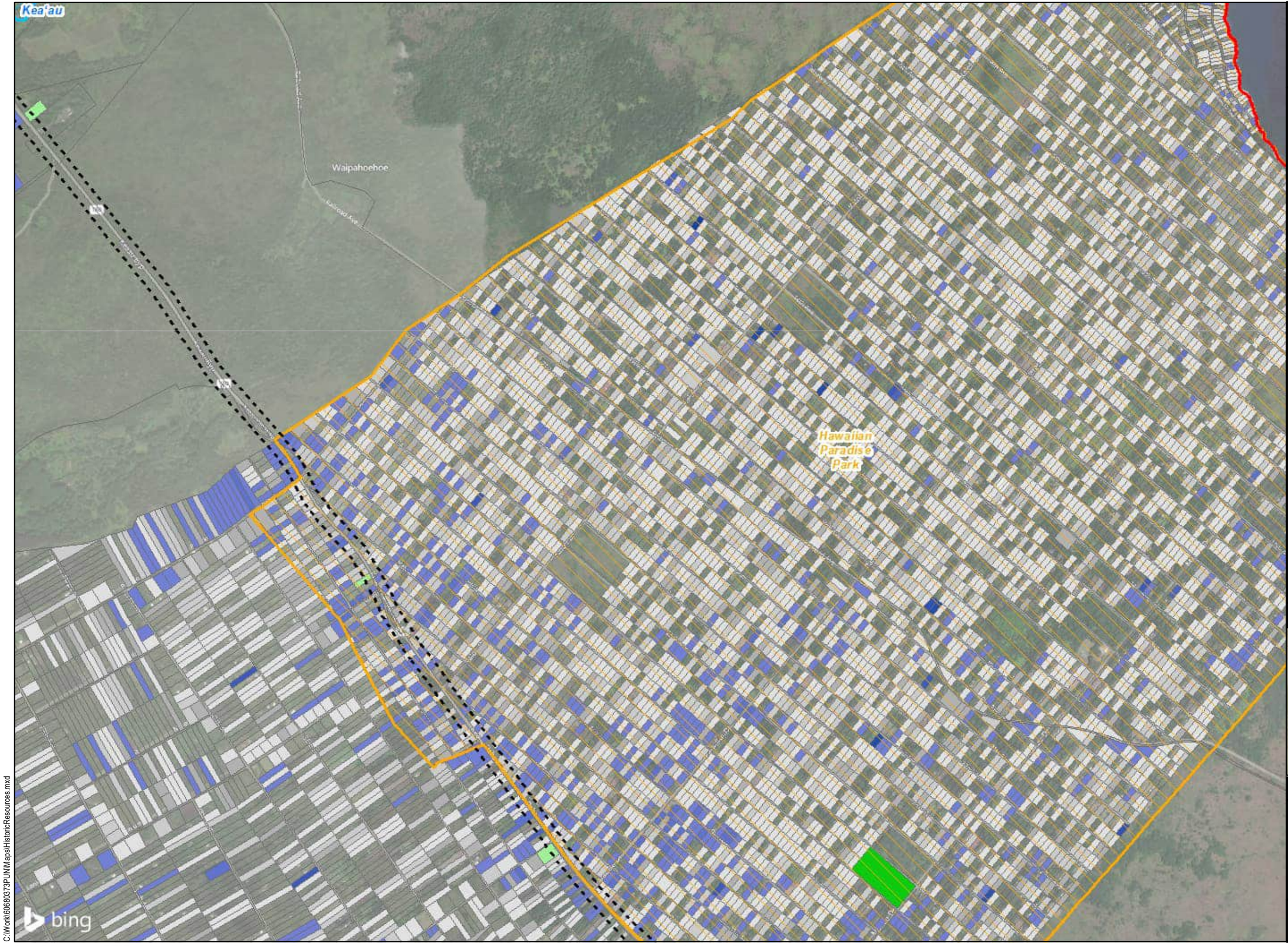

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Subdivisions
- Historic Communities
- Historic Road Corridors

Residential Parcels

- Parcels without Buildings
- 1850-1899
- 1900-1909
- 1910-1919
- 1920-1929
- 1930-1939
- 1940-1949
- 1950-1959
- 1960-1969
- 1970-1982
- 1983-1989
- 1990-1999
- 2000-2021

Commercial Parcels

- 1850 - 1899
- 1990 - 1909
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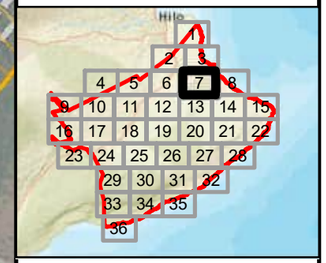
- 1970 - 1982
- 1983 - 1989
- 1990 - 1999
- 2000 - 2022



LOCATOR MAP

N

0 1,000 2,000 Feet

1 inch = 2,000 feet

AECOM
1001 Bishop St. STE 1600
Honolulu, HI 96813

Document Path:
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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Subdivisions
- Hawiiian Homelands
- Historic Road Corridors

Residential Parcels

- Parcels without Buildings
- 1850-1899
- 1900-1909
- 1910-1919
- 1920-1929
- 1930-1939
- 1940-1949
- 1950-1959
- 1960-1969
- 1970-1982
- 1983-1989
- 1990-1999
- 2000-2021

Commercial Parcels

- 1850 - 1899
- 1990 - 1909
- 1910 - 1919
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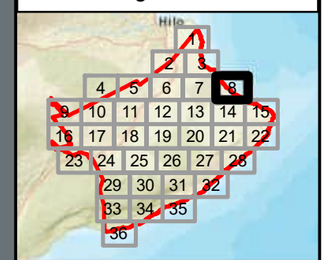
- 2000 - 2022



LOCATOR MAP

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1 inch = 2,000 feet

AECOM
1001 Bishop St. STE 1600
Honolulu, HI 96813

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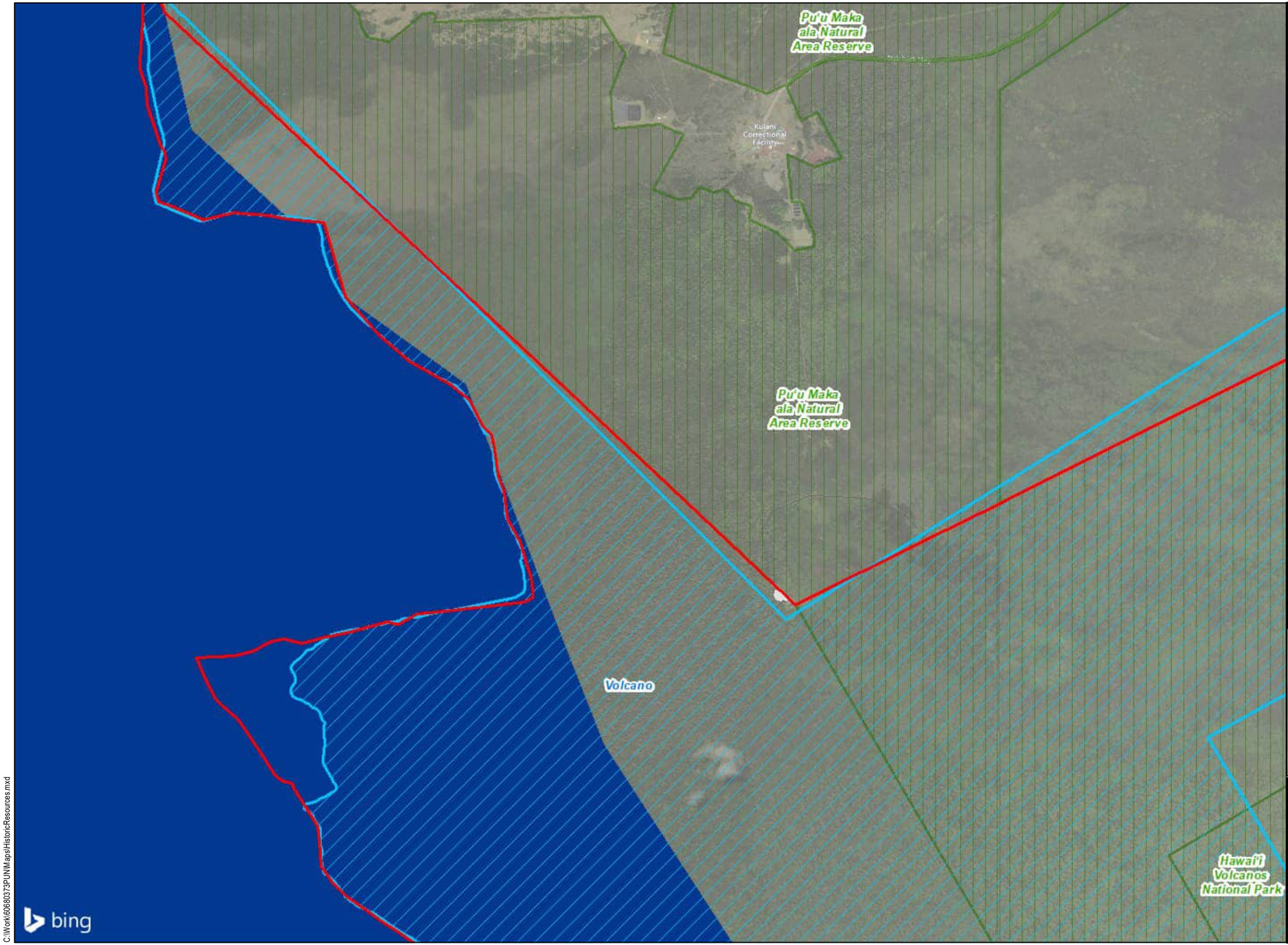

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Communities
- Recreation Areas and Reserves

Residential Parcels

- Parcels without Buildings
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- 1900-1909
- 1910-1919
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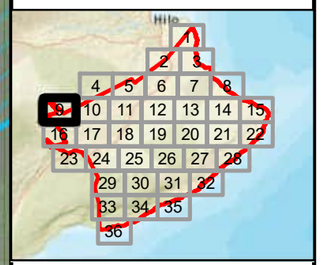

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Honolulu, HI 96813

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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Communities
- Recreation Areas and Reserves

Residential Parcels

- Parcels without Buildings
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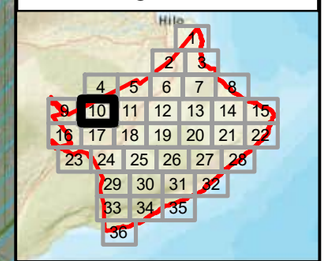

LOCATOR MAP

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1001 Bishop St. STE 1600
Honolulu, HI 96813

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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Subdivisions
- Historic Communities
- Recreation Areas and Reserves
- Historic Road Corridors

Residential Parcels

- Parcels without Buildings
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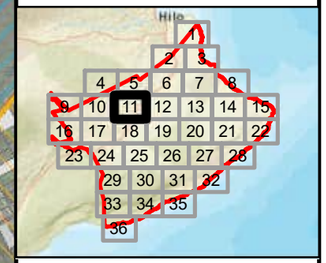

LOCATOR MAP

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Honolulu, HI 96813

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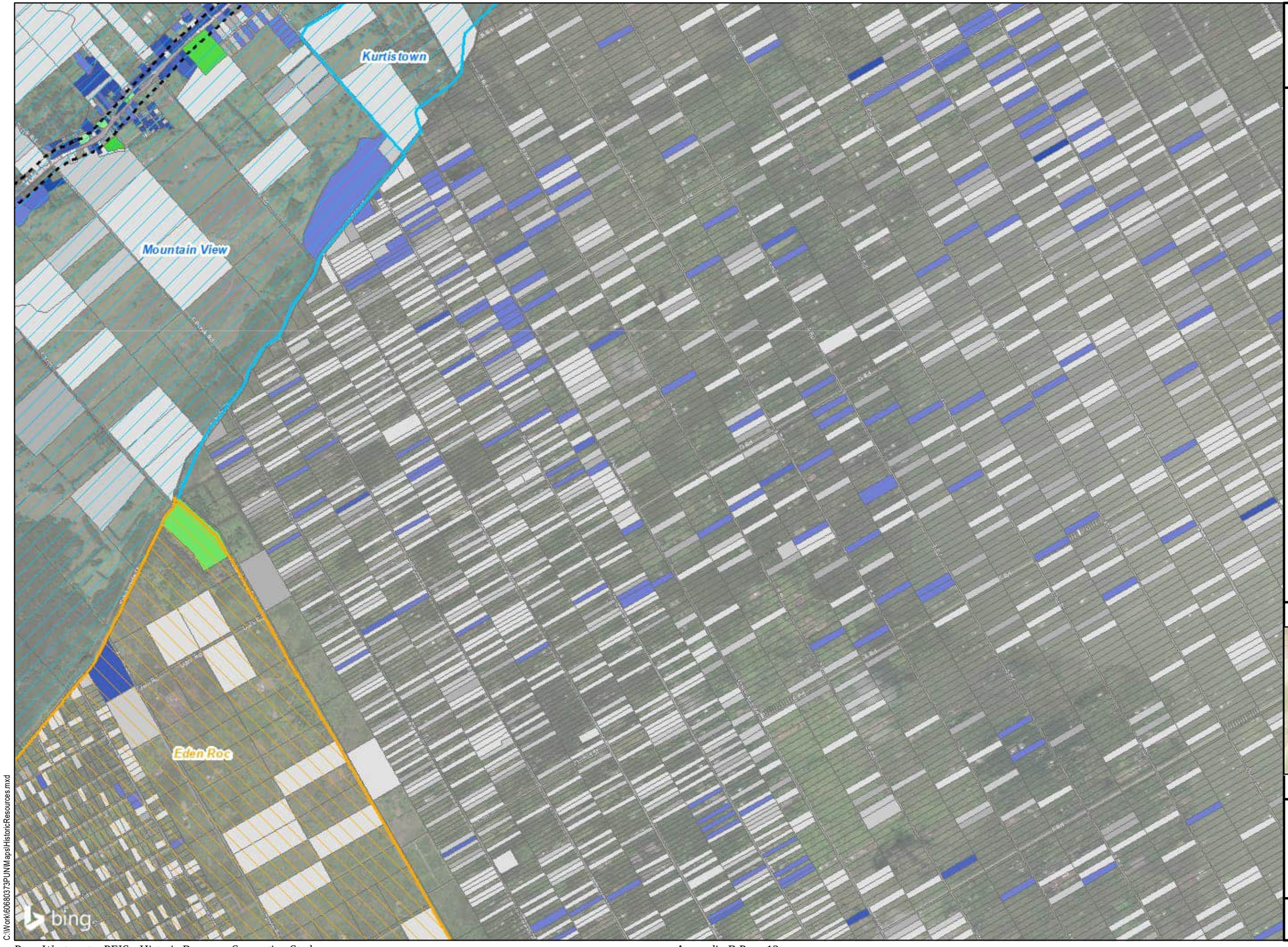

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Subdivisions
- Historic Communities
- Historic Road Corridors

Residential Parcels

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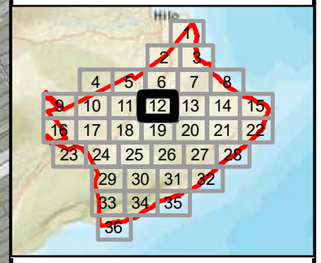

LOCATOR MAP

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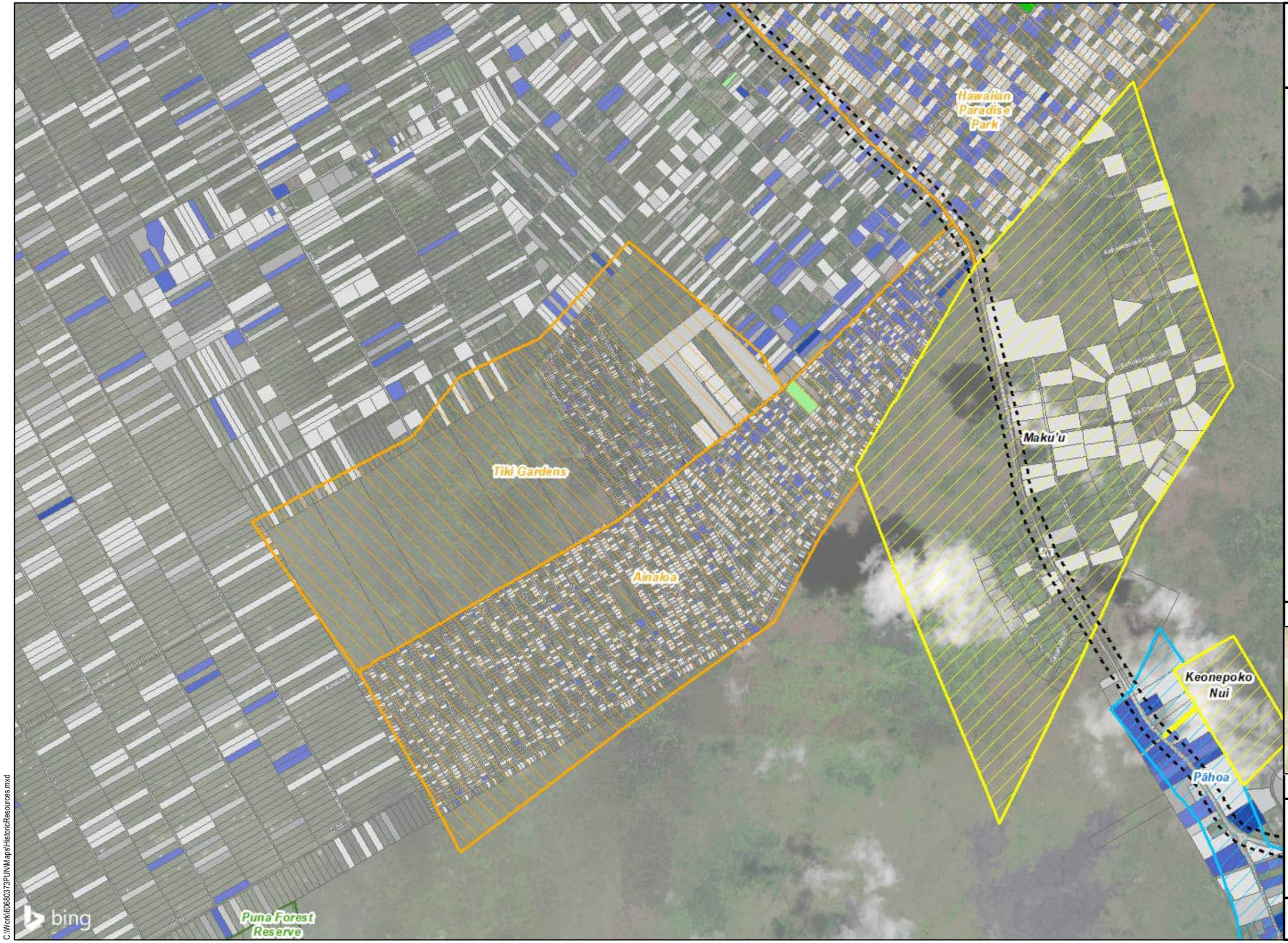

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Subdivisions
- Historic Communities
- Hawiian Homelands
- Recreation Areas and Reserves
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Residential Parcels

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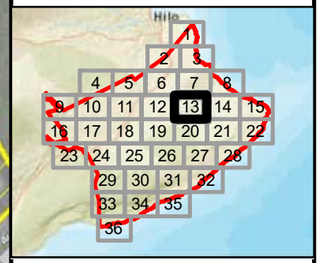

LOCATOR MAP

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Honolulu, HI 96813

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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

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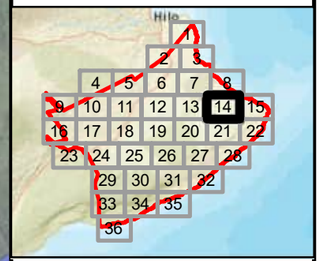

LOCATOR MAP

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1001 Bishop St. STE 1600
Honolulu, HI 96813

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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Road Corridors

Residential Parcels

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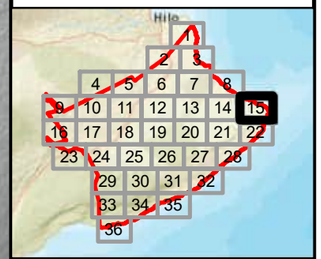

LOCATOR MAP

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Honolulu, HI 96813

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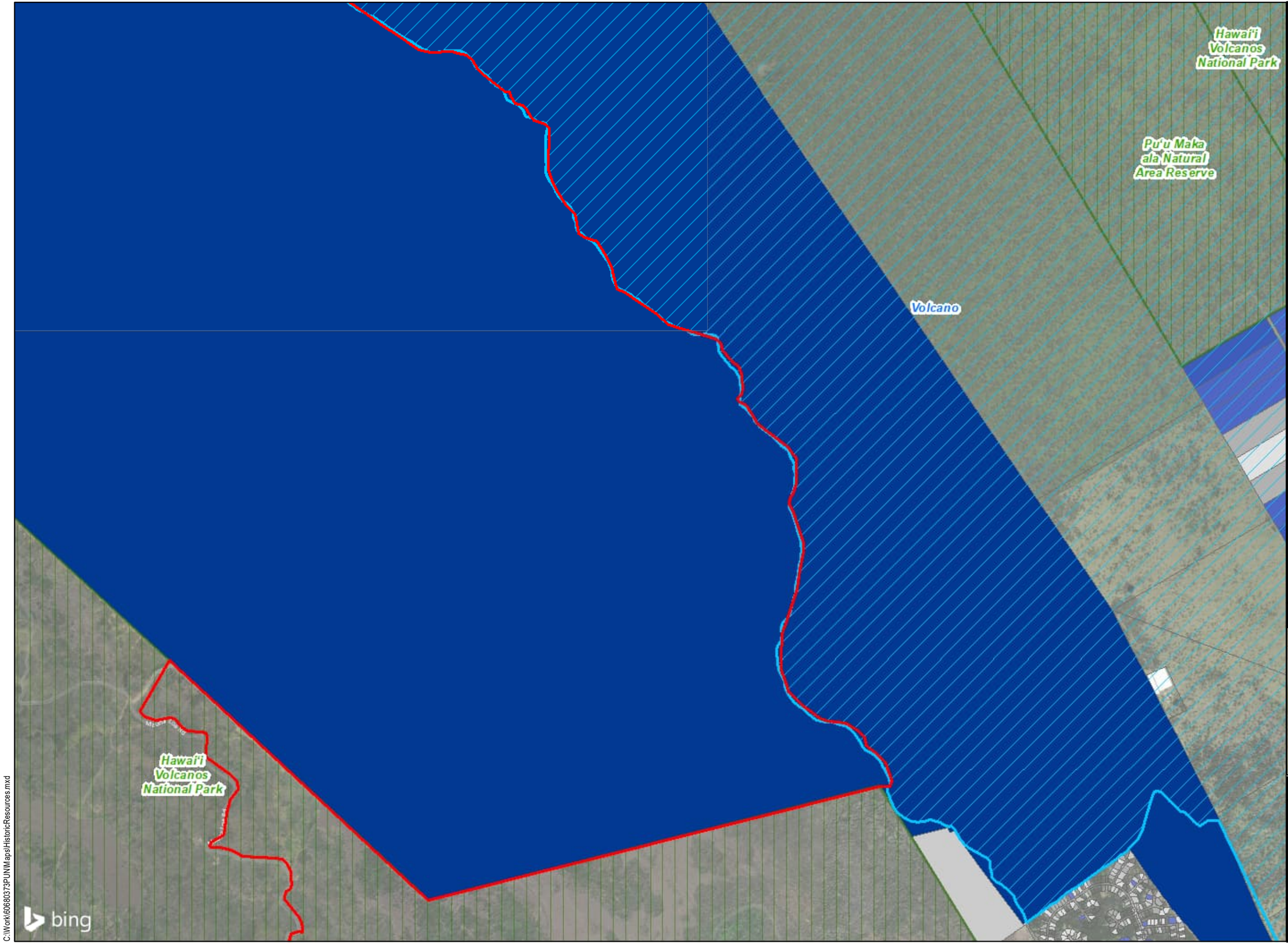

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Communities
- Recreation Areas and Reserves

Residential Parcels

- Parcels without Buildings
- 1850-1899
- 1900-1909
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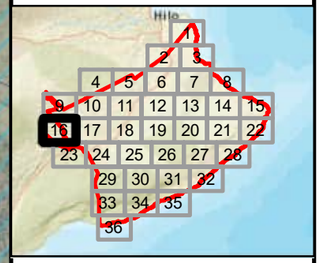

LOCATOR MAP

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Honolulu, HI 96813

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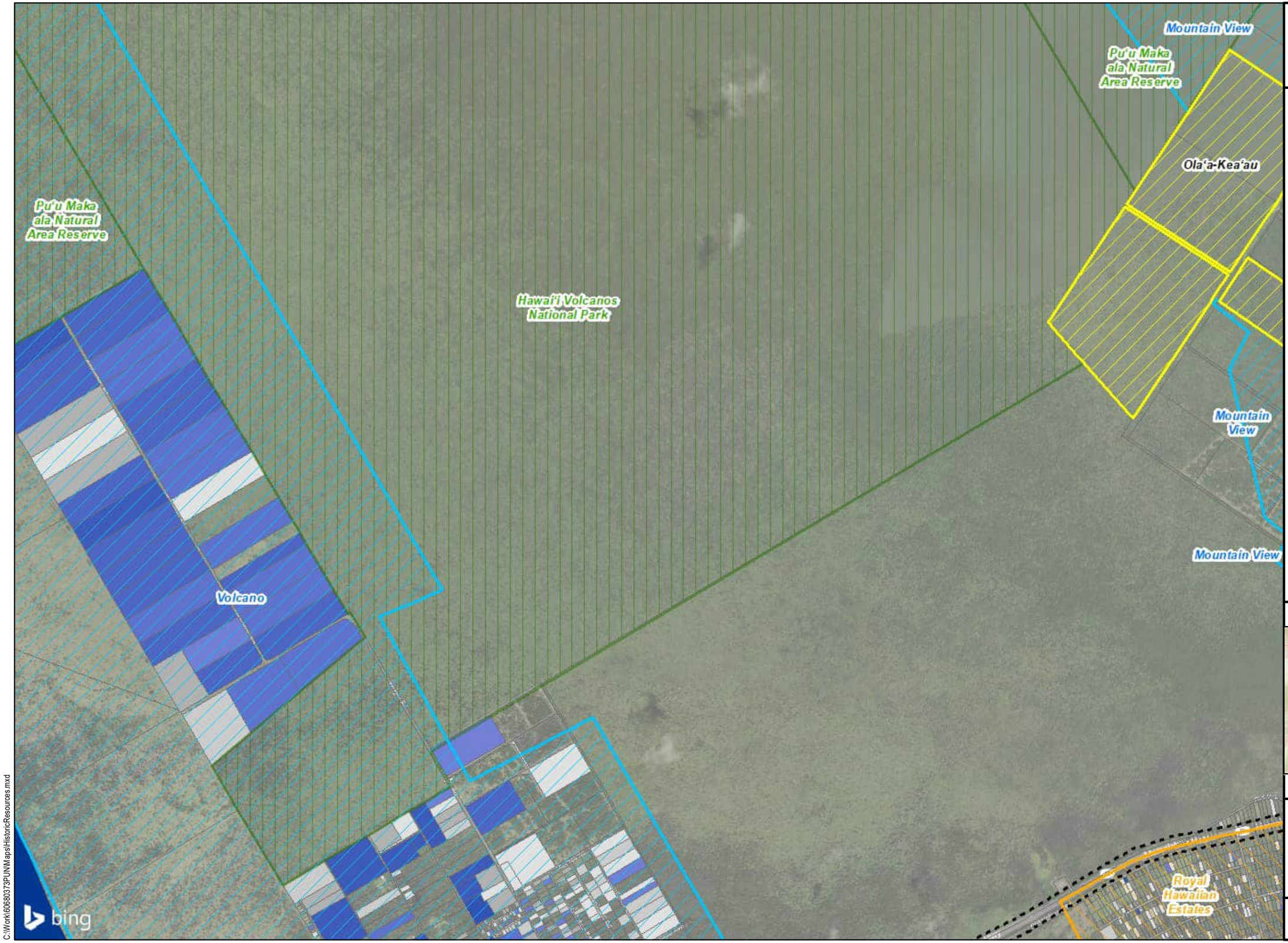

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Subdivisions
- Historic Communities
- Hawiian Homelands
- Recreation Areas and Reserves
- Historic Road Corridors

Residential Parcels

- Parcels without Buildings
- 1850-1899
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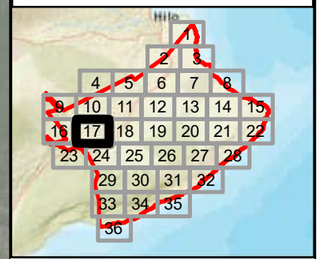

LOCATOR MAP

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Honolulu, HI 96813

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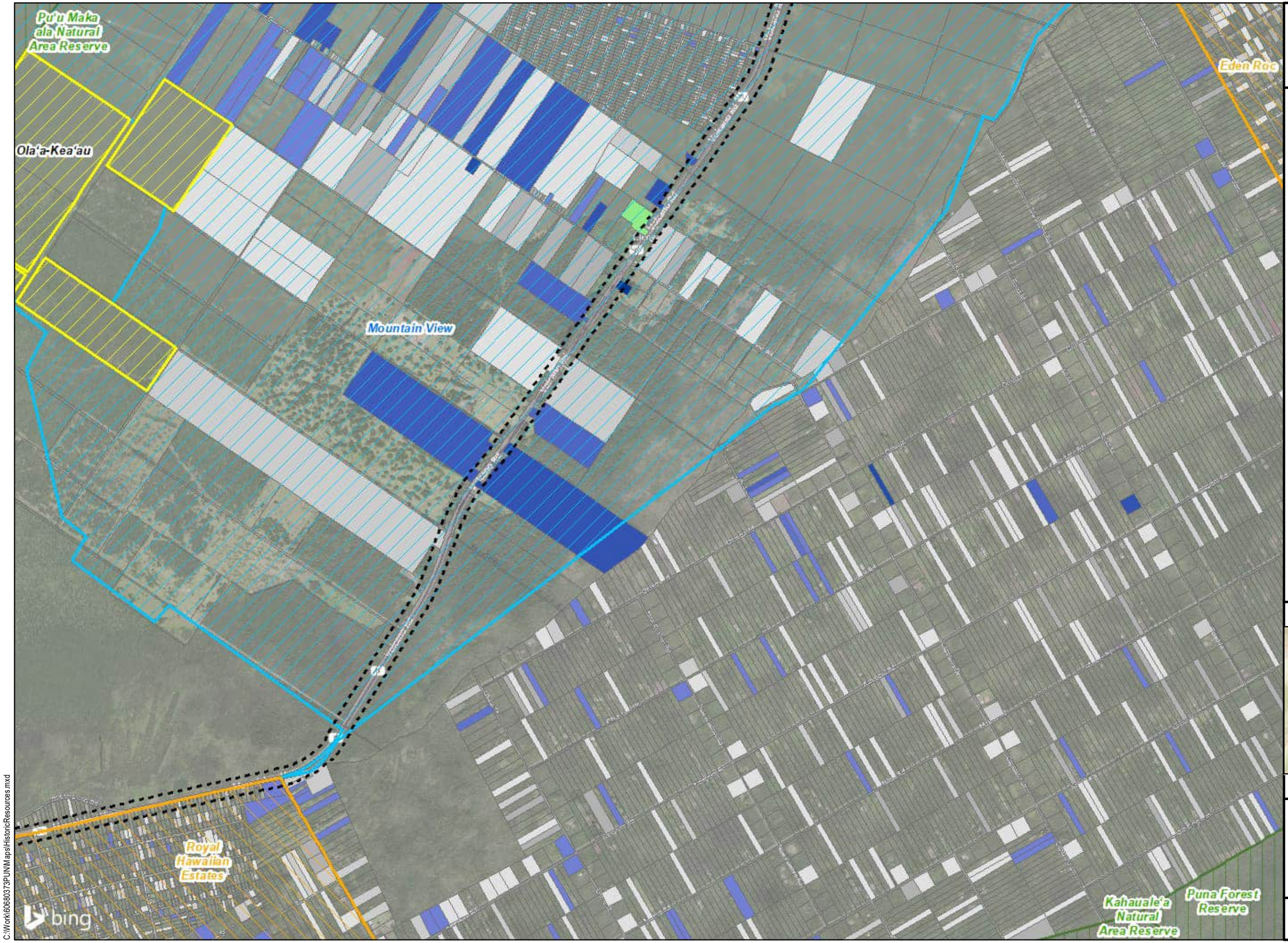

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Subdivisions
- Historic Communities
- Hawiian Homelands
- Recreation Areas and Reserves
- Historic Road Corridors

Residential Parcels

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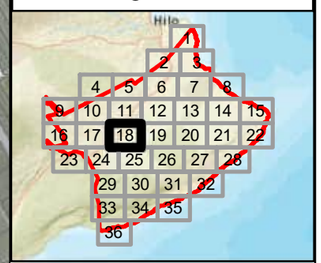

LOCATOR MAP

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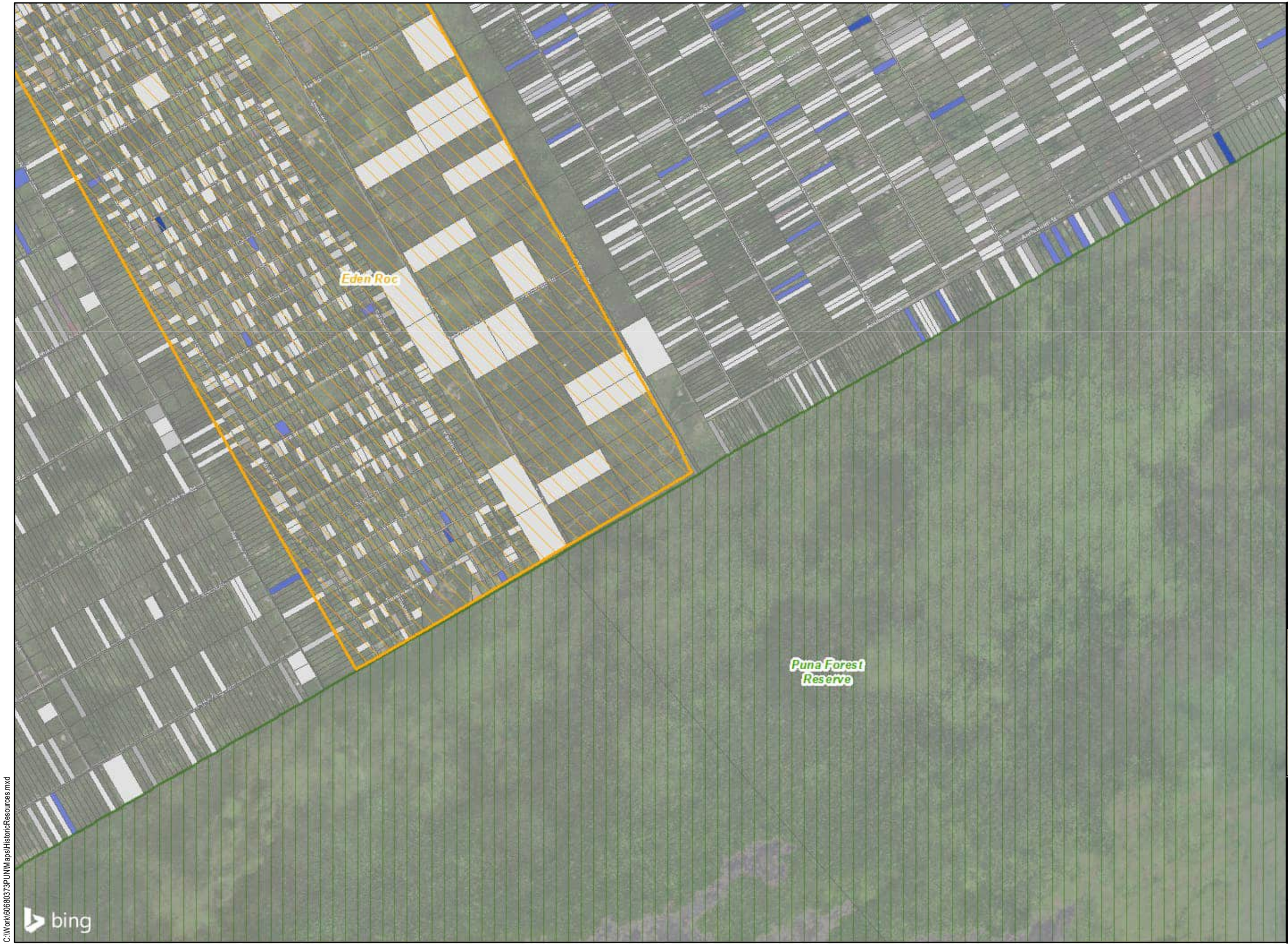

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Subdivisions
- Recreation Areas and Reserves

Residential Parcels

- Parcels without Buildings
- 1850-1899
- 1900-1909
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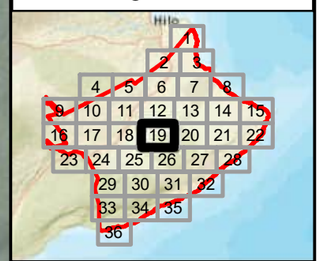

LOCATOR MAP

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Honolulu, HI 96813

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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Communities
- Recreation Areas and Reserves

Residential Parcels

- Parcels without Buildings
- 1850-1899
- 1900-1909
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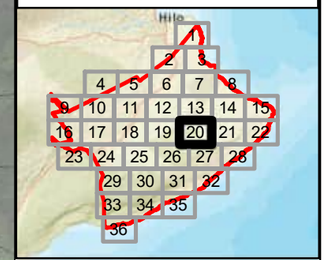

LOCATOR MAP

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Honolulu, HI 96813

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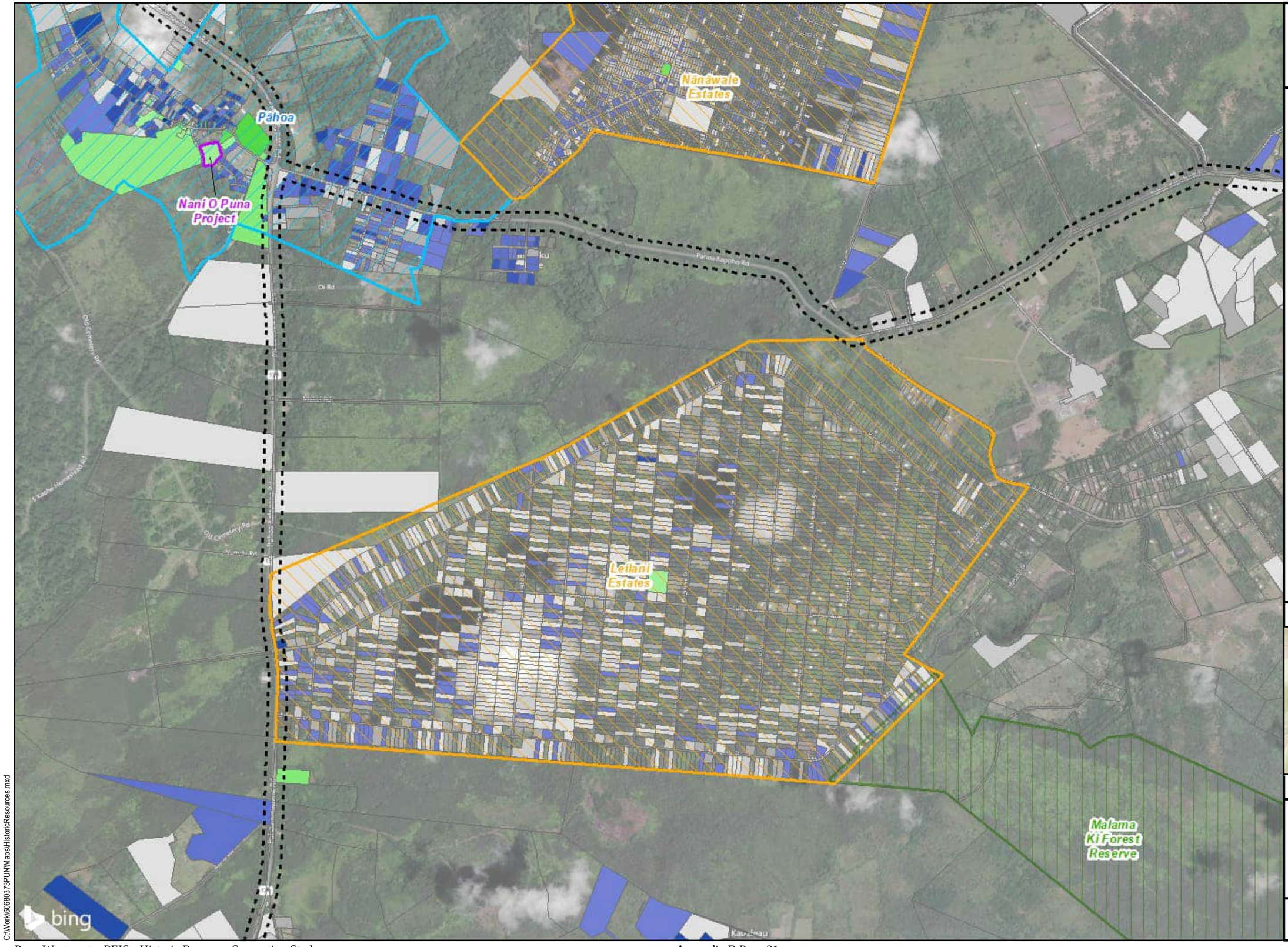
HISTORIC RESOURCES ANALYSIS MAP SET



Legend

- Project Area
- Historic Subdivisions
- Historic Communities
- HHA Development
- Recreation Areas and Reserves
- Historic Road Corridors

Residential Parcels

- Parcels without Buildings
- 1850-1899
- 1900-1909
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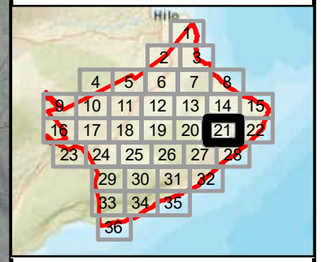

LOCATOR MAP

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AECOM
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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
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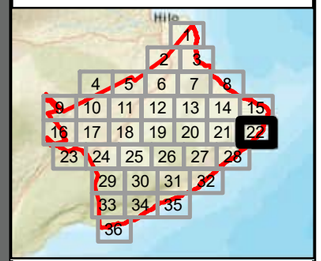

LOCATOR MAP

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HISTORIC RESOURCES ANALYSIS MAP SET

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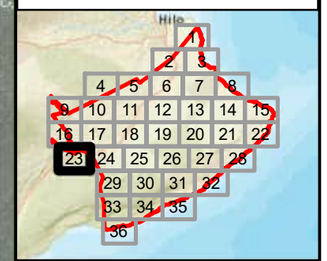

LOCATOR MAP

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Honolulu, HI 96813

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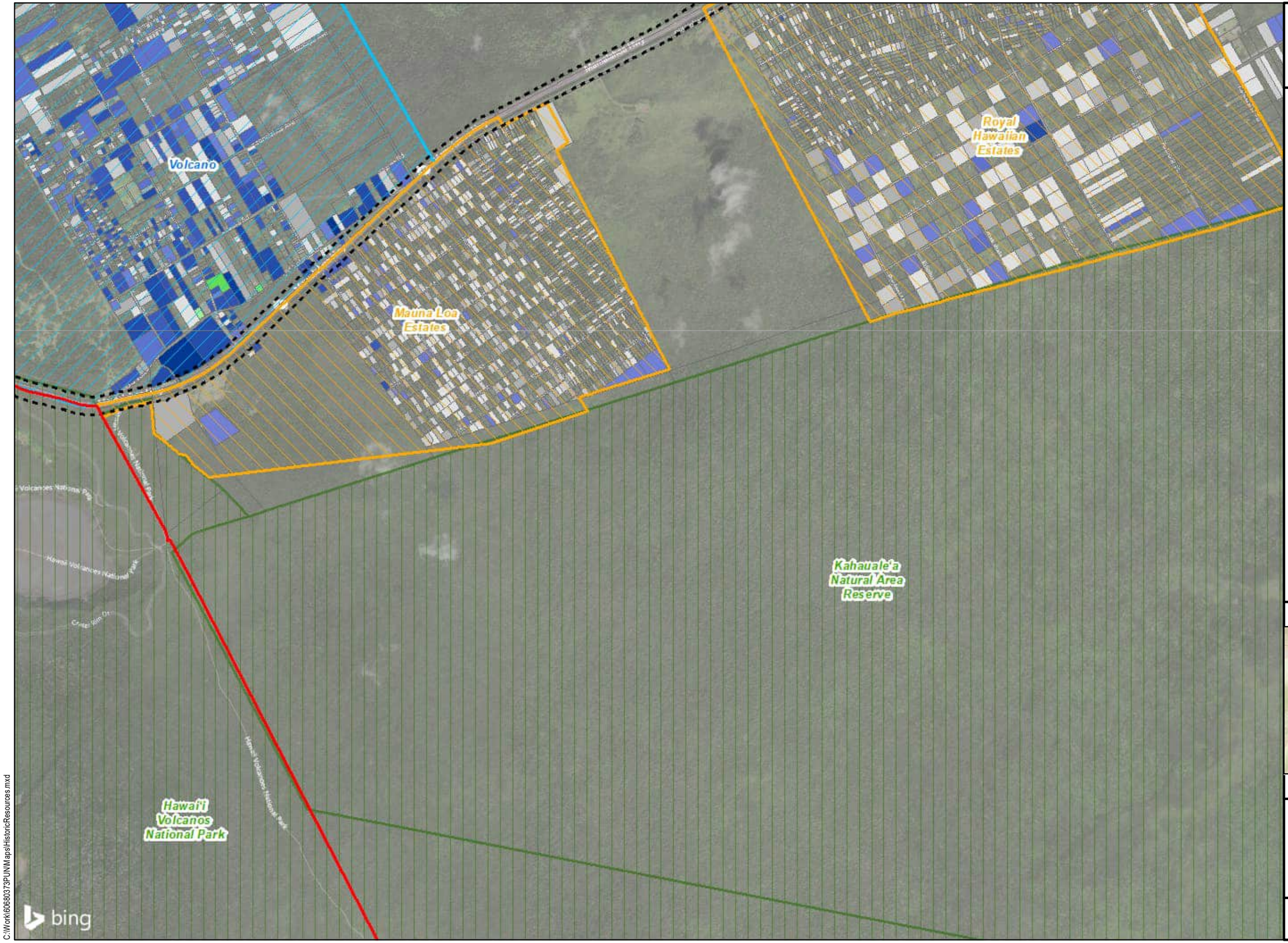

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
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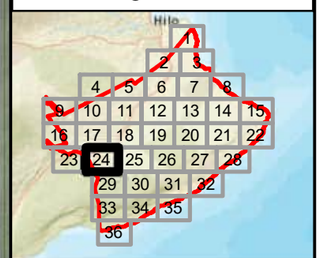

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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Subdivisions
- Recreation Areas and Reserves

Residential Parcels

- Parcels without Buildings
- 1850-1899
- 1900-1909
- 1910-1919
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- 2000-2021

Commercial Parcels

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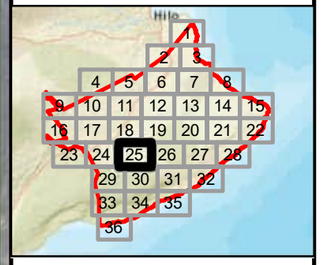

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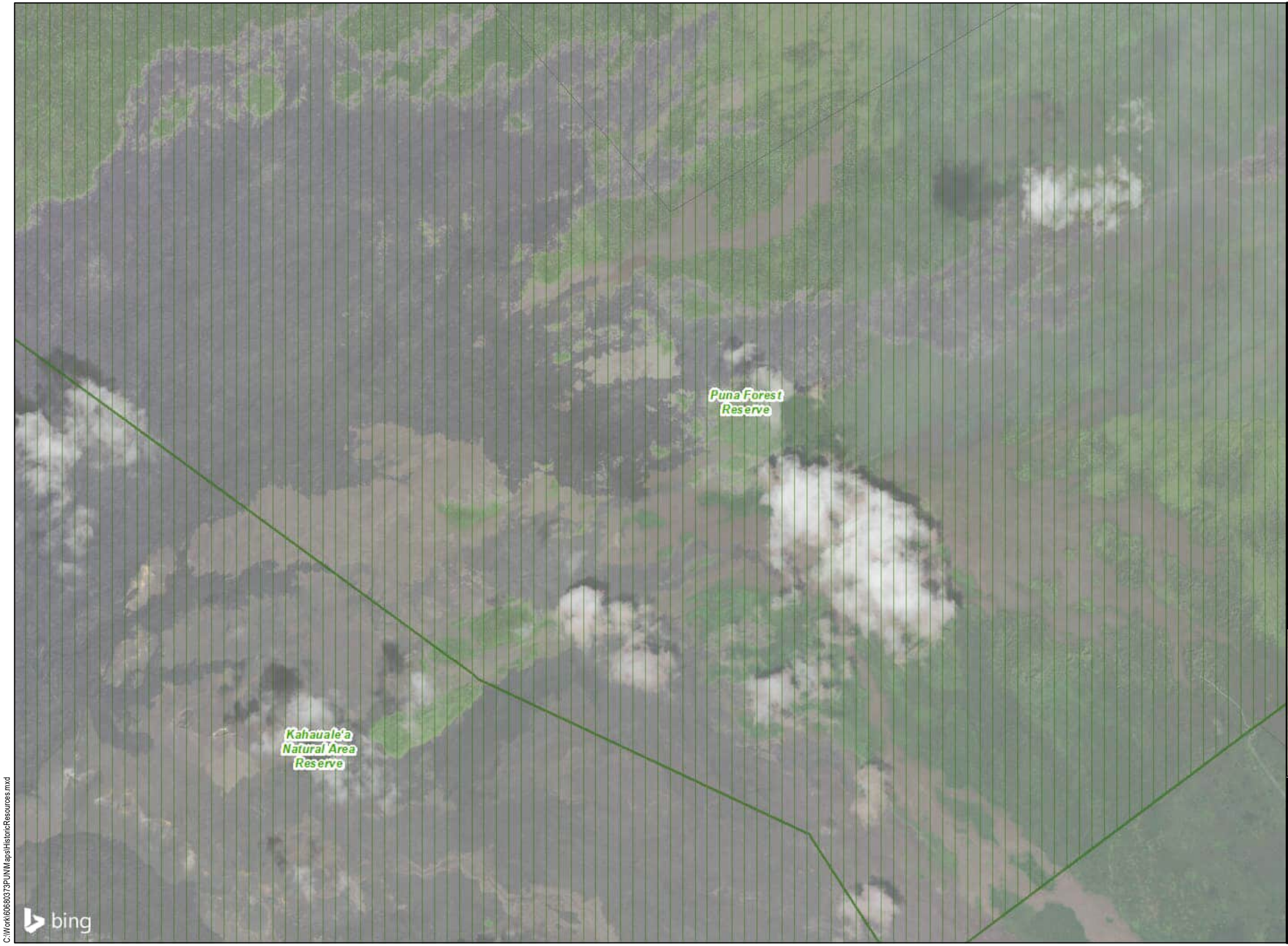

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Recreation Areas and Reserves

Residential Parcels

- Parcels without Buildings
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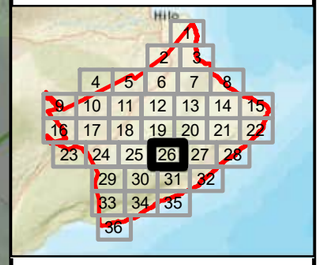

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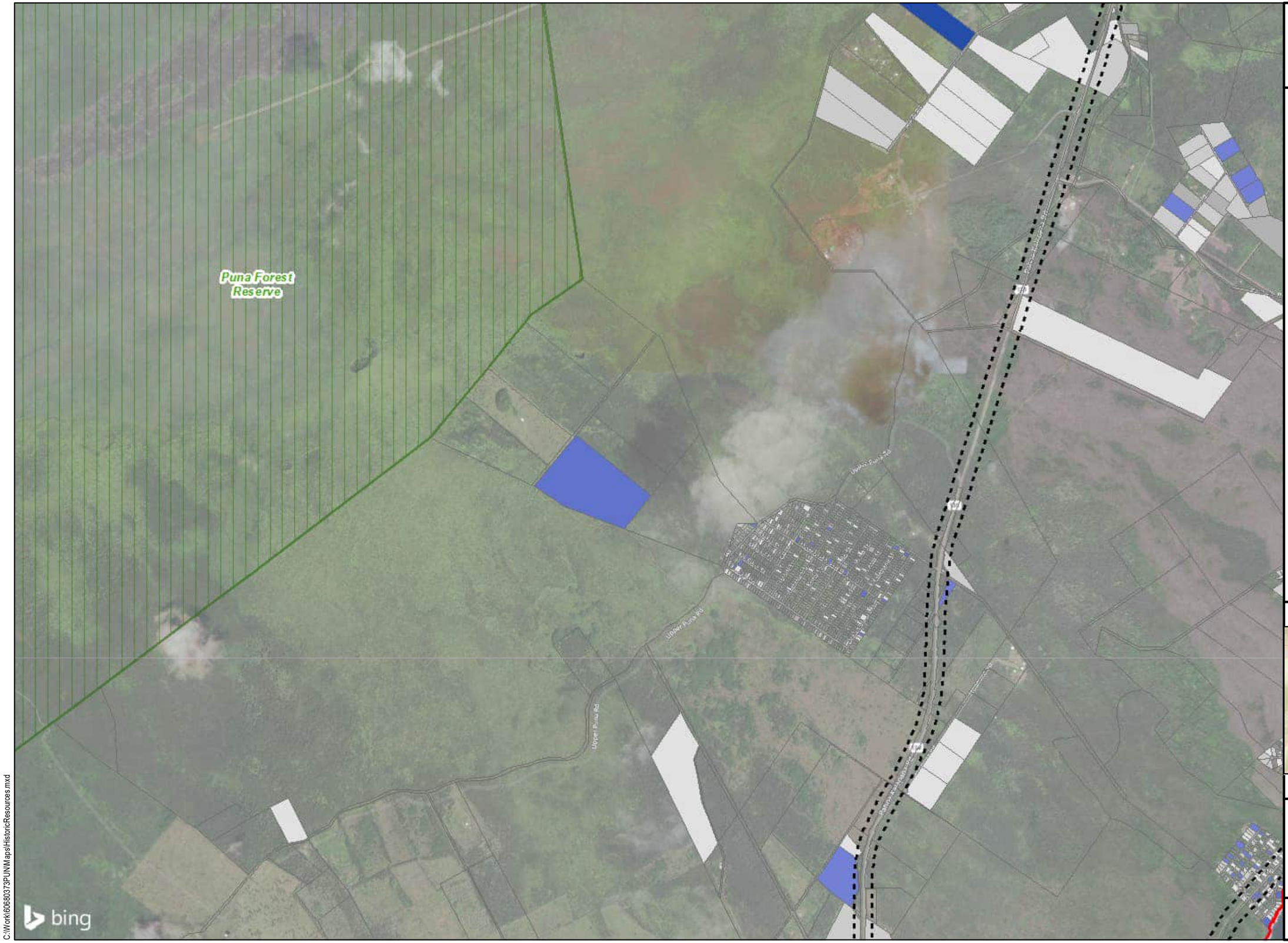

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Recreation Areas and Reserves
- Historic Road Corridors

Residential Parcels

- Parcels without Buildings
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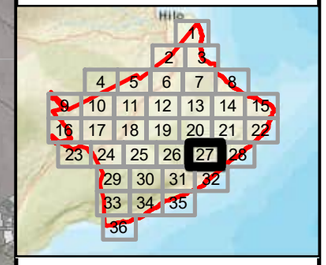

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HISTORIC RESOURCES ANALYSIS MAP SET

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- Project Area
- Recreation Areas and Reserves
- Historic Road Corridors

Residential Parcels

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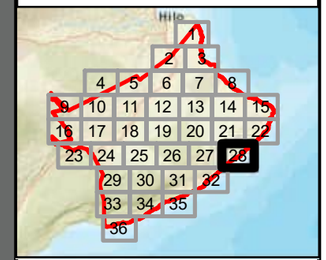

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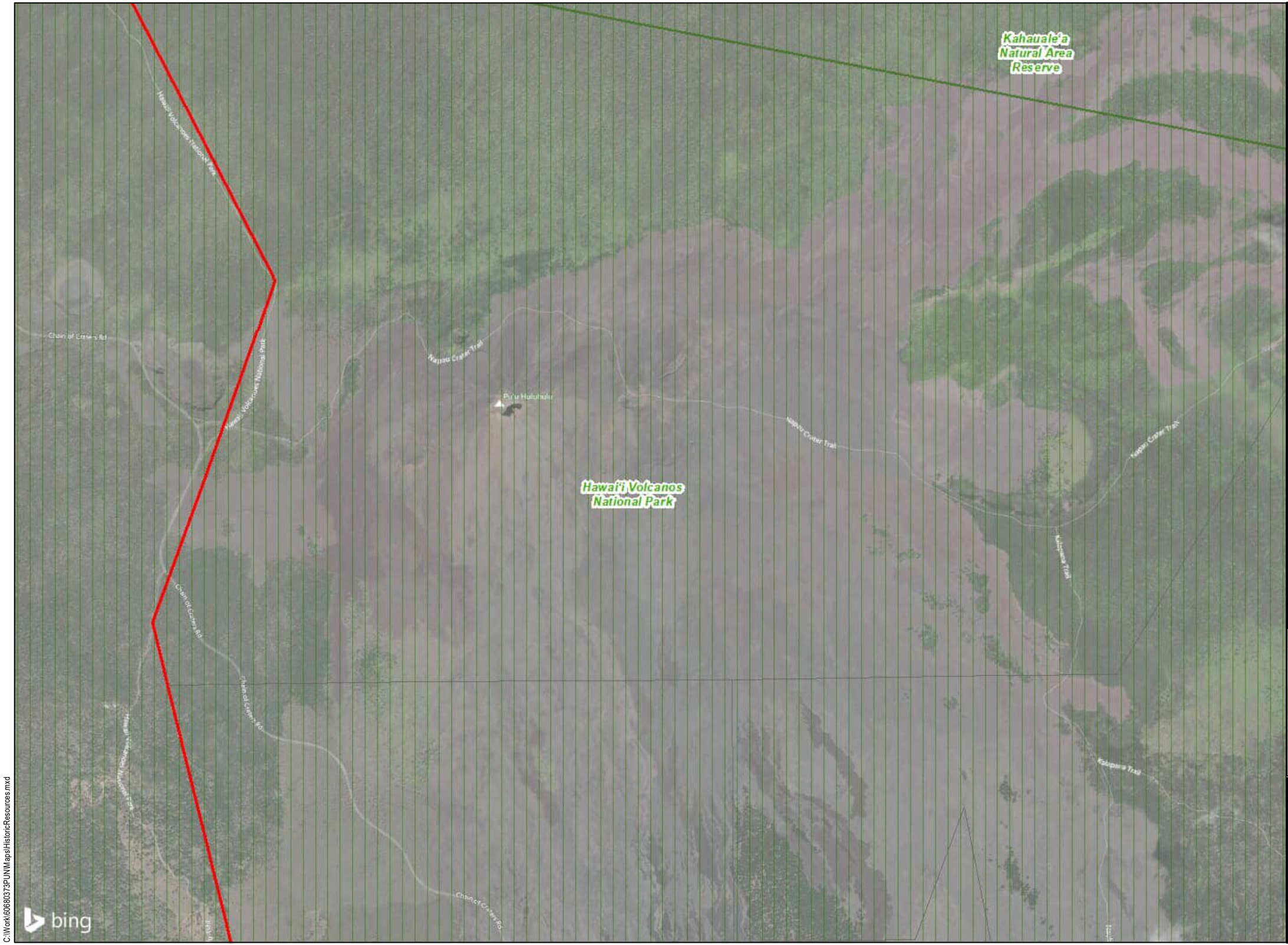

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Recreation Areas and Reserves

Residential Parcels

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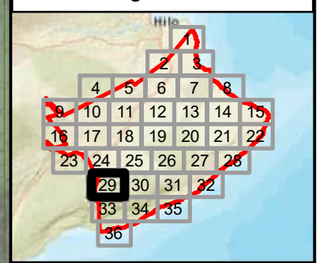

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HISTORIC RESOURCES ANALYSIS MAP SET

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Residential Parcels

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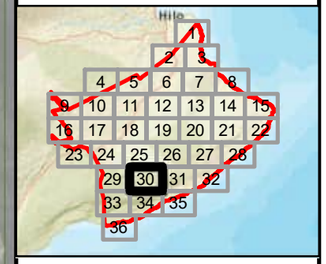

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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Recreation Areas and Reserves
- Historic Road Corridors

Residential Parcels

- Parcels without Buildings
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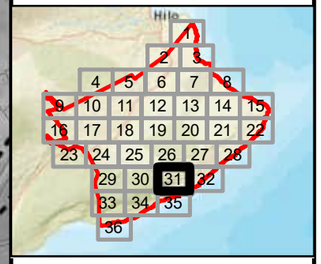

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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Historic Communities
- Historic Road Corridors

Residential Parcels

- Parcels without Buildings
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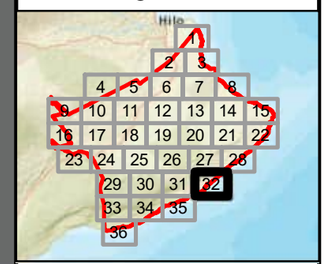

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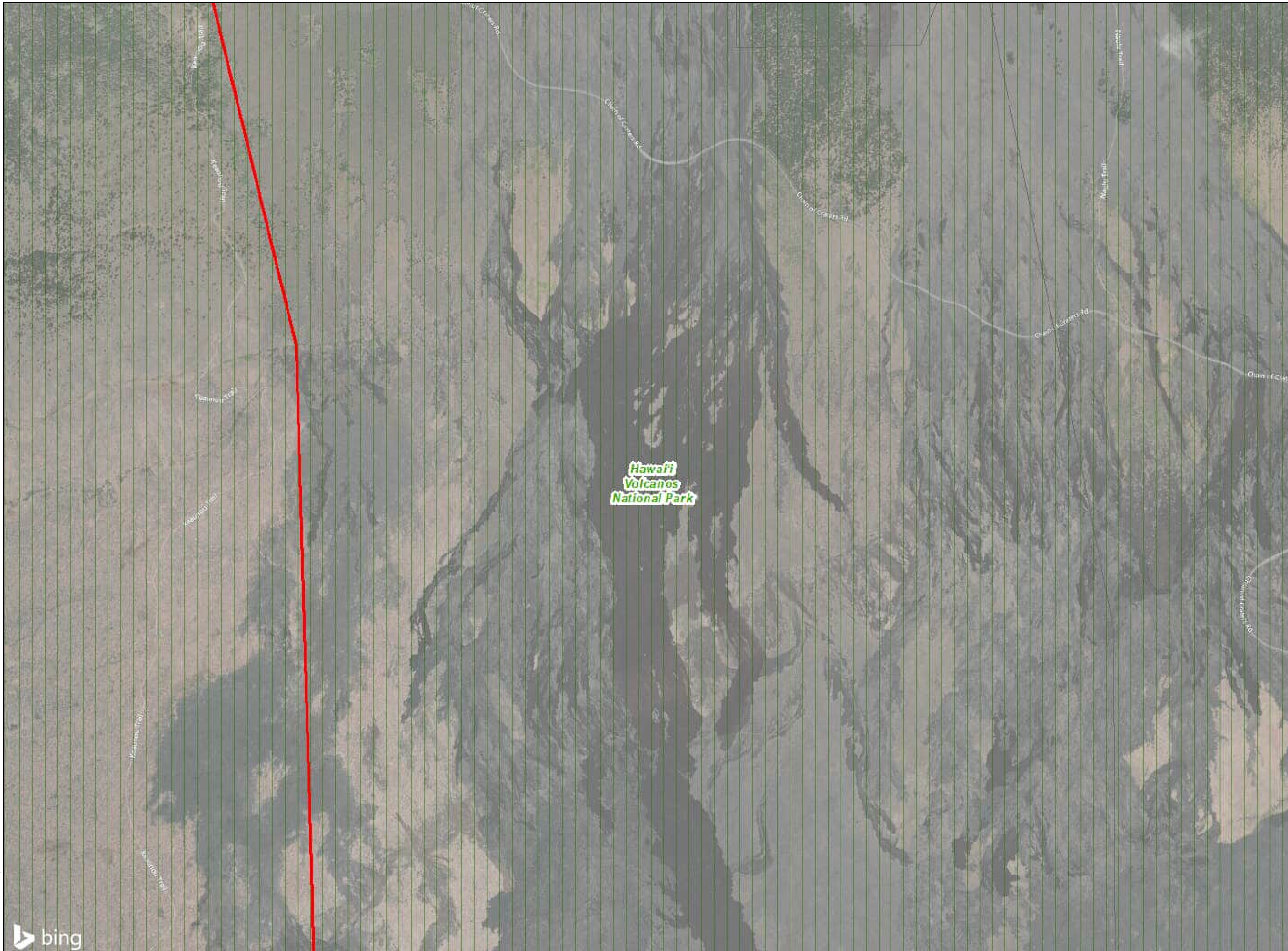

Legend

- Project Area
- Recreation Areas and Reserves

Residential Parcels

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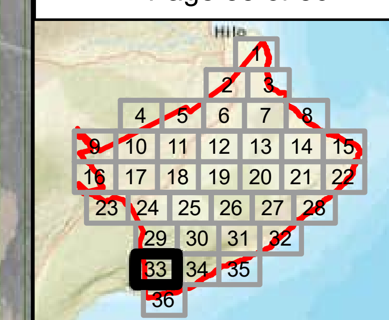

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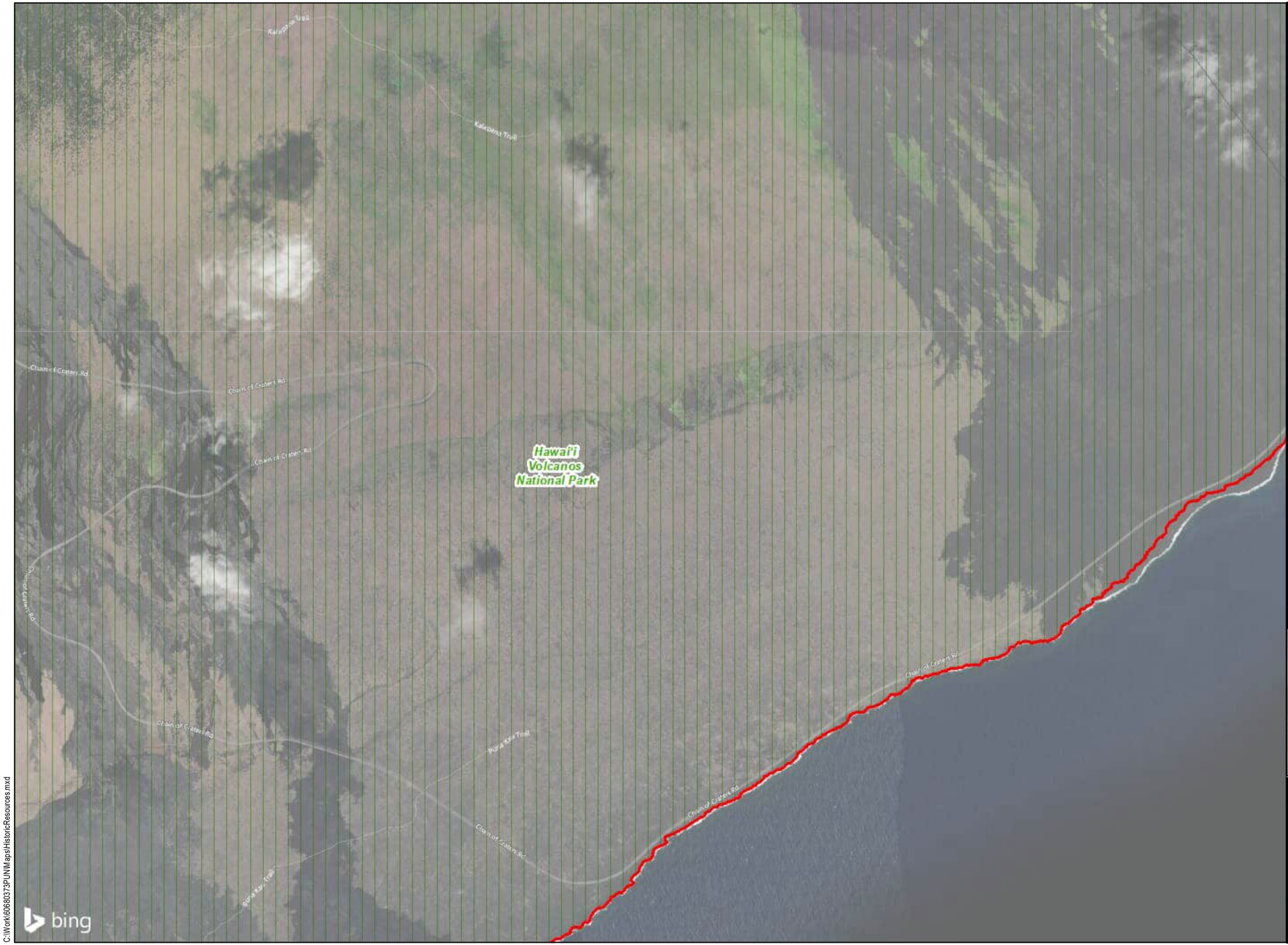

HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Recreation Areas and Reserves

Residential Parcels

- Parcels without Buildings
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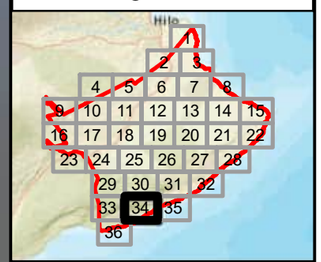

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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

- Project Area
- Recreation Areas and Reserves

Residential Parcels

- Parcels without Buildings
- 1850-1899
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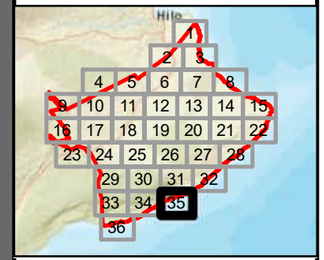

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HISTORIC RESOURCES ANALYSIS MAP SET

Legend

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Residential Parcels

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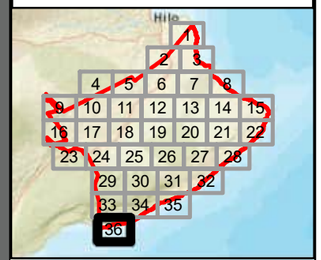

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Appendix C:
Cultural Impact Assessment

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Cultural Impact Assessment for the Puna Wastewater PEIS Project, Puna District; Keauhou and Kapāpala, Kaʻū, Hawaiʻi TMKs: (3) 1-1-001 through 009, 9-9-001 (por.), and 9-9-002 through 010

Prepared for
AECOM Technical Services, Inc.
On behalf of the
County of Hawaii, Department of Environmental Management

Prepared by
Chantellee Konohia Spencer, B.A.
and
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawaiʻi, Inc.
Kailua, Hawaiʻi
(Job Code: HAWAII 15)

January 2023

Oʻahu Office
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Fax: (808) 262-4950

www.culturalsurveys.com

Maui Office
1860 Main St.
Wailuku, Hawaiʻi 96793
Ph: (808) 242-9882
Fax: (808) 244-1994

Management Summary

Reference	Cultural Impact Assessment for the Addition of Wastewater Services for the Puna District, Multiple Ahupua‘a, Puna District, Hawai‘i Island TMKs: Multiple (Spencer and Hammatt 2022)
Date	January 2023
Project Number(s)	Cultural Surveys Hawai‘i, Inc. (CSH) Job Code: HAWAII 15
Agencies	The Environmental Review Program (ERP)
Land Jurisdiction	State of Hawai‘i, County of Hawai‘i, Private
Project Location	The project area comprises the entire Puna District on Hawai‘i Island, as well as a small portion of the Ka‘ū District in the vicinity of Volcano Village near the summit of Kīlauea.
Project Description	The County of Hawai’i (COH) DEM is preparing the required planning document— including a Programmatic Environmental Impact Statement (PEIS)—for establishing wastewater services for the Puna District through an anticipated 30-year planning period (the “proposed action’). The PEIS will analyze at a programmatic level potential environmental impacts (including impacts to historic properties) of the COH proposed action to install wastewater collection and treatment facilities in the project area. Broad proposals and/or planning-level decisions will be evaluated in the PEIS to allow informed choice among planning-level alternatives and the development of broad mitigation strategies. The PEIS will not address project-level issues such as precise footprints or specific design details that are not yet ready for decision at the planning level.
Document Purpose and Regulatory Context	This cultural impact assessment (CIA) supports compliance for the Addition of Wastewater Services for the Puna District with: • The mandate set forth by the Hawai‘i State Constitution (Articles IX and XII), courts, Hawai‘i Revised Statutes (HRS), and Hawai‘i Administrative Rules (HAR) and other Hawai‘i State laws requiring government agencies to promote and preserve cultural beliefs, practices. and resources of Native Hawaiians and other ethnic groups; This CIA contains information gathered from archival research and consultation, compiled in order to “analyze the impact of a proposed action on cultural practices and features associated with the project area” (Office of Environmental Quality Control 1997). Cultural practices and cultural features may include traditional cultural properties (TCPs), designated significant historic properties under State of Hawai‘i significance Criterion e, pursuant to HAR §13-275-6 and §13-284-6. Significance Criterion e refers to historic properties that “have an

	important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity" (HAR §13-275-6 and §13-284-6).
Results of Background Research	Background research for the proposed project yielded the following information: **<u>Puna District:</u>** 1. Puna was one of Hawai‘i's wealthiest agricultural regions. It is only in recent times that volcanic eruptions have destroyed much of Puna's best land. The *mo‘olelo* or narrative stories of Puna also emphasize the area's familial, genealogical, and political connections to the neighboring districts of Ka‘ū and Hilo. 2. The first foreigners to see the Puna coast were crew members of Captain Cook's third voyage to the Pacific in 1779. They were the first to note the differences in population and cultivation between the southwestern section of Puna and the more easterly area. 3. In describing the district of Puna, Coan emphasized the abundant rainfall and evidence of volcanic activity, and the fields of vegetables and fruits grown in those regions with both deep soils and access to water. 4. Very few *kuleana* awards were granted in all of Puna. One *kuleana* comprising 13.64 acres was awarded in Kea‘au, to Hewahewa (LCA 8081, Royal Patent 4360). The claim indicated the land was unfenced with no house, and that coffee was being grown (Hurst 1994:12–13, 17). This parcel was sold to the Roman Catholic Church in 1865. 5. The missionary Rev. Titus Coan estimated the population of Puna was 4,371 in the year 1841, which stayed constant until at least 1846, when Chester Lyman visited the area. However, in a second journey to the area in 1871, Lyman (1924:103) noted a rapid depopulation: "There are but few people in this region […] miserably poor and for some time past have been almost in a state of famine." Decreasing population was also the result of the introduction of many foreign diseases, to which the Native Hawaiians had no natural immunity. 6. In May 1899 Olaa Sugar Company leased 3,812 acres of land in ‘Ōla‘a (Pāhoa up to Mountain View) from W.H. Shipman for a term of 40 years (Maly 1999:59). Several more land exchanges were made the same year. The lands were allowed to be cleared

(by horse and mule) for the cane fields, preserving only certain fruit trees, and by 1901 the Olaa Sugar Company held 4,000 acres of land under cane cultivation, employing 1,100 men (Hurst 1994:14–17).

7. A 40-ft right-of-way from Kea‘au to Hilo was granted to the Hilo Railway Company in December 1899; the right-of-way was to revert to Shipman when the railway was no longer in use (Hurst 1994:15). In 1900, a 17-mile coastal extension was constructed to the sugarcane fields near Kapoho. Spurs were built inland to additional fields in Pāhoa and Kama‘ili. The rail transportation occurred primarily from the ‘Ōla‘a, Pāhoa, and Kapoho fields and was used to haul sugar to the mill in ‘Ōla‘a.
8. By the 1920s the Kea‘au Ranch consisted of 50,000 acres, extending from the coast to elevations of 1800 ft amsl (Henke 1929:32). The ranch stretched from ‘Ōla‘a in the north to Pāhoa in the south.
9. In 1911 the territorial government set apart 19,850 acres of forest in Puna as the Puna Forest Reserve, on the recommendation that such action would allow for collection of revenue from the ongoing timber operations (Uyeoka et al. 2014:286–7). An additional 5,888 acres were added to the Forest Reserve in 1928.

Ka‘ū District:

1. The portion of upland Keauhou in the vicinity of the project area would have been too wet and cold for cultivation or permanent habitation, and instead would have been used for capture of birds for their feathers and collection of *‘ōhi‘a* and *koa* woods for numerous uses (Kawachi 2003:4).
2. An archaeological study conducted at a cave in Hilina Pali in Kapāpala found evidence of Hawaiian occupation by AD 1600, and documented sites including shelters and trails used for seasonal sweet potato cultivation, harvesting of *māmaki* (*Pipturus albidus*) for *tapa* (barkcloth) manufacture, collection of fresh water, and transportation to settlements along the coast (Cleghorn 1980:30).
3. Ellis’ party approached Kīlauea from the Kā‘u side, crossing the Ponahohoa Chasm in Kapāpala which was associated with a recent eruptive event (Ellis 1963:141). Ellis’ guide was a resident of Kapāpala, who “owned a small garden near.” Ellis generally described this area of Kapāpala, situated between the sea and the foot of Mauna Loa, as fertile land, noting “The road by which we returned lay through a number of fields of mountain taro, which appears to be cultivated here more extensively than the sweet

	potato" (Ellis 1963:152). 4. In the Māhele the *‘ili* of Keauhou was awarded to and retained by Victoria Kamāmalu. Kapāpala was claimed by Kamake‘e Pi‘ikoi who relinquished it in commutation for lands elsewhere, and it was subsequently retained as Crown Lands. 5. During the latter 1800s the vicinity of the project area in Ka‘ū was largely influenced by the establishment of ranching and ongoing activity around the Kīlauea Summit. In 1863 Chiefess Kamāmalu and her father M. Kekūanao‘a formally leased lands in Keauhou for the development of goat and cattle ranching, *pulu* and timber harvesting businesses, the Keauhou boat landing at the coast, and a new Volcano House (Maly and Maly 2005:275; Young 2022). 6. The deadly 2 April 1868 earthquake—considered the largest recorded earthquake in the history of Hawai‘i Island—caused a landslide and tsunami that washed away the ancient village of Keauhou (Pukui et al. 1976:104), among other coastal villages through Ka‘ū and Puna. 7. Ranching was a key land use in both Kapāpala and Keauhou during the early 1900s. By this time Kapāpala Ranch encompassed about 75,000 acres, extending from sea level to about 6,500 ft elevation. According to Henke (1929:35), these lands were mostly under lease from the government, and only about 40,000 acres had "good to fair grazing." 8. Maly and Maly (2005:273) note, "From the early 1900s, prisoners at Namakanipaio worked on rebuilding the 'Peter Lee Road' into Ka‘ū, and on roads and trails around Kīlauea, and towards Puna. The prison site was closed shortly after 1915." Nāmakanipaio is located west of the Volcano House, just beyond the limits of the project area in Keauhou. 9. In 1928 the Kilauea Forest Reserve was established in the portion of upper Keauhou adjoining the Upper Waiakea and Olaa forest reserves. This land was "originally a part of the private forest reserve established by Trustees of the B.P. Bishop Estate" (Maly and Maly 2005:331).
Results of Community Consultation	CSH attempted to contact key stakeholders but, to date, not interviews have been formally conducted.
Identification of Cultural Practices	With no usable responses through consultation efforts, no cultural practices were identified.
Identification of	Impacts to ongoing cultural practices will be identified within the project

Impacts to Cultural Practices	area during community consultation for this CIA once interviews are conducted and completed.
Mitigation Possibilities Identified During Background Research and Consultation	The results of community consultation, underscored by background research conducted for this CIA, inform the following mitigation possibilities promoting and preserving cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups: 1. Project construction workers and all other personnel involved in the construction and related activities of the project should be informed of the possibility of inadvertent cultural finds, including human remains. In the event that any potential historic properties are identified during construction activities, all activities will cease and the SHPD will be notified pursuant to HAR §13-280-3. In the event that *iwi kūpuna* (ancestral remains) are identified, all earth moving activities in the area will stop, the area will be cordoned off, and the SHPD and Police Department will be notified pursuant to HAR §13-300-40. In addition, in the event of an inadvertent discovery of human remains, the completion of a burial treatment plan, in compliance with HAR §13-300 and HRS §6E-43, is recommended. 2. In the event that *iwi kūpuna* and/or cultural finds are encountered during construction, project proponents should consult with cultural and lineal descendants of the area to develop a reinterment plan and cultural preservation plan for proper cultural protocol, curation, and long-term maintenance.

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Section 1 Introduction

1.1 Project Description

On behalf of the County of Hawai‘i, Department of Environmental Management (DEM) and at the request of AECOM, Cultural Surveys Hawai‘i, Inc. (CSH) has prepared this literature review report (LR) for the Puna Wastewater PEIS Project. The project area comprises the entire Puna District on Hawai‘i Island, as well as a small portion of the Ka‘ū District in the vicinity of Volcano Village near the summit of Kīlauea. The project area is depicted on a portion of the 1975 U.S. Geological Survey (USGS) 1:250,000-scale topographic map (Figure 1), tax zone maps (Figure 2 and Figure 3), a 2017 aerial photograph (Figure 4), and a client-provided map (Figure 5).

The County of Hawai'i DEM is preparing the required planning documents—including a Programmatic Environmental Impact Statement (PEIS)—for establishing wastewater services for the Puna District through an anticipated 30-year planning period (the "proposed action").

The PEIS will analyze at a programmatic level, potential environmental impacts (including impacts to historic properties) of the COH proposed action to install wastewater collection and treatment facilities in the project area. Broad proposals and/or planning-level decisions will be evaluated in the PEIS to allow informed choice among planning-level alternatives and the development of broad mitigation strategies.

The PEIS will not address project-level issues such as precise footprints or specific design details that are not yet ready for decision at the planning level.

1.2 Regulatory Context

This CIA supports compliance for the Addition of Wastewater Services for the Puna District Project with:

- The mandate set forth by the Hawai‘i State Constitution (Articles IX and XII), courts, Hawai‘i Revised Statutes (HRS), and Hawai‘i Administrative Rules (HAR) and other Hawai‘i State laws requiring government agencies to promote and preserve cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups;

1.3 Document Purpose

This CIA contains information gathered from archival research and consultation, compiled in order to "analyze the impact of a proposed action on cultural practices and features associated with the project area" (Office of Environmental Quality Control 1997). Cultural practices and cultural features may include traditional cultural properties (TCPs), designated significant historic properties under State of Hawai‘i significance Criterion e, pursuant to HAR §13-275-6 and §13- 284-6. Significance Criterion e refers to historic properties that "have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity" (HAR §13-275-6 and §13-284-6).

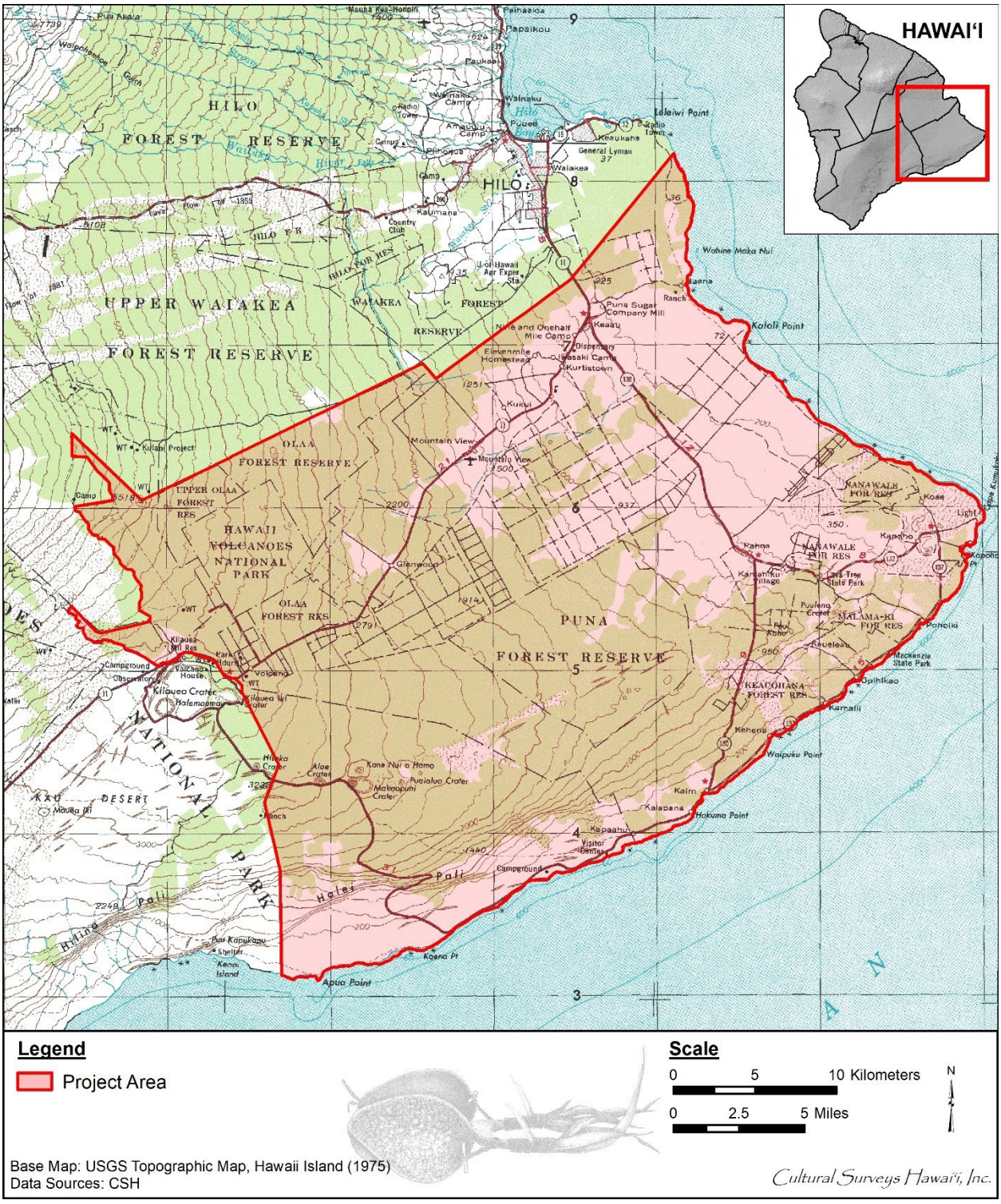

Figure 1. Portion of the 1975 USGS 1:250,000-scale topographic map of Hawai‘i Island showing the location of the project area

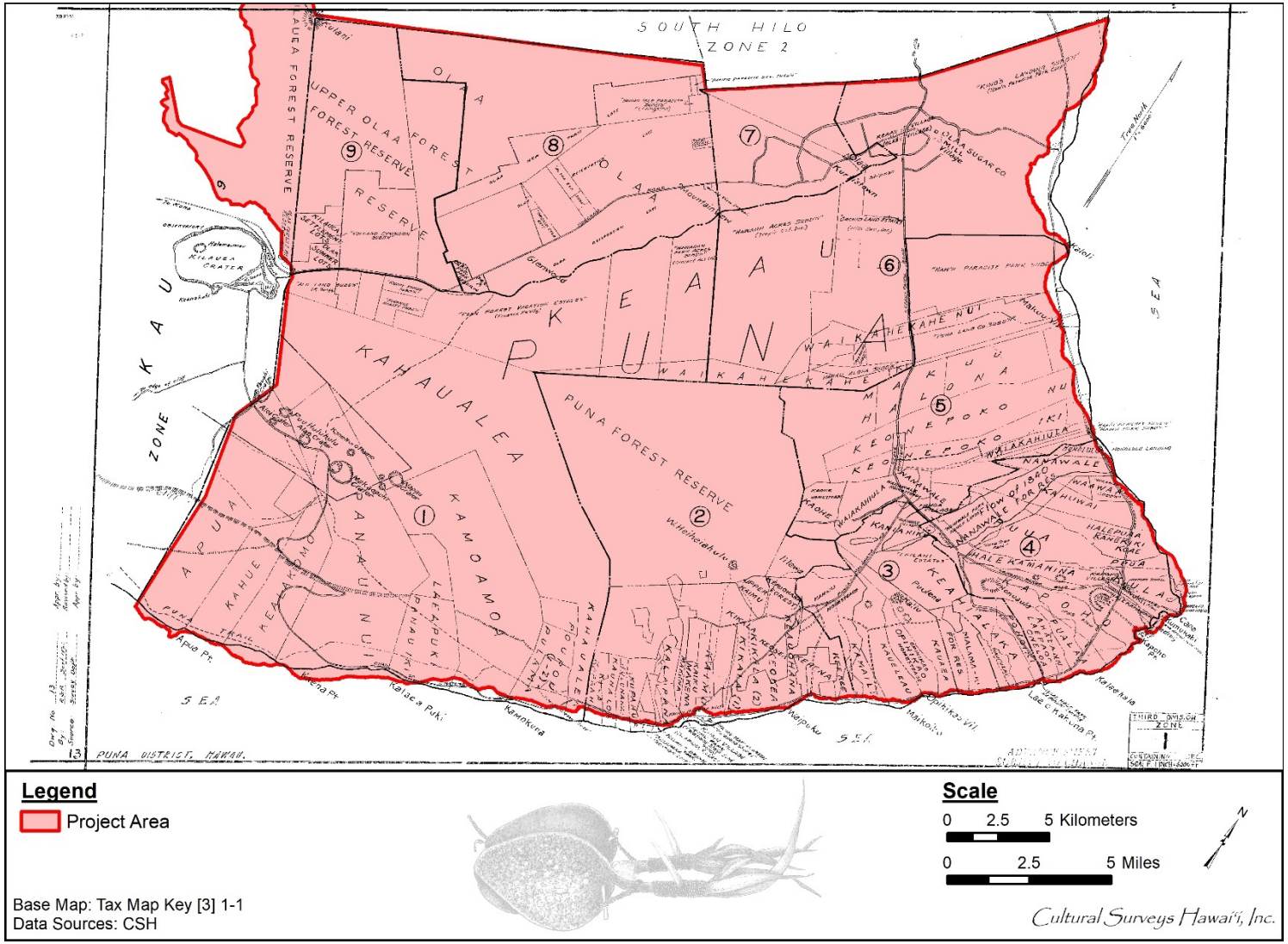

Figure 2. Tax Map Key (TMK) (3) 1-1 showing the project area in Puna District (Hawai‘i TMK Service 2014)

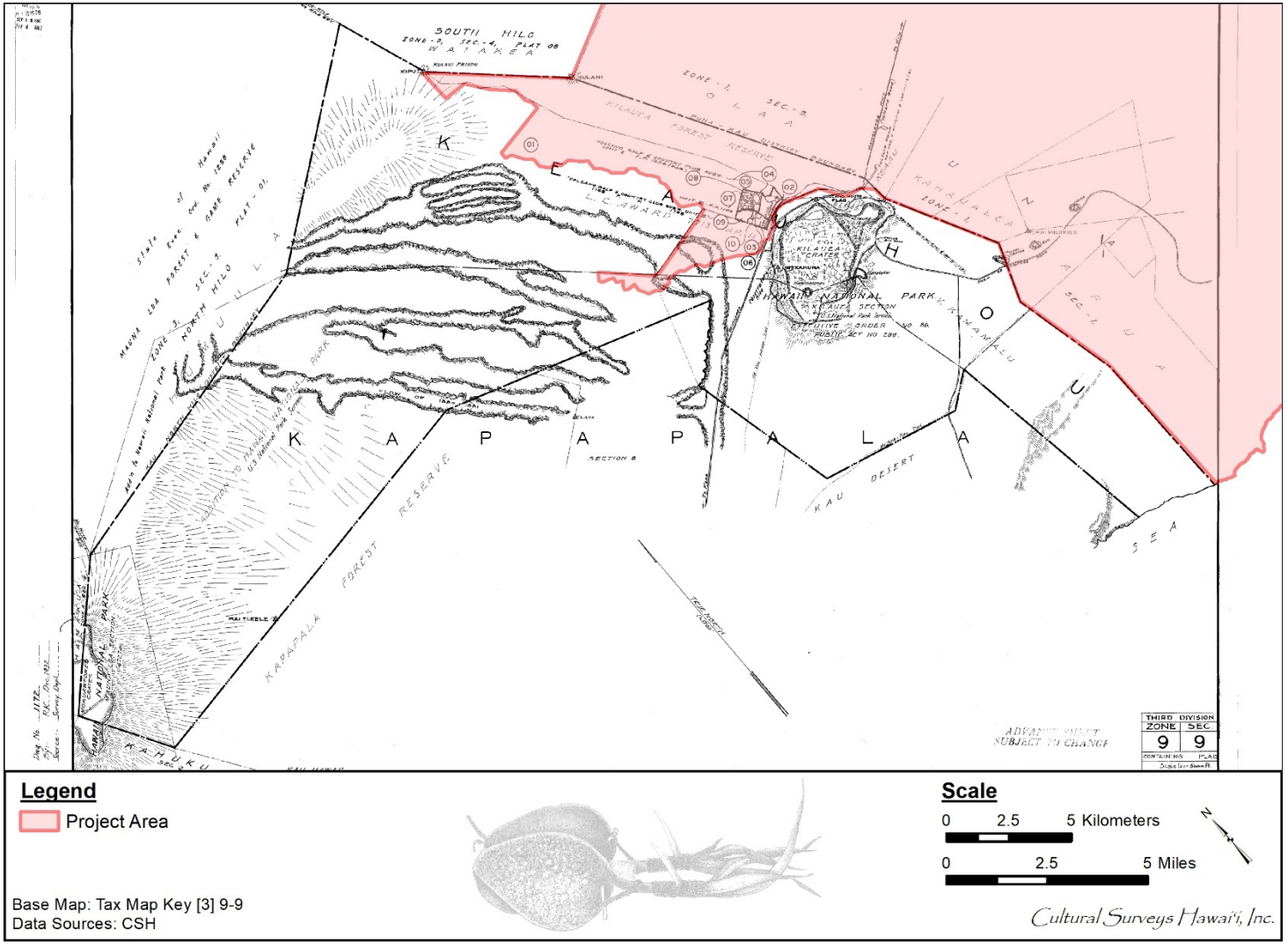

Figure 3. TMK: (3) 9-9 showing the project area in Ka‘ū District (Hawai‘i TMK Service 2014)

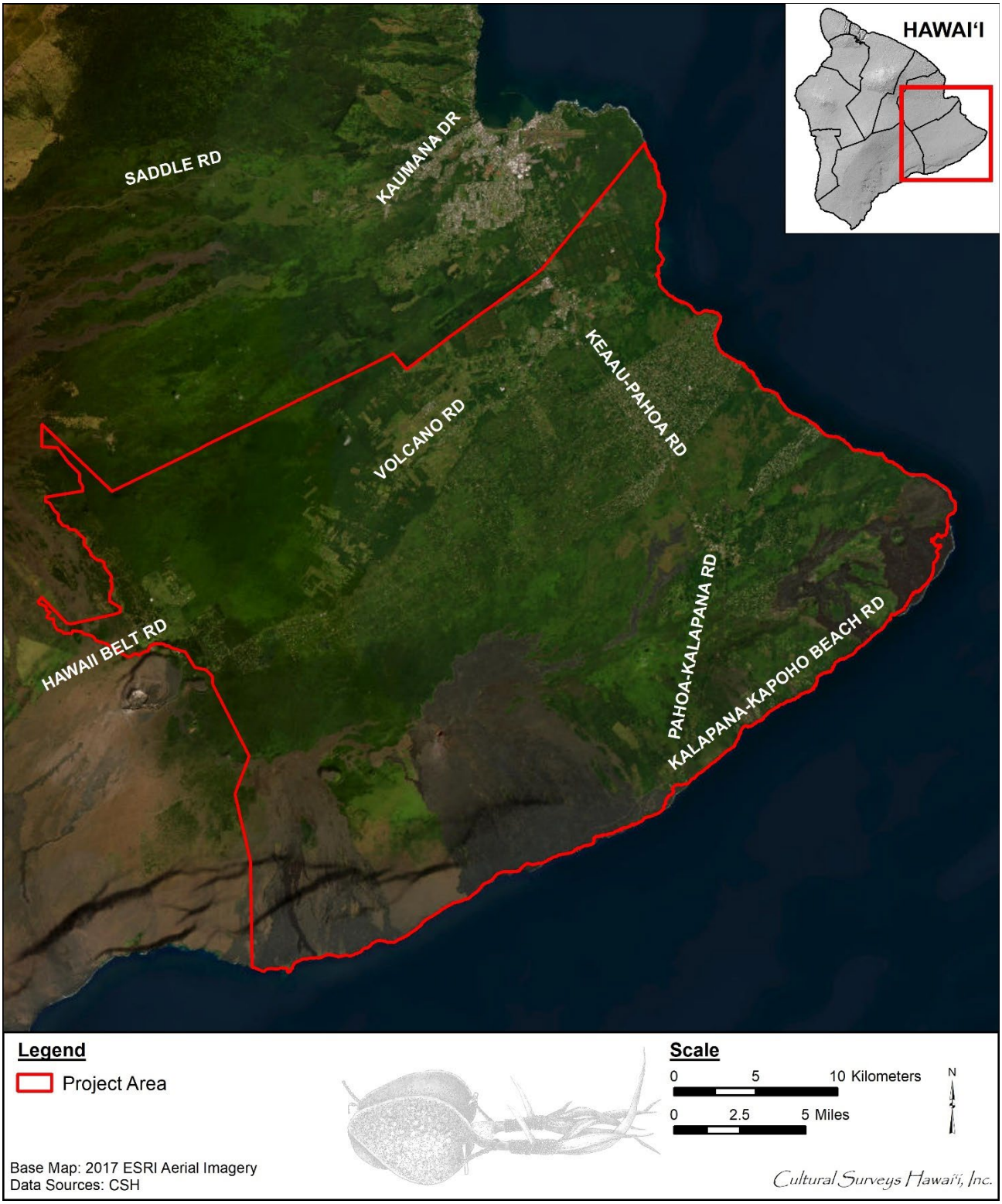

Figure 4. Aerial photograph of the project area (ESRI 2017)

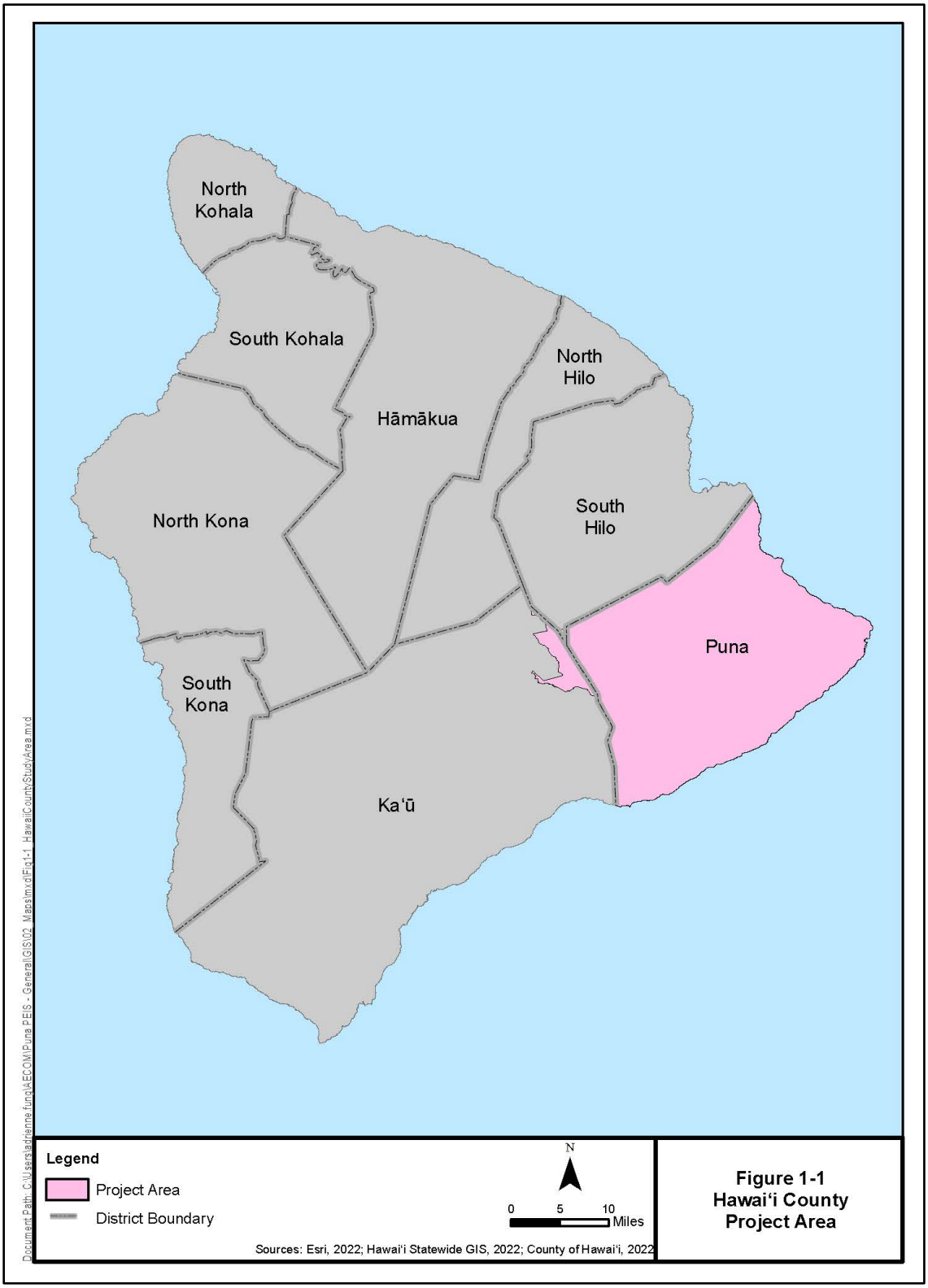

Figure 5. Map showing the project area extent in pink (courtesy of client)

1.4 Scope of Work

The scope of work for this cultural component includes the following:

1. Examination of cultural and historical resources, including Land Commission documents, historic maps, and previous research reports, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal, and other resources or agricultural pursuits as may be indicated in the historic record.
2. Review of previous archaeological work at and near the subject parcel that may be relevant to reconstructions of traditional land use activities; and to the identification and description of cultural resources, practices, and beliefs associated with the parcel.
3. Consultation and interviews with knowledgeable parties regarding cultural and natural resources and practices at or near the parcel; present and past uses of the parcel; and/or other practices, uses, or traditions associated with the parcel and environs.
4. Preparation of a report that summarizes the results of these research activities and provides recommendations based on findings.

1.5 Natural Environment

The project area is located in the Puna District and a small, upland portion of Ka‘ū District on windward side of Hawai‘i Island. The project area ranges from sea level to approximately 1,906 m (6,253 feet [ft]) above mean sea level (amsl). Annual rainfall in the project area is generally dependent on elevation, generally ranging from 1,500–2,500 mm (59–98 inches) along the coast to over 6,000 mm (236 inches) in the dense rainforests in the northeastern portion of Puna (Figure 6). Large portions of the project area have been set aside as forest reserve (see Figure 1).

1.5.1 *Nā Lepo* (Soils)

Soils throughout the project area are generally patterned after its geology (see Figure 7). The most substantial soils in the project area are silty clay loams generally found within the areas of oldest Mauna Loa flows, though some small pockets of this soil type are also present in the eastern-central portions of the project area near the Highway 130 corridor. Soils and land types found in the Kīlauea portion of the project area are almost entirely characterized as *pāhoehoe* or *‘a‘ā* lava flows or cinder lands with little to no soil cover, or muck or loam soils containing high proportions of gravels, stones, or rocks.

1.5.2 *Nā Makani* (Winds)

For Native Hawaiians, *makani* (wind) were named for various reasons such as describing the intensity or direction of the wind, relating the wind to a story, or even relating the wind to the landscape. David Malo, a Native Hawaiian historian, explains some general terms related to wind:

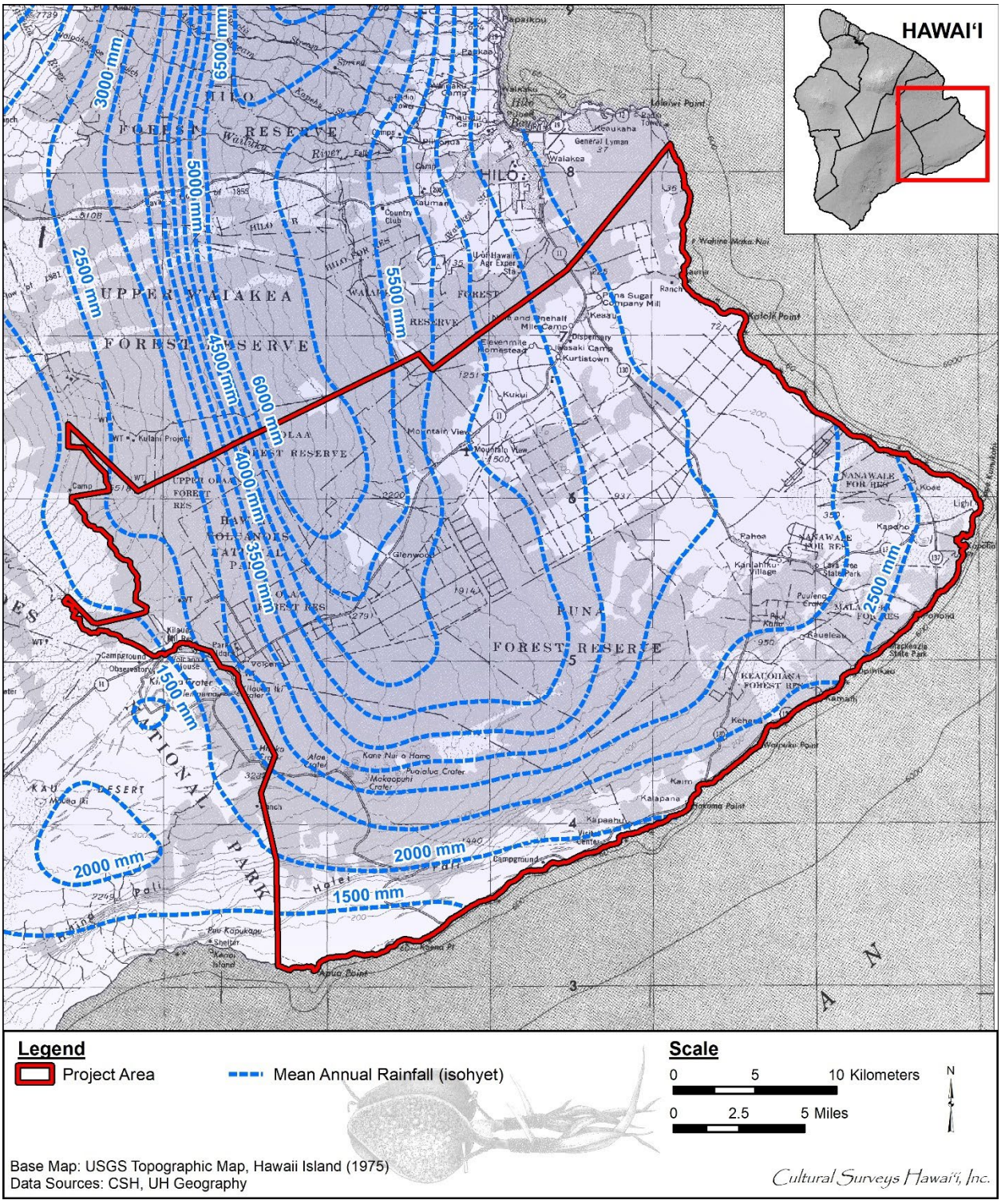

Figure 6. Portion of the 1975 USGS 1:250,000-scale topographic map of Hawai‘i Island showing main annual rainfall throughout the project area (“isohyet” is defined as a smooth line joining points of equal rainfall on a map)

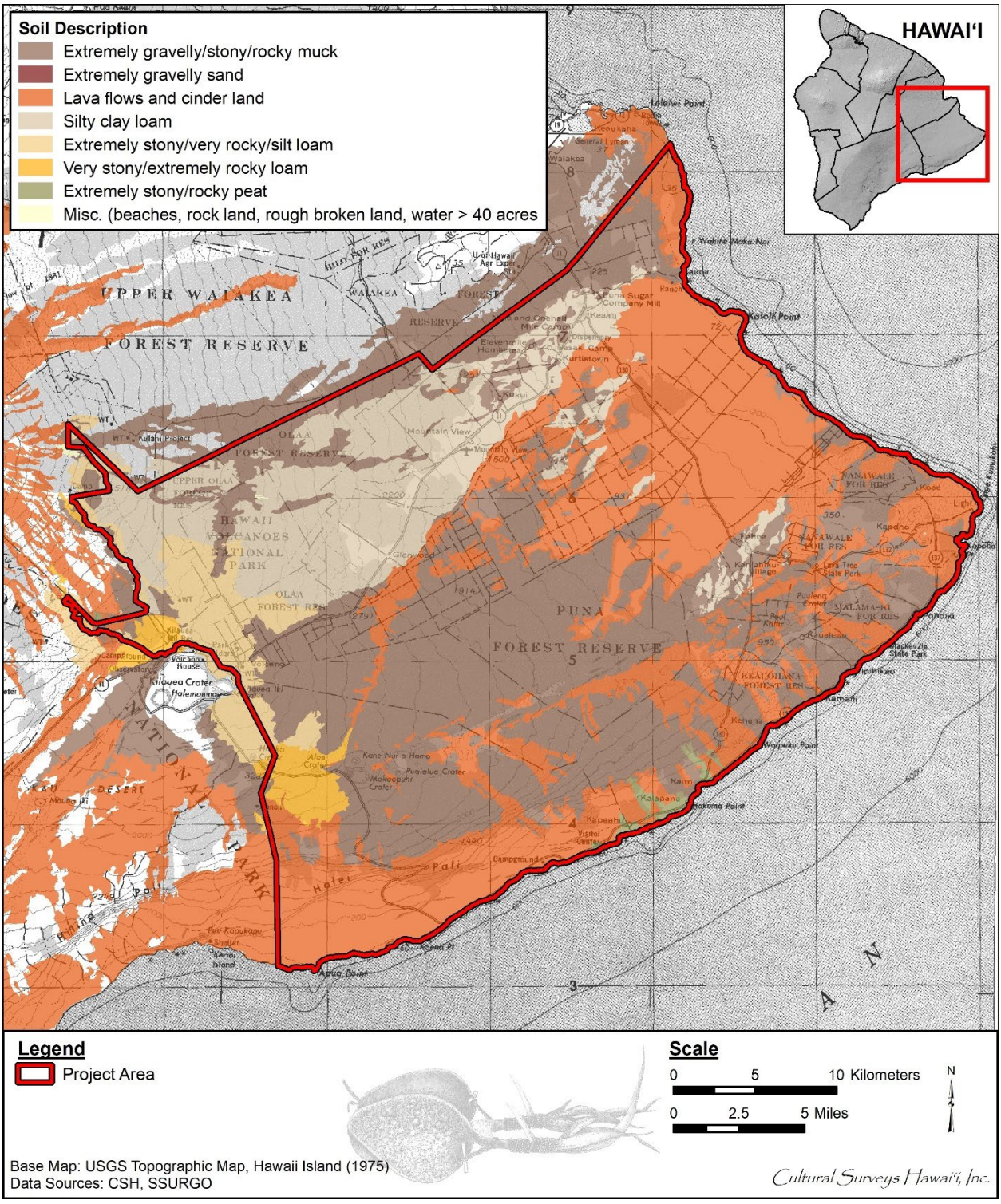

Figure 7. Overlay of *Soil Survey of the Island of Hawaii* (Sato et al. 1973), indicating generalized soil types within and surrounding the project area (U.S. Department of Agriculture Soils Survey Geographic Database [USDA SSURGO] 2001)

> […] There was the *kona*, a wind from the south, of great violence and of wide extent. It affected all sides of an island, east, west, north, and south, and continued for many days […] The *kona* wind often brings rain, though sometimes it is rainless […] The *hoolua*, a wind that blows from the north, sometimes brings rain and sometimes is rainless […] The *hau* is a wind from the mountains, and they are thought to be the cause of it, because this wind invariably blows from the mountains outwards towards the circumference of the island. [Malo 1951:14]

There can be a number of winds found within the project area once confirmed.

1.5.3 *Nā Ua* (Rains)

Precipitation is a major component of the water cycle, and is responsible for depositing *wai* (fresh water) on local flora. Pre-Contact *kānaka* (Native Hawaiians) recognized two distinct annual seasons. The first, known as *kau* (period of time, especially summer) lasts typically from May to October and is a season marked by a high-sun period corresponding to warmer temperatures and steady trade winds. The second season, *ho‘oilo* (winter, rainy season) continues through the end of the year from November to April and is a much cooler period when trade winds are less frequent, and widespread storms and rainfall become more common (Giambelluca et al. 1986:17).

Each small geographic area on O‘ahu had a Hawaiian name for its own rain. According to Akana and Gonzalez (2015):

> Rain names are a precious legacy from our kūpuna who were keen observers of the world around them and who had a nuanced understanding of the forces of nature. They knew that one place could have several types of rain, each distinct from the other. They knew when a particular rain would fall, its color, its duration, its intensity, its path, its sound, its scent, and its effect on the land and their lives […] Rain names are a treasure of cultural, historical, and environmental information. [Akana and Gonzalez 2015:xx]

There can be a number of rains found within the project area once confirmed.

1.6 Built Environment

Development in the project area is generally within the town centers and along the major transportation routes of Highways 11, 130, 132, and 137. Many of the towns in the project area such as Kea‘au, Pāhoa, Mountain View, and Glenwood were established in association with the sugar plantations and other historic-era land use. Remnants of these historic activities are still present and include the former Olaa Sugar Mill, plantation homes and shops, churches, schools, railroad berms and tracks, and other plantation-related features. The extent of the numerous residential subdivisions in the project area are visible in Figure 1. Most of these subdivisions were established in the 1950s and 1960s in agriculturally zoned lands. In the past few decades, the populations within these subdivisions have increased dramatically, straining the limited infrastructure in Puna. Many of the privately held lands outside the residential areas are under lease for commercial agriculture.

Section 2 CIA Methods

2.1 Archival Research

Research centers on Hawaiian activities including *ka‘ao* (legends), *wahi pana* (storied places), *‘ōlelo no‘eau* (proverbs), *oli* (chants), *mele* (songs), traditional *mo‘olelo* (stories), traditional subsistence and gathering methods, ritual and ceremonial practices, and more. Background research focuses on land transformation, development, and population changes beginning with the early post-Contact era to the present day.

Cultural documents, primary and secondary cultural and historical sources, previous archaeological reports, historic maps, and photographs were reviewed for information pertaining to the study area. Research was primarily conducted at the CSH library. Other archives and libraries including the Hawai‘i State Archives, the Bishop Museum archives, the University of Hawai‘i at Mānoa’s Hamilton Library, Ulukau, The Hawaiian Electronic Library (Ulukau.org 2004), the State Historic Preservation Division (SHPD) library, the State of Hawai‘i Land Survey Division, the Hawaiian Historical Society, and the Hawaiian Mission Houses Historic Site and Archives are also repositories where CSH cultural researchers gather information. Information on Land Commission Awards (LCAs) were accessed via Waihona ‘Aina Corporation’s Māhele database (Waihona ‘Aina 2000), the Office of Hawaiian Affairs (OHA) Papakilo Database (Office of Hawaiian Affairs 2015), and the Ava Konohiki Ancestral Visions of ‘Āina website (Ava Konohiki 2015).

2.1.1 *Nā Nūpepa ‘Ōlelo Hawai‘i* (Hawaiian Language Newspapers)

Hawaiians lived in an advanced, oral society in which genealogies, stories, and chants—nearly their entire history—was learned and passed down through memorization and oration. In January 1822, printing was introduced to the Islands (Dibble 1843:192) and the first item printed was an instructional book produced for and by the Lahainaluna Seminary. The preface of this book reads as follows:

> Perhaps the Sandwich Island’s Mission owes an apology to the literary world for having reduced to writing a language of such variety and extent as the Hawaiian, and published so many books in it, without having given any account either of the genius structure or peculiarities of the language. [Andrews 1836]

By September 1823, several hundred Hawaiians were making progress in learning to read (Dibble 1843:197). More instructional material for Lahainaluna was printed as well as Bibles and hymn books to assist missionaries in their teachings. Nearly ten years after printing’s introduction to the Islands, the first Hawaiian language newspaper, *Ka Lama Hawai‘i,* was produced by the Lahainaluna Seminary (Dibble 1843:331). This newspaper could be compared to a school newsletter that published school announcements and featured “miscellaneous instruction for the school” (Dibble 1843:331).

It should be noted that all the materials printed at this time were written without any Hawaiian diacritics such as the *‘okina* (glottal stop) and *kahakō* (macron). Though this was probably for ease of production, this also helped Hawaiians in learning to read. Dibble explains,

> The missionaries adopted also the simple method of avoiding all arbitrary spelling. Every word is spelled precisely as it is pronounced, so that to teach spelling is scarcely an object. Every one who can combine two letters in a syllable and put two syllables together can both read and spell with readiness. The art of reading, therefore, is very easily acquired. I think I am safe in saying that the children of Hawaii learn to read their language in a much shorter time than our children do in English. [Dibble 1843:193]

The success of printing at Lahainaluna and the speed with which Hawaiians learned to read brought more printing presses to the Islands and birthed new newspapers. The Hawaiian electronic library, Ulukau, has a database of old Hawaiian newspapers. Forty-eight newspapers are available on this site, though one paper, *The Liberal*, published only in 1893, is in English. The articles printed in these papers were far more detailed and unfiltered than what we read today. Horrific accidents, causes of death, and personal advertisements are just a few examples of what they contained. A great deal can be learned about a place or time through these newspapers. They are utilized in this report to understand the daily realities of *kama‘āina* (native born) living in the *ahupua‘a.*

CSH utilizes Ulukau’s Hawaiian Language Newspaper database in order to find articles that mention the *ahupua‘a* or *moku* (district) of the proposed project area. Information can be found by entering keywords, like place names. To narrow down searches, as many *wahi pana* throughout Hawai‘i share the same name, newspapers are categorized by name and the date published. Hawaiian language articles will be presented in this report once the project area has been determined.

2.2 Community Consultation

2.2.1 Scoping for Participants

We begin our consultation efforts by utilizing our previous contact list to facilitate the interview process. We then review an in-house database of *kūpuna* (elders), *kama‘āina*, cultural practitioners, lineal and cultural descendants, Native Hawaiian Organizations (NHOs; includes Hawaiian Civic Clubs and those listed on the Department of Interior’s NHO list), and community groups. We also contact agencies such as SHPD, OHA, and the appropriate Island Burial Council where the proposed project is located for their response on the project and to identify lineal and cultural descendants, individuals and/or NHO with cultural expertise and/or knowledge of the study area. CSH is also open to referrals and new contacts.

2.2.2 “Talk Story” Sessions

Prior to the interview, CSH cultural researchers explain the role of a CIA, how the consent process works, the project purpose, the intent of the study, and how their *‘ike* and *mana‘o* will be used in the report. The interviewee is given an Authorization and Release Form to read and sign.

“Talk Story” sessions range from the formal (e.g., sit down and *kūkā* [consultation, discussion] in the participant’s place of choice over set interview questions) to the informal (e.g., hiking to cultural sites near the study area and asking questions based on findings during the field outing). In some cases, interviews are recorded and transcribed later.

CSH also conducts group interviews, which range in size. Group interviews usually begin with set, formal questions. As the group interview progresses, questions are based on interviewees' answers. Group interviews are always transcribed and notes are taken. Recorded interviews assist the cultural researcher in 1) conveying accurate information for interview summaries, 2) reducing misinterpretation, and 3) adding missing details to *mo‘olelo*.

CSH seeks *kōkua* (assistance) and guidance in identifying past and current traditional cultural practices of the study area. Those aspects include general history of the *ahupua‘a*; past and present land use of the study area; knowledge of cultural sites (for example, *wahi pana*, archaeological sites, and burials); knowledge of traditional gathering practices (past and present) within the study area; cultural associations (*ka‘ao* and *mo‘olelo*); referrals; and any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the study area.

2.2.3 Interview Completion

After an interview, CSH cultural researchers transcribe and create an interview summary based on information provided by the interviewee. Cultural researchers give a copy of the transcription and interview summary to the interviewee for review and ask that they make any necessary edits. Once the interviewee has made those edits, we incorporate their *‘ike* and *mana‘o* into the report. When the draft report is submitted to the client, cultural researchers then prepare a finalized packet of the participant's transcription, interview summary, and any photos that were taken during the interview. We also include a thank you card and honoraria. This is for the interviewee's records.

It is important that CSH cultural researchers cultivate and maintain community relationships. The CIA report may be completed, but CSH researchers continuously keep in touch with the community and interviewees throughout the year—such as checking in to say hello via email or by phone, volunteering with past interviewees on community service projects, and sending holiday cards to them and their *‘ohana* (family). CSH researchers feel this is an important component to building relationships and being part of an *‘ohana* and community.

"*I ulu no ka lālā i ke kumu*—the branches grow because of the trunk," is an *‘ōlelo no‘eau* (#1261) shared by Mary Kawena Pukui with the simple explanation: "Without our ancestors we would not be here" (Pukui 1983:137). As cultural researchers, we often lose our *kūpuna* but we do not lose their wisdom and words. We routinely check obituaries and gather information from other informants if we have lost our *kūpuna*. CSH makes it a point to reach out to the *‘ohana* of our fallen *kūpuna* and pay our respects including sending all past transcriptions, interview summaries, and photos for families to have on file for genealogical and historical reference.

Section 3 *Ka‘ao* and *Mo‘olelo* (Legends and Stories)

Hawaiian storytellers of old were greatly honored; they were a major source of entertainment and their stories contained teachings while interweaving elements of Hawaiian lifestyles, genealogy, history, relationships, arts, and the natural environment (Pukui and Green 1995:IX). According to Pukui and Green (1995), storytelling is better heard rather than read for much becomes lost in the transfer from the spoken to the written word and *ka‘ao* are often full of *kaona* or double meanings.

Ka‘ao are defined by Pukui and Elbert (1986:108) as a "legend, tale […], romance, [and/or], fiction." *Ka‘ao* may be thought of as oral literature or legends, often fictional or mythic in origin, and have been "consciously composed to tickle the fancy rather than to inform the mind as to supposed events" (Beckwith 1970:1). Conversely, Pukui and Elbert (1986:254) define *mo‘olelo* as a "story, tale, myth, history, [and/or] tradition". The *mo‘olelo* are generally traditional stories about the gods, historic figures or stories which cover historic events and locate the events with known places. *Mo‘olelo* are often intimately connected to a tangible place or space.

In differentiating *ka‘ao* and *mo‘olelo* it may be useful to think of *ka‘ao* as expressly delving into the *wao akua* (realm of the gods), discussing the exploits of *akua* (gods) in a primordial time. *Mo‘olelo* on the otherhand, reference a host of characters from *ali‘i* (royalty), to *akua* (gods) and *kupua* (supernatural beings), to finally *maka‘āinana* (commoners), and discuss their varied and complex interactions within the *wao kānaka* (realm of man). Beckwith elaborates, "In reality, the distinction between *ka‘ao* as fiction and *mo‘olelo* as fact cannot be pressed too closely. It is rather in the intention than in the fact" (Beckwith 1970:1). Thus a so-called *mo‘olelo*, which may be enlivened by fantastic adventures of *kupua*, "nevertheless corresponds with the Hawaiian view of the relation between nature and man" (Beckwith 1970:1).

Both *ka‘ao* and *mo‘olelo* provide important insight into a specific geographical area, adding to a rich fabric of traditional knowledge. The preservation and passing on of these stories through oration remains a highly valued tradition. Additionally, oral traditions associated with the study area communicate the intrinsic value and meaning of a place, specifically its meaning to both *kama‘āina* as well as others who also value that place.

The following section will present a larger collection of traditional accounts of ancient Hawaiians living in the vicinity of the project area, once that area is determined. Many relate an age of mythical characters whose epic adventures inadvertently lead to the Hawaiian race of *ali‘i* and *maka‘āinana*. The *ka‘ao* in and around the project area shared below are some of the oldest Hawaiian stories that have survived; they still speak to the characteristics and environment of the area and its people.

3.1.1 *Nā Wahi Pana* (Storied Places)

Hawaiian place names convey a wide variety of information about the relationships among people, landscapes and other natural and cultural resources. Place names may also express cultural, historical and/or spiritual values and concepts important to Hawaiian world views. It is common for places and landscape features to have multiple names, some of which may only be known to certain *‘ohana* (families) or even certain individuals within *‘ohana*, and many of which have been lost, forgotten or kept secret through time. Place names may also convey *kaona*

(hidden meanings) and *huna* (secret) information that may even have political or subversive undertones. Before the introduction of writing to the islands, when cultural information was exclusively preserved and perpetuated orally, Hawaiians gave names to literally everything in their environment, including individual garden plots and *‘auwai* (ditches), house sites, intangible phenomena such as meteorological and atmospheric effects, *pōhaku* (stone), *pūnāwai* (springs), and many others.

A *wahi pana*, also referred to as a place name, “physically and poetically describes an area while revealing its historical or legendary significance” (Landgraf 1994:v). *Wahi pana* can refer to natural geographic locations, such as streams, peaks, rock formations, ridges, and offshore islands and reefs, or they can refer to Hawaiian divisions, such as *ahupua‘a* and *‘ili* (land section, next in importance to an *ahupua‘a* and usually a subdivision of an *ahupua‘a*), and man-made structures, such as fishponds. *Wahi pana* may also express cultural, historical and/or spiritual values and concepts important to Hawaiian world views.

3.1.1.1 *Nā Inoa ‘Āina* (Place Names)

A place names table will be generated once the Ahupua‘a and project area are determined.

3.1.2 *Nā Mele* (Songs)

A number of late nineteenth, twentieth, and twenty-first century *mele* concern or mention Waikāne and Waiāhole Ahupua‘a. These particular *mele* may also be classified as *mele wahi pana* (songs for legendary or historic places). *Mele wahi pana* such as those presented here may or may not be accompanied by *hula* (dance) or *hula wahi pana* (dance for legendary or historic places). As the Hula Preservation Society notes,

> Hula Wahi Pana comprise a large class of dances that honor places of such emotional, spiritual, historical, or cultural significance that chants were composed for them. Only the composers of the chants could know the deepest meanings, as they would be reflections of their feelings and experiences . . . Since the subjects of Wahi Pana compositions are extremely varied, their implementation through hula are as well. Coupled with the differences from one hula style and tradition to the next, Hula Wahi Pana can be exceptionally diverse. They can be done sitting or standing, with limited body movement or wide free movement; with or without the use of implements or instruments; with the dancers themselves chanting and/or playing an implement or being accompanied by the *ho‘opa‘a* [drummer and *hula* chanter (memorizer)]. Beyond the particular hula tradition, what ultimately determines the manner in which a Hula Wahi Pana is performed are the specific place involved, why it is significant, the story being shared about it, and its importance in the composer’s view. [Hula Preservation Society 2014]

Mele will be listed once the Ahupua‘a and project area are determined.

3.1.3 *Nā ‘Ōlelo No‘eau* (Proverbs)

Hawaiian knowledge was shared by way of oral histories. Indeed, one’s *leo* (voice) is oftentimes presented as *ho‘okupu* (“to cause growth,” a gift given to convey appreciation, to strengthen bonds); the high valuation of the spoken word underscores the importance of the oral tradition (in this case, Hawaiian sayings or expressions), and its ability to impart traditional

Hawaiian “aesthetic, historic, and educational values” (Pukui 1983:vii). Thus, in many ways these expressions may be understood as inspiring growth within reader or between speaker and listener:

> They reveal with each new reading ever deeper layers of meaning, giving understanding not only of Hawai‘i and its people but of all humanity. Since the sayings carry the immediacy of the spoken word, considered to be the highest form of cultural expression in old Hawai‘i, they bring us closer to the everyday thoughts and lives of the Hawaiians who created them. Taken together, the sayings offer a basis for an understanding of the essence and origins of traditional Hawaiian values. The sayings may be categorized, in Western terms, as proverbs, aphorisms, didactic adages, jokes, riddles, epithets, lines from chants, etc., and they present a variety of literary techniques such as metaphor, analogy, allegory, personification, irony, pun, and repetition. It is worth noting, however, that the sayings were spoken, and that their meanings and purposes should not be assessed by the Western concepts of literary types and techniques. [Pukui 1983:vii]

Simply, *‘ōlelo no‘eau* may be understood as proverbs. The Webster dictionary notes it as “a phrase which is often repeated; especially, a sentence which briefly and forcibly expresses some practical truth, or the result of experience and observation.” It is a pithy or short form of folk wisdom. Pukui equates proverbs as a treasury of Hawaiian expressions (Pukui 1995:xii). Oftentimes within these Hawaiian expressions or proverbs are references to places. This section draws from the collection of author and historian Mary Kawena Pukui and her knowledge of Hawaiian proverbs describing *‘āina*, chiefs, plants, and places. Proverbs will be presented once the Ahupua‘a and project area have been determined.

Section 4 Traditional and Historical Background

This section contains a summary of the traditional and historical background associated with the project area. The project area includes the entire district of Puna and two *ahupua‘a* (traditional land divisions) in Ka‘ū District. According to cultural researcher Kepā Maly (1999:12), the Puna District is comprised of approximately 50 *ahupua‘a*. For general reference these *ahupua‘a* are listed in Appendix A along with corresponding acreages. The project area also overlaps small, upland portions of the two easternmost *ahupua‘a* in Ka‘ū District: Keauhou and Kapāpala.

Each subject heading below is broken into two subheadings, addressing the background of the Puna and Ka‘ū districts separately. Background for the district of Puna is discussed generally, as it covers a wide geographical area and numerous individual *ahupua‘a*. Background for the Ka‘ū District more specifically addresses Keauhou and Kapāpala.

4.1 Traditional Background

4.1.1 Puna District

According to Handy and Handy (1972), myths and legends provide an understanding of an early time when the district of Puna was famous for its long stretch of sand, fertile plains, and its *hala* (*pandanus*) trees and *‘awa* (*Piper methysticum*). Many *‘ōlelo no‘eau* (poetical sayings) and legends also describe Pele’s devouring of land by causing lava to cover either large areas of the region or more limited sections of it. Traditions imply Puna was one of Hawai‘i’s wealthiest agricultural regions. It is only in recent times that volcanic eruptions have destroyed much of Puna’s best land. The *mo‘olelo* or narrative stories of Puna also emphasize the area’s familial, genealogical, and political connections to the neighboring districts of Ka‘ū and Hilo. This connection is demonstrated by the mention of certain key place names both as places and as people.

Barrère (1971:11) has speculated that the reason for the relatively small amount of traditional literature about Puna was the “remarkably successful” conversion of the natives to Christianity. This effort began when the Reverend William Ellis’ missionary party visited the district in 1823 and was continued and strengthened under Rev. Titus Coan’s management of the mission district beginning in 1835. In 1841, Wilkes noted, “Almost all the hills or craters of any note [in Puna] have some tradition connected with them; but I found that the natives were now generally unwilling to narrate these tales, calling them ‘foolishness’” (Wilkes 1845:[4]186).

In the early history of Hawai‘i there were many chiefs, each ruling one or several *ahupua‘a*, entire districts, or several districts. Emory et al. (1959) provide an explanation as to why there is a comparative lack of traditional political history surrounding Puna:

> We find that Puna, as a political unit, played an insignificant part in shaping the course of the history of Hawai‘i island. Unlike the other districts of Hawai‘i, no great family arose upon whose support one or another of the chiefs seeking power had to depend for his success. Puna lands were desirable, and were eagerly sought, but their control did not rest upon the conquering of Puna itself, but rather upon control of the adjacent districts, Ka‘ū and Hilo. An attempt to follow in

> detail the course of Puna's history is bound up with the fortunes of the ruling families on either side of her. [Emory et al. 1959:15]

In the late 1500s, the government was united under the rule of Līloa, who became the *ali‘i nui* (high chief) over the entire island. He was a descendant of Pili, probably a high chief in the AD 1200-1300s period (Cordy 2000:160), who was said to be a voyager from the ancestral land of Kahiki. Līloa proclaimed an elder son, Hākau to be his heir, but gave to a younger son, ‘Umi (Umi-a-Līloa), the care of the god Kūkā‘ilimoku and his *heiau* (pre-Christian place of worship). After Līloa's death, his younger son ‘Umi rebelled against the rightful heir, his older brother Hākau. The district chiefs refused to acknowledge his island-wide rights, and each chief went back to rule their respective district (or districts). ‘Umi fought endless battles and finally triumphed over all of these chiefs, including a chief of Puna named Hua‘a, and Imaikalani, "the powerful blind chief of Kau and parts of Puna" (Fornander 1996:99). Ultimately ‘Umi united the island once again under one *ali‘i nui* (Kamakau 1961:17–19).

The period following the death of Umi-a-Līloa was characterized by cycles of strife and peace (Fornander 1996:111–115). Puna does not seem to have had a district chief of its own; instead, it was at various times under the domination of the Hilo chiefs (descendants of ‘Umi and his wife Pi‘ikea) and the Kona chiefs (descendants of ‘Umi and his wife Kapukini).

In 1754 the chief Kalani‘ōpu‘u became the *ali‘i nui* of Hawai‘i Island (Kamakau 1992:78). Kalani‘ōpu‘u sent for his son, Kiwala‘o, and his favored nephew, Kamehameha. In an act reminiscent of Līloa and his two sons (Hākau and ‘Umi), Kalani‘ōpu‘u made the son his heir, with the right to perform the ritual to dedicate a *heiau*, but gave his god, Kūkā‘ilimoku, into the care of Kamehameha (Kamakau 1992:107).

One warrior who had originally fought on Kalani‘ōpu‘u's side was a chief of Puna named ‘Īmakakoloa, "the dark ‘awa among the hala blossoms of Puna" (Kamakau 1992:86). This warrior rebelled against the rule of Kalani‘ōpu‘u:

> It was I-maka-koloa, a chief of Puna, who rebelled, I-maka-koloa the choice young ‘awa [favorite son] of Puna. He seized the valuable products of this district, which consisted of hogs, gray tapa cloth (*‘eleuli*), tapas made of *mamaki* bark, fine mats made of young pandanus blossoms (*‘ahu hinalo*), mats made of young pandanus leaves (*‘ahuao*), and feathers of the *‘o‘o* and *mamo* birds of Puna. [Kamakau 1992:106]

Kalani‘ōpu‘u moved with his court to Hilo and sent a war party into Puna to find ‘Īmakakoloa, but he escaped and hid with his people for almost a year. The court then moved to Ka‘ū and under the direction of a *kahu* (guardian or advisor), men began to burn the villages of Puna, until they found ‘Īmakakoloa, hidden on an islet off the Puna coast. ‘Īmakakaloa was taken to Ka‘ū, where his body was to be presented as a sacrifice at the dedication of Hālauwilua Heiau near South Point by Kiwala‘o, son of Kalani‘ōpu‘u (Kamakau 1992:108).

It was here that Kamehameha, like ‘Umi before him, made his bid for ascendancy over his cousin, the rightful heir, by seizing the body of ‘Īmakakoloa during the dedication ceremony and offering it to the gods himself, thus completing the dedication of the *heiau*, a duty that Kalani‘ōpu‘u had reserved for his son (Kamakau 1992:109). Kiwala‘o was later killed during a battle with Kamehameha's forces, who went on to conquer all of Hawai‘i by 1791 and unified all

of the Hawaiian Islands under his rule by 1810 (Barrère 1971:7; Cordy 2000:191–208; Fornander 1996:72-78; Malo 1951:258).

During Kamehameha's conquest to gain control over Hawai‘i Island, he battled against many *ali‘i* on Hawai‘i Island. During one of his battles with Keawema‘uhili and Keōua, the infamous event of the "Law of Māmalahoe" took place in Puna. Kamakau (1992) recalls how this law came about:

> Since Keawe-ma‘u-hili and Keoua had joined forces against Kamehameha there was no place for him in Hilo; he camped his men at Laupahoehoe in Hilo Paliku (Hilo by the cliff). Afterwards Kamehameha and Ka-haku‘i paddled to Papa‘i and on to Kea‘au in Puna where some men and women were fishing, and a little child sat on the back of one of the men. Seeing them about to go away, Kamehameha leaped from his canoe intending to catch and kill the men, but they all escaped with the women except two men who stayed to protect the man with the child. During the struggle Kamehameha caught his foot in a crevice of the rock and was stuck fast; and the fishermen beat him over the head with a paddle. Had it not been that one of the men was hampered with the child and their ignorance that this was Kamehameha with whom they were struggling; Kamehameha would have been killed that day. This quarrel was named Ka-lele-iki, and from the striking of Kamehameha's head with a paddle came the law of Mamala-hoe (Broken paddle) for Kamehameha. [Kamakau 1992:125–126]
>
> At the time when he became ruling chief over all Hawaii, there were brought to him those men who had struck him with a paddle, together with their wives and children. All the chiefs said, 'Let them be stoned to death!' Kamehameha replied, 'The law of the broken paddle is declared: no chief or officer of execution is to take their lives. It is I who should by right be stoned.' What a wonderful thing for a chief thus to mete out justice toward those who had injured him! [Kamakau 1992:181]

4.1.2 Ka‘ū District

Keauhou is traditionally considered an *‘ili* (subdivision or land parcel within an *ahupua‘a*) of Kapāpala (Maly and Maly 205:ii). The land division of Keauhou can be described as

> […] among the most significant land areas in the Hawaiian Islands, as it is the home of Kīlauea, and abode of the goddess Pele. Because of the active volcanic nature of Kīlauea, and its manifestations of Pele and her family, as witnessed the geologic phenomena, the lua o Pele (volcano of Pele) has been a focal point of native traditions and religion; and since western contact, it has been the most frequently visited and written of landscape in the Hawaiian Islands. [Maly and Maly 2005:ii]

The portion of upland Keauhou in the vicinity of the project area would have been too wet and cold for cultivation or permanent habitation, and instead would have been used for capture of birds for their feathers and collection of *‘ōhi‘a* and *koa* woods for numerous uses (Kawachi 2003:4). The Keauhou Trail, connecting the Kīlauea Summit area with the coast some 10 miles away, generally followed the Ka‘ū-Puna District boundary (Kawachi 2003:4).

An archaeological study conducted at a cave in Hilina Pali in Kapāpala found evidence of Hawaiian occupation by AD 1600, and documented sites including shelters and trails used for seasonal sweet potato cultivation, harvesting of *māmaki* (*Pipturus albidus*) for *tapa* (barkcloth) manufacture, collection of fresh water, and transportation to settlements along the coast (Cleghorn 1980:30).

4.2 Early Historic Period

4.2.1 Puna District

4.2.1.1 Early Accounts by Foreigners

The first foreigners to see the Puna coast were crew members of Captain Cook's third voyage to the Pacific in 1779. They were the first to note the differences in population and cultivation between the southwestern section of Puna and the more easterly area:

> The East part of Opoona [Puna] is flat, covered with Coco nut trees, and the land far back is of a Moderate height. As well as we could judge this is a very fine part of the Island, perhaps the best.
>
> On the SW extremity of Opoona the hills rise abruptly from the Sea side, leaving but a narrow border, and although the sides of the hills have a fine verdure, yet they do not seem Cultivated and when we sailed pretty near and along this end of Opoona, we did not observe that it was equally populous with the eastern parts. [Beaglehole 1967:606]

In 1823, British missionary William Ellis and members of the American Board of Commissioners for Foreign Missions (ABCFM)—Asa Thurston and Artemas Bishop—toured the island of Hawai‘i. After touring Ka‘ū District, they made a side trip inland to the Kīlauea crater, then returned back to shore near the Ka‘ū/Puna border. Mr. Ellis kept a detailed journal of his travels and was the second foreigner to note the differences in population and cultivation of the various areas of Puna.

T. Stell Newman (1971) reviewed the journal of William Ellis for his 1823 tour of Hawai‘i Island to reconstruct the environmental characteristics of aboriginal agricultural lands on different parts of the island. Based on Ellis' early observations, there were two main types of dryland farming in Hawai‘i, either in field systems or in scattered fields. As seen on the map provided in Newman (1971) (Figure 8), Ellis recorded only scattered fields on the northern coast of Puna, as opposed to the more organized field systems of the southern Puna coast.

> Within the western beginning of this field system, around Kaimū, Ellis approved of the 'extent of cultivation in the neighbourhood [*sic*], together with the decent and orderly appearance of the people,' and contemplated making Kaimū the location of a new mission. The next day, the party traveled on to Keouohana to preach, then to the villages of Kehena and Kamā‘ili, where they rested. They next traveled to ‘Opihikao (also written ‘Opihikāō [Pukui et al 1976:171]),

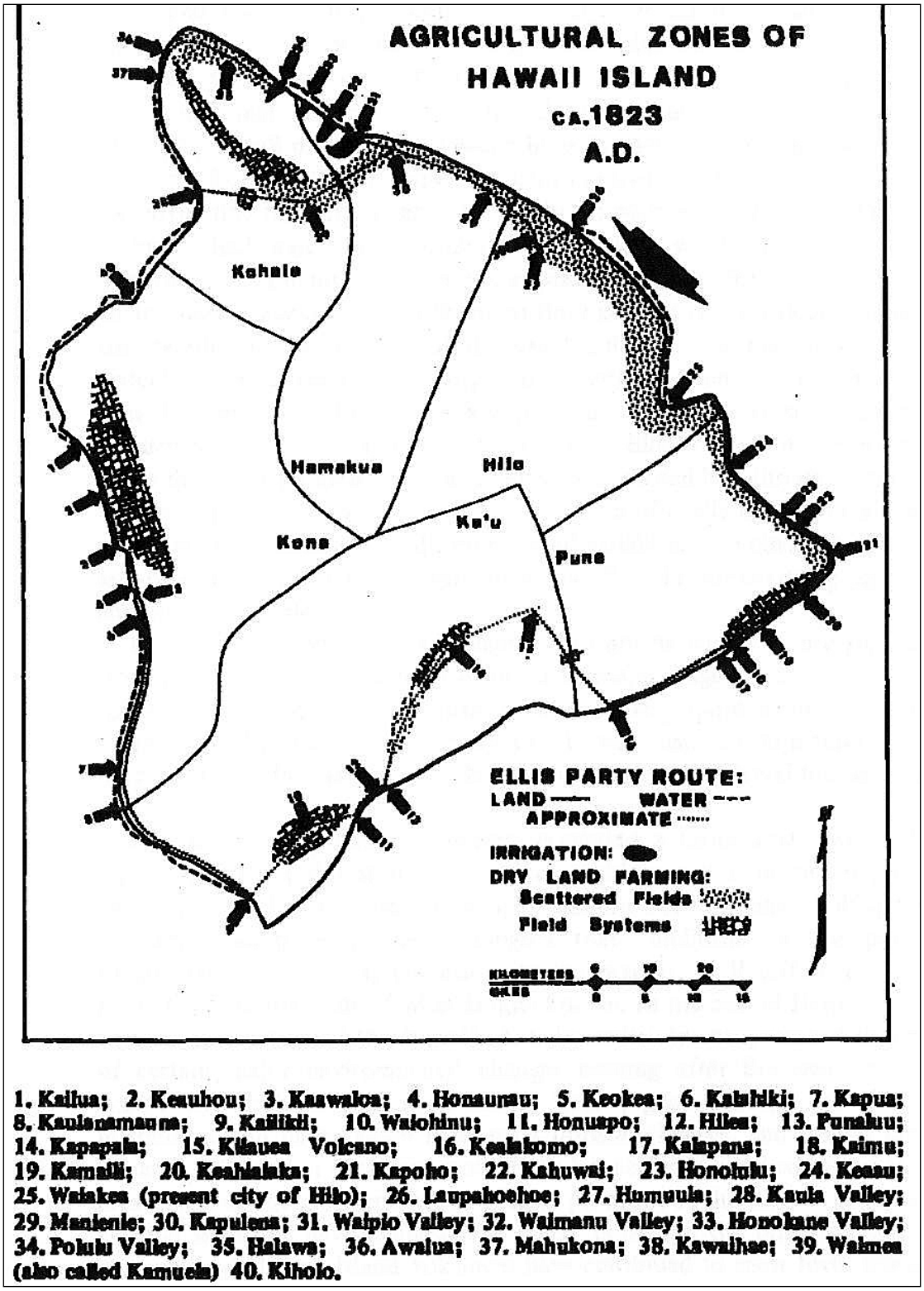

Figure 8. Newman’s (1971) map of the Ellis party route

> not making any mention of the ahupua‘a of Kaueleau, suggesting there was not a large enough population in that area to stop for a sermon. They gave a sermon at ‘Opihikao, which Ellis describes as a ‘populous village, situated within a short distance of the sea’. [Ellis 1963:200]

They continued east along the coastal trail:

> We then proceeded about two miles, principally through cultivated grounds, to Kauaea. About 300 people, excited by curiosity, soon collected around us, to whom Mr. Thurston preached. [Ellis 1963:201]

Their stay in the *ahupua‘a* of Kauaea was brief, so there is little description of the area. The group next traveled to the *ahupua‘a* of Malama and then to Keahialaka, the residence of Kinao, the governor of the Puna District. The party split up at Keahialaka, with Ellis remaining with the sick chief of Puna, Kinao, and the rest of the party continuing north to the village of Pū‘āla‘a.

> When they reached Pualaa, the above-mentioned village, they were kindly welcomed by the head man, who soon had the people of the place collected at their request, and to them Mr. Thurston proclaimed the news of salvation through Jesus Christ. The chief furnished the travelers with a hospitable supper and comfortable lodgings. […]
>
> About half-past eleven we took leave of them, and directed our way across the eastern point. A most beautiful and romantic landscape presented itself on our left, as we traveled out of Pualaa. The lava covered with a tolerably thick layer of soil, and the verdant plain, extending several miles toward the foot of the mountains, was agreeable diversified by groups of picturesque hills, originally craters, but now clothed with grass, and ornamented with clumps of trees. [Ellis 1963:205]

Barrère (1971:10) believes there may have been less than 100 people in the crowd that came to hear the missionaries at Pū‘āla‘a, since Ellis always gave an estimate of the audience when it was greater than 100 people. The chief of Puna, Kinao, visited by Ellis, may be Kinau, a son of Kamehameha, who was at one time considered his principal heir. Kamehameha instead selected a younger son, Liholiho, to be next *ali‘i nui* of the islands (‘Ī‘ī 1959:33, 37).

The missionary groups traveled to Kapoho and then past Kula, sometimes traveling “on the top of a wall four feet high and about three feet wide, formed of fragments of lava that had been collected from the surface of the enclosures which these walls surrounded” (Ellis 1963:211). They reached Kahuwai in the afternoon where they met with an assembled group of about 150 people, then traveling up the coast to Honolulu Landing to spend the night and continuing to Waiakahiula in the morning. Bishop left the group to continue the tour traveling along the coast to Kea‘au, and Ellis and Thurston followed the next day:

> Being somewhat recovered by noon, I was able to proceed with Mr. Thurston. The country was populous, but the houses stood singly, or in small clusters, generally on the plantations, which were scattered over the whole country. Grass and herbage were abundant, vegetation in many places luxuriant, and the soil, though shallow, was light and fertile.

> Soon after five p.m. we reached Kaau [Kea‘au], the last village in the division of Puna. It was extensive and populous, abounding with well-cultivated plantations of taro. Sweet potatoes, and sugar-cane; and probably owes its fertility to a fine rapid stream of water, which, descending from the mountains, runs through it into the sea. It was the second stream we had seen on the island […] [Ellis 1963:212]

Later in 1823, a mission station opened in Hilo, which was responsible for the districts of Hilo, Puna, and part of Ka‘ū. In 1833, two churches were dedicated, one in Hilo, and one in Kuolo, on the eastern boundary in Puna (Hilo Station Report 1833:3). The missionary Titus Coan became head of the Hilo Station in 1835 and took his first tours through Hilo and Puna with his fellow preacher Mr. Lyman in the same year. Mr. Coan reported the following:

> Soon after, I made a tour with him into Puna, one wing of our field, and then through the district of Hilo, in an opposite direction. These tours introduced me to the people for whom I was to labor, and with whom I had a burning desire to communicate freely, and helped me greatly in acquiring the language. […]
>
> For many years after our arrival there were no roads, no bridges, and no horses in Hilo, and all my tours were made on foot. These were three or four annually through Hilo, and as many in Puna; the time occupied in making them was usually ten to twenty days for each trip. [Coan 1882:20]

In describing the district of Puna, Coan emphasized the abundant rainfall and evidence of volcanic activity, and the fields of vegetables and fruits grown in those regions with both deep soils and access to water.

> Its [Puna’s] shore line, including its bends and flexures, is more than seventy miles in extent. For three miles inland from the sea it is almost a dead level, with a surface of pahoehoe or field lava, and a-a or scoriaceous lava, interspersed with more or less rich volcanic soil and tropical verdure, and sprinkled with sand-dunes and a few cone and pit-craters. […] The rains are abundant, and subterranean fountains and streams are numerous, carrying the waters down to the sea level, and filling caverns, and bursting up along the shore in springs and rills, even far out under the sea. […]
>
> Puna has many beautiful groves of the cocoa-palm, also breadfruit, pandanus, and ohia, and where there is soil it produces under cultivation, besides common vegetables, arrowroot, sugar-cane, coffee, cotton, oranges, citrons, limes, grapes, and other fruits. On the highlands, grow wild strawberries, cape gooseberries, and the ohelo, a delicious berry resembling our whortleberry. [Coan 1882:26]

In 1840 J.J. Jarves, editor of the *Polynesian*, documented a trip around the island. In addition to noting a village at ‘Ōla‘a, Jarves described taking an inland “middle Puna road” to view an eruption occurring in Nānāwale (Jarves 1840 cited in Maly 1999:33–34).

The Wilkes Expedition made a trip to the summit of the Kīlauea Crater in 1841, then returned along the Puna coast, descending from the crater to Kapoho. The route the Wilkes Expedition took extended through Waiakahiula downslope to the Puna coast. Nordhoff (1874:41), in his guide to the Hawaiian Islands, suggests “your pleasantest plan is to ride from Hilo by the direct

road to the crater, and return by way of Puna" over the 70 miles back along the coastal path to Hilo, likely similar to the route Wilkes took in the 1840s:

> Almost the whole of it [Puna] is a land of desolation. A narrow trail across unceasing beds of lava, a trail which in spots was actually hammered down to make it smooth enough for horses' feet, and outside of whose limits in most places your horse will refuse to go, because he knows it is too rough for beast or man; this is your road. [Nordhoff 1874:41]

Most of these early visitors followed an ancient coastal foot trail; in the late nineteenth century this became a horse trail called the "Old Government Road" (Lass 1997:15). To improve these paths for horses, the variously spaced paving stones that marked the foot trail were removed and curb stones were added to mark the edges of the trail and guide the horses. It is uncertain exactly when the foot trail was altered into an "improved road." Alfred Hudson thought it was constructed right before the Wilkes Expedition of 1840-1841, since Wilkes (1845) states, "In some places they have taken great pains to secure a good road or walking path; thus, there is a part of the road from Nanavalie [Nānāwale] to Hilo which is built of pieces of lava. […]" However, Lass does not believe this was a horse trail, since Wilkes also states, "[T]he road is exceedingly fatiguing to the stranger, as the lumps are so arranged that he is obliged to take a long and a short step alternatively, but this the natives do not seem to mind, and they pass over the road with great facility […]" (Wilkes 1845:191). This suggests the trail was made of variously spaced paving stones. During a tour of Puna in 1848 by the missionaries Henry Lyman and Titus Coan, no mention is made of an improved road. Lass (1997:17) believes the present form of the Old Government Road was constructed around the early 1870s.

4.2.1.2 Land Use

The U.S. Army Engineer Division contracted for an archaeological and historical literature search as part of the Lava Flow Control Study for Hilo, Hawai‘i (McEldowney 1979). The search included Kea‘au and surrounding *ahupua‘a* in the Hilo and Puna districts, encompassing the northern approximate half of the Puna district. Significant to the current project are the geographic and ecological zone classifications for early historic-period land use, which are presented in the report. These five zone classifications (McEldowney 1979:64) are listed below, and are pictured in Figure 9.

I: Coastal Settlement
II: Upland Agricultural
III: Lower Forest
IV: Rainforest
V: Subalpine or Montane

The coastal settlement land extends from the shore to about a half-mile inland (at 20-50 ft in elevation). The upland agricultural zone was once an open grassland band extending up to 3 miles inland and 1,500 ft in elevation; this zone contained scattered agricultural features and some temporary residence.

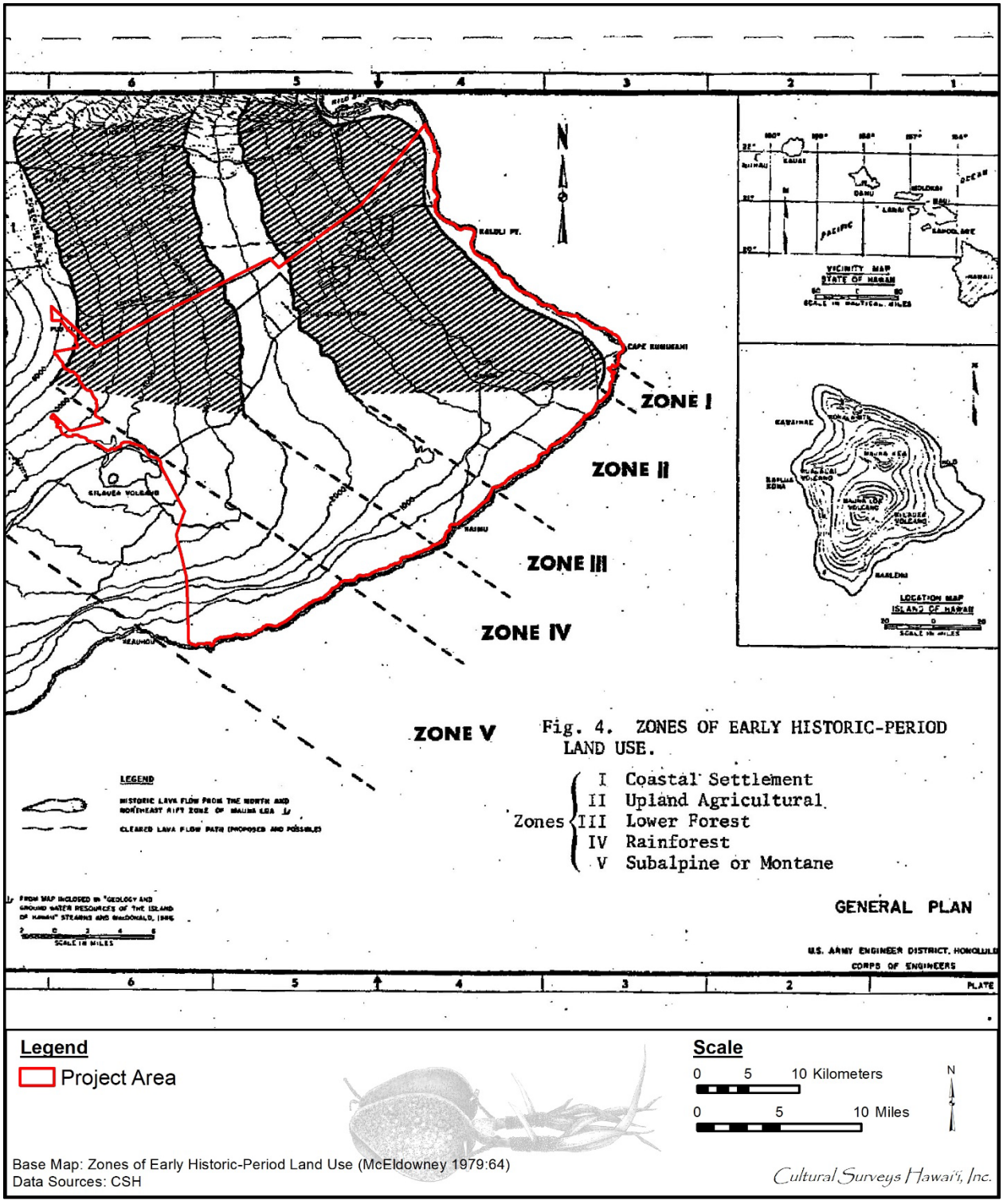

Figure 9. Map showing Zones of Early Historic-Period Land Use as described by McEldowney (1979:64) in relation to the northern half of the project area

The lower forest, beginning at elevations of 1,500 ft to 2,500 ft, was used to gather resources such as wood, bird feathers, fiber, and some food crops. The upland rainforest, at elevations from 2,500 ft to 5,500 ft, was used mainly by bird catchers to collect feathers and to gather other resources not available at the lower elevations. In the post-Contact era, the forest areas were also used for the collection of resources that could be sold as trade items to foreigners, such as sandalwood and *pulu* (McEldowney 1979). *Pulu* is the soft substance at the base of *hāpu‘u* ferns, which was shipped to California to be used for furniture and mattress stuffing (Baxley 1865:596; see also Section 3.4.1.2). The sub-alpine zone was located at elevations above 5,500 ft. Trails from one district to another are the major features found in this subzone.

The missionary Titus Coan described the forested lowlands of Puna, which at the time were still lightly inhabited and used for agriculture:

> The inhabited belt is one to three miles wide and in a few places there were hamlets and scattered villages five to ten miles inland. Beyond this narrow shore belt there is a zone of forest trees with a tropical jungle from ten to twenty-five miles wide, almost impenetrable by man or beast. [Coan 1882:29]

In Puna, historic accounts relate the cultivation of taro in cleared forest areas, dryland taro and sweet potatoes from the lower forest edge, and breadfruit and coconut trees near the coast. E.S. Craighill Handy related several methods of cultivation common and unique to Puna:

> In the wet, lowland forests of Puna, taro used to be planted under the pandanus trees, which were felled and cleared to let in the sun after the taro had rooted and put forth the first grown of leaves. It is said that here the cutting was planted wrapped in a roll of dry pandanus leaf to keep it moist and give it nourishment in the stony ground of the lava-covered lowlands. [Handy 1940:53]

> Despite the fact that sweet potatoes were planted almost universally and many patches are still maintained [as of 1931-1932], the Puna natives seem to regard this vegetable with little interest, probably because Puna people prided themselves upon and relished their breadfruit, and also because potato was nowhere and at no time the staple for this rainswept district. [Handy 1940:165]

Charles Wilkes and others described the myriad methods of sweet potato cultivation in Puna:

> [Potatoes] […] are seen to be growing literally among heaps of stones and pieces of lava, with scarcely soil enough to cover them; yet they are, I am informed the finest on the island. [Wilkes 1845:4:188]

> [Potatoes are planted] […] by digging holes in the lava where it was a little decayed, carrying a handful of earth to each of these holes, and planting there in a wet season, he got a very satisfactory crop. [Nordhoff 1874:94]

> The natives pick out the stones to the depth often of from 2 to 4 feet, and in the bottom plant the potato—how it can expand in such a place is a wonder. [Lyman 1846, July 7]

> [Potatoes are planted in] […] the holes dug among the stones to receive the potatoes where some of them 6 feet in depth—thus securing a degree of moisture and shelter from the sun though no more soil than at the surface. [Lyman 1846, July 13]

Titus Coan (1882:40) noted arrowroot, cotton, coffee, oranges, citrons, limes grapes, and other fruits and vegetables were grown in Puna. Handy and Handy (1972) also mention the unusual cultivation of breadfruit in Puna: “Except in Puna, Hawaii, breadfruit was wholly secondary to taro and sweet potato as a staple. We are told that in Puna in a good year, breadfruit may be eaten for eight months of the year, beginning with May” (Handy and Handy 1972:152).

4.2.2 Ka‘ū District

Missionary William Ellis visited Kīlauea during his 1923 tour, providing the first known written account of the volcano:

> The volcano of Kirauea, the largest of which we have any account, and which was, until visited by us, unknown to the civilized parts of the world, is situated in the district of Kapapala, nearly on the boundary line between the divisions of Kau and Puna, twenty miles from the sea-shore. [Ellis 1963:179]

Ellis’ party approached Kīlauea from the Kā‘u side, crossing the Ponahohoa Chasm in Kapāpala which was associated with a recent eruptive event (Ellis 1963:141). Ellis’ guide was a resident of Kapāpala, who “owned a small garden near.” Ellis generally described this area of Kapāpala, situated between the sea and the foot of Mauna Loa, as fertile land, noting “The road by which we returned lay through a number of fields of mountain taro, which appears to be cultivated here more extensively than the sweet potato” (Ellis 1963:152). He also noted the use of caves in the area, both for residence and collection of water (Ellis 1963:154, 157).

A 1953 National Park Service publication describes how accommodations for early tourists to the volcano began to develop over the years following Ellis’ visit:

> In the short span between Ellis’ visit in 1823 and the early 1840’s, Kilauea began coming into its own and more and more visitors came to marvel at it. Shelters improvised from boughs, grass, fern fronds, and other readily available materials were constructed one after another to protect visitors from the damp climate of the region, but these lasted only briefly. The *Polynesian* for July 20, 1844, reported that visitors to Kilauea would be gratified to learn that an enterprising Hawaiian had erected a comfortable thatched house on the brink of the crater, provided food, and in other ways added to the comforts and conveniences of travellers [*sic*].
>
> This first business enterprise at Kilauea apparently did not receive much patronage, for it was out of business in 1846 when Benjamin Pitman, Sr., a Hilo businessman, built a grass hut on the northeastern side of the crater and appropriately called it the Volcano House, a name which was to last for a long time. James J. Jarves, Editor of the *Polynesian*, visited Kilauea in the fall of 1847 and reported to his readers on the rates at the Volcano House: 37-1/2 cents for a fowl, 62-1/2 for a hen turkey, 25 for a small calabash of potatoes, and $1 a head for lodging.

> Pitman’s enterprise apparently did not prove lucrative either, for Charles Hitchcock, an 1856 visitor, found the grass house but no sign of life in it, not even the manager. The primitive Volcano House of the day consisted of one room about fourteen by twenty feet in size. A mat covered the earthen floor. An 1860 visitor claims that twenty-three persons slept in that small space one night, another that it was capable of accommodating forty! [National Park Service 2006]

Aside from the ongoing activities at the summit, land use in the vicinity of the project area during this time would have likely represented a continuation of traditional activities, predominately the collection of forest resources.

4.3 The Māhele and the Kuleana Act

In the mid-nineteenth century, during the time of Kamehameha III, a series of legal and legislative changes were brought about in the name of land reform (see the works of Jon Chinen 1958, 1971 for a thorough and well-written explanation). Before the Māhele, all land belonged to the *akua* (gods), held in trust for them by the paramount chief, and managed by subordinate chiefs.

Following the enactment of a series of new laws from the mid-1840s to mid-1850s, Kamehameha III divided the land into four categories: Crown Lands reserved for himself and the royal house; Government Lands for the government; Konohiki Lands claimed by *ali‘i* and their *konohiki* (supervisors); and *kuleana*, small plots claimed by the *maka‘āinana* (commoners) (Chinen 1958:8–15). These claims are described in Land Commission Award (LCA) testimony from the claimants and witnesses. A Royal Patent (RP), which quit-claimed the government’s interest in the land, was issued on most Land Commission Awards (Chinen 1958:14). In some cases, more than one RP number was issued for an LCA, especially in cases where there were several widely separated *‘āpana* (lots), such as an award with agricultural land in one *ahupua‘a* and a house lot in another.

Ali‘i were required to pay a commutation fee to the government for their confirmed Konohiki Land titles; this payment could be in cash or in the return of land to the government or crown. Many *ali‘i* elected to return substantial portions of their awarded lands to avoid the one-third commutation cash fee. The Kuleana Act of 1850 allowed *maka‘āinana*, in principle, to own land parcels where they were currently and actively cultivating and/or residing. In 1851, certain Government Lands became available for purchase in lots of 1 to 50 acres in fee simple; this new category of land ownership became known as Royal Patent Grants or Land Grants.

Although many Hawaiians did not submit or follow through on claims for their lands, the distribution of LCAs can provide insight into patterns of residence and agriculture. Many of these patterns probably had existed for centuries past. Examining the patterns of *kuleana* LCA parcels in the vicinity of the project area provides insight into the likely intensity and nature of Hawaiian activity in the area.

4.3.1 Puna District

The Māhele disposition of each *ahupua‘a* in Puna (i.e., classified as belonging to the Crown, Konohiki, or Government) is listed below in Table 2.

Very few *kuleana* awards were granted in all of Puna. One *kuleana* comprising 13.64 acres was awarded in Kea‘au, to Hewahewa (LCA 8081, Royal Patent 4360). The claim indicated the land was unfenced with no house, and that coffee was being grown (Hurst 1994:12–13, 17). This parcel was sold to the Roman Catholic Church in 1865. According to Lyman (1924, 10 July 1846) “one [*kuleana* award] for 13+ acres in Kahaualea, was to Baranaba an early convert to Christianity, and Rev. Titus Coan […] the other, for 7+ acres in Kehena was to one Haka.” Other *kuleana* may have been awarded but the general takeaway from the current research is that these awards are few and far between in Puna.

The general absence of *kuleana* awards throughout the Puna district may indicate the paucity of habitation in the region during the mid-1800s. The lack of *kuleana* awards along the coast, where numerous villages were documented by travelers in the early part of the century, due to a tsunami devastating the coast of East Hawai‘i sometime before 1846, or may be more related to political and/or other social factors than a total absence of inhabitants. Unfortunately, *kuleana* data cannot be utilized to reconstruct mid-1800s settlement patterns for Puna.

4.3.2 Ka‘ū District

In the Māhele the *‘ili* of Keauhou was awarded to and retained by Victoria Kamāmalu. Kapāpala was claimed by Kamake‘e Pi‘ikoi who relinquished it in commutation for lands elsewhere, and it was subsequently retained as Crown Lands. Regarding LCA in these land divisions, Maly and Maly (2005) note,

> Unfortunately, our review of all records submitted to the Commissioner to Quiet Land Titles, revealed no applications from native tenants for *kuleana* in the *‘ili* of Keauhou, or the larger *ahupua‘a* of Kapāpala. And only one claim was made for the neighboring land of ‘Āpua [in Puna] by Kumauna (*Helu* 11091), which was not awarded. The absence of claims is unexplained in any records reviewed, though we know from traditional and historical accounts, both pre- and post-dating the Māhele, that individuals were living at [the village of] Keauhou (and in the larger area of Kapāpala), and working the lands from sea level to the forest and mountain zones […] [Maly and Maly 2005:210]

Table 1. *Ahupua‘a* of Puna with Acreages and Māhele Disposition

Ahupua‘a	Acreage (approx.)	Disposition of land after the Māhele (Crown, Government, or Konohiki)
Ahalanui, Laepao‘o, Oneloa	1,338	Government, Government, Government
‘Āpua	10,488	Crown
Halepua‘a, Kānekīkī	1,659	Government, Government
Honolulu	368	Government
Hulunanai	443	Not named in Māhele Book
‘Ili‘ililoa	76	Not named in Māhele Book
Kahauale‘a	27,323	Konohiki
Kahue	4,627	Not named in Māhele Book

Ahupua‘a	Acreage (approx.)	Disposition of land after the Māhele (Crown, Government, or Konohiki)
Kahuwai	3,084	Konohiki
Kaimū, Mākena	4,867	Crown, Government
Kalapana, Kupahua	6,811	Government, Government
Kamoamoa	10,660	Konohiki
Kapoho	4,204	Konohiki
Kauaea	1,651	Konohiki
Kaueleau	2,288	Government/Konohiki
Kaukulau	463	Government
Kea‘au	65,460	Konohiki
Keahialaka	5,677	Konohiki
Kealakomo	4,677	Government
Keauohana, Kehena, Ke‘eke‘e	2,730	Government, Konohiki, Not named in Māhele Book
Keonepoko 1	4,661	Government
Keonepoko 2	3,102	Government
Kīkala, Kēōkea	3,111	Government/Konohiki, Government
Kukuihala, Kamā‘ili	2,776	Not named in Māhele Book, Government
Kula	3,326	Konohiki
Laeāpuki	3,634	Government
Maku‘u, Pōpōkī, Hālona	8,431	Government, Government, Government
Malama, Kī (boundary of these lands never surveyed, so they are always written “Malama-Kī”)	1,888	Government
Nānāwale	1,280	Government
‘Ōla‘a	60,464	Crown
‘Opihikao	1,164	Government
Pānau	14,463	Konohiki/Government
Pohoiki	666	Government
Poupou, Pūlama	3,083	Government, Government
Pū‘āla‘a	1,021	Konohiki
Pu‘ua	4,875	Konohiki
Wa‘awa‘a	850	Government
Waiakahiula, Ka‘ohe	32,271	Konohiki, Government

Ahupua‘a	Acreage (approx.)	Disposition of land after the Māhele (Crown, Government, or Konohiki)
Waikahekahe	2,909	[see below]
Waikahekaheiki	3,848	Konohiki
Waikakekahenui	4,166	Konohiki

4.4 Mid- to Late 1800s

4.4.1 Puna District

4.4.1.1 Population Changes

The mid-1800s were marked by a decline in population throughout Hawai‘i. Cordy (2000:49–50) estimates there may have been 12,000–15,000 people in Puna (29,000 for Puna and Hilo combined) at the time of first Western Contact (AD 1778). Population for each *ahupua‘a* may have ranged from 50 to 100 residents, based on the size of the *ahupua‘a* and the availability of food resources. By the time of the first missionary census, the combined population of the districts of Hilo and Puna was 12,500, a decline of over 50% for Puna. Soon after Contact, people began to move to port cities or other trading areas. Since Puna has no good harbor, it lost a large portion of its population to out-migration.

The missionary Rev. Titus Coan estimated the population of Puna was 4,371 in the year 1841, which stayed constant until at least 1846, when Chester Lyman visited the area. However, in a second journey to the area in 1871, Lyman (1924:103) noted a rapid depopulation: “There are but few people in this region […] miserably poor and for some time past have been almost in a state of famine.” Decreasing population was also the result of the introduction of many foreign diseases, to which the Native Hawaiians had no natural immunity. Four epidemics occurred in 1848 and 1849, killing at least 1,000 people in the Hilo and Puna Districts (Coan 1882:260; Crozier and Barrère 1971:7; Lyman 1906:168–169). Furthermore, destructive earthquakes in the spring of 1868 caused a 75-mile stretch of the Puna-Ka‘ū coastline to subside and a tsunami destroyed numerous coastal homes and villages (Coan 1882:314–316).

By 1860, the population of Puna was only 2,200 people, and by 1890, it had decreased to only 800 people (Schmitt 1968:71). Titus Coan wrote in 1882, “Our people are now greatly diminished by death, and by being drawn away to the numerous plantations of the islands, upon ranches, in various industries with foreigners, and by hundreds into Honolulu, and on board vessels […]” (Coan 1882:121). Also visiting in the 1880s, Captain Dutton noted, “The native population is somewhat scanty and has undergone a great decrease within the present century, as in all other parts of the island” (Dutton 1884:147).

4.4.1.2 Advent of Commercial Enterprise

One of the earliest commercial endeavors in Puna was the harvesting of *pulu*, the soft yellow wool from the base of the tree fern used for stuffing mattresses and pillows. Shipments were first sent to California in 1847. That year 14,327 pounds, valued at $573.08, shipped out. By 1860, the *pulu* industry had peaked with 650,000 pounds exported. By 1884, only 500 pounds were shipped to the States (Thrum 1911:10). A Mission Station Report of 1860 relates the ruinous effect upon the native population of participation in the *pulu* trade:

> The effect—on them—is not good; not that the pulu is not a source from which they might secure comfort to themselves and families, but the actual result is the reverse. They are offered goods to almost any amount, to be paid for in pulu; this to a native is a strong temptation to go into debt. Consequently many of them are deeply in debt and almost all to some extent. The policy of the traders is to get them in debt and to keep them there so long as possible […] [T]hey are almost entirely under the control of their creditors, and are compelled to live in the pulu regions, at the peril of losing their houses and lots, and whatever other property they may possess. Thus their homes are almost in reality deserted, ground uncultivated. [W.C. Shipman 1860]

Coffee cultivation was first attempted in Puna by the 1890s. According to McEldowney (1979:40) "[i]n 1898 government land in Ola‘a was divided into homesteads to foster a projected coffee industry which, due to drops in the international price of coffee, a severe blight, and a poor choice of farm plots, barely lasted two years." Around 1894 a man named Robert Rycroft also grew coffee on about 35 acres in Pohoiki and developed a mill downslope near Pohoiki Bay (Cordy 1977:4). The fledgling coffee industry of Puna could not compete with similar growers in the Kona region, and coffee operations in Puna declined after 1905 and disappeared completely by 1927 (University of Hawai‘i 1927 in Cordy 1977:4). Coffee trees continued to grow in scattered clumps in the area, but local informants who lived in the area in the mid-twentieth century said the beans were not harvested (Kennedy et al. 1991:20).

Meanwhile, ranching was also being attempted in Puna. In 1860 the estate of Lunalilo (including the lands of Kea‘au) was mortgaged to Mr. Charles R. Bishop. The lease for Kea‘au subsequently passed to a series of holders including Rufus A. Lyman among others (Maly 1999:69, 77, 80, 83). Lyman also secured leases during this time to the lands of other Puna *ahupua‘a* (Maly 1999:79–80). According to Henke (1929:33), Keaau Ranch was established about 1875 by Lyman, Bishop, and partners including P.C. Jones, John Paty, and others, but in 1877 the lease and business interests in Kea‘au including the ranch were purchased by William H. Shipman and J.E. Eldarts (Maly 1999:84). A few years later in 1882 all of Kea‘au and Waikahekahehenui to the south were sold to W.H. Shipman, Samuel Damon, and J. Elderts (Maly 1999:91–92). Shipman later purchased the interest of his other partners to become the sole owner (W.H. Shipman Ltd. 2022).

During this time travel was conducted over a few well-established cart roads and smaller lateral foot or horse trails. An 1886 map (Figure 10) depicts the “Hilo and Volcano Road” extending from Waiākea in Hilo through ‘Ōla‘a and Kea‘au to the Kīlauea Summit; the “Puna Road” running from Hilo along the Puna coast to Kahaualea where it then turned upslope and back up to the summit; and a branch from this latter road accessing a landing at Keauhou in Ka‘ū. An 1893 map of Puna (Figure 11) shows similar access routes and very limited development throughout the project area, aside from a large new area of homestead lots within ‘Ōla‘a. The establishment of homesteads and improved access in Puna toward the end of the nineteenth century also provided economic opportunity for small-scale farmers:

> In the 1890s, the Government was also opening up large tracts of Homestead lands throughout Puna, which were sold for residential and agricultural use. Because the rich agricultural parcels were generally situated three or more miles inland, above the 400 foot elevation Homestead lands could be better accessed, and their produce better transported by a new and more direct inland route between Puna and Hilo. [Maly 1999:6]

This new transportation route through inland Puna was first surveyed by A.B. Loebenstein in 1892. Thus, “the basic alignment of the Kea‘au-Pāhoa Highway (now Highway 130) was established and construction underway in 1895” (Maly 1999:6). This new route, as well as the extent of homestead tracts in relation to other land use areas, is depicted in a 1906 map of Hawai‘i Island (Figure 12).

A newly improved Volcano Road was completed in 1894, extending from Hilo through Shipman lands in Kea‘au to the summit of Kīlauea. This road provided an improved access route for visitors to the volcano, accommodating four-horse stagecoaches and “reducing the travel time from Hilo from two days to six and one-half hours” (National Park Service 2006). This significant reduction in travel time would have meant fewer and/or shorter stops at places of rest along the way, including the “Olaa Halfway House” shown on Figure 10; this specific location was mentioned in many of the early historic accounts of travelers to the volcano. Hilo became the principal departure point for Kīlauea, rather than other places in Ka‘ū. An 1893 article in a Hawaiian language newspaper describes how development of the route was transforming the surrounding landscape:

> The sections of Crown Land, adjoining the road have been leased. There are twelve miles of road that pass these lands, and the people are now working hard to cultivate the land. There are also many good houses that are being built, though those who travel along the road do not even see half of the areas worked, and they are hidden by the forest. This is because the forest has been protected from planting and from taking wood from along the road side […] The land of Olaa, which has been left from ancient times as wilderness (*nahelehele*), is now being planted in gardens since the making of this good road. [*Ku Okoa*, 26 August 1893:3, translated in Maly and Maly 2005:270]

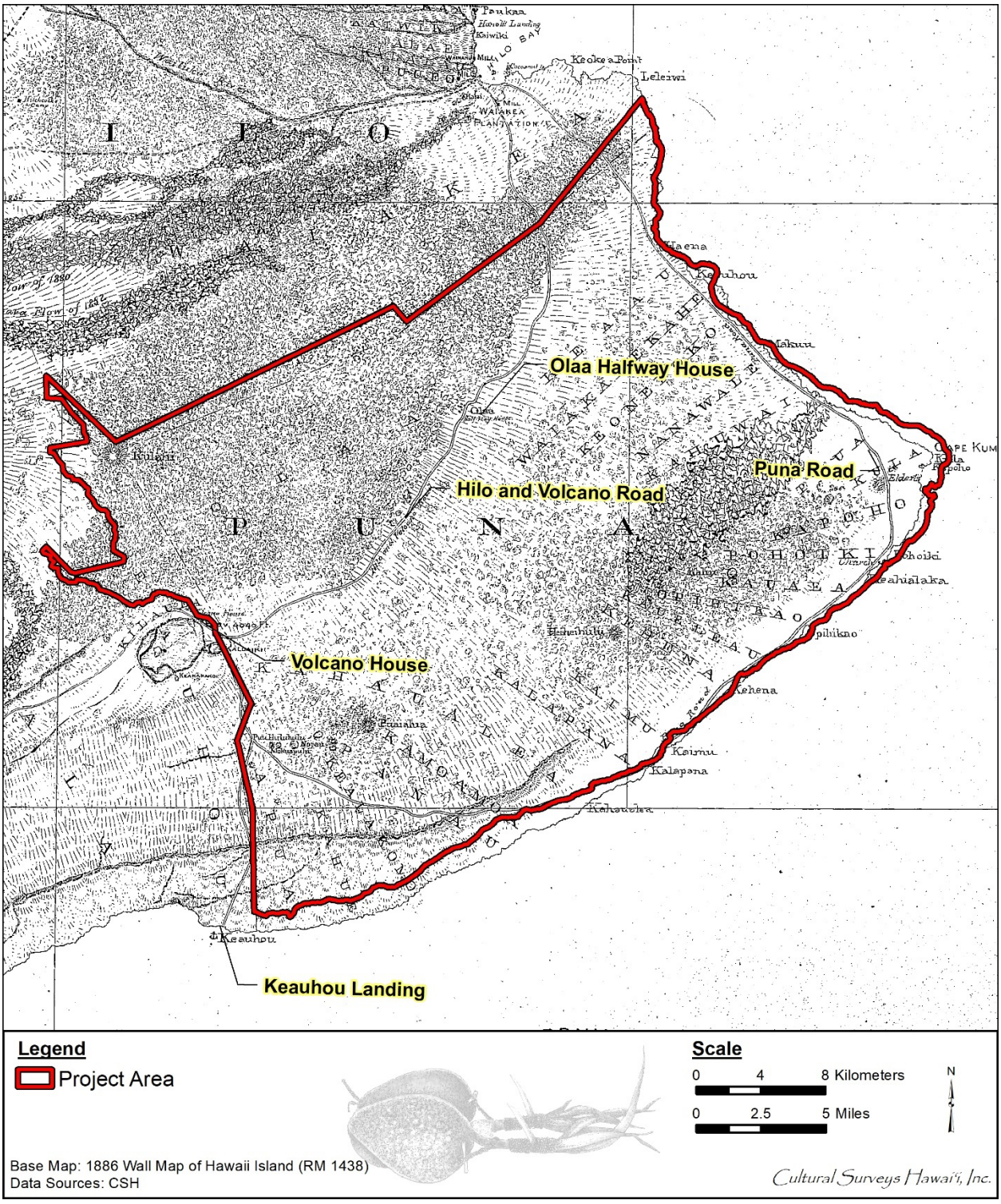

Figure 10. Portion of the 1886 Wall map of Hawaii Island showing the various roadways and places of lodging and the landing at Keauhou in Ka‘ū

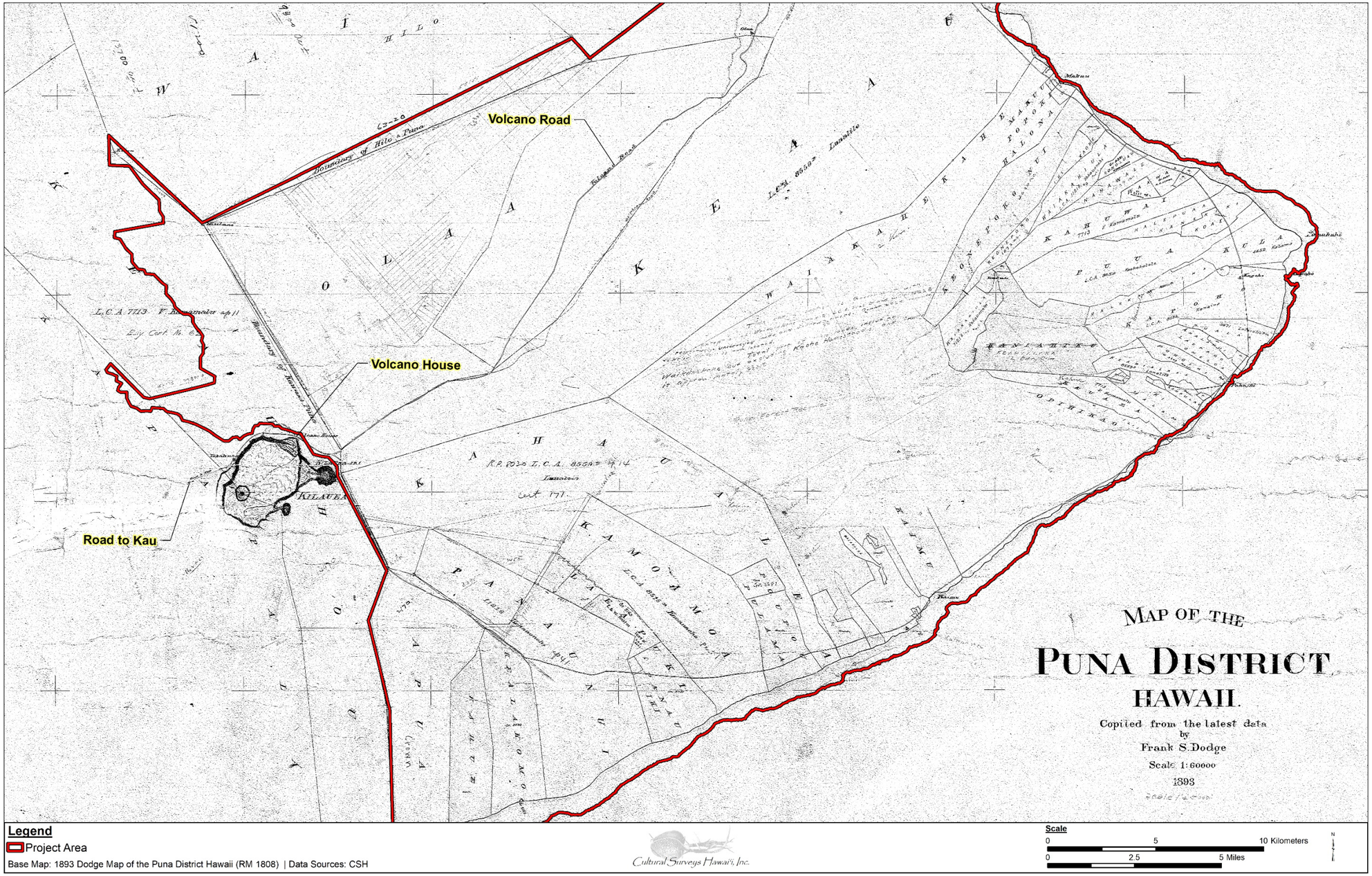

Figure 11. Portion of the 1893 Dodge map of Puna District showing roadways, Volcano House, and the grid-like homestead lots in upper ‘Ōla‘a

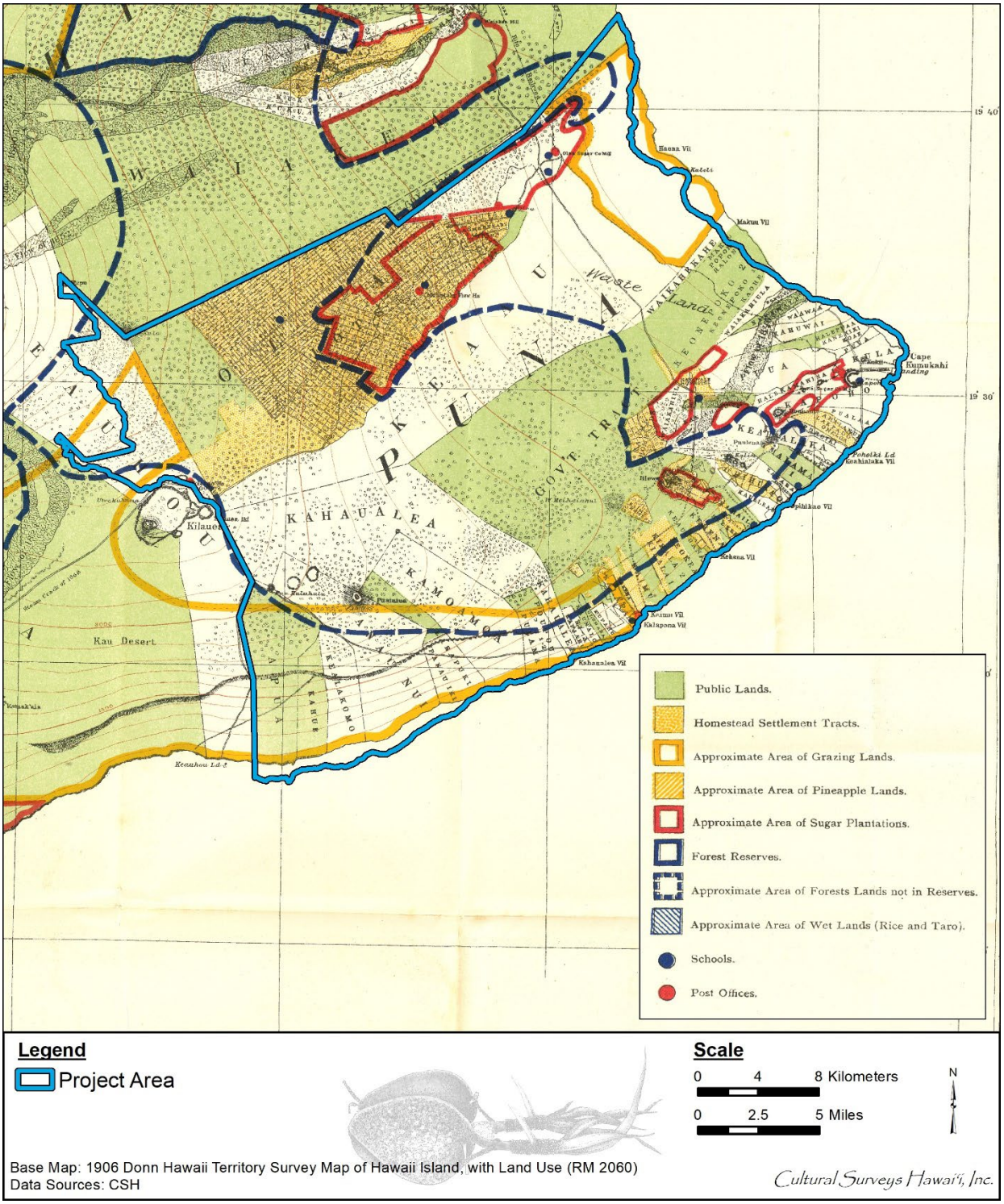

Figure 12. Portion of the 1906 Donn Hawaii Territory Survey map of Hawaii Island showing the new upslope road, various areas of different land use, villages along the coast, post office and school locations, the railroad, and other features; note the area labeled as “Waste Land” crossing upland Kea‘au to Keonepoko

4.4.1.3 Bernice Pauahi Bishop Estate

Another significant development during the late 1800s was the establishment of Bishop Estate. Lands retained by the *ali‘i* Victoria Kamāmalu in the Māhele and passed down through the royal family to Bernice Pauahi Bishop formed the basis of the Bishop Estate following her death in 1884. According to researcher Peter Young (2022), “her combined lands were dedicated to the establishment of the trust forming the Bishop Estate and the subsequent forming of Kamehameha Schools.” As a result, Bishop Estate was situated to lease large acreages in Puna and elsewhere for agricultural purposes.

4.4.2 Ka‘ū District

During the latter 1800s the vicinity of the project area in Ka‘ū was largely influenced by the establishment of ranching and ongoing activity around the Kīlauea Summit. In 1863 Chiefess Kamāmalu and her father M. Kekūanao‘a formally leased lands in Keauhou for the development of goat and cattle ranching, *pulu* and timber harvesting businesses, the Keauhou boat landing at the coast, and a new Volcano House (Maly and Maly 2005:275; Young 2022). In 1866 the Volcano House was reconstructed offering more comfortable quarters and amenities to guests. A new, larger building was completed in 1877, which was expanded again in 1891 (National Park Service 2006); the location of Volcano House is depicted on both Figure 10 and Figure 11.

Mark Twain was among those who visited Kīlauea during this time period. During his visit in 1866, he noted the trail markers (*ahu*) or “pyramids of stones painted white, […] set up at intervals to mark the path to the lookout house and guard unaccustomed feet from wandering into the abundant chasms that line the way” (Twain 1866 in Day 1966:293). Kawachi (2003:6) remarks that modern roads were often build over older trails, likely obliterating “trail markers and other cultural resources such as those seen by Twain in 1866.”

Twain also remarked the “the whole country is given up to cattle ranching” (Day 1966:289). This activity was occurring on both a subsistence scale and larger commercial scale during this time period. Kapapala Ranch was a commercial venture established in Kapāpala Ahupua‘a ca. 1860, with headquarters “located *mauka* of the government road about six miles on the Hilo side of Pahala” (Henke 1929:35).

The deadly 2 April 1868 earthquake—considered the largest recorded earthquake in the history of Hawai‘i Island—caused a landslide and tsunami that washed away the ancient village of Keauhou (Pukui et al. 1976:104), among other coastal villages through Ka‘ū and Puna.

In the late 1880s Captain Peter Lee oversaw completion of a carriage road between Pāhala and the Kīlauea Summit. This road, depicted on Figure 11 as the “Road to Kau,” served as a primary access for those visiting the summit until the Volcano Road through Puna was completed in 1894 (National Park Service 2006).

4.5 Early to Mid-1900s

4.5.1 Puna District

4.5.1.1 Sugar Industry

In May 1899 Olaa Sugar Company leased 3,812 acres of land in ‘Ōla‘a (Pāhoa up to Mountain View) from W.H. Shipman for a term of 40 years (Maly 1999:59). Several more land

exchanges were made the same year. The lands were allowed to be cleared (by horse and mule) for the cane fields, preserving only certain fruit trees, and by 1901 the Olaa Sugar Company held 4,000 acres of land under cane cultivation, employing 1,100 men (Hurst 1994:14–17). Development of the plantation between 1900 and 1905 “included construction of the railroad, Ola‘a Sugar Mill, shops and stores, public and Japanese language schools, churches, a cemetery, and labor camp housing” (Hurst 1994:15). Many of these new features are shown on Figure 12 in relation to the extent of plantation lands and homestead tracts as of 1906. This industrial expansion in Kea‘au marks the beginning of massive landscape alterations and clearing operations which would have obliterated most, if not all, above-ground archaeological features present on the plantation lands. Notably, Figure 12 describes the upland portion of Kea‘au to Keonepoko below the forest reserve as “Waste Land” not being used for even grazing.

The sugarcane fields eventually stretched from the south Hilo border to Cape Kumukahi, then west to inland areas of south Puna. The plantation employed share laborers and ethnic workers including Japanese and, later, Filipinos, living in plantation camps (Hawaii Sugar Planters’ Association 1992; Takaki 1983:27). In 1936, the Olaa Sugar Company made the merger official and took over the Puna Sugar Company, which was based in Pāhoa and only operated for six years (Condé and Best 1973:93). Prior to that, the Puna Sugar Company operated as a division of the Olaa Sugar Company (Dorrance and Morgan 2000:107).

4.5.1.2 The Hilo Railway Company and the Timber Industry

A 40-ft right-of-way from Kea‘au to Hilo was granted to the Hilo Railway Company in December 1899; the right-of-way was to revert to Shipman when the railway was no longer in use (Hurst 1994:15). In 1900, a 17-mile coastal extension was constructed to the sugarcane fields near Kapoho. Spurs were built inland to additional fields in Pāhoa and Kama‘ili. The rail transportation occurred primarily from the ‘Ōla‘a, Pāhoa, and Kapoho fields and was used to haul sugar to the mill in ‘Ōla‘a. In 1901, the railway was extended from 8 ½ mile camp south to the Mountain View/Glenwood vicinity, at the 17-mile mark of Volcano Road (Condé and Best 1973:99, 211, 388). The extended railway was also used by tourists visiting the Kīlauea Summit:

> Visitors transferred from the railroad coaches to horse-drawn carriages at Glenwood and later to motor buses for the remainder of the trip to Kilauea. Increasing acceptability of the horseless carriage and improvement of the Volcano Road caused the Hilo Railroad to discontinue its Glenwood run in 1926. By this time, surfacing of the Volcano Road to the park boundary had been almost completed. [National Park Service 2006]

In 1907, the Hawaiian Mahogany Lumber Company (later called the Pāhoa Lumber Company) was founded, initially for the purpose of making *‘ōhi‘a* wood rails for the railroad. Much woodland was cleared in ‘Ōla‘a, but the woodcutting was also conducted in other areas of Puna:

> Most of the ties for this contract will be cut in the Puna District on homestead lots above Olaa on lands of the Puna plantation that are being cleared for cane, and on other lands in Puna on which rubber will be planted. The ties will be shipped from Hilo by steamers and sailing vessels, the first shipment being sometime in the spring of 1908. [Board of Commissioners of Agriculture and Forestry 4th report in Condé and Best 1973:101]

Figure 12 shows clearly how extensive the homesteads were in ‘Ōla‘a. McEldowney (1979:41) notes, “Many people who had come from the U.S. Mainland to farm the unsuccessful Ola‘a homesteads eventually moved to Hilo and contributed to its increasing diversity.”

In 1914, the Hilo Railway Company went into receivership and was reorganized as the Hawai‘i Consolidated Railway. Portable tracks were used in the cane fields until 1945. Figure 13 shows the extent of the railway at that time. Prior to using the portable tracks, loaded carts were pulled by mule to the main line. On 1 April 1946 a tsunami inundated the railway on the Hāmākua Coast and in Hilo, forcing the Hawai‘i Consolidated Railway Company out of business (Condé and Best 1973:99, 211, 388). However, portions of the Puna Division continued to be operated by the Olaa Sugar Company until 1948, when trucks took over the transportation of the sugarcane (Treiber 2005:59).

4.5.1.3 Ranching

By the 1920s the Kea‘au Ranch consisted of 50,000 acres, extending from the coast to elevations of 1800 ft amsl (Henke 1929:32). The ranch stretched from ‘Ōla‘a in the north to Pāhoa in the south. In his survey of cattle ranches on Hawai‘i Island, Henke (1929) provides the following additional information:

> The ranch formerly included lands in the Waiakea and Keaau sections now planted to sugar cane.
>
> Much of this land is pahoehoe and aa lava (undated flows) sufficiently decomposed and covered with thin soil in many places to afford mediocre pasturage. Fruit trees do particularly well in these partially decomposed aa flows.
>
> The ranch carries about 4,000 grade Herefords with about 100 bulls, 25 purebred and the other high grade. All cows except those kept for breeding cows are spayed. The rough character of many parts of the ranch necessitates more bulls than would otherwise be needed.
>
> The ranch has about 70 miles of fences, both stone and wire. Holes for posts have to be blasted in the lava. The region has a rather heavy rainfall, 106 inches in 1925, 85 inches in 1926 and 196 in 1927 at the ranch headquarters on the sea at Haena and this provides sufficient streams and pools of water for the cattle.
>
> Cattle from Keaau ranch are often sent to a higher ranch, Puu Oo [located on Mauna Kea above Hilo], belonging to the same owner, when about one year old and only about 150 are marketed annually direct from Keaau.

Ranching was never a very lucrative business in the area since the soil was too poor for good pasturage (United States Army Corps of Engineers 1979:88).

4.5.1.4 Forest Reserves

In 1911 the territorial government set apart 19,850 acres of forest in Puna as the Puna Forest Reserve, on the recommendation that such action would allow for collection of revenue from the ongoing timber operations (Uyeoka et al. 2014:286–7). An additional 5,888 acres were added to the Forest Reserve in 1928.

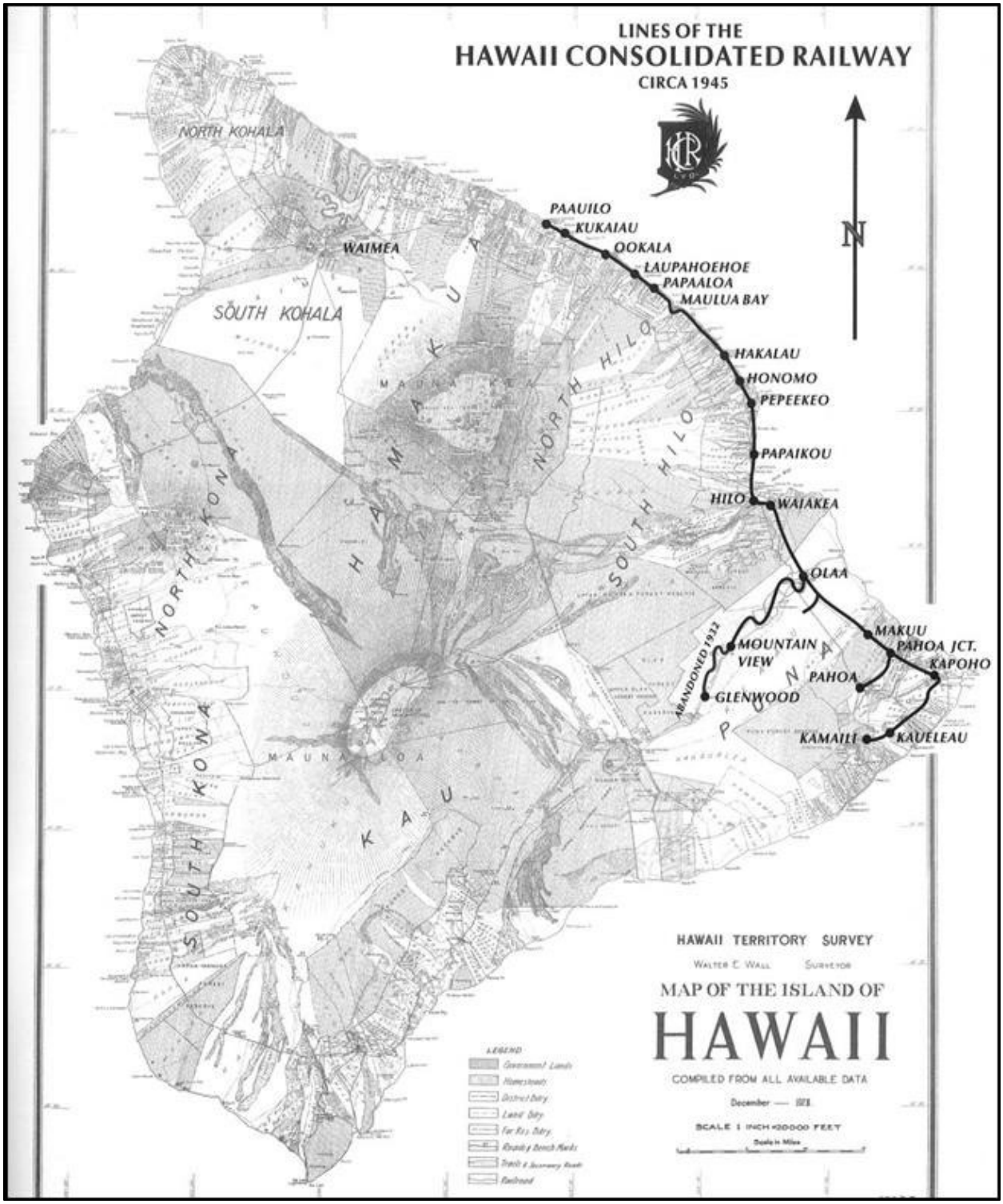

Figure 13. 1928 Territory Survey map of Hawai‘i Island by Walter E. Wall, overlain with the route of the Hawai‘i Consolidated Railway ca. 1945 (figure from Treiber 2005)

According to Maly and Maly (2005:325), between 1913 and 1923 the Upper Waiakea and Upper Olaa forest reserves had also been established on 51,800 acres and 9,280 acres, respectively, both adjoining upper Keauhou in Ka‘ū where the Bishop Estate held forest in private reserve.

In 1918 approximately 20,000 acres in ‘Ōla‘a were recommended to be set apart as the Olaa Forest Reserve. A report from Forester C.S. Judd describes a “heavy forest of native trees […] which is impenetrable except for the roads and trails which have been cut though it,” and notes the prior attempts to farm coffee and raise cattle that had been unsuccessful due to the wet, cool, weather and poor, rocky soil (C.S. Judd 1918 cited in Maly and Maly 2005:328). The report also states,

> Sufficient land has been left out of the area recommended to be set aside to provide for the need of additional homesteads at the *makai* or lower end where soil conditions are more favorable, and a sufficient area at the high elevation near the upper end, not far from the Volcano House, has been reserved for additional summer lots. [C.S. Judd 1918 in Maly and Maly 2005:328]

Establishment of the “Olaa Summer Lots” appears to be the precursor to development of what is now known as Volcano Village. The 1930 USGS topographic map (Figure 14) depicts the extent of the summer lots, a “Volcano School” close to Volcano Road, and another area labeled “Olaa Settlement Lots” to the north.

Additional reserves were also established during the early 1900s in lower elevations of Puna, including the Keauohana, Malama-Ki, and Nanawale forest reserves. Some of these forest reserves in Lower Puna are visible on a 1927 map in relation to homestead areas (Figure 15).

4.5.1.5 Hawai‘i Volcanoes National Park and the Kilauea Military Camp

In 1916 the United States Congress established the National Park Service, and Hawai‘i National Park (later renamed as Hawai‘i Volcanoes National Park or HVNP) was established that same year. The Kīlauea area was by that time already a “popular destination for adventurers, scientists, entrepreneurs, and tourists” (Nakamura 2016:1). Proponents of establishment of the park in the years prior included Lorrin A. Thurston, son of missionary Asa Thurston, and Thomas Jagger, a geologist from the Massachusetts Institute of Technology (MIT) who had served as director of the Hawaiian Volcano Observatory at Kīlauea since 1912 (Nakamura 2016:9–12).

In 1916 the Kilauea Military Camp (KMC) was also established at the Kīlauea Summit within the bounds of the National Park (see Figure 14). Like the National Park, this installation was heavily promoted by L.A. Thurston (Nakamura 2016:14). The KMC website provides the following brief history for the approximately 50-acre camp:

> What once began as an idea by Hilo Board of Trade members for a training ground for the National Guard and an Army ‘vacation and health recruiting station’ has become one of Hawaii’s most unique resorts for the military […]
>
> In its one hundred years of existence, KMC had served as a training facility, housed a Navy camp, hosted numerous dignitaries including General Dwight D. Eisenhower who later became the president of the United States,

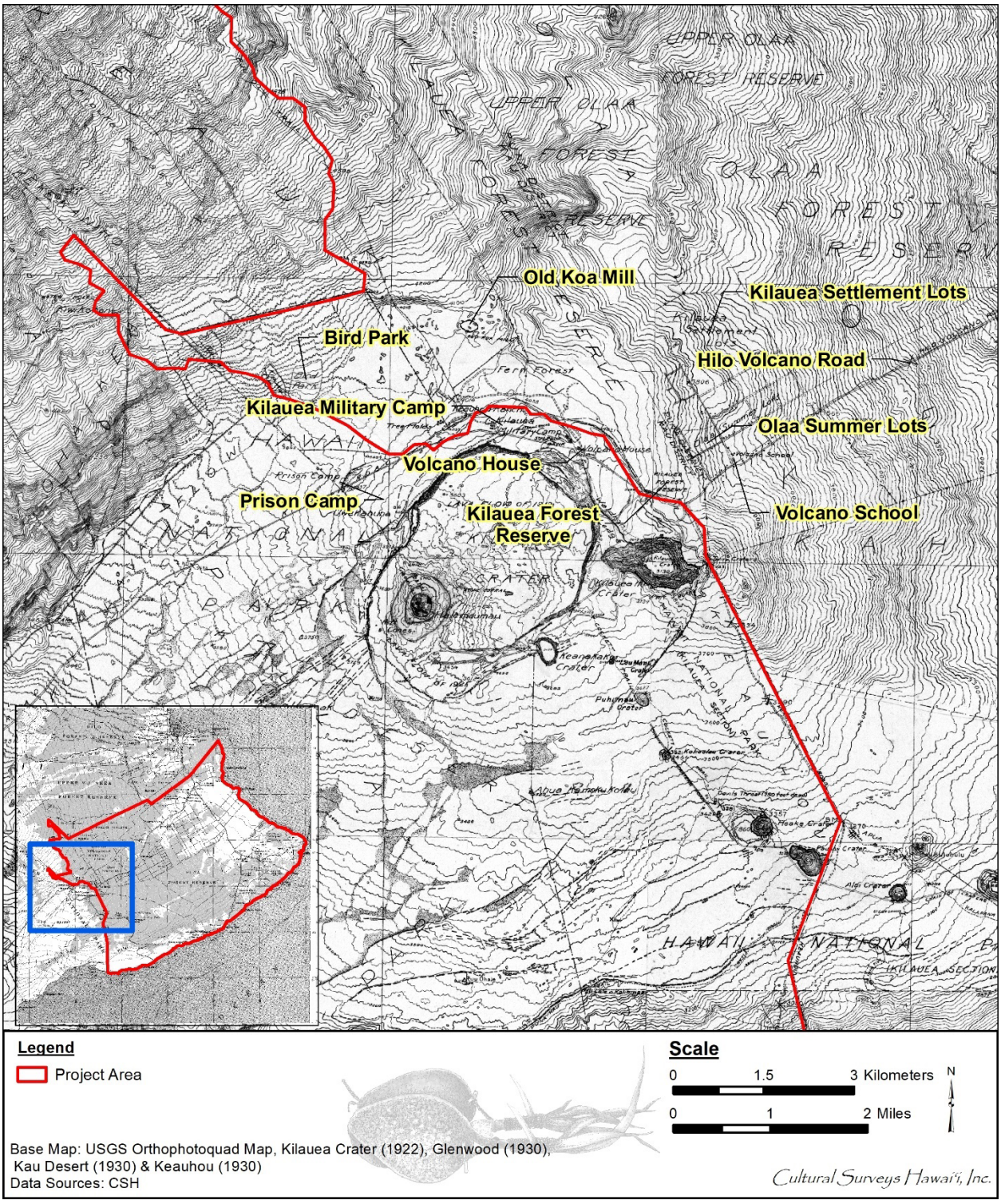

Figure 14. Portions of the 1922 Kilauea Crater and 1930 Glenwood, Kau Desert, and Keauhou USGS topographic quadrangles showing the new Olaa Summer Lots, Kilauea Settlement Lots, Volcano School, and key locations around the Kīlauea Summit

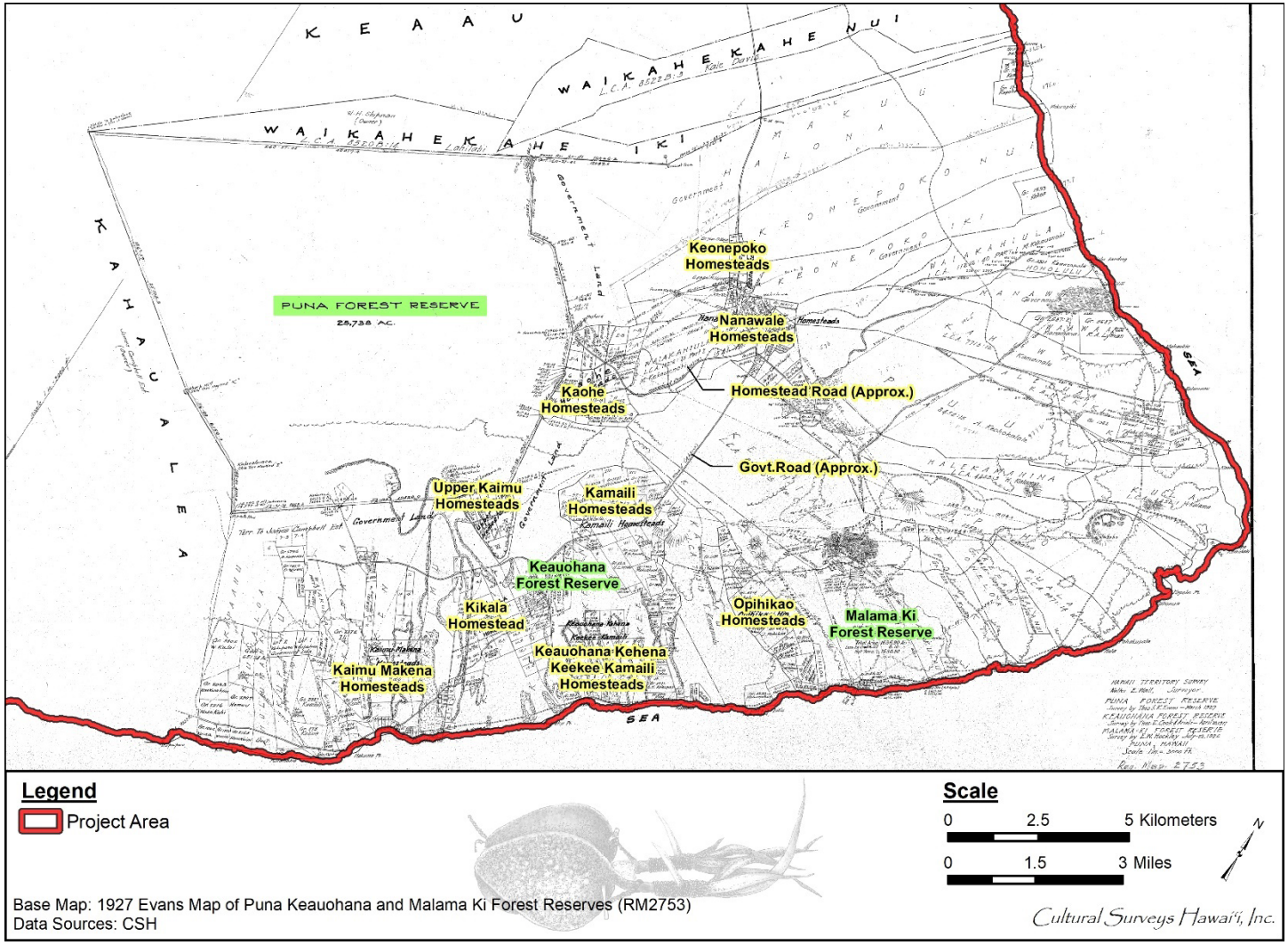

Figure 15. Portion of the 1927 Evans map of Puna Keauohana and Malama Ki Forest Reserves showing forest reserve locations, homestead areas, and roadways

> and briefly served as an internment camp and later as a prisoner-of-war camp during World War II. [Kilauea Military Camp 2020]

While the Kīlauea Summit and KMC are located outside the project area, a large portion of the Kīlauea section of HVNP is within the project area in Puna, and the establishments at the summit are a major draw to the vicinity of Volcano Village and areas north of the summit located within the project area (in Ka‘ū). Many of the features at the summit, as well as major roadways and the extent of the Volcano Village area, are depicted on a 1944 NPS map (Figure 16).

4.5.1.6 Hawaiian Homelands and Residential Developments

The Hawaiian Homes Commission Act of 1920 created a Hawaiian Homes Commission to administer certain public lands, called Hawaiian Home Lands, for homesteads (Department of Hawaiian Homelands 2022). The homestead lots were (and continue to be) leased for a long-term period at a very low rate to be used for residential, agricultural, or pastoral purposes. In Puna, Hawaiian Home Lands lots were established in both coastal and uplands portions of Maku‘u, and the Kā‘ohe-‘Ōla‘a Homesteads were established in upper ‘Ōla‘a upslope near Glenwood.

Starting in the 1950s, various residential subdivisions throughout Puna were incorporated for residential and agricultural use. A brief history of this development found on the website for Orchidlands Estates, one of several residential subdivisions within agricultural-zoned lands in Puna, fairly well sums up life in the district during this time:

> In the early 1900’s the Puna lands were used primarily for raising cattle. The land was marginal at best for farming and ranching, so in the late 1950’s the property owners decided to subdivide and sell off most of this land. The developer’s permits were issued for Orchidland Estates, Hawaiian Paradise Park, Hawaiian Acres, and several other subdivisions all at the same time. It should be noted that this ‘time’ was before Hawaii became a state. By getting the permits under the rules of the Territory of Hawaii, the developers were able to avoid the more strict requirements of the U.S. Federal Government. We ended up with some huge subdivisions of ¼ to 3 acre parcels, agriculturally zoned, with private roads, and no utilities or services provided.
>
> Priced at under 500 dollars, the parcels sold rather quickly, however, very few people became residents. Only those with a strong pioneering spirit were able to overcome the absence of phones, electricity, County water, road maintenance, and other services. We had catchment systems for water, generator, and solar systems for electricity, and phones, well, back then it didn’t seem like such a big deal to not have a phone. It should be noted that Hawaiian Tel[com] was first to provide a utility service to the people of Orchidland. Road maintenance became the biggest issue. The developers had made beautiful red cinder roads, which, in the Puna rains, lasted just about long enough to take the picture. If you lived in Orchidland in the 60’s or 70’s, you were on your own and you knew it. The roads that weren’t used became overgrown, the roads that were used became washed out.

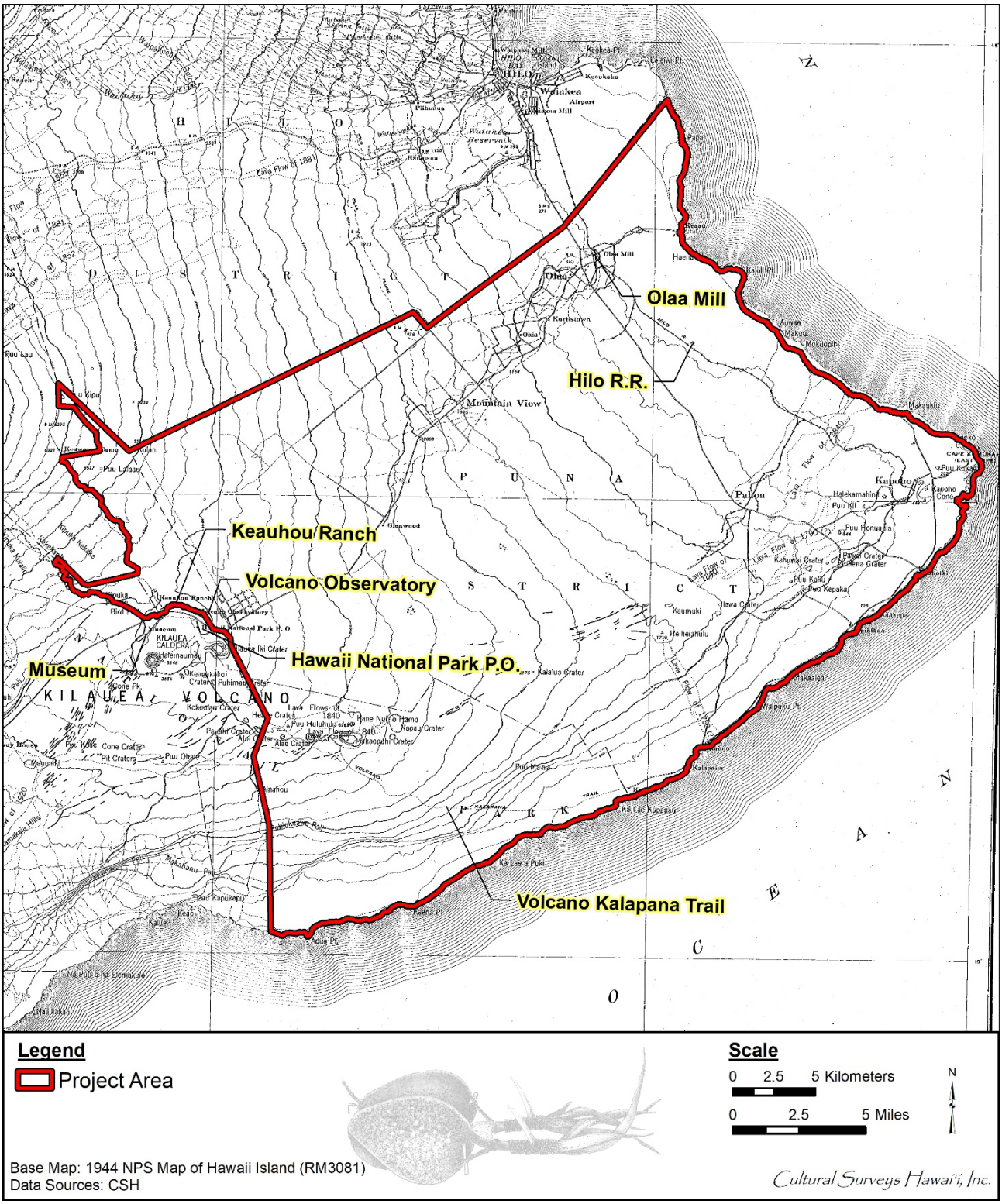

Figure 16. Portion of the 1944 NPS map of Hawai‘i Island showing roadways, the railroad, Keauhou Ranch, Olaa Sugar Mill, and key locations around the Kīlauea Summit

> The biggest appeal of this area back then, and to a certain extent now, was the price. This land has always been the cheapest in Hawaii, and the only option for many folks who wanted to own a piece of the rock. Commonly, people would live in tents or shacks until the land was paid off, building their house a stick at a time or in a series of additions. The rustic nature was endearing. People were very proud to say, 'It's humble, but it's mine'. [Orchidland Estates 2014]

The various residential subdivisions throughout Puna are visible as grid-like patterns on aerial images from the 1970s (Figure 17 and Figure 18).

4.5.2 Ka‘ū District

4.5.2.1 Ranching

Ranching was a key land use in both Kapāpala and Keauhou during the early 1900s. By this time Kapāpala Ranch encompassed about 75,000 acres, extending from sea level to about 6,500 ft elevation. According to Henke (1929:35), these lands were mostly under lease from the government, and only about 40,000 acres had "good to fair grazing."

The Keauhou Ranch was established at the turn of the century by D.T. Shipman. It was managed by W.H. Shipman from about 1913 to 1923, when it was purchased by A.M. Brown W.H. Shipman purchased the ranch in 1937 following Brown's death (Henke 1929:32; Maly and Maly 2005:291). The ranch and its association with other activity at the Kīlauea Summit are described as follows:

> Keauhou Ranch, with its headquarters near the Military Camp, one mile from the Volcano House, has an area of 35,000 acres, all leased from private owners, about 20,000 of which have fair to good grazing value. The ranch extends from sea level to about 7,800 feet elevation.
>
> Water for the cattle must be caught from roofs and held in tanks. The tanks have a life of about ten years, the iron rods holding the staves together being the first to break. The storage capacity of these tanks is sufficient to carry the cattle through an eight months' drought period.
>
> The ranch has six large paddocks, four being used for fattening and two for weaning. About 30 miles of wire fence are found on the ranch […]
>
> The ranch has 55 saddle horses for ranch use and horses are rented to guests at the Volcano House and Military Camp. Horses and pack mules and guides are furnished for parties who desire to go to the top of Mauna Loa […]
>
> The ranch markets about 225 cattle per year, weighing about 450 pounds dressed weight at two years of age. All are marketed on Hawaii and three-fourths of them are slaughtered on the ranch for the Military Camp and the Volcano House.
>
> The ranch has about 250 pigs, using a purebred Chester White boar. The sows are rather mixed as to breed but Chester White blood predominates. One hog feed unique to this place is steamed tree ferns, which are steamed for one week over natural steam rifts found in the ground of this volcanic region.

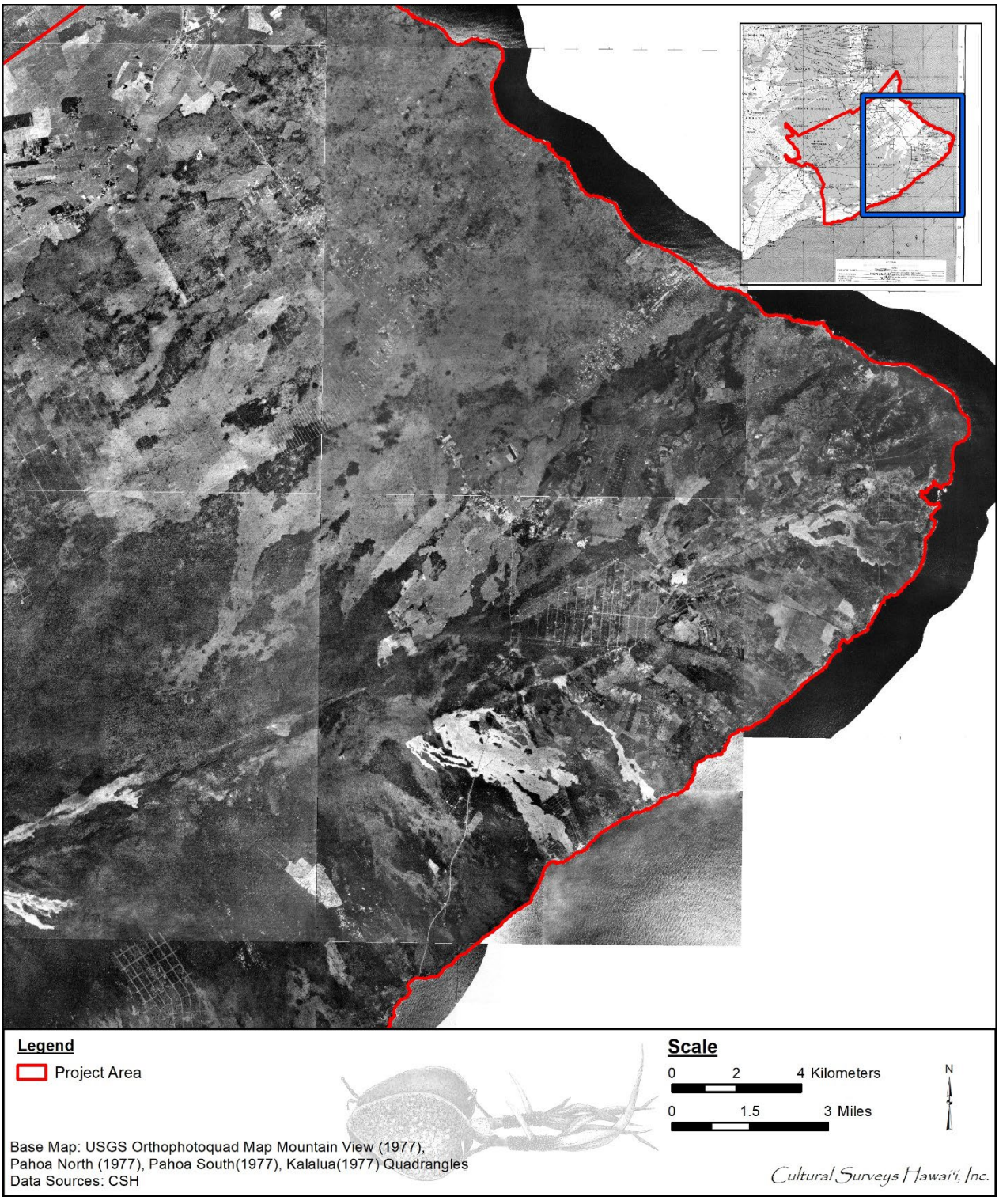

Figure 17. Portion of the 1977 USGS orthophotoquad aerial photo (Kalalua, Mountain View, Pahoa North, and Pahoa South quadrangles), showing the extent of residential and agricultural development in the eastern portion of the project area

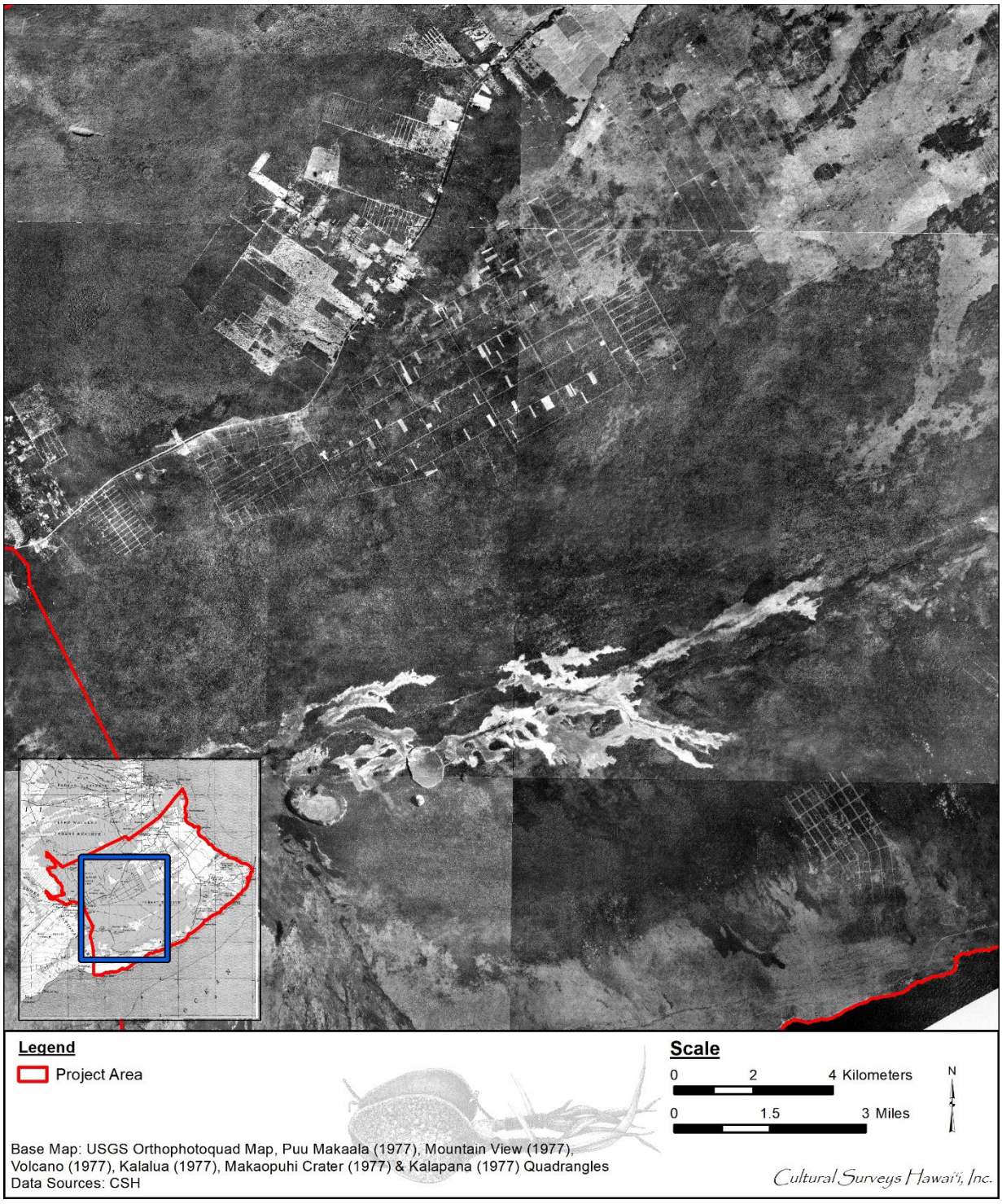

Figure 18. Portion of the 1977 USGS orthophotoquad aerial photo (Kalalua, Kalapana, Makaopuhi Crater, Mountain View, Puu Makaala, and Volcano quadrangles), showing the extent of residential and agricultural development in the western portion of the project area

> The only cost for these cooked tree ferns is the labor cost of cutting and bringing them in, which amounts to about $5 a ton.
>
> Garbage is also used as a hog feed, this being obtained from the military camp […]
>
> No cattle have been kept on the lower land for some years, efforts having been made to first eliminate the goats. This has been fairly well accomplished and some fifty head are being put there now. [Henke 1929:31]

4.5.2.2 Developments in and around the National Park

Maly and Maly (2005:273) note, “From the early 1900s, prisoners at Namakanipaio worked on rebuilding the ‘Peter Lee Road’ into Ka‘ū, and on roads and trails around Kīlauea, and towards Puna. The prison site was closed shortly after 1915.” Nāmakanipaio is located west of the Volcano House, just beyond the limits of the project area in Keauhou.

In 1907 George Lycurgus, owner of Volcano House at the time, formed a company with others to log *‘ōhi‘a* from within Keauhou Ranch lands:

> The lumbermen erected a sawmill on the site where they rough-milled the ohia and shipped it by rail to the present 29-Mile community where Peter Lee finished the milling of the wood into railroad ties. From there the ties were hauled by wagon to the rail terminal at Glenwood and shipped to Hilo for further consignment to the mainland. The enterprise proved profitable for a time, but after two years the demand for Hawaiian railroad ties lessened and the business started going downhill. Lycurgus and his partners then began to log the *koa* (an indigenous mahogany used in the manufacture of furniture) forests in the area, but found the cores of the tree trunks rotten and the wood useless. Lycurgus lost $10,000 in his lumbering venture. Sections of the railbed laid by the lumbermen remain in evidence in the Land of Pele in the half century that has passed. [National Park Service 2006]

Hilo resident H.W. Kinney in 1913 published a visitor’s guide titled *The Island of Hawaii* in which he described his travels throughout the island. Of interest to the current project area is Kinney’s explorations of the areas north of Kīlauea Crater in which he observed trails and ranching and logging features:

> Northwest of the Volcano House is another interesting region. The first east side road from the main road leading to Kau, goes into the famous fern forest, with its magnificent growth of gigantic tree ferns. The second east trail leads to the gate of the Shipman ranch. Just beyond this a trail, turning sharply to the left, leads to the tree moulds, formed where the lava surrounded trees, and, burning them out, left holes as casts of the trees. The main trail leads to the ranch house, and through the paddocks into the splendid forest of gigantic *koa* trees, beyond the old lumber mill, whence leads a railroad track, used for hauling the logs to a point close to the Volcano House, whence they are taken by wagon to Glenwood. It affords a good walk through *koa* and fern forest, emerging near the hotel. Both *koa* and fern forests are traversed by good trails, made by the loggers. From the ranch house a trail leads west to a small peach and fig orchard. Another trail leads from

> the ranch house to Puu Oo ranch on the mountain slope. A trail follows the N.W. side of the crater to the Uwekahuna bluff, whence a good view is had of the crater, pit and surrounding country. [Kinney 1913 in Maly and Maly 2005:207]

A land exchange in 1920 between Bishop Estate (owner of Keauhou Ahupua‘a) and the Territorial Government helped establish additional portions of the Kīlauea section of Hawai‘i National Park (Young 2022). Other Bishop Estate lands under lease to Keauhou Ranch were developed in 1921 by the Volcano House Hotel as the Volcano Golf Course. The course initially opened with three holes, but by 1922 was developed into a 9-hole course; later in 1946 the course was expanded to a full 18 holes (Young 2022). In 1932, the Volcano House was expanded to offer 115 rooms, but burned down in 1940; a new hotel was constructed the following year and expanded in 1953 (National Park Service 2006).

In 1928 the Kilauea Forest Reserve was established in the portion of upper Keauhou adjoining the Upper Waiakea and Olaa forest reserves. This land was “originally a part of the private forest reserve established by Trustees of the B.P. Bishop Estate” (Maly and Maly 2005:331).

4.6 Contemporary Land Use

4.6.1 Puna District

In the modern era Puna has been significantly impacted by geological activity. Eruptions in 1955 and 1960 along Kīlauea’s Lower East Rift Zone (LERZ) impacted communities, infrastructure, and prime agricultural lands (USGS). A 1975 earthquake off the coast of Kalapana caused widespread subsidence along the southern Puna coastline and triggered a large tsunami. A 1983–2018 eruption from the Pu‘u ‘Ō‘ō‘ vent along the Middle East Rift Zone covered a large swath of the southern Puna coastline, impacting communities around Kalapana and other areas to the south within HVNP. In May 2018 the eruption moved down-rift from Pu‘u ‘Ō‘ō‘ to a series of fissures in and below the Leilani Estates subdivision within the LERZ. The 2018 eruption inundated many residential and agricultural areas, major roadways, and several miles of coastline between Kapoho and Pohoiki.

Private efforts to explore development of geothermal power generation in Puna were undertaken by Richard Lyman at Kapoho during the 1960s (Schroeder 2015). Over the following decades interest and research expanded to larger areas of Kīlauea’s East Rift Zone. Soon community opposition began to build based on cultural, safety, and environmental concerns (Boyd et al. 2002:17–18). In 1993 the Puna Geothermal Venture (PGV) plant became operational and was acquired by Ormat Technologies in 2004 (Hunt 2015). Despite operational issues and incidents, continued opposition from the community, and a brief closure following impacts from the 2018 LERZ eruption, the plant continues to operate.

The majority of the lands in Puna are currently privately owned lots under 5 acres each, private lands under lease for commercial agriculture, and state or federal lands (including large areas of forest reserve and HVNP). The largest commercial crops include macadamia, papaya, orchids, and other cut flowers. The bottled-water industry has grown immensely in and around Kea‘au in recent years, tapping into the pristine underground waters flowing through the area. The population of Puna has increased dramatically in recent years, and some commercial expansion has occurred particularly in and around the towns of Kea‘au and Pāhoa.

4.6.2 Ka‘ū District

In 1968 the Volcano Golf Course was acquired by C. Brewer and renovated (Young 2022). Koa logging was allowed in the privately held section of Keauhou into the early 1990s (Maly and Maly 2005:334). Tourism remains the economic mainstay for the volcano area, and Volcano Village offers a number of amenities to tourists visiting HVNP or travelling between Kona and Hilo. The population of the Volcano Village area has continued to increase, with many residents commuting elsewhere (such as Hilo) for work.

Section 5 Previous Archaeological Research

This section contains a high-level overview of previous archaeological research in the project area. Table 2 is a summary of the available prior archaeological studies within the project area; for each study it lists the abbreviated citation (full citations are found in the References Cited in Section 9) and the study type, location, and findings. These study areas are depicted generally on Figure 19. Another map (Figure 20) illustrates the locations of historic properties identified during these prior archaeological investigations, including culturally modified lava tubes, *heiau*, burials, and other archaeological features.

The earliest archaeological studies in the project area were island-wide surveys of *heiau* (Thrum 1908, Stokes 1919). These were followed by surveys conducted by the Bishop Museum (e.g., Hudson 1932; Hansen 1956–68; Crozier and Barrère 1971). The studies covering the largest geographical extents have generally been conducted in association with the following:

- Hawai‘i Volcanoes National Park (Tuggle and Tomori-Tuggle 2008);
- Geothermal development (Haun et al. 1985; Holmes 1985; Hammatt and Borthwick 1988; Kennedy 1991; Sweeny and Burtchard 1994)
- W.H. Shipman lands (Hunt 1993);
- Forest reserve related projects (Yent and Ota 1982; Uyeoka et al. 2014, Bautista et al. 2017);
- Roadway or other infrastructure developments (Bevaqua and Dye 1972; Komori 1987; Major and Dixon 1992; Borthwick and Hammatt 1995; Haun and Henry 2004a; Clark and Rechtman 2005; Wilkinson et al 2010);
- Other proposed developments (Hammatt 1978; Rosendahl 1982; McGerty and Spear 2000; Haun and Henry 2013a); and
- Lava tube systems in Puna (Emory 1945; Kam 1982; Yent 1983; Olsen 1984; Stone and Teshima 1989; McEldowney and Stone 1991; Allred et al. 1997; Allred et al. 2002). The archaeological contents within the cluster of tubes located in the Pāhoa vicinity have been documented in greater detail than those within the tube systems to the north (including the lengthy Kazumura Cave); this explains the lack of “historic property” data points along the northern tube systems.

Numerous smaller studies have been undertaken for private landowners, particularly within the Special Management Area along the coastline. Notably, only two of the studies listed in Table 2 are within the Ka‘ū portion of the project area (Kawachi 2003; Tuggle and Tomonori-Tuggle (2008); the remainder are all within Puna District.

Previous archaeological studies in the project area have yielded general patterns of findings. Pre-Contact sites are predominately found along the coastal strip or in subsurface lava tubes, or within HVNP which has been largely protected from historic and modern development. The nature of surface pre-Contact sites throughout most of the upland areas was generally more transient or involved construction using natural materials; even if left undisturbed these sites would have decomposed or been overcome by the forest over time.

Historic-era sites are also found along the coast, and in upland areas where historic land use was occurring. These historic land uses were often highly ground disturbing (e.g., preparation of

cane fields for planting, clearing of pasture for cattle, development of roadways and residential camps, tourist attractions, or town centers) and would have likely destroyed any older pre-Contact features once present. Historic-era sites include but are not limited to plantation clearing mounds, flumes, roadways, and residential camps; railroad berms, tracks, and other related remnants; cattle enclosures or other ranching features; historic buildings, shops, and residences within and around camps, homesteads, or villages and along transportation routes; and historic trails and roadways.

Regarding State Inventory of Historic Places (SIHP) designations in Table 2, it wasn't until the 1970s or later that reports began to include standardized SIHP numbers for documented sites. In cases where SIHP numbers are listed in association with earlier studies, this information has likely been correlated from other reports during prior research. Each SIHP number begins with the designation for Hawai‘i State ("50"), then Hawai‘i Island ("10"), then the applicable USGS quadrangle number (e.g., "46" for Kapoho Quadrangle or "55" for Pahoa South Quadrangle), and finally the individual 5-digit site number.

Table 2. Previous archaeological studies in the project area

Reference	Type of Study	Location	Results
Thrum 1908	Survey of *heiau*	Island-wide	Describes 18 *heiau* in Puna District, identified as Wahaula in Pulama; Makaiwa; Waiaka; Makaoiki; Punaluu; Niukukahi; Napalua; Kikoa; Kumakaula; Mahinaakaka; Oolo; Kalepa; Kue; Haliipalala; Wahaula in Kamaili; Pulena; Kukii; and Kekaloa
Stokes 1919 (see Stokes and Dye 1991)	Survey of *heiau*	Island-wide	Documented 12 *heiau* in Puna, many previously identified by Thrum (1908), identified as Haliipalala; Kekaloa; Kikoa; Kue; Kukii; Kumakaula; Mahinaakaaka; Makaoiki; Niukukahi; Punaluu,Wahaula; and Waiaka
Baker 1931	Petroglyph study	Kalapana to ‘Āpua Ahupua‘a, Puna	Discusses and photo documents various petroglyphs in Puna District; also notes short-constructed bit of ancient trail and desert village (p.64), possible village of Kamoamoa
Hudson 1932	Archaeological survey	Coastal zone between Kapoho and Pohoiki Ahupua‘a, Puna	Identified several sites including SIHP # 50-10-36-00109, a *hōlua* slide in Pū‘āla‘a; SIHP #s -00110 and -00111, two agricultural sites near the slide; SIHP # -00145, a possible house site; and SIHP # -00147, possible habitation platforms
Emory 1945	Archaeological exploration	Shipman Cave, Kea‘au Ahupua‘a, Puna, TMK: (3) 1-6	SIHP # 50-10-36-20678 (“Shipman Cave”), a lava tube containing evidence of habitation, refuge, and burial; findings of food and tools
Hansen 1956–1968	Archaeological survey	Puna District	Extensive documentation of archaeological sites in Puna District by Bishop Museum
Orr 1968	Documentation of Kahuwai Village	Kahuwai Village, Kahuwai Ahupua‘a, Puna	Mapping of Kahuwai Village, SIHP # 50-10-46-04278, and findings of excavations with depths
Ladd 1969	Reconnaissance, data recovery, preservation	Chain of Craters Rd right-of-way in Hawai‘i Volcanoes National Park, Puna	Discussion of archaeological sites in Puna District selected for data recovery (salvage) and/or stabilization and restoration in Hawai‘i Volcanoes National Park area
Orr 1968	Reconnaissance	Kahuwai Ahupua‘a, Puna	Discusses elevated Hawaiian trails specifically in *ahupua‘a* of Kahuwai

Reference	Type of Study	Location	Results
Loo and Bonk 1970	Archaeological inventory	Puna	Description and evaluation of 32 archaeological sites in Puna District
Newman 1970	Multi-discipline synthesis of cultural practices	Island-wide	Synthesis of Hawai‘i Island’s fishing and farming practices using data from multi-disciplines (archeology, historical sources, general ecology, botany, geophysics, and marine biology); mentions a field system in Puna based on Ellis’s account in 1823, southwest of Kapoho, and scattered fields along Puna coastal strip from Kapoho to Hilo
Barrera and Barrère 1971	Archaeological and historical survey	Coastal zone of Kupahua (Kalapana) Ahupua‘a	Survey area divided into three zones: A, B, and C; observed numerous sites, however, only documented examples of each general site type
Crozier and Barrère 1971	Archaeological and historical survey	Pū‘āla‘a Ahupua‘a, Puna	Described remnants of Pū‘āla‘a Village (SIHP # 50-10-46-04294) and several platforms (SIHP #s -03946 through -03950)
Bevacqua and Dye 1972	Archaeological reconnaissance	Kapoho-Kalapana Hwy Corridor, Kaimū-Kapoho Ahupua‘a, Puna	Documented 48 archaeological sites including Pū‘āla‘a Village (SIHP # 50-10-46/55-02502, later assigned as SIHP # -04294); four platforms (-02504, -02514, -02523, -02532); six enclosures (-02506, -02508, -02509, -02512, -02513, -02521); five cemeteries (-02519, Hale Family; -02534, Pua‘akanu; -02538; -02539; -02547, Kaipuuelelu); three trails (-02530, King’s Highway; -02535; -02540, Kehena Beach Trail); 14 site complexes (-02503, -02505, -02507, -02515, -02516, -02520, -02522, -02524, -02533, -02536, -02537, -02542, -02543); two ponds (-02510, Pohoiki Warm Spring; -02518, Keahialaka Pond); a mound (-02531); a lava tube (-02526); a coffee mill (-02511); two *heiau* (-02500, Kuki‘i; -02517, Mahinaakaka); eight clusters of petroglyphs (-02501 or Kapoho petroglyphs, and -02525, -02527, -02528, -02529, -02544, -02545, -02546); and C-shape (-02541)
Barrera 1973	Archaeological reconnaissance	Pū‘āla‘a Ahupua‘a, Puna	Documented 150 archaeological sites including enclosures, mounds, agricultural and habitation sites, platforms, and caves; test pits excavated at two cave sites
Kikuchi 1973	Survey of prehistoric Hawaiian aquacultural systems (fishponds)	Statewide	Classified two fishponds in Kapoho Ahupua‘a: *pu‘uone* (site 18) and *loko kuapā* (site 26/26A)

Reference	Type of Study	Location	Results
Ching et al. 1974	Archaeological surface survey	Kaimū and Kalapana Ahupua‘a, Puna	Documented 25 archaeological sites assigned as SIHP # 50-10-63-06199 through -06223; sites include habitation and agricultural features, *heiau,* cisterns, walls, and trails; noted SIHP #s -06228 (Hudson site 163), -06229 (Hudson site 164), and -06230 (Hudson site 165) destroyed
Ewart and Luscomb 1974	Archaeological reconnaissance	Coastal zone of Kea‘au, Waikahekahe, Maku‘u, Keonepoko, and Waiakahiula Ahupua‘a, Puna	Documented 138 archaeological sites, including 30 sites in Kea‘au; three sites in Waikahekahe; 17 sites in Maku‘u; 79 sites in Keonepoko; and nine sites in Waiakahiula (text reads 118 total sites but table in report lists 138 total sites)
Palama 1976	Surface survey	Kaimū-Kalapana Beach Park, Puna	Documented three sites: SIHP #s 50-10-63-06277 (walls); -06278 (house platform); and -06279 (possible ag. enclosure)
Bordner 1977	Archaeological reconnaissance	Pāhoa (Maku‘u Ahupua‘a), Puna, TMK: (3) 1-5-010:017	Documented SIHP # 50-10-45-06417, an *ahu* (cairn)
Cordy 1977	Archaeological inventory survey	Pohoiki Bay, Pohoiki Ahupua‘a, Puna	No significant findings; previous archaeological research indicated nearby presence of SIHP #s 50-10-46-02509 through -02511; two metal poles located in water near existing boat ramp
Palama and Bordner 1977	Archaeological inventory survey	Kaimū and Kalapana Ahupua‘a, Puna	Documented 20 archaeological sites: SIHP #s 50-10-64-06280 through -06299; sites included agricultural and habitation complexes; walls; enclosures; Poluki Heiau; house sites; and a legendary stone
Hammatt 1978	Archaeological reconnaissance	Kea‘au Ahupua‘a, Puna	Documented 27 archaeological sites, six previously identified by Ewart and Luscomb (1974); sites assigned as SIHP #s 50-10-36-01845, -01846, and -06461 through -06476; sites included walls; possible burials; cultural deposits; platforms; lava sink; house foundation; *pohaku* (stone) pike; and a mound
McEldowney 1979	Archaeological and historical literature review	Hilo and Puna	By analyzing literature from early historic period and archaeological data, proposed a zonal settlement pattern described in terms of elevation
Bonk 1980a	Archaeological survey	2 acres in Keahialaka Ahupua‘a, Puna, TMK (3) 1-3-009:007 (por.)	Surveyed “easement #5,” one of six proposed easements; no significant findings

Reference	Type of Study	Location	Results
Bonk 1980b	Archaeological survey	Five, 2-acre sections of land for proposed drilling site in Keahialaka and Pohoiki Ahupua‘a, Puna	Surveyed 5 “easements” (#1, #2, #3, #4, and #6); easement #5 previously surveyed (Bonk 1980a); a cave identified in easement #2’s location, with native cultigens observed at cave site
Ladd 1981	Archaeological field survey	28 acres surrounding Cape Kumukahi Lighthouse, Kula Ahupua‘a, Puna	Surveyed four lighthouses on three islands: Kaua‘i (Makahuena Point); Maui (Hawea Point); and Hawai‘i (Cape Kumukahi and Kawaihae); historic features included stone outcrop platform, *ahu* and shelter cave, and historic name glyphs
Hommon 1982	Archaeological reconnaissance	2 areas in Kahauale‘a Ahupua‘a, Puna, TMKs: (3) 1-1-00:001 and 1-2-008:001	No significant findings; did note an old jeep road and a ginger plant as evidence of human activity
Kam 1982	Archaeological reconnaissance	Pāhoa Cave, Keonepokoiki, Ahupua‘a, Puna, TMK: (3) 1-5-009:009	Examined Pāhoa Cave; documented 20 burials; based on presence of ceramic and glass beads at one burial concluded cave used during late pre-Contact to early post-Contact period
Rosendahl 1982	Archaeological reconnaissance	490 acres for proposed W.H. Shipman Industrial Park, Kea‘au Ahupua‘a, Puna, TMK: (3) 1-6-003:012 por.	No significant findings
Yent and Ota 1982	Archaeological reconnaissance	Nānāwale Forest Reserve, Halepua‘a Section, Halepua‘a Ahupua‘a, Puna, TMKs: (3) 1-4-003:008 and 010	Documented five types of archaeological sites: enclosures, mounds, pits or depressions, walls, and *ahu*; no SIHP #s assigned
Cox 1983	Archaeological reconnaissance	Cape Kumukahi, Kula Ahupua‘a, Puna	Documented SIHP # 50-10-46-10002, comprising nine “clusters” of platforms and other features
Yent 1983	Archaeological survey	Lava tube in Pāhoa, Puna, TMK: (3) 1-5-008:001	Documented SIHP # 50-10-45-14900, part of Pāhoa cave system; in northeast tube identified terraces, walls and five burials; in southwest tube identified platforms, walls, walkways, scatter of cultural materials of midden, charcoal, animal bones, human teeth, and an *ahu*

Reference	Type of Study	Location	Results
Bonk 1984	Archaeological survey	74.9 acres near Kapoho Crater, Kapoho and Kula Ahupua‘a, Puana, TMK: (3) 1-4-002:016 por.	No significant findings
Carse et al. 1984	Compilation and Ethnographic study	Kahuwai Ahupua‘a, Puna	Describes Kahuwai Village (SIHP # 50-10-46-04278) including history, cultural resources, and oral interviews of Kahuwai residents
Olson 1984	Multi-discipline research investigation	Puna, TMK: (3) 1-6-009:376	Documents extensive Puna Cave complex (also known a Shipman Cave or Kazumura Cave), SIHP # 50-10-44, 45, 53, 54-10001; examines correlation of mythology with archaeological evidence regarding Pele
Rogers-Jourdane and Nakamura 1984	Archaeological reconnaissance	12 acres in Kapoho Ahupua‘a, Puna, TMKs: (3) 1-4-001:001, 002, 019	No significant findings
Haun et al. 1985	Archaeological reconnaissance	Wao Kele ‘O Puna Natural Area Reserve; Waiakahiula Ahupua‘a, Puna	Documented five to six cairns and mounds on southeast summit of Pu‘u Heiheiahulu (Transect five), assessed as possible burials; also noted two concrete foundations and a small cairn, all most likely used for surveyor’s markers
Holmes 1985	Literature review	Puna Forest Reserve/Wao Kele ‘O Puna Natural Area Reserve; Waikahiula Ahupua‘a, Puna	Documented a trail (Kaimū Trail) and possible bird catching shelters
Cordy 1987a	Archaeological reconnaissance	Keauohana Ahupua‘a, Puna, TMK: (3) 1-2-009:003 por.	Documented 15 sites, 14 assigned as SIHP #s 50-10-55-10922 through -10936; sites included trails, walls, platforms, agricultural areas and complexes, cemeteries, and burials
Cordy 1987b	Documentation of Kahuwai Village	Kahuwai Village, Kahuwai Ahupua‘a, Puna	Recordation of Kahuwai Village (SIHP # 50-10-46-04278) to support a preservation plan

Reference	Type of Study	Location	Results
Komori 1987	Cultural and biological resources survey	Pohoiki to Puna- Substation 69KV Transmission Corridor, Kapoho to Kea‘au Ahupua‘a, Puna, TMKs: (3) 1-4, 1-5, and 1-6	Identified 14 archaeological sites within sample transect, three of historic age; sites included mostly agricultural features with associated habitation areas; feature types consisted of irrigation ditches, terraces, platforms, modified outcrops, refuge and burial caves, petroglyphs, and a historic cement and stone foundation
Bonk 1988	Archaeological reconnaissance	James Campbell Estate property, upper Kaimū and Makena Ahupua‘a, Puna, TMK: (3) 1-2-010:003	No significant findings
Cordy 1988	Archaeological field inspection	Kahuwai Village, Kahuwai Ahupua‘a, Puna	Discusses previous archaeological work, history, and preservation recommendations for Kahuwai Village (SIHP # 50-10-46-04278)
Hammatt and Borthwick 1988	Archaeological assessment and historical research	Kīlauea East Rift Zone, Puna	Review of archaeological and historical documents including maps to assess potential adverse effects of geothermal development of three separate subzones to archaeological resources; based on data, recommended mitigation of impact on potential site areas should be concerned only with specific potentially sensitive areas to be affected by well sites, power lines, and roads on a project-by-project basis
Rosendahl 1988	Archaeological reconnaissance	Keonepokonui and Keonepokoiki Ahupua‘a, Puna, TMKs: (3) l-5:010:003 por., 1-5-009:009 por., l-5-008:001 por., 006 por.	No significant findings
Bonk 1989	Archaeological reconnaissance	Uplands of Kamā‘ili, Kehena, and Kīkala Ahupua‘a, Puna	No significant findings
Cordy 1989	Archaeological survey	Kahuwai Village, Kahuwai Ahupua‘a, Puna	Defined the boundaries of Kahuwai Village, SIHP # 50-10-46-04278

Reference	Type of Study	Location	Results
Rosendahl 1989	Archaeological field inspection	3.5 acres in Maku‘u, Pōpoki, and Hālona Ahupua‘a, Puna, TMK: (3) 1-5-010:028	No significant findings
Stone and Tashima 1989	Archaeological survey	Pāhoa Cave, Keonepokoiki and Keonepokonui Ahupua‘a, Puna, TMKs: (3) 1-5-010:3 and 1-5-116:030, 031, 049–057	Documented 8 sites within Pāhoa Cave system/network, including platforms, alignments, midden scatter, and burials
Barrera and Lerer 1990	Archaeological inventory survey	14 acres in Maku‘u Ahupua‘a, Puna, TMK: (3) 1-5-010:033	Documented six sites and associated features (SIHP #s 50-10-45-14675 and -14981 through -14985), including habitation and agricultural complexes; stone walls, a midden deposit, freshwater springs, platforms, and alignments observed but not documented in portion of study area planned for conservation
Bonk 1990	Archaeological reconnaissance	Upper Kaimū, Maku‘u, Ka‘ohe, Kehena, Ka‘apahu, and Kamā‘ili Ahupua‘a, Puna	No significant findings
Carter and Somers 1990	Field surveys and data recovery	Puna to Ka‘ū Historic District (Kalapana-Wahaula area)	Preliminary report of findings of five projects from 1987 to 1989; total of 15,000 archaeological features and components covering an area of 390 acres identified and documented; areas examined included vicinity of Waha‘ula Heiau in Poupou-Kauka area and Ka‘ili‘ili Village
Kennedy 1990	Archaeological reconnaissance	12 acres in Kapoho Ahupua‘a, Puna, TMKs: (3) 1-4-001:002 por. and 019 por.	No significant findings
Kirkendall and Hunt 1990	Archaeological reconnaissance	Two parcels in Wa‘awa‘a Ahupua‘a, Puna, TMKs: (3) 1-4-028:041 and 042	Documented one archaeological site comprising 14 features, not assigned an SIHP #
Kennedy 1991a	Archaeological inventory survey	Wao Kele ‘O Puna, Waiakahiula-Ka‘ohe Ahupua‘a, Puna, TMK: (3) 1-2-010:001 por.	Documented two sections of railroad tracks and 4-ft high earthen berm, likely associated with railroad; no SIHP #s assigned

Reference	Type of Study	Location	Results
Kennedy 1991b	Archaeological inventory survey	Kīlauea Middle East Rift Zone, Waiakahiula-Ka‘ohe Ahupua‘a, Puna, TMK: (3) 1-2-010:003	No significant findings
Kennedy et al. 1991; Dunn et al. 1995	Archaeological inventory survey	Pū‘āla‘a Village, Ahalanui, Oneloa, and Laepao‘o Ahupua‘a, TMKs: (3) 1-4-002:013, 014, 024, 069, and 070	Documented 48 sites (SIHP #s 50-10-46-11565, -11574, -11899, -11926, -12007, -12124 through -12141, -12143 through -12147, -12153, -12154, -12156 through -12162, -12185, -12188, -12572, -12668, -12699, -12704, -12724, -12726, -12774, and -16178) comprising 26 complexes and 22 single feature sites; site types included alignment, cave, C-shape, enclosure, hearth, indeterminate agriculture, modified outcrop, mound, platform, terrace, trail and wall; functional categories identified include agricultural, habitation, ancillary habitation, temporary habitation, boundary wall, burial, animal husbandry, and transportation
McEldowney and Stone 1991	Cave survey	Former Puna Forest Reserve/Wao Kele O Puna, Waiakahiula-Kaohe Ahupua‘a, Puna, TMKs: (3) 1-2-010:002 and 003	Identified three lava tube systems (Northern, Middle, and Southern) extending from former Puna Forest Reserve to Pāhoa area: SIHP # 50-10-55-14899 (Northern tube system) contained three burials and a structurally modified collapsed rock pile; SIHP # 50-10-55-14901 (lower segment), and SIHP # 50-10-55-14902 (upper segment), part of Southern lava tube system, and both contain extensive burials; SIHP # 50-10-45-14900 (Middle lava tube system) contained walls, burials, scattering of shell and bone midden, modified collapse rock piles, fire hearth, and rock arrangements
Franklin et al. 1992	Archaeological inventory survey	Waikahekahenui and Waikahekahe Ahupua‘a, TMKs: (3) 1-6-004:021, 057	Documented two sites: SIHP # 50-10-44-17848, a rock alignment; and -17849, stacked terrace; both agricultural features
Major and Dixon 1992	Archaeological inventory survey	Pohoiki No. 2 Transmission Line Corridor between Puna and Pohoiki substations, Puna	Documented six archaeological sites including SIHP #s 50-10-44-17967 (double-faced, core-filled wall), -17962 and -17963 (two burial caves), -17964 (terraces, wall, and a platform/mound), -17965 (burial cave with walls, a ramp, and terraces), and -17966 (walls, terraces, paving, platforms, cupboard, a cairn, and enclosures)

Reference	Type of Study	Location	Results
Rosendahl 1992a	Archaeological field inspection	Three areas within A&O golf course in Ahalanui and Oneloa Ahupua‘a, Puna	No significant findings
Rosendahl 1992b	Archaeological field inspection	45.945 acres in ‘Ōla‘a Ahupua‘a, Puna, TMK: (3) 1-7-017:003	No significant findings
Spear 1992	Archaeological assessment	3 parcels in Ahalanui Ahupua‘a, Puna, TMKs: (3) 1-4-002:005, 006, and 061	No significant findings
Barrera 1993	Archaeological reconnaissance	66 acres in Keauohana Ahupua‘a, Puna, TMKs: (3) 1-2-009:006 and 008	Documented 18 archaeological features including SIHP #s -19031, -10932, and -10933) previously documented by Cordy (1987a); sites included an agricultural complex, and both possible and confirmed graves
Chaffee and Spear 1993	Archaeological survey	Maku‘u Aquafarms in Maku‘u Ahupua‘a, Puna TMK: (3) 1-5-010:033	Documented SIHP #s 50-10-45-14675 Fea. J (irregular-shaped mound) and -14985 Fea. C (platform), Fea. L (platform), and Fea. M (platform); human remains discovered in SIHP # -14985 Feas. L and M
Charvet-Pond and Rosendahl 1993	Archaeological inventory survey	3.6 acres in Maku‘u, Pōpōkī, and Hālona Ahupua‘a, Puna, TMK: (3) 1-5-010:029	Documented five sites: SIHP #s 50-10-45-18418, trail; -18419, cattle walls; -18420, terrace complex; -18421, bait cups; and -18422, a horticultural complex
Franklin and Maly 1993	Archaeological inventory survey	3 acres in Kaimū and Makena Ahupua‘a, Puna, TMK: (3) 1-2-006:033 por.	Documented two archaeological sites: SIHP # 50-10-55-19060, a trail; and -19061, a boundary wall
Hunt 1993	Archaeological reconnaissance	600 acres of Shipman Lands in Kea‘au Ahupua‘a, Puna, TMKs: (3) 1-6-003:003, 007, 008, 011, 012, 027, 029, 058, 073, 075, 084, 086, and 090	Identified 50 archaeological features (not assigned SIHP numbers), likely clearance mounds associated with plantation activities; features concentrated near Kea‘au town
Major 1993	Archaeological monitoring	Pohoiki No. 2 Tramission Line Corridor between Puna and Pohoiki substations,	Revisited and remapped SIHP #s 50-10-45-17962 and -17963 (cave sites) prior to construction; no new sites identified; no impacts to SIHP #s -17962 and -17963; concluded based on data recovery excavations

Reference	Type of Study	Location	Results
		Puna	at breach of -17967, wall built between 1907 and 1916
Conte et al. 1994	Archaeological inventory survey	735 acres of DHHL Maku‘u farm and ag. lands in Maku‘u, Pōpōkī, and Hālona Ahupua‘a, Puna, TMKs: (3) 1-5-010:004 and 1-5-008:003	No significant findings
Farrell and Wells 1994	Archaeological inventory survey	3.23-acre parcel in Keonepokoiki, Puna, TMK: (3) 1-5-009:042	Documented two archaeological sites: SIHP # 50-10-45-18758 and -18759; a later study (Farrell and Dega 2013) re-identified both sites and preservation was requested by SHPD; preservation plan prepared (Farrell et al. 2014)
Hurst and Schilz 1994	Archaeological survey	Kea‘au-Pāhoa Road, Kea‘au Town Section, Puna, TMK: (3) 1-6-003	No significant findings
Sweeney and Burtchard 1994 (see also Burtchard and Moblo 1994)	Archaeological survey	Kīlauea East Rift Zone, Puna	Documented 16 sites (archaeological and/or cultigen areas) including previously documented Kūki‘i Heiau (SIHP # 50-10-46-02500) and *hōlua* slide area (-05245), and 14 newly identified features assigned temporary sites numbers including the Pu‘u Kūka‘e mounds, Kūki‘i Cyst, cultigens at Halekamahina Crater, rock mounds and linear stacked rock features; Pu‘ulena and Kahuwai craters with evidence of observed cultigens; lava tubes with human remains or other modifications; four *‘awa* patches; abandoned road; bunker; mounds on Heiheiahulu crater; Pu‘u Kauka *kipuka*; and sections of Pahoa Lumber Company Railroad Grade
Barrera 1995	Archaeological data recovery	Kaueleau Ahupua‘a, Puna, TMK: (3) 1-3-004:013	Documented SIHP # 50-10-55-15312, complex comprising a platform, wall, fireplace, and paved area; two test units and a trench excavated
Borthwick and Hammatt 1995	Archaeological assessment	Kamā‘ili, Ke‘eke‘e, and Kehena and Keauohana Ahupua‘a, Puna, TMKs: (3) 1-2-009:003 por., 1-2-030; 1-2-031	No significant findings
Spear et al.	Data recovery	Maku‘u Aquafarms, Maku‘u	Documented SIHP # 50-10-45-14675 Features B (enclosure), C

Reference	Type of Study	Location	Results
1995		Ahupua‘a, TMK: (3) 1-5-010:033	(terrace), R (lava blister), Y (mound), AP (enclosure), # -14985 Features C (platform), J (terrace), L (mound), and M (platform); radiocarbon dating sample resulted in dates ranging from AD 1660 to 1950
Hunt 1996	Archaeological inventory survey	4.54 acres in Keahialaka Ahupua‘a, Puna, TMK: (3) 1-3-008:003	No significant findings
Allred et al. 1997	Speleological investigation	Herbert C. Shipman Cave, Puna	Re-visited Shipman’s Cave and analyzed Kenneth Emory’s (1945) study; located other entrances into cave as described by Emory and concluded “Shipman Cave” actually comprises two separate caves: Kazumura Cave and Keala Cave
Latinis et al. 1997	Archaeological inventory survey with subsurface testing	94-acre parcel in Ke‘eke‘e Ahupua‘a, Puna, TMK: (3) l-2-009:029	Documented six archaeological sites: SIHP #s 50-10-55-02539, cemetery, previously documented by Bevacqua and Dye (1972); -21139, an agricultural complex with 32 features; -21140, enclosure; -21141, enclosure; -21142, adjacent enclosures; and -21143, platform (possible *heiau*)
Lass 1997	Archaeological reconnaissance	Old Government Rd in Kea‘au Ahupua‘a, Puna	Documented 15 sites: SIHP #s 50-10-36-21273 (Old Government Rd) and -21259 through -212272 (walls, enclosures, a WWII bunker, and two trenches)
Walker et al. 1997	Archaeological inventory survey	75 acres for Kea‘au High School site, Kea‘au Ahupua‘a, TMKs: (3) 1-6-003:portions 003, 015, and 084	Documented SIHP # 50-10-44-21191, Hilo Railway Co. right-of-way
Devereux et al. 1998	Archaeological inventory survey	Ahalanui Park and Pohoiki (Isaac Hale) Park, Pohoiki, Ahalanui, and Laepao‘o Ahupua‘a, Puna, TMKs: (3) 1-4-002:005, 006, and 061; 1-3-008:016 and 013; and 1-4-002:008	Documented two sites: SIHP #s 50-10-46-02507, remnants of former permanent habitation site complex previously documented by Bevacqua and Dye (1972); and -21352, a well

Reference	Type of Study	Location	Results
Masterson and Hammatt 1998	Archaeological inventory survey	2.46 acres for Kea‘au Elderly Housing Project, Kea‘au Ahupua‘a, Puna, TMKs: (3) 1-6-143: portions 018 and 039	No significant findings; modern Filipino Camp observed
Rechtman and Henry 1998	Site inspection and limited subsurface testing	Two parcels at Hawaiian Beaches Estates in Waiakahiula Ahupua‘a, Puna, TMKs: (3) 1-5-003:042 and 043	Documented two sites: SIHP #s 50-10-45-19013, an agricultural complex of four features (depressions and terraces); and -19014, burial platform; both sites previously documented by Ewart and Luscomb (1974); SIHP # -19014 tested and a chamber revealed that confirmed site type and function
Maly 1999	Ethnographical study	Kea‘au section of Historic Puna Trail/Old Government Rd, Kea‘au Ahupua‘a, TMK: (3) 1-6-001	Documented SIHP # 50-10-36-21273, Puna Trail/Old Government Rd
Stasack and Stasack 1999	Petroglyph survey	‘Āinahou Ranch Cave System in ‘Āpua Ahupua‘a, Puna	Documentation of ‘Āinahou Petroglyph Cave, SIHP # 50-10-62-21751; total of 123 petroglyphs identified
Corbin 2000	Archaeological inventory survey	Kauaea, Kaueleau, and Kamā‘ili Ahupua‘a, Puna, TMKs: (3) 1-3-002:portions 006, 054, 055, 058, 068, 076, 077, 078, 090, 108; 1-3-003:006 por.; and 1-3-004:013 por.	Documented SIHP # 50-10-55-22500, an agricultural complex comprising of 41 features
McGerty and Spear 2000	Archaeological inventory survey	300 acres for proposed KSBE East Hawai‘i Campus in Kea‘au Ahupua‘a, Puna, TMK: (3) 1-6-003:012 por.	Re-identified ten previously discovered features (Hunt 1993); only six determined to be archaeological features; one new feature identified; seven features of SIHP # 50-10-44-21823 documented, all related to sugarcane clearing activities

Reference	Type of Study	Location	Results
Rechtman 2000	Archaeological survey	32-acre parcel in Kapoho Ahupua‘a, Puna, TMK: (3) l-4-017:003	No significant findings
Clark et al. 2001	Archaeological inventory survey	Waiakahiula Ahupua‘a, Puna, TMK: (3) 1-5-002:024	Documented SIHP # 50-10-55-22966, railroad turntable; and -22967, a bulldozed earthen railroad bed with associated cement slab feature
Ritchey 2001	Petroglyph discussion	Cape Kumukahi, Kula Ahupua‘a, Puna	Discusses documentation of Cape Kumukahi petroglyphs including numbering, type, location, and characteristics, methodology of data collection, and its relationship with previous archaeological studies
Allred et al. 2002	Survey and documentation	Kazumura Cave, Kea‘au and Waiakahekahenui Ahupua‘a, Puna	Survey, data compilation, and cartography of Kazumura Cave; mostly describes natural features, but some maps include area of charcoal, an *ahu*, and a “stone altar” near a tube opening (p63)
Haun and Henry 2002a	Archaeological inventory survey	7-acre parcel in Kaueleau Ahupua‘a, Puna, TMK: (3) 1-3-002:071	No significant findings
Haun and Henry 2002b	Archaeological inventory survey	2-acre parcel in Wa‘awa‘a, Puna, TMK: (3) 1-4-028:038	Documented five sites comprising 37 features including a habitation terrace (SIHP # 50-10-46-23392), three agricultural complexes (-23390, -23391 and -23393), and a wall (-23389)
Elmore and Kennedy 2003	Archaeological assessment	412.5 acres in Keahialaka Ahupua‘a, Puna, TMK: (3) 1-3-008:004 por.	No significant findings; documented remnants of old *koa* mill but determined not to be 50 years or greater in age
Kawachi 2003	Literature review and field inspection	10,20.5 acres in Keauhou, Ka‘ū, TMK: (3) 9-9-001:017	No significant findings
Rechtman 2003	Archaeological and limited cultural assessment	DHHL lands in Hālona and Maku‘u Ahupua‘a, Puna, TMK: (3) 1-5-008:001	No significant findings
Desilets and Rechtman 2004	Archaeological inventory survey	Maku‘u, Pōpōkī, and Hālona, Puna, TMK: (3) 1-5-008:003	Documented two historic properties: SIHP # 50-10-45-24231, an enclosure complex of three features; and -24232, a terrace; five test units excavated among -24231; due to insufficient number of cultural materials, functionality of both sites unknown
Haun and Henry 2004a	Archaeological assessment	Along northeast side of Hwy 130 in Kea‘au, Puna,	No significant findings

Reference	Type of Study	Location	Results
		portions of TMKs: (3) 1-5-036:117-122; 1-6-001:015, 021; 1-6-003:002, 065, 068, 074; 1-6-004:011, 045, 047-051, 053-056; 1-6-064:269, 283–289	
Haun and Henry 2004b	Archaeological inventory survey	4.099-acre parcel in Wa‘awa‘a, Puna, TMK: (3) 1-4-028:033–034	Documented six archaeological sites comprising 42 features (SIHP #s 50-10-46-23997 through -24002); feature types included excavated pits, enclosures, modified outcrops, terraces, and a platform; sites associated with habitation, agriculture, animal husbandry, and a burial
Kasberg and Rechtman 2004	Archaeological monitoring	DHHL lands in Hālona and Maku‘u Ahupua‘a, Puna, TMK: (3) 1-5-008:001	No significant findings
Rechtman 2004	Archaeological reconnaissance	Approx. 19.5-acre parcel in Keonepokonui and Keonepokoiki Ahupua‘a, TMK: (3) 1-5-007:017	No significant findings; a lava tube encountered but found to contain only modern trash, most likely carried by rainfall runoff
Clark and Rechtman 2005	Archaeological reconnaissance	Pohoiki Road Realignment in Oneloa Ahupua‘a, Puna, TMKs: (3) 1-4-002:009, 013 and 1-3-008:016	Within project area documented five features of previously identified SIHP # 50-10-46-12157 (agricultural and habitation complexes); also documented locations of two other previously identified sites located outside but near project area, including SIHP # -12153 (burial platform), and -12156 (lava blister with burials)
Rechtman 2005	Archaeological monitoring	DHHL residential subdivision in Hālona and Maku‘u Ahupua‘a, TMK: (3) 1-5-008:003	No significant findings
Clark and Rechtman 2006	Archaeological inventory survey	2.282-acre parcel in Wa‘awa‘a Ahupua‘a, Puna, TMK: (3) 1-4-028:041	One site with 14 features first identified by Kirkendall and Hunt (1990) re-located and reassigned site and feature designations; documented sites included SIHP #s 50-10-46-22516, agricultural complex; -25517, core-filled wall; -25518, raised trail; -25519, habitation complex; and -25520, agricultural complex; one test unit excavated in -25519 Feature A, and a preservation plan later written

Reference	Type of Study	Location	Results
			for SIHP #s - 25516, -25518, and -25519 (Berrigan et al. 2008); parcel is in portion of former Land Grant 1363 to Pakaka in 1854
Hammatt and Shideler 2006	Archaeological reconnaissance	Keakealani Outdoor Education Center, Mountain View Elementary School, and Pāhoa Elementary, Intermediate and High Schools, ‘Ōla‘a and Waiakahiula Ahupua‘a, Puna District	No further work recommended for proposed cesspool upgrade project at any of four schools
Haun and Henry 2006	Archaeological assessment	52.2-acre parcel in ‘Ōla‘a, Puna, TMK: (3) 1-8-008:007	No significant findings
Monahan et al. 2006	Archaeological inventory survey	2.8 acres in Kapoho Ahupua‘a, Puna, TMK: (3) 1-4-002:036 por.	Documented remains of a *loko kuapa* fishpond (unnamed) at Kapoho Bay, not assigned an SIHP #
Clark et al. 2007	Archaeological inventory survey	Kulia Farm, 38-acre parcel in Pōpōkī Ahupua‘a, Puna, TMK: (3) 1-5-010:023	Documented five archaeological sites: SIHP # 50-10-45-26165 (possible agricultural shrine/*heiau*); -26166 (historic trail/roadway); -26167 (habitation complex with three features); -26168 (remnant agricultural complex with four features); -26169 (agricultural complex with 54 features); two test units excavated at -26169; parcel includes portion of Land Grant 1537 issued to Kapohana in 1855
Haun and Henry 2007	Archaeological inventory survey	1-acre parcel in Kamā‘ili Ahupua‘a, Puna, TMK: (3) 1-3-002:050	Documented 58.4-m segment of King’s Trail/Old Government Rd (SIHP # 50-10-46-02530), first recorded by Bevacqua and Dye (1972)
Clark et al. 2008	Archaeological inventory survey	5.586-acre parcel in Maku‘u, Puna, TMK: (3) 1-5-010:032	Documented nine sites: SIHP # 50-10-45-26658 (portion of Old Government Rd), -26659 (historic habitation enclosure/pavement), -26660 (historic habitation complex with five features), -26661 (modified bedrock), -26662 through -26664 (three overhangs with historic burial features), -26665 (burial platform), and -26666 (an agricultural complex with 55 features); six test units excavated; preservation plan written for SIHP # -26660 (Pestana et al. 2009); parcel is portion of former Land Grant 1013:1 to Maiau in 1852

Reference	Type of Study	Location	Results
Corbin 2008	Archaeological inventory survey	0.88-acre coastal parcel in Wa‘awa‘a, Puna, TMK: (3) 1-4-028:009	Documented one archaeological site with three features: SIHP # 50-10-46-26465 consists of a platform (Feature A), clearing mound (Feature B), and a C-shaped wall (Feature C)
Escott 2008	Field inspection	64.48 acres in ‘Ōla‘a Ahupua‘a, Puna, TMK: (3) 1-7-017:170	No significant findings
Haun and Henry 2008a	Archaeological inventory survey	8 acres in Kea‘au, TMKs: (3) 1-6-004:011, 047-053, 055, 056; and 1-6-064:266-269, 283–286	Documented SIHP # 50-10-44-26874, Waipāhoehoe Bridge and associated roadway
Haun and Henry 2008b	Archaeological monitoring	Mountain View Elementary School, ‘Ōla‘a Ahupua‘a, TMK: (3) 1-8-001:007	No significant findings
Runyon et al. 2008	Archaeological monitoring	Pāhoa Elementary School, Waiakahiula 2 Ahupua‘a, TMKs: (3) 1-5-114:002, 025	No significant findings
Tuggle and Tomonari-Tuggle 2008	Archaeological overview, assessment, and research design	Hawai‘i Volcanoes National Park, Puna and Ka‘ū	Discusses Hawaiian archaeology through lens of volcanic action; parts of Puna District discussed
Wilkinson et al. 2008a	Archaeological monitoring	Kea‘au Middle School, Kea‘au Ahupua‘a, Puna District	No significant findings
Wilkinson et al. 2008b	Archaeological monitoring	Pāhoa Intermediate and High School, Waiakahiula Ahupua‘a, Puna District	No significant findings
Rechtman and Clark 2009	Archaeological and limited cultural assessment	1.287 acres in ‘Ōla‘a Ahupua‘a, Puna, TMKs: (3) 1-8-001:045 and 050	No significant findings
Wilkinson et al. 2009	Archaeological monitoring	Keakealani Outdoor Education Center, ‘Ōla‘a Ahupua‘a, Puna, TMK: (3) 1-	No significant findings

Reference	Type of Study	Location	Results
		9-004:019	
Wilkinson et al. 2010	Archaeological inventory survey	Kea‘au-Pāhoa Rd, Kea‘au to Waiakahiula Ahupua‘a, TMKs: (3) 1-5 and 1-6	Documented one previously identified historic property: SIHP # 50-10-44-26874, abandoned concrete bridge (Waipāhoehoe Bridge) and associated roadway
Clark and Rechtman 2011	Archaeological assessment	0.415-acre conservation parcel in Wa‘awa‘a, Puna, TMK: (3) 1-4-028:007	No significant findings; some previously identified features and two additional features determined to be modern
Dye 2011	Archaeological reconnaissance	18 acres at Pū‘āla‘a Ahupua‘a, Puna, TMK: (3) 1–4–002:015 por.	Northern portion of 18-acre project covered by 1955 lava flow; southern portion partially mapped by Bishop Museum (Crozier and Barrère 1971) as part of *mauka* portion of Pū‘āla‘a Village (SIHP # 50-10-46-04294); additional archaeological sites north and south of village identified and described, including six possible burials; features of Pū‘āla‘a Village recommended for preservation
Haun and Henry 2011	Archaeological inventory survey	1.97-acre parcel in Wa‘awa‘a Ahupua‘a, Puna, TMK: (3) 1-4-028:023	Documented two archaeological sites: SIHP #s 50-10-46-28138, platform; and -28139, an agricultural complex with 18 features consisting of pits, retaining walls, modified outcrops, and mounds; one test unit excavated in SIHP # -28138
Uyeoka et al. 2011	Archaeological investigation	7.6-acres in Kahuwai Village, Kahuwai Ahupua‘a, Puna, TMK: (3) 1-4-003	Documented six archaeological complexes comprising 230 features; sites included habitation, agricultural, and ceremonial functions
Rechtman 2012	Archaeological assessment	2.1-acre parcel in Keonepokoiki Ahupua‘a, Puna, TMK: (3) 1-5-009:035	No significant findings
Ah Sam and Rechtman 2013	Archaeological inventory survey	3.5-acre parcel in Pōpōkī Ahupua‘a, Puna, TMK: (3) 1-5-010:028	Documented two archaeological sites previously recorded by Charvet-Pond and Rosendahl (1993): SIHP # 50-10-45-18418, portion of Feature A, trail section; and -18419 Feature A, wall; SIHP # -18418 Feature A recommended for preservation (Rechtman 2014)
Escott 2013	Archaeological inventory survey	0.217607-acre parcel on Pāpi‘o St in Hawaiian Beaches, Waiakahiula	Documented two previously identified archaeological sites: SIHP #s 50-10-45-19012, an agricultural complex of four features (two depressions and two terraces) and -19014, burial platform; nine shovel

Reference	Type of Study	Location	Results
		Ahupua‘a, Puna	probes conducted at Feature A of -19012
Haun and Henry 2013a	Archaeological inventory survey	309 acres in Kauea Ahupua‘a, Puna, TMK: (3) 1-3-009:005 por.	Documented six archaeological sites: SIHP #s 50-10-55-29723, trail; -29724, transportation complex with four features; -29725, enclosure; -29726, transportation complex with two features; -29727, concrete slab; and -29728, railroad grade; the trail, SIHP # -29723 recommended for preservation (Haun and Henry 2013b)
Haun and Henry 2013c	Archaeological assessment	Ten 1-acre parcels in Kea‘au Ahupua‘a, Puna, TMKs: (3) 1-5-041:016–018; 1-5-043:005; 1-5-044:132; 1-5-046:080; 1-5-046:098; 1-5-047:068; 1-5-048:140; and 1-5-048:222	No significant findings
Haun and Henry 2013d	Archaeological assessment	Ten 1-acre parcels in Kea‘au and Waikahekahe Ahupua‘a, Puna, TMKs: (3) 1-5-026:021 and 129; 1-5-28:097, 098 and 165; 1-5-048:157; 1-5-049:033, 121 and 122; and 1-5-050:078	No significant findings
Haun and Henry 2013e	Archaeological assessment	1-acre parcel in Waikahekahenui Ahupua‘a, Puna, TMK: (3) 1-5-041:046	No significant findings
Rechtman and Zenobi 2013	Archaeological assessment	4.92-acre parcel in Keonepokonui Ahupua‘a, Puna, TMK: (3) 1-5-008:005	No significant findings
Clark et al. 2014	Archaeological inventory survey	35.5-acre parcel at Pohoiki Bay, Pohoiki and Keahialaka Ahupua‘a, Puna	Documented five previously identified archaeological sites (SIHP #s 50-10-46-02510, Pohoiki Warm Spring; -02511, historic Rycroft coffee mill complex; -02515, habitation complex; -02516, agricultural complex; and -02530, a section of old coastal Government Rd); and 22 newly identified archaeological sites assigned as SIHP # -30129 through -30150, associated primarily with agriculture and historic-era

Reference	Type of Study	Location	Results
			activity
Escott 2014	Archaeological inventory survey	23.334-acre parcel in Mountain View, ‘Ōla‘a Ahupua‘a, Puna	Documented one archaeological site: SIHP # 50-10-44-29815, historic drainage ditch
Haun and Henry 2014a	Archaeological inventory survey	120.02-acre property in Ke‘eke‘e Ahupua‘a, Puna, TMKs: (3) 1-2-009:028, 029, and 036	Documented 19 archaeological sites comprising 608 individual features; included five previously documented sites (SIHP #s 50-10-55-02539, -21139 through -21142 [found to be destroyed], and -21142) and 15 newly identified sites (SIHP #s 50-10-55-30024 through -30037) comprising 11 single sites and nine complexes; feature types included lava tubes; walls; platforms; pits, walkways; terraces; a lava blister; a U-shape; a C-shape; burials; soil swales; modified gullies and depressions; and enclosures
Haun and Henry 2014b	Archaeological inventory survey	Waiākea Timber Management area, Waiākea and ‘Ōla‘a Ahupua‘a, South Hilo and Puna, TMKs: (3) 1-8-012:001 por.; 2-4-008:portions 001, 006, 010 and 022	Documented three archaeological sites including two sites in ‘Ōla‘a, (SIHP #s 50-10-34-20870, disturbed remnant historic flume; and SIHP # 50-10-43-30088, historic ‘Ōla‘a Back Rd/Ihope Rd); and one site in Waiākea, South Hilo (SIHP # 50-10-35-18697, a previously identified cave with human remains)
Haun and Henry 2014c	Archaeological assessment	7.34-acre parcel in Kaueleau Ahupua‘a, Puna, TMK: (3) 1-3-002:070	No significant findings
Reeve 2014a	Archaeological field inspection	Kamehameha School property, Kahuwai Ahupua‘a, Puna, TMK: (3) 1-5-009:007	Documented two historic properties previously identified by Major and Dixon (1992): SIHP #s 50-10-45-17962, lava tube containing human remains; and -17967, a historic wall
Reeve 2014b	Archaeological field inspection	Kamehameha School properties in Kahuwai and Kauaea Ahupua‘a, Puna	Inspected two emergency evacuation routes: in Kahuwai Ahupua‘a no significant findings, noted proposed route previously disturbed by cane/papaya cultivation, and a lava flow ca. 1840 might have covered traces of archaeological evidence; in Kauaea Ahupua‘a two archaeological sites previously recorded by Haun and Henry (2013) documented (SIHP #s 50-10-55-29726, historic road; and -29728, a

Reference	Type of Study	Location	Results
			railroad grade)
Uyeoka et al. 2014	Ethnohistorical study with archaeological aerial survey	Wao Kele O Puna	Relocated four of seven mounds features previously identified as Site 94-6 by Sweeney and Burtchard (1994); also documented Kaimū cave and noted four *pu‘u* with evidence of native cultigens
Barna and Rechtman 2015	Archaeological inventory survey	Two parcels in Hawaiian Shores Subdivision, Waiakahiula Ahupua‘a, Puna, TMKs: (3) 1-5-088:042 and 043	Documented one site with five features: SIHP # 50-10-45-30226, an agricultural complex consisting of three modified depressions (Features A, C, and E), wall (Feature B), and a mound (Feature D)
Crowell and Higelmire 2015a	Archaeological inventory survey	Kea‘au Ahupua‘a, Puna, TMK: (3) 1-5-053:093	No significant findings
Crowell and Higelmire 2015b	Archaeological inventory survey	Kea‘au Ahupua‘a, Puna, TMK: (3) 1-1-020:085	No significant findings
Crowell and Higelmire 2015c	Archaeological inventory survey	Kea‘au Ahupua‘a, Puna, TMK: (3) 1-6-143:023	No significant findings
Crowell and Higelmire 2015d	Archaeological inventory survey	Waikahekahe Ahupua‘a, Puna, TMK: (3) 1-5-017:118	No significant findings
Haun and Henry 2015	Archaeological assessment	1.0 acre in Kea‘au, Puna, TMK: (3) 1-5-046:107	No significant findings
Wheeler et al. 2015	Archaeological field inspection	Kea‘au Middle School, Kea‘au Ahupua‘a, Puna, TMKs: (3) 1-6-002:001 and 1-6-003:059	School Buildings B, C, D, and E, found to be greater than 50 years old; portion of an *‘auwai* (irrigation ditch) documented adjacent to Buildings D and G; consultation with SHPD Architecture Branch recommended
Bautista, Wilkinson, Hammatt 2017a	Archaeological inventory survey	Kua O Ka Lā Public Charter School, Pū‘āla‘a Ahupua‘a, Puna, TMK: (3) 1-4-002:015 por.	Documented one historic property: SIHP # 50-10-46-30573, pre-Contact complex comprising two features, a lava tube (Feature A) and associated cairn (Feature B)
Bautista,	Archaeological	1.526-acre area in Kea‘au	No significant findings

Reference	Type of Study	Location	Results
Wildey, Hammatt 2017	assessment	Ahupua‘a, Puna, TMKs: (3) 1-6-151:002, 003, 006, and 999	
Bautista, Wilkinson, Hammatt 2017b	Archaeological condition assessment	Wao Kele O Puna, Waiakahiula and Ka‘ohe Ahupua‘a, Puna, TMKs: (3) 1-2-010:002, 003	Identified five previously documented sites within Wao Kele O Puna: SIHP #s 50-10-54-14899, northern portion of Northern Lava Tube documented by McEldowney and Stone (1991); -14900, Middle Lava Tube system/Pāhoa Cave documented by McEldowney and Stone (1991) and Yent (1983), respectively; -19849, Pahoa Lumber Co. railroad grade documented by Kennedy (1991b) and Sweeny and Burtchard (1995); -19853, five or more cairns or mounds on south summit of Pu‘u Heiheiahulu documented by Haun et al. (1985) and Sweeney and Burtchard (1995); and -19854, pre-Contact/historic agricultural and native cultigen site documented by Sweeney and Burtchard (1995); determined 27 June 2014 lava flow likely impacted portions of SIHP #s -19849 and -14900
Wilkinson et al. 2017	Archaeological field inspection	Kea‘au High School, Kea‘au Ahupua‘a, Puna, TMKs: (3) 1-6-003:110 por., 111, 112 por., and 118	No significant findings; research indicated at one time portion of SIHP # 50-10-45-21191 (a section of Hilo Railroad Co./Hawai‘i Consolidated ROW) present within or immediately adjacent to project area, but no evidence of this historic property identified during field inspection due to prior land disturbance
Barna and Bibby 2018	Archaeological assessment	6.9-acre parcel in Keonepokoiki Ahupu‘a, Puna, TMK: (3) 1-5-009:053	No significant findings
Clark 2018	Archaeological field inspection	1.460-acre parcel in Wa‘awa‘a Ahupua‘a, Puna, TMK: (3) 1-4-028:012	No significant findings
Rechtman and Tam Sing 2018	Archaeological inventory survey	6.7-acre parcel in Kea‘au Ahupua‘a, Puna, TMK: (3) 1-6-003:103	Documented two archaeological sites, including one site previously identified by Walker et al. 1997 (SIHP # 50-10-44-21191, a section of Hilo Railroad Co./Hawai‘i Consolidated ROW) and one newly identified site (SIHP # -30766, remnants of a historic wall)
Folk 2020	Archaeological field inspection	0.63-acre parcel in Wa‘awa‘a Ahpua‘a, Puna, TMK: (3) 1-4-028:121	No significant findings

Reference	Type of Study	Location	Results
Kepa‘a and Clark 2020	Archaeological assessment	Wa‘awa‘a Ahupua‘a, Puna, TMK: (3) 1-4-028:008	No significant findings

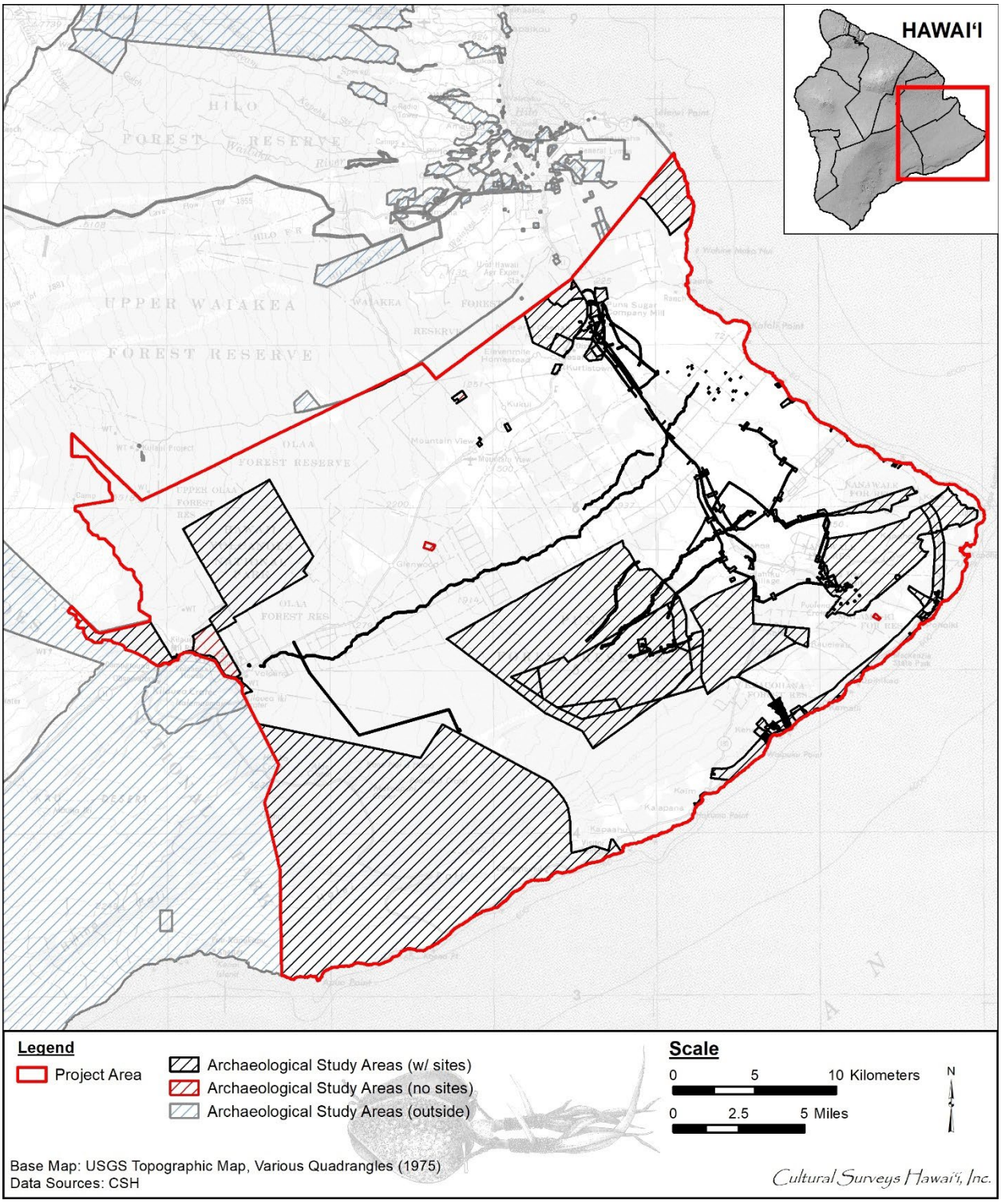

Figure 19. Portion of the 1975 USGS 1:250,000-scale topographic map of Hawai‘i Island showing the locations of prior archaeological studies within the project area

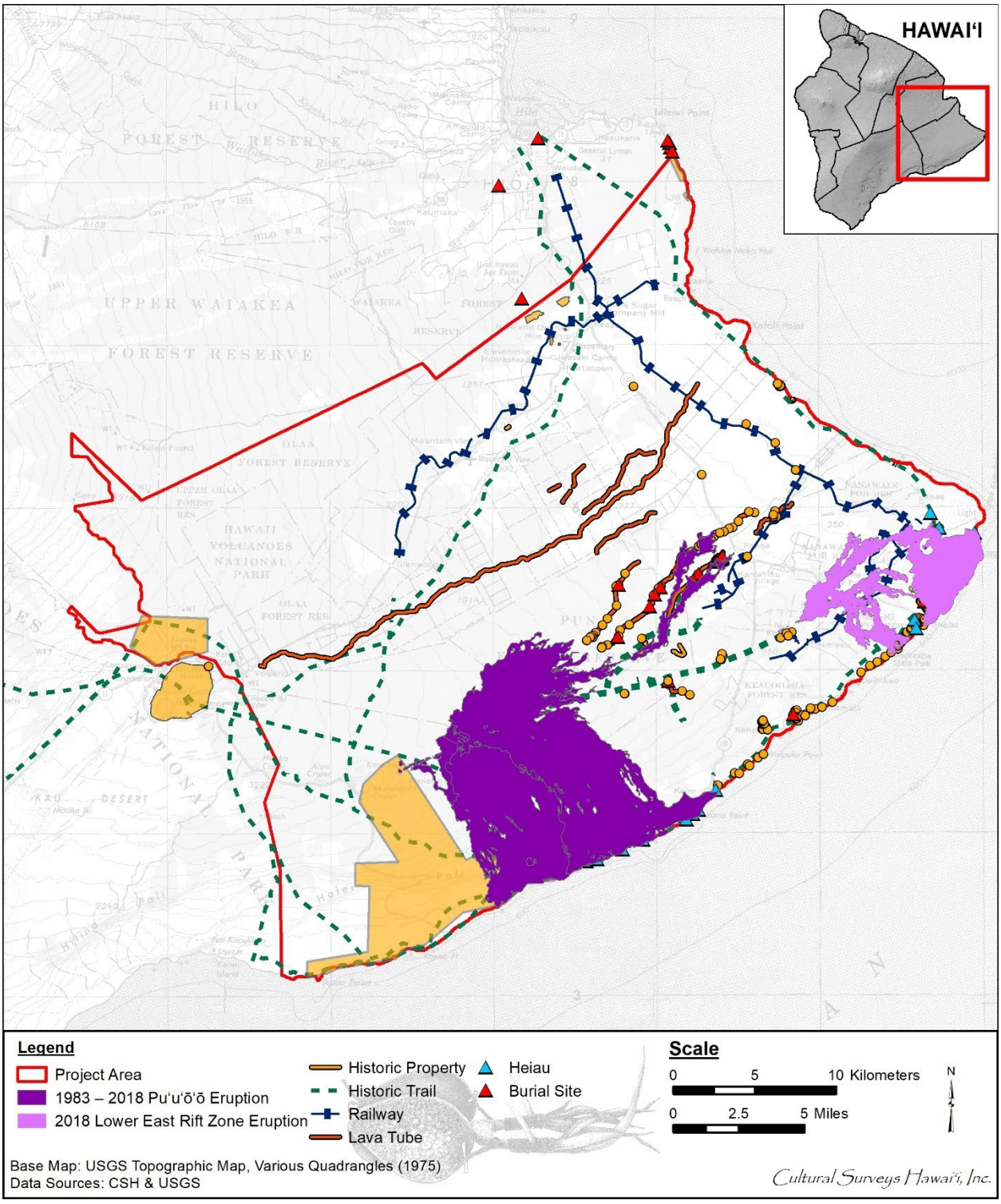

Figure 20. Portion of the 1975 USGS 1:250,000-scale topographic map of Hawai‘i Island showing the locations of historic properties (including lava tube systems) previously documented within the project area

Section 6 Community Consultation

6.1 Introduction

CSH attempted to contact key stakeholders but, to date, not interviews have been formally conducted..

6.2 Community Contact Letter

Letters along with a map and aerial photograph were mailed with the following text:

> With this letter, Cultural Surveys Hawai‘i (CSH) humbly requests your *mana‘o* and *‘ike* (experience, insights, and perspectives) regarding past and ongoing cultural, practices, beliefs, and resources within the Pāhoa and Kea‘au Ahupua‘a.
>
> Consultation with traditional cultural practitioners, *kūpuna*, *kama‘āina*, and Hawai‘i’s diverse ethnic communities is an important and deeply valued part of our work and the environmental review process for proposed projects in Hawai‘i. Your contributions will revitalize and keep alive knowledge of cultural practices, storied places, and life experiences that will remind Hawai‘i’s children of their history for generations to come.
>
> Project Description
>
> At the request of AECOM Technical Services, Inc., on behalf of the County of Hawai‘i Department of Environmental Management (DEM), CSH is conducting a cultural impact assessment (CIA) for the Addition of Wastewater Services for the Puna District Project. The project area is depicted on a portion of the U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles (Figure 1) and an aerial photograph (Figure 2).
>
> The County of Hawai‘i DEM is proposing to prepare a programmatic environmental impact statement (PEIS) for additional wastewater services for the Puna District through an anticipated 30-year planning period. The PEIS will analyze at a programmatic level, the potential environmental impacts of future County DEM actions associated with providing wastewater collection and treatment facilities. The focus of the study will be the areas of Pāhoa and Kea‘au where cesspools are currently the predominant means of wastewater disposal.
>
> Broad proposals and/or planning level decisions will be evaluated in the PEIS to allow informed choice among planning level alternatives and the development of broad mitigation strategies. The PEIS will not address project-level issues such as precise footprints or specific design details that are not yet ready for decision at the planning level. Project-level environmental reviews prepared pursuant to applicable laws for specific components proposed may follow the PEIS.

HAWAII 15 - CIA for the Addition of Wastewater Services for the Puna District Project

Aloha mai kākou Name of Recipient,

With this letter, Cultural Surveys Hawai‘i (CSH) humbly requests your *mana‘o* and *‘ike* (experience, insights, and perspectives) regarding past and ongoing cultural, practices, beliefs, and resources within the Pāhoa and Kea‘au Ahupua‘a.

Consultation with traditional cultural practitioners, *kūpuna*, *kama‘āina*, and Hawai‘i’s diverse ethnic communities is an important and deeply valued part of our work and the environmental review process for proposed projects in Hawai‘i. Your contributions will revitalize and keep alive knowledge of cultural practices, storied places, and life experiences that will remind Hawai‘i’s children of their history for generations to come.

Project Description

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Broad proposals and/or planning level decisions will be evaluated in the PEIS to allow informed choice among planning level alternatives and the development of broad mitigation strategies. The PEIS will not address project-level issues such as precise footprints or specific design details that are not yet ready for decision at the planning level. Project-level environmental reviews prepared pursuant to applicable laws for specific components proposed may follow the PEIS.

The County, as the proposing agency, has determined that this action may have a significant effect on the environment and, therefore, will require the preparation of a PEIS based on the agency’s judgement and experience. Per HAR Title 11 Chapter 200.1-14(d)(2), the County is choosing to prepare this PEIS in accordance with subchapter 10, beginning with the publication of a PEIS preparation notice (PEISPN).

Purpose of this Study

The purpose of a CIA is to gather information on Hawai‘i’s cultural resources, practices, or beliefs that have occurred or still occur within the proposed project area and the Pāhoa and Kea‘au Ahupua‘a. This is accomplished through consultation and background research using previously written documents, studies, and interviews. This information is used to assess potential

Figure 21. Community Consultation Letter, page one

HAWAII 15 - CIA for the Addition of Wastewater Services for the Puna District Project

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impacts by the proposed project to the specific identified resources, practices, and beliefs in the project area and throughout the Pāhoa and Kea‘au Ahupua‘a. As a traditional cultural practitioner and holder of long-term knowledge, your insight, input, and perspective provide a valuable contribution to the assessment of potential effects of this project and an understanding of how to protect these resources and practices.

Insights focused on the following topics in the project area (shown on the attached Figures 1 and 2) are especially helpful and appreciated:

- Your knowledge of traditional cultural practices of the past within the proposed project area and the Pāhoa and Kea‘au Ahupua‘a
- Your specific traditional cultural practice and its connection to the proposed project area and the Pāhoa and Kea‘au Ahupua‘a
- The different natural resources associated with your specific traditional cultural practice
- Legends, stories, or chants associated with your specific traditional cultural practices and their relationships to the proposed project area and the Pāhoa and Kea‘au Ahupua‘a
- Referrals to other *kūpuna*, *kama‘āīna*, and traditional cultural practitioners knowledgeable about the proposed project area and the Pāhoa and Kea‘au Ahupua‘a
- Your comments or thoughts on the potential impacts the proposed project may have on your ongoing traditional cultural practices and natural resources within the proposed project area and the Pāhoa and Kea‘au Ahupua‘a
- Your knowledge of cultural sites and *wahi pana* (storied places) within the proposed project area and the Pāhoa and Kea‘au Ahupua‘a
- Your comments or thoughts on the potential impacts the proposed project may have on cultural sites and *wahi pana* within the proposed project area and the Pāhoa and Kea‘au Ahupua‘a

Consultation Information

Consultation is an important and deeply valued part of the CIA and environmental review process. Your contributions will revitalize and keep alive our combined knowledge of past and ongoing cultural practices, historic places, and experiences, reminding our children of their history generation after generation.

With your agreement to participate in this study, your contributions will become part of the comprehensive understanding of traditions of the area, and part of the public record; they will be available for future access through the Environmental Review Program (formerly the Office of Environmental Quality Control) (https://planning.hawaii.gov/erp/) and at the State Historic Preservation Division Library (https://dlnr.hawaii.gov/shpd/about/research-resources-library).

As a part of this process, your knowledge may be used to inform future CIAs and other heritage studies of cultural practices and resources that need protection from impacts of proposed future projects. If you engage in consultation, and the *mana‘o* and *‘ike* you provide appears in the

Figure 22. Community Consultation Letter, page two

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Page 3

study, we would like to recognize your contribution by including your name. If you prefer not to allow your name to be included, your information can be attributed to an anonymous source.

The consultation interview structure and format are flexible. We will accommodate your preference on how to get together; talk story, over the phone, by email correspondence, remotely via Zoom, MS Teams, Google Chat or other remote meeting platforms.

Your knowledge of the resources and potential effect of the project on traditional practices in the project area and the Pāhoa and Kea‘au Ahupua‘a focusing on the topics in the bullet points above can also be submitted in a written statement. CSH will provide return postage of your written statement on request.

CSH is happy to provide a list of topics for discussion, a more structured questionnaire of interview questions, or any other assistance that might be helpful.

If you have questions regarding consultation, or are interested in participating in this study, please contact CSH Cultural Researcher Chantellee Spencer by email at cspencer@culturalsurveys.com or phone at (808) 965-6478.

Mahalo nui,

Chantellee Konohia Spencer

CSH Cultural Researcher

Figure 23. Community Consultation Letter, page three

The County, as the proposing agency, has determined that this action may have a significant effect on the environment and, therefore, will require the preparation of a PEIS based on the agency's judgement and experience. Per HAR Title 11 Chapter 200.1-14(d)(2), the County is choosing to prepare this PEIS in accordance with subchapter 10, beginning with the publication of a PEIS preparation notice (PEISPN).

Purpose of this Study

The purpose of a CIA is to gather information on Hawai‘i's cultural resources, practices, or beliefs that have occurred or still occur within the proposed project area and the Pāhoa and Kea‘au Ahupua‘a. This is accomplished through consultation and background research using previously written documents, studies, and interviews. This information is used to assess potential impacts by the proposed project to the specific identified resources, practices, and beliefs in the project area and throughout the Pāhoa and Kea‘au Ahupua‘a. As a traditional cultural practitioner and holder of long-term knowledge, your insight, input, and perspective provide a valuable contribution to the assessment of potential effects of this project and an understanding of how to protect these resources and practices.

Insights focused on the following topics in the project area (shown on the attached Figures 1 and 2) are especially helpful and appreciated:

Your knowledge of traditional cultural practices of the past within the proposed project area and the Pāhoa and Kea‘au Ahupua‘a

Your specific traditional cultural practice and its connection to the proposed project area and the Pāhoa and Kea‘au Ahupua‘a

The different natural resources associated with your specific traditional cultural practice

Legends, stories, or chants associated with your specific traditional cultural practices and their relationships to the proposed project area and the Pāhoa and Kea‘au Ahupua‘a

Referrals to other *kūpuna*, *kama‘āīna*, and traditional cultural practitioners knowledgeable about the proposed project area and the Pāhoa and Kea‘au Ahupua‘a

Your comments or thoughts on the potential impacts the proposed project may have on your ongoing traditional cultural practices and natural resources within the proposed project area and the Pāhoa and Kea‘au Ahupua‘a

Your knowledge of cultural sites and *wahi pana* (storied places) within the proposed project area and the Pāhoa and Kea‘au Ahupua‘a

Your comments or thoughts on the potential impacts the proposed project may have on cultural sites and *wahi pana* within the proposed project area and the Pāhoa and Kea‘au Ahupua‘a

Consultation Information

Consultation is an important and deeply valued part of the CIA and environmental review process. Your contributions will revitalize and keep alive our combined knowledge of past and ongoing cultural practices, historic places, and experiences, reminding our children of their history generation after generation.

With your agreement to participate in this study, your contributions will become part of the comprehensive understanding of traditions of the area, and part of the public record; they will be available for future access through the Environmental Review Program (formerly the Office of Environmental Quality Control) (https://planning.hawaii.gov/erp/) and at the State Historic Preservation Division Library (https://dlnr.hawaii.gov/shpd/about/research-resources-library).

As a part of this process, your knowledge may be used to inform future CIAs and other heritage studies of cultural practices and resources that need protection from impacts of proposed future projects. If you engage in consultation, and the *mana‘o* and *‘ike* you provide appears in the study, we would like to recognize your contribution by including your name. If you prefer not to allow your name to be included, your information can be attributed to an anonymous source.

The consultation interview structure and format are flexible. We will accommodate your preference on how to get together; talk story, over the phone, by email correspondence, remotely via Zoom, MS Teams, Google Chat or other remote meeting platforms.

Your knowledge of the resources and potential effect of the project on traditional practices in the project area and the Pāhoa and Kea‘au Ahupua‘a focusing on the topics in the bullet points above can also be submitted in a written statement. CSH will provide return postage of your written statement on request.

CSH is happy to provide a list of topics for discussion, a more structured questionnaire of interview questions, or any other assistance that might be helpful.

6.3 Community Contact Table

Below in Table 3 are the names of the individuals contacted for the CIA. Results are presented below in alphabetical order.

Table 3 Community Contact Table

Name	Affiliation	Comments
Blakemore, Kalena	Puna Rep, Hawai‘i Island Burial Council	Letter and figures sent via email 16 September 2022
Farden, Hailama	President, Association of Hawaiian Civic Clubs	Letter and figures sent via email 16 September 2022
Hussey, Sylvia M.	Chief Executive Office, Office of Hawaiian Affairs	Letter and figures sent via email 16 September 2022

Kern, Zendo	Planning Director, Hawaii County Cultural Resources Commission	Letter and figures sent via email 16 September 2022
Trask, Mililani	Hawai‘i Island Trustee, Office of Hawaiian Affairs	Letter and figures sent via email 16 September 2022 Immediate reply; email address unavailable

Section 7 Traditional Cultural Practices

Timothy R. Pauketat succinctly describes the importance of traditions, especially in regards to the active manifestation of one's culture or aspects thereof. According to Pauketat,

> People have always had traditions, practiced traditions, resisted traditions, or created traditions […] Power, plurality, and human agency are all a part of how traditions come about. Traditions do not simply exist without people and their struggles involved every step of the way. [Pauketat 2001:1]

It is understood that traditional practices are developed within the group, in this case, within the Hawaiian culture. These traditions are meant to mark or represent aspects of Hawaiian culture that have been practiced since ancient times. As with most human constructs, traditions are evolving and prone to change, resulting from multiple influences including modernization as well as other cultures. It is well known that within Hawai‘i, a "broader 'local' multicultural perspective exists" (Kawelu 2015:3). While this "local" multicultural culture is deservedly celebrated, it must be noted that it often comes into contact with "traditional Hawaiian culture." This contact between cultures and traditions has undoubtedly resulted in numerous cultural entanglements. These cultural entanglements have prompted questions regarding the legitimacy of newly evolved traditional practices. The influences of "local" culture are well noted throughout this section, and understood to represent survival or "the active sense of presence, the continuance of native stories, not a mere reaction, or a survivable name. Native survivance stories are renunciations of dominance, tragedy and victimry" (Vizenor 1999:vii). Acknowledgement of these "local" influences helps to inform nuanced understandings of entanglement and of a "living [Hawaiian] contemporary culture" (Kawelu 2015:3). This section strives to articulate traditional Hawaiian cultural practices practiced within the *ahupua‘a* in ancient times, and the aspects of these traditional practices that continue to be practiced today; however, this section also challenges "tropes of authenticity" (Cipolla 2013) and acknowledges the multicultural influences and entanglements that may "change" or "create" a tradition.

This section will integrate information from Sections 3–5 in examining cultural resources and practices identified within or in proximity of the project area once it is determined.

7.1 Gathering Practices

An example of a possible traditional cultural practice practiced within the Ahupua‘a and project area once it is determined.

7.2 Agricultural Practices

An example of a possible traditional cultural practice practiced within the Ahupua‘a and project area once it is determined.

7.3 Burials

An example of a possible traditional cultural practice practiced within the Ahupua‘a and project area once it is determined.

Section 8 Recommendations

8.1 Results of Background Research

Background research for the study yielded the following results which are presented in approximate chronological order:

Puna District:

1. Puna was one of Hawai‘i’s wealthiest agricultural regions. It is only in recent times that volcanic eruptions have destroyed much of Puna’s best land. The *mo‘olelo* or narrative stories of Puna also emphasize the area’s familial, genealogical, and political connections to the neighboring districts of Ka‘ū and Hilo.
2. The first foreigners to see the Puna coast were crew members of Captain Cook’s third voyage to the Pacific in 1779. They were the first to note the differences in population and cultivation between the southwestern section of Puna and the more easterly area.
3. In describing the district of Puna, Coan emphasized the abundant rainfall and evidence of volcanic activity, and the fields of vegetables and fruits grown in those regions with both deep soils and access to water.
4. Very few *kuleana* awards were granted in all of Puna. One *kuleana* comprising 13.64 acres was awarded in Kea‘au, to Hewahewa (LCA 8081, Royal Patent 4360). The claim indicated the land was unfenced with no house, and that coffee was being grown (Hurst 1994:12–13, 17). This parcel was sold to the Roman Catholic Church in 1865.
5. The missionary Rev. Titus Coan estimated the population of Puna was 4,371 in the year 1841, which stayed constant until at least 1846, when Chester Lyman visited the area. However, in a second journey to the area in 1871, Lyman (1924:103) noted a rapid depopulation: “There are but few people in this region […] miserably poor and for some time past have been almost in a state of famine.” Decreasing population was also the result of the introduction of many foreign diseases, to which the Native Hawaiians had no natural immunity.
6. In May 1899 Olaa Sugar Company leased 3,812 acres of land in ‘Ōla‘a (Pāhoa up to Mountain View) from W.H. Shipman for a term of 40 years (Maly 1999:59). Several more land exchanges were made the same year. The lands were allowed to be cleared (by horse and mule) for the cane fields, preserving only certain fruit trees, and by 1901 the Olaa Sugar Company held 4,000 acres of land under cane cultivation, employing 1,100 men (Hurst 1994:14–17).
7. A 40-ft right-of-way from Kea‘au to Hilo was granted to the Hilo Railway Company in December 1899; the right-of-way was to revert to Shipman when the railway was no longer in use (Hurst 1994:15). In 1900, a 17-mile coastal extension was constructed to the sugarcane fields near Kapoho. Spurs were built inland to additional fields in Pāhoa and Kama‘ili. The rail transportation occurred primarily from the ‘Ōla‘a, Pāhoa, and Kapoho fields and was used to haul sugar to the mill in ‘Ōla‘a.

8. By the 1920s the Kea‘au Ranch consisted of 50,000 acres, extending from the coast to elevations of 1800 ft amsl (Henke 1929:32). The ranch stretched from ‘Ōla‘a in the north to Pāhoa in the south.
9. In 1911 the territorial government set apart 19,850 acres of forest in Puna as the Puna Forest Reserve, on the recommendation that such action would allow for collection of revenue from the ongoing timber operations (Uyeoka et al. 2014:286–7). An additional 5,888 acres were added to the Forest Reserve in 1928.

Ka‘ū District:

1. The portion of upland Keauhou in the vicinity of the project area would have been too wet and cold for cultivation or permanent habitation, and instead would have been used for capture of birds for their feathers and collection of *‘ōhi‘a* and *koa* woods for numerous uses (Kawachi 2003:4).
2. An archaeological study conducted at a cave in Hilina Pali in Kapāpala found evidence of Hawaiian occupation by AD 1600, and documented sites including shelters and trails used for seasonal sweet potato cultivation, harvesting of *māmaki* (*Pipturus albidus*) for *tapa* (barkcloth) manufacture, collection of fresh water, and transportation to settlements along the coast (Cleghorn 1980:30).
3. Ellis’ party approached Kīlauea from the Kā‘u side, crossing the Ponahohoa Chasm in Kapāpala which was associated with a recent eruptive event (Ellis 1963:141). Ellis’ guide was a resident of Kapāpala, who “owned a small garden near.” Ellis generally described this area of Kapāpala, situated between the sea and the foot of Mauna Loa, as fertile land, noting “The road by which we returned lay through a number of fields of mountain taro, which appears to be cultivated here more extensively than the sweet potato” (Ellis 1963:152).
4. In the Māhele the *‘ili* of Keauhou was awarded to and retained by Victoria Kamāmalu. Kapāpala was claimed by Kamake‘e Pi‘ikoi who relinquished it in commutation for lands elsewhere, and it was subsequently retained as Crown Lands.
5. During the latter 1800s the vicinity of the project area in Ka‘ū was largely influenced by the establishment of ranching and ongoing activity around the Kīlauea Summit. In 1863 Chiefess Kamāmalu and her father M. Kekūanao‘a formally leased lands in Keauhou for the development of goat and cattle ranching, *pulu* and timber harvesting businesses, the Keauhou boat landing at the coast, and a new Volcano House (Maly and Maly 2005:275; Young 2022).
6. The deadly 2 April 1868 earthquake—considered the largest recorded earthquake in the history of Hawai‘i Island—caused a landslide and tsunami that washed away the ancient village of Keauhou (Pukui et al. 1976:104), among other coastal villages through Ka‘ū and Puna.
7. Ranching was a key land use in both Kapāpala and Keauhou during the early 1900s. By this time Kapāpala Ranch encompassed about 75,000 acres, extending from sea level to about 6,500 ft elevation. According to Henke (1929:35), these lands were

mostly under lease from the government, and only about 40,000 acres had “good to fair grazing.”

8. Maly and Maly (2005:273) note, “From the early 1900s, prisoners at Namakanipaio worked on rebuilding the ‘Peter Lee Road’ into Ka‘ū, and on roads and trails around Kīlauea, and towards Puna. The prison site was closed shortly after 1915.” Nāmakanipaio is located west of the Volcano House, just beyond the limits of the project area in Keauhou.
9. In 1928 the Kilauea Forest Reserve was established in the portion of upper Keauhou adjoining the Upper Waiakea and Olaa forest reserves. This land was “originally a part of the private forest reserve established by Trustees of the B.P. Bishop Estate” (Maly and Maly 2005:331).

8.2 Results of Community Consultation

CSH attempted to contact key stakeholders but, to date, not interviews have been formally conducted.

8.3 Impacts and Recommendation

The results of community consultation, underscored by background research conducted for this CIA, inform the following mitigation possibilities promoting and preserving cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups:

1. Project construction workers and all other personnel involved in the construction and related activities of the project should be informed of the possibility of inadvertent cultural finds, including human remains. In the event that any potential historic properties are identified during construction activities, all activities will cease and the SHPD will be notified pursuant to HAR §13-280-3. In the event that *iwi kūpuna* (ancestral remains) are identified, all earth moving activities in the area will stop, the area will be cordoned off, and the SHPD and Police Department will be notified pursuant to HAR §13-300-40. In addition, in the event of an inadvertent discovery of human remains, the completion of a burial treatment plan, in compliance with HAR §13-300 and HRS §6E-43, is recommended.
2. In the event that *iwi kūpuna* and/or cultural finds are encountered during construction, project proponents should consult with cultural and lineal descendants of the area to develop a reinterment plan and cultural preservation plan for proper cultural protocol, curation, and long-term maintenance

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1845 *Narrative of the U.S. Exploring Expedition during the Years 1838-1842, Vol. IV*. Lea and Blanchard, Philadelphia.

Wilkinson, Sarah, Oliver Bautista, and Hallett H. Hammatt

2017 *Archaeological Literature Review and Field Inspection Report for the Kea‘au High School Proposed Clearing and Grubbing of Approximately 4 Acres Project, Kea‘au Ahupua‘a, Puna District, Hawai‘i Island, TMKs: [3] 1-6-003:110 (por.), 111, 112 (por.), and 118*. Cultural Surveys Hawai‘i, Inc., Kailua, Hawai‘i.

Wilkinson, Sarah, Aulii Mitchell, and Hallett H. Hammatt

2010 *Archaeological Inventory Survey Report for the Kea‘au-Pāhoa Road Widening Project, Kea‘au Ahupua‘a to Waiakahiula Ahupua‘a, Puna District, Island of Hawai‘i TMK [3] 1-5 (various plats and parcels); 1-6 (various plats and parcels)*. Cultural Surveys Hawai‘i, Inc., Kailua, Hawai‘i.

Wilkinson, Sarah, Roseanna Runyon, and Hallett H. Hammatt

2008a *Archaeological Monitoring Report For Kea‘au Middle School, Hawai‘i Inter-Island DOE Cesspool Project, Kea‘au Ahupua‘a, Puna District, Island of Hawai‘i, TMK: [3] 1-6-002:001 and 1-6-003:059.* Cultural Surveys Hawai‘i, Inc., Kailua, Hawai‘i.

2008b *Archaeological Monitoring Report for Pāhoa High and Intermediate School, Hawai‘i Inter-Island DOE Cesspool Project, Puna District, Island of Hawai’i TMK: [3] 1-5-003:038, 039, 045; 1-5-114:026.* Cultural Surveys Hawai‘i, Inc., Kailua, Hawai‘i.

2009 *Archaeological Monitoring Report For Keākealani Outdoor Education Center, Hawai‘i Inter-Island DOE Cesspool Project, ‘Ōla‘a Ahupua‘a, Puna District, Island of Hawai‘i, TMK: [3] 1-9-004:019*. Cultural Surveys Hawai‘i, Inc., Kailua, Hawai‘i.

Wall, Walter A.

1886 Hawai‘i Island. W.A. Wall, Surveyor. Registered Map 1438. Hawai‘i Land Survey Division, State of Hawai‘i, Department of Accounting and General Services, Honolulu. Available online at http://dags.hawaii.gov/survey/search.php.

Yent, Martha

1983 *Survey of a Lava Tube. Pahoa, Puna, Hawaii Island, TMK: 1-5-08:1*. Division of State Parks, Department of Land and Natural Resources, Honolulu.

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1982 *Archaeological Reconnaissance Survey Nanawale Forest Reserve Halepua‘a Section. Puna, Hawaii Island. Tax Map Key: 1-4-03:08, 1-4-03:10*. Division of State Parks and Historic Sites, Department of Land and Natural Resources, Honolulu.

Young, Peter

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Appendix D:
Pre-Assessment Consultation Comments and Responses

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From: Cory <333cory@gmail.com>
Sent: Saturday, September 24, 2022 4:26 AM
To: Hartman, Kelly
Subject: Addition of Wastewater Services for the Puna District

Hello, please put me on the e-mail list for info on this project. thanks, Cory Harden

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

SENT VIA EMAIL

Cory Harden
333cory@gmail.com

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Cory Harden:

Thank you for your email dated September 24, 2022 regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project.

Your contact information has been added to the distribution list for ongoing consultation.

We appreciate your commenting on the PEISPN. Your email and this response will be included in the Programmatic Draft Environmental Impact Statement. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

Mitchell D. Roth
Mayor

Kenneth Bugado Jr.
Acting Police Chief

County of Hawai'i

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

September 29, 2022

Ms. Kelly Hartman
County of Hawaii
Department of Environmental Management
345 Kekuanaoa Street, Suite 41
Hilo, Hawaii 96720
Kelly.Hartman@hawaiicounty.gov

Dear Ms. Hartman:

SUBJECT: AVAILABILITY OF PROGRAMMATIC ENVIRONMENTAL IMPACT STATE PREPARATION NOTICE ADDITION OF WASTEWATER SERVICES FOR THE PUNA DISTRICT

This is in response to a letter dated September 12, 2022, from Mayor Mitchell D. Roth, announcing the availability of the programmatic environmental impact statement preparation notice (PEISPN) for the proposed Addition of Wastewater Services for the Puna District, located in the planning area for the Puna Community Development Plan on the Island of Hawaii.

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

Thank you for allowing us the opportunity to comment.

If you have any questions, please contact Captain Scott Amaral, Puna Patrol, at 965-2716 or via email at scott.amaral@hawaiicounty.gov.

Sincerely,

for KENNETH A.K. QUIOCHO
ASSISTANT POLICE CHIEF
AREA I OPERATIONS BUREAU

SA:lli/22HQ1188

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

Kenneth A.K. Quiocho, Assistant Police Chief
Area I Operations Bureau
Police Department
County of Hawai'i
349 Kapi'olani Street
Hilo, HI 96720-2389

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Assistant Chief Quiocho:

Thank you for your letter dated September 29, 2022 regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project.

Your comments are acknowledged.

We appreciate your commenting on the PEISPN. Your letter and this response will be included in the Programmatic Draft Environmental Impact Statement. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

HAWAII FIRE DEPARTMENT . COUNTY OF HAWAII .

HILO, HAWAII 96720

DATE September 30, 2022

Memorandum

TO : KELLY HARTMAN, DEM, COUNTY OF HAWAII

FROM : CAPTAIN CLINTON BAYBAYAN, FIRE PREVENTION BRANCH

SUBJECT: ADDITION OF WASTEWATER SERVICES FOR THE PUNA DISTRICT

In regards to the above mentioned project, Fire Department Access and Water Supply shall comply with Chapter 18 of the 2018 Hawaii State Fire Code and Chapter 26 of the Hawaii County Code. For any questions please email Clinton.Baybayan@hawaiicounty.gov or call 808-323-4761.

Respectfully Submitted,

Clinton Baybayan
Fire Prevention Captain
Fire Prevention Branch
Hawaii Fire Department

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

Clinton Baybayan, Fire Prevention Captain
Fire Prevention Branch
Fire Department
County of Hawai'i
25 Aupuni Street, Suite 2501
Hilo, HI 96720

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Captain Baybayan:

Thank you for your memorandum dated September 30, 2022 regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project.

As applicable, the requirements of Chapter 18 of the 2018 Hawai'i State Fire Code and Chapter 26 of the Hawai'i County Code would be incorporated into the design of site-specific wastewater services and infrastructure.

We appreciate your commenting on the PEISPN. Your memorandum and this response will be included in the Programmatic Draft Environmental Impact Statement. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

Frankenthaler, Victor

From:	Cab General <Cab.General@doh.hawaii.gov>
Sent:	Friday, October 07, 2022 10:12 PM
To:	Hartman, Kelly; Loui, Rae
Subject:	DOH Clean Air Branch Comments on Addition of Wastewater Services for the Puna District (EIS Preparation Notice)

Aloha,

Thank you for the opportunity to review the subject project.
Please see our standard comments at:

https://health.hawaii.gov/cab/files/2022/10/Standard-Comments-for-Land-Use-Reviews-Clean-Air-Branch-2022-3.pdf

Please let me know if you have any questions.

Barry Ching
Clean Air Branch
Hawaii Department of Health
(808) 586-4200

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

Barry Ching
Clean Air Branch
Department of Health
State of Hawai'i
2827 Waimano Home Road, #130
Pearl City, HI 96782

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Mr. Ching:

Thank you for your email dated October 8, 2022 regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project. We have reviewed the standard comments provided via the link in your email and offer the following responses:

- All necessary permits will be obtained prior to construction.
- The Proposed Action does not include construction or demolition activities that involve asbestos.
- Best management practices will be implemented to minimize visible fugitive dust emissions. All construction work will be in conformance with the air pollution control standards contained in Hawai'i Administrative Rules Title 11, Chapter 60.1, Air Pollution Control, including §60.1-33, Fugitive Dust.
- Operation of the Proposed Action will increase the number of Department of Environmental Management personnel, although the scale of the increase in personnel is undetermined at the time of writing. In turn, the increase in personnel potentially will negligibly affect demographics.
- The Proposed Action will involve improving wastewater treatment infrastructure to essentially meet the standards to protect people's health and will not induce population growth that cannot be reasonably foreseen.

- Providing bike racks and/or electric vehicle charging stations is not part of the plan being addressed by the Programmatic Environmental Impact Statement.

We appreciate your commenting on the PEISPN. Your email and this response will be included in the Programmatic Draft Environmental Impact Statement. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

Brennan Low

I am sorry I missed tonights meeting. I want so share some suggestions gleaned from a guest lecture in a UH Hilo 'Tropical Bioeconomy' class (tought by Peter Matlock). I specifically asked the speaker, Jennifer White, a national expert in microalgae cultivation and use, what proactive things could be done when making a new wastewater treatment plant. She had mentioned they were a growing feedstock source for algae production. Anyway, she shared a few references to best practices and companies that are using municipal wastewater as a feedstock for algae production, as a biofuel. I wanted to pass these along to those doing this study. Puna has a big problem with toxic discharge already, and some of these methods may also offer remediation benefits, turning waste into biofuel.

Gross-Wen Technologies is a company that manufactures and sell alge biofilm filters that can clean wastewater and make a product as a side benefit. https://algae.com/

AECom is a huge international consulting firm that apparently has some experience doing the same kind of thing that Gross-Wen is doing.

https://aecom.com/press-releases/aecom-enters-strategic-partnership-with-genifuel-to-transform-algae-and-wastewater-biosolids-into-sustainable-aviation-fuel/

Not sure if producing aviation fuel is likely, but the part about their proprietary method of cleaning up harmful algal blooms could be of interest. I think those occur in the water off of HPP as well.

The idea is creating something worthwhile out of the wastewater. Kona companies do quite well growing Algae, and Biofuel is already being produced at Shipman Industrial. Perhaps there are synergies with this growing industry and your efforts to clean the water.
Thanks for giving this notion a ponder.

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

Brennan Low
16-521 Orchidland Drive
Kea'au, HI 96749

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Low:

Thank you for your October 12, 2022 comments, submitted via the SmartComment website, regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project.

Your comments are acknowledged. Algae can be used in wastewater treatment applications. The Facility Plan will review the level of treatment required to meet water quality objectives for various effluent reuse/disposal options. Specific treatment technology selection would be done during future design tasks after the wastewater program has been established by the current facility planning effort.

We appreciate your commenting on the PEISPN. Your comments and this response will be included in the Programmatic Draft Environmental Impact Statement. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

WasteWater Education 501(c)3

As a community advisory service for both US and international sites, we would advocate strongly for creation of a 'water reuse and recharge' system? As a Water Environment Federation member we strongly support the concept of 'one water' - most new facilities describe themselves as water recovery plants not wastewater treatment. Being a tropical location vastly increases the opportunity for biological, plant based systems - a system of systems that compliment their locations and add water back in to the environment rather than discharge partially treated effluent downstream. Each then treats to site and need - and in the event of drought or flood at one the whole system doesn't crash. We invite you to look at the expertise of our staff and Board of Directors at https://wastewatereducation.org and our most recent Annual Report at https://express.adobe.com/video/JWFFvOOCSeF8a

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

Dendra Best, Executive Director
WasteWater Education 501(c)3
Post Office Box 792
Traverse City, MI 49685

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Ms. Best:

Thank you for your October 18, 2022 comments, submitted via the SmartComment website, regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project.

Effluent water reuse and recharge systems will be evaluated in the Facility Plan.

We appreciate your commenting on the PEISPN. Your comments and this response will be included in the Programmatic Draft Environmental Impact Statement. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

10/14/22

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

Sep 27, 2022

MEMORANDUM

TO: **DLNR Agencies:**
_X_ Div. of Aquatic Resources (kendall.l.tucker@hawaii.gov)
___ Div. of Boating & Ocean Recreation
_X_ Engineering Division (DLNR.ENGR@hawaii.gov)
_X_ Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
_X_ Div. of State Parks (curt.a.cottrell@hawaii.gov)
_X_ Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
_X_ Office of Conservation & Coastal Lands (sharleen.k.kuba@hawaii.gov)
_X_ Land Division – Hawaii District (gordon.c.heit@hawaii.gov)

FROM: Russell Y. Tsuji, Land Administrator *Russell Tsuji*
SUBJECT: Programmatic Environmental Impact Statement Preparation Notice for the Proposed **Addition of Wastewater Services for the Puna District**
LOCATION: Puna, Island of Hawaii; TMK: Numerous
APPLICANT: AECOM Technical Services, Inc., on behalf of the County of Hawaii, Department of Environmental Management

Transmitted for your review and comment is information on the above-referenced subject matter. The Programmatic EISPN was published on September 23, 2022, by the State Environmental Review Program (formerly the Office of Environmental Quality Control) at the Office of Planning and Sustainable Development in the periodic bulletin, The Environmental Notice, available at the following link:

https://files.hawaii.gov/dbedt/erp/The_Environmental_Notice/2022-09-23-TEN.pdf

Please submit any comments by **October 21, 2022**. If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura directly via email at darlene.k.nakamura@hawaii.gov. Thank you.

BRIEF COMMENTS:

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

Signed: _____
Print Name: GORDON C. HEIT
Division: Land Division
Date: 10/18/22

Attachments
cc: Central Files

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

Gordon C. Heit
Land Division
Department of Land and Natural Resources
State of Hawai'i
Post Office Box 621
Honolulu, HI 96809

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Mr. Heit:

Thank you for your memorandum dated October 18, 2022 regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project.

We understand that the Land Division does not have any comments on the proposed project at this time.

We appreciate your commenting on the PEISPN. Your memorandum and this response will be included in the Programmatic Draft Environmental Impact Statement. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

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

Sep 27, 2022

MEMORANDUM

FROM: ~~TO:~~ **DLNR Agencies:**
X Div. of Aquatic Resources (kendall.l.tucker@hawaii.gov)
___Div. of Boating & Ocean Recreation
X Engineering Division (DLNR.ENGR@hawaii.gov)
X Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
X Div. of State Parks (curt.a.cottrell@hawaii.gov)
X Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
X Office of Conservation & Coastal Lands (sharleen.k.kuba@hawaii.gov)
X Land Division – Hawaii District (gordon.c.heit@hawaii.gov)

TO: ~~FROM:~~ Russell Y. Tsuji, Land Administrator *Russell Tsuji*
SUBJECT: Programmatic Environmental Impact Statement Preparation Notice for the Proposed **Addition of Wastewater Services for the Puna District**
LOCATION: Puna, Island of Hawaii; TMK: Numerous
APPLICANT: AECOM Technical Services, Inc., on behalf of the County of Hawaii, Department of Environmental Management

Transmitted for your review and comment is information on the above-referenced subject matter. The Programmatic EISPN was published on September 23, 2022, by the State Environmental Review Program (formerly the Office of Environmental Quality Control) at the Office of Planning and Sustainable Development in the periodic bulletin, The Environmental Notice, available at the following link:

https://files.hawaii.gov/dbedt/erp/The_Environmental_Notice/2022-09-23-TEN.pdf

Please submit any comments by **October 21, 2022**. If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura directly via email at darlene.k.nakamura@hawaii.gov. Thank you.

BRIEF COMMENTS:

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

Signed: *[signature]*
Print Name: Carty S. Chang, Chief Engineer
Division: Engineering Division
Date: Oct 20, 2022

Attachments
cc: Central Files

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/Russell Y. Tsuji

Ref: Programmatic Environmental Impact Statement Preparation Notice for the Proposed Addition of Wastewater Services for the Puna District
Location: Puna, Island of Hawaii
TMK(s): Numerous
Applicant: AECOM Technical Services, Inc., on behalf of the County of Hawaii, Department of Environmental Management

COMMENTS

The rules and regulations of the National Flood Insurance Program (NFIP), Title 44 of the Code of Federal Regulations (44CFR), are in effect when development falls within a Special Flood Hazard Area (high-risk areas). Be advised that 44CFR, Chapter 1, Subchapter B, Part 60 reflects the minimum standards as set forth by the NFIP. Local community flood ordinances may stipulate higher standards that can be more restrictive and would take precedence over the minimum NFIP standards.

The owner of the project property and/or their representative is responsible to research the Flood Hazard Zone designation for the project. Flood zones subject to NFIP requirements are identified on FEMA's Flood Insurance Rate Maps (FIRM). The official FIRMs can be accessed through FEMA's Map Service Center (msc.fema.gov). Our Flood Hazard Assessment Tool (FHAT) (http://gis.hawaiinfip.org/FHAT) could also be used to research flood hazard information.

If there are questions regarding the local flood ordinances, please contact the applicable County NFIP coordinating agency below:

- Oahu: City and County of Honolulu, Department of Planning and Permitting (808) 768-8098.
- Hawaii Island: County of Hawaii, Department of Public Works (808) 961-8327.
- Maui/Molokai/Lanai County of Maui, Department of Planning (808) 270-7139.
- Kauai: County of Kauai, Department of Public Works (808) 241-4849.

Signed: _____
CARTY S. CHANG, CHIEF ENGINEER

Date: Oct 20, 2022

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

Carty S. Chang, Chief Engineer
Engineering Division
Department of Land and Natural Resources
State of Hawai'i
1151 Punchbowl Street, Room 221
Honolulu, HI 96813

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Mr. Chang:

Thank you for your memorandum dated October 20, 2022 regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project.

A majority of the Project Area is located in Federal Emergency Management Agency (FEMA) Zone X, an area of minimal flood hazard outside of the Special Flood Hazard Area, or Zone D, an area of undetermined food hazard. A review of the FEMA flood insurance rate maps will be completed for the Proposed Action, and work will be conducted in accordance with minimum NFIP requirements and any additional or more restrictive local standards.

We appreciate your commenting on the PEISPN. Your memorandum and this response will be included in the Programmatic Draft Environmental Impact Statement. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

W.H. Shipman
Limited

October 20, 2022

AECOM Technical Services, Inc.
1001 Bishop Street, Suite 1600
Honolulu, Hawai'i 96813-3698

Re: Programmatic Environmental Impact Statement Preparation Notice
Addition of Wastewater Services for the Puna District

To Whom It May Concern:

On behalf of W.H. Shipman, Limited (WHS), please consider these comments regarding the above. WHS is one of the landowners in the Village of Kea'au and for lands in the vicinity. Under the Puna Community Development Plan (Puna CDP), Kea'au Village is designated as a Regional Town Center, the objective of which is to enhance the role of existing village town centers by allowing expanded commercial uses, facilitating the development of farmers markets and community gathering places, opportunities for special needs housing, *and infrastructure to support more compact development forms and multi-modal travel. Puna CDP, Section 3.1.2.*

As part of its Master Plan for the area, and consistent with the goals of the Puna CDP, WHS prepared a Final Environmental Impact Statement (EIS) in July of 2020, which assessed proposed impacts and mitigation measures that involved the development of a mixed use village at Kea'au that provides a diversity of housing choices, expanded commercial opportunities, and the enhancement or relocation of existing and future civic uses (e.g. police and fire station and transit hub).

Included with the EIS was a segment regarding the likely need for development of a new wastewater treatment plant (WWTP), at a possible location near the Keaau-Pahoa Bypass Road.

WHS is very supportive of the County's scoping efforts. As the geographic village crossroads serving the Puna community's growing needs, it is apparent that as a Regional Town Center, Kea'au Village should be seriously considered for the development of a wastewater system serving the area. WHS is willing to work cooperatively with the County to provide a suitable location for either (1) the site of a WWTP, or (2) a collection system for transmitting wastewater to the County's WWTP at Keaukaha, if it is feasible to do so.

16-127 Lapa'au Road Kea'au, HI 96749
tel.: 808.966.9325 • fax: 808.966.8522
www.whshipman.com

Should there be any questions or should you be in need of further information, please do not hesitate to let us know.

Sincerely,

KIMO LEE
Director of Development
W.H. Shipman, Limited

cc: Kelly Hartman, Department of Environmental Management
Kelly.Hartman@hawaiicounty.gov

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

Kimo Lee, Director of Development
W.H. Shipman, Limited
16-127 Lapa'au Road
Kea'au, HI 96749

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Mr. Lee:

Thank you for your letter dated October 20, 2022 regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project.

Your comments are acknowledged. The County of Hawai'i will coordinate with W.H. Shipman to identify a suitable location for both a wastewater treatment plant (WWTP) site and sewage collection system for conveyance of wastewater to either a new local WWTP or the Hilo WWTP in Keaukaha.

We appreciate your commenting on the PEISPN. Your letter and this response will be included in the Programmatic Draft Environmental Impact Statement. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

HA-23-62

TM

DAVID Y. IGE
GOVERNOR OF HAWAII

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

RECEIVED
OFFICE OF CONSERVATION
AND COASTAL LANDS

2022 SEP 28 A 8:18

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

Sep 27, 2022

MEMORANDUM

TO: **DLNR Agencies:**
X Div. of Aquatic Resources (kendall.l.tucker@hawaii.gov)
___Div. of Boating & Ocean Recreation
X Engineering Division (DLNR.ENGR@hawaii.gov)
X Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
X Div. of State Parks (curt.a.cottrell@hawaii.gov)
X Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
X Office of Conservation & Coastal Lands (sharleen.k.kuba@hawaii.gov)
X Land Division – Hawaii District (gordon.c.heit@hawaii.gov)

FROM: Russell Y. Tsuji, Land Administrator *Russell Tsuji*
SUBJECT: Programmatic Environmental Impact Statement Preparation Notice for the Proposed **Addition of Wastewater Services for the Puna District**
LOCATION: Puna, Island of Hawaii; TMK: Numerous
APPLICANT: AECOM Technical Services, Inc., on behalf of the County of Hawaii, Department of Environmental Management

Transmitted for your review and comment is information on the above-referenced subject matter. The Programmatic EISPN was published on September 23, 2022, by the State Environmental Review Program (formerly the Office of Environmental Quality Control) at the Office of Planning and Sustainable Development in the periodic bulletin, The Environmental Notice, available at the following link:

https://files.hawaii.gov/dbedt/erp/The_Environmental_Notice/2022-09-23-TEN.pdf

Please submit any comments by **October 21, 2022**. If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura directly via email at darlene.k.nakamura@hawaii.gov. Thank you.

BRIEF COMMENTS:

* Will await the Draft EIS to provide Comments

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

Signed: K. Tiger Mills
Print Name: K. Tiger Mills
Division: DLNR - OCCL
Date: 10/20/2022

Attachments
cc: Central Files

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

K. Tiger Mills
Office of Conservation and Coastal Lands
Department of Land and Natural Resources
State of Hawai'i
1151 Punchbowl Street, Room 131
Honolulu, HI 96813

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Ms. Mills:

Thank you for your memorandum dated October 21, 2022 regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project.

We understand that the Office of Conservation and Coastal Lands does not have any comments on the proposed project at this time and will await the Programmatic Draft Environmental Impact Statement (PDEIS) to provide comments.

We appreciate your commenting on the PEISPN. Your memorandum and this response will be included in the PDEIS. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

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

Sep 27, 2022

MEMORANDUM

TO: **DLNR Agencies:**
X Div. of Aquatic Resources (kendall.l.tucker@hawaii.gov)
___Div. of Boating & Ocean Recreation
X Engineering Division (DLNR.ENGR@hawaii.gov)
X Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
X Div. of State Parks (curt.a.cottrell@hawaii.gov)
X Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
X Office of Conservation & Coastal Lands (sharleen.k.kuba@hawaii.gov)
X Land Division – Hawaii District (gordon.c.heit@hawaii.gov)

FROM: Russell Y. Tsuji, Land Administrator *Russell Tsuji*
SUBJECT: Programmatic Environmental Impact Statement Preparation Notice for the Proposed **Addition of Wastewater Services for the Puna District**
LOCATION: Puna, Island of Hawaii; TMK: Numerous
APPLICANT: AECOM Technical Services, Inc., on behalf of the County of Hawaii, Department of Environmental Management

Transmitted for your review and comment is information on the above-referenced subject matter. The Programmatic EISPN was published on September 23, 2022, by the State Environmental Review Program (formerly the Office of Environmental Quality Control) at the Office of Planning and Sustainable Development in the periodic bulletin, The Environmental Notice, available at the following link:

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Please submit any comments by **October 21, 2022**. If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura directly via email at darlene.k.nakamura@hawaii.gov. Thank you.

BRIEF COMMENTS:

( ) We have no objections.
(☑) We have no comments.
( ) We have no additional comments.
( ) Comments are included/attached.

Signed: *Brian J. Neilson*
Print Name: Brian J. Neilson- Administrator
Division: Aquatic Resources
Date: Oct 24, 2022

Attachments
cc: Central Files

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF AQUATIC RESOURCES
1151 PUNCHBOWL STREET, ROOM 330
HONOLULU, HAWAII 96813

Date: 10/21/22
DAR # AR0251

MEMORANDUM

TO: Brian J. Neilson
DAR Administrator

FROM: Troy Sakihara TSS, Aquatic Biologist

SUBJECT: Review of Programmatic Environmental Impact Statement Preparation Notice (EISPN) for the Proposed Addition of Wastewater Services for the Puna District

Request Submitted by: Russell Y. Tsuji, Land Administrator
Puna District, County of Hawaii

Location of Project:

Brief Description of Project:

On behalf of Hawaii County, Aecom Services has submitted a Progammatic EISPN for review. As part of the Puna Community Development Plan, Hawaii County is proposing the addition of services and infrastructure to support wastewater collection, treatment and disposal throughout the Puna District, which are currently non-existent in said district. In particular, wastewater facilities are intended for regional town neighborhood and community centers, and potential neighborhood village centers established in the future. The proposed actions are intended to facilitate economic recovery, community health and well-being, improve infrastructure, and reduce the reliance on substandard wastewater disposal methods (cesspools) to reduce impacts to natural resources and the environment.

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: _____ Date: Oct 24, 2022
Brian J. Neilson
DAR Administrator

DAR# AR0251

Brief Description of Project

Three wastewater system options are being considered: 1) Onsite- mechanical or natural processes to collect, treat and dispose/reclaim wastewater from single dwellings or buildings, 2) Decentralized- managed on-site wastewater system and/or cluster of systems to collect, treat, and disperse/reclaim wastewater from a small community or service area, 3) Centralized- a managed system of a collection of sewers with a single treatment plant that collects and treats water from an entire service area.

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

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Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

Brian J. Neilson, Administrator
Division of Aquatic Resources
Department of Land and Natural Resources
State of Hawai'i
1151 Punchbowl Street, Room 330
Honolulu, HI 96813

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Mr. Neilson:

Thank you for your memorandum dated October 24, 2022 regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project.

We understand that the Division of Aquatic Resources does not have any comments on the proposed project at this time.

We appreciate your commenting on the PEISPN. Your memorandum and this response will be included in the Programmatic Draft Environmental Impact Statement. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

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

Sep 27, 2022

MEMORANDUM

FROM: **DLNR Agencies:**
_X_ Div. of Aquatic Resources (kendall.l.tucker@hawaii.gov)
___Div. of Boating & Ocean Recreation
_X_ Engineering Division (DLNR.ENGR@hawaii.gov)
_X_ **Div. of Forestry & Wildlife** (rubyrosa.t.terrago@hawaii.gov)
_X_ Div. of State Parks (curt.a.cottrell@hawaii.gov)
_X_ Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
_X_ Office of Conservation & Coastal Lands (sharleen.k.kuba@hawaii.gov)
_X_ Land Division – Hawaii District (gordon.c.heit@hawaii.gov)

TO: Russell Y. Tsuji, Land Administrator *Russell Tsuji*
SUBJECT: Programmatic Environmental Impact Statement Preparation Notice for the Proposed **Addition of Wastewater Services for the Puna District**
LOCATION: Puna, Island of Hawaii; TMK: Numerous
APPLICANT: AECOM Technical Services, Inc., on behalf of the County of Hawaii, Department of Environmental Management

Transmitted for your review and comment is information on the above-referenced subject matter. The Programmatic EISPN was published on September 23, 2022, by the State Environmental Review Program (formerly the Office of Environmental Quality Control) at the Office of Planning and Sustainable Development in the periodic bulletin, The Environmental Notice, available at the following link:

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Please submit any comments by **October 21, 2022**. If no response is received by this date, we will assume your agency has no comments. Should you have any questions, please contact Darlene Nakamura directly via email at darlene.k.nakamura@hawaii.gov. Thank you.

BRIEF COMMENTS:

( ) We have no objections.
( ) We have no comments.
( ) We have no additional comments.
(☑) Comments are included/attached.

Signed: *Lainie Berry*
Print Name: LAINIE BERRY, Wildlife Program Mgr.
Division: Division of Forestry and Wildlife
Date: Nov 16, 2022

Attachments
cc: Central Files

DAVID Y. IGE
GOVERNOR OF HAWAII

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

ROBERT K. MASUDA
FIRST DEPUTY

M. KALEO MANUEL
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

October 24, 2022

MEMORANDUM *Log no. 3831*

TO: RUSSELL Y. TSUJI, Land Administrator
Land Division

FROM: LAINIE BERRY, Wildlife Program Manager
Division of Forestry and Wildlife

SUBJECT: **Division of Forestry and Wildlife Comments for the Programmatic Environmental Impact Statement Preparation Notice (EISPN) for the Proposed Addition of Wastewater Service for the Puna District on Hawai‘i Island**

The Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) has received your request for comments for Programmatic EISPN for the addition of wastewater services for the Puna District on the island of Hawai‘i; TMKs: Numerous. The proposed project consists of adding wastewater collection, treatment, and disposal infrastructure and services for regional town centers, community and neighborhood village centers, and future locations that will be subject to community review encompassed by all of Council District 4, most of Council District 5, and portions of Council Districts 3 and 6. Options considered for wastewater infrastructure include onsite, decentralized, and centralized systems.

DOFAW concurs with the U.S. Fish and Wildlife Service’s determination regarding threatened and endangered listed species that may potentially occur in the proposed project area as indicated in Section 4.6.1 (Flora) and 4.6.2 (Fauna) of the Programmatic EISPN. We would also like to add the following State-listed species that may occur in the project vicinity: the Hawaiian Hawk or ‘Io (*Buteo solitarius*), and anchialine shrimp species *Vetericaris chaceorum* and *Procaris hawaiana.*

DOFAW provides the following additional comments regarding the potential for the proposed work to affect listed species in the vicinity of the project area.

- Hawaiian Hoary Bat or ‘Ōpe‘ape‘a (*Lasiurus cinereus semotus*): Any required site clearing should be timed to avoid disturbance to bats during their birthing and pup rearing season (June 1 through September 15). During this period woody plants greater than 15 feet (4.6 meters) tall should not be disturbed, removed, or trimmed. Barbed wire should also be avoided for any construction because bats can become ensnared and killed by such fencing material during flight.

- Hawaiian petrel or ʻUʻau (*Pterodroma sandwichensis*), Band-rumped Storm-petrel (*Oceanodroma castro*), and Newell's Shearwater or ʻAo (*Puffinus newelli*): Artificial lighting can adversely impact these seabirds, which may pass through the area at night, by causing them to become disoriented. This disorientation can result in their collision with manmade structures or the grounding of birds. For nighttime work that might be required, DOFAW recommends that all lights used to be fully shielded to minimize the attraction of seabirds. Nighttime work that requires outdoor lighting should be avoided during the seabird fledging season, from September 15 through December 15. This is the period when young seabirds take their maiden voyage to the open sea. Permanent lighting also poses a risk of seabird attraction, and as such should be minimized or eliminated to protect seabird flyways and preserve the night sky. For illustrations and guidance related to seabird-friendly light styles that also protect seabirds and the dark starry skies of Hawaiʻi, please visit https://dlnr.hawaii.gov/wildlife/files/2016/03/DOC439.pdf.

- Hawaiian stilt (*Himantopus mexicanus knudseni*), Hawaiian coot (*Fulica alai*), Hawaiian gallinule (*Gallinula chloropus sandvicensis*), Hawaiian Duck (*Anas wyvilliana*), and Hawaiian Goose (*Branta sandvicensis*): It is against State law to harm or harass these species of waterbird. If any of these species are present during construction, all activities within 100 feet (30 meters) should cease and the bird or birds should not be approached. Work may continue after the bird or birds leave the area of their own accord. If a nest is discovered at any point, please contact the Hawaiʻi Island Branch DOFAW Office at (808) 974-4221.

- If the proposed project incorporates the construction of water features (e.g., wastewater treatment plants, ponds, etc.) that may serve as attractants to waterbirds, we recommend that you should consider implementing additional mitigation measures to avoid avian mortality during project design and during operation for the long term.

- Hawaiian Monk Seal (*Monachus schauinslandi*) and threatened Green Sea Turtle (*Chelonia mydas*): If either species is detected within 100 meters of the project area all nearby construction operations should cease and not continue until the focal animal has departed the area on its own accord.

- Yellow-faced bees (*Hylaeus spp*.): DOFAW recommends surveys done by an entomologist be conducted before work occurs at the proposed coastal areas from the project site. Yellow-faced Bee surveys should occur between the months of April to November.

- Hawaiian Hawk or ʻIo (*Buteo solitarius*): DOFAW recommends surveying the area to ensure no Hawaiian Hawk nests are present if trees are to be cut. ʻIo nests may be present during the breeding season from March to September.

- Blackburn's Sphinx Moth (*Manduca blackburni*) or BSM: Portions of the project area fall within the range of the State listed BSM. Larvae of BSM feed on many nonnative hostplants that include tree tobacco (*Nicotiana glauca*), which grows in disturbed soil. We recommend contacting the Hawaiʻi Island Branch DOFAW office at (808) 974-4221 for

further information about where BSM may be present and whether a vegetation survey should be conducted to determine the presence of plants preferred by BSM. DOFAW recommends removing plants less than one meter in height or during the dry time of the year to avoid harm to BSM. If you intend to either remove tree tobacco over one meter in height or to disturb the ground around or within several meters of these plants, they must be thoroughly inspected by a qualified biologist for the presence of BSM eggs and larvae.

- Streams: Project work on or at streams could affect endangered native Hawaiian damselflies (*Megalagrion* spp.) that may be present. DOFAW, therefore, recommends a survey be conducted by a qualified entomologist to determine if listed damselflies are present in the project area and to assess any potential impacts to those species.

- Anchialine Ponds: Proposed work that occurs near anchialine ponds could affect endangered anchialine shrimp species such as *Vetericaris chaceorum* and *Procaris hawaiana*, and the endangered damselfly *Megalagrion xanthomelas*. DOFAW, therefore, recommends a survey be conducted by a qualified entomologist to determine if listed damselflies are present in the project area and to assess any potential impacts to those species.

- Mull‘s picture-wing fly (*Drosophila mulli*) spp.: The State threatened *D. mulli* is a picture-wing fly endemic to montane wet forests on the island of Hawai‘i. Populations are closely associated with their breeding host, the fan palm or loulu, *Pritchardia beccariana*. As stated in the PEISN, the project area falls within critical habitat for *D. mulli*. There are three designated critical habitats from which the species is known to occur: ‘Ōla‘a, Waiākea, and Stainback Forests. If work is to take place within or near the before mentioned critical habitats, a vegetation survey should be conducted to determine the presence of *Pritchardia beccariana*. If present, a buffer zone of several meters should be implemented to avoid disturbance, and these plants must be thoroughly inspected by a qualified entomologist for the presence of *D. mulli* eggs and larvae. Further consultation with DOFAW may be required to determine avoidance and minimization measures to prevent impacts to the species.

- Picture-wing fly (*Drosophila digressa*): The State endangered *D. digressa* is an endemic picture-wing fly found only on the island of Hawai‘i in elevations ranging from approximately 2,000 to 4,500 ft (610 to 1,370 m), in the lowland mesic, montane mesic, and montane wet ecosystems. This species relies on the decaying stems of *Charpentiera* spp. and *Pisonia* spp. plants to deposit their eggs and complete larvae development. The wet montane forest habitat of the ‘Ōla‘a Small Tract in Hawai‘i Volcanoes National Park and the Manukā Natural Area Reserve in mesic habitat are the most recently known sites to be occupied by *D. digressa*. DOFAW recommends that a vegetation survey be conducted to determine the presence of host plants, *Charpentiera* spp. and *Pisonia* spp., in areas where the picture-wing fly is known to occur, or that may present suitable habitat. A buffer zone of several meters should be implemented to avoid disturbance, and a qualified entomologist should inspect the plants thoroughly for the presence of *D. digressa* eggs and larvae. Further consultation with DOFAW may be required, if the species detected within or near

the proposed project site, to determine avoidance and minimization measures to prevent impacts to the species.

- Plants: We recommend that surveys for rare and endangered plants be conducted in all proposed affected areas prior to commencing work due to the potential presence of them. Aside from those listed in the PEIS, we also recommend surveys for the following species that are or were known from the project area: *Cyanea shipmanii*, *Plantago hawaiiensis*, *Ranunculus hawaiensis*, *Sesbania tomentosa*, *Vicia menziesii*, and *Zanthoxylum hawaiiense*. DOFAW should be notified at (808) 587-0166 if any listed species are found. Once more is known about the specific sites where there will be disturbance, please refer to avoidance measures to at the following link to guide compliance and planning minimization actions: https://www.fws.gov/media/plant-avoidance-and-minimization-measures

- DOFAW recommends using native plant species for landscaping that are appropriate for the area (i.e., climate conditions are suitable for the plants to thrive, historically occurred there, etc.). Please do not plant invasive species. DOFAW also recommends consulting the Hawai‘i-Pacific Weed Risk Assessment at www.plantpono.org to determine the potential invasiveness of plants proposed for use in the project and for guidance on the selection and evaluation of landscaping plants.

- DOFAW recommends minimizing the movement of plant or soil material between worksites. Soil and plant material may contain invasive fungal pathogens (e.g., Rapid ‘Ōhi‘a Death), vertebrate and invertebrate pests (e.g., Little Fire Ants, Coqui Frogs), or invasive plant parts that could harm our native species and ecosystems. We recommend consulting the Big Island Invasive Species Committee (BIISC) at (808) 933-3340 to help plan, design, and construct the project, learn of any high-risk invasive species in the area, and ways to mitigate their spread. All equipment, materials, and personnel should be cleaned of excess soil and debris to minimize the risk of spreading invasive species.

- To prevent the spread of Rapid ‘Ōhi‘a Death (ROD), DOFAW requests that the information and guidance at the following website be reviewed and followed if ‘ōhi‘a trees are present at the project site that will be removed, trimmed, or potentially injured: https://cms.ctahr.hawaii.edu/rod.

- You should avoid importing to Hawai‘i Island soil or other plant material from off-island. Soil and plant material may contain fungi (e.g., Rapid ‘Ōhi‘a Death) and other pathogens that could harm our native species and ecosystems. We recommend consulting the Hawai‘i Interagency Biosecurity Plan at http://dlnr.hawaii.gov/hisc/plans/hibp/ in planning, design, and construction of the project.

- Due to the arid climate and risks of wildfire to listed species, we recommend coordinating with the Hawai‘i Wildfire Management Organization at (808) 850-900 or admin@hawaiiwildfire.org, on how wildfire prevention can be addressed in the project area.

We appreciate your efforts to work with our office for the conservation of our native species. These comments are general guidelines and should not be considered comprehensive for this site or project. It is the responsibility of the applicant to do their own due diligence to avoid any negative environmental impacts. Should the scope of the project change significantly, or should it become apparent that threatened or endangered species may be impacted, please contact our staff as soon as possible. If you have any questions, please contact Paul Radley, Protected Species Habitat Conservation Planning Coordinator at (808) 295-1123 or paul.m.radley@hawaii.gov.

Sincerely,

Lainie Berry

LAINIE BERRY
Wildlife Program Manager

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

Lainie Berry, Wildlife Program Manager
Division of Forestry and Wildlife
Department of Land and Natural Resources
State of Hawai'i
1151 Punchbown Street, Room 325
Honolulu, HI 96813

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Dr. Berry:

Thank you for your memorandum dated October 24, 2022 regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project. We offer the following responses to your comments, using the same organization as in your memo:

The State-listed Hawaiian Hawk or 'Io (*Buteo solitarius*) and the State and federally listed anchialine shrimp species *Vetericaris chaceorum* and *Procaris hawaiana* have been added to the list of species that may occur in the project vicinity.

- Recommended measures to avoid and minimize potential impacts to Hawaiian hoary bat have been incorporated into the Proposed Action.

- Recommended measures to avoid and minimize potential impacts to Hawaiian seabirds have been incorporated into the Proposed Action.

- Recommended measures to avoid and minimize potential impacts to Hawaiian waterbirds have been incorporated into the Proposed Action.

- The Proposed Action may include construction of wastewater treatment plants and other water features that could be an attractant to waterbirds. If Hawaiian waterbirds are found to be present at wastewater treatment plants during operation, the County will coordinate with the Division of Forestry and Wildlife (DOFAW) and the United States Fish and

Wildlife Service (USFWS) regarding measures that can be implemented to avoid impacts.

- Recommended measures to avoid and minimize potential impacts to Hawaiian monk seals and green sea turtles have been incorporated into the Proposed Action.
- Recommended measures to avoid and minimize potential impacts to yellow-faced bees have been incorporated into the Proposed Action.
- Recommended measures to avoid and minimize potential impacts to Hawaiian hawk have been incorporated into the Proposed Action.
- Recommended measures to avoid and minimize potential impacts to Blackburn's sphinx moth have been incorporated into the Proposed Action.
- Recommended measures to avoid and minimize potential impacts to Hawaiian damselflies have been incorporated into the Proposed Action.
- Recommended measures to avoid and minimize potential impacts to anchialine shrimp and orangeblack Hawaiian damselfly have been incorporated into the Proposed Action.
- Recommended measures to avoid and minimize potential impacts to picture-wing flies have been incorporated into the Proposed Action.
- Recommended measures to avoid and minimize potential impacts to picture-wing flies have been incorporated into the Proposed Action.
- Surveys for rare and endangered plants will be performed when construction activities are required outside existing developed areas or modified sites.
- *Cyanea shipmanii*, *Plantago hawaiiensis*, *Ranunculus hawaiensis*, *Sesbania tomentosa*, *Vicia menziesii*, and *Zanthoxylum hawaiiense* have been added to the list of endangered plant species that may occur in the project vicinity.
- DOFAW will be notified of any listed plant species identified during the surveys.
- Applicable USFWS Avoidance, Minimization, and Conservation Measures for Listed Plants have been reviewed and incorporated into the Proposed Action.
- Disturbed areas will be restored with native or non-invasive plants, as appropriate for the location; with a preference for native plants. Invasive plant species will not be used for site restoration or landscaping. Hawai'i-Pacific Weed Risk Assessment at www.plantpono.org will be reviewed to determine the invasiveness of plants proposed for site restoration or landscaping and for guidance on the selection and evaluation of landscaping plants.

- Recommended measures to avoid and minimize the spread of invasive fungal pathogens, vertebrate and invertebrate pests, and invasive plants have been incorporated into the Proposed Action.

- The Proposed Action will follow information and guidance provided by the University of Hawai'i at Mānoa's College of Tropical Agriculture and Human Resources to prevent the spread of Rapid 'Ōhi'a Death.

- The Proposed Action will avoid importing soil or plant material from off-island.

- The Hawai'i Interagency Biosecurity Plan will be consulted during the planning, design, and construction of the Proposed Action.

- As the individual projects are developed, the Hawai'i Wildfire Management Organization will be consulted on measures to prevent and address wildfires in the project area.

- DOFAW will be consulted if there are significant changes to the scope of the Proposed Action or if it becomes apparent that threatened and endangered species may be impacted.

We appreciate your commenting on the PEISPN. Your memorandum and this response will be included in the Programmatic Draft Environmental Impact Statement. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

STATE OF HAWAIʻI
OFFICE OF PLANNING
& SUSTAINABLE DEVELOPMENT

DAVID Y. IGE
GOVERNOR

MARY ALICE EVANS
DIRECTOR

235 South Beretania Street, 6th Floor, Honolulu, Hawaiʻi 96813
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DTS202209230932NA

Coastal Zone Management Program

Environmental Review Program

Land Use Commission

Land Use Division

Special Plans Branch

State Transit-Oriented Development

Statewide Geographic Information System

Statewide Sustainability Branch

October 25, 2022

Ms. Kelly Hartman
Department of Environmental Management
County of Hawaiʻi
345 Kekūanāoʻa Street, Suite 41
Hilo, Hawaiʻi 96720

Dear Ms. Hartman:

Subject: Programmatic Environmental Impact Statement Preparation Notice: Proposed Addition of Wastewater Services for the Puna District

Thank you for the opportunity to provide comments on the Programmatic Environmental Impact Statement Notice (PEISPN) for the subject project, which was received by the Office of Planning and Sustainable Development (OPSD).

The proposed action involves the expansion of wastewater collection, treatment, and disposal infrastructure and services in the Project Area, which is comprised of the lands within the Puna Community Development Plan (PCDP) area. It is our understanding that the expansion of the wastewater services is being pursued to (1) enhance economic recovery in the Project Area post-2018 Kilauea Eruption and Hurricane Lane, and (2) improve groundwater and surface water quality through provision of wastewater treatment options, including sewer systems, in lieu of cesspools.

OPSD strongly supports the County's proposed action, especially efforts to provide sewer systems or package treatment systems in regional growth centers. This fully supports State efforts to promote density and multifamily housing in village centers that are served by County transit hubs. OPSD notes that the County identified a Keaau Wastewater System as a Transit-Oriented Development (TOD) Project in the *State Strategic Plan for Transit-Oriented Development*, issued by the Hawaiʻi Interagency Council for Transit-Oriented Development in 2017/2018. OPSD recommends consultation with the County Planning Department to confirm that this is still a priority for the Department.

OPSD also recommends that the draft and final EIS examine and discuss the potential long-term and cumulative direct and secondary impacts that provision of additional wastewater capacity may have on stimulating growth in areas that are currently underserved by other County services—and mitigative

measures that may be required to encourage a more compact rural growth pattern and avoid dispersed rural sprawl.

Thank you again for the opportunity to review and provide comments on the PEISPN. If you have any questions, please contact Ruby Edwards, Land Use Division, ruby.m.edwards@hawaii.gov, (808) 587-2817.

Mahalo,

Mary Alice Evans

Mary Alice Evans
Director

c: Zendo Kern, County of Hawaii Planning Department
Rae Loui, AECOM Technical Services, Inc.

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

Mary Alice Evans, Director
Office of Planning and Sustainable Development
State of Hawai'i
Post Office Box 2359
Honolulu, HI 96804

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Ms. Evans:

Thank you for your letter dated October 25, 2022 regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project.

The Kea'au Wastewater System was included in the draft Annual Report of the Hawai'i Interagency Council for Transit-Oriented Development and is the subject of this Programmatic Environmental Impact Statement. It remains a priority for the County Planning Department.

The proposed provision of County wastewater infrastructure and services, as well as the possible provision of other public services including County water and public transit, could stimulate growth. Focusing the provision of wastewater services on smaller lots, closer to major transportation routes and especially transit routes, and within or adjacent to existing, developing, and planned urban centers would favor urban, residential infilling and thereby potentially would slow urban sprawl.

We appreciate your commenting on the PEISPN. Your letter and this response will be included in the Programmatic Draft Environmental Impact Statement. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

JOSH GREEN, M.D.
GOVERNOR | KE KIA'ĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIA'ĀINA

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

STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

Dec 29, 2022

County of Hawaii
Department of Environmental Management
Attn: Ms. Kelly Hartman
Environmental Planner
345 Kekuanao'a Street, Suite 41
Hilo, Hawaii 96720

via email: kelly.hartman@hawaiicounty.gov

Dear Ms. Hartman:

SUBJECT: Cumulative Impact Information Request – Projects in the Puna District – Programmatic Environmental Impact Statement (PEIS) for the Addition of Wastewater Collection located at Puna District, Island of Hawaii; TMK: Numerous

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

At this time, the DLNR has no comments to offer on the subject matter. Should you have any questions, please feel free to contact Darlene Nakamura at (808) 587-0417 or email: darlene.k.nakamura@hawaii.gov. Thank you.

Sincerely,

Russell Tsuji

Russell Y. Tsuji
Land Administrator

cc: Central Files

Mitchell D. Roth
Mayor

Lee E. Lord
Managing Director

Ramzi I. Mansour
Director

Brenda D. Iokepa-Moses
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

345 Kekūanāo'a Street, Suite 41 · Hilo, Hawai'i 96720
Ph: (808) 961-8083 · Fax: (808) 961-8086
Email: cohdem@hawaiicounty.gov

February 15, 2023

Russell Y. Tsuji, Administrator
Land Division
Department of Land and Natural Resources
State of Hawai'i
Post Office Box 621
Honolulu, HI 96809

Subject: Comments on the Programmatic Environmental Impact Statement Preparation Notice Addition of Wastewater Services for the Puna District

Dear Mr. Tsuji:

Thank you for your letter dated December 29, 2022 regarding the Programmatic Environmental Impact Statement Preparation Notice (PEISPN) for the subject project.

We understand that the Land Division does not have any comments on the proposed project at this time.

We appreciate your commenting on the PEISPN. Your letter and this response will be included in the Programmatic Draft Environmental Impact Statement. Should you have any questions, please contact Ms. Kelly Hartman, Environmental Management Planner, Department of Environmental Management, at (808) 961-8512 or email at *Kelly.Hartman@hawaiicounty.gov*.

Sincerely,

Ramzi I. Mansour
Director

Appendix E:
Public Scoping Meetings Comment Response Matrix

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No.	Agency/Organization	Level[1]	Venue/Form[2]	Date	Topic	Comment	Response and Action
1	Dendra Best, Executive Director, WasteWater Education 501(c)3	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Project Purpose	Is the principal goal economic development or environmental protection?	**Response provided during meeting:** Both are project goals. The efforts go hand in hand. **Additional information:** The purpose of the Proposed Action is to aid the economic recovery of the Project Area and Hawai‘i County, and secondarily to contribute to the improvement of groundwater and surface water quality.
2	Dendra Best, Executive Director, WasteWater Education 501(c)3	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Centralized Collection	How can a centralized collection system be affordable and resilient?	**Response provided during meeting:** A centralized collection system can be either a conventional or packaged unit. A centralized collection system will be more cost effective with more users connected (economy of scale). **Additional information:** The Facility Plan will provide life cycle cost estimates using historical local Hawai‘i utility construction costs for various wastewater collection and treatment options to assess whether or not a centralized collection system can be affordable and resilient. Affordabilitity is impacted by the development density and the number of potential customers.
3	Dendra Best, Executive Director, WasteWater Education 501(c)3	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Water Reclamation and Reuse	Are you considering water reclamation and reuse?	**Response provided during meeting:** Yes, all options are being considered, but water reclamation and reuse may only be suitable for certain sites. **Additional information:** Water reclamation and reuse may be suitable for certain locations within the Project Area and is being evaluated in the Facility Plan.
4	Dendra Best, Executive Director, WasteWater Education 501(c)3	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Wastewater Alternatives & Innovations	WAI had a $20k grant assistance program?	**Response provided during meeting:** Yes, WAI is also assisting the cesspool conversion committee and the County. **Additional information:** The County is aware that WAI may be able to provide insights into the Puna wastewater program as a result of their participation on the cesspool conversion committee.

[1] Federal, State of Hawai‘i, County of Hawai‘i, Private / Individuals
[2] 12 Oct 2022 Public Scoping Meeting, 20 Oct 2022 Virtual Public Scoping Meeting

No.	Agency/Organization	Level[1]	Venue/Form[2]	Date	Topic	Comment	Response and Action
5	Dendra Best, Executive Director, WasteWater Education 501(c)3	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Importing Soil	Why import?	**Response provided during meeting:** The idea is to prevent effluent from flowing through the ground at a high velocity. Import helps to slow effluent flow. **Additional information:** Soil used for a leach field must be suitable as described in Hawai‘i Administrative Rules (HAR) 11-62. Suitable soil must act as an effective filter in the removal of organisms and suspended solids before the effluent reaches any highly permeable earth formations, bedrock, or groundwater. In some locations within the Project Area suitable soil may not exist, so it would have to be imported.
6	Dendra Best, Executive Director, WasteWater Education 501(c)3	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Importing Soil	Why not use ground local lava rock? We do in Australia.	**Response provided during meeting:** Lava rock has to be crushed to cinder. This is what was referred to as “importing” cinder. **Additional information:** Lava rock may be considered during the design of wastewater treatment and disposal systems if it meets the requirements outlined in HAR 11-62. The local lava rock would need to be crushed, washed, and screened to meet HAR 11-62 requirements.
7	Dendra Best, Executive Director, WasteWater Education 501(c)3	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Importing Soil	But the voids form treatment packets for bacteria to form.	HAR 11-62 requires gravel or crushed stone to be used. The material should be washed and should range in size from three-fourths to two and one-half inches to provide the required void area mentioned in the comment.
8	April Bullis	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Wastewater Technologies / Financial Incentives	What are the different technologies for wastewater treatment available and incentives to assist the homeowners?	**Response provided during meeting:** If you live in a remote area, an incinerating toilet may be the best option. But if you live in a dense residential area, it may be better to connect to a centralized system. Other options are reuse of groundwater onsite; packaged units for residential clusters. It is case specific. We know we need to make conversion affordable and incentives will be considered. **Additional information:** There are many different technologies for wastewater treatment that will be considered by the designers after the program is defined by the Facility Plan. The Facility Plan will identify the level of treatment needed for reuse/disposal and provide life cycle cost estimates for each. The Facility Plan will also describe present incentives, funding, and financing options that are available.

No.	Agency/Organization	Level[1]	Venue/Form[2]	Date	Topic	Comment	Response and Action
9	April Bullis	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Wastewater Technologies / Financial Incentives	For the financial incentives for the homeowners, are there any discussion of things that would offset the need for a treatment plant and its maintenance? Would there be any incentive for individual to choose incinerating toilets?	**Response provided during meeting:** Operation and maintenance is a major consideration. It depends on the area. If you live off the grid and far away, and there is no way we could connect you to a sewer, then, yes, you have the option of using an incinerating toilet. But where there are clusters of homes, it does not make sense to use incinerating toilets, because there are by products that have to be disposed of and you still have the grey water. **Additional information:** Both current and previous financial incentives for the homeowners' wastewater systems will be described in the Facility Plan along with life-cycle cost estimates for each option. Estimated operation and maintenance costs are a major consideration. Specific technologies will not be selected in the Facility Plan. Technology selection will be made during design after the recommended program is developed and approved via the ongoing facility planning and PEIS process.
10	April Bullis	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Wastewater Technologies	From what I have researched, the Cinderella toilets are pathogen free, if the waste is properly incinerated. They costs a couple thousand dollars versus $35,000 to do a sewer reconfiguring.	**Response provided during meeting:** Yes, if done correctly. If you have a house of five or more people, it becomes difficult. A central system makes sense in a clustered residential area. **Additional information:** Technology selection for individual properties will be done during the design. The current Facility Plan and PEIS will provide information on the types of treatment available for the wastewater program in the Project Area. The Facility Plan will describe other relevant considerations (example: other sources of wastewater within each home that are not discharged into the toilet but would also require treatment and disposal).
11	April Bullis	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Wastewater Technologies / Financial Incentives	Will there be financial incentives to choose those options? Will the homeowner have a choice as to what option they choose?	**Response provided during meeting:** State and County legislators are working on providing incentives (tax credits/vouchers). **Additional information:** State legislators approved funding for cesspool conversions in June 2022 for providing funding incentives for future cesspool conversions/wastewater treatment. Refer to Act 087 (HB 1806), Act 153 (HB 2195), and Act 183 (HB 2088).

No.	Agency/Organization	Level[1]	Venue/Form[2]	Date	Topic	Comment	Response and Action
12	April Bullis	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Financial Incentives	Given the challenge of converting so many cesspools, will there be incentives to convert as soon as possible, and taper the incentives to get less the longer you wait?	**Response provided during meeting:** You can do the conversion any time you want, so it is recommended that the homeowner keep calling the State Department of Health and look at options. Try to tap into whatever options exist now, if you can. **Additional information:** The funding incentives were approved in June 2022. There is an incentive to apply for the funding as soon as possible. Act 153 (HB 2195) is a pilot program that ends June 30, 2028. There is no guarantee that the program will be extended in the future.
13	Jared Gates	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Funding for Implementation	Is there additional funding in place for implementation of wastewater infrastructure?	**Response provided during meeting:** Funding for buildout has not been secured yet. The first step is to identify a need and potential locations for specific types of wastewater facilities. **Additional information:** Although funding for construction of a County of Hawai‘i wastewater infrastructure system for the Project Area has not been secured yet, the first step in the process is to identify a need and potential locations for specific types of wastewater facilities. The Facility Plan and PEIS are intended to estimate the life cycle costs and assess environmental impacts of the potential County of Hawai‘i wastewater infrastructure system for the Project Area.
14	Jared Gates	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Project Purpose	Is part of the intent to develop infrastructure for future growth as well.	**Response provided during meeting:** That is the intent. When we look at it, we don’t look only at today’s capacity. We look at a service area with potential for growth. **Additional information:** The purpose of the Proposed Action is to aid the economic recovery of the Project Area and Hawai‘i County, and secondarily to contribute to the improvement of groundwater and surface water quality.

No.	Agency/Organization	Level[1]	Venue/Form[2]	Date	Topic	Comment	Response and Action
15	Jared Gates	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Conversion Timeframe	To meet the 2050 deadline, approximately 500 cesspools per year will have to be converted. Converting so many cesspools will be a challenge. This will require significant construction manpower.	**Response provided during meeting:** Yes, we recognize that and that is why we are starting this effort now. If we wait until the last minute, it will not get done. We are working with the state to set interim milestones, such as 2030 for high-priority conversions. It takes about three weeks for a contractor to convert an existing cesspool. We are working with the County to allow expediting permitting for conversion to and construction of septic tanks. If near a sewer system, we encourage connection to the system. **Additional information:** The estimated cost and time schedule required for converting cesspools are being assessed in the Facility Plan. These estimates will be compared to developing a County of Hawai‘i sewer system for the Project Area. The options under consideration range from all individual systems to a County of Hawai‘i sewer system serving the entire Project Area and include combinations of individual systems and County of Hawai‘i sewers.
16	Jared Gates	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Conversion Rationale	Has it been shown that the septic systems that are being installed are tangibly better for the environment than cesspools that are in place?	**Response provided during meeting:** There are studies through the CDC. The State Department of Health has standards that have to be met to ensure that the effluent is being treated sufficiently to meet DOH requirements. **Additional information:** Note that septic systems settle waste solids upstream of the effluent disposal leach field/seepage pit by design which provides an improvement compared to cesspools where the settling and effluent disposal occur in the same tank. The Hawai‘i Department of Health (HDOH) has standards that have to be met to provide improved water quality by requiring proper wastewater treatment combined with proper effluent absorption systems as required to meet of State of Hawai‘i water quality requirements.

No.	Agency/Organization	Level[1]	Venue/Form[2]	Date	Topic	Comment	Response and Action
17	Jared Gates	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Cost of Conversion	Is there an estimated cost to convert a cesspool to a septic tank?	**Response provided during meeting:** It depends on the site and the percolation rate. If soil needs to be imported, $45,000. If soil does not need to be imported, $20,000. If a centralized system is implemented, that would reduce the burden on individual homeowners. **Additional information:** The estimated cost to convert a cesspool to an approved HDOH individual treatment system is site specific and varies on a case-by-case basis. In some instances the actual cost may be less than $20,000, in other instances the actual cost may exceed $45,000.
18	Jared Gates	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Cost of Conversion	So this project could offer some options offset the cost and take some of the burden off of the homeowners?	**Response provided during meeting:** Potentially, if this feasibility study proves that it is feasible to put in a wastewater treatment plant and we get the funding. **Additional information:** As discussed, the County of Hawai‘i sewer system could potentially be a feasible way to take some of the financial burden off of the homeowners. Life cycle cost estimates will be provided in the Facility Plan to help the County decide the most economical approach to use in the Project Area.
19	Jared Gates	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Monitoring Wells	Is part of the process to do testing of the private wells that are in place.	**Response provided during meeting:** I don’t think we are as part of this project. As we design, we have restrictions and offsets, including offsets from water systems and water wells. **Additional information:** The Facility Plan and PEIS will not be testing private wells. The well owner should perform testing if there is a concern over their well water quality.
20	Steve Hirakami	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Water Distribution	Tied in with the wastewater issue is the potable water issue. Can the EIS be tied in to possibly developing improvement districts for water distribution?	**Response provided during meeting:** The grant was specific in looking at wastewater services, so that is where our focus will be. **Additional information:** No change.
21	Steve Hirakami	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Effluent Transport to Ocean	There was dye tracing in Kapoho Beach lots and Vacationland and the results were astounding (bad).	Acknowledged. This is being taken into consideration as the Facility Plan is completed.
22	Steve Hirakami	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Cesspools	I've heard of septic tanks being allowed to drain into an existing cesspool.	Acknowledged. The feasibility of allowing treated wastewater effluent from septic tanks to drain into an existing cesspool is a design issue that can be evaluated on a case by case basis along with other site-specific approaches described in HAR 11-62. It will not be developed as an option in the Facility Plan.

No.	Agency/Organization	Level[1]	Venue/Form[2]	Date	Topic	Comment	Response and Action
23	Susan Jamerson	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Wastewater Technologies	Are you looking at different technologies and types of systems in different neighborhoods? For example, having a centralized collection system for HPP, Orchid Land, Leilani, etc. but cluster systems in smaller areas.	**Response provided during meeting:** Yes, we will identify a suite of options and, based on neighborhood needs/characteristics, will recommend certain technologies for each neighborhood. Cost will also be a factor in determining feasibility. **Additional information:** The Facility Plan is identifying a suite of options based on neighborhood needs/characteristics. The level of treatment and type of effluent reuse/disposal for each neighborhood area is being evaluated at the programmatic level. Life cycle cost estimates will be provided. The specific technologies for each neighborhood would be selected during the design phase.
24	Susan Jamerson	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Cost of Connection	Certain neighborhoods, if they have an HOA and can insist homeowners connect to a centralized system, could potentially apply for USDA Rural Development loan/grant package funding.	**Response provided during meeting:** Correct, and in that case the HOA will not bear the direct burden of those costs. However, eventually all County residents may see increased fees to fund County-wide improvements. **Additional information:** No change.
25	Susan Jamerson	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Town and Village Centers	Can you explain the Kapoho "Future Neighborhood Location Subject to Community Reviews"?	**Response provided during meeting:** These points and Town and Village Centers are derived from the Puna CDP. A link to the CDP will be provided in the chat. Puna Community Development Plan: https://www.planning.hawaiicounty.gov/home/showpublisheddocument/301707/637205017973800000 **Additional information:** Future locations subject to community review are potential additional Neighborhood Village Centers that may be established.

No.	Agency/Organization	Level[1]	Venue/Form[2]	Date	Topic	Comment	Response and Action
26	Susan Jamerson	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Effluent Transport to Ocean	Have any dye tracing studies been done in Puna? How long does it take for dye to get to the ocean from Nanawale? Or other densely populated areas?	**Response provided during meeting:** The University of Hawai‘i may have done studies involving dye tracing. A link to these studies will be provided in the chat. DOH Cesspools and Prioritization for Replacement Report: https://health.hawaii.gov/opppd/files/2017/12/Act-125-HB1244-HD1-SD3-CD1-29th-Legislature-Cesspool-Report.pdf **Additional information:** According to the University of Hawai‘i study cited in the HDOH report, the infiltration travel time from the ground surface to the groundwater could be as short as a fraction of an hour. Also, 25 percent of domestic wells sampled in the study area tested positive for wastewater indicator bacteria.
27	Susan Jamerson	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Wastewater Technologies	I'm also wondering if the study will look at lot size and usage when proposing technologies - meaning very small lots must hook up, 1 acre lots need a new technology (not basic septic) while 3 acres and up could put in regular septic. Etc.	**Response provided during meeting:** Usually anything greater than 10,000 SF will require a leach field. Other technologies are available for lots less than 10,000 SF. Waivers are possible for houses built before 1991. All options will be considered when individual homeowners apply for their permits. **Additional information:** HAR 11-62 allows for exemptions for certain situations. The Facility Plan is looking at potential County of Hawai‘i areawide sewers; it is not a lot-by-lot assessment. Areas with zoning of 1 acre or less, institutional (schools, hospitals etc.), commercial, and industrial will be evaluated for sewering.
28	Bill McClellan	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Facility Planning	Is this going to start closer to the ocean level and work your way up the mountain, or are you go to the top and work your way down?	**Response provided during meeting:** The planning effort will not necessarily start/end at one specific area. However, actual buildout will maximize cost and construction efficiencies. It really depends on what type of wastewater facility is selected. Topography, operation/maintenance costs will also be factors, including minimizing the number of lift stations and pump stations. **Additional information:** The planning effort will not necessarily start/end at one specific area. However, actual implementation phasing will consider water quality needs, cost, construction efficiencies, and other factors. It also depends on what type of wastewater facilities are recommended for the program (onsite vs. centralized treatment, conventional gravity sewers vs. individual pumping units with pressure sewers, etc.).

No.	Agency/Organization	Level[1]	Venue/Form[2]	Date	Topic	Comment	Response and Action
29	Bill McClellan	Private / Individuals	Public Scoping Meeting	12 Oct 2022	Groundwater Quality	Paradise Park residents have private wells that years ago, when they were put in, were drinkable. But now some nasty things are starting to show up in their water and they are having to stop using their wells.	**Response provided during meeting:** That is the whole idea of this study. Cesspools have the potential to degrade the groundwater because they leach straight into the groundwater. **Additional information:** The Proposed Action is intended to improve groundwater and surface water quality within the Project Area. Centralized water treatment systems and updated individual wastewater systems would replace the use of cesspools and other outdated, substandard wastewater disposal methods that pose a risk to human health and surrounding environment.
30	Deborah Ward	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Project Funding	Is there designated funding available for the project after the PEIS is accepted? Once the Plan is finalized, will DEM engage the community on funding options?	**Response provided during meeting:** Funding for buildout has not been secured yet. The first step is to identify a need and potential locations for specific types of wastewater facilities. Once this occurs, the Plan is completed, the County will seek Federal and State funding. DEM will explore all funding opportunities, including improvement and assessment districts. **Additional information:** DEM will receive input/comments and engage the community regarding funding before finalizing the plan.
31	Deborah Ward	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Geographic Focus	Are you primarily focused on commercial areas, so that development can expand?	**Response provided during meeting:** No, the intent is to focus on all lots in the project area, regardless of land use. Commercial and higher density areas may be able to accommodate certain technologies that are not feasible in more rural areas. **Additional information:** No change.
32	Deborah Ward	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Geographic Focus	Do you anticipate linking folks in the subdivisions (some 80,000+ lots) or only along the public roads and commercial sites?	**Response provided during meeting:** All options will be evaluated with the intent of finding the most sustainable, cost-effective, and efficient solution. **Additional information:** No change.
33	Deborah Ward	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Construction in Blue Rock	Significant issues? Blue rock, and the huge expense of creating channels for sewage lines—disruptive to homes, neighborhoods etc. if it takes as long as the Keaukaha mess we have endured for several years.	**Response provided during meeting:** All options will be evaluated. **Additional information:** Potential for encountering these issues is acknowledged. Estimated cost and schedule requirements will be developed considering the issues mentioned in the comment for all of the options.

No.	Agency/Organization	Level[1]	Venue/Form[2]	Date	Topic	Comment	Response and Action
34	Deborah Ward	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Groundwater Pollution	Due to the huge amount of artesian water in Puna, we have a billion gallons of water seeping out to the near shore a DAY, so the groundwater pollution may not be a significant as it would be in Kona district for example. A lot of folks are drilling wells, and those wells may well be impacted by uphill sewage.	**Response provided during meeting:** We understand that groundwater is being constantly lost to the ocean and that water flows downhill, however, dilution of the groundwater is not the right solution. **Additional information:** Potential groundwater quality/contamination issues is one of the considerations being used to prioritize the need for wastewater system improvements during the Facility Plan and PEIS.
35	Deborah Ward	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Cost of Conversion	Will the county or state ever consider assisting those who are considered too far from a centralized or decentralized systems to put in septic systems, and could this option be part of the PEIS?	**Response provided during meeting:** Yes, if that is the preferred wastewater system identified by the County for that area. For homes that are isolated, too far from centralized or decentralized systems, individual systems may be the correct technology. **Additional information:** County or State exemptions and/or assistance related to cesspool conversions may currently be available via present and potential future legislation (e.g., Act 087: HB 1806, Act 153: HB 2195).
36	Deborah Ward	Private / Individuals	Virtual Public Scoping Meeting chat message	20 Oct 2022	Distribution List	I really appreciate this workshop, and look forward to hearing more as you proceed. Please add Sierra Club Hawaii Island Group as a consulted party, and we would welcome additional input opportunities as you proceed.	Sierra Club Moku Loa Group has been added to the distribution list for ongoing consultation.

Appendix F:
Public Engagement Strategy

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Public Engagement Strategy for the Programmatic Environmental Impact Statement (PEIS) for the Addition of Wastewater Services for the Puna District, County of Hawai'i

The public engagement strategy for the PEIS for the Addition of Wastewater Services for the Puna District, County of Hawai'i is comprised of four main elements, which are described below.

PEIS Public Scoping Meetings

Pursuant to Hawai'i Administrative Rules 11-200.1-23(d), the County is required to conduct at least one public scoping meeting that shall be audio recorded. The purpose of this meeting is to receive input from the public that will inform the content of the PEIS. For this project, an in-person public scoping meeting was conducted Wednesday, October 12, 2022, from 5-7 pm at the Kea'au High School Cafeteria and recorded by Nā Leo TV, a public television station serving the County of Hawai'i. Nā Leo TV broadcast the recording and a link to the recording was posted to the project StoryMap site (described below). A virtual public scoping meeting was also conducted for this project on Thursday, October 20, 2022, from 12-1 pm. The virtual public scoping meeting was recorded and a link to the recording was posted to the project StoryMap site.

An invitation to the in-person public scoping meeting was sent directly via email to stakeholders who have provided email addresses, and a one-page flyer announcing the meeting was distributed to the public at the Revitalize Puna sixth community activation on Tuesday, October 11, 2022. Hard copies of the flyer included a QR code to facilitate smart phone users' access to the StoryMap. The meeting included a presentation that provided an overview of the project and reserved time for oral public comments and questions.

ESRI StoryMap

An ESRI StoryMap (website) was developed to provide the public with another option to obtain information about the project. This allows dissemination of factual information about the project that is accessible to users 24 hours a day, 7 days a week. The StoryMap went live on September 23, 2022 (the date when the PEIS Preparation Notice (PEISPN) was published in the Environmental Review Program's *The Environmental Notice*).

It can be accessed at https://storymaps.arcgis.com/stories/50e624065fa641598326febe6316327b and has been and will be updated over the course of the project. As mentioned previously, recordings of the PEIS public scoping meetings have been linked to the StoryMap. An on-line survey platform called SmartComment (described below) was linked to the StoryMap after the scoping meeting to obtain additional input from the public. The on-line survey was open to receive comments until October 23, 2022 (the date when the PEISPN 30-day public review period closed). The on-line survey will be opened to receive comments during the Programmatic Draft Environmental Impact Statement (PDEIS) public comment period as well.

SmartComment

SmartComment, a web-based software, is being utilized for public comments for the PEIS. SmartComment was linked to the StoryMap so that both went live to the public at the same time (September 23, 2022). While the public can use the software to attach PDF comments, most users comment directly using the software, allowing the County to group comment responses under topic headings. SmartComment enhances the quantity and quality of comments and will provide a method for receiving public comments during the entire planning process.

In-Person Engagement

In addition to the in-person and virtual public scoping meetings, other in-person engagement opportunities will be provided that will offer updates on the project. These will include but not be limited to Puna Community Development Plan Action Committee meetings and quarterly Revitalize Puna community activations.