ICF

August 18, 2025

Ms. Mary Alice Evans, Director
Environmental Review Program
Office of Planning and Sustainable Development
235 S. Beretania Street, Suite 702
Honolulu, HI 96813

Ms. Dawn N. S. Chang, Chairperson
Department of Land and Natural Resources
Kalanimoku Building
1151 Punchbowl St.
Honolulu, HI 96813

Subject: Publication of the Draft Environmental Impact Statement for the Kauaʻi Island Utility Cooperative Habitat Conservation Plan

Dear Ms. Evans and Ms. Chang,

On behalf of the Applicant, Kauaʻi Island Utility Cooperative, ICF is submitting the Draft Environmental Impact Statement (Draft EIS) for the Kauaʻi Island Utility Cooperative Habitat Conservation Plan, on the island of Kauaʻi. In accordance with Hawaiʻi Administrative Rules (HAR) §11-200.1-5(e)(5)(C), the Draft EIS has been simultaneously filed with the Environmental Review Program and the Board of Land and Natural Resources as the Accepting Authority, via the Department of Land and Natural Resources, Division of Forestry and Wildlife.

We respectfully request that the Draft EIS be published in the next edition of *The Environmental Notice* on August 23, 2025. An electronic copy of this transmittal letter and the supporting files have been uploaded to the Environmental Review Program online submittal portal including the audio file of the scoping meeting held on June 28, 2022. As required by HAR §11-200.1-5(e)(5)(D) paper copies of the Draft EIS will be submitted to the Lihuʻe Public Library and the Hawaiʻi Documents Center.

Should you have any questions, please contact Tanya Copeland of ICF at (970) 691-4724 or tanya.copeland@icf.com.

Sincerely,
Tanya Copeland, Principal

Tanya Copeland

CC:

David Smith, Administrator, DOFAW, DLNR
Jason Omick, Wildlife Program Manager, DOFAW, DLNR
Jesse Adams, Protected Species Habitat Conservation Planning Associate, DOFAW, DLNR
Dawn Huff, Joule Group, LLC

From: dbedt.opsd.erp@hawaii.gov
To: DBEDT OPSD Environmental Review Program
Subject: New online submission for The Environmental Notice
Date: Sunday, August 17, 2025 7:11:58 AM

Action Name

Kauaʻi Island Utility Cooperative Habitat Conservation Plan Draft EIS

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
- (2) Propose any use within any land classified as a conservation district

Judicial district

Kauaʻi - multiple districts

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

Various, Island-wide

Action type

Applicant

Other required permits and approvals

Federal Incidental Take Permit; State Incidental Take License; Natural Area Reserve Research Permit; Natural Area Reserve System Special Use Permits; Conservation District Use Permit; Forest Reserve Special Use Permit; Hawaiʻi State Park System Special Use Permit

Discretionary consent required

State Incidental Take License; Conservation District Use Permit; Non-Exclusive Land Easement

Agency jurisdiction

State of Hawaiʻi

Approving agency

Department of Land and Natural Resources

Agency contact name

Jesse Adams

Agency contact email (for info about the action)

jesse.w.adams.researcher@hawaii.gov

Email address for receiving comments

hcp@kiuc.coop

Agency contact phone

(808) 635-2057

Agency address

DLNR Division of Forestry and Wildlife, Attention: Habitat Conservation Planning
Kalanimoku Building, 1151 Punchbowl St., Room 325
Honolulu, HI 96813
United States
Map It

Accepting authority

Department of Land and Natural Resources

Applicant

Kaua'i Island Utility Cooperative

Applicant contact name

Dawn Huff

Applicant contact email

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Applicant contact phone

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Applicant address

4463 Pahe'e Street, Suite 1
Lihu'e, HI 96766-2000
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Map It

Is there a consultant for this action?

Yes

Consultant

ICF

Consultant contact name

Tanya Copeland

Consultant contact email

tanya.copeland@icf.com

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(970) 691-4724

Consultant address

980 9th Street, Suite 1200
Sacramento, CA 95814
United States
Map It

Action summary

KIUC is applying for an incidental take license (ITL) under HRS Chapter 195D and an incidental take permit (ITP) under Section 10 of the Endangered Species Act. The ITL and ITP would authorize the incidental take of federally- and state-listed seabirds, waterbirds, and honu (green sea turtle). KIUC developed a second Draft Habitat Conservation Plan to support application for the ITL and ITP that is available for download at: https://www.kiuc.coop/habitat-conservation-plan. The Draft EIS evaluates issuance of an ITL and ITP authorizing the incidental take of the Covered Species from the Covered Activities (including implementation of the HCP conservation strategy) over a 50-year permit term. This Draft EIS has been prepared to meet both state (HRS Chapter 343) and federal (National Environmental Policy Act) environmental review requirements. The statutory 45-day public review and comment period for the HRS Chapter 343 Draft EIS ends October 7, 2025. However, to align the review periods for the second Draft HCP and the Draft EIS, comments on the HRS Chapter 343 Draft EIS will be accepted if they are received or postmarked by October 22, 2025.

Attached documents (signed agency letter & EA/EIS)

- KIUC-Draft-EIS-Transmittal-Ltr.pdf
- 2025_06_KIUC_HCP_Draft-EIS_508.pdf
- KIUC_Scoping_Mtg_Recording_AudioVideo.mp4

ADA Compliance certification (HRS §368-1.5):

The authorized individual listed below acknowledges that they retain the responsibility for ADA compliance and are knowingly submitting documents that are unlocked, searchable, and may not be in an ADA compliant format for publication. Audio files do not include transcripts, captions, or alternative descriptions. The project files will be published without further ADA compliance changes from ERP, with the following statement included below the project summary in The Environmental Notice: "If you are experiencing any ADA compliance issues with the above project, please contact (authorized individual submitting the project at email)."

Shapefile

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

Action location map

- KIUC-HCP-Location-Map1.zip

Authorized individual

Tanya Copeland

Authorized individual email

tanya.copeland@icf.com

Authorized individual phone

(970) 691-4724

Authorization

- The above named authorized individual hereby certifies that he/she has the authority to make this submission.

DRAFT ENVIRONMENTAL IMPACT STATEMENT
KAUAʻI ISLAND UTILITY COOPERATIVE
HABITAT CONSERVATION PLAN

PREPARED FOR:

U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, HI 96850

State of Hawaiʻi, Department of Land and Natural Resources
1151 Punchbowl St.
Honolulu, HI 96813

PREPARED BY:

ICF
980 9th Street, Suite 1200
Sacramento, CA 95814

June 2025

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ENVIRONMENTAL IMPACT STATEMENT FOR THE KAUAʻI ISLAND UTILITY COOPERATIVE HABITAT CONSERVATION PLAN DRAFT (X) FINAL ( )

Project Title:	Kauaʻi Island Utility Cooperative Habitat Conservation Plan (Kauaʻi Island, Hawaiʻi)
Subject:	Draft Environmental Impact Statement
Lead Federal Agency:	U.S. Department of the Interior, U.S. Fish and Wildlife Service
State Accepting Authority:	State of Hawaiʻi, Department of Land and Natural Resources
Point of Contact:	Koa Matsuoka, Fish and Wildlife Biologist; Office Phone: (808) 210-6295; Email: Koa_Matsuoka@fws.gov; 300 Ala Moana Boulevard, Room 3-122, Honolulu, Hawaiʻi 96850
Docket Number:	FWS-R1-ES-2022-0068

Abstract:

This environmental impact statement (EIS) has been prepared to meet both federal and state environmental review requirements for the U.S. Fish and Wildlife Service (Service) and Hawaiʻi Department of Land and Natural Resources (DLNR). Kauaʻi Island Utility Cooperative (KIUC) developed the Draft KIUC Habitat Conservation Plan (HCP; ICF 2025) to support an application to the Service for an incidental take permit in accordance with section 10 of the Endangered Species Act of 1973 (16 United States Code 1539) and an application for a state incidental take license in accordance with Hawaiʻi Revised Statutes Chapter 195D.

KIUC is seeking take authorization for the following species: ʻaʻo (Newell's shearwater, *Puffinus newelli*), ʻuaʻu (Hawaiian petrel, *Pterodroma sandwichensis*), ʻakēʻakē (band-rumped storm-petrel, *Hydrobates castro*), aeʻo (Hawaiian stilt, *Himantopus mexicanus knudseni*), koloa maoli (Hawaiian duck, *Anas wyvilliana*), ʻalae keʻokeʻo (Hawaiian coot, *Fulica alai*), ʻalae ʻula (Hawaiian common gallinule, *Gallinula galeata sandvicensis*), nēnē (Hawaiian goose, *Branta sandvicensis*), and honu (green sea turtle, *Chelonia mydas*).

The Service prepared this Draft EIS according to the requirements of the National Environmental Policy Act (42 United States Code 4321–4370 et seq.), the United States Department of the Interior's National Environmental Policy Act Procedures (43 Code of Federal Regulations 46), and the Service's guidance for compliance with those laws, including the 2016 *Habitat Conservation and Planning and Incidental Take Permit Processing Handbook* (USFWS and NOAA 2016). DLNR has determined that the Draft HCP's use of state lands and State Conservation District land for implementation of conservation measures proposed in the Draft HCP would trigger environmental review under the Hawaiʻi Environmental Policy Act. Therefore, this EIS has also been prepared in accordance with Hawaiʻi Revised Statutes Chapter 343, *Environmental Impact Statements*, and Hawaiʻi Administrative Rules Title 11, Chapter 200.1, *Environmental Impact Statement Rules*.

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Contents

Appendices

Tables and Figures

Figure **Page**

Acronyms and Abbreviations

Term	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
APE	area of potential effects
BLNR	Board of Land and Natural Resources
BMP	best management practice
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CIA	Cultural Impact Assessment
CNPDPS	Central North Pacific distinct population segment
CO_2	carbon dioxide
CSH	Cultural Surveys Hawaiʻi, Inc.
DAR	Division of Aquatic Resources
DLNR	Hawaiʻi Department of Land and Natural Resources
DOFAW	Hawaiʻi Department of Land and Natural Resources Division of Forestry and Wildlife
DPS	distinct population segment
EA	environmental assessment
EIS	environmental impact statement
EISPN	Environmental Impact Statement Preparation Notice
EJScreen	Environmental Justice Screening and Mapping Tool
ESA	Endangered Species Act of 1973
ESRC	Endangered Species Recovery Committee
FEMA	Federal Emergency Management Agency
GHG	greenhouse gas
HAR	Hawaiʻi Administrative Rules
HCP	Habitat Conservation Plan
HFC	hydrofluorocarbon
HRS	Hawaiʻi Revised Statutes
IPaC	Information for Planning and Consultation
ITL	incidental take license
ITP	incidental take permit
JCS	Joint Conservation Strategy
KIUC	Kauaʻi Island Utility Cooperative
kW	kilowatt
LED	light-emitting diode
LOS	level of service
MHI	Main Hawaiian Islands
mi	circuit-mile
MW	megawatt

N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAR	Natural Area Reserve
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
Nihoku	Nihoku Ecosystem Restoration Project
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent to Prepare an Environmental Impact Statement
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
PDM	Population Dynamics Model
PF	Predator Fence
PM_{10}	particulate matter 10 microns or less in diameter
$PM_{2.5}$	particulate matter 2.5 microns or less in diameter
R_{max}	maximum theoretical rate of increase in abundance
Service	United States Fish and Wildlife Service
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SOS	Save our Shearwaters
SWAP	State Wildlife Action Plan
U.S.C.	United States Code
USEPA	U.S. Environmental Protection Agency
V/C	volume to capacity

Introduction

Kaua'i Island Utility Cooperative (KIUC) developed the Draft *Kaua'i Island Utility Cooperative Habitat Conservation Plan* (HCP; ICF 2025) to support its application for an incidental take permit (ITP) from the U.S. Fish and Wildlife Service (Service) and its request for an incidental take license (ITL) from the Hawai'i Board of Land and Natural Resources (BLNR).

U.S. Fish and Wildlife Service

Under section 10 of the Endangered Species Act of 1973 (ESA) (16 United States Code [U.S.C.] 1539), state or local governments, private landowners, corporations, or other non-federal entities may be authorized, through issuance of a section 10(a)(1)(B) ITP, to conduct activities that may result in take of a threatened or endangered species as long as the take is incidental to, and not the purpose of, an otherwise lawful activity. As defined in section 3(19) of the ESA (16 U.S.C. 1532), "take" of listed endangered or threatened species means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." KIUC prepared a Draft HCP to address reasonably certain incidental take of eight federally listed seabirds and waterbirds and one federally listed sea turtle.

The Service prepared this Draft Environmental Impact Statement (EIS) according to the requirements of the National Environmental Policy Act (NEPA) (42 U.S.C. 4321–4370 et seq.)[1]; the United States Department of the Interior's NEPA Procedures (43 Code of Federal Regulations [CFR] 46); and the Service's guidance for compliance with those laws, including the 2016 *Habitat Conservation and Planning and Incidental Take Permit Processing Handbook* (USFWS and NOAA 2016).

Department of Land and Natural Resources

The BLNR will process an application for an ITL for the same eight species of seabirds and waterbirds and one species of sea turtle that were included in the federal ITP application and are also listed as threatened or endangered by the State of Hawai'i. Take of species protected under state law (Hawai'i Revised Statutes [HRS] Chapter 195D) is prohibited unless authorized via an ITL issued by, and an HCP approved by, BLNR. Take defined under state law (HRS Chapter 195D) means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect endangered or threatened species of aquatic life or wildlife, or to cut, collect, uproot, destroy, injure, or possess endangered or

[1] Executive Order 14154, Unleashing American Energy (January 20, 2025), and a Presidential Memorandum, Ending Illegal Discrimination and Restoring Merit-Based Opportunity (January 21, 2025), require the Department of the Interior to strictly adhere to NEPA, 42 U.S.C. 4321 et seq. Furthermore, such Order and Memorandum repeal Executive Orders 12898 (February 11, 1994) and 14096 (April 21, 2023). Because Executive Orders 12898 and 14096 have been repealed, complying with such Orders is a legal impossibility. The Service verifies that it has complied with the requirements of NEPA, including the Department of the Interior's regulations and procedures implementing NEPA at 43 CFR Part 46 and Part 516 of the Departmental Manual, consistent with the President's January 2025 Order and Memorandum. The Service has also voluntarily considered the Council on Environmental Quality's rescinded regulations implementing NEPA, previously found at 40 CFR Parts 1500–1508, as guidance to the extent appropriate and consistent with the requirements of NEPA and Executive Order 14154.

threatened species of aquatic life or land plants, or to attempt to engage in such conduct. KIUC prepared a single Draft HCP to support both the federal ITP application and the state ITL application.

The Hawaiʻi Department of Land and Natural Resources (DLNR) has determined that the Draft HCP's use of state lands and State Conservation District land for implementation of conservation measures proposed in the Draft HCP would trigger environmental review under the Hawaiʻi Environmental Policy Act (HEPA). Therefore, this EIS has also been prepared in accordance with HRS Chapter 343, *Environmental Impact Statements*, and Hawaiʻi Administrative Rules (HAR), Title 11, Chapter 200.1, *Environmental Impact Statement Rules*.

Proposed Action and Decisions to Be Made

Service

The Service is reviewing KIUC's ITP application and will evaluate issuance of an ITP under section 10(a)(1)(B) of the ESA to authorize incidental take of nine federally listed species from specified Covered Activities proposed across the island of Kauaʻi over 50 years. Subject to compliance with applicable Service general permitting requirements found at 50 CFR Part 13, the Service will issue an ITP if the application meets the issuance criteria identified in section 10(a)(2)(B) of the ESA and the requirements of the associated ESA implementing regulations (50 CFR 17.22, 17.32). Under the ESA, once the Service determines that an ITP application is complete, the Service may implement one of the following options: issue an ITP conditioned on implementation of the HCP, issue an ITP conditioned on implementation of the HCP as modified or supplemented by specified terms and conditions, or deny the ITP application. The Service's decision will also be informed by the data, analyses, and findings in this EIS and public comments received on the Draft EIS and Draft HCP. The Service will independently document its determination in an ESA section 10 findings document, ESA section 7 biological opinion, and NEPA Record of Decision developed at the conclusion of the ESA and NEPA compliance processes. If the Service finds that all requirements for issuance of the ITP are met, it will issue the requested permit, subject to terms and conditions deemed necessary or appropriate to carry out the purposes of ESA section 10.

DLNR

The Hawaiʻi EIS process (HRS Chapter 343) and associated regulations (HAR Chapter 11-200) provide guidance to develop an informational document that discloses the environmental effects of a proposed ITL action; the effects of that action on the economic welfare, social welfare, and cultural practices of the affected community and state; the effects of economic activities arising out of the proposed action; measures proposed to minimize adverse effects; and the alternatives to the proposed action and their environmental effects. In this case, the trigger for HRS Chapter 343 compliance is the proposed use of state lands and Conservation District land for implementation of mitigation measures proposed in the Draft HCP.

Use of Conservation District lands is conditional upon approval by BLNR. HRS Chapter 195D (Conservation of Aquatic Life, Wildlife, and Land Plants) provides general agency authority to DLNR to conserve, manage, and protect indigenous Hawaiian species. This includes the authority to review and recommend approval of HCPs to BLNR, which also issues ITLs. The role of the Endangered

Species Recovery Committee (ESRC) (HRS 195D-25) is to serve as a consultant to BLNR on matters relating to endangered, threatened, proposed, and candidate species. ESRC reviews HCP permit applications and makes recommendations to BLNR on whether they should be approved, amended, or rejected. ESRC reviews any revisions to the HCP resulting from public comment and provides a recommendation to approve or deny the HCP/ITL application to BLNR. The BLNR process for review and approval of an HCP and issuance of the state ITL is a separate process but may occur in parallel with the federal process. After consultation with ESRC, BLNR may issue a take authorization in the form of a temporary license as part of an HCP to allow take otherwise prohibited if the take is incidental to, and not the purpose of, carrying out an otherwise lawful activity (HRS section 195D-4(g)).

Purpose and Need

Service

The Service's purpose and need for the proposed federal action is to comply with its legal obligation to (1) process KIUC's request for an ESA section 10(a)(1)(B) ITP authorizing the incidental take of certain ESA-listed species in association with carrying out otherwise lawful KIUC activities; and (2) to either grant, grant with conditions, or deny the ITP request in compliance with section 10(a)(1)(B) and other applicable laws.

DLNR

The state needs to evaluate the environmental impacts associated with the use of state land, and land within a designated Conservation District, to implement the HCP supporting the issuance of an ITL, pursuant to HRS Chapter 343 (HEPA). Additionally, the purpose of the state action is to fulfill DLNR's authority under HRS Chapter 195D to consider KIUC's application for take of state-listed species for the Covered Activities in the Plan Area. The need for the state action is to respond to KIUC's request for an ITL and to either approve or deny the request.

Public Engagement

Public Scoping

On June 8, 2022, the Service published a Notice of Intent to Prepare an EIS (NOI) in the *Federal Register* (87 *Federal Register* 34897). All members of the public, including any interested parties, were encouraged to submit comments on the scope of analysis, alternatives, and suggestions on data or information to consider in the EIS. The scoping period ended on July 8, 2022. Also on June 8, 2022, DLNR initiated a 30-day public scoping period for the EIS with publication of an Environmental Impact Statement Preparation Notice (EISPN) in *The Environmental Notice* and distribution of the HEPA EISPN by mail or email to the Hawaiʻi Documents Center (Hawaiʻi State Public Library), Lihue Public Library, government agencies, elected officials, and other stakeholders. The Service and DLNR considered all comments received on the NEPA NOI and HEPA EISPN during development of this Draft EIS. Comments received on the NEPA NOI and HEPA EISPN are summarized in Appendix B, *Scoping Summary*.

Public Review of the Draft HCP

Pursuant to HRS 195D-21, DLNR reviews the Draft HCP for consistency with state regulations on the take of listed species and publishes a notice of availability of the Draft HCP in *The Environmental Notice* for a 60-day public comment period. The availability of the Draft HCP was announced in the January 23, 2023, issue of *The Environmental Notice*, commencing a public review and comment period that ended March 24, 2023, and included a public hearing on Kauaʻi on March 27, 2023. The Draft HCP published concurrent with this Draft EIS incorporates the comments received on the Draft HCP published in January 2023, as well as continued collaboration and comments from the Service and DLNR.

Alternatives

The Service analyzed four alternatives in detail in the Draft EIS: the No Action alternative (Alternative A), the proposed action (Alternative B, the KIUC HCP), Additional Minimization (Alternative C), and Additional Mitigation (Alternative D). Chapter 2, *Alternatives*, describes additional alternatives that the Service considered but eliminated from detailed study.

Alternative A: No Action

The No Action alternative serves as a baseline for comparing the impacts of the proposed action and the action alternatives. Under Alternative A, the Service and BLNR would not issue take authorizations through an ITP to KIUC for the Covered Species and the Covered Activities described under Alternative B (i.e., powerline operation, powerline modification, and lighting operations). Under the No Action alternative, KIUC would not implement the Draft HCP, the conservation measures currently being implemented by KIUC would cease, and the impact of KIUC's taking of ESA-listed species would not be mitigated.

Under Alternative A, there would be no obligation to maintain the conservation sites in the absence of the federal ITP and state ITL. KIUC would continue to operate its existing and new infrastructure to provide services to its customers in the Plan Area. These activities, including powerline operation, modification, and lighting operations, would continue to be subject to ESA and HRS Chapter 195D take prohibitions.

For analysis purposes, the Service assumes KIUC would operate and maintain existing and future infrastructure that is under its ownership or direct control including, without limitation, powerlines, support structures, and lighting, in accordance with historical practices. This includes the expansion of KIUC-owned infrastructure in accordance with current plans and trends on Kauaʻi.

The Service also assumes that existing physical modifications to KIUC-owned infrastructure that are designed to avoid or minimize the impact of KIUC's taking of listed species would remain in place and operational for their useful life. Those physical modifications are described in more detail under Conservation Measure 1 and Conservation Measure 2 below and include:

- Reconfiguration of the vertical profile of existing powerlines to reduce the maximum wire height and reduce the number of wires in a vertical array[2]

[2] There are three reconfiguration projects identified in the Draft HCP.

- Removal of 69-kilovolt transmission line in Mānā[3]
- Removal of existing static wires[4]
- Installation of bird flight diverters on powerlines[5]
- Retrofit of existing streetlights to minimize light attraction and reduce risk of seabird fledgling fallout (i.e., installation of full cut-off shield fixtures)[6]

Under the No Action alternative, any incidental take of ESA-listed species would not be authorized and KIUC would assume all legal risk for incidental take resulting from its activities. Unauthorized take would be expected to continue because there are no known practicably feasible means of avoiding all take from KIUC's current or future proposed activities. KIUC cannot obtain take coverage by instituting take minimization or mitigation measures that are not authorized through state and federal incidental take permitting processes. Under the No Action alternative, the impact of KIUC's taking of ESA-listed species would not be mitigated.

Alternative B: Proposed Action

Under Alternative B, the proposed action, the Service and BLNR would authorize incidental take of Covered Species from Covered Activities in the Permit Area including implementation of the conservation strategy over a 50-year permit term and described in the Draft HCP. Based on the information available at this time, the Service has identified the proposed action as its preferred alternative because it would best accomplish the purpose and need of the proposed action while fulfilling its statutory mission and responsibilities, giving consideration to economic, environmental, technical, and other factors. This section summarizes the Draft HCP Plan Area and Permit Area, permit term, Covered Species, Covered Activities, conservation strategy, and monitoring and adaptive management program. The full description of these can be found in KIUC's Draft HCP (ICF 2025).

Plan Area and Permit Area

The Draft HCP *Plan Area* consists of the entire island of Kauaʻi.

The *Permit Area* is the specific locations of all Covered Activities and conservation measures (i.e., the geographic area where the federal ITP and state ITL apply); these locations are described below under *Covered Activities* and under *Implementation of the Conservation Strategy*, and generally include the locations of KIUC's existing facilities, the conservation sites where conservation measures could be implemented for seabirds, and nesting beaches where conservation measures would be implemented for honu (green sea turtle, *Chelonia mydas*). Operation of new or extended powerlines (for transmission and distribution) is also a Covered Activity in the Draft HCP. The vast majority of new transmission lines and distribution lines would either be added to existing poles or placed on new poles adjacent to existing lines (i.e., in the same transmission line or distribution line

[3] This activity is only proposed for the Mānā Plains area.
[4] Including projects completed under the KIUC Short-term HCP (i.e., spans 328–342 from Waialo Road to Brydeswood, span 352 at Fujita Tap, and span 581 at Halewili Positron to Aepo Substation); excluding portions of the Powerline Trail.
[5] Including projects completed under the KIUC Short-term HCP (i.e., spans 244–254, 1.6 kilometers from the Waimea Bridge to Kaumakani, and spans 1196–1214, 2.9 kilometers from Moloaʻa to Kīlauea.
[6] Measure included in the KIUC Short-term HCP.

corridor). However, there could be future powerlines or streetlights outside existing corridors (at locations that are not yet defined) that would be covered by the Draft HCP and included in the Permit Area.

Permit Term

KIUC requested a 50-year permit term and take authorization because:

1. A 50-year permit term provides the regulatory certainty necessary to ensure it can continue to provide cost-effective electricity to its members.
2. The 50-year permit term represents the amount of time KIUC believes is necessary to implement the conservation strategy and achieve full offset of the impacts of the taking on the covered threatened and endangered species.
3. The Draft HCP can achieve an overall net gain in the recovery of the Covered Species over a 50-year period as required under HRS 195D-30.

Covered Species

Nine species are proposed for incidental take authorization in the Draft HCP and are referred to as *Covered Species* (Table ES-1). The Covered Species were selected based on their listing status and potential for incidental take as defined by the federal ESA and HRS Chapter 195D. Draft HCP Appendix 1B, *Evaluation of Species Considered for Coverage*, describes the evaluation process and rationale by which KIUC selected the Covered Species.

Table ES-1. Covered Species

English Name	Hawaiian Name	Scientific Name	Status[a] (Federal/State)
Newell's shearwater	ʻaʻo	*Puffinus newelli*	T/T
Hawaiian petrel	ʻuaʻu	*Pterodroma sandwichensis*	E/E
Band-rumped storm-petrel[b]	ʻakēʻakē	*Hydrobates castro*	E/E
Hawaiian stilt[c]	aeʻo	*Himantopus mexicanus knudseni*	E/E
Hawaiian duck	koloa maoli	*Anas wyvilliana*	E/E
Hawaiian coot	ʻalae keʻokeʻo	*Fulica alai*	E/E
Hawaiian common gallinule	ʻalae ʻula	*Gallinula galeata sandvicensis*	E/E
Hawaiian goose	nēnē	*Branta sandvicensis*	T/E
Green sea turtle[d]	honu	*Chelonia mydas*	T/T

[a] Status:
E = Listed as endangered under the federal ESA or HRS Chapter 195D.
T = Listed as threatened under the federal ESA or HRS Chapter 195D.
[b] Hawaiʻi distinct population segment.
[c] Proposed for downlisting to threatened in 2021. Final rule is still pending.
[d] Central North Pacific Region distinct population segment.

Covered Activities

The proposed action is the authorization of incidental take that would occur as the result of implementation of Covered Activities. The *Covered Activities*, as described in the Draft HCP, include three categories: (1) powerline operations including modifications, (2) lighting operations (facility lights and streetlights) and use of night lighting for repairs, and (3) implementation of the Draft HCP conservation strategy.

Powerline Operations

KIUC owns and operates overhead electric powerlines on Kauaʻi. The wire sizes and pole heights vary widely for each type of powerline depending on site-specific physical circumstances present along the powerline corridor (e.g., topography). Moreover, powerline configuration may switch from one type to another (and often back again) within distances of as little as a few hundred feet.

All overhead wires with the potential to cause take of Covered Species fall into one of the following three categories: (1) transmission wires, (2) distribution wires, and (3) communication wires. KIUC is seeking coverage for all existing and, after completing their construction, future KIUC overhead wires falling into one of these three categories and all existing and future KIUC supporting structures holding these overhead wires. There are roughly 26,000 KIUC-owned support structures that support KIUC-owned and -operated overhead transmission wires, distribution wires, and communication wires.

Powerline Modifications

KIUC periodically modifies transmission lines and distribution lines in response to changes in electricity demand. In other cases, KIUC may modify powerline systems in response to changing land uses that might interfere with safe and reliable power delivery. In either instance, these powerline modifications are Covered Activities if they result in an increase in wire height, exposure of wires, or new powerlines on the landscape.

New or Extended Powerlines

Operation of new or extended powerlines (for transmission and distribution) is a Covered Activity in the Draft HCP. It is estimated that 360 miles (mi) (579.4 kilometers [km]) of new wires and support structures could be constructed over the 50-year permit term across KIUC's electric system. Construction of new powerlines is not a Covered Activity because construction activities are not expected to result in take of Covered Species. Once wires are in place (they do not need to be electrified), they are a Covered Activity under the Draft HCP. KIUC is requesting take coverage for the operation of new wires and support structures in locations that are currently unknown. KIUC estimates that over the 50-year permit term, a maximum of 360 mi (579.4 km) of new wires will be required; this represents a 24-percent increase from the existing 1,531 mi (2,464 km) of powerlines and would represent an average of 7 mi (11.3 km) per year for 50 years.

Adding Wires to Existing Powerline Circuits

KIUC adds new powerlines into its existing electric system (i.e., on existing poles or towers and on existing support structures) to increase capacity. KIUC frequently adds new wires to the existing powerline circuits to accommodate growth in demand and to increase redundancy in the system. KIUC does not control where new demands for electrical service will arise. Construction of new powerlines on existing powerline circuits is not a Covered Activity under the Draft HCP because construction activities are not reasonably certain to result in take of Covered Species. Once wires are in place (they do not need to be electrified), they are a Covered Activity under the Draft HCP. KIUC is requesting take coverage for the operation of new wires added to existing powerline circuits in locations that are currently unknown.

Lighting Operations

Facility Lights

Operation of facility lights at the Port Allen Generating Station and the Kapaia Power Generating Station is a Covered Activity. Both facilities maintain night lighting for operations, visibility of personnel, and safety.

Night Lighting for Repair of Facilities

When equipment failure or powerline damage occurs, KIUC must restore power to its customers as quickly as possible.[7] For the purpose of restoring power, KIUC may need nighttime lighting in order to ensure worker safety during repair or replacement of existing powerlines (in cases where the damage is too extensive to utilize the existing infrastructure), support structures, and substations. While repair work at night due to outages is rare, KIUC is requesting take coverage for the use of night lighting for emergency repair work that occurs during the seabird fallout season (September 15 to December 15) over the 50-year permit term. This emergency nighttime lighting coverage applies for repairs to, or replacement of, existing or new powerlines, support structures, and substations. Substations are not a Covered Activity but, in the event that repairs at substations are required to restore power outages and require nighttime lighting, the nighttime lighting is a Covered Activity.

Streetlights

Existing Streetlights. KIUC owns and operates approximately 4,150 streetlights under agreements with the state, County of Kauaʻi, and private entities, which includes those at KIUC facilities. All lights are switched on and off at sunset and sunrise automatically by photosensitive switches installed in individual lights. All of KIUC's streetlights have full-cutoff shielded fixtures, designed to direct the light downward and outward, rather than upward toward the sky. Operation of existing KIUC streetlights is a Covered Activity because they contribute to the lightscape on Kauaʻi. For a streetlight to be considered operational under the Draft HCP, the light must be energized and operational (i.e., streetlight construction, prior to the light being energized and operational, is not a Covered Activity).

New Streetlights. KIUC expects to operate up to 1,754 new shielded streetlights along roadways on Kauaʻi over the 50-year permit term (an average of 35 new streetlights per year). Based on growth projections on Kauaʻi, the number of new streetlights is not expected to exceed 50 per year. As with all the existing streetlights on Kauaʻi, any new streetlights will also be equipped with full-cutoff shields. Operation of future KIUC streetlights is a Covered Activity because they contribute to the lightscape on Kauaʻi. Construction of new streetlights is not a Covered Activity because installation of the streetlights is not expected to result in take of any Covered Species given that the light is not operational during construction. KIUC asserts that it has no authority over the siting of new streetlights because it is the secondary developer asked to provide electricity and install streetlights based upon the request of a primary developer.

[7] This does not include catastrophic events like Hurricane ʻIniki that threaten human life and property.

Implementation of the Conservation Strategy

Activities related to implementation of the Draft HCP conservation strategy at the conservation sites may result in incidental take of the Covered Species. The Draft HCP conservation strategy includes biological goals and objectives for each Covered Species, which broadly describe desired future conditions and how they would be achieved. It also includes conservation measures that KIUC would implement to avoid, minimize, and mitigate the impact on Covered Species from Covered Activities such that the impact of the taking is minimized and mitigated to the maximum extent practicable, as required under ESA section 10(a)(2)(B)(ii) and associated implementing regulations at 50 CFR 17.22 (endangered species) and 17.32 (threatened species), and 50 CFR 222.25, 222.27, and 222.31 and HRS Chapter 195D. KIUC proposes to fully offset the impact of its taking and provide a net benefit through implementation of the Draft HCP conservation strategy. KIUC would implement and fund six conservation measures as summarized below.

Conservation Measure 1. Implement Powerline Collision Minimization Projects

Minimization actions under this conservation measure include reconfiguration of powerlines (i.e., changing the profile from vertical to horizontal and reducing the number of layers, thereby reducing the maximum wire height), static wire removal, and installation of bird flight diverters to substantially reduce powerline collisions. Bird flight diverters are regularly spaced reflective or light-emitting diode (LED) devices that make powerlines more visible to birds, reducing the number of collisions.

KIUC began implementation of powerline collision minimization projects in 2015 but completed the vast majority of planned minimization projects for existing powerlines between 2020 and May 2024. These powerline collision minimization projects include the installation of 113.2 mi (182.2 km) of flight diverters, removed 82.9 mi (133.4 km) of static wire, and reconfiguration of 7.8 mi (12.5 km) of powerline to reduce the maximum wire height, the number of vertical wire levels, and the vertical profile of wire arrays. These minimization measures were often installed in combination. Overall, approximately 127.3 mi (204.8 km) of KIUC powerlines have had minimization measures applied. KIUC also buried approximately 0.5 mi (0.8 km) of distribution wires on Kāhili mountain as part of the KIUC Short-term HCP[8] and removed a section of 69-kilovolt transmission line in Mānā as a system improvement project in 2023, which will further reduce powerline collision risk in those areas. Based on KIUC's powerline monitoring data, the estimated strike reduction by span ranges from 42 to 95 percent, depending on the minimization technique or combination of techniques applied.

All new powerline installations would be planned and implemented while considering how operation of those installations would potentially affect Covered Species. The vast majority of new transmission lines and distribution lines would either be added to existing poles or placed on new poles adjacent to existing lines (i.e., in the same transmission line or distribution line corridor). Appropriate minimization would be deployed on new powerlines with the goal of achieving the greatest practicable level of reduction to potential strike risk in any given location. Standards for new powerlines include avoiding installation of static wire, minimizing powerline height and

[8] KIUC buried these wires underground because the Underline Monitoring Program indicated that these very short powerlines (19.7–26.2 feet [6–8 m] above ground) had the highest collision rate on the island because the wires were mounted on a steep mountain ridge running directly through colonies of ʻaʻo (Newell's shearwater, *Puffinus newelli*) and ʻuaʻu (Hawaiian petrel, *Pterodroma sandwichensis*).

vertical wire levels, and installing bird flight diverters. To the extent practicable, KIUC would also avoid construction of new powerlines in high-collision zones (e.g., ridgelines, tops of slopes, between seabird colonies and the ocean) and avoid long powerline spans across valleys (i.e., perpendicular to valleys). KIUC, the Service, and DLNR have jointly developed a special review and approval process for any new powerlines (and streetlights) proposed in a specifically defined area of northwestern Kaua'i that includes the conservation sites.

Conservation Measure 2. Implement Measures to Minimize Light Attraction

Minimization actions under this conservation measure include installation of full-cutoff shield fixtures and dimming exterior night lighting during the fledgling fallout season. In 2017, all existing KIUC streetlights were retrofitted with full-cutoff shields to minimize light attraction, and all KIUC streetlights were converted from high-pressure sodium bulbs to more energy-efficient 3,000-kilowatt LED bulbs. In 2019, KIUC replaced all green light bulbs in streetlights with white light bulbs to further reduce light attraction. Light from all new streetlights during the permit term will be similarly minimized.

KIUC also operates night lighting at two facilities covered by the Draft HCP, the Port Allen Generating Station and the Kapaia Generating Station. In 2019, KIUC retrofitted all the exterior lights at the Port Allen Generating Station and the Kapaia Generating Station. At the Port Allen Generating Station, KIUC replaced its existing freestanding exterior facility lights with full-cutoff white LED lights and shielded wall-mounted white LED box lighting. Similarly, at the Kapaia Generating Station, all the 150-watt high-pressure sodium streetlights and building lights were shielded to direct light downward, away from the sky. Any new lights installed at the two covered facilities by KIUC during the permit term would utilize these same minimization features.

KIUC would continue to dim the exterior lighting at the Port Allen Generating Station during the fledgling fallout season (September 15 to December 15) to minimize light attraction. At the beginning of the fallout season, all exterior facility lights are dimmed to the lowest extent practicable. At the end of the fallout season, lights are returned to full brightness. Lights at the Kapaia Generating Station are not proposed to be converted to dimmable lights because the risk of fallout of covered seabirds from lights at the Kapaia Generating Station is extremely low. Interior building lights at both facilities would be turned off at night during the fledgling fallout season (September 15 to December 15) to avoid light attraction. If interior building lights must be turned on for any portion of the night, retractable screens or shades would be used to block lights from emitting from the building.

KIUC may also need to utilize artificial lighting during the seabird fallout season if power outages occur between September 15 and December 15. Nighttime lighting would only be used to respond to power outages and, if lights are used, they are necessary for the safety of workers and to conduct the required power restoration work. At work sites where nighttime lighting is required during these 3 months, KIUC would search for grounded birds after the work is completed according to the same protocol used at the covered facilities. KIUC would conduct annual training on how to search for and properly handle downed covered seabirds at the covered facilities.

This conservation measure only applies to the covered seabird species because they are the only Covered Species group affected by light attraction away from coastal locations.

Conservation Measure 3. Provide Funding for the Save our Shearwaters Program

KIUC began funding and largely implementing the Save our Shearwaters (SOS) program with DLNR in 2003. Under the Draft HCP, KIUC will fund the SOS program to a consistent level of $300,000 dollars per year (in 2023 dollars)[9] to rescue, rehabilitate, and release all covered seabirds and waterbirds found within the SOS program's operational area on Kauaʻi, regardless of the source of injury. Under the SOS program, grounded seabirds, waterbirds, and other native birds rescued by members of the public or businesses can be turned into SOS program staff. Injured birds are assessed, rehabilitated if possible, and released back into the wild by trained staff and volunteers and professional veterinary staff. All rehabilitation actions occur at an accredited animal rescue facility with extensive equipment and facilities for any necessary procedure to treat minor injuries or perform major surgery or treatment, including extended stays prior to release back into the wild. KIUC will also employ a public outreach and education program, in coordination with the SOS program, to inform and educate the public about the risks of powerline strikes and light attraction to the Covered Species on Kauaʻi. This conservation measure applies to covered seabirds and covered waterbirds.

Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites

KIUC will manage and enhance 12 conservation sites for the Draft HCP. Conservation sites are specific parcels in the Plan Area where KIUC would continue to implement management actions to increase the reproductive success of ʻaʻo (Newell's shearwater, *Puffinus newelli*) and ʻuaʻu (Hawaiian petrel, *Pterodroma sandwichensis*) breeding colonies, and to benefit ʻakēʻakē (band-rumped storm-petrel, *Hydrobates castro*) occurring in the region. Most of the 12 conservation sites that were selected for the Draft HCP are the same sites where KIUC has been funding predator control, seabird monitoring, and invasive plant species control annually since 2011 for the KIUC Short-term HCP and in the interim period between the KIUC Short-term HCP and commencement of the Draft HCP. All conservation sites except for Upper Mānoa Valley Predator Fence (PF) would be established prior to issuance of the federal ITP and state ITL. Management actions at conservation sites would include the following:

- Predator control measures would be implemented at all conservation sites and will be used to establish predator-free breeding habitat or substantially reduce predation. Predators include cats; rats and mice (rodents); pigs, deer, and goats (ungulates); feral bees; and barn owls. Terrestrial predator control methods may include deployment of cameras, various trap types depending on targeted species (e.g., cats, rats), bait stations, snares, hunting, and other control methods. Intensive predator control will be implemented at all sites without predator exclusion fencing. Intensive predator control creates a barrier through strategic placement of trapping and monitoring cameras along known routes and ingress points and around known seabird burrow locations.
- Predator exclusion fencing would be maintained that is impenetrable to most introduced terrestrial predators including feral cats, rats, pigs, and goats. KIUC will maintain existing predator exclusion fences at Pōhākea PF and Honopū PF. KIUC will construct two additional predator exclusion fences within the Upper Limahuli Preserve PF by 2025 and Upper Mānoa Valley PF by 2027, and maintain those fences for the remainder of the permit term. KIUC will maintain an existing ungulate fence at Honopū and an existing pig exclusion fence at Upper

[9] KIUC funding will increase annually to keep pace with inflation.

Limahuli Preserve. A number of other conservation sites are within a state Natural Area Reserve (NAR) that is bordered by sections of ungulate exclusion fence that were constructed and are maintained by other entities and that are combined with steep terrain deemed unpassable by pigs.

- Social attraction techniques would be used at conservation sites contained within predator exclusion fences to establish new colonies at those sites within otherwise suitable breeding habitat. Social attraction methods would include removal of unsuitable vegetation and replanting with native species, installation of artificial burrows, and broadcasting calls in the restored habitat during peak breeding season (April through mid-August). Social attraction would be implemented at Upper Limahuli Preserve PF, Pōhākea PF, Honopū PF, and Upper Mānoa Valley PF.
- KIUC would fund continual invasive plant species management within the Upper Limahuli Preserve, Honopū, and the four social attraction sites (including a 30-foot perimeter around the outside of the predator exclusion fences). Invasive plant species control at the other conservation sites would occur on an as-needed basis, when species are documented during monitoring and determined to be spreading or otherwise problematic. Invasive plant control techniques would involve uprooting, cutting, sawing, or girdling from invasive plants combined with herbicide application as described in the Draft HCP.

Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Shielding Program

A nest detection and shielding program would be implemented to minimize and offset the effects of light attraction on honu (green sea turtles) from KIUC streetlights and to provide a net benefit to the species. Nest shielding would initially be installed on the full length of the seven beaches, which were identified by KIUC, the Service, and DLNR Division of Aquatic Resources (DAR) as having suitable honu (green sea turtle) nesting habitat, and that have KIUC streetlights visible from that habitat (refer to Draft HCP Section 4.4.5.2 and Figures 4-12 a–g for additional information on beaches selected for nest shielding, including locations). The nest shielding would be installed when active honu (green sea turtle) nests are detected via annual drone surveys or monitoring surveys (in areas where drone surveys are not permitted or not practicable). Light-proof fencing would be erected around the nest after approximately 45 days of incubation to minimize the potential for vandalism. After the honu (green sea turtle) hatchlings have emerged and entered the ocean, the fence would be removed and evidence of hatching will be reported to the Service, DLNR, and DAR within 24 hours. Unhatched eggs, deceased hatchlings, or samples of either would be sent to the National Oceanic and Atmospheric Administration (NOAA) by a permitted biologist for DNA analysis.

Annual monitoring would occur on all beaches on Kauaʻi with suitable honu (green sea turtle) habitat within view of KIUC streetlights to allow for continual updates to the nest-shielding program by identifying additional beaches that may require shielding as well as removing locations where environmental conditions change and light attractant risks are removed. All staff and monitors would be required to complete an annual training provided by the Service, DLNR, or DAR, or trainers approved by the Service, DLNR, and DAR, that would allow them to recognize honu (green sea turtle) tracks, signs of nesting, and hatchling activity, as well as the proper techniques for installing a temporary light shield. These measures would be implemented over the 50-year permit term unless KIUC is able to demonstrate to the Service, DLNR, and DAR that permanent modification of existing and future streetlights fully avoids take of honu (green sea turtles).

Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle

Measures implemented to minimize the impact of streetlights on the covered seabirds (Conservation Measure 2) do not reduce streetlight visibility to honu (green sea turtle) hatchlings. As of 2020, KIUC and the Service identified 29 streetlights that are visible from suitable honu (green sea turtle) nesting habitat within the Plan Area. Additional modifications of streetlights may be possible to reduce light attraction of honu (green sea turtle) hatchlings at these locations without compromising public health or safety. KIUC will work with the state and county to determine the range of available practicable minimization measures and their timeline for implementation. Light-minimization techniques may include additional shielding, change in wattage, change in wavelength, or a combination of these measures. If no practicable minimization measures can be agreed upon, KIUC would not be required to implement this conservation measure further, and instead would continue to implement the shielding required under Conservation Measure 5 throughout the life of the permit term. If new locations are identified as beaches and the surrounding vicinity change over time or new streetlights are installed that could cast light onto suitable honu (green sea turtle) nesting habitat, the same light-minimization techniques agreed upon for the existing 29 streetlights would be implemented for any additional streetlights identified throughout the permit term.

Monitoring and Adaptive Management

The proposed action includes implementation of a monitoring and adaptive management program (Draft HCP Chapter 6, *Monitoring and Adaptive Management Program*). The goal of the monitoring component of the program is to evaluate on an ongoing basis whether KIUC is complying with incidental take authorizations and is meeting, or is likely to achieve, the biological goals and objectives. As part of the monitoring and adaptive management program, KIUC would oversee and implement:

- Compliance monitoring to track the status of HCP implementation and that the requirements of the HCP are being met. Compliance monitoring verifies that KIUC is carrying out the terms of the HCP, the federal ITP, and the state ITL.
- Take monitoring that compares the actual take that occurs during HCP implementation to the take limit authorized by the federal ITP and state ITL.
- Effectiveness monitoring to assess the biological performance of the HCP. Specifically, the effectiveness monitoring evaluates the implementation and success of the conservation strategy (Draft HCP Chapter 4, *Conservation Strategy*).

Draft HCP Chapter 6, *Monitoring and Adaptive Management Program*, outlines the adaptive management process and describes potential triggers for implementing adaptive management actions. Broadly, adaptive management may be required if existing practices under or overachieve the HCP’s biological goals and objectives or if more efficient or effective practices could be implemented to achieve the biological goals and objectives. Adaptive management and monitoring would be integrated into one program that includes required monitoring and adaptive management actions and data and reporting requirements (refer to Draft HCP Chapter 7, *Plan Implementation*, for details regarding data management and reporting).

Alternative C: Additional Minimization

Under Alternative C, the Draft HCP would include the same Permit and Plan Areas, Covered Species, permit term, and monitoring and adaptive management program as the proposed action, but the Draft HCP's conservation strategy would be modified to reduce impacts of the proposed action in the following ways. The Service and DLNR have developed this alternative to the proposed action for the purposes of the NEPA and HEPA analysis. The Service and DLNR determined it would be technically and economically feasible because the minimization measures proposed under Alternative C are similar to the measures already proposed under Alternative B but to a greater degree. KIUC has not specifically evaluated the alternative for technical and economic feasibility.

Alternative C would implement additional minimization measures on existing powerline spans that have higher collision risk[10] for seabirds to further reduce the collision risk for seabirds:

- Reconfigure the vertical profile of 4.4 mi of existing powerlines that have higher collision risk[10] and that have not already been reconfigured.[11] Reconfiguration includes measures such as reducing the maximum wire height and/or reducing the number of wires in a vertical array.
- Remove static wire on 0.7 mi of existing powerlines that have higher collision risk[10] and that have not already had static wire removed.[12]
- Install flight diverters on 2.7 mi of existing powerlines that have higher collision risk[10] and that have not already had flight diverters installed (LED or reflective).[13]
- Employ flight diverters on each layer of wires on all powerline spans (8.9 mi) that have higher collision risk.[10]

Alternative C would implement the following additional minimization measures for 360 mi of new powerlines:

- Construct new powerlines with wires in one horizontal plane, with exceptions only for human health and safety and other applicable laws and regulations.[14] For purposes of NEPA analysis, it is assumed that 50 percent (180 mi) of new powerlines would be constructed in one horizontal plane. KIUC predicts a buildout of 360 mi of new powerlines over the 50-year permit term.
- Install flight diverters that illuminate powerlines (e.g., reflective, neon, LED diverters) on new powerline spans that would have higher collision risk (no exceptions).[15]
- Employ bird flight diverters on each layer of all wires within all new powerline spans that would have higher collision risk. This only applies to wires not in a horizontal plane.

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[10] Higher-risk spans include 8.9 mi of powerlines defined by teal and light green colors on Figure 2-7 in Chapter 2 that reflect strike rates for seabirds between 10 and 20 (teal) or 20 and 40 (light green) after minimization completed through May 2024. Strike rates are the estimated annual strikes (or collisions) per span by covered seabirds.

[11] Three reconfiguration projects (C-LC1, C-CP1, and C-CP2) were implemented in 2020 as part of the Draft HCP (see Figure 2-3 in Chapter 2).

[12] Powerline spans where static wire has not been removed are shown on Figure 2-4 in Chapter 2.

[13] Powerline spans where flight diverters have not been installed are shown on Figure 2-3 in Chapter 2.

[14] The Draft HCP qualifies that new powerlines will be installed in one horizontal plane to the greatest extent possible.

[15] The Draft HCP states that all new powerlines will be evaluated to determine if flight diverters are a practicable minimization technique. If flight diverters are practicable, they will be installed at the time of construction.

Alternative C would include the following additional lighting minimization measure for existing and new streetlights to reduce light attraction for seabirds:

- Reduce the number of lumens emitted from lightbulbs by 15 percent by using light dimmers.

Alternative C would increase funding by 50 percent to SOS:

- Increased funding would support the rescue and rehabilitation of injured listed seabird species beyond what is proposed in the Draft HCP. Additional funding could be used to expand outreach and public education efforts, thereby increasing the discovery rate of seabirds during the fallout season (from 10 percent[16] to 20 percent of total streetlight fallout).
- An increase in discovery and intake rates would necessitate additional capacity to rehabilitate injured birds. Additional funding could be used to increase rehabilitation capacity proportionately to the increase in listed seabird discovery and intake. Funds could be used to (1) obtain a stable lease or permanent facility for long-term operations, (2) retain qualified staff through higher wages, and/or (3) fund critical care isolation, a decontamination area, wading pools, medical supplies, and a designated vehicle to reduce operational vulnerability.

Alternative D: Additional Mitigation

Under Alternative D, the Draft HCP would include the same Permit and Plan Areas, Covered Activities, Covered Species, permit term, and monitoring and adaptive management program as the proposed action, but the conservation strategy would be modified to increase conservation as described below. The Service and DLNR have developed this alternative to the proposed action for the purposes of the NEPA and HEPA analysis and in response to scoping comments. The Service and DLNR determined it would be technically and economically feasible because the mitigation measures proposed under Alternative D are similar to the measures already proposed under Alternative B but to a greater degree. KIUC has not specifically evaluated the alternative for technical and economic feasibility.

Alternative D would specify an increase in the total acreage of mitigation effort beyond what is included in the proposed action. Alternative D would also increase the intensity and area of management actions proposed in the Draft HCP to include a combination of:

- Expanded ungulate control on state land around the conservation sites within the Hono O Nā Pali NAR. This measure would increase the acreage that is enclosed by ungulate fences by 1,915 acres to benefit seabird productivity.
- Expanded predator control in 1,394 acres of three additional conservation sites (beyond those included in the Draft HCP) where predator-proof fences, social attraction (including installation of artificial burrows), and a predator trapping network would be implemented to benefit seabird productivity.
- Regional barn owl control: Expanded area of barn owl control outside conservation sites by 1,394 acres.

[16] Draft HCP Section 5C.2.1.6 estimates that the detectability rate for SOS at streetlights is 10.4 percent as a worst-case estimate for all three covered seabird species.

- Expanded predator control, habitat management, waterbird population monitoring, and barn owl control within an area outside of the conservation sites (50 acres of state land within the Mānā Plain wetlands).

Alternative D would also include increasing funds to KIUC's existing volunteer program by 15 percent to better staff measures for sea turtles:

- Increase staffing, volunteer network, and outreach effort of the existing volunteer program that seeks to protect honu (green sea turtle) through education, public awareness, and support for public outreach activities that promote respectful behavior and reduce disturbance to basking sea turtles.
- Add marine debris removal as part of existing volunteer program. Marine pollution can lead to the ingestion of, and entanglement in, marine debris such as plastic and monofilament fishing line. Although the direct effects of ingesting marine debris may or may not be lethal to honu (green sea turtle), it results in varying side effects that could increase the probability of death (see Section 3A.9.5.9 of the Draft HCP).

Summary of Impact Analysis

Table ES-2 summarizes the impacts that could occur under the proposed action and alternatives for all environmental issues analyzed in the EIS. Chapter 3, *Affected Environment and Environmental Consequences*, provides the existing conditions and a detailed analysis of potential effects. Cumulative effects are analyzed in Chapter 4, *Reasonably Foreseeable and Cumulative Effects*, and are not included in the table.

Table ES-2. Summary of Potential Impacts

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
Covered Species		
Seabirds		
Existing infrastructure modifications designed to reduce harm and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would remain in place. Measures already in place by KIUC to avoid and minimize powerline collision impacts on seabirds would continue to reduce powerline collisions during the useful life of the infrastructure. Unauthorized take of seabird species would likely continue, because KIUC would not be able to avoid take of listed species, nor could it reduce and mitigate all impacts of the taking in order to obtain take authorization through formal permitting processes. Under Alternative A, KIUC funding for the SOS program is not projected to continue. Without annual contributions from KIUC, the SOS program may continue with alternate sources of funding but would likely operate at a reduced capacity, and the public outreach and education component of the program would substantially decrease. Based on four of the five the model outputs, ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) are likely to experience a population decline over the 50-year permit term under the No Action alternative, likely due to the future lack of maintenance and replacement of the implemented minimization measures and the cessation of funding and maintenance of the	Under Alternative B, KIUC would manage and enhance 12 conservation sites as part of its Draft HCP to support the breeding success of ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel), and in doing so also reduce predation of ʻakēʻakē (band-rumped storm-petrel). Social attraction strategies, including habitat restoration, artificial burrow installation, and playback of seabird calls, would be used to expand and establish seabird colonies, primarily ʻaʻo (Newell's shearwater), at the sites with predator exclusion fences. With the proposed action, the Population Dynamics Model (PDM) stable-trend and Joint Conservation Strategy (JCS) flat-line model scenarios indicate there would be significant population increases during the 50-year permit term, while the PDM worse-case and JCS worst-case and mid-point model scenarios indicate moderate to severe population declines. Both the JCS flat-line and the PDM stable-trend scenarios show 50-year population increases of over 300 percent for ʻaʻo (Newell's shearwater). There is wider variation between the two stable model scenarios for ʻuaʻu (Hawaiian petrel), but both indicate significant population gains of about 240 percent for the JCS and nearly 600 percent for the PDM. None of the scenarios indicate ʻaʻo (Newell's shearwater) or ʻuaʻu (Hawaiian petrel) populations would go extinct under the proposed action.	Under Alternative C, the additional minimization would have a minimal added benefit to both seabird species when compared to the proposed action. Population outcomes based on the five model scenario outputs are similar to the proposed action conclusions. Both species are not expected to become locally extinct with additional minimization, but ʻuaʻu (Hawaiian petrel) is expected to experience a steeper population decline than ʻaʻo (Newell's shearwater). The anticipated minimal benefits of Alternative C are not anticipated to result in an adverse impact over the 50-year permit term. Under Alternative C, it is anticipated based on qualitative assumptions that the additional minimization would have a small degree of added benefits to ʻakēʻakē (band-rumped storm-petrel) when compared to the No Action alternative and proposed action. This is based on additional reduced take from added light and powerline minimization. The model outputs for additional mitigation suggest Alternative D would have a more beneficial influence on both ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) populations by the end of the permit term when compared to the other alternatives. However, under the JCS worst-case and PDM worse-case model scenarios, a decline is predicted for ʻuaʻu (Hawaiian petrel) although an increase in growth rate would occur near the end of the permit term. Under Alternative D, additional

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
conservation areas, particularly predator control measures. One of the five model scenarios produced an increase in populations of the two species due to conservation actions occurring outside of the Draft HCP. For ʻakēʻakē (band-rumped storm-petrel), similar impacts are expected, but at a minimal level over the 50-year permit without implementation of the Draft HCP's conservation measures and due to the continued existence of threats (e.g., predators, light attraction).	Results from all five model scenarios imply that the proposed action would have fewer adverse impacts than the No Action alternative for both ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel). For ʻakēʻakē (band-rumped storm-petrel), benefits of the Draft HCP conservation strategy were estimated based on qualitative assumptions. Beneficial impacts include reducing powerline collisions in the Waimea Canyon area, reducing light attraction, facilitating rehabilitation and release of downed birds through the SOS program, likely increased survival due to predator control activities, and establishment of a protected colony within the Honopū PF.	mitigation would provide more benefits to ʻakēʻakē (band-rumped storm-petrel) when compared to Alternatives A, B, and C. This is due to expanded predator control on the landscape beyond the scope of Alternative B resulting in less predation, which would result in increased survival of ʻakēʻakē (band-rumped storm-petrel).
Waterbirds		
Measures already in place by KIUC to avoid and minimize powerline collision impacts on waterbirds, which include reconfiguration of powerlines from vertical to a horizontal profile, removal of static wire, removal of 69-kilovolt transmission line in Mānā, and bird flight diverters on powerlines, would continue to benefit the covered waterbirds for the duration of their useful life under this alternative regardless of whether the Draft HCP is implemented. These minimization measures are expected to reduce waterbird powerline collisions by 90 percent in areas where powerlines and covered waterbirds occur until expiration of powerline diverter useful life. Under Alternative A, KIUC would not contribute $300,000 annually to the SOS program on Kauaʻi. Without annual contributions from KIUC, the SOS program may continue but would	KIUC's implementation of powerline collision minimization measures includes removal of static wire, removal of 69-kilovolt transmission line in Mānā, and installation of bird flight diverters. KIUC would also avoid construction of new transmission and distribution lines in high-collision zones in the Plan Area to the maximum extent possible. These minimization measures are expected to contribute to about a 90-percent reduction in powerline collision of covered waterbirds for powerline spans that occur in areas where the covered waterbirds occur. Because the span of powerlines that traverse the areas where waterbirds occur is a small portion (limited to the Mānā Plains and Hanalei spans) compared to KIUC's entire powerline system, Alternative B is likely to have significant beneficial but not adverse impacts on covered waterbirds with regard to	Under Alternative C, KIUC would implement additional minimization measures (e.g., additional powerline reconfiguration, static wire removal, flight diverter installation) to further minimize risk of waterbird collision with KIUC's powerlines. Because Alternative C includes activities covered under Alternative B, it would have similar impacts on covered waterbirds as Alternative B. Under Alternative C, KIUC would increase funding to the SOS program by 50 percent ($450,000) beyond the $300,000 proposed annually in the Draft. Because this increased funding for the SOS program would not result in additional waterbirds being brought in for rehabilitation due to non-KIUC sources (e.g., botulism, vehicle collisions) compared to Alternative B, it would likely not have an

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
likely not have adequate funds to keep staff and maintain the facilities at full capacity. The benefits of already established minimization measures and the fact that populations of all covered waterbirds are either stable or have been increasing over the last few decades (Paxton et al. 2022) on Kauaʻi suggest no significant impacts on the covered waterbird species' overall populations under Alternative A.	powerline collision avoidance and minimization measures. Under Alternative B, KIUC would contribute $300,000 annually to the SOS program. It is estimated that 920 individuals of the covered waterbirds would be killed by powerline collisions over the 50-year term of the Draft HCP and that the SOS program alone is expected to completely offset this loss by rehabilitating 2,500 covered waterbirds. Alternative B, therefore, is expected to have a long-term beneficial impact on the five covered waterbird species.	(adverse or beneficial) impact on the covered waterbirds. In addition to the activities covered under Alternative B, Alternative D conservation measures such as predator control would be expanded to hundreds of acres outside but in the vicinity of the conservation sites identified under Alternative B. Control of cats and barn owls that are known to prey on covered waterbirds is expected to have a slight beneficial effect on the covered waterbird populations. Furthermore, implementing conservation measures to control predators within the Mānā Plains area is expected to have a direct beneficial impact on covered waterbird species by increasing survival and reproductive success of listed waterbirds. Alternative D would also have significantly beneficial impacts on covered waterbirds compared to Alternatives A, B and C.
Reptiles: Honu (Green Sea Turtle)		
In locations where coastal streetlights are visible from suitable beach habitat, honu (green sea turtle) hatchlings may become disoriented by downward-facing lights on land and crawl toward these artificial light sources, where they may be eaten by predators or run over by cars, resulting in incidental take. Currently, measures implemented to minimize the impact of KIUC-operated streetlights on covered seabirds do not reduce streetlight visibility to honu (green sea turtle) hatchlings. KIUC has identified 29 KIUC-operated streetlights visible from suitable honu (green sea turtle) nesting habitat in the Plan Area as of 2020. Without minimization or mitigation, the number of honu (green sea turtle) nests	Under Alternative B, KIUC would implement a nest detection and shielding program to minimize and offset the effects of light attraction from KIUC streetlights on honu (green sea turtle). Nest shielding would initially be installed on seven beaches identified by KIUC, the Service, DLNR Division of Forestry and Wildlife, and State of Hawaiʻi DAR as having suitable nesting habitat and KIUC streetlights that have been documented as being visible from that habitat. KIUC assumes that monitoring and minimization measures conducted under Alternative B would result in take avoidance for honu (green sea turtle) nests and provide a net benefit for the species.	Additional powerline collision minimization, additional lighting minimization measures, and increased funding to the SOS program proposed under Alternative C would have no effect on honu (green sea turtle). Implementation of additional mitigation related to predator control under Alternative D would not alter adverse impacts on honu (green sea turtle) beyond those identified for Alternative B. Under Alternative D, KIUC would increase funding to KIUC's existing volunteer program by 15% to expand the outreach efforts to the public, expand the volunteer network, and implement a marine debris removal program for honu (green sea turtle), which would result in increased public awareness to maintain

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
affected by KIUC streetlights is expected to be less than one per year. Under Alternative A, incidental take of honu (green sea turtle) would continue to occur.		recommended distances from turtles and reduce marine debris entanglement hazards, which would have a long-term beneficial impact on the population.
Other State and Federally Listed Species		
Mammals		
Under the No Action alternative, KIUC's continued operation of existing and new infrastructure is unlikely to affect ʻōpeʻapeʻa (Hawaiian hoary bat, *Lasiurus semotus*), because powerlines do not pose a collision risk for the species and KIUC will implement measures that avoid affecting bats while conducting vegetation management near powerlines. ʻŌpeʻapeʻa (Hawaiian hoary bat) may be drawn to outdoor lighting to forage on a concentration of flying insects. However, this light attraction is benign and may be beneficial to ʻōpeʻapeʻa (Hawaiian hoary bat) because it facilitates the congregation of a food source. Because ʻīlio-holo-i-kauaua (Hawaiian monk seal, *Neomonachus schauinslandi*) is not attracted to artificial lighting and does not come in contact with other KIUC infrastructure, it is not likely that ʻīlio-holo-i-kauaua (Hawaiian monk seal) would be affected by KIUC's operation of existing (with modifications) or new infrastructure.	Management actions proposed under Alternative B have the potential to affect ʻōpeʻapeʻa (Hawaiian hoary bat) if woody vegetation is removed for the construction of predator exclusion fences during the bat pupping/rearing season. However, KIUC would implement measures identified in the Draft HCP to ensure that take of ʻōpeʻapeʻa (Hawaiian hoary bat) does not occur in connection with vegetation management. With these operational controls in place, adverse impacts on ʻōpeʻapeʻa (Hawaiian hoary bat) are not likely. Management actions proposed under Alternative B to implement a honu (green sea turtle) nest detection (biological monitoring) and shielding program (installation of light-proof fencing around sea turtle nests) could be a source of disturbance for ʻīlio-holo-i-kauaua (Hawaiian monk seal), especially if a pup is present. However, because female ʻīlio-holo-i-kauaua (Hawaiian monk seal) are not known to pup on the seven beaches identified for the nest-shielding program and typically avoid areas with high levels of human activity for pupping, it is unlikely that the nest-shielding program will affect ʻīlio-holo-i-kauaua (Hawaiian monk seal) pupping. In the rare event where ʻīlio-holo-i-kauaua (Hawaiian monk seal) are present or pupping on beaches identified for the nest-shielding program and	KIUC's operation of existing or new powerlines or streetlights with additional minimization applied under Alternative C is not likely to affect ʻīlio-holo-i-kauaua (Hawaiian monk seal) or ʻōpeʻapeʻa (Hawaiian hoary bat). The terrestrial habitat used by ʻīlio-holo-i-kauaua (Hawaiian monk seal) is typically restricted to beaches along the coast and they are not known to be attracted to artificial lighting. As described under Alternative A, powerlines do not pose a collision risk for ʻōpeʻapeʻa (Hawaiian hoary bat); therefore, additional minimization to reduce collision risk for seabirds is not likely to affect ʻōpeʻapeʻa (Hawaiian hoary bat). Expanded minimization measures at the conservation sites as part of Alternative D would have similar potential affects on ʻōpeʻapeʻa (Hawaiian hoary bat) as described under Alternative B. With the operational controls identified in Appendix 1B, *Evaluation of Species Considered for Coverage*, of the Draft HCP in place, adverse impacts on ʻōpeʻapeʻa (Hawaiian hoary bat) are not likely. Increased honu (green sea turtle) outreach and implementation of a marine debris removal program under Alternative D could occur on the same beaches used by ʻīlio-holo-i-kauaua (Hawaiian monk seal) and could be a source of disturbance for ʻīlio-holo-i-kauaua (Hawaiian monk seal) if present. However, with

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
	honu (green sea turtle) nests are identified within 50 feet (15 meters [m]) of a ʻīlio-holo-i-kauaua (Hawaiian monk seal) or 150 feet (46 m) of a ʻīlio-holo-i-kauaua (Hawaiian monk seal) mother and pup, KIUC will contact and coordinate with DAR, NOAA, and the Service on the best approach to implement based upon the situation for honu (green sea turtle) nest shielding to avoid any disturbance or disruption to nearby ʻīlio-holo-i-kauaua (Hawaiian monk seal). Therefore, monitoring and the nest-shielding program are not anticipated to have adverse impacts on ʻīlio-holo-i-kauaua (Hawaiian monk seal).	implementation of the buffer distance recommended by NOAA and DLNR DAR, increased sea turtle outreach and marine debris removal are not likely to affect ʻīlio-holo-i-kauaua (Hawaiian monk seal).
Reptiles: Honuʻea (Hawksbill Sea Turtle)		
Honuʻea (hawksbill sea turtle, *Eretmochelys imbricata*) hatchlings may become disoriented by downward-facing lights on land and crawl toward these artificial light sources where they may be eaten by predators or run over by vehicles, resulting in incidental take. However, honuʻea (hawksbill sea turtle) inhabiting the Hawaiian Islands are rare with an average of fewer than 15 females documented nesting annually across the entire archipelago and only 0.1 percent of documented honuʻea (hawksbill sea turtle) nests on Kauaʻi (Gaos et al. 2021). Therefore, KIUC's operation of existing (with modifications) or new infrastructure would not affect honuʻea (hawksbill sea turtle).	Management actions proposed under Conservation Measure 5 to implement a honu (green sea turtle) nest detection and shielding program could have beneficial impacts on honuʻea (hawksbill sea turtle). Increased biological monitoring as well as installation of light-proof fencing around sea turtle nests would benefit honuʻea (hawksbill sea turtle) nests if present; however, given the extremely uncommon nesting of honuʻea (hawksbill sea turtle) in the Plan Area, monitoring and nest fencing are not likely to affect honuʻea (hawksbill sea turtle).	Alternative C is anticipated to have the same impact as Alternative B because this alternative involves the same activities as Alternative B with regard to listed honuʻea (hawksbill sea turtle). Additional powerline collision minimization and increased SOS program funding proposed under Alternative C would not affect honuʻea (hawksbill sea turtle). Increased funding for sea turtle monitoring and marine debris removal under Alternative D may have a beneficial impact for honuʻea (hawksbill sea turtle). Given the extremely rare nesting of honuʻea (hawksbill sea turtle) in the Permit Area, increased sea turtle monitoring and marine debris removal under Alternative D are not likely to affect honuʻea (hawksbill sea turtle).
Birds		
Unlike the three covered seabird species, all other listed bird species typically fly during the day, with the exception of short-tailed albatross	As presented under Alternative A, effects on listed forest birds are not likely to occur. Short-tailed albatross may fly at night; however, this	The operation of powerlines with additional minimization as proposed under Alternative C is not likely to affect other listed bird species,

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
(*Phoebastria albatrus*). This, together with their acute vision, makes it unlikely that KIUC's existing or new infrastructure would affect these bird species, because they readily avoid colliding with utility lines and other powerline infrastructure. Although short-tailed albatross may fly at night, they are not known to collide with infrastructure. Short-tailed albatrosses may be affected by artificial lighting, limited to fishing vessels at night. Light attraction on land is expected to be less for short-tailed albatrosses than it is for the covered seabirds. Short-tailed albatrosses are not known to breed on Kauaʻi; while they may migrate through the Plan Area, they are considered rare and not a resident species. Therefore, it is not likely short-tailed albatrosses would be affected by light attraction on Kauaʻi.	species is not known to collide with infrastructure, but is subject to light attraction. KIUC has installed full-cutoff shielded fixtures on existing streetlights, which would apply to new streetlights under Alternative B. This reduces light attraction for the species. Given this measure and the rarity of the species on Kauaʻi, light attraction effects on short-tailed albatross are not likely to occur. Under Alternative B, management actions proposed under Conservation Measure 4, including predator control, to manage and enhance seabird breeding habitat and colonies at conservation sites are not likely to affect other listed birds. Of the four listed forest birds, only puaiohi (small Kauaʻi thrush, *Myadestes palmeri*) has been documented to have been unintentionally killed by a Goodnature A24 trap for rodents (Shiels et al. 2022). However, the four listed forest birds are not known to be present within the conservation sites. Therefore, it is unlikely that any of these species would accidentally be caught in a predator trap within the conservation sites. KIUC would implement minimization measures in the Avian Protection Plan (Appendix C). Listed forest bird species are unlikely to be affected by implementation of the conservation strategy in the Draft HCP.	because they have limited potential for interaction with KIUC infrastructure based on their distribution and typically fly during daylight. Similar to under Alternatives A and B, impacts from powerlines and lighting on short-tailed albatross under Alternative C are unlikely to occur because the species is not known to collide with infrastructure and is rare on Kauaʻi. Under Alternative D, construction of additional ungulate and predator exclusion fencing, weatherports, helicopter landing zones, and artificial burrows; implementation of predator trapping; and invasive species removal have the potential to adversely affect other listed forest-dwelling species through nest loss from vegetation clearing. To fully avoid effects on other listed birds, avoidance and minimization measures in the Avian Protection Plan (Appendix C) would be followed. With implementation of these avoidance and minimization measures, effects on other listed bird species are unlikely to occur.
Invertebrates		
KIUC's existing infrastructure does not occur within or near mesocaverns, caves, or streams inhabited by listed invertebrates (ʻuku noho ana [Kauaʻi cave amphipod, *Spelaeorchestia koloana*], peʻe peʻe paka ʻole [Kauaʻi cave wolf spider, A*delocosa anops*], Newcomb's snail (*Erinna newcombi*), *Drosophila sharpi*, and *D.*	As presented for Alternative A, there is no mechanism for impacts on listed invertebrates (ʻuku noho ana [Kauaʻi cave amphipod], peʻe peʻe paka ʻole [Kauaʻi cave wolf spider], Newcomb's snail, *D. sharpi*, and *D. musaphilia*) from this activity. Implementation of the Draft HCP conservation strategy under Alternative B	Additional measures to minimize powerline collisions and light attraction under Alternative C are unlikely to affect listed invertebrates because operation of powerlines and streetlights with additional minimization would not disturb the mesocaverns, caves, or streams inhabited by these species.

Alternative A: No Action	**Alternative B: Proposed Action**	**Alternative C and Alternative D**
musaphilia). It is assumed that new infrastructure would avoid these habitats; therefore, Alternative A would not affect these species.	is not likely to affect listed invertebrates because management actions would not occur in mesocaverns, caves, or streams inhabited by listed invertebrates.	Implementation of additional mitigation under Alternative D is not likely to occur in mesocaverns, caves, or streams inhabited by listed invertebrates and Alternative D is not likely to affect listed invertebrates (ʻuku noho ana [Kauaʻi cave amphipod], peʻe peʻe paka ʻole [Kauaʻi cave wolf spider], Newcomb's snail, *D. sharpi*, and *D. musaphilia*).
Plants		
There are more than 100 listed plants in the Plan Area as well as multiple rare species. KIUC's operation of existing and new infrastructure does not require ground disturbance; therefore, state- or federally listed plants would not be trampled or removed. Alternative A would not affect these species.	Construction of predator exclusion fence and artificial burrows, predator and invasive plant species removal, and seabird habitat enhancement as described under Conservation Measure 4 would result in discrete areas of vegetation clearing and ground disturbance at conservation sites. As described in the Draft HCP, multiple avoidance and minimization measures would be implemented as part of the proposed action to ensure conservation measures do not adversely affect listed plants (e.g., field surveys before finalizing fence alignments or locations for artificial burrows and before construction/installation to prevent damage or harm to rare plants). With incorporation of avoidance and minimization measures, effects from implementing Conservation Measure 4 are not likely to occur.	Operation of powerlines and streetlights with additional minimization, and additional funding for the SOS program, as part of Alternative C would not involve ground disturbance and would not affect listed plant species. Under Alternative D, vegetation and ground disturbance associated with construction of additional ungulate and predator exclusion fencing, artificial burrows, weatherports, and helicopter landing zones, as well as predator and invasive plant species removal and seabird habitat enhancement, have the potential to affect listed plant species. The Service and DLNR assume that the same avoidance and minimization measures incorporated into the proposed action would also be implemented under Alternative D to ensure conservation measures do not adversely affect listed plants. With implementation of these avoidance and minimization measures, additional mitigation under Alternative D would not be likely to affect other listed plant species. To the extent that fenced areas include rare and listed plant species, if listed plants occur within fenced areas, Alternative D may protect listed plants from depredation by rodents and degradation by ungulates and over the long term have beneficial impacts on listed plants.

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
Migratory Bird Species		
Migratory bird species including ʻaukuʻu (black-crowned night heron, *Nycticorax nycticorax*), kōlea (Pacific-golden plover, *Pluvialis fulva*), and pueo (Hawaiian short-eared owl, *Asio flammeus sandwichensis*) have been documented to collide with powerlines (Travers et al. 2023). Under Alternative A, these and other migratory bird species would likely be affected by powerline strikes, which could lead to adverse effects on those species. Light attraction has been documented to affect several migratory seabird species including ʻuaʻu kani (wedge-tailed shearwater, *Ardenna pacifica*), noio (black noddy, *Anous minutus melanogenys*), ʻou (Bulwer's petrel, *Bulweria bulwerii*), ʻaoʻū (Christmas shearwater, *Puffinus nativitatis*), koaʻeʻ kea (red-tailed tropicbird, *Phaethon rubricauda*), mōlī (Laysan albatross, *Phoebastria immutabilis*), and kaʻupu (black-footed albatross, *Phoebastria nigripes*). It is likely that these and other migratory seabird species would be adversely affected by light attraction. Under Alternative A, KIUC would not contribute $300,000 annually to the SOS program on Kauaʻi. Without annual contributions from KIUC, the SOS program may continue but would likely not have adequate funds to keep staff and maintain the facilities at full capacity and is not likely to offset the number of migratory birds taken by light attraction and/or collision with KIUC powerlines.	The operation of bird flight diverters on much of KIUC's powerline system would make those powerlines more visible to other bird species, further reducing the risk of collisions. Alternative B is likely to have a beneficial impact on migratory bird species in this regard. Under Alternative B, KIUC has already minimized light attraction by installing full-cutoff shielded fixtures for streetlights. Although not all migratory species are susceptible to disorientation or fallout, any measure that minimizes light visible to migratory bird species flying overhead will help reduce disorientation or fallout, and Alternative B is likely to have a beneficial impact on migratory bird species in this regard. Management actions proposed under Alternative B including predator exclusion fence construction, predator trapping, and invasive species removal have the potential to adversely affect migratory forest-dwelling species such as ʻapapane (*Himatione sanguinea*), Kauaʻi ʻamakihi (*Hemignathus kauaiensis*), and ʻanianiau (lesser ʻamakihi, *Hemignathus parvus*) through nest loss from vegetation clearing to construct fences. However, by following minimization measures in the Avian Protection Plan (Appendix C), this can be fully avoided. KIUC's proposed support of the SOS program under Alternative B may provide additional long-term benefits to migratory seabird species through the retrieval, evaluation, rehabilitation, and release of live individuals of these species.	Implementing additional measures as described under Alternative C to avoid and minimize collisions for birds is expected to have a beneficial impact on migratory species such as ʻuaʻu kani (wedge-tailed shearwater), ʻaukuʻu (black-crowned night heron), kōlea (Pacific-golden plover), and pueo (Hawaiian short-eared owl) that have been documented to collide with powerlines. Similarly, additional lighting minimization measures under Alternative C would likely benefit migratory seabird species such as ʻuaʻu kani (wedge-tailed shearwater), noio (black noddy), ʻou (Bulwer's petrel), ʻaoʻū (Christmas shearwater), koaʻeʻ kea (red-tailed tropicbird), mōlī (Laysan albatross), and kaʻupu (black-footed albatross), which are known to be affected by artificial light attraction. Additionally, increased funding for the SOS program is expected to have a significant beneficial impact on migratory seabird species such as ʻuaʻu kani (wedge-tailed shearwater), noio (black noddy), ʻou (Bulwer's petrel), ʻaoʻū (Christmas shearwater), koaʻeʻ kea (red-tailed tropicbird), mōlī (Laysan albatross), and kaʻupu (black-footed albatross) through increased search efforts and public outreach. Alternative D is expected to have similar effects on migratory bird species as Alternative B. Over the long term, the proposed increase of mitigation activities under Alternative D have the potential to benefit migratory seabird species by decreasing their risk of predation by removing introduced mammals (e.g., rats, cats, dogs) and barn owls and enhancing habitat quality by excluding ungulates (e.g., deer, goats, pigs). The native pueo (Hawaiian short-eared

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
		owl), as a ground-nesting bird, could benefit from the existence of a predator-free fenced area in which to breed.
Critical Habitat and Other Land Designations		
KIUC powerlines, streetlights, and buildings mostly exist outside designated or proposed critical habitat and other land designations and have no direct impact on these areas, with the exception of KIUC streetlights that affect proposed critical habitat for honu (green sea turtle). While these streetlights are outside of proposed critical habitat for honu (green sea turtle), they exist near the coastline and compete with the natural light scape, which is critical to ensure the migration of honu (green sea turtle) hatchlings from their nest sites to the ocean. With multiple light sources, honu (green sea turtle) hatchlings become disoriented and do not find the ocean habitat that supports the next phase of their lifecycle or crawl landwards to artificial light sources, where they can be eaten by predators or run over by vehicles. KIUC has identified a total of 29 streetlights that are currently visible from honu (green sea turtle) nesting habitat. Under Alternative A, this impact decreases the availability and quality of suitable nesting sites in proposed critical habitat for honu (green sea turtle) and would continue to occur.	Under Alternative B, proposed management actions at conservation sites would affect designated critical habitat for several species, primarily plants. All seabird conservation sites under Alternative B are within designated or proposed critical habitat; proposed management activities would result in habitat modification and direct impacts on critical habitat including removal of critical habitat by clearing vegetation for the installation of fencing, artificial burrows, weatherports, and landing zones and causing ground disturbance. KIUC would implement best management practices (BMP) during construction and maintenance of fences to reduce the risk of soil compaction, erosion, runoff, and sedimentation. Over the long term, beneficial impacts on critical habitat are anticipated because the fencing and predator removal would minimize degradation of critical habitat by rodents and ungulates. Management actions proposed under Alternative B to implement a honu (green sea turtle) nest detection and shielding program would also affect proposed critical habitat for honu (green sea turtles). The installation of light-proof fencing around sea turtle nests may be considered a short-term temporary impact on critical habitat because it would temporarily obstruct the pathway between nesting beaches and foraging grounds; however, given the temporary nature of fence installation, which will be removed after a nest hatches, and the	Under Alternative C, implementing additional measures to avoid and minimize collisions, additional lighting minimization measures, and additional SOS program funding is not likely to affect critical habitat and other land designations, because implementation of these measures is not expected to result in new ground disturbance, vegetation removal, or additional impacts. Alternative D would be anticipated to have similar but larger-scale impacts on critical habitat and other land designations as Alternative B. The increase in fencing would result in approximately 3.8 acres (1.5 hectares) of additional site clearing and an additional 0.4 acre (0.2 hectare) of ground disturbance for installation of fence posts and mesh skirt compared to Alternative B. Avoidance and minimization measures would be incorporated during these activities to prevent unintentional damage or harm to the essential physical and biological features of critical habitat. Over the long term, significant beneficial impacts on critical habitat and other land designations are anticipated because the fencing and predator removal would protect critical habitat from degradation by rodents and ungulates.

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
	low average nesting density of honu (green sea turtle), no significant effects on critical habitat are anticipated.	
Non-listed Flora		
KIUC's continue operation of existing and future infrastructure under Alternative A would not result in ground disturbance; therefore, non-listed flora would not be trampled or removed. In addition, the operation of infrastructure would not increase the presence or density of invasive plant species, feral ungulates, or pathogens, diseases, and insects that may affect non-listed flora. Therefore, there would be no impact on non-listed flora under Alternative A.	Under Alternative B, KIUC would implement a conservation strategy, including management actions proposed under Conservation Measure 4 to manage and enhance seabird breeding habitat and colonies at conservation sites. These activities have the potential to affect non-listed flora. Vegetation clearing and ground disturbance associated with construction of predator exclusion fence and artificial burrows, predator and invasive plant species removal, and seabird habitat enhancement have the potential to affect non-listed flora species. To the extent that native species occur within fenced areas, fencing would protect and enhance the plants' survival and propagation because fencing and predator removal would protect non-listed native flora from depredation by rodents and degradation by ungulates.	Alternative C would implement additional minimization measures on existing and new powerlines to reduce collision risk for seabirds, implement additional lighting minimization for existing and new streetlights to reduce light attraction for seabirds, and increase funding to the SOS program. Alternative C is anticipated to have the same impact on non-listed flora as Alternative B because the operation of KIUC's infrastructure with additional minimization and additional funding for the SOS program would not result in additional ground disturbance or fence construction that could disturb or benefit non-listed native flora. The increased mitigation effort proposed under Alternative D would result in impacts similar to those described under Alternative B, but over a greater area. As described for Alternative B, management actions to manage and enhance seabird colonies and breeding habitat have the potential to affect non-listed flora through ground disturbance, fencing, and invasive plant species removal. Ground disturbance from the construction of ungulate and predator exclusion fencing, weatherports, helicopter landing zones, and artificial burrows could adversely affect non-listed native flora while fencing, removal of invasive plant species, and predator control would protect non-listed native flora from depredation by rodents and degradation by ungulates. Overall, Alternative D would have the greatest potential to benefit non-listed native flora. Alternative D would actively

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
		remove invasive, nonnative flora to the benefit of other non-listed native and rare flora.
Non-listed Fauna		
Native Birds		
There is no evidence to suggest that existing KIUC infrastructure would affect non-listed native birds. No significant impacts on non-listed fauna species would occur under Alternative A.	Impacts on non-listed native migratory birds in the Permit Area are discussed under *Migratory Bird Species.*	Under Alternative C, implementing additional minimization measures on existing and new powerlines to reduce collision risk for seabirds, implement additional lighting minimization for existing and new streetlights to reduce light attraction for seabirds, and increase funding to the SOS program is not expected to result in new ground disturbance, vegetation removal, or additional impacts on non-listed fauna. Alternative C would be anticipated to have similar impacts to those of Alternative B on other fauna because this alternative involves substantially the same activities as Alternative B. Alternative D would be anticipated to have a similar but larger-scale impact on other fauna as Alternative B. Increased predator control and exclusion fence construction would likely benefit native bird species.
Native Invertebrates		
There is no evidence to suggest that existing KIUC infrastructure would affect non-listed native invertebrates. No significant impacts on non-listed fauna species would occur under Alternative A.	Under Alternative B, management actions proposed under Conservation Measure 4, including proposed predator exclusion fence or artificial burrow construction, predator control, invasive plant species removal, and seabird habitat enhancement, have the potential to affect native invertebrates due to habitat loss and disturbance. However, over the long term, beneficial impacts on native invertebrates would be anticipated because fencing would reduce disturbance from ungulates while enhancing invertebrate habitat; removal of	Under Alternative C, implementing additional minimization measures on existing and new powerlines to reduce collision risk for seabirds, implement additional lighting minimization for existing and new streetlights to reduce light attraction for seabirds, and increase funding to the SOS program is not expected to result in new ground disturbance, vegetation removal, or additional impacts on non-listed fauna. Alternative C would be anticipated to have similar impacts to those of Alternative B on other fauna because this alternative involves

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
	predators, such as rats and mice, would reduce predation.	substantially the same activities as Alternative B. Under Alternative D, increased ungulate and predator exclusion fencing, weatherports, helicopter landing zones, artificial burrow construction, invasive species removal, and predator trapping may result in habitat loss and disturbance for native invertebrates. Over the long term, beneficial impacts on native invertebrates would be anticipated because fencing would protect them from disturbance by nonnative ungulates while enhancing habitat and reducing predators such as rats and mice.
Nonnative Birds		
Under Alternative A, it is possible the SOS program would continue without annual contributions from KIUC, but may not have adequate funds to keep staff and maintain the facilities at full capacity; however, this is not expected to have a significant impact on non-listed fauna.	Under Alternative B, management actions proposed to manage and enhance seabird breeding habitat and colonies at conservation sites would be implemented to actively remove barn owls to benefit covered bird species. The removal of barn owls would likely also benefit other listed and native species. Alternative B would actively remove barn owls, which would benefit other listed and native species.	Under Alternative C, implementing additional minimization measures on existing and new powerlines to reduce collision risk for seabirds, implement additional lighting minimization for existing and new streetlights to reduce light attraction for seabirds, and increase funding to the SOS program is not expected to result in new ground disturbance, vegetation removal, or additional impacts on non-listed fauna. Alternative C would be anticipated to have similar impacts to those of Alternative B on other fauna because this alternative involves substantially the same activities as Alternative B. Alternative D would directly affect several nonnative bird species through increased predator control and exclusion fence construction to benefit covered bird species. Over the long term, significant adverse impacts on nonnative bird species are anticipated, but would benefit Covered Species, other listed species, and native species.

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
Nonnative Mammals		
There is no evidence to suggest that existing KIUC infrastructure would affect nonnative mammals. No significant impacts on non-listed fauna species would occur under Alternative A.	Under Alternative B, management actions proposed in Conservation Measure 4 to manage and enhance seabird breeding habitat and colonies at conservation sites would be implemented to actively remove nonnative mammal species that predate on seabirds (e.g., cats, rats, mice, pigs, goats) to benefit covered bird species. The removal of these species would likely also benefit other listed and native species. Alternative B would actively remove nonnative mammals that predate on seabirds, which would benefit other listed and native species.	Under Alternative C, implementing additional minimization measures on existing and new powerlines to reduce collision risk for seabirds, implement additional lighting minimization for existing and new streetlights to reduce light attraction for seabirds, and increase funding to the SOS program is not expected to result in new ground disturbance, vegetation removal, or additional impacts on non-listed fauna. Alternative C would be anticipated to have similar impacts to those of Alternative B on other fauna because this alternative involves substantially the same activities as Alternative B. Alternative D would directly affect several nonnative mammal species through increased predator control and exclusion fence construction to benefit covered bird species. Over the long term, significant adverse impacts on nonnative mammal species are anticipated, but would benefit Covered Species, other listed species, and native species.
Invasive Invertebrates		
There is no evidence to suggest that existing KIUC infrastructure would affect invasive invertebrates. No significant impacts on non-listed fauna species would occur under Alternative A.	Under Alternative B, management actions proposed in Conservation Measure 4 to manage and enhance seabird breeding habitat and colonies at conservation sites would be implemented to actively remove invasive feral bees to benefit covered bird species. The removal of feral bees would likely also benefit other listed and native species. Alternative B would actively remove feral bees, which would benefit other listed and native species.	Under Alternative C, implementing additional minimization measures on existing and new powerlines to reduce collision risk for seabirds, implement additional lighting minimization for existing and new streetlights to reduce light attraction for seabirds, and increase funding to the SOS program is not expected to result in new ground disturbance, vegetation removal, or additional impacts on non-listed fauna. Alternative C would be anticipated to have similar impacts to those of Alternative B on other fauna because this alternative involves

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
		substantially the same activities as Alternative B. Alternative D would include the active removal of feral bees to benefit covered bird species. The removal of feral bees would likely also benefit other listed and native species. Over the long term, significant adverse impacts on invasive insects are anticipated, but would benefit Covered Species, other listed species, and native species.
Hydrology and Soils		
KIUC's continued operation of existing and new infrastructure under Alternative A would not result in new sources of ground disturbance and there would be no new impacts on hydrology and soils.	Under the proposed action, the potential for adverse impacts on hydrology and soils would be primarily associated with the construction of new predator exclusion fences at two conservation sites (2,259 linear feet [688.5 m] of fence at Upper Limahuli Preserve PF and 4,294 linear feet [1,308.8 m] of fence at Upper Mānoa Valley PF), installation of artificial burrows, the maintenance of the four social attraction sites (Pōhākea, Honopū, Upper Limahuli, and Upper Mānoa Valley), and the replacement of fences up to two times each during the 50-year permit term. The construction of new fencing could alter drainage patterns, concentrate surface flows, and increase runoff quantities and velocities, which could promote soil erosion to a greater degree when compared to fence replacement activities that would occur within the same areas disturbed during the initial fence installation. Vegetation removal and soil compaction are likely to result from operation and maintenance activities associated with the conservation strategy, exposing soil to the erosive forces of rain and overland stormwater runoff and	Alternative C would result in similar impacts on hydrology and soils as Alternative B. Additional minimization measures associated with Alternative C would not result in additional ground disturbance, fence construction, maintenance, or change in invasive plant management when compared to Alternative B. Alternative D includes additional mitigation measures that could adversely affect hydrology and soils beyond those included in the proposed action by expanding predator control in an additional 1,394 acres (564 hectares) and increasing the area protected with ungulate fencing by 1,915 acres (775 hectares). Additionally, Alternative D would construct additional artificial burrows (at social attraction sites), landing zones, and weatherports to increase the total acreage of mitigation effort beyond what is included in Alternative B. As a result, Alternative D would result in greater impacts on hydrology and soils when compared to the other alternatives, although implementation of BMPs for erosion and fencing specifications as described in the Draft HCP conservation strategy could reduce potential impacts on hydrology and soils.

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
	causing indirect impacts beyond project footprints, especially in areas with steep terrain. KIUC would reduce the risk of soil compaction, erosion, runoff, and sedimentation by avoiding impacts on surface waters through the application of BMPs during construction and maintenance activities as described in Section 4.2.2.2 of the Draft HCP. Construction and maintenance equipment used to implement the conservation strategy could result in accidental spills or leaks of petroleum products such as gasoline and hydraulic fluid onto the ground surface, potentially contaminating soils or reaching surface waters if not properly contained and cleaned up, although the risk of a major spill is anticipated to be low.	Alternative D includes a mitigation measure for habitat management actions for the Mānā Plain wetlands that would result in greater beneficial impacts on hydrology, soils, and wetland function, when compared to the other alternatives, by focusing additional management on 50 acres (20 hectares) of land managed by DLNR for the restoration and conservation of wetlands.
Air Quality and Climate Change		
KIUC's continued operation of existing and new infrastructure under Alternative A would not result in new sources of air emissions and there would be no new impacts on hydrology and soils.	Vehicle and helicopter trips associated with implementation of the conservation strategy would produce exhaust emissions of criteria pollutants, volatile organic compounds, hazardous air pollutants, and greenhouse gases. Emissions from the internal combustion engines powering these vehicles and helicopters would add marginally to the volume of pollutants in the vicinity. These emissions would be temporally distributed over the permit term and would disperse substantially due to persistent northeast trade winds. There are no nonattainment or maintenance areas overlapping the Plan Area, and air quality is generally considered good on Kauaʻi. As a result, emissions from vehicle and helicopter trips associated with implementation of the conservation strategy are not likely to lead to a violation of ambient air quality standards or	Additional minimization measures associated with Alternative C would not result in any new potential sources of air pollutant emissions compared to Alternative B. As a result, Alternative C would be anticipated to result in similar impacts on air quality resources as Alternative B. Alternative D would be anticipated to result in similar impacts on air quality and climate change as Alternative B but would result in greater impacts on air quality from the approximately 78 additional helicopter trips annually throughout the 50-year permit term to implement additional mitigation measures. Because these additional emissions from helicopter trips would be distributed temporally over the permit term, localized geographically, and quickly dispersed, emissions associated with Alternative D are not

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
	have a noticeable impact on long-term air quality or climate change in the region.	likely to lead to a violation of ambient air quality standards.
Cultural Resources		
Modifications to existing and new infrastructure under Alternative A, such as powerline diverters already installed for minimization, would continue to have visual effects on historic resources for the duration of their functional life. The visual impact of new powerlines would vary depending on the setting where new powerlines are sited and could range from being visually screened to being visually prominent. Existing fences and weatherports would not have effects on cultural resources because there is a lower expected occurrence of cultural sites above the 500-foot (152.4-m) elevation where the conservation sites are located.	Under the proposed action, the potential for adverse effects on cultural resources would be primarily associated with the surface disturbance associated with construction of new predator exclusion fences at two conservation sites (2,259 linear feet [688.5 m] of fence at Upper Limahuli Preserve PF and 4,294 linear feet [1,308.8 m] of fence at Upper Mānoa Valley PF), installation of artificial burrows at two social attraction sites (Upper Limahuli Preserve PF and Upper Mānoa Valley PF), installation of two up to 500-square-foot (46.5-square-m) weatherports at Upper Mānoa Valley, and maintenance of the four social attraction sites (Pōhākea PF, Honopū PF, Upper Limahuli PF, and Upper Mānoa Valley PF). Impacts on cultural resources are not expected to occur due to the limited extent of proposed ground disturbance combined with a predicted low density of historic properties in the interior areas where the conservation sites are located. The visual impact of new powerlines would vary depending on the setting where new powerlines are sited and could range from being visually screened to being visually prominent. Visual effects from the modification of powerlines and lights present a minimal change to existing infrastructure. These modifications are visible but would likely be indistinguishable by the casual observer. The degree of contrast of the visual modifications to the landscape would be nonexistent or minimal; therefore, it is unlikely that visual effects would alter characteristics of historic properties	Under Alternative C, the operation of existing and new powerlines with additional collision minimization and the operation of existing or new streetlights with additional lighting minimization would not result in new sources of ground disturbance and would result in a change to existing infrastructure that would likely still be indistinguishable to the casual observer compared to Alternative B. As a result, the impacts of Alternative C on cultural resources would be similar to the impacts of Alternative B. Ground disturbance under Alternative D would be greater than under Alternatives B and C. However, similar to the other alternatives, impacts on cultural resources are not expected to occur under Alternative D due to the overall limited extent of proposed ground disturbance combined with a predicted low density of historic properties in the interior areas where the conservation sites are located. Similarly, there are no anticipated visual effects from additional mitigation because the archaeological site distribution is relatively low in upland areas above 500 feet (152.4 m) elevation where these actions would occur.

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
	qualifying them for inclusion in or eligibility for the National Register of Historic Places, assuming they were present. Implementation of the Covered Activities is not anticipated to affect the cultural, historical, and natural resources identified as cultural practices or beliefs in the Cultural Impact Assessment and Ka Paʻakai Analysis (Appendix D) because these activities would not affect the ability of people to participate in or access any of these resources or practices. Fencing that would be maintained under the Draft HCP's conservation strategy would not preclude access to state lands; subsistence activities such as hunting and gathering would remain permissible within fenced areas with appropriate permits, consistent with existing access rights irrespective of fencing. Implementation of the Draft HCP would further the protection of native seabirds and native plants identified as valued cultural, historical, or natural resources in the Permit Area (Appendix D, Section 9.2) and KIUC's proposed implementation of powerline collision minimization and lighting minimization for streetlights and facilities is consistent with the recommended feasible actions to be taken to reasonably protect Native Hawaiian rights (Appendix D, Section 9.2.3).	
Socioeconomics		
It is expected that future electric utility rates under Alternative A would be less than under Alternative B. KIUC would increase rates in the future under Alternative A to offset inflation, but there would not be a need to generate revenue and increase rates in response to implementation of future minimization actions	As described in Draft HCP Appendix 7B, future rate cases are likely as KIUC continues to recover costs associated with Draft HCP implementation and other operational needs, with estimates suggesting that the timing of future rate case requests could be as short as every 3 to 5 years, or as long as every 10 or	Under Alternative C, the impacts on electricity rates in Kauaʻi would likely exceed those of Alternative B due to the higher costs associated with implementing the additional minimization measures, resulting in higher utility rates for customers over Alternatives A and B as KIUC seeks to recover these costs. Any rate increases

Alternative A: No Action	**Alternative B: Proposed Action**	**Alternative C and Alternative D**
and conservation measures as under Alternative B. Any rate increases would disproportionately affect low-income households within KIUC's service area because the cost of utilities represents a larger proportion of household income in low-income households.	more years (ICF 2025). It is expected that future electric utility rate increases under Alternative B would be greater than under Alternative A. KIUC would need to generate revenue to offset both the cost of inflation and the cost of implementing the Draft HCP, whereas under Alternative A KIUC would only need to offset inflation. Any rate increases would disproportionately affect low-income households within KIUC's service area because the cost of utilities represents a larger proportion of household income in low-income households. Implementation of the Draft HCP under Alternative B would generate employment to maintain fencing and social attraction sites; to implement powerline minimization, predator and invasive species control, sea turtle nest detection and shielding, and the Draft HCP's monitoring program; and to staff the SOS program that the Draft HCP would fund. Employment generated by implementation of the Draft HCP would have beneficial impacts on income and tax revenue and benefit the local economy.	would disproportionately affect low-income households within KIUC's service area because the cost of utilities represents a larger proportion of household income in low-income households. Implementation of additional powerline minimization under Alternative C would generate a higher level of employment, income, and tax revenue compared to the proposed action that would benefit the local economy. Under Alternative D, the impacts on electricity rates in Kauaʻi would likely exceed those of Alternative B due to the higher costs associated with implementing the additional mitigation measures. The exact percentage increase is unknown, but the increases are likely to occur periodically over the life of the permit term. Any rate increases would disproportionately affect low-income households within KIUC's service area because the cost of utilities represents a larger proportion of household income in low-income households. Implementation of additional mitigation under Alternative D would generate a higher level of employment, income, and tax revenue compared to the proposed action that would benefit the local economy.
Public Infrastructure and Services		
Power Infrastructure		
KIUC's continued operation of existing and new infrastructure under Alternative A would not result new impacts on power infrastructure.	Under Alternative B, KIUC's island-wide powerline collision minimization plan will have already been completed prior to the start of the permit term, and the same or similar minimization techniques would be applied to all newly operated power lines throughout the duration of the 50-year permit term. The operation of powerlines with minimization	Under Alternative C, the operation of powerlines and streetlights with additional minimization and increased funding for the SOS program would not affect the reliability of KIUC's power generation, transmission, or distribution system and there would be no

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
	measures for avian collision and the operation of lighting for facilities, streetlights, and night repairs in a manner that would reduce light attraction would not affect the reliability and resilience of KIUC's power generation, transmission, or distribution within KIUC's service area.	impact on power infrastructure caused by implementation of additional minimization. Implementation of additional mitigation under Alternative D would not affect the reliability of KIUC's power generation, transmission, or distribution system and there would be no impact on power infrastructure.
Public Roadway System		
KIUC's continued operation of existing and new infrastructure under Alternative A would not result new impacts on the public roadway system.	The conservation sites at Honopū, Honopū PF, and Pihea would be accessed by vehicles for implementation of annual seabird monitoring, predator control, social attraction, and invasive plant species management. All compliance monitoring, take monitoring, and effectiveness monitoring for KIUC powerlines would also be conducted with vehicles. In total, an estimated 1,200 vehicle trips per year would be required to implement the Draft HCP under Alternative B. These vehicle trips would add to baseline levels of traffic on arterial highways and introduce reduced-speed truck traffic driving to transport fencing to helicopter departure points. Overall impacts on traffic would be negligible, with 1,200 vehicle trips per year equaling fewer than four trips per day on average. The traffic volume added as a result of implementing the Draft HCP would be less than 0.02 percent of the average daily traffic volumes of between 26,000 and 33,000 vehicles per day on the main arterial routes of Kaumualiʻi Highway and Kūhiō Highway. Volume-to-capacity ratios are not expected to change as a result of the additional vehicle trips needed to implement the Draft HCP.	Under Alternative C, the operation of powerlines and streetlights with additional minimization and increased funding for the SOS program would not increase the number of vehicle trips required for implementation of the conservation strategy or for annual monitoring of KIUC's powerlines, and impacts on public roadways would be similar to the impacts described for Alternative B. Additional mitigation effort under Alternative D would increase the number of vehicle trips required for the transport of staff and materials to areas where additional conservation effort would be directed. This would include additional vehicle trips for transporting staff and materials either directly to conservation sites or to helicopter departure points for subsequent transfer by helicopter to sites that are inaccessible by vehicle. Although vehicle trips would increase under Alternative D compared to Alternative B, given the low number of estimated vehicle trips (1,200 vehicle trips per year under Alternative B), the incremental increase in vehicle trips under Alternative D is not expected to result in impacts that are substantially different from those of Alternative B.

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
Public Transit System		
KIUC's continued operation of existing and new infrastructure under Alternative A would not result new impacts on the public transit system.	Implementation of the Covered Activities, conservation strategy, and monitoring program under Alternative B would not affect public transit systems on Kauaʻi because activities that could result in lane closures or relocation of bus stops are not proposed as part of the proposed action. As described above, the number of vehicle trips needed to implement the Draft HCP would be low compared to existing vehicle traffic. Level of service for bus transit routes is not expected to be affected by vehicle trips to implement the Draft HCP.	Under Alternative C, operation of powerlines and streetlights with additional minimization and increased funding for the SOS program would not increase the number of vehicle trips required for implementation of the conservation strategy or for annual monitoring of KIUC's powerlines, and impacts on public transit would be similar to the impacts described for Alternative B. Additional mitigation effort under Alternative D would increase the number of vehicle trips required for the transport of staff and materials to areas where additional conservation effort would be directed. This would include additional vehicle trips for transporting staff and materials either directly to conservation sites or to helicopter departure points for subsequent transfer by helicopter to sites that are inaccessible by vehicle. Although vehicle trips would increase under Alternative D compared to Alternative B, given the low number of estimated vehicle trips (1,200 vehicle trips per year under Alternative B), the incremental increase in vehicle trips under Alternative D is not expected to result in impacts that are substantially different from those of Alternative B.
Recreation		
Under Alternative A, KIUC would continue to operate its existing and new infrastructure without a comprehensive mitigation program. The Hanakāpīʻai, Hanakoa, North Bog, Pihea, Pōhākea, Pōhākea PF, Honopū, and Honopū PF conservation sites are open to public hunting and traditional gathering practices for	In the long term, the implementation of conservation measures under Alternative B would result in long-term beneficial effects on recreation associated with the enjoyment of natural resources by protecting wildlife and natural areas. Reducing bird collisions would benefit places like the Kīlauea Point National	The additional minimization measures under Alternative C would further reduce risks to seabirds and waterbirds as a result of population increases, with more opportunities for recreational bird watchers. Additionally, the 15-percent reduction in light emission using dimmers would better protect seabird

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
community members with valid permits and licenses; walkovers and gates on existing ungulate fences would continue to provide public access at these sites under Alternative A. However, existing ungulate fencing has reduced the abundance of game within fenced areas of the conservation sites, reducing hunting incentive in these areas where game animals such as feral pigs and goats have been reduced. Additionally, there is no hunting incentive within the Pōhākea PF and Honopū PF conservation sites because ungulates and predators are not present within areas fenced with predator exclusion fence, and public access is restricted within the areas maintained as social attraction sites. Under Alternative A, these conditions for public hunting access and recreation would continue and there would be no new impacts on recreational facilities or activities.	Wildlife Refuge, where birdwatching and photography are popular. Installing streetlights with full-cutoff shields would minimize light pollution, improving both wildlife protection and recreational facility lighting. Annual funding of the SOS program would support seabird rescue efforts, indirectly benefiting recreational activities such as birdwatching and wildlife photography. However, maintenance of existing ungulate exclusion fencing around the Hanakāpīʻai, Hanakoa, North Bog, Pihea, Pōhākea, and Honopū conservation sites could result in limited impacts on public hunting opportunities by reducing the abundance of pigs, deer, and goats in these areas. The implementation of conservation measures at all other sites would not affect public hunting, gathering practices, or other recreational activities because these areas are on private land, or are on private land not open to public hunting, or are already restricted access. The management and maintenance of the conservation sites could result in some temporary adverse effects due to helicopter noise on the recreational setting across the island and more specifically at the conservation sites when fences are being constructed or replaced and during regular transport of crews to conservation sites to implement the conservation strategy. Impacts of the implementation of the honu (green sea turtle) nest detection and shielding program described under Conservation Measure 5 on recreation would be short term and localized and would not restrict public access to beaches.	populations from light attraction, improving the overall environment for nature-based recreation. Potential effects on public hunting opportunities would be the same as described under Alternative B. Alternative C provides greater long-term benefits by further protecting natural resources found on Kauaʻi, resulting in greater beneficial effects on nature-based recreational experiences in the island's scenic and biodiverse areas compared to Alternative A or Alternative B. Under Alternative D, the impacts on recreation would be similar to those under Alternative B, but with increased short-term disruptions due to the implementation of additional mitigation measures, including expanded predator and ungulate control fencing in areas where expanded predator control or habitat management would overlap with state parks, the NAR, and preserves. In the long term, the increased areas enclosed by ungulate or predator exclusion fencing within the Hono O Nā Pali NAR would result in increased effects on recreational uses such as birdwatching, public hunting, and hiking when compared to Alternatives A and C. Expanded predator control, increased ungulate and predator exclusion fencing, and the construction of additional helicopter landing zones and weatherports would also result in a greater effects on public hunting opportunities and recreational uses when compared to Alternatives B and C. In the long term, Alternative D would provide enhanced benefits for nature-based recreation in the areas where additional mitigation is occurring, as well as other parts of the island that may benefit from the increased protections of Covered Species.

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
Scenic Resources		
The visual impact of modifications to existing and new powerlines under Alternative A would vary depending on the setting where new powerlines are sited and could range from being visually screened to being visually prominent.	The powerline retrofit measures described under Alternative B may make new powerlines minimally intrusive to scenic resources and reduce visual clutter, which would all result in beneficial impacts on scenic resources compared to Alternative A by making powerlines less intrusive. The use of the bird flight diverters could be considered a minor adverse impact on scenic views due to the use of reflective or LED diverters that make powerlines more visible to birds as well as humans. However, LED diverters are not installed along roadways and in visual sight of neighborhoods; therefore, the visual impacts from this type of diverter would be lower. The measures to minimize light pollution have beneficial scenic impacts by reducing light pollution and preserving night sky visibility especially in rural and less developed areas. The continued funding of the SOS program would have indirect beneficial impacts on scenic areas by supporting additional seabird rescue and rehabilitation and maintaining biodiversity in scenic regions such as the Nā Pali Coast, Waimea Canyon, and Hanalei Bay, preserving the natural beauty that attracts visitors to these areas. The construction of new fences and replacement of existing fences could have short-term temporary impacts on scenic resources in the direct vicinity of the conservation sites depending on viewer elevation and distance. Fence lines could be visible from farther away if the viewer is observing from a high-elevation lookout point, although vegetation screening would likely minimize impacts. The broader ecological	Under Alternative C, the impacts on scenic resources would be similar to those under Alternative B, but with increased visual disruptions due to the implementation of additional minimization measures such as additional reflective or LED flight diverters on high-risk powerline spans. However, LED diverters are not installed along roadways and in visual sight of neighborhoods; therefore, the visual impacts from this type of diverter would be negligible. In the long term, Alternative C would result in enhanced benefits to scenic resources that are enhanced by wildlife. Under Alternative C, the 15-percent reduction in light emissions using dimmers would result in greater reductions in light pollution, providing greater beneficial impacts on scenic resources in dark-sky and remote scenic areas. While there would be greater impacts on scenic resources from the implementation of additional minimization projects, Alternative C provides greater long-term benefits to scenic resources by further protecting natural resources across the island. Under Alternative D, the impacts on scenic resources would be similar to those under Alternative B, but with increased visual disruptions due to the implementation of additional mitigation measures. In the long term, the visual changes from predator control, fencing, weatherports, and helicopter landing zones would have negligible impacts on scenic resources, although they may be visible from some more remote recreation areas. The additional mitigation associated with Alternative D would provide enhanced

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
	improvements resulting from the conservation sites would result in long-term beneficial impacts that enhance the scenic value of the island's rural habitats and enhance the natural aesthetic and biodiversity of these regions. The sea turtle conservation measures would reduce light pollution near key coastal regions, resulting in a beneficial impact on scenic values by minimizing light pollution and preserving night sky visibility. Nest-shielding measures would have visual impacts on beachgoers; however, these are expected to be short term and localized to a small proportion of the total beach area. These measures would also result in long-term beneficial impacts on sea turtles, enhancing wildlife-based scenic resources.	beneficial impacts on scenic resources in areas where additional mitigation is occurring, as well as other parts of the island that may benefit from the increased protections of Covered Species. While short-term adverse impacts from the implementation of additional mitigation (e.g., fencing) may occur on scenic resources in remote areas, Alternative D would result in greater long-term beneficial impacts on scenic resources.
Land Use		
KIUC's continued operation of existing and new infrastructure under Alternative A would not result new impacts on land use. All conservation sites except for Upper Mānoa Valley PF would be established prior to issuance of the federal ITP and state ITL. Under Alternative A, there would be no obligation to maintain the conservation sites in the absence of the federal ITP and state ITL.	Implementation of the Covered Activities and conservation strategy under Alternative B would not temporarily or permanently change existing land ownership, land designations, or land uses. Predator control, predator exclusion fencing, social attraction, and invasive plant species management within the Upper Limahuli Preserve PF conservation site under Alternative B would result in beneficial effects on land use by supporting the objective of the Special (S) subzone (Limahuli Valley Special Subzone) and benefiting the natural resources of the area in the long term. Additionally, the conservation strategy under Alternative B would result in beneficial effects on land use by satisfying the following identified land uses in the Protective (P) and Resource (R) subzones under HAR § 13-5-22 and HAR § 13-5-24: *P-4, Removal of Invasive Species* and *D-1, Public Purpose Uses*. The conservation strategy under Alternative B	Alternative C would result in impacts on land use that are similar to those of Alternative B. Additional minimization measures associated with Alternative C would not temporarily or permanently change existing land ownership, land designations, or land uses compared to Alternative B. Alternative D would result in similar impacts on land use as Alternative B but could result in greater long-term beneficial impacts on state parks, preserves, and the NAR. Alternative D would contribute to the management goals and programs for the Hono O Nā Pali NAR and Kōkeʻe State Park, resulting in greater beneficial effects than Alternative B. Additionally, the expanded predator control, habitat management, waterbird population monitoring, and barn owl control within the Mānā Plain wetlands under Alternative D would be consistent with DLNR management goals for

Alternative A: No Action	Alternative B: Proposed Action	Alternative C and Alternative D
	would be consistent with, and complement, management guidance for the Hono O Nā Pali NAR, Nā Pali Coast State Wilderness Park, Kōkeʻe State Park, Nā Pali-Kona Forest Reserve, Limahuli Garden and Preserve, and National Tropical Botanical Garden. Therefore, Alternative B would result in long-term beneficial impacts on land use in these areas by supporting existing management programs to protect, maintain, and enhance natural resources. Under Alternative B, powerline operation, modification, use of night lighting for repairs, and lighting operations (facility lights and streetlights) are anticipated to occur within areas where county and/or state agencies have reviewed and approved plans and deemed that the activities are appropriate and consistent with existing land uses in the area.	the area and result in greater beneficial effects on 50 acres (20 hectares) of state-managed lands when compared to Alternative B.

Chapter 1
Purpose and Need

1.1 Introduction

This chapter provides an introduction (Section 1.1), a summary of the proposed action and decisions to be made (Section 1.2), the purpose and need for action (Section 1.3), consultation and coordination (Section 1.4), and public engagement (Section 1.5). This environmental impact statement (EIS) has been prepared to meet both federal and state environmental review requirements as described under applicable subheadings for the United States Fish and Wildlife Service (Service) and Hawai‘i Department of Land and Natural Resources (DLNR) in the sections below.

1.1.1 U.S. Fish and Wildlife Service

Kaua‘i Island Utility Cooperative (KIUC) developed the Draft *Kaua‘i Island Utility Cooperative Habitat Conservation Plan* (HCP; ICF 2025) to support an application to the Service for an incidental take permit (ITP). Under section 10 of the Endangered Species Act of 1973 (ESA) (16 United States Code [U.S.C.] 1539), state or local governments, private landowners, corporations, or other non-federal entities may be authorized, through issuance of a section 10(a)(1)(B) ITP, to conduct activities that may result in take of a threatened or endangered species as long as the take is incidental to, and not the purpose of, an otherwise lawful activity.

An application for incidental take authorization is supported by an HCP that describes, among other things, the anticipated effects of the proposed taking on listed species; how those effects on the species would be avoided, minimized and mitigated; and how the HCP implementation would be funded. As defined in section 3(19) of the ESA (16 U.S.C. 1532), “take” of listed endangered or threatened species means to “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” KIUC prepared a Draft HCP to address reasonably certain incidental take of eight federally listed seabirds and waterbirds and one federally listed sea turtle.

The Service prepared this Draft EIS according to the requirements of the National Environmental Policy Act (NEPA), 42 U.S.C. 4321–4370 et seq.)[1]; the United States Department of the Interior’s NEPA Procedures (43 Code of Federal Regulations [CFR] 46); and the Service’s guidance for

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[1] Executive Order 14154, Unleashing American Energy (January 20, 2025), and a Presidential Memorandum, Ending Illegal Discrimination and Restoring Merit-Based Opportunity (January 21, 2025), require the Department of the Interior to strictly adhere to NEPA, 42 U.S.C. 4321 et seq. Furthermore, such Order and Memorandum repeal Executive Orders 12898 (February 11, 1994) and 14096 (April 21, 2023). Because Executive Orders 12898 and 14096 have been repealed, complying with such Orders is a legal impossibility. The Service verifies that it has complied with the requirements of NEPA, including the Department of the Interior’s regulations and procedures implementing NEPA at 43 CFR Part 46 and Part 516 of the Departmental Manual, consistent with the President’s January 2025 Order and Memorandum. The Service has also voluntarily considered the Council on Environmental Quality’s rescinded regulations implementing NEPA, previously found at 40 CFR Parts 1500–1508, as guidance to the extent appropriate and consistent with the requirements of NEPA and Executive Order 14154.

compliance with those laws, including the 2016 *Habitat Conservation and Planning and Incidental Take Permit Processing Handbook* (USFWS and NOAA 2016).

1.1.2 Department of Land and Natural Resources

The Board of Land and Natural Resources (BLNR) will process an application for an incidental take license (ITL) for the same eight species of seabirds and waterbirds and one species of sea turtle that were included in the federal ITP application and are also listed as threatened or endangered by the State of Hawaiʻi.

Take of species protected under state law (Hawaiʻi Revised Statutes [HRS] Chapter 195D) is prohibited unless authorized via an ITL issued by, and an HCP approved by, BLNR. Take defined under state law (HRS Chapter 195D) means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect endangered or threatened species of aquatic life or wildlife; or to cut, collect, uproot, destroy, injure, or possess endangered or threatened species of aquatic life or land plants; or to attempt to engage in such conduct. KIUC prepared a single Draft HCP to support both the federal ITP application and the state ITL application.

DLNR has determined that the Draft HCP's use of state lands and State Conservation District land for implementation of conservation measures proposed in the Draft HCP would trigger environmental review under the Hawaiʻi Environmental Policy Act (HEPA). Therefore, this EIS has also been prepared in accordance with HRS Chapter 343, *Environmental Impact Statements*, and Hawaiʻi Administrative Rules (HAR), Title 11, Chapter 200.1, *Environmental Impact Statement Rules*.

1.2 Proposed Action and Decisions to Be Made

1.2.1 Service

The Service will evaluate issuance of an ITP under section 10(a)(1)(B) of the ESA to authorize incidental take of nine federally listed species from specified Covered Activities proposed across the island of Kauaʻi over 50 years. As a condition of an ITP, an applicant must prepare and submit to the Service an HCP containing the following mandatory elements set forth under section 10(a)(2)(A) of the ESA and detailed further in ESA implementing regulations (50 CFR 17.22, 17.32):

- The impact that will likely result from the taking
- The steps the applicant will take to minimize and mitigate such impacts, and the funding that will be available to implement such steps
- The alternative actions to such taking the applicant considered, and the reasons why such alternatives are not being utilized
- Such other measures that the Service (under authority delegated by the Secretary of the Interior) may require as being necessary or appropriate for the purposes of the HCP

Subject to compliance with applicable Service general permitting requirements found at 50 CFR Part 13, the Service will issue an ITP if the application meets the following issuance criteria identified in section 10(a)(2)(B) of the ESA and the requirements of the associated ESA implementing regulations (50 CFR 17.22, 17.32):

- The taking of the listed species will be incidental to, and not the purpose of, carrying out an otherwise lawful activity.
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of the taking on the species.
- The applicant will ensure that adequate funding for implementation of the HCP will be provided.
- The applicant has provided procedures to deal with unforeseen circumstances.
- The taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild.
- Other measures required by the Service as being necessary or appropriate for purposes of the HCP will be implemented.

Under the ESA, once the Service determines that an ITP application is complete, the Service may implement one of the following options:

- Issue an ITP conditioned on implementation of the HCP
- Issue an ITP conditioned on implementation of the HCP as modified or supplemented by specified terms and conditions
- Deny the ITP application

The Service's decision will also be informed by the data, analyses, and findings in this EIS and public comments received on the Draft EIS and Draft HCP. The Service will independently document its determination in an ESA section 10 findings document, ESA section 7 biological opinion, and NEPA Record of Decision developed at the conclusion of the ESA and NEPA compliance processes. If the Service finds that all requirements for issuance of the ITP are met, it will issue the requested permit, subject to terms and conditions deemed necessary or appropriate to carry out the purposes of ESA section 10.

1.2.2 DLNR

The Hawaiʻi EIS process (HRS Chapter 343) and associated regulations (HAR Chapter 11-200) provide guidance to develop an informational document that discloses the environmental effects of a proposed ITL action; the effects of that action on the economic welfare, social welfare, and cultural practices of the affected community and state; the effects of economic activities arising out of the proposed action; measures proposed to minimize adverse effects; and the alternatives to the proposed action and their environmental effects. In this case, the trigger for HRS Chapter 343 compliance is the proposed use of state lands and Conservation District land for implementation of mitigation measures proposed in the Draft HCP. Conservation District lands were established to protect and preserve vital natural resources in Hawaiʻi, and are managed by DLNR, through the Office of Conservation and Coastal Lands. Use of these lands is conditional upon approval by BLNR. HRS Chapter 343 contains comprehensive environmental policy to encourage productive and enjoyable harmony between people and their environment, promote efforts that will prevent damage to the environment, and enrich the understanding of ecological systems and natural resources important to the people of Hawaiʻi.

HRS Chapter 6E (Historic Preservation) and its associated regulations (HAR Chapters 13-198 and 13-276) provide guidance for identifying, evaluating, and assessing the adverse effects of undertakings on cultural resources under state law.

HRS Chapter 195D (Conservation of Aquatic Life, Wildlife, and Land Plants) provides general agency authority to DLNR to conserve, manage, and protect indigenous Hawaiian species. This includes the authority to review and recommend approval of HCPs to BLNR, which also issues ITLs. DLNR is also authorized to acquire by purchase, donation, or otherwise lands or interests therein needed to carry out the programs relating to the intent and purpose of this chapter.

The role of the Endangered Species Recovery Committee (ESRC) (HRS 195D-25) is to serve as a consultant to BLNR on matters relating to endangered, threatened, proposed, and candidate species. ESRC reviews HCP permit applications and makes recommendations to BLNR on whether they should be approved, amended, or rejected. ESRC reviews any revisions to the HCP resulting from public comment and provides a recommendation to approve or deny the HCP/ITL application to BLNR. The BLNR process for review and approval of an HCP and issuance of the state ITL is a separate process but may occur in parallel with the federal process. HRS section 195D-4(g) establishes a process for permitting incidental take. After consultation with ESRC, BLNR may issue a take authorization in the form of a temporary license as part of an HCP to allow take otherwise prohibited if the take is incidental to, and not the purpose of, carrying out an otherwise lawful activity.

Pursuant to HRS 195D-21, BLNR, upon recommendation from ESRC, in cooperation with other stakeholders, after a public hearing on the island affected, and upon an affirmative vote of no less than two-thirds of its authorized membership, may enter into an HCP, if it determines that:

(A) The plan will further the purposes of Chapter 195D by protecting, maintaining, restoring, or enhancing identified ecosystems, natural communities, or habitat types upon which endangered, threatened, proposed, or candidate species depend within the area covered by the plan;

(B) The plan will increase the likelihood of recovery of the endangered or threatened species that are the focus of the plan; and

(C) The plan satisfies all the requirements of Chapter 195D.

Under HRS 195D-30, HCPs, ITLs, and subsequent actions authorized under those plans and licenses must be designed to result in an overall net gain in the recovery of threatened and endangered species in Hawaiʻi.

1.3 Purpose and Need

1.3.1 Service

The Service's purpose and need for the proposed federal action is to comply with its legal obligation to (1) process KIUC's request for an ESA section 10(a)(1)(B) ITP authorizing the incidental take of certain ESA-listed species in association with carrying out otherwise lawful KIUC activities; and (2) to either grant, grant with conditions, or deny the ITP request in compliance with section 10(a)(1)(B) and other applicable laws.

1.3.2 DLNR

The state needs to evaluate the environmental impacts associated with the use of state land, and land within a designated Conservation District, to implement the HCP supporting the issuance of an ITL, pursuant to HRS Chapter 343 (HEPA). Additionally, the purpose of the state action is to fulfill DLNR's authority under HRS Chapter 195D to consider KIUC's application for take of state-listed species for the Covered Activities in the Plan Area. The need for the state action is to respond to KIUC's request for an ITL and to either approve or deny the request.

1.4 Consultation and Coordination

A list of permits and approvals required for approval and implementation of the Draft HCP and a list of agencies consulted during development of the EIS are provided in Appendix A, *Agency Consultation and Coordination*.

1.5 Public Engagement

1.5.1 Public Scoping

On June 8, 2022, the Service published a Notice of Intent to Prepare an EIS (NOI) in the *Federal Register* (87 *Federal Register* 34897). All members of the public, including any interested parties, were encouraged to submit comments on the scope of analysis, alternatives, and suggestions on data or information to consider in the EIS. The scoping period ended on July 8, 2022.

Also on June 8, 2022, DLNR initiated a 30-day public scoping period for the EIS with publication of an Environmental Impact Statement Preparation Notice (EISPN) in *The Environmental Notice* and distribution of the HEPA EISPN by mail or email to the Hawaiʻi Documents Center (Hawaiʻi State Public Library), Lihue Public Library, government agencies, elected officials, and other stakeholders. See Appendix A, *Consultation and Coordination,* for the complete distribution list for the HEPA EISPN.

A virtual scoping meeting jointly hosted by the Service and DLNR was held on June 28, 2022, from 5:00 pm to 7:00 pm Hawaiʻi Standard Time. Consistent with HAR 11-200.1-23(d), the virtual scoping meeting included presentations, a question-and-answer session, and an opportunity to provide oral comments. The meeting was recorded, and a court reporter was also available to transcribe public comments; however, no public comments were made at the virtual scoping meeting.

The United States Environmental Protection Agency, Earthjustice, and three individuals provided comments on the NEPA NOI. Earthjustice and six state agencies responded to the HEPA EISPN; however; only Earthjustice and three state agencies provided comments. The other three state agencies responded that they either had no comments or no objection. Response to early consultation (scoping) comments is required under HEPA (HAR 200.1-24) but is not required by NEPA or the United States Department of the Interior's NEPA Procedures (43 CFR 46). The Service and DLNR considered all comments received on the NEPA NOI and HEPA EISPN during development of this Draft EIS. Comments received on the NEPA NOI and HEPA EISPN are summarized in

Appendix B, *Scoping Summary*. Consistent with HAR 200.1-24, KIUC has also responded to the specific comments received on the HEPA EISPN in Appendix B, Table B-1.

1.5.2 Public Review of the Draft HCP

Pursuant to HRS 195D-21, DLNR reviews the Draft HCP for consistency with state regulations on the take of listed species and publishes a notice of availability of the Draft HCP in *The Environmental Notice* for a 60-day public comment period. The availability of the Draft HCP was announced in the January 23, 2023, issue of *The Environmental Notice*, commencing a public review and comment period that ended March 24, 2023, and included a public hearing on Kaua'i on March 27, 2023. During the public review period for the Draft HCP, ESRC met to review and provide comments on the Draft HCP and conduct site visits. A total of eight public comment submissions were received during the comment period for the Draft HCP, including from the American Bird Conservancy, Earthjustice (written comments and testimony), Pacific Missile Range Facility, Pacific Rim Conservation, two ESRC members (Dr. Kawika Winter and Dr. Loyal Mehrhoff), and one individual. Comments received on the Draft HCP are posted and available for review at https://dlnr.hawaii.gov/wildlife/hcp/draft-hcps/. KIUC reviewed all written comments received during the comment period for the Draft HCP and all questions and comments from ESRC, DLNR, non-governmental organizations, and the public. The Draft HCP published concurrent with this Draft EIS incorporates the comments received on the Draft HCP published in January 2023, as well as continued collaboration and comments from the Service and DLNR.

Chapter 2
Alternatives

2.1 Introduction

This chapter presents NEPA and HEPA requirements for the development of alternatives to the proposed action (Section 2.1), describes alternatives analyzed in detail (Section 2.2), and describes alternatives considered but eliminated from detailed study (Section 2.3).

2.1.1 Service

NEPA section 102(C)(iii) and 43 CFR 46.415(b) require that an EIS consider a reasonable range of alternatives when evaluating the environmental effects of an action. Alternatives considered include, without limitation, those alternatives submitted by commenters during the scoping process. See Appendix B, *Scoping Summary*, for a summary of submitted alternatives, information, and analyses identified during scoping. Evaluation of the alternatives considered in this Draft EIS fulfills the Service's NEPA responsibility to provide alternatives that meet the purpose and need of the proposed action and address significant issues.

2.1.2 DLNR

Similarly, Hawai'i Administrative Rules (HAR) 11-200.1-24 directs that a Draft EIS should describe in a separate and distinct section the alternative of No Action as well as reasonable alternatives that could attain the objectives of the action. The Draft EIS should include a rigorous exploration and objective evaluation of the environmental impacts of all such alternative actions, with particular attention given to alternatives that might enhance environmental quality or avoid, reduce, or minimize some or all the adverse environmental effects, costs, and risks of the action. The alternatives analysis should be sufficiently detailed to allow the comparative evaluation of environmental benefits, costs, and risks of the proposed action and each reasonable alternative. For alternatives that were eliminated from detailed study, the Draft EIS should contain a brief discussion of the reasons for not studying those alternatives in detail.

2.2 Alternatives Analyzed in Detail

The EIS alternatives development process was a four-step process:

1. The Service and DLNR identified alternatives to screen, including alternatives raised during the 30-day public scoping period for the EIS, the state's 60-day public review period for the Draft HCP, or through internal deliberation. In addition, the Service and DLNR considered the alternatives to incidental take developed by KIUC and described in the Draft HCP.
2. The Service and DLNR screened the suggested alternatives to assess whether the suggested alternative would meet the purpose and need, would be technically and economically feasible, would have different impacts compared to the proposed action, and would contain sufficient detail to support a comparative evaluation.

3. Based on the results of Step 2, the Service and DLNR determined whether the suggested alternative should be carried forward as an EIS alternative analyzed in detail or be dismissed from detailed analysis.
4. The Service and DLNR then further reviewed the suggested alternatives carried forward for detailed analysis to determine whether suggested alternatives could be combined to create additional action alternatives for the EIS.

The alternatives analyzed in detail in this EIS are as follows:

- Alternative A: No Action
- Alternative B: Proposed Action
- Alternative C: Additional Minimization
- Alternative D: Additional Mitigation

Alternatives that were considered but eliminated from detailed study are discussed in Section 2.3.

2.2.1 Alternative A: No Action

The No Action alternative serves as a baseline for comparing the impacts of the proposed action and the action alternatives. Under Alternative A, the Service and BLNR would not issue take authorizations through an incidental take permit (ITP) to KIUC for the Covered Species described in Section 2.2.2.3 and the Covered Activities described in Section 2.2.2.4 (i.e., powerline operation, powerline modification, and lighting operations). Under the No Action alternative, KIUC would not implement the Draft HCP, the conservation measures currently being implemented by KIUC would cease, and the impact of KIUC's taking of ESA-listed species would not be mitigated.

Under Alternative A, there would be no obligation to maintain the conservation sites in the absence of the federal ITP and state ITL. KIUC would continue to operate its existing and new infrastructure to provide services to its customers in the Plan Area. These activities, including powerline operation, modification, and lighting operations, would continue to be subject to ESA and HRS Chapter 195D take prohibitions.

For analysis purposes, the Service assumes KIUC would operate and maintain existing and future infrastructure that is under its ownership or direct control including, without limitation, powerlines, support structures, and lighting, in accordance with historical practices. This includes the expansion of KIUC-owned infrastructure in accordance with current plans and trends on Kauaʻi.

The Service also assumes that existing physical modifications to KIUC-owned infrastructure that are designed to avoid or minimize the impact of KIUC's taking of listed species would remain in place and operational for their useful life. Those physical modifications are described in more detail under Conservation Measure 1 and Conservation Measure 2 in Section 2.2.2.5 and include:

- Reconfiguration of the vertical profile of existing powerlines to reduce the maximum wire height and reduce the number of wires in a vertical array[2]
- Removal of 69-kilovolt transmission line in Mānā[3]

[2] There are three reconfiguration projects identified in the Draft HCP.
[3] This activity is only proposed for the Mānā Plains area.

- Removal of existing static wires[4]
- Installation of bird flight diverters on powerlines[5]
- Retrofit of existing streetlights to minimize light attraction and reduce risk of seabird fledgling fallout (i.e., installation of full cut-off shield fixtures)[6]

Under the No Action alternative, any incidental take of ESA-listed species would not be authorized and KIUC would assume all legal risk for incidental take resulting from its activities. Unauthorized take would be expected to continue because there are no known practicably feasible means of avoiding all take from KIUC's current or future proposed activities. KIUC cannot obtain take coverage by instituting take minimization or mitigation measures that are not authorized through state and federal incidental take permitting processes. Under the No Action alternative, the impact of KIUC's taking of ESA-listed species would not be mitigated.

2.2.2 Alternative B: Proposed Action

Under Alternative B, the proposed action, the Service and BLNR would authorize incidental take of Covered Species from Covered Activities in the Permit Area including implementation of the conservation strategy over a 50-year permit term and described in the Draft HCP. Based on the information available at this time, the Service has identified the proposed action as its preferred alternative because it would best accomplish the purpose and need of the proposed action while fulfilling its statutory mission and responsibilities, giving consideration to economic, environmental, technical, and other factors. This section summarizes the Draft HCP Plan Area and Permit Area, permit term, Covered Species, Covered Activities, conservation strategy, and monitoring and adaptive management program. The full description of these can be found in KIUC's Draft HCP (ICF 2025).

2.2.2.1 Plan Area and Permit Area

The Draft HCP *Plan Area* consists of the entire island of Kauaʻi (Figure 2-1).

The *Permit Area* is the specific locations of all Covered Activities and conservation measures (i.e., the geographic area where the federal ITP and state incidental take license [ITL] apply); these locations are described below in Section 2.2.2.4, *Covered Activities*, and in Section 2.2.2.5, *Conservation Strategy*, and generally include the locations of KIUC's existing facilities (Figure 2-1), the conservation sites where conservation measures could be implemented for seabirds (Figure 2-5), and nesting beaches where conservation measures would be implemented for honu (green sea turtle, *Chelonia mydas*). Operation of new or extended powerlines (for transmission and distribution) is also a Covered Activity in the Draft HCP. The vast majority of new transmission lines and distribution lines would either be added to existing poles or placed on new poles adjacent to existing lines (i.e., in the same transmission line or distribution line corridor). However, there could

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[4] Including projects completed under the KIUC Short-term HCP (i.e., spans 328–342 from Waialo Road to Brydeswood, span 352 at Fujita Tap, and span 581 at Halewili Positron to Aepo Substation); excluding portions of the Powerline Trail.

[5] Including projects completed under the KIUC Short-term HCP (i.e., spans 244–254, 1.6 kilometers from the Waimea Bridge to Kaumakani, and spans 1196–1214, 2.9 kilometers from Moloaʻa to Kīlauea.

[6] Measure included in the KIUC Short-term HCP.

be future powerlines or streetlights outside existing corridors (at locations that are not yet defined) that would be covered by the Draft HCP and included in the Permit Area.

2.2.2.2 Permit Term

KIUC requested a 50-year permit term and take authorization because:

1. A 50-year permit term provides the regulatory certainty necessary to ensure it can continue to provide cost-effective electricity to its members.
2. The 50-year permit term represents the amount of time KIUC believes is necessary to implement the conservation strategy and achieve full offset of the impacts of the taking on the covered threatened and endangered species.
3. The Draft HCP can achieve an overall net gain in the recovery of the Covered Species over a 50-year period as required under HRS 195D-30.

2.2.2.3 Covered Species

Nine species are proposed for incidental take authorization in the Draft HCP and are referred to as *Covered Species* (Table 2-1). The Covered Species were selected based on their listing status and potential for incidental take as defined by the federal ESA and HRS Chapter 195D. Draft HCP Appendix 1B, *Evaluation of Species Considered for Coverage*, describes the evaluation process and rationale by which KIUC selected the Covered Species.

Table 2-1. Covered Species

English Name	Hawaiian Name	Scientific Name	Status[a] (Federal/State)
Newell's shearwater	ʻaʻo	*Puffinus newelli*	T/T
Hawaiian petrel	ʻuaʻu	*Pterodroma sandwichensis*	E/E
Band-rumped storm-petrel[b]	ʻakēʻakē	*Hydrobates castro*	E/E
Hawaiian stilt[c]	aeʻo	*Himantopus mexicanus knudseni*	E/E
Hawaiian duck	koloa maoli	*Anas wyvilliana*	E/E
Hawaiian coot	ʻalae keʻokeʻo	*Fulica alai*	E/E
Hawaiian common gallinule	ʻalae ʻula	*Gallinula galeata sandvicensis*	E/E
Hawaiian goose	nēnē	*Branta sandvicensis*	T/E
Green sea turtle[d]	honu	*Chelonia mydas*	T/T

[a] Status:
E = Listed as endangered under the federal ESA or HRS Chapter 195D.
T = Listed as threatened under the federal ESA or HRS Chapter 195D.
[b] Hawaiʻi distinct population segment.
[c] Proposed for downlisting to threatened in 2021. Final rule is still pending.
[d] Central North Pacific Region distinct population segment.

2.2.2.4 Covered Activities

The proposed action is the authorization of incidental take that would occur as the result of implementation of Covered Activities. The *Covered Activities*, as described in the Draft HCP, include three categories: (1) powerline operations including modifications, (2) lighting operations (facility lights and streetlights) and use of night lighting for repairs, and (3) implementation of the Draft HCP conservation strategy. These are summarized below as they are presented in the Draft HCP.

Powerline Operations

KIUC owns and operates overhead electric powerlines on Kauaʻi (Figure 2-1). The wire sizes and pole heights vary widely for each type of powerline depending on site-specific physical circumstances present along the powerline corridor (e.g., topography). Moreover, powerline configuration may switch from one type to another (and often back again) within distances of as little as a few hundred feet. This changeability makes it impossible to map the differences on a system-wide scale.

All overhead wires with the potential to cause take of Covered Species fall into one of the following three categories: (1) transmission wires, (2) distribution wires, and (3) communication wires (Figure 2-2). KIUC is seeking coverage for all existing and, after completing their construction, future KIUC overhead wires falling into one of these three categories and all existing and future KIUC supporting structures holding these overhead wires. Supporting structures include only poles, towers, lattice structures, and H-frames[7] (hereafter referred to as support structures). There are roughly 26,000 KIUC-owned support structures that support KIUC-owned and -operated overhead transmission wires, distribution wires, and communication wires.

Types of KIUC Overhead Wires

Transmission Wires: KIUC owns and operates 171.3 circuit miles (mi)[8] (275.7 kilometers [km]) of transmission lines. Transmission wires are typically raised between 59 feet (18 meters [m]) and 79 feet (24 m) above the ground, with the tallest lines more than 100 feet (34 m) above the ground (Figure 2-2). There are roughly 1,616 KIUC-owned support structures that support the transmission wires that can range in height from 30 to 110 feet (48.3 to 177 m). The transmission circuits are protected from lightning strikes by a wire mounted above the conductor wire, known as an overhead shield wire, span wire, static wire, or earth wire. The static wire, if present, is typically the highest wire and, because it is a smaller and lighter wire, it sags less than the conductor wires. The majority of static wire on KIUC's system has been removed as part of KIUC's minimization plan. As of May 2024, there are approximately 5.3 mi (8.5 km) of static wire remaining on the system, the majority of which (3.0 mi [4.8 km]) is north and south of the powerline trail.

A single transmission circuit is typically composed of three conductor wires (three phases) that can be on one or both sides of the pole and can switch back and forth. These wires are nearly always bare aluminum; often two circuits are mounted on a single pole. This configuration is common on the west side of Kauaʻi. However, on the east and north sides of Kauaʻi, transmission lines often include double circuits with six wires on alternate sides of the pole. Transmission wires can be arranged in three different types of arrays.

- Vertical arrays, where the conductor wires are immediately above one another on the pole (Figure 2-2)

[7] Poles and towers are columns or posts that are differentiated based on the type of material: poles are wood, and towers are steel. Lattice structures and H-frame structures are also currently part of the grid system and can be made of either wood or steel.

[8] A circuit mile is defined as 1 mile of either a set of alternating current three-phase conductors in an overhead or underground alternating current circuit, or one pole of a direct current circuit.

- Triangular arrays, where conductor cables are mounted on either side of the pole
- Horizontal arrays, where the lines are mounted on horizontal crossarms or post-type insulators, which is rare for transmission wires but more common for distribution wires

Distribution Wires: KIUC owns and operates 1,360 mi (2,189 km) of distribution lines. Distribution wires built on the same pole as transmission wires are always mounted underneath the transmission wires (termed an *under-build*; Figure 2-2a). Where transmission wires are not present, distribution wires are mounted on support structures that are 30 to 50 feet (12 to 15 m) tall (Figure 2-2b), often with under-build service circuits mounted below the distribution wires. Distribution circuits can range from two to four wires (i.e., one to three conductors and a neutral wire), depending on the requirements in the area. Distribution wires can be placed closer together than transmission wires because they carry a lower voltage. As with transmission lines, the distribution wires are arranged in a variety of ways depending upon each pole’s site-specific circumstances; it is common for distribution wires to be vertically spaced on alternating sides of the pole. Moreover, distribution circuits frequently change from one configuration to another over a short distance. In some instances, distribution wires owned by other public agencies or private entities are located on the same pole with KIUC distribution wires. The operation (i.e., presence) of distribution wires located on the same pole, but owned and operated by other entities, is not a KIUC-proposed Covered Activity in its Draft HCP.

Communication Wires. KIUC owns and operates approximately 70 mi (113 km) of communication lines. Communication wires are typically only present where transmission lines are also present but are not present in all transmission line locations. The communication wire, if present, is typically mounted below the transmission and distribution wires and is therefore typically the nearest wire to the ground (Figure 2-2a and Figure 2-2b). Because the communication wire consists of fragile fiber-optic cable, it is protected by a black plastic buffer tube. The buffer tubes may be different diameters depending on the length of the wire. In some cases, the communication wire is combined with the static wire and located at the top line in an array. These overhead fiber and static combined lines have been removed as part of KIUC’s minimization plan and have been replaced with a fiber cable mounted below the distribution layer.

Powerline Modifications

KIUC periodically modifies transmission lines and distribution lines in response to changes in electricity demand. In other cases, KIUC may modify powerline systems in response to changing land uses that might interfere with safe and reliable power delivery. In either instance, these powerline modifications are Covered Activities if they result in an increase in wire height, exposure of wires, or new powerlines on the landscape, as described below.

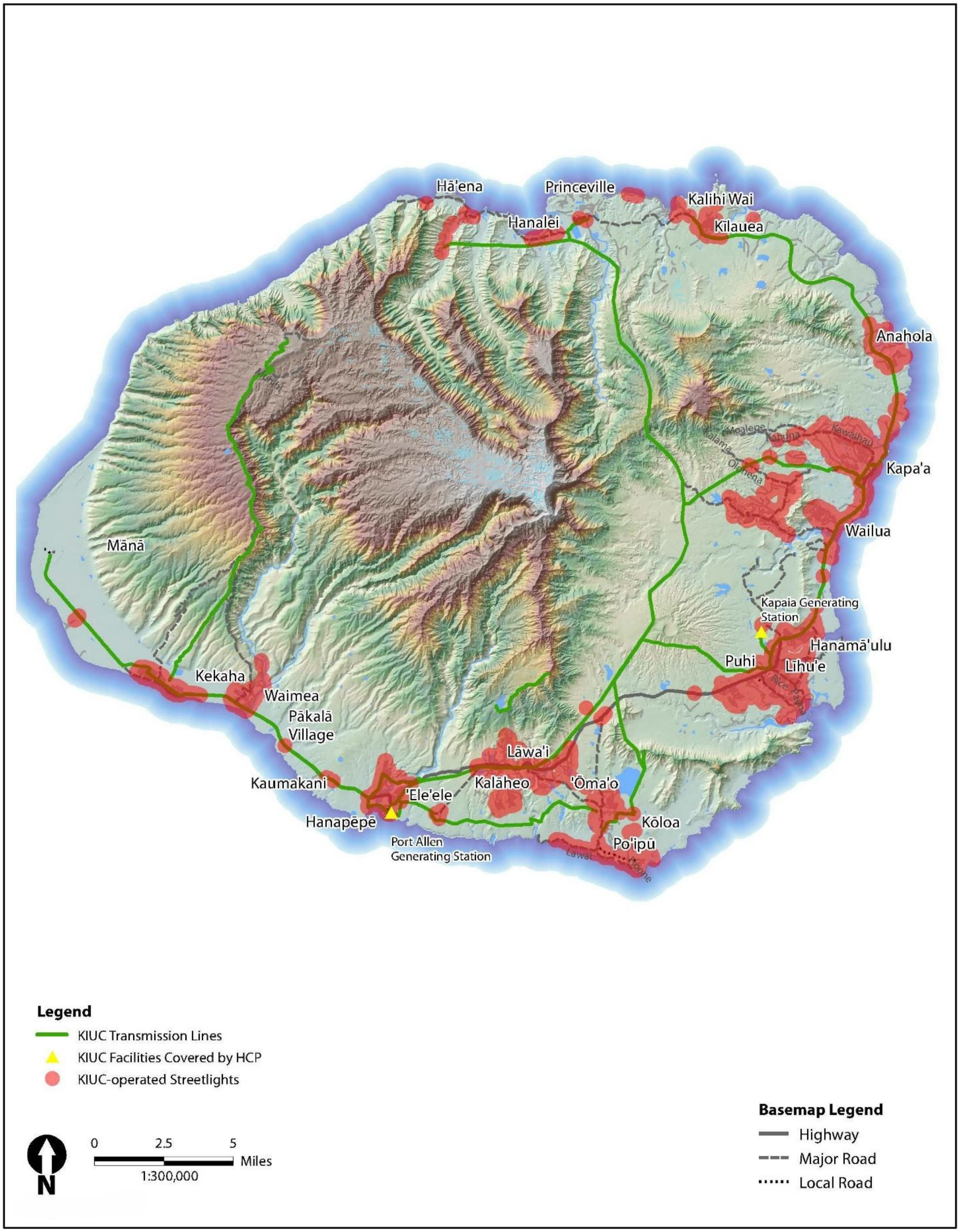

Figure 2-1. Plan Area and KIUC Existing Facilities

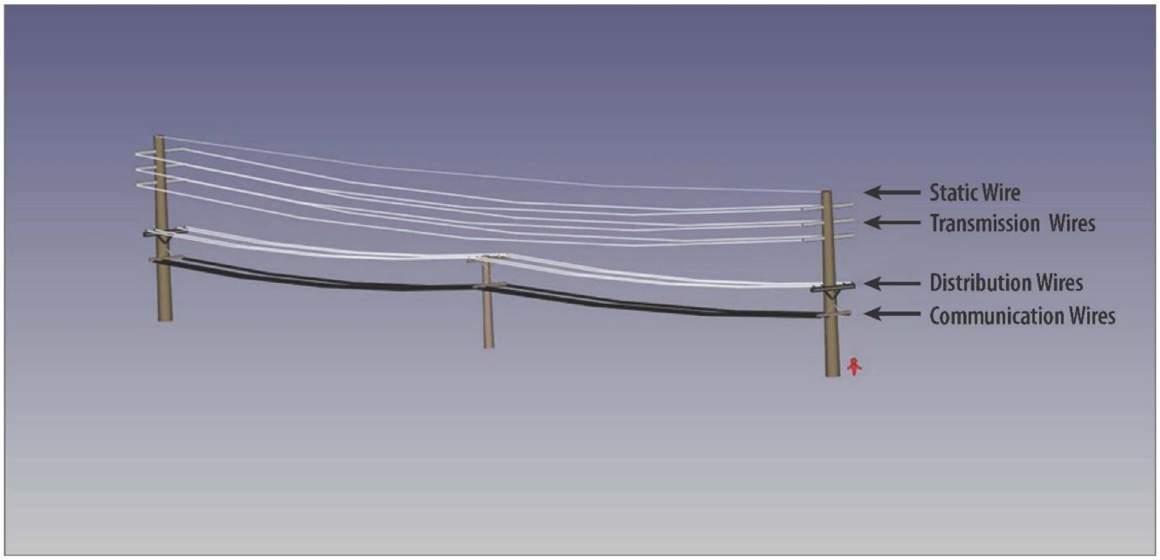

FIGURE 2-2a. Types of wires covered in the KIUC HCP, shown in a vertical array.

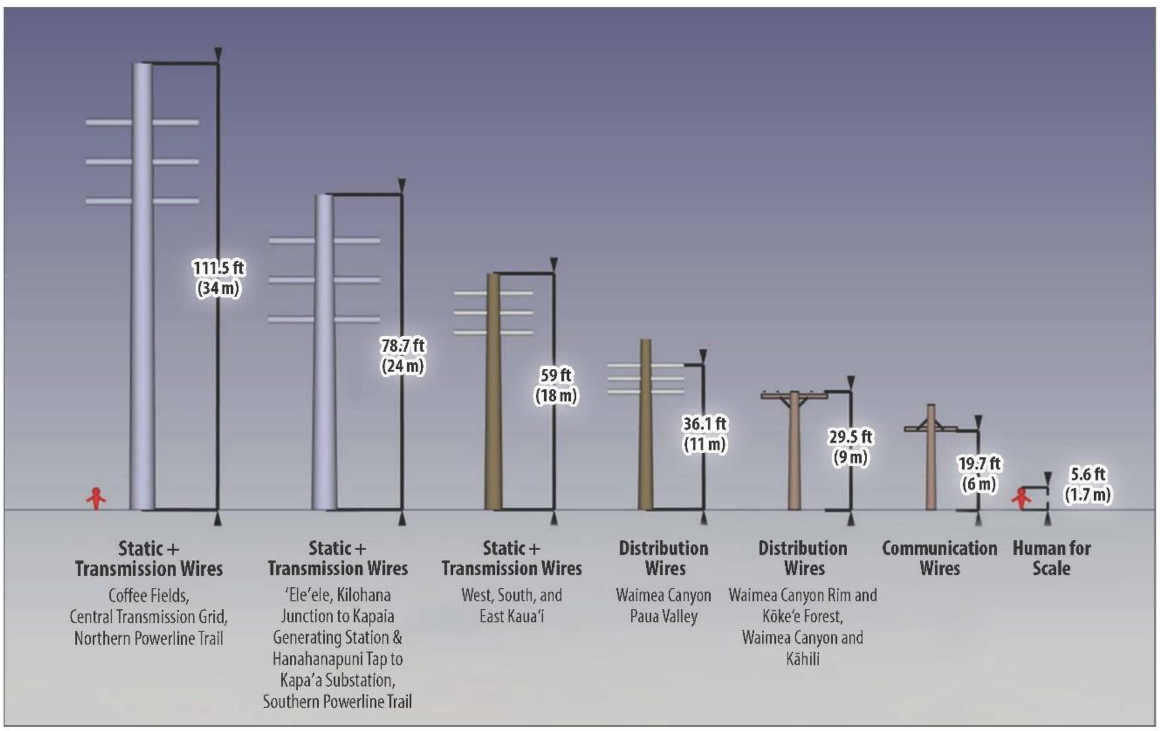

FIGURE 2-2b. Typical wire heights of KIUC transmission, distribution, and communication lines based on general location.

Figure 2-2. Typical Wire Types and Heights of KIUC Powerlines

Increasing Wire Height

KIUC increases wire height primarily to meet minimum clearance standards. For example, reconductoring, which replaces a smaller conductor with a heavier-duty one, is occasionally necessary to accommodate increasing electrical loads on the lines. To maintain a proper offset distance between the wires, the height of a heavier-duty line must sometimes be increased. KIUC estimates that over the 50-year permit term, 16 percent of its existing total transmission wire length (i.e., 27.2 mi [43.8 km]) will require wire height increases. This equates to an average of 0.54 mi (0.9 km) per year of wire modifications for 50 years.

Vegetation Management that Exposes Wires

Vegetation management is performed near powerlines to maintain adequate clearance. Vegetation management is a Covered Activity only when and where it exposes wires that were previously shielded by vegetation. The act of managing the vegetation is not a Covered Activity because it does not cause take of species proposed for incidental take authorization.

New or Extended Powerlines

When there is no additional capacity or space available on existing poles or towers, KIUC must construct new powerline corridors with new poles or towers. To save costs, improve efficiency of operations, and minimize visual impacts, KIUC strives to place these new powerlines in an existing right-of-way adjacent to existing power poles or towers. However, there are many cases where this is not feasible owing to narrow rights-of-way or land use constraints that do not allow a wider corridor. In these instances, KIUC would construct a new powerline (with new poles or towers) in a new right-of-way. In addition, there is a very remote chance that storm or other damage to existing powerlines is so severe that new powerlines in a new right-of-way may be required to restore service to an area.

KIUC will also need to expand the system of distribution lines to service new homes and businesses that are developed outside of the existing network of distribution lines. These expansions are expected to require extending existing distribution and/or transmission lines or building new transmission and/or distribution lines.

Operation of new or extended powerlines (for transmission and distribution) is a Covered Activity in the Draft HCP. As mentioned above, it is estimated that 360 mi (579.4 km) of new wires and support structures could be constructed over the 50-year permit term across KIUC's electric system. Construction of new powerlines is not a Covered Activity because construction activities are not expected to result in take of Covered Species. Once wires are in place (they do not need to be electrified), they are a Covered Activity under the Draft HCP.

Adding Wires to Existing Powerline Circuits

KIUC adds new powerlines into its existing electric system (i.e., on existing poles or towers and on existing support structures) to increase capacity, especially to carry additional electrical load during times of peak usage. New powerlines can provide redundancy in the system that reduce or prevent power outages for customers. New powerlines are expected in response to growing demand for power due to population growth. In addition, KIUC expects to install new powerlines to connect new power sources (e.g., new renewable generation stations) to the electric grid.

KIUC frequently adds new wires to the existing powerline circuits to accommodate growth in demand and to increase redundancy in the system. In some cases, KIUC can offset the effects of the additional wires by changing the vertical arrangement to a horizontal (i.e., one-level) arrangement.

In all these cases, KIUC does not control where new demands for electrical service will arise. KIUC asserts that new electrical service is requested by the county, the state, or private developers. If the requested new electrical service cannot be provided through existing lines, new powerlines are installed to provide the requested electricity based on the request of a primary developer of the new power demand (e.g., a new residential development, a new commercial development, or a new power generation source).

Construction of new powerlines on existing powerline circuits is not a Covered Activity under the Draft HCP because construction activities are not reasonably certain to result in take of Covered Species. Once wires are in place (they do not need to be electrified), they are a Covered Activity under the Draft HCP. KIUC is requesting take coverage for the operation of new wires added to existing powerline circuits in locations that are currently unknown. KIUC estimates that over the 50-year permit term, a maximum of 360 mi (579.4 km) of new wires will be required; this represents a 24-percent increase from the existing 1,531 mi (2,464 km) of powerlines and would represent an average of 7 mi (11.3 km) per year for 50 years.

Lighting Operations

KIUC operates nighttime lighting at two of its facilities, for temporary emergency power outage repairs and for KIUC-owned streetlights. This section describes which facility lights, temporary outage repair lighting, and streetlights are covered by the Draft HCP.

Facility Lights

Operation of facility lights at the Port Allen Generating Station and the Kapaia Power Generating Station (Figure 2-1) is a Covered Activity. Both facilities maintain night lighting for operations, visibility of personnel, and safety.

The Port Allen Generating Station is at Port Allen east of Hanapēpē. Facility lighting at the Port Allen Generating Station includes 29 KIUC-owned lights mounted on poles and placed throughout the facility and eight lights mounted on building walls. In September 2019, the existing 150-watt high-pressure sodium streetlights were retrofitted with 41- and 90-watt white light-emitting diode (LED) bulbs, allowing output to be dimmed while still maintaining visibility for staff. In addition, the eight wall-mounted lights were retrofitted with shielded wall-mounted white LED box lighting.

The Kapaia Power Generating Station is approximately 1 mi (1.6 km) northwest of the town of Līhuʻe. Lighting consists of KIUC-owned streetlights and building lights placed throughout the facility in the parking lot and outdoor work areas. The streetlights consist of 150-watt high-pressure sodium bulbs placed close to one another and relatively close to the ground. Each bulb is housed in a shield that completely covers the bulb except for the downward-facing glass. The design reflects all the light downward so that there is no upward lateral light transmission. The building lights use the same design concept but use a lower-wattage bulb.

Despite the light-attraction minimization efforts at the Port Allen Generating Station and Kapaia Power Generating Station, any KIUC infrastructure that produces light at night when the covered seabirds are fledging has the potential to cause fallout, resulting in incidental take. As such, the entire surfaces of the Port Allen Generating Station and Kapaia Power Generating Station are covered under the Draft HCP because seabird fallout may occur anywhere within the approximately 9-acre (3.6-hectare) and 14-acre (5.7-hectare) stations, respectively.

Night Lighting for Repair of Facilities

When equipment failure or powerline damage occurs, KIUC must restore power to its customers as quickly as possible.[9] For the purpose of restoring power, KIUC may need nighttime lighting in order to ensure worker safety during repair or replacement of existing powerlines (in cases where the damage is too extensive to utilize the existing infrastructure), support structures, and substations. While repair work at night due to outages is rare, KIUC is requesting take coverage for the use of night lighting for emergency repair work that occurs during the seabird fallout season (September 15 to December 15) over the 50-year permit term. This emergency nighttime lighting coverage applies for repairs to, or replacement of, existing or new powerlines, support structures, and substations. Substations are not a Covered Activity but, in the event that repairs at substations are required to restore power outages and require nighttime lighting, the nighttime lighting is a Covered Activity.

Restoration of power takes on average 1 hour to complete and night lighting is operated for approximately half of that time. The first half-hour is typically used to troubleshoot and set up, and the last half-hour is used to perform the repair using lights. Based on records of past outages, KIUC estimated an average of 1.7 hours per year of emergency nighttime lighting to be necessary during the covered seabird fallout season (September 15 to December 15). This equates to 85 hours total nighttime lighting use over the 50-year permit term with the potential to take covered seabirds.

Streetlights

Existing Streetlights

KIUC owns and operates approximately 4,150 streetlights under agreements with the state, County of Kauaʻi, and private entities, which includes those at KIUC facilities (Figure 2-1). All lights operated by KIUC are under its ownership. Most of these lights are on poles and towers that also carry electric lines, but some of the lights are stand-alone fixtures on their own stanchions. All lights are switched on and off at sunset and sunrise automatically by photosensitive switches installed in individual lights. As of 2017, all KIUC streetlights were converted from high-pressure sodium to more energy-efficient LED bulbs, and of these approximately 75 percent are 41-watt bulbs and approximately 25 percent are 90-watt bulbs. All of KIUC's streetlights have full-cutoff shielded fixtures. Full cutoff shielded fixtures are designed to direct the light downward and outward, rather than upward toward the sky.

Operation of existing KIUC streetlights is a Covered Activity because they contribute to the lightscape on Kauaʻi. For a streetlight to be considered operational under the Draft HCP, the light must be energized and operational (i.e., streetlight construction, prior to the light being energized and operational, is not a Covered Activity). Despite efforts to minimize the amount of upward directed light from KIUC streetlights, they may still result in fallout of a covered seabird fledgling, resulting in incidental take. In locations where coastal streetlights are visible from suitable beach habitat, honu (green sea turtle) hatchlings may become disoriented by downward-facing lights, resulting in incidental take.

[9] This does not include catastrophic events like Hurricane ʻIniki that threaten human life and property.

New Streetlights

KIUC expects to operate up to 1,754 new shielded streetlights along roadways on Kauaʻi over the 50-year permit term (an average of 35 new streetlights per year). Based on growth projections on Kauaʻi, the number of new streetlights is not expected to exceed 50 per year. As with all the existing streetlights on Kauaʻi, any new streetlights will also be equipped with full-cutoff shields.

Operation of future streetlights is a Covered Activity for the same reason as described above for existing streetlights. Construction of new streetlights is not a Covered Activity because installation of the streetlights is not expected to result in take of any Covered Species given that the light is not operational during construction. KIUC asserts that it has no authority over the siting of new streetlights because it is the secondary developer asked to provide electricity and install streetlights based upon the request of a primary developer.

Implementation of the Conservation Strategy

Activities related to implementation of the Draft HCP conservation strategy at the conservation sites may result in incidental take of the Covered Species. The conservation measures implemented at the conservation sites include construction and maintenance of predator exclusion fences, predator control within and outside of the predator exclusion fences, social attraction to attract covered seabirds to new nesting colony sites within the fenced areas, and selective invasive plant species control. These activities are further described in Section 2.2.2.5, *Conservation Strategy*.

2.2.2.5 Conservation Strategy

The Draft HCP conservation strategy includes biological goals and objectives for each Covered Species which broadly describe desired future conditions and how they would be achieved. It also includes conservation measures that KIUC would implement to avoid, minimize, and mitigate the impact on Covered Species from Covered Activities such that the impact of the taking is minimized and mitigated to the maximum extent practicable, as required under ESA section 10(a)(2)(B)(ii) and associated implementing regulations at 50 CFR 17.22 (endangered species) and 17.32 (threatened species), 50 CFR 222.25, 222.27, and 222.31, and HRS Chapter 195D. KIUC proposes to fully offset the impact of its taking and provide a net benefit through implementation of the Draft HCP conservation strategy.

Conservation Measures

KIUC would implement and fund six conservation measures as summarized below. Additional details of each measure can be found in Draft HCP Chapter 4, Section 4.4, *Conservation Measures*.

Conservation Measure 1. Implement Powerline Collision Minimization Projects

Minimization actions under this conservation measure include reconfiguration of powerlines (i.e., changing the profile from vertical to horizontal and reducing the number of layers, thereby reducing the maximum wire height), static wire removal, and installation of bird flight diverters to substantially reduce powerline collisions. Bird flight diverters are regularly spaced reflective or LED devices that make powerlines more visible to birds, reducing the number of collisions.

KIUC began implementation of powerline collision minimization projects in 2015 but completed the vast majority of planned minimization projects for existing powerlines between 2020 and May 2024. These powerline collision minimization projects include the installation of 113.2 mi (182.2 km) of flight diverters, removed 82.9 mi (133.4 km) of static wire, and reconfiguration of 7.8 mi (12.5 km) of powerline to reduce the maximum wire height, the number of vertical wire levels, and the vertical profile of wire arrays. These minimization measures were often installed in combination. Overall, approximately 127.3 mi (204.8 km) of KIUC powerlines have had minimization measures applied. Figure 2-3 and Figure 2-4 show the location of the three reconfiguration projects (C-CP1, C-CP2, and C-LC1), bird flight diverter, and static wire minimization projects identified in Draft HCP Appendix 4B, *KIUC Minimization Projects*. KIUC also buried approximately 0.5 mi (0.8 km) of distribution wires on Kāhili mountain as part of the KIUC Short-Term HCP[10] and removed a section of 69-kilovolt transmission line in Mānā as a system improvement project in 2023, which will further reduce powerline collision risk in those areas. Based on KIUC's powerline monitoring data, the estimated strike reduction by span ranges from 42 to 95 percent, depending on the minimization technique or combination of techniques applied.

Although all KIUC's island-wide plan of powerline minimization projects have been completed prior to the start of the Draft HCP permit term, minimization will continue to be an important tool throughout the permit term for new lines and for existing lines in situations where minimization is not as effective as estimated or where powerline monitoring indicates a significant increase in strikes compared with the estimated strike rate derived from the Bayesian model using powerline strike data collected between 2013 and 2019.

As described in Section 2.2.2.2, KIUC will need to construct new transmission and distribution lines during the 50-year permit term to provide power to new development on Kauaʻi. All new powerline installations would be planned and implemented while considering how operation of those installations would potentially affect Covered Species. The vast majority of new transmission lines and distribution lines would either be added to existing poles or placed on new poles adjacent to existing lines (i.e., in the same transmission line or distribution line corridor). Appropriate minimization would be deployed on new powerlines with the goal of achieving the greatest practicable level of reduction to potential strike risk in any given location. Standards for new powerlines include avoiding installation of static wire, minimizing powerline height and vertical wire levels, and installing bird flight diverters. To the extent practicable, KIUC would also avoid construction of new powerlines in high-collision zones (e.g., ridgelines, tops of slopes, between seabird colonies and the ocean) and avoid long powerline spans across valleys (i.e., perpendicular to valleys). KIUC, the Service, and DLNR have jointly developed a special review and approval process for any new powerlines (and streetlights) proposed in a specifically defined area of northwestern Kauaʻi that includes the conservation sites (see Draft HCP Appendix 4E, *Review of New Powerlines and Streetlights in Northwestern Kauaʻi*).

[10] KIUC buried these wires underground because the Underline Monitoring Program indicated that these very short powerlines (19.7–26.2 feet [6–8 m] above ground) had the highest collision rate on the island because the wires were mounted on a steep mountain ridge running directly through colonies of ʻaʻo (Newell's shearwater, *Puffinus newelli*) and ʻuaʻu (Hawaiian petrel, *Pterodroma sandwichensis*).

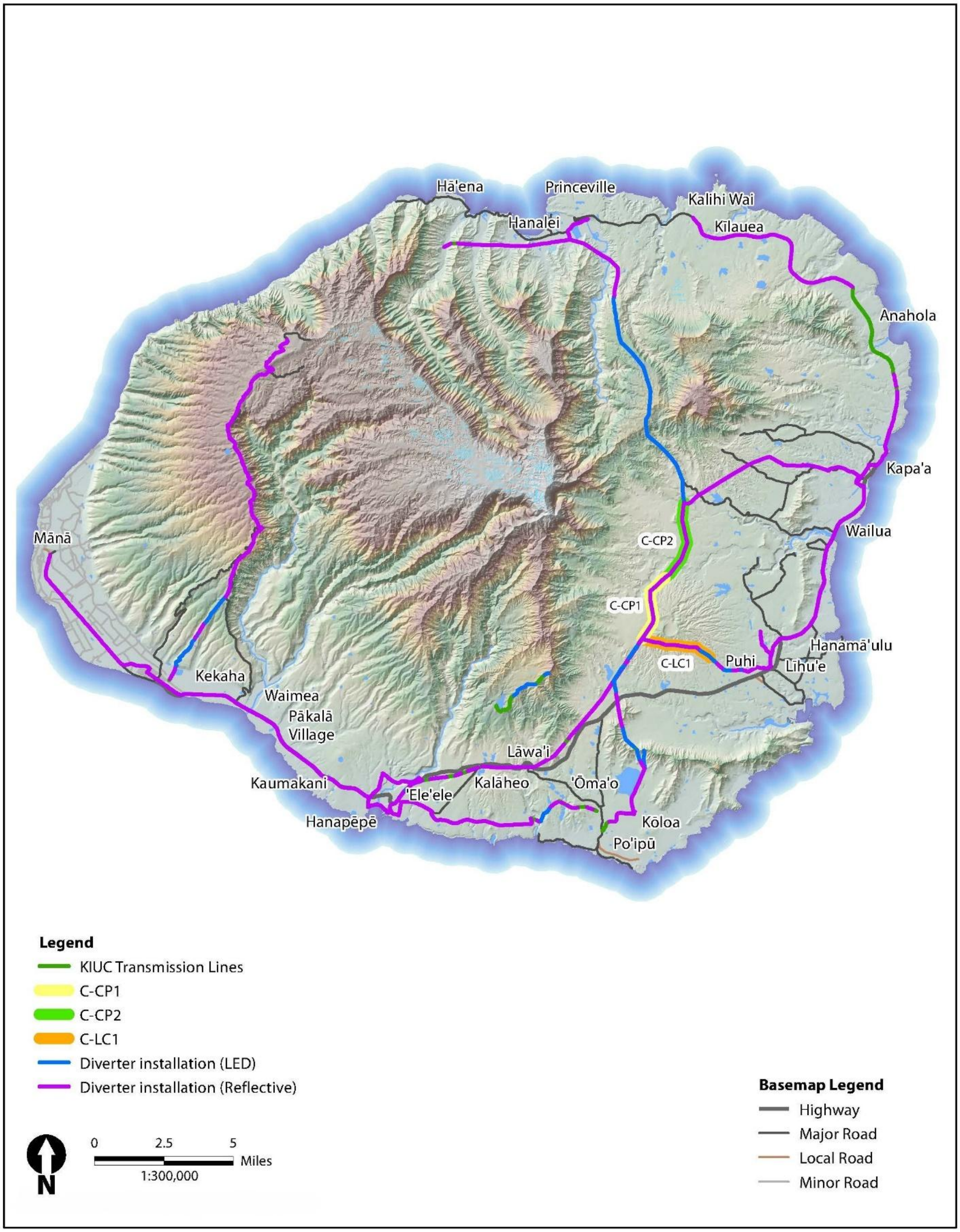

Figure 2-3. KIUC Powerline Reconfiguration Projects Implemented in 2020 with Bird Flight Diverter Installation Overlaid

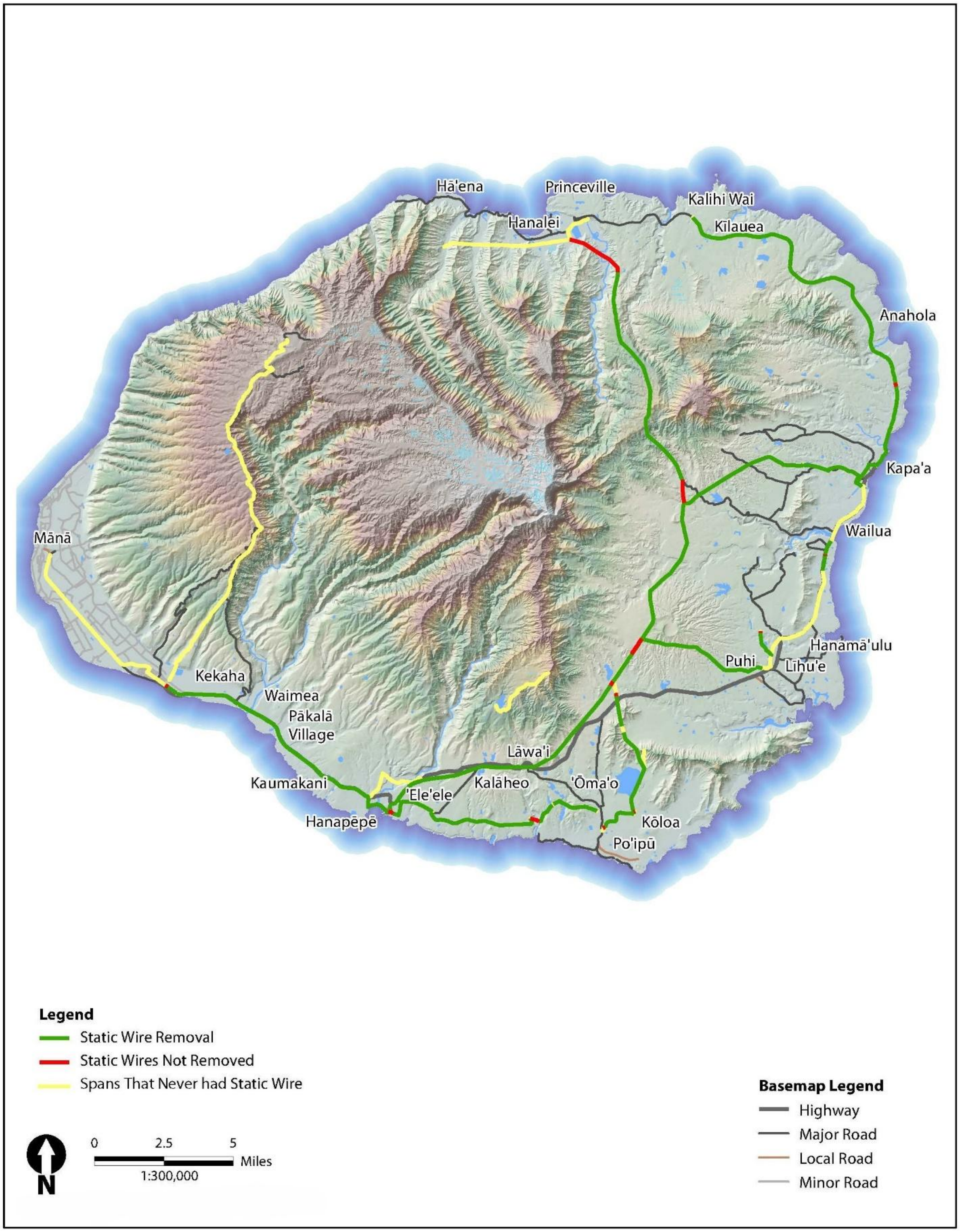

Figure 2-4. KIUC Wire Minimization Project Locations

Conservation Measure 2. Implement Measures to Minimize Light Attraction

Minimization actions under this conservation measure include installation of full-cutoff shield fixtures and dimming exterior night lighting during the fledgling fallout season. In 2017, all existing KIUC streetlights were retrofitted with full-cutoff shields to minimize light attraction, and all KIUC streetlights were converted from high-pressure sodium bulbs to more energy-efficient 3,000-kilowatt LED bulbs. In 2019, KIUC replaced all green light bulbs in streetlights with white light bulbs to further reduce light attraction. Light from all new streetlights during the permit term will be similarly minimized.

KIUC also operates night lighting at two facilities covered by the Draft HCP, the Port Allen Generating Station and the Kapaia Generating Station. In 2019, KIUC retrofitted all the exterior lights at the Port Allen Generating Station and the Kapaia Generating Station. At the Port Allen Generating Station, KIUC replaced its existing freestanding exterior facility lights with full-cutoff white LED lights and shielded wall-mounted white LED box lighting. Similarly, at the Kapaia Generating Station, all the 150-watt high-pressure sodium streetlights and building lights were shielded to direct light downward, away from the sky. Any new lights installed at the two covered facilities by KIUC during the permit term would utilize these same minimization features.

KIUC would continue to dim the exterior lighting at the Port Allen Generating Station during the fledgling fallout season (September 15 to December 15) to minimize light attraction. At the beginning of the fallout season, all exterior facility lights are dimmed to the lowest extent practicable. At the end of the fallout season, lights are returned to full brightness. Lights at the Kapaia Generating Station are not proposed to be converted to dimmable lights because the risk of fallout of covered seabirds from lights at the Kapaia Generating Station is extremely low. Interior building lights at both facilities would be turned off at night during the fledgling fallout season (September 15 to December 15) to avoid light attraction. If interior building lights must be turned on for any portion of the night, retractable screens or shades would be used to block lights from emitting from the building.

KIUC may also need to utilize artificial lighting during the seabird fallout season if power outages occur between September 15 and December 15. Nighttime lighting would only be used to respond to power outages and, if lights are used, they are necessary for the safety of workers and to conduct the required power restoration work. At work sites where nighttime lighting is required during these 3 months, KIUC would search for grounded birds after the work is completed according to the same protocol used at the covered facilities. KIUC would conduct annual training on how to search for and properly handle downed covered seabirds at the covered facilities.

This conservation measure only applies to the covered seabird species because they are the only Covered Species group affected by light attraction away from coastal locations.

Conservation Measure 3. Provide Funding for the Save our Shearwaters Program

KIUC began funding and largely implementing the Save our Shearwaters (SOS) program with DLNR in 2003. Under the Draft HCP, KIUC will fund the SOS program to a consistent level of $300,000 dollars per year (in 2023 dollars)[11] to rescue, rehabilitate, and release all covered seabirds and waterbirds found within the SOS program's operational area on Kauaʻi, regardless of the source of injury. Under the SOS program, grounded seabirds, waterbirds, and other native birds rescued by

[11] KIUC funding will increase annually to keep pace with inflation.

members of the public or businesses can be turned into SOS program staff. Injured birds are assessed, rehabilitated if possible, and released back into the wild by trained staff and volunteers and professional veterinary staff. All rehabilitation actions occur at an accredited animal rescue facility with extensive equipment and facilities for any necessary procedure to treat minor injuries or perform major surgery or treatment, including extended stays prior to release back into the wild. KIUC will also employ a public outreach and education program, in coordination with the SOS program, to inform and educate the public about the risks of powerline strikes and light attraction to the Covered Species on Kauaʻi. This conservation measure applies to covered seabirds and covered waterbirds.

Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites

KIUC will manage and enhance 12 conservation sites for the Draft HCP (Figure 2-5). Conservation sites are specific parcels in the Plan Area where KIUC would continue to implement management actions to increase the reproductive success of ʻaʻo (Newell's shearwater, *Puffinus newelli*) and ʻuaʻu (Hawaiian petrel, *Pterodroma sandwichensis*) breeding colonies, and to benefit ʻakēʻakē (band-rumped storm-petrel, *Hydrobates castro*) occurring in the region. Most of the 12 conservation sites that were selected for the Draft HCP are the same sites where KIUC has been funding predator control, seabird monitoring, and invasive plant species control annually since 2011 for the KIUC Short-term HCP and in the interim period between the KIUC Short-term HCP and commencement of the Draft HCP. All conservation sites except for Upper Mānoa Valley Predator Fence (PF) would be established prior to issuance of the federal ITP and state ITL. Management actions at conservation sites would include the following:

- Predator control measures would be implemented at all conservation sites and will be used to establish predator-free breeding habitat or substantially reduce predation. Predators include cats; rats and mice (rodents); pigs, deer, and goats (ungulates); feral bees; and barn owls. Terrestrial predator control methods may include deployment of cameras, various trap types depending on targeted species (e.g., cats, rats), bait stations, snares, hunting, and other control methods. Intensive predator control will be implemented at all sites without predator exclusion fencing. Intensive predator control creates a barrier through strategic placement of trapping and monitoring cameras along known routes and ingress points and around known seabird burrow locations.
- Predator exclusion fencing would be maintained that is impenetrable to most introduced terrestrial predators including feral cats, rats, pigs, and goats. KIUC will maintain existing predator exclusion fences at Pōhākea PF and Honopū PF. KIUC will construct two additional predator exclusion fences within the Upper Limahuli Preserve PF by 2025 and Upper Mānoa Valley PF by 2027, and maintain those fences for the remainder of the permit term. KIUC will maintain an existing ungulate fence at Honopū and an existing pig exclusion fence at Upper Limahuli Preserve. A number of other conservation sites are within a state Natural Area Reserve that is bordered by sections of ungulate exclusion fence that were constructed and are maintained by other entities and that are combined with steep terrain deemed unpassable by pigs (Figure 2-6).

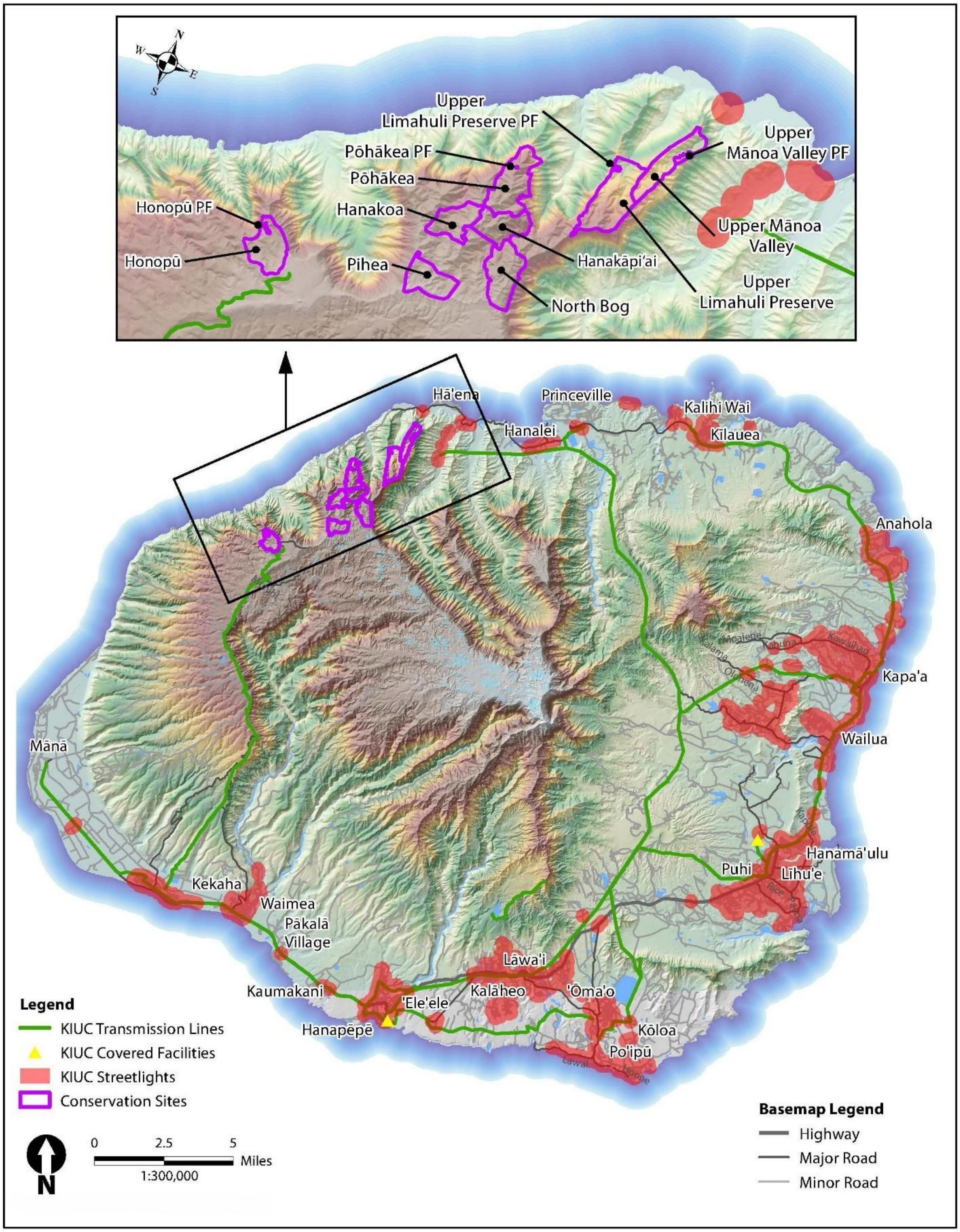

Figure 2-5. Draft HCP Conservation Sites

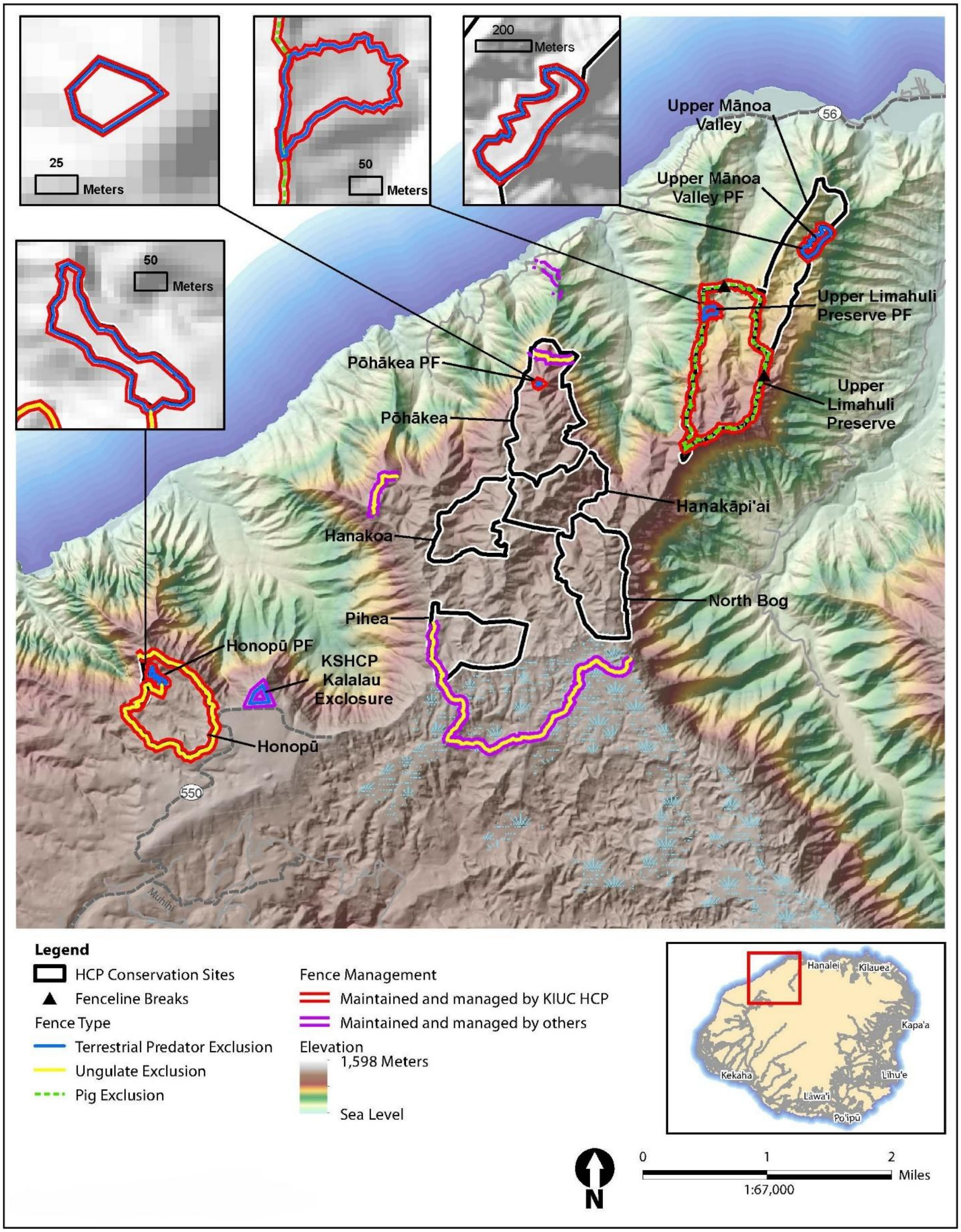

Figure 2-6. Predator Exclusion Fences Supporting the Draft HCP Conservation Sites

- Social attraction techniques would be used at conservation sites contained within predator exclusion fences to establish new colonies at those sites within otherwise suitable breeding habitat. Social attraction methods would include removal of unsuitable vegetation and replanting with native species, installation of artificial burrows, and broadcasting calls in the restored habitat during peak breeding season (April through mid-August). Social attraction would be implemented at Upper Limahuli Preserve PF, Pōhākea PF, Honopū PF, and Upper Mānoa Valley PF.
- KIUC would fund continual invasive plant species management within the Upper Limahuli Preserve, Honopū, and the four social attraction sites (including a 30-foot perimeter around the outside of the predator exclusion fences). Invasive plant species control at the other conservation sites would occur on an as-needed basis, when species are documented during monitoring and determined to be spreading or otherwise problematic. Invasive plant control techniques would involve uprooting, cutting, sawing, or girdling from invasive plants combined with herbicide application as described in Draft HCP Appendix 4D, *Best Management Practices for Invasive Plant Species Control*.

Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Shielding Program

A nest detection and shielding program would be implemented to minimize and offset the effects of light attraction on honu (green sea turtles) from KIUC streetlights and to provide a net benefit to the species. Nest shielding would initially be installed on the full length of the seven beaches, which were identified by KIUC, the Service, and DLNR Division of Aquatic Resources (DAR) as having suitable honu (green sea turtle) nesting habitat, and that have KIUC streetlights visible from that habitat (refer to Draft HCP Section 4.4.5.2 and Figures 4-12 a–g for additional information on beaches selected for nest shielding, including locations). The nest shielding would be installed when active honu (green sea turtle) nests are detected via annual drone surveys or monitoring surveys (in areas where drone surveys are not permitted or not practicable). Light-proof fencing would be erected around the nest after approximately 45 days of incubation to minimize the potential for vandalism. After the honu (green sea turtle) hatchlings have emerged and entered the ocean, the fence would be removed and evidence of hatching will be reported to the Service, DLNR, and DAR within 24 hours. Unhatched eggs, deceased hatchlings, or samples of either would be sent to the National Oceanic and Atmospheric Administration by a permitted biologist for DNA analysis.

Annual monitoring would occur on all beaches on Kauaʻi with suitable honu (green sea turtle) habitat within view of KIUC streetlights to allow for continual updates to the nest-shielding program by identifying additional beaches that may require shielding as well as removing locations where environmental conditions change and light attractant risks are removed. All staff and monitors would be required to complete an annual training provided by the Service, DLNR, or DAR, or trainers approved by the Service, DLNR, and DAR, that would allow them to recognize honu (green sea turtle) tracks, signs of nesting, and hatchling activity, as well as the proper techniques for installing a temporary light shield. These measures would be implemented over the 50-year permit term unless KIUC is able to demonstrate to the Service, DLNR, and DAR that permanent modification of existing and future streetlights fully avoids take of honu (green sea turtles) (see Conservation Measure 6).

Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle

Measures implemented to minimize the impact of streetlights on the covered seabirds (Conservation Measure 2) do not reduce streetlight visibility to honu (green sea turtle) hatchlings. As of 2020, KIUC and the Service identified 29 streetlights that are visible from suitable honu (green sea turtle) nesting habitat within the Plan Area. Additional modifications of streetlights may be possible to reduce light attraction of honu (green sea turtle) hatchlings at these locations without compromising public health or safety. KIUC will work with the state and county to determine the range of available practicable minimization measures and their timeline for implementation. Light-minimization techniques may include additional shielding, change in wattage, change in wavelength, or a combination of these measures. If no practicable minimization measures can be agreed upon, KIUC would not be required to implement this conservation measure further, and instead would continue to implement the shielding required under Conservation Measure 5 throughout the life of the permit term. If new locations are identified as beaches and the surrounding vicinity change over time or new streetlights are installed that could cast light onto suitable honu (green sea turtle) nesting habitat, the same light-minimization techniques agreed upon for the existing 29 streetlights would be implemented for any additional streetlights identified throughout the permit term.

2.2.2.6 Monitoring and Adaptive Management

The proposed action includes implementation of a monitoring and adaptive management program (Draft HCP Chapter 6, *Monitoring and Adaptive Management Program*). The goal of the monitoring component of the program is to evaluate on an ongoing basis whether KIUC is complying with incidental take authorizations and is meeting, or is likely to achieve, the biological goals and objectives. As part of the monitoring and adaptive management program, KIUC would oversee and implement:

- Compliance monitoring to track the status of HCP implementation and that the requirements of the HCP are being met. Compliance monitoring verifies that KIUC is carrying out the terms of the HCP, the federal ITP, and the state ITL.
- Take monitoring that compares the actual take that occurs during HCP implementation to the take limit authorized by the federal ITP and state ITL.
- Effectiveness monitoring to assess the biological performance of the HCP. Specifically, the effectiveness monitoring evaluates the implementation and success of the conservation strategy (Draft HCP Chapter 4, *Conservation Strategy*).

The goal of the adaptive management component of the program is to outline a system for adjusting the HCP management strategy using the monitoring results. *Adaptive management* is a structured approach to decision-making in the face of uncertainty that makes use of the experience of management and monitoring results in an embedded feedback loop of monitoring, evaluating, and adjusting management strategies. The kinds of uncertainties the HCP adaptive management program is intended to address are related to data uncertainty and the causes and conditions affecting successful achievement of the HCP's biological goals and objectives.

Draft HCP Chapter 6, *Monitoring and Adaptive Management Program*, outlines the adaptive management process and describes potential triggers for implementing adaptive management actions. Broadly, adaptive management may be required if existing practices under or overachieve the HCP's biological goals and objectives or if more efficient or effective practices could be implemented to achieve the biological goals and objectives.

Adaptive management and monitoring would be integrated into one program that includes required monitoring and adaptive management actions and data and reporting requirements (refer to Draft HCP Chapter 7, *Plan Implementation*, for details regarding data management and reporting).

2.2.3 Alternative C: Additional Minimization

Under Alternative C, the Draft HCP would include the same Permit and Plan Areas, Covered Species, permit term, and monitoring and adaptive management program as the proposed action, but the Draft HCP's conservation strategy would be modified to reduce impacts of the proposed action in the following ways. The Service and DLNR have developed this alternative to the proposed action for the purposes of the NEPA and HEPA analysis. The Service and DLNR determined it would be technically and economically feasible because the minimization measures proposed under Alternative C are similar to the measures already proposed under Alternative B but to a greater degree. KIUC has not specifically evaluated the alternative for technical and economic feasibility.

Alternative C would implement additional minimization measures on existing powerline spans that have higher collision risk[12] for seabirds (Figure 2-7) to further reduce the collision risk for seabirds:

- Reconfigure the vertical profile of 4.4 mi of existing powerlines that have higher collision risk[12] and that have not already been reconfigured.[13] Reconfiguration includes measures such as reducing the maximum wire height and/or reducing the number of wires in a vertical array.
- Remove static wire on 0.7 mi of existing powerlines that have higher collision risk[12] and that have not already had static wire removed.[14]
- Install flight diverters on 2.7 mi of existing powerlines that have higher collision risk[12] and that have not already had flight diverters installed (LED or reflective).[15]
- Employ flight diverters on each layer of wires on all powerline spans (8.9 mi) that have higher collision risk.[12]

Alternative C would implement the following additional minimization measures for 360 mi of new powerlines (Figure 2-7):

- Construct new powerlines with wires in one horizontal plane, with exceptions only for human health and safety and other applicable laws and regulations.[16] For purposes of NEPA analysis, it is assumed that 50 percent (180 mi) of new powerlines would be constructed in one horizontal plane. KIUC predicts a buildout of 360 mi of new powerlines over the 50-year permit term.

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[12] Higher-risk spans include 8.9 mi of powerlines defined by teal and light green colors on Figure 2-7 that reflect strike rates for seabirds between 10 and 20 (teal) or 20 and 40 (light green) after minimization completed through May 2024. Strike rates are the estimated annual strikes (or collisions) per span by covered seabirds.

[13] Three reconfiguration projects (C-LC1, C-CP1, and C-CP2) were implemented in 2020 as part of the Draft HCP (see Figure 2-3).

[14] Powerline spans where static wire has not been removed are shown on Figure 2-4.

[15] Powerline spans where flight diverters have not been installed are shown on Figure 2-3.

[16] The Draft HCP qualifies that new powerlines will be installed in one horizontal plane to the greatest extent possible.

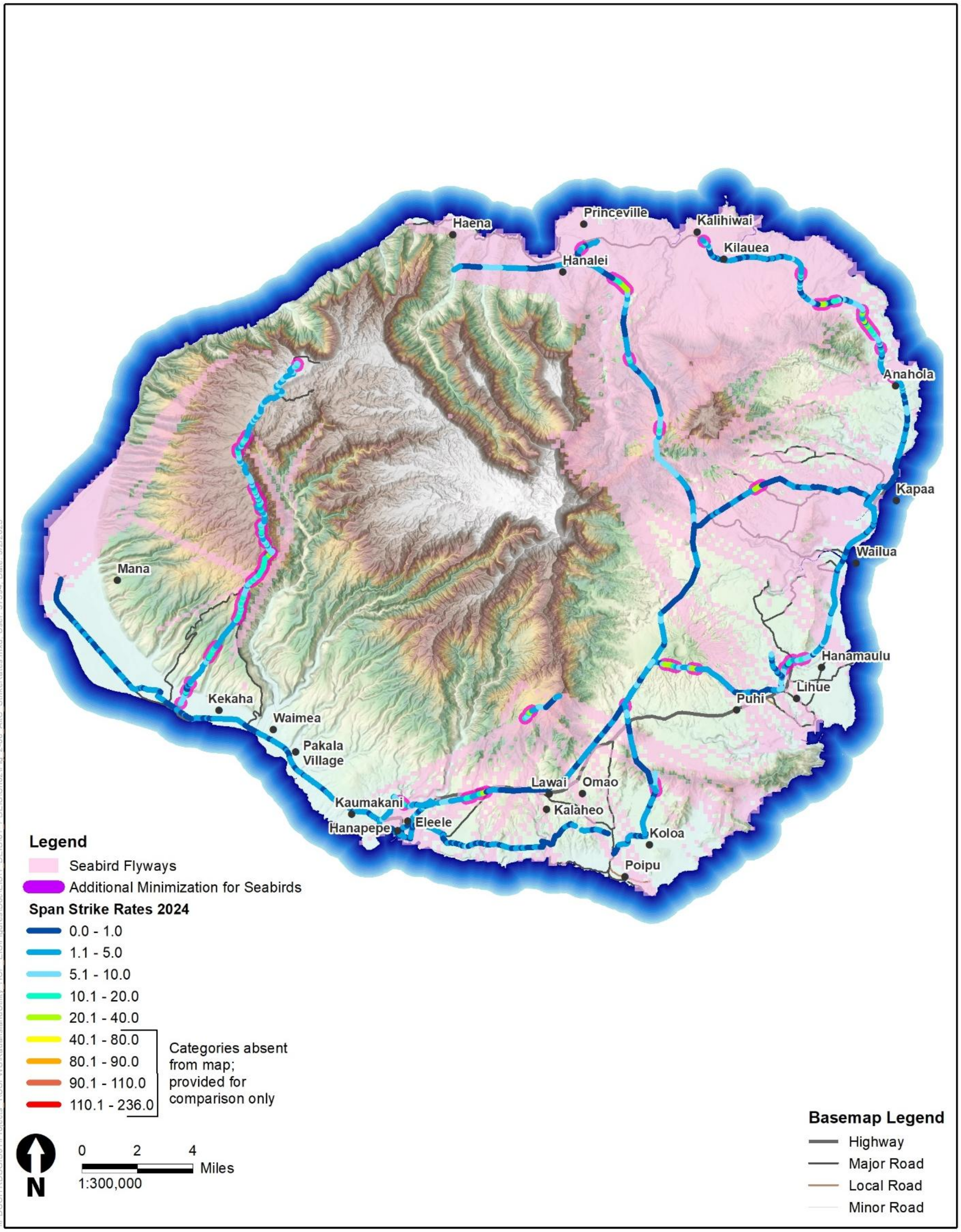


Figure 2-7. Alternative C: Additional Minimization

- Install flight diverters that illuminate powerlines (e.g., reflective, neon, LED diverters) on new powerline spans that would have higher collision risk (no exceptions).[17]
- Employ bird flight diverters on each layer of all wires within all new powerline spans that would have higher collision risk. This only applies to wires not in a horizontal plane.

Alternative C would include the following additional lighting minimization measure for existing and new streetlights to reduce light attraction for seabirds:

- Reduce the number of lumens emitted from lightbulbs by 15 percent by using light dimmers.

Alternative C would increase funding by 50 percent to SOS:

- Increased funding would support the rescue and rehabilitation of injured listed seabird species beyond what is proposed in the Draft HCP. Additional funding could be used to expand outreach and public education efforts, thereby increasing the discovery rate of seabirds during the fallout season (from 10 percent[18] to 20 percent of total streetlight fallout).
- An increase in discovery and intake rates would necessitate additional capacity to rehabilitate injured birds. Additional funding could be used to increase rehabilitation capacity proportionately to the increase in listed seabird discovery and intake. Funds could be used to (1) obtain a stable lease or permanent facility for long-term operations, (2) retain qualified staff through higher wages, and/or (3) fund critical care isolation, a decontamination area, wading pools, medical supplies, and a designated vehicle to reduce operational vulnerability.

2.2.4 Alternative D: Additional Mitigation

Under Alternative D, the Draft HCP would include the same Permit and Plan Areas, Covered Activities, Covered Species, permit term, and monitoring and adaptive management program as the proposed action, but the conservation strategy would be modified to increase conservation as described below. The Service and DLNR have developed this alternative to the proposed action for the purposes of the NEPA and HEPA analysis and in response to scoping comments. The Service and DLNR determined it would be technically and economically feasible because the mitigation measures proposed under Alternative D are similar to the measures already proposed under Alternative B but to a greater degree. KIUC has not specifically evaluated the alternative for technical and economic feasibility.

Alternative D would specify an increase in the total acreage of mitigation effort beyond what is included in the proposed action. Alternative D would also increase the intensity and area of management actions proposed in the Draft HCP to include a combination of:

- Expanded ungulate control on state land around the conservation sites within the Hono O Nā Pali Natural Area Reserve. This measure would increase the acreage that is enclosed by ungulate fences by 1,915 acres to benefit seabird productivity.
- Expanded predator control in 1,394 acres of three additional conservation sites (beyond those included in the Draft HCP) where predator-proof fences, social attraction (including installation

[17] The Draft HCP states that all new powerlines will be evaluated to determine if flight diverters are a practicable minimization technique. If flight diverters are practicable, they will be installed at the time of construction.
[18] Draft HCP Section 5C.2.1.6 estimates that the detectability rate for SOS at streetlights is 10.4 percent as a worst-case estimate for all three covered seabird species.

of artificial burrows), and a predator trapping network would be implemented to benefit seabird productivity.

- Regional barn owl control: Expanded area of barn owl control outside conservation sites by 1,394 acres.
- Expanded predator control, habitat management, waterbird population monitoring, and barn owl control within an area outside of the conservation sites (50 acres of state land within the Mānā plain wetlands).

Alternative D would also include increasing funds to KIUC's existing volunteer program by 15 percent to better staff measures for sea turtles:

- Increase staffing, volunteer network, and outreach effort of the existing volunteer program that seeks to protect honu (green sea turtle) through education, public awareness, and support for public outreach activities that promote respectful behavior and reduce disturbance to basking sea turtles.
- Add marine debris removal as part of existing volunteer program. Marine pollution can lead to the ingestion of, and entanglement in, marine debris such as plastic and monofilament fishing line. Although the direct effects of ingesting marine debris may or may not be lethal to honu (green sea turtle), it results in varying side effects that could increase the probability of death (see Section 3A.9.5.9 of the Draft HCP).

2.3 Alternatives Considered but Eliminated from Detailed Study

In addition to analyzing the proposed action and No Action alternative, the Service is required to evaluate reasonable alternatives. For alternatives that the agency eliminated from detailed study, the Service must briefly discuss in the EIS the reasons they were eliminated (43 CFR 46.420(c)). Similarly, HAR 11-200.1-24 directs that a Draft EIS should describe the alternatives that were eliminated from detailed study and briefly discuss the reasons for not studying those alternatives in detail. The following alternatives to the proposed action were considered but dismissed from detailed analysis in this EIS for the reasons described below.

2.3.1 Underground High-Risk Transmission Lines

In the Draft HCP, KIUC considers an alternative to take that would underground transmission lines where past monitoring demonstrated the highest concentration of bird strikes. The highest concentration of bird strikes with powerlines occurs on KIUC's cross-island transmission line, which runs from Port Allen across the interior of Kauaʻi to Wainiha. To evaluate this alternative, KIUC commissioned a study in 2015 (Electric Power Engineers, Inc. 2015) to assess the technical and economic feasibility of undergrounding three high-collision spans of the cross-island line. This study concluded that while undergrounding the cross-island line spans would completely eliminate the potential for covered seabird collisions in those areas, it would be very difficult and prohibitively expensive to construct and maintain. In addition, when line failures did occur, they would be very difficult to locate and repair, and this would result in extended circuit outages that increase the risk of a system failure with wide-ranging adverse consequences. Additionally, undergrounding presents potential impacts on native plant species and historic or cultural resources that would be disturbed during construction or repair activities.

In this study, the cost to underground KIUC transmission lines in high-risk collision areas was estimated to be roughly $10 million per mi of existing overhead line (inflated to 2023 dollars) with per-mi costs ranging between $7.5 million and $14.3 million depending on the spans. Using the per-mi costs noted above, KIUC extrapolated the costs to underground all 47 mi (75.6 km) of cross-island line and associated connector lines from the Port Allen Generating Station to Wainiha, including the Powerline Trail. KIUC estimated that undergrounding the cross-island line would cost a minimum of $215 million and potentially reach costs of up to more than twice that amount (over $430 million) (ICF 2025). The cross-island line does not have high-risk transmission lines for its entire length. If KIUC only undergrounded the high-risk spans of the cross-island line, a large portion would be moved underground. This would result in a significant cost based on the cost per mile. KIUC already has some of the highest electricity rates in the county and a very small base of ratepayers that would carry these additional costs. As demonstrated by this analysis, it would be both infeasible and cost prohibitive to move substantial segments of KIUC's high-risk powerlines underground.

2.3.2 On-grounding Powerlines

While not discussed in the Draft HCP, the Service and DLNR considered an alternative that would install powerlines close to the ground without burial (i.e., on-ground) to eliminate the potential for bird strikes. On-grounding is not feasible in rough topography, along corridors with cross streets, or in residential or commercial areas, which limits the potential for installing on-ground powerlines in the Permit Area. A similar proposal to on-ground powerlines on Haleakala, Maui, estimated that on-grounding 1.5 mi of powerline would cost at least $10 million (or $6.7 million per mi) compared to KIUC's estimate of $7.5 million to $14.3 million per mi to underground powerlines in high-collision risk areas (see Section 2.3.1). Based on this analysis, the Service and DLNR determined that it would be technically infeasible and cost prohibitive to on-ground all or most of KIUC's powerlines.

2.3.3 Tree Planting to Shield Powerlines

An alternative was considered that would lower and shield powerlines with vegetation (e.g., trees, bushes). The Draft HCP considered an alternative to take that would involve extensive tree planting in areas with exposed powerlines, especially in any high-strike locations along perimeter lines. The trees, once tall enough, would shield the powerlines and reduce Covered Species collisions. The Service and DLNR reviewed the alternative proposed in the Draft HCP and concur with KIUC's conclusion that it would be technically infeasible because:

- Many interior powerlines are elevated above the existing tree line.
- The alternative is inconsistent with vegetation management objectives to maintain a clearance between powerlines and surrounding vegetation to reduce risk of trees falling on the lines, and resulting powerline failure, especially during storms.
- Land on either side of the powerlines where trees would need to be planted and maintained is mostly privately owned, and it would be infeasible to negotiate with all individual landowners to plant and maintain trees on their property.

2.3.4 Eliminate Take by Removing Powerlines and Lights

In the Draft HCP, KIUC considers an alternative to eliminate the possibility of take of covered seabirds and covered waterbirds by: (1) removing all powerlines on the island of Kauaʻi that result in take, and (2) removing or turning off all streetlights and facility lights that result in take during the seabird fledging season (September 15 to December 15). While this alternative would avoid the take of covered seabirds and waterbirds, it was determined to not be feasible or practicable and was eliminated from detailed study. KIUC asserts that it cannot remove all of its powerlines that have a reasonable likelihood of take of Covered Species because it is mandated by state regulations to provide reliable electricity to its customers. Similarly, KIUC asserts that it is not feasible to eliminate nighttime lighting along state and county roadways during the 3 months of the seabird fledging season. Streetlight operation is governed by state and county regulations and operated for public safety. Generation and distribution facilities that KIUC operates 24 hours per day, 7 days per week, must be lit at night for reasons of public and worker health and safety. The Service and DLNR concur that removing all powerlines is not practicable because residents of Kauaʻi depend on existing electrical infrastructure. Removing or turning off all streetlights and facility lights is also not a practicable take minimization measure due to public safety considerations.

2.3.5 Shorter Permit Term (30 Years)

This alternative would be the same as the proposed action, but the ITP term would be 30 years instead of 50 years. This alternative was eliminated from detailed study because it would not meet the purpose and need to fulfill the Service's conservation obligations under the ESA, because the Draft HCP would not be expected to show adequate conservation benefits in a 30-year timeframe to achieve biological goals and objectives for ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel). Per modeling used to evaluate the impacts of the alternatives (Section 3.2.1.1, *Seabirds*) on ʻaʻo (Newell's shearwater), the biological goal and objective of a viable population may not be met until 2051 (year 26 of the permit term) (Figure 5-5a in Chapter 5 of the Draft HCP). A 30-year permit term may not allow enough time for adaptive management to be applied if the biological goal and objective is not met by the estimated timeframe. Similarly, KIUC would likely not be able to achieve an overall net benefit in the recovery of threatened and endangered species as required under HRS 195D-30 for ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel).

2.3.6 Additional Species Covered

The Service and DLNR considered an alternative that would include the federally and state-listed ʻōpeʻapeʻa (Hawaiian hoary bat, *Lasiurus semotus*) as an additional species covered by the ITP and ITL. ʻŌpeʻapeʻa (Hawaiian hoary bat) is listed as endangered under the ESA and HRS Chapter 195D. No critical habitat has been designated for ʻōpeʻapeʻa (Hawaiian hoary bat), although the species is widespread on Kauaʻi. The only KIUC activity with the potential to affect ʻōpeʻapeʻa (Hawaiian hoary bat) is the pruning or removal of trees. To evaluate the potential for ʻōpeʻapeʻa (Hawaiian hoary bat) take as a result of vegetation trimming and removal, KIUC commissioned and implemented a pre-trimming bat monitoring program using thermal imaging during the bat pup rearing seasons (June 1 through September 15) from 2013 to 2015. No bats were found by KIUC and its contractors over the 662 tree-trimming unit-days during 3 years of monitoring (ICF 2025, Appendix 1B). Although no bats were found, KIUC agreed to refrain from trimming or removing vegetation over 15 feet (4.6 m) tall in potential habitat during pup rearing season. This alternative was dismissed from detailed analysis because, with implementation of the measures proposed under the Draft HCP, KIUC will avoid take of ʻōpeʻapeʻa (Hawaiian hoary bat). Additionally, this alternative was eliminated from detailed study because it would not meet the purpose and need to respond to the applicant's request. The applicant did not seek incidental take coverage for ʻōpeʻapeʻa (Hawaiian hoary bat) based on its ability to avoid incidental take.

2.3.7 Increased SOS Funding for Waterbirds

The Service and DLNR considered an alternative that would increase SOS program funding specifically for waterbirds, thereby further minimizing take beyond that in the proposed action; however, this alternative was eliminated from detailed study because most of the waterbird intake to the SOS program is attributed to botulism rather than injuries caused by KIUC's Covered Activities. As a result, increasing SOS program funding for waterbirds would not result in the rehabilitation of substantially larger numbers of waterbirds that have sustained injuries from KIUC's Covered Activities. This alternative was dismissed from detailed analysis because it would not reduce the take of waterbirds from KIUC's Covered Activities.

2.3.8 Additional Targeted Minimization for Honu (Green Sea Turtle)

The Service and DLNR considered an alternative that would include additional targeted minimization for honu (green sea turtle) such as removing streetlights that are visible from sea turtle nesting beaches or turning streetlights off during the nesting season. KIUC cannot remove or turn off its streetlights that have a reasonable likelihood of take of honu (green sea turtle) because streetlight operation is governed by state and county regulations and performed for public safety. The Service and DLNR determined that removing or turning off streetlights in proximity to beaches during honu (green sea turtle) nesting season is not practicable due to human safety standards and that there are currently no other practicable measures that could reduce take beyond what is already included in the Draft HCP as Conservation Measure 5 (Implement a Green Sea Turtle [honu] Nest Detection and Shielding Program) and Conservation Measure 6 (Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle [honu]). Therefore, this alternative was eliminated from detailed study.

2.4 Summary and Comparison of the Alternatives

Table 2-2. Comparison of Alternative Features

Topic	Alternative A: No Action	Alternative B: Proposed Action	Alternative C: Additional Minimization	Alternative D: Additional Mitigation
Permit Duration	An ITP and ITL would not be issued to KIUC.	50 years	50 years	50 years
Plan Area	An ITP and ITL would not be issued and no Plan Area would be defined.	Island of Kauaʻi	Island of Kauaʻi	Island of Kauaʻi
Permit Area	An ITP and ITL would not be issued and no Permit Area would be defined.	Includes the specific locations of all Covered Activities and areas where the conservation strategy would be implemented	Same as the proposed action	Additional conservation sites would be included in the Permit Area.
Covered Species	No federally or state-listed species would be covered by an ITP or ITL, respectively.	ʻaʻo (Newell's shearwater), ʻuaʻu (Hawaiian petrel, *Pterodroma sandwichensis*), ʻakēʻakē (band-rumped storm-petrel, *Hydrobates castro*), aeʻo (Hawaiian stilt, *Himantopus mexicanus knudseni*), koloa maoli (Hawaiian duck, *Anas wyvilliana*), ʻalae keʻokeʻo (Hawaiian coot, *Fulica alai*)), alae ʻula (Hawaiian common gallinule, *Gallinula galeata sandvicensis*), nēnē (Hawaiian goose, *Branta sandvicensis*), honu (green sea turtle, *Chelonia mydas*)	Same as the proposed action	Same as the proposed action

Topic	Alternative A: No Action	Alternative B: Proposed Action	Alternative C: Additional Minimization	Alternative D: Additional Mitigation
Covered Activities	An ITP and ITL would not be issued and no incidental take from KIUC activities would be authorized.	Powerline operations, lighting operations, and implementation of the HCP conservation strategy.	Same as the proposed action	Same as the proposed action
Streamline Future ESA Compliance[19]	No	Yes	Yes	Yes
Potential for Incidental Take	Incidental take is occurring now and would be expected to continue to occur. An ITP and ITL would not be issued and the HCP would not be implemented. KIUC would remain responsible for all unauthorized take caused by its actions.	Incidental take during the permit term would continue to occur but the impact of the taking of the Covered Species would be fully offset and provide a net benefit through implementation of Draft HCP conservation measures during the permit term.	Incidental take of seabirds and waterbirds would be reduced during the permit term compared to the proposed action.	Additional mitigation would not reduce the incidental take of Covered Species that is caused by KIUC's Covered Activities, but would increase the productivity of Covered Species compared to the proposed action.
Conservation Strategy	Minimization projects already completed by KIUC under Draft HCP Conservation Measures 1 and 2 would remain in place and operational for their useful life. Other conservation measures to fund the SOS program, manage and enhance seabird breeding habitat, and minimize light attraction for honu (green sea turtle) hatchlings would not be implemented (Conservation Measures 2 through 6).	Undertaken in accordance with the conservation strategy outlined in the Draft HCP.	KIUC would implement additional minimization for powerline collision and light attraction and increase funding for the SOS program beyond what is proposed in the Draft HCP.	KIUC would implement additional ungulate control, predator control, and social attraction to benefit seabird productivity; expand predator control, habitat management, waterbird population monitoring, and barn owl control within Mānā plain wetlands; and increase funding for the sea turtle volunteer program to better staff conservation measures for sea turtles.

[19] See Section 7.6 of the Draft HCP for a description of the minor modifications or major amendments that may be made to the Draft HCP after issuance of the ITP and ITL.

Topic	Alternative A: No Action	Alternative B: Proposed Action	Alternative C: Additional Minimization	Alternative D: Additional Mitigation
Monitoring and Reporting	None required	Standardized compliance monitoring, take monitoring, effectiveness monitoring and assessment, and annual reporting to USFWS and DLNR.	Same as the proposed action	Same as the proposed action
Adaptive Management	None required	Adaptive management program is based on results of monitoring and reporting; components of the conservation strategy may then be modified based on results of adaptive management.	Same as the proposed action	Same as the proposed action
No Surprises Rule	N/A	Regulatory assurances for all Covered Species. This is assuming permit compliance and no jeopardy.	Same as the proposed action	Same as the proposed action
Amendment Process	N/A	HCP modifications and ITP/ITL amendments could be made as described in Draft HCP Section 7.6, *Revisions and Amendments*.	Same as the proposed action	Same as the proposed action

N/A = not applicable

Chapter 3
Affected Environment and Environmental Consequences

3.1 Introduction

This chapter presents the existing conditions and potential environmental effects of the proposed action and alternatives.

3.1.1 Scope of the Analysis

Following the introduction, this chapter addresses the following resources: Covered Species including seabirds, waterbirds, and honu (green sea turtle, *Chelonia mydas*) (Section 3.2); other state and federally listed species (Section 3.3); migratory bird species (Section 3.4); critical habitat and other land designations (Section 3.5); non-listed flora (Section 3.6); non-listed fauna including native fauna and nonnative fauna (Section 3.7); hydrology and soils (Section 3.8); air quality and climate change including greenhouse gases (GHG) and carbon sequestration (Section 3.9); cultural resources (Section 3.10); socioeconomics including population, race and ethnicity, household characteristics, income and poverty, housing characteristics, economic base, and electric utility rates (Section 3.11); public infrastructure and services including power infrastructure, public roadway system, public transit system, and public safety and educational facilities (Section 3.12); recreation (Section 3.13); scenic resources (Section 3.14); and land use (Section 3.15).

Each resource section includes a subsection describing the affected environment, followed by a subsection describing the potential environmental consequences of the proposed action and alternatives. The affected environment sections describe the existing environmental conditions. The environmental consequences sections describe the potential direct and indirect impacts of the proposed action and alternatives. Each resource section concludes with an overall comparison of alternatives. In considering the significance of potential effects, the analysis addresses the degree, duration, and geographic extent of beneficial and adverse effects. For each resource area, effects were considered at an island-wide scale (Plan Area) or a localized scale focused on the footprint where activities would occur (Permit Area) depending on anticipated scope of impact on the resource. Cumulative impacts are described in Chapter 4, *Reasonably Foreseeable and Cumulative Effects*.

The proposed action, Alternative C, and Alternative D incorporate measures to minimize and mitigate the impact of the potential taking of Covered Species and are designed to result in an overall net gain in the recovery of threatened and endangered species. The analysis of effects in Chapter 3, *Affected Environment and Environmental Consequences*, considers these measures as well as additional protections that may be required in compliance with existing laws, policies, and regulations. The analysis also considers best management practices (BMP) that may be implemented to mitigate or reduce adverse effects on other resource areas, where applicable and in accordance with existing regulatory requirements.

An incidental take permit (ITP) from the Service provides an applicant with incidental take authorization under the ESA for Covered Species from certain activities described in the supporting

HCP. An incidental take license (ITL) from the state provides an applicant with similar authorization under HRS 195D. The applicant must obtain permits from other entities, as necessary, and ensure that their activities are otherwise lawful. The scope of the analysis of this Draft EIS is focused on the impacts from the Covered Activities as described in the Draft HCP on the human environment. The potential impacts are further assessed on a broad scale (the Plan Area) over the 50-year ITP and ITL terms, and identify how implementation of the Covered Activities, including the proposed conservation strategy, may result in incidental take of the Covered Species.

3.1.2 Analysis Assumptions

The following assumptions apply to all resources (e.g., Covered Species, flora, fauna, air quality, cultural resources) in this EIS analysis:

1. KIUC completed all powerline collision minimization projects described in the Draft HCP by May of 2024, including 1,13.2 miles (mi) (182.2 kilometers [km]) of bird flight diverters installed, 82.9 mi (133.4 km) of static wire removed, three powerline reconfiguration projects totaling 7.8 mi (12.5 km), and removal of a section of 69-kilovolt transmission line in Mānā. These minimization measures were often undertaken in combination. To minimize light attraction, KIUC retrofitted all existing streetlights that it owns and operates with full-cutoff shielded fixtures and retrofitted all the exterior lights at the Port Allen Generating Station and at the Kapaia Generating Station with shielded lighting. The EIS analysis assumes minimization projects already completed by KIUC would remain in place and be operational for their useful life under Alternative A (No Action), Alternative B (Proposed Action), Alternative C (Additional Minimization), and Alternative D (Additional Mitigation).
2. Construction activities are not part of the proposed action or Alternatives A, C, or D except where conservation measures will be implemented at conservation sites under Alternatives C and D. KIUC did not include construction activities related to powerline collision minimization, new powerline construction, or construction of new streetlights in its request for incidental take because they are not reasonably certain to result in the incidental take of ESA-listed species.
3. The Draft HCP describes conservation measures to be implemented at conservation sites, some of which have already been completed and some of which are ongoing or planned. The EIS analysis assumes that conservation measures involving construction of physical features such as predator control fencing that were completed prior to commencement of the permit term (by KIUC or other entities) would remain in place and be operational under all EIS alternatives, including Alternative A (No Action), Alternative B (Proposed Action), Alternative C (Additional Minimization), and Alternative D (Additional Mitigation). This includes:
    - Existing pig exclusion fence surrounding the entire boundary of Upper Limahuli Preserve. A portion of this fence shares a boundary with the Upper Mānoa Valley.
    - Existing sections of strategically placed ungulate exclusion fences that, in combination with steep terrain, restrict ungulates from entering Hono O Nā Pali Natural Area Reserve (NAR) where the Pihea, North Bog, Pōhākea, Pōhākea predator fence (PF), Hanakoa, and Hanakāpiʻai conservation sites are located.
    - Existing ungulate fence at Honopū.
    - Existing predator exclusion fences at Honopū PF and Pōhākea.

4. The EIS analysis assumes that conservation measures described in the Draft HCP that are ongoing or planned and that require an annual commitment of funding and staff resources by KIUC would continue under Alternative B (Proposed Action) and both Alternatives C and D but would not continue under Alternative A (No Action). Under Alternative A, there would be no obligation to maintain the conservation sites in the absence of the federal ITP and state ITL. Conservation measures that involve an ongoing or planned commitment of funding and staff resources by KIUC (and that would be discontinued under Alternative A) include:
    - Ongoing maintenance of existing ungulate fence at Honopū, existing pig exclusion fence at Upper Limahuli Preserve, existing predator exclusion fences at Honopū PF and Pōhākea PF, and existing ungulate fence at Honopū.
    - Ongoing annual seabird monitoring at all 12 conservation sites via burrow monitoring, call rate monitoring using song meters, and auditory surveys.
    - Ongoing annual seabird monitoring (i.e., call rate monitoring) at 20 locations along the Nā Pali Coast.
    - Ongoing predator control at all 12 conservation sites utilizing cameras, traps, bait stations, snares, hunting, and other control methods.
    - Ongoing invasive plant control at all 12 conservation sites that can involve uprooting, cutting, sawing, or girdling from plants and applying herbicide.
    - Ongoing and planned social attraction techniques at Pōhākea PF, Upper Limahuli PF, Honopū PF, and Upper Mānoa Valley PF such as replanting with native species, installing artificial burrows, and broadcasting calls during peak breeding season to attract covered seabirds.
    - Annual funding of the Save Our Shearwaters (SOS) program, an avian rescue and rehabilitation program that operates year-round on Kaua‘i to rehabilitate and release grounded seabirds and waterbirds.
    - Annual honu (green sea turtle) nest detection and shielding to minimize light attraction from KIUC streetlights for honu (green sea turtle) hatchlings.
    - KIUC’s monitoring and adaptive management program to monitor implementation of the Draft HCP and effectiveness of conservation measures on an ongoing basis and identify when adaptive management would be applied to improve their effectiveness.
    - Maintenance and/or replacement of existing minimization such as bird flight diverters beyond its useful life.
5. The EIS analysis assumes the following potential sources of ground disturbance under each of the EIS alternatives:
    - Alternative A (No Action): No potential sources of ground disturbance are identified because the conservation measures proposed in the Draft HCP would not be implemented under No Action.
    - Alternative B (Proposed Action): KIUC would construct two predator exclusion fences and an estimated 30 artificial burrows at Upper Limahuli PF and Upper Mānoa Valley PF as part of the Draft HCP. KIUC would maintain predator exclusion fences and artificial burrows at all four social attraction sites throughout the permit term:

  - 2,259 linear feet (688.5 meters [m]) of predator exclusion fence would be installed at Upper Limahuli Preserve PF by 2025, resulting in approximately 1.0 acre (0.4 hectare) of site clearing (removal of rocks and vegetation greater than 1 foot [30 centimeters] in height) and 0.1 acre (0.04 hectare) of ground disturbance for installation of fence posts and mesh skirt.
  - 4,294 linear feet [1,308.8 m] of predator exclusion fence would be installed at Upper Mānoa Valley PF by 2027, resulting in approximately 1.9 acres (0.8 hectare) of site clearing (removal of rocks and vegetation greater than 1 foot [30 centimeters] in height) and 0.2 acre (0.08 hectare) of ground disturbance for installation of fence posts and mesh skirt.
  - Predator exclusion fence at each of the four social attraction sites (Pōhākea PF, Honopū PF, Upper Limahuli PF, and Upper Mānoa Valley PF) would be replaced in whole up to two times during the 50-year permit term, cumulatively resulting in approximately 4.2 acres (1.7 hectares) of site clearing (removal of rocks and vegetation greater than 1 foot [30 centimeters] in height) and 0.4 acre (0.2 hectare) of ground disturbance for installation of fence posts and mesh skirt each time that the fence is replaced in the same areas disturbed during initial fence installation.
  - The installation and maintenance of artificial burrows at Upper Limahuli Preserve PF, Pōhākea PF, Honopū PF, and Upper Mānoa Valley PF would also result in localized ground disturbance at social attraction sites. Approximately 30 artificial burrows each would be installed during setup of social attraction sites at Upper Limahuli PF and Upper Mānoa Valley PF (Draft HCP Appendix 7A; ICF 2025) and artificial burrows would be maintained at all four social attraction sites throughout the permit term.
  - One or two new helicopter landing zones and two weatherports would be constructed at Upper Mānoa Valley as part of the Draft HCP. Construction of helicopter landing zone(s) would require vegetation clearing but would not involve ground disturbance. Construction of the weatherports would require vegetation clearing and each weatherport would result in up to 500 square feet (46.5 square m) of ground disturbance to install the structures (for a total of 1,000 square feet [93 square m]).
- Alternative C (Additional Minimization) would operate KIUC's powerlines with additional collision minimization applied. Operation of powerlines with additional minimization would not result in new ground disturbance.
- Alternative D (Additional Mitigation): KIUC would construct additional ungulate exclusion fencing, predator exclusion fences, artificial burrows (at social attraction sites), landing zones, and weatherports to increase the total acreage of mitigation effort beyond what is included in the proposed action. KIUC would maintain ungulate and predator exclusion fences and artificial burrows at social attraction sites throughout the permit term:
  - Additional ungulate suppression under Alternative D would install up to 4,277 linear feet (1,304 m) of ungulate exclusion fencing, resulting in approximately 1.9 acres (0.8 hectare) of site clearing (removal of rocks and vegetation greater than 1 foot [30 centimeters] in height) and 0.2 acre (0.08 hectare) of ground disturbance for installation of fence posts and mesh skirt.
  - Alternative D would install up to an additional 4,138 linear feet (1,261 m) of predator exclusion fencing, resulting in approximately 6.1 acres (2.5 hectares) of site clearing

(removal of rocks and vegetation greater than 1 foot [30 centimeters] in height) and 0.6 acre (0.2 hectare) of ground disturbance for installation of fence posts and mesh skirt.

- Up to 30 artificial burrows would be installed at each of three conservation sites (up to 90 artificial burrows in total).
- Up to two new helicopter landing zones would be constructed at each of three conservation sites (for a total of up to six landing zones). Construction of helicopter landing zone(s) would require vegetation clearing but would not involve ground disturbance.
- One weatherport would be constructed at each of three conservation sites. Construction of each weatherport would result in up to 500 square feet (46.5 square m) of ground disturbance (for a total of 1,500 square feet [139.4 square m]).

6. EIS assumptions related to air emissions under each of the EIS alternatives include the following:
   - Alternative A (No Action): No potential sources of air emissions are identified because the conservation measures proposed in the Draft HCP would not be implemented under No Action.
   - Alternative B (Proposed Action): Implementation of the conservation strategy would result in an estimated 1,200 vehicle trips and 245 helicopter trips on an annual basis.
     - Estimated vehicle and helicopter trips to implement the conservation strategy at conservation sites are based on the following assumptions:
       - Honopū, Honopū PF, and Pihea would be accessed primarily by vehicle and occasionally by helicopter for sling loads to implement annual seabird monitoring, predator control, social attraction, and invasive plant species management.
       - The conservation sites at North Bog, Pōhākea, Pōhākea PF, Hanakoa, Hanakāpiʻai, Upper Limahuli, Upper Limahuli PF, Upper Mānoa Valley, and Upper Mānoa Valley PF would be accessed by helicopter utilizing existing landing zones and weatherports for overnight trips. Helicopter trips to the site are required for implementation of annual seabird monitoring, predator control, social attraction, and invasive plant species management.
       - Helicopter inspections of the fence lines would be completed once a month while accessing a conservation site by helicopter, and quarterly for dedicated fence inspections and maintenance.
       - Observational monitoring of all KIUC powerlines utilizes vehicles and helicopters.
       - Installation of acoustic song meters on power poles utilizes vehicles and helicopters at least twice monthly throughout the seabird season.
       - Estimated trips include trips for rapid response for seabirds caught in traps, cat/barn owl detections, fence breaches, etc.
     - The crew and materials required for installation of predator exclusion fences and predator eradication at Upper Limahuli PF and Upper Mānoa Valley PF would be

transported to the sites by helicopter and involve an estimated 67 helicopter trips through 2025 and an estimated 73 helicopter trips through 2027.

- The crew and materials required for replacement of predator exclusion fences twice during the permit term would be transported to each of the four social attraction sites (Pōhākea PF, Honopū PF, Upper Limahuli PF, and Upper Mānoa Valley PF) by helicopter, resulting in an estimated 440 helicopter trips over the permit term.

- Alternative C (Additional Minimization) would operate KIUC's powerlines with additional collision minimization applied. Operation of powerlines with additional minimization would not result in new air emissions.
- Alternative D (Additional Mitigation): Implementation of ungulate suppression, predator control, and social attraction at three additional conservation sites (beyond what is proposed in the Draft HCP) would add approximately 78 helicopter trips annually throughout the permit term.

3.2 Covered Species

This section describes the existing conditions of the Covered Species and analyzes the direct and indirect effects of the proposed action and alternatives on the Covered Species within the Permit and Plan Areas.

3.2.1 Methods

There are nine species (Table 2-1) in the Draft HCP that were selected as Covered Species based on their federal and state listing status and the potential for the Covered Activities to result in incidental take. These species include three seabirds, five waterbirds, and one reptile. The evaluation process and rationale used by KIUC to select the Covered Species is described in Draft HCP Appendix 1B, *Evaluation of Species Considered for Coverage*. In summary, Covered Species were chosen based on listing status, likelihood of occurrence in the Plan Area, reasonable likelihood of take from the Covered Activities, and whether sufficient scientific information is available.

Section 3.2.3, *Environmental Consequences*, assesses the impact of the proposed action (Alternative B), the No Action alternative (Alternative A), and two other action alternatives (Alternative C, Additional Minimization, and Alternative D, Additional Mitigation) on other listed species. The assumptions presented in Section 3.1.2 were applied when analyzing the impacts of each alternative on the species identified in this section.

3.2.1.1 Seabirds

Various resources consulted to prepare the affected environment section for seabirds included annual technical reports regarding implementation of the KIUC Short-Term HCP, scientific papers, technical reports from Kauaʻi research organizations, the Draft HCP, the 2015 State Wildlife Action Plan (SWAP) (DLNR 2015), and environmental assessments (EA) for other HCPs on Kauaʻi (USFWS 2011a; DLNR and USFWS 2020). These resources are cited throughout the sections below. All assumptions discussed under Section 3.1.2 were applied when analyzing the impacts on the seabirds in this section.

Population trends for ʻaʻo (Newell's shearwater, *Puffinus newelli*) and ʻuaʻu (Hawaiian petrel, *Pterodroma sandwichensis*) on Kauaʻi over the 50-year permit term were projected for Alternatives A, B, C, and D using two models that include five modeling scenarios. Each scenario represents a different population trend and uses different datasets and assumptions. The Population Dynamics Model (PDM) is the model developed by KIUC and used in the Draft HCP to predict potential long-term species population trends and impacts from implementation of Covered Activities including the proposed conservation strategy (ICF 2025). It comprises two population trend scenarios: a stable trend and a worse-case scenario. The Joint Conservation Strategy (JCS) is the model developed by the Service (Vorsino 2016; USFWS 2025a, 2025b) to predict potential long-term species population trends and impacts from Covered Activities proposed in the Draft HCP. The JCS comprises three modeling scenarios: a worst-case scenario, a mid-point scenario, and a flat-line scenario meant to reflect observed demographic and population trends. In this EIS, the PDM and JCS were used to evaluate the impacts of the EIS alternatives and the analysis presents the outputs of all five scenarios.

The following is a brief description of each of the five scenarios in regard to the population trend for ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) on Kauaʻi. The modeling scenarios used in this EIS are assessments of the general population trend that are repeatable, reproducible, and adjustable and used to inform management efforts. The PDM stable-trend scenario assumes the starting trend of the population inside the conservation sites is increasing and the population outside of the Draft HCP conservation sites[1] is flat, meaning no increase or decline. The PDM worse-case scenario assumes the population trend outside of the Draft HCP conservation sites is rapidly declining. The JCS worst-case scenario reflects the survivorship of the seabirds on Kauaʻi, with additional input of mortality from powerline collisions and fallout from light. It reflects an overall population trend in which the population is declining outside of the conservation sites. The JCS flat-line scenario reflects a population that is neither increasing or decreasing and any additional minimization and mitigation increases the population size proportionally. The JCS mid-point scenario is derived from understandings and assumptions of both the worst-case and flat-line scenarios to estimate a population that falls between all available sources of data.

The models (PDM and JCS) are based on different assumptions and therefore are not directly comparable. Rather, the two modeling approaches present a range of possible population projections on Kauaʻi over the 50-year permit term, with the PDM worse-case scenario and the JCS worst-case scenarios representing the low end of the range, and the PDM stable trend and JCS flat-line scenarios representing the high end of the potential population range.

Both models use various datasets (e.g., radar, SOS program intake, seabird colony monitoring, powerline collision monitoring) and assumptions, each comprising different components of the overall population trends for the two seabird species. This is due to the datasets covering different geographic regions of the island, the different situations occurring between those regions, or conflicting understandings of the projected population. For example, in the northwestern region of Kauaʻi, there is an increasing population trend where active management is occurring, whereas outside of this region there is little to no seabird management, leading to either a decreasing population trend or a trend that is neither increasing nor decreasing. Under the worse-case scenario of the PDM, areas outside of the conservation sites are exposed to powerline collisions and light attraction and are expected to decrease over time (refer to Draft HCP Section 5.3.2.4, *Beneficial Effects and Net Effects*, p. 5-51; Draft HCP Figure 5-7a for ʻaʻo (Newell's shearwater); and Draft HCP Appendix 5E, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*). Under the JCS, the passage rate within areas outside of the conservation sites subject to threats (powerline collisions, light attraction, and predation) is reflective of largely breeding adult birds that have managed to persist with ongoing threats. As these birds begin to age out of the population, it is anticipated there will be another dramatic crash of the population, accounting for the loss of those breeders who are experiencing powerline impacts on their offspring. It is expected that there will be little replacement occurring of these breeding birds. Over the permit term, additional data are expected to become available and will be incorporated as needed into the models (see Chapter 6, *Monitoring and*

[1] The distinction made for areas outside of the conservation sites versus within is based on the threats to the species and management actions for the species. Initial modeled trends inside the conservation sites are positive in the PDM, for both the stable and worse case scenarios, consistent with monitoring data from the conservation sites during the last decade. Outside of the conservation sites, the species are exposed to the primary threats of powerlines, artificial lights, and predation. The conservation sites are within the portion of Kauaʻi that lacks powerlines and artificial lights and where active management for the species occurs (e.g., predator control). For more information, refer to the *Presence in Plan Area* sections.

Adaptive Management Program, of the Draft HCP for specific information) to refine the understanding of the seabird population trends and update model assumptions.

Both the JCS and PDM account for the seabird species' life history traits (e.g., longevity, age to reproduction, reproductive success), biology, and sources of natural causes of death. The models also account for human-caused effects such as historical, current, and future anticipated powerline collisions, fallout due to light attraction, and conservation activities. Information regarding the above effects on seabirds are provided in Section 3.2.2, *Affected Environment*, Section 3.2.3, *Environmental Consequences*, and Section 4.2, *Past, Present, and Reasonably Foreseeable Future Actions*. The population trends provided in each scenario are an overall indication of the status of the species because they reflect the effects (i.e., beneficial and adverse, natural and human-caused) from past, present, and future actions and the proposed project on the seabirds. These two modeling approaches were developed using the best available information to help inform the understanding of the species' population dynamics. These models are not directly comparable and it is likely that none of the modeling scenarios are a completely accurate picture of what is happening with the species. Rather, both model approaches are tools that help us understand the range of possible scenarios. It is anticipated that some portions of the Kauaʻi population may be more aligned with the individual scenarios than others.

The ʻakēʻakē (band-rumped storm-petrel, *Hydrobates castro*) populations on Kauaʻi are largely unknown due to their known breeding sites being in remote and inaccessible locations. Subsequently, modeling is not available to assess how the ʻakēʻakē (band-rumped storm-petrel) population on Kauaʻi will be affected by the measures outlined in the EIS alternatives.

3.2.1.2 Waterbirds

Resources consulted to prepare the affected environment section for waterbirds included scientific papers, the recovery plan for Hawaiian waterbirds (USFWS 2011b), the Draft HCP, and the 2015 SWAP (DLNR 2015). Section 3.2.3.2 assesses the impact of the Covered Activities described in the Draft HCP on covered waterbirds for the four EIS alternatives. The information on species' biology, habitat use, threats, and population trends as discussed in Section 3.2.2.2, *Waterbirds*, and Appendix 3A (*Species Accounts*) of the Draft HCP was used to assess impacts of each alternative.

3.2.1.3 Honu (Green Sea Turtle)

In Section 3.2.2.3, information regarding the status and the most recent distribution of honu (green sea turtle) in the Plan Area was obtained from documents from regulatory agencies of the Service, National Marine Fisheries Service (NMFS), and DLNR. Information specific to the species' biology such as basking, breeding, and nesting behavior was obtained from relevant scientific articles.

Section 3.2.3.3 assesses the impacts of light attraction from KIUC streetlights and implementation of a turtle nest detection and shielding program as a conservation measure in the Draft HCP on honu (green sea turtle). Because powerline collisions would not affect honu (green sea turtle), such impact is not assessed. Scientific research articles on the general impacts of lighting on honu (green sea turtle) behavior were used when analyzing the environmental consequences for this species for all four of the alternatives. Applicable assumptions from Section 3.1.2, *Analysis Assumptions*, were used when analyzing the impacts on honu (green sea turtle) in Section 3.2.3.3.

3.2.2 Affected Environment

This section on the affected environment summarizes each of the Covered Species' listing information, distribution and general behavior, nesting and breeding behavior, threats, presence in the Plan Area, population trends, and population estimates for the island of Kauaʻi.

3.2.2.1 Seabirds

The three seabirds covered in the Draft HCP include ʻaʻo (Newell's shearwater), ʻuaʻu (Hawaiian petrel), and the Hawaiʻi distinct population segment (DPS) of ʻakēʻakē (band-rumped storm-petrel). Each of these seabirds is pelagic, spending the majority of their lives at sea and coming to land only to breed (Spear et al. 2007; Ainley et al. 2014). They generally nest in burrows. The breeding season typically is from March through December, although this varies among the species. During the non-breeding season, the covered seabirds forage throughout the tropical Pacific.

ʻAʻo (Newell's Shearwater)

Listing Information

ʻAʻo (Newell's shearwater) is listed as threatened under the ESA (40 *Federal Register* 44149 [Oct. 28, 1975]) but no critical habitat has been designated. The species is also listed as threatened under the state HRS, Chapter 195D, Section 195D-4, Endangered and Threatened Species.

General Distribution and Behavior

ʻAʻo (Newell's shearwater) is a member of the seabird family Procellariidae (Ainley et al. 2020) that is endemic to the Main Hawaiian Islands (MHI) (Niʻihau, Kauaʻi, Oʻahu, Molokaʻi, Maui, Lānaʻi, Kahoʻolawe, and Hawaiʻi). ʻAʻo (Newell's shearwater) are present year-round in the eastern tropical Pacific Ocean, particularly in waters around the MHI. During the non-breeding season (winter and autumn), ʻaʻo (Newell's shearwater) is highly pelagic, found mostly east and south of the Hawaiian Islands (Ainley et al. 2020). During this time, they are absent within 125 mi (201 km) of the Hawaiian Islands (Spear et al. 1995a).

ʻAʻo (Newell's shearwater) rely heavily on tuna and other large, predatory fish to drive prey (predominantly squid) toward the ocean surface (Spear et al. 2007; Ainley et al. 2014). ʻAʻo (Newell's shearwater) capture prey by pursuit-plunging (whereby the bird submerges completely and pursues food for a substantial distance underwater) (Ainley et al. 2020). Flight is strong, with rapid wing beats interspersed with short glides (Spear and Ainley 1997a, 1997b).

ʻAʻo (Newell's shearwater) breed at a late age (6 years to first breeding) and have low fecundity and high adult survival (Warham 1990; Ainley et al. 2001; Griesemer and Holmes 2011). There is no specific information on their longevity. Based on what is known among other shearwaters, it is reasonable to assume they can live more than 30 years (Ainley et al. 2001).

Nesting and Breeding Behavior

ʻAʻo (Newell's shearwater) remain at sea for the first few years of life. Adults arrive at inland breeding sites in late March/early April. From late April and possibly through mid-May, breeding adults forage at sea (Raine and Banfield 2015). Nests are buried in thick vegetation, around ferns and tree roots in dense forests, steep slopes, and cliffs (KESRP 2019a). Breeding pairs lay a single egg between late May and early June. Through October, both parents embark on daily trips to sea.

Provisioning by both adults continues through September (Ainley et al. 2014). Fledglings fly from burrows to sea from late September through mid-November and peak in October. Breeding is restricted to the southeastern Hawaiian Islands.

Threats

ʻAʻo (Newell's shearwater) faces numerous threats that have led to major declines in their population and continue to affect the species. These threats include collisions with powerlines, attraction to artificial lighting, predation by introduced species, habitat loss, and oceanic threats exacerbated by climate change. Powerline collisions are a major issue because seabirds fail to see powerlines during their nocturnal flights, leading to injury or death (Travers et al. 2021, 2023). Seabirds colliding with powerlines on Kauaʻi likely occurred prior to when it was documented in the early 1990s (Cooper and Day 1998); however, the extent was not fully understood until an effective monitoring method was developed through the KIUC Short-term HCP. Artificial lighting causes fledglings, and sometimes adults, to become disoriented, causing them to circle lights and eventually fall to the ground (referred to as *fallout*) (Telfer et al. 1987). In the process of falling, they may collide with structures. Once grounded, they are vulnerable to being killed by introduced predators or vehicles. Another major threat is predation by introduced animals such as feral cats, rats, pigs, barn owls, and feral bees (Raine et al. 2020, 2023). Predation adversely affects the species by reducing survivorship of multiple life stages (i.e., egg, chick, and adult, but not pelagic juvenile stage) (Raine et al. 2020).

Habitat modification also plays a role, with human activities and nonnative animals spreading invasive plant species that reduce the availability of suitable nesting sites (USFWS 2016). For example, nonnative plants (e.g., strawberry guava [*Psidum guava*]) can form impenetrable stands of vegetation that limit access by seabirds to their burrows and potential nest sites (Duffy 2010; Vanzandt et al. 2014). The impact of climate change, such as more frequent and intense storms, rising temperatures, and habitat shifts, is expected to increase habitat modification. These environmental changes can cause physical damage to habitats, disrupt breeding, and exacerbate the spread of invasive species. In addition, fisheries pressure may affect ʻaʻo (Newell's shearwater) because they forage closely with high-value predatory fish like yellowfin tuna (Spear et al. 2007). Decline of the tuna may affect the feeding patterns of ʻaʻo (Newell's shearwater). The combination of these threats, both human-induced and natural, has led to a decline in the shearwater population on Kauaʻi and continues to affect the species.

Presence in Plan Area

Historically, ʻaʻo (Newell's shearwater) are thought to have occupied the mountain slopes on Kauaʻi including those on the eastern and southern sides of the island. It is estimated that 90 percent of the known ʻaʻo (Newell's shearwater) population occurs on Kauaʻi (Ainley et al. 2020). Their current distribution in the Plan Area is based on contemporary audio surveys is presented in Figure 3.2-1. The majority of the ʻaʻo (Newell's shearwater) breeding areas are concentrated in the northwestern (e.g., Nā Pali Coast, Upper Limahuli Preserve, Hono O Nā Pali) and northern (e.g., valleys of Wainiha, Hanalei, and Lumahaʻi) portions of Kauaʻi, in mountainous areas within deep valleys and along edges of steep ridges (Ainley and Holmes 2011; Ainley et al. 2020). These areas are typically dominated by dense vegetation, and habitat suitability models suggest that slope, density of rock fragments within the soil, and native vegetation are key factors predicting their known distribution in the Plan Area (Troy et al. 2016). Currently, ʻaʻo (Newell's shearwater) generally do not nest in coastal regions with the exception of two sites located at Kīlauea Point National Wildlife Refuge (NWR). One site at

Kīlauea Point NWR contains a few breeding pairs, which was established through a cross-fostering translocation project that occurred between 1978 and 1980 (Byrd et al. 1984). The other site is within the Nihoku predator exclusion fence in which 86 ʻaʻo (Newell's shearwater) were translocated from 2016 to 2020 (Young et al. 2023).

Most managed sites (e.g., with intensive predator control) for ʻaʻo (Newell's shearwater) occur within the northwestern portion of Kauaʻi and are currently managed via KIUC (i.e., North Bog, Pōhākea, Pōhākea PF, Hanakāpi'ai and Hanakoa units within the Hono O Nā Pali NAR, Upper Limahuli Preserve, Upper Mānoa Valley, Honopū, and Honopū PF) (Draft HCP Appendix 5E, Table 5E-1). These sites are in the portion of the island least affected by threats of powerlines and artificial light sources. Predation by introduced predators is the primary threat to the northwestern colonies, although predator control efforts have significantly reduced this threat in managed conservation areas. Furthermore, for managed areas, there are ample survey data available from auditory surveys, acoustic monitoring, and burrow monitoring efforts.

The remaining ʻaʻo (Newell's shearwater) are distributed in unmanaged areas in the following portions of Kauaʻi: Hanalei, Wainiha, and Lumahaʻi Valleys, Nā Pali Coast, Waimea Canyon, and areas adjacent to the Conservation Sites for the Draft HCP. ʻAʻo (Newell's shearwater) colonies in unmanaged areas outside of the northwestern portion of the island are primarily affected by threats of powerline collisions, light attraction, and predation (Troy et al. 2016). Information and data regarding the species within these areas come from radar surveys, powerline collision monitoring, SOS program data, auditory surveys, and acoustic monitoring via song meters (e.g., Nā Pali Coast).

Population Trend Scenarios

Despite over 30 years of monitoring and conservation of ʻaʻo (Newell's shearwater) and more intensive work over the last 10 years, uncertainty remains about the current status and population trend for the species. This uncertainty is a function of the long-lived and cryptic nature of the species' life history, as well as the difficulty in assessing the relative effects of the different threats across the species' geographic scope and life stages. Multiple different datasets help to inform our understanding of the species, including:

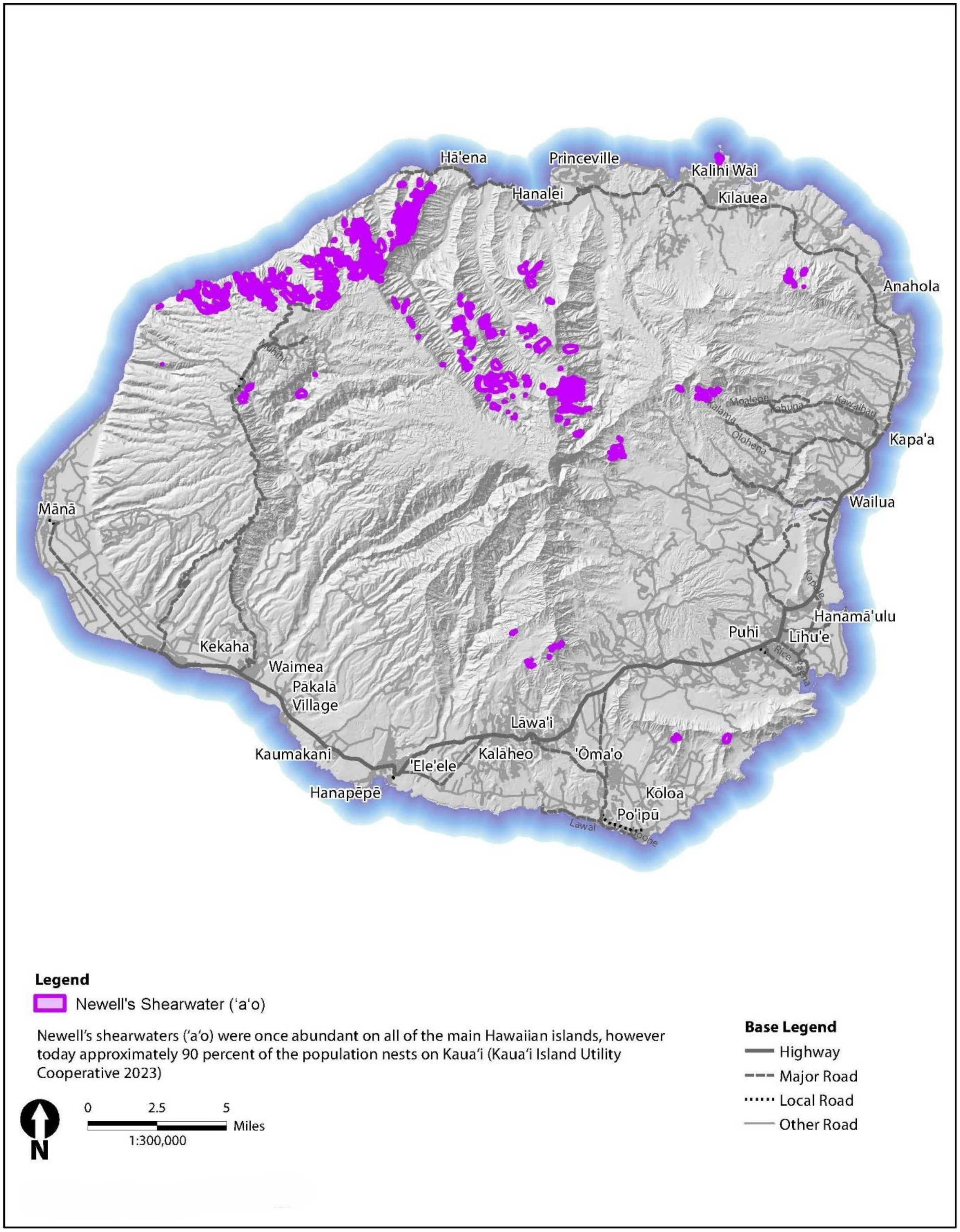
- Radar Monitoring: This dataset has been consistently collected from 1993 to 2022 at sites from Wainiha to Kekaha (Wainiha and Lumahaʻi sites added in 2006). This dataset is the strongest dataset to demonstrate long-term trends, but may not account for the majority of the northwestern portion of the island, where a major proportion of the population is currently located.
- Powerline Collision Monitoring: This dataset has been collected annually since 2012 at sample powerline segments. The data are used to infer trends of powerline collisions by seabirds over the entire powerline system. These data do not account for the majority of the central and northwestern portions of the island. Also, given that 80 percent of powerline strikes are reported to be from subadults (Ainley et al. 2001), it primarily accounts for that age class.
- Colony Monitoring: The dataset has been collected since before 2001 through call rate monitoring, auditory surveys, and burrow monitoring. This dataset is constrained by accessibility of the sites, expenses associated with monitoring (e.g., helicopter costs), and constraints on the power of the data for analysis. Monitored colonies are primarily in relatively accessible locations of the northwestern portion of the island, which tend to be lower-slope areas with potentially higher depredation effects.

- SOS Program: This dataset has been collected since the SOS program was initiated in 1979 and provides information on seabirds recovered and turned into the program by the public and volunteers. Ninety-five percent or more of the seabirds collected are fledglings. Due to the opportunistic nature of seabirds being turned in, the data are used to corroborate population trends via other datasets.
- At-Sea Monitoring: This dataset is derived from observations conducted aboard research vessels from 2006 through 2012. The collection locations do not necessarily overlap yearly, do not account for differences in foraging areas between subadults and adults, and may not account for the complete extent of the foraging area.

These datasets help inform the status of the species and how the species' population may change over time given certain management actions. No single dataset is representative of the population as a whole; however, it is likely that individual colonies may be represented by the dataset more closely aligned with that colony's unique circumstances. For example, ʻaʻo (Newell's shearwater) in the northwestern portion of Kauaʻi are better represented by the colony monitoring dataset than the radar or SOS program datasets. Alternatively, ʻaʻo (Newell's shearwater) in disparate colonies closest to the developed and unmanaged portions of Kauaʻi are likely better represented by the radar and SOS program datasets.

Modeling can assist us in addressing the inherent variability between the datasets and how they influence our understanding of species' outcomes. Throughout this EIS we use models as a means of analyzing the wide extent of best available information and informing management decisions.

The understanding of the species on Kauaʻi has changed drastically over the past 15 years from a dramatic population decline (Trend 1) to a population that is neither increasing nor decreasing (Trend 2). Data derived for Trend 1 and 2 were used to inform four of the five population modeling scenarios (mid-point and flat-line scenarios for the JCS and the worse-case and stable-trend scenarios for the PDM) described in Section 3.2.1.1, *Seabirds*. It is unknown and uncertain as to how Trend 1 and 2 along with overall impacts on the species (e.g., powerline collisions, fallout from light attraction, predation, climate change) affect the long-term survival of the species.



Sources: ICF 2025; KESRP 2019b; USFWS 2020a

Figure 3.2-1. Known Distribution of Breeding Areas for ʻAʻo (Newell's Shearwater) on Kauaʻi Based on Auditory Surveys

Trend 1—Steep Decline (1993–2013)

Based on data, the ʻaʻo (Newell's shearwater) population on Kauaʻi experienced a steep decline. Raine et al. (2017a) used 21 years (1993–2013) of radar survey data and 37 years (1979–2015) of data on fledglings rescued by the SOS program on Kauaʻi to assess the population trends of ʻaʻo (Newell's shearwater). The radar survey data estimated annual numbers of adult ʻaʻo (Newell's shearwater) flying from the ocean to inland breeding grounds during the peak seasonal incubation period between May and mid-July. Data were gathered at 13 different sites starting at Hanalei on the north, down along the east coast (Wailua), to the last site at Kekaha on the south shore. The SOS data provided insight into the changes in the numbers of fallout-related fledglings of ʻaʻo (Newell's shearwater). The data represented a continuous dataset of 30,552 rescued fledglings of ʻaʻo (Newell's shearwater) reported during the 37-year period. Together, the two datasets provide a view of the population trend for most of the geographic area of Kauaʻi (not including the northwestern portion of the island where most of the managed colonies occur).

Radar data indicated a 94-percent decrease in the overall ʻaʻo (Newell's shearwater) population during the survey period (1993–2013), with an average rate of decline of 13 percent per year (Raine et al. 2017a). Ninety-two percent of the radar sites showed this sharp decline. Radar data from 1993 to 2020 showed an average rate of decline of 6.9 percent per year (Raine and Rossiter 2020). Ninety-two percent of the radar sites showed this sharp decline. Therefore, radar-based population counts indicated two decades of dramatic decline of ʻaʻo (Newell's shearwater) on Kauaʻi. The SOS program data showed an upward population trend from 1979 to 1992, with progressively fewer rescued birds being reported. However, after the island's major hurricane (Iniki) in 1992, the data indicated a sharp and continuous downward trend in the ʻaʻo (Newell's shearwater) numbers on Kauaʻi from 1992 to 2015 (23 years); a similar trend was observed in the radar data. The large-scale declines found in this study are attributed to the significant threats facing seabirds on Kauaʻi, which include powerline collisions, light attraction, introduced predators, and habitat modification potentially exacerbated after hurricane Iniki. Although the steep decline has not continued, this sharp decline in the population may have impacts on the long-term survival of the species.

Trend 2—Stable Population (2013–Present)

An analysis based on recent radar data may suggest that the Kauaʻi subpopulation of ʻaʻo (Newell's shearwater) is neither significantly increasing nor decreasing, following the extreme decline that occurred in the population. This stable-population analysis is based on three datasets (i.e., radar, powerline collisions, and SOS program) for the portion of Kauaʻi from Wainiha to Kekaha. Radar data from 2010–2022 indicated no significant trend (increase or decrease) for either ʻaʻo (Newell's shearwater) or ʻuaʻu (Hawaiian petrel) (Raine and Rossiter 2020; Sahin 2023). The radar data used to imply a flat trend line were a subset of a longer-term dataset that began in 1993 (Sahin 2023). Additionally, powerline collision data and passage rates (number of seabirds transiting powerlines) estimated from visual nighttime observations during the powerline monitoring surveys from 2013–2019 show a relatively consistent number of annual powerline collisions and passage rates, indicating population numbers have not declined or increased (Travers et al. 2020, 2023, 2024). The years 2020–2023 are not included because significant amounts of powerline strike minimization were implemented during this timeframe. Data since 2010 from the SOS program for rehabilitating fallout birds corroborate this trend (Ainley et al. 2023).

Population Estimates for Kauaʻi

ʻAʻo (Newell's shearwater) populations are estimated using multiple approaches. Due to difficulty with studying the covered seabird species, each population estimate is derived from different data sources and sets of assumptions. Each estimate has uncertainties and limitations. When analyzed together, these approaches provide a range of reasonable estimates that possibly represents the current status of the covered seabird population. For the modeling scenarios, three different population estimates were evaluated.

Statewide population estimates are described by at-sea surveys from 1998 to 2011 in three areas in the Central and Eastern Tropical Pacific Ocean (Joyce 2016). The Joyce (2016) model predicted an estimated abundance of 27,011 ʻaʻo (Newell's shearwater) within the study area, with the 95-percent quantile upper bound being 37,125 and 18,254 as the lower bound. Kauaʻi supports roughly 90 percent of the known total population of ʻaʻo (Newell's shearwater) and is used for nesting (Ainley et al. 2020). The Joyce estimates of shearwaters at sea has limitations, and it does not represent individuals on Kauaʻi. Therefore, the PDM and JCS models used alternative population estimates more specific to Kauaʻi.

Spatially explicit estimates of ʻaʻo (Newell's shearwater) breeding pair abundance on Kauaʻi are used as the starting population of the PDM (Draft HCP Appendix 5E). These estimates were derived by auditory surveys and burrow monitoring data from managed sites on Kauaʻi and acoustic call rates from the Nā Pali Coast, with the most recently analyzed data being from 2021. This approach addresses the differences between breeding colonies located in different parts of Kauaʻi and the benefits of localized conservation efforts. For select areas (e.g., Hanalei to Kekaha), radar trend and strike estimates were used as the data source for initial population estimates. The PDM estimate of the Kauaʻi metapopulation of ʻaʻo (Newell's shearwater) in 2021 under the assumptions of the worse-case scenario is 40,454 individuals (ages 1+), with 25,140 of these individuals at breeding age (ages 6+).

The PDM further incorporates trends based on three datasets to initialize the population estimate of the worse-case scenario and stable-trend scenario (Draft HCP Chapter 5). The datasets analyzed include radar data collected by the Kauaʻi Endangered Seabird Recovery Project from 2010–2022, powerline strike data collected by KIUC from 2013–2019, and collected and rescued seabird data from the SOS program starting in 2012. The worse-case scenario of the PDM assumes the populations outside of conservation areas are in rapid decline and is intended to estimate the lower plausible bound of population trends outside the conservation sites. The initial population used in the PDM worse-case scenario is 32,292 individuals in 2025. The stable-trend scenario assumes the initial population trend outside of the conservation sites is relatively stable, and is intended to estimate the upper plausible bound of population trends outside the conservation sites. The initial population used in the PDM stable-trend scenario is 119,887 individuals in 2025.

The JCS model used an alternate starting population derived from habitat suitability models (Troy et al. 2014) combined with Archipelago Research and Conservation auditory surveys and nearest neighbor distances between active burrows (Raine pers. comm. 2021). The estimates applied the habitat suitability models to both managed and unmanaged areas of Kauaʻi. The starting population for the JCS is based on the 2020 estimate of 25,328–32,568 individuals (age 1+) on Kauaʻi. The JCS model then projected the starting population size for the beginning of the permit term in 2025 .

ʻUaʻu (Hawaiian Petrel)

Listing Information

ʻUaʻu (Hawaiian petrel), endemic to the MHI, is listed as endangered under the ESA (32 *Federal Register* 4001 [March 11, 1967]) and there is no designated critical habitat. The species is also listed as endangered under HRS Chapter 195D, Section 195D-4, Endangered and Threatened Species.

General Distribution and Behavior

ʻUaʻu (Hawaiian petrel) is a member the seabird family Procellariidae that was once abundant and widely distributed across Hawaiʻi. Currently, the species nests on Kauaʻi, Maui, Lānaʻi, and Hawaiʻi (Ainley and Holmes 2011), with smaller and more recent documentation of presence on Oʻahu (Young et al. 2019) and Molokaʻi.

ʻUaʻu (Hawaiian petrel) forage widely throughout the North Pacific (Spear et al. 1995b; Wiley et al. 2012) and occur throughout the central tropical and subtropical Pacific Ocean, as well (DLNR 2015). For example, satellite-tracked birds from Maui and Lānaʻi traveled northwestward to the Kuroshio Current/Transition Zone then eastward to the California Current before returning to Hawaiʻi (Ainley and Holmes 2011). Birds from Kauaʻi follow the same long-trip foraging routes as those from Maui and Lānaʻi, but have also been tracked making shorter foraging trips to a mere 62 mi (100 km) north of Kauaʻi (Raine et al. 2017a).

Nesting and Breeding Behavior

Currently, breeding is restricted to high elevations of Kauaʻi, Molokaʻi, Lānaʻi, Maui, and Hawaiʻi (Simons and Bailey 2020). The breeding cycle of ʻuaʻu (Hawaiian petrel) in a colony is synchronous. Breeding phenology varies among islands; in Kauaʻi (Lānaʻi and Molokaʻi), birds arrive at their colonies 2 weeks to 1 month later than those on Lānaʻi and Maui (Raine et al. 2025). On Kauaʻi, ʻuaʻu (Hawaiian petrel) typically arrive at their breeding grounds and colonies in mid-April and start forming pairs (Raine et al. 2025).

After pairing and nest building, breeding adults return to sea to build energy stores and return in late May to mid-June to lay eggs. Eggs typically hatch in July, at which point both parents fly to the ocean to forage and return to feed the nestling. The first chicks start to fledge in mid-October. Fledging peaks in November and breeding colonies are generally empty by mid-December (KESRP 2019a; Raine et al. 2025).

Key predictors of nest site selection include increased slope, an understory dominated by native vegetation (to provide protection from nonnative predators), and open canopy (Vanzandt et al. 2014).

Threats

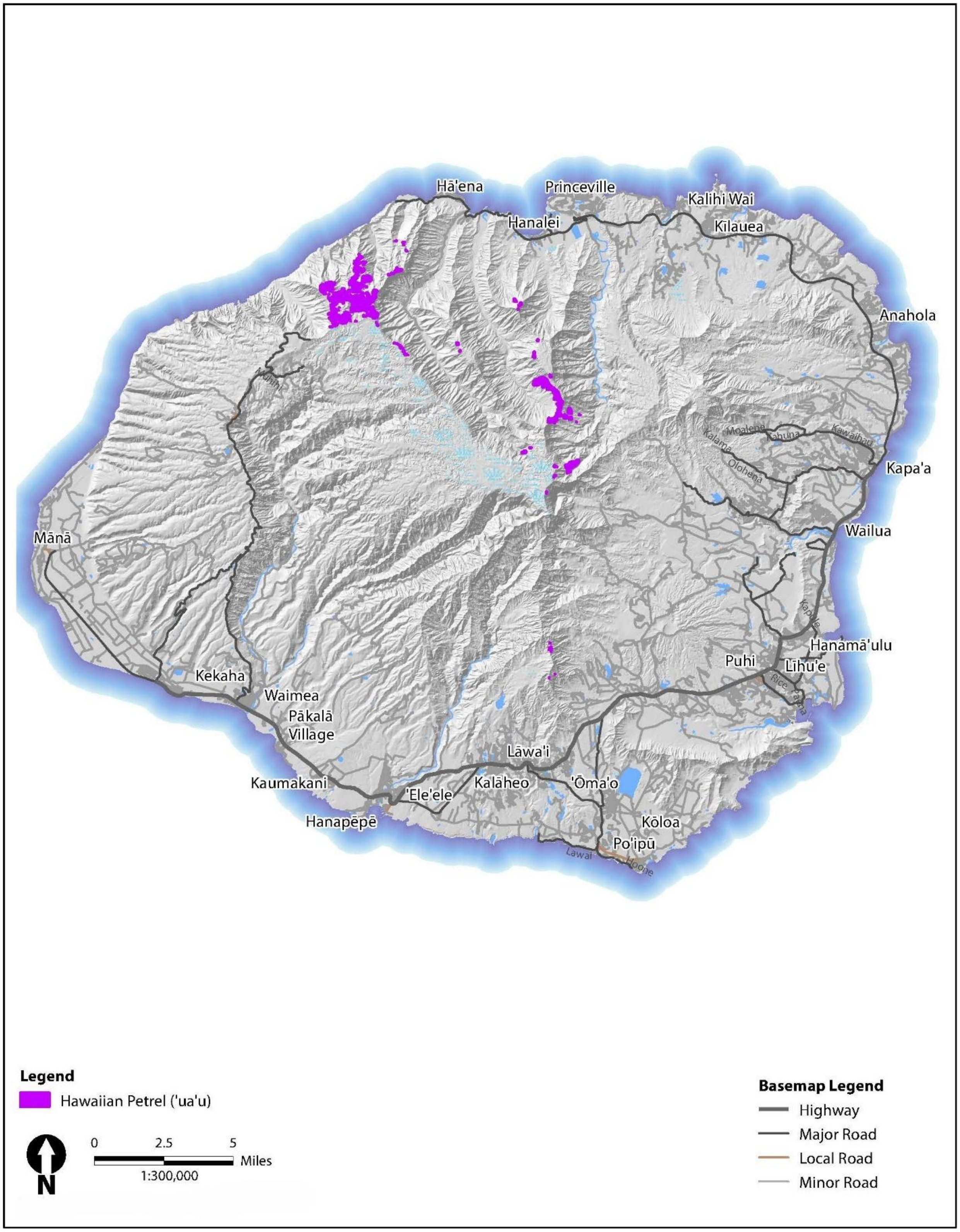
The threats facing ʻuaʻu (Hawaiian petrel) are similar to those faced by ʻaʻo (Newell's shearwater), but powerline collisions and predation are more of a threat than light attraction. Compared to ʻaʻo (Newell's shearwater), fewer ʻuaʻu (Hawaiian petrel) collide with powerlines (Travers et al. 2023a). In addition, very few ʻuaʻu (Hawaiian petrel) have been found grounded and turned into the SOS program during the fledging season compared to ʻaʻo (Newell's shearwater) (Raine et al. 2017b). Climate change and fisheries interactions pose the same threats to ʻuaʻu (Hawaiian petrel) as to ʻaʻo

(Newell's shearwater) (Draft HCP Appendix 3A). For additional information, refer to the *Threats* section for ʻaʻo (Newell's shearwater).

Presence in Plan Area

Fossil and anecdotal evidence suggests that historically, prior to Polynesian colonization, ʻuaʻu (Hawaiian petrel) were found in a variety of habitats from the mountain summits down to sea level on Kauaʻi (Olson and James 1982). Currently, the main populations on Kauaʻi are concentrated in the northwestern and central portions of the island, where no development has occurred (Figure 3.2-2). Kauaʻi supports approximately 33 percent of the total population of ʻuaʻu (Hawaiian petrel) (Raine pers. comm. as cited in Vorsino 2020). Breeding areas are in dense, montane wet forest, primarily along valley headwalls, particularly those of steep slopes covered with uluhe fern (*Dicranopteris linearis*, and *Sticherus owhyhensis*) (Troy et al. 2016). Compared to ʻaʻo (Newell's shearwater), ʻuaʻu (Hawaiian petrel) typically use habitat at higher elevations but that are less steep and less vegetated, and closer to wind-exposed ridges (Troy et al. 2016). The only current coastal nesting site, established artificially, is at Kīlauea Point National Wildlife Refuge.

Sites managed for ʻuaʻu (Hawaiian petrel) occur primarily within the Draft HCP conservation sites of Upper Limahuli Preserve, Pihea, North Bog, Pōhākea, Hanakāpi'ai, and Hanakoa (mainly predator control). These sites are away from most powerlines and light sources. Due to the remote site locations and management efforts, the covered seabirds in this area are expected to be the least affected by stressors when compared to the other subpopulations. Because breeding sites are managed and studied, these areas have the best available data (e.g., annual auditory surveys, extensive burrow searches) for population estimates based on annual monitoring surveys for breeding pairs (e.g., Raine et al. 2022).



Sources: ICF 2025; KESRP 2019b; USFWS 2020a

Figure 3.2-2. Distribution of ʻUaʻu (Hawaiian Petrel) on Kauaʻi Based on Auditory Surveys

ʻUaʻu (Hawaiian petrel) within unmanaged areas include Hanalei, Wainiha, and Lumahaʻi Valleys, and areas adjacent to the Draft HCP conservation sites. ʻUaʻu (Hawaiian petrel) are not known to occur in the Waimea Canyon area. Areas outside of the northwestern portion of Kauaʻi are most affected by powerline collisions and predation (e.g., Troy et al. 2017). Because these areas are unmanaged and largely inaccessible, data are limited to sources from radar surveys, acoustic monitoring (remote song meters), powerline collision monitoring, and SOS program data. ʻUaʻu (Hawaiian petrel) do not experience fallout at rates similar to ʻaʻo (Newell's shearwater), so SOS program data do not provide much information for this species.

Population Trend Scenarios

The datasets described above that were used to define the population trend scenarios for ʻaʻo (Newell's shearwater) are also applicable to ʻuaʻu (Hawaiian petrel) and data obtained through radar monitoring, powerline collision monitoring, colony monitoring, SOS program reporting, and at-sea monitoring were also used to inform the overall population trend scenarios for ʻuaʻu (Hawaiian petrel).

The understanding of the species on Kauaʻi has changed drastically over the past 15 years from a dramatic population decline (Trend 1) to a population that is neither increasing nor decreasing (Trend 2). Data derived for Trend 1 and 2 were used to inform four of the five population modeling scenarios (mid-point and flat-line scenarios for the JCS and the worse-case and stable trend scenarios for the PDM) described in Section 3.2.1.1, *Seabirds*. It is unknown and uncertain as to how Trend 1 and 2 along with overall impacts on the species (e.g., powerline collisions, fallout from light attraction, predation, climate change) affect the long-term survival of the species.

Trend 1—Steep Decline

Based on data, the ʻuaʻu (Hawaiian petrel) population on Kauaʻi experienced a steep decline. Raine et al. (2017a) analyzed 21 years of ornithological radar data at eight sites across Kauaʻi, including both the northern and southern shores of the island. The sites in this analysis were not the mountain conservation areas but were along roadways surveyed by a truck-mounted radar system. The radar data indicated that ʻuaʻu (Hawaiian petrel) experienced a long-term population decline across the island, with a 78-percent reduction in radar targets from 1993–2013. Most radar detections were recorded on the northern shore sites, including at Wainiha, Lumahaʻi (surveyed starting in 2006), and Hanalei Valleys (surveyed starting in 1993), which are known to be the remaining primary breeding sites for ʻuaʻu (Hawaiian petrel). The radar detections at the southern shore sites were low for all the years analyzed. Personal observations by research biologists suggest the former large colonies in the southern areas of Kalāheo and Kaluahonu have decreased dramatically over recent decades. Analysis by Raine et al. (2017a) contrasted results presented by Day et al. (2003), which suggested the ʻuaʻu (Hawaiian petrel) populations had possibly increased from 1993 to 2001. The reanalysis by Raine et al. standardized the times used in the analysis, which changed the time periods assessed in the radar observation surveys. By standardizing the dataset and including additional years of data, Raine et al. concluded the ʻuaʻu (Hawaiian petrel) population on Kauaʻi followed a similar declining trend that the ʻaʻo (Newell's shearwater) population experienced. Although the steep decline has not continued, this sharp decline in the population over a period of time may have impacts on the long-term survival of the species.

Trend 2—Stable Population

An alternative analysis based on more recent radar data suggests the Kauaʻi subpopulation of ʻuaʻu (Hawaiian petrel) appears to be stable (i.e., showing no trend of significantly increasing or decreasing). This analysis is based on three datasets, primarily in the high-strike zone of Kekaha to Hanalei. Radar data from 2010–2022 indicated no significant trend (increase or decrease) for either ʻaʻo (Newell's shearwater) or ʻuaʻu (Hawaiian petrel). The radar data used are a subset of a longer-term dataset that began in 1993 (Sahin 2023). Additionally, powerline collision data and passage rates (number of seabirds transiting powerlines) estimated from visual nighttime observations during the powerline monitoring surveys from 2013–2019 show a relatively consistent number of annual powerline collisions and passage rates, indicating population numbers have not declined or increased (Travers et al. 2020, 2023, 2024). The years 2020–2023 are not included in this stable trend because powerline strike minimization took place in this timeframe, and showed significant reductions in powerline strikes (Travers et al. 2022). Data since 2010 from the SOS program for rehabilitating fallout birds corroborate this trend (Ainley et al. 2023). This trend follows the steep decline previously described.

Population Estimates (Overall and Kauaʻi)

ʻUaʻu (Hawaiian petrel) populations are estimated using multiple approaches. Due to difficulty with studying the covered seabird species, each population estimate is derived from different data sources and sets of assumptions. Each estimate has uncertainties and limitations. When analyzed together, these approaches provide a range of reasonable estimates that possibly represents the current status of the covered seabird population. For the modeling scenarios, three population estimates were evaluated.

Statewide population estimates for ʻuaʻu (Hawaiian petrel) are described by at-sea surveys from 1998 to 2011 in three areas in the Central and Eastern Tropical Pacific Ocean (Joyce 2016). The Joyce (2016) model of ʻuaʻu (Hawaiian petrel) yielded an estimate of minimum population of 52,186 ʻuaʻu (Hawaiian petrel) within the entire study area over the entire survey span of 1998–2011, with the 95-percent quantile upper bounds of 67,379 birds and the lower bound of 39,823 birds. ʻUaʻu (Hawaiian petrel) are dispersed across the MHI, so the at-sea estimates capture the spread of the population, not just the Kauaʻi island subpopulation (estimated to be about 33 percent of the entire population).

Because of the spatial deficiencies, uncorrected sources of statistical bias, and other limitations detailed in the Draft HCP (Appendix 5F), the at-sea population estimates were not incorporated into the PDM or JCS model. The Joyce estimates of ʻuaʻu (Hawaiian petrel) at sea have limitations and do not represent individuals on Kauaʻi. Therefore, the PDM and JCS model used alternative population estimates as the basis of the modeling scenarios.

Spatially explicit estimates of ʻuaʻu (Hawaiian petrel) breeding pair abundance on Kauaʻi are used as the starting population of the PDM (Draft HCP Appendix 5F). As with ʻaʻo (Newell's shearwaters), these estimates were derived by auditory surveys and burrow monitoring data from managed sites on Kauaʻi and acoustic call rates for the Nā Pali Coast, with the most recently analyzed data being from 2021. This approach addresses the differences between breeding colonies located in different parts of Kauaʻi and the benefits of localized conservation efforts. For select areas (e.g., Hanalei to Kekaha), radar trend and powerline strike estimates were used as the data source for initial population estimates. The PDM population estimate of the Kauaʻi subpopulation of ʻuaʻu (Hawaiian petrel) in 2021 is 27,814 individuals (ages 1+), with 17,473 of these individuals being breeding age (ages 6+) under the worse-case scenario.

The PDM further incorporates trends based on three datasets to initialize the population of the worse-case scenario and stable-trend scenario (Draft HCP Chapter 5). The datasets analyzed include radar data collected by KESRP from 2010–2022, powerline strike data collected by KIUC from 2013–2019, and collected and rescued seabird data from the SOS program starting in 2012. The worse-case scenario of the PDM assumes the initial population inside the conservation sites is increasing, but the populations outside of conservation areas are in rapid decline. This scenario is intended to estimate the lower plausible bound of population trends outside the conservation sites. The initial population used in the PDM worse-case scenario is 28,547 individuals in 2025. The stable-trend scenario assumes the population inside the initial conservation sites is increasing and the initial population trend outside of the conservation sites is relatively stable. This scenario is intended to estimate the upper plausible bound of population trends outside the conservation sites. The initial population used in the PDM stable-trend scenario is 77,806 individuals in 2025.

The JCS model used an alternate starting population derived from habitat suitability models (Troy et al. 2014) combined with Archipelago Research and Conservation auditory surveys and nearest neighbor distances between active burrows (Raine pers. comm. 2021). The estimates applied the habitat suitability models to both managed and unmanaged areas of Kauaʻi. The starting population for the JCS model is based on the 2020 estimate of 25,278–32,173 individuals (age 1+) on Kauaʻi. The model then applied assumptions and trends to derive the starting populations of the beginning of the permit term in 2025 (Raine pers. comm. 2021).

ʻAkēʻakē (Band-rumped Storm-petrel)

Listing Information

ʻAkēʻakē (band-rumped storm-petrel) is a member of the seabird family Hydrobatidae. Recent genetic studies have found that the Hawaiian population of this species is genetically distinct from other populations throughout its global range (Taylor et al. 2019). The Hawaiʻi DPS was first listed as endangered under the ESA in 2016 (USFWS 2016). ʻAkēʻakē (band-rumped storm-petrel) is also listed as endangered under HRS Chapter 195D, Section 195D-4, Endangered and Threatened Species.

General Distribution and Behavior

ʻAkēʻakē (band-rumped storm-petrel) is found throughout tropical/subtropical areas in the Atlantic, Indian, and Pacific Oceans (Taylor et al. 2019). Three distinct breeding areas occur in the Pacific, including one in Hawaiʻi. The Hawaiʻi DPS is distributed throughout the Pacific Ocean Basin and nests in the Hawaiian Islands (Raine et al. 2017b; USFWS 2021a). ʻAkēʻakē (band-rumped storm-petrel) is nocturnal and typically flies with relatively shallow wingbeats and glides on slightly bowed wings.

During the non-breeding season, some ʻakēʻakē (band-rumped storm-petrel) remain near their breeding island. Others enter more open ocean and pelagic waters. Their at-sea distribution is relatively unknown compared to the previous two seabirds discussed; however, ʻakēʻakē (band-rumped storm-petrel) have been observed 600 mi (966 km) north and 1,000 mi (1,609 km) south of Hawaiʻi, and between Hawaiʻi and Japan (USFWS 2016). While at sea, they forage at the surface by dipping and surface seizing (USFWS 2021a). Compared to the two seabirds previously discussed, ʻakēʻakē (band-rumped storm-petrel) forage primarily at night (USFWS 2021a).

Threats

Threats to ʻakēʻakē (band-rumped storm-petrel) are expected to be comparable to those faced by ʻaʻo (Newell's shearwater), including similar climate-change related environmental stressors. The foraging behavior of ʻakēʻakē (band-rumped storm-petrel) differs from that of ʻaʻo (Newell's shearwater) because it does not associate with tunas, so changes to tuna populations are not expected to directly affect ʻakēʻakē (band-rumped storm-petrel). Rat predation is expected to affect ʻakēʻakē (band-rumped storm-petrel) more than ʻaʻo (Newell's shearwater) because it is a smaller seabird that inhabits remote areas without comprehensive predator control measures (Raine et al. 2017b).

Nesting and Breeding Behavior

The species likely does not breed until 3 to 7 years of age, and may live to 20 years (Ainley et al. 2020; USFWS 2021a). Much of the breeding biology of ʻakēʻakē (band-rumped storm-petrel) is approximated from the Galápagos Islands. The nesting season in the Galápagos occurs during the boreal summer. A single egg is laid and incubated for an average of 42 days, and young fledge in 64–70 days (Ainley and Holmes 2011). Different populations breed in distinct seasons (USFWS 2021a). Kauaʻi appears to be the primary nesting site for the Hawaiʻi DPS, although there has been documentation on Maui and Hawaiʻi. The breeding season on Kauaʻi is June through October (Raine et al. 2017b).

Presence in Plan Area

ʻAkēʻakē (band-rumped storm-petrel) bones were found at sea level elevation on Kauaʻi suggesting that historically, prior to human contact, this species occurred in coastal habitat on the island. Historically, ʻakēʻakē (band-rumped storm-petrel) have also been noted from Hanapēpē Valley and Nuʻalolo ʻĀina and Waimea Canyon (Wood et al. 2002). In terms of geographic distribution in Kauaʻi, breeding colonies and nesting locations are concentrated along the Nā Pali Coast in the northwestern and sheer cliff walls of Waimea Canyon in the southwestern part of the island (Raine et al. 2017b), both of which are associated with sparsely vegetated, steep, and remote cliffs. Small pockets of these birds also occur in some of the wetter and heavily vegetated valleys that contain exposed rocky cliff faces, such as Lumahaʻi and Wainiha. Key predictors of their distribution are average rainfall, vegetation type, and slope, and the species may be associated with steep, sparsely vegetated cliffs (Raine et al. 2017b).

In the Plan Area, evidence of the species' presence is based on vocalizations and auditory surveys (Wood et al. 2002). The 2002 study estimated there to be between 171 and 221 nesting pairs on Kauaʻi (Wood et al. 2002; USFWS 2016, 2021a), making it home to the largest population in the archipelago. A review of available literature from Wood et al. (2002) on birds from Kauaʻi indicates that the nesting cycle may be up to 184 days between the arrival of adults to fledging of chicks. The study suggests that adults copulate 39 days after arriving, lay eggs 33 days later, incubate for 52 days, and fledge 70 days post hatching. A more recent study incorporating human auditory surveys, automated acoustic surveys, mist-netting, and data from seabird rescue programs indicates that adult ʻakēʻakē (band-rumped storm-petrel) arrive on Kauaʻi in late May and finish egg laying by mid-June, and chicks fledge from late September to mid-November (Raine et al. 2017b).

Population Estimates for Kauaʻi

The Hawaiian population of ʻakēʻakē (band-rumped storm-petrel) is largely unknown. The known breeding sites of ʻakēʻakē (band-rumped storm-petrel) on Kauaʻi are remote and largely inaccessible, making population estimates difficult for this species. Compared to historic population levels and distributions, ʻakēʻakē (band-rumped storm-petrel) appears to be significantly reduced in numbers and range when compared to pre-Polynesian colonization (Raine et al. 2017b).

3.2.2.2 Waterbirds

The five waterbirds covered in the Draft HCP include aeʻo (Hawaiian stilt, *Himantopus mexicanus knudseni*), koloa maoli (Hawaiian duck, *Anas wyvilliana*), ʻalae keʻokeʻo (Hawaiian coot, *Fulica alai*), ʻalae ʻula (Hawaiian common gallinule, *Gallinula galeata sandvicensis*), and nēnē (Hawaiian goose, *Branta sandvicensis*). Each of these waterbirds is endemic to Hawaiʻi (i.e., only found in Hawaiʻi) and is listed as endangered at the state and federal levels, except for nēnē (Hawaiian goose), which is listed as threatened. Apart from the more terrestrial nēnē (Hawaiian goose), the covered waterbirds are restricted to wetlands and open-water habitat in Kauaʻi. All covered waterbirds are non-migratory, with exact movements within Kauaʻi and between islands being species dependent. Long-term census data indicate that the statewide population of the covered waterbirds are stable and/or increasing, with overall population trends being influenced by population trends on Kauaʻi (Paxton et al. 2021).

Aeʻo (Hawaiian Stilt)

Listing Information

Aeʻo (Hawaiian stilt), a subspecies of black-necked stilt (*Himantopus mexicanus*), is a long-legged, slender shorebird with a long, thin beak. Aeʻo (Hawaiian stilt) was first listed as endangered under the ESA in 1970. In 2021, the Service proposed reclassifying and downlisting this species to threatened (USFWS 2021b). This review process remains ongoing. Critical habitat has not been designated. Aeʻo (Hawaiian stilt) is also listed as endangered under HRS Chapter 195D, Section 195D-4, Endangered and Threatened Species.

Distribution and General Behavior

Aeʻo (Hawaiian stilt) is a wading bird present in wetland habitats below 660 feet (201 m) elevation on all the MHI except Kahoʻolawe (USFWS 2011b, 2020b). Aeʻo (Hawaiian stilt) are opportunistic feeders, using a range of aquatic habitats. Their habitat use is limited by water depth (shallow) and vegetation cover, and they typically forage in early successional marshland or aquatic habitat in waters shallower than 9 inches (22.9 centimeters) (USFWS 2011b).

Aeʻo (Hawaiian stilt) frequently move among wetland habitats and are known to use ephemeral lakes, alkaline ponds, anchialine pools, prawn farm ponds, marshlands, and tidal flats. Aeʻo (Hawaiian stilt) most commonly walk or wade over short distances as opposed to flying. They consume a variety of invertebrates and other aquatic organisms between their foraging and breeding habitat daily (USFWS 2011b).

Nesting and Breeding Behavior

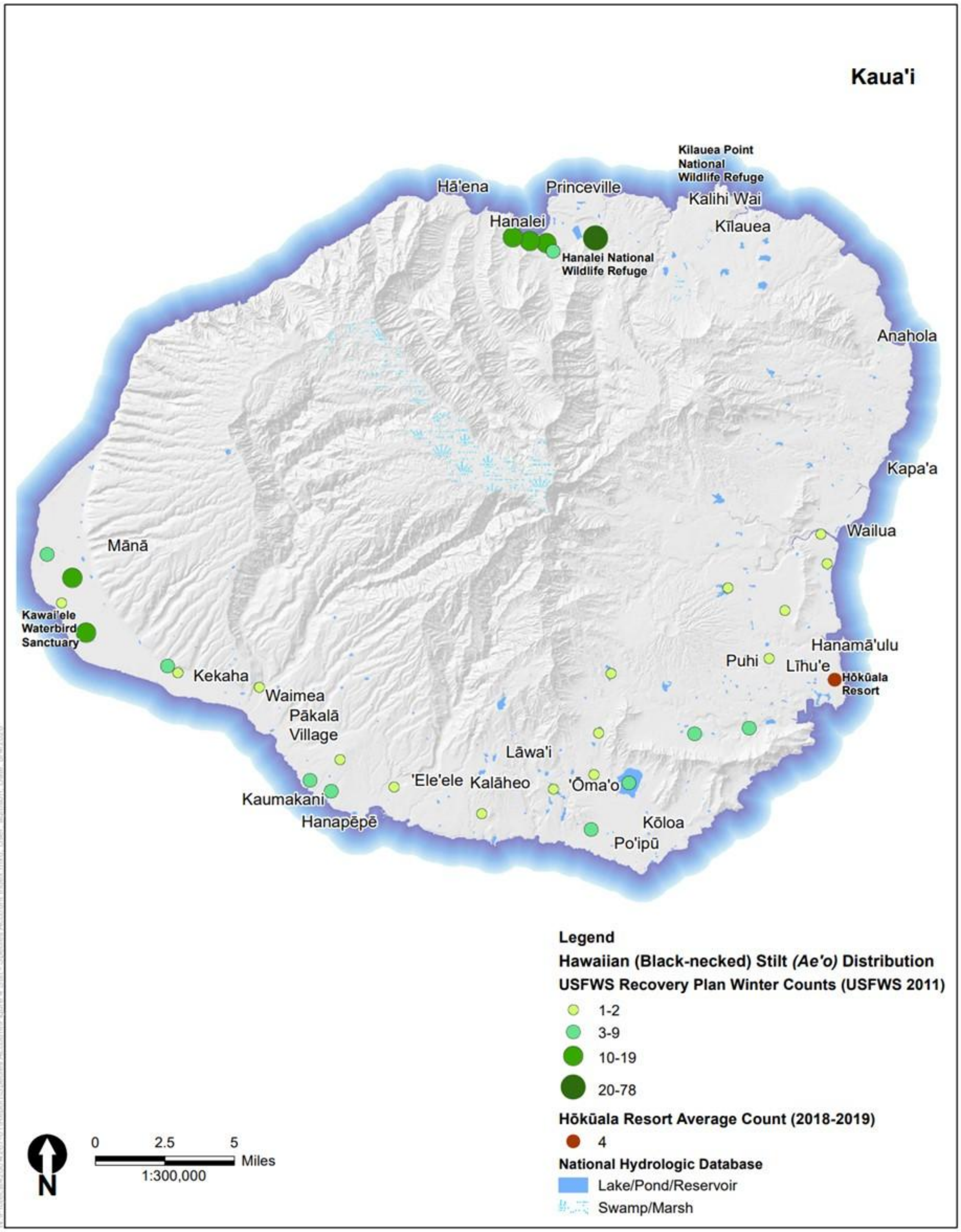
Minimal information on the lifespan and survivorship of aeʻo (Hawaiian stilt) is available (USFWS 2011b). Aeʻo (Hawaiian stilt) nesting season typically extends from mid-February through August, with variation based on water levels. Stilts normally lay three to four eggs, and these eggs are incubated for approximately 24 days (USFWS 2011b). Chicks depart their nests within 24 hours of hatching and remain with their parents for several months afterward. Chicks accompany adults on their daily foraging as late as February of the year after hatch (Robinson et al. 2020). The highest densities of nests occur on large mudflat expanses interspersed with low-growing vegetation (USFWS 2011b). Nests are generally shallow depressions lined with stones, twigs, and debris.

Threats

Threats affecting aeʻo (Hawaiian stilt) include predation by invasive mammals, wetland habitat loss, disease, and environmental contaminants (USFWS 2011b). Predation and habitat loss, however, are thought to be the greatest threats to aeʻo (Hawaiian stilt) (USFWS 2011b). Predation by rats, bullfrogs (*Lithobates catesbeianus*), feral cats, and feral dogs is a direct threat to the recovery of aeʻo (Hawaiian stilts). Rats and bullfrogs mostly target eggs and chicks, while feral cats and dogs target chicks, subadults, and adults (USFWS 2020b). Loss of wetlands through filling and draining for agriculture and development has largely contributed to the loss of wetland habitats used by aeʻo (Hawaiian stilt) (USFWS 2011b). Hydrological alterations caused by flood control and channelization have resulted in making some available wetland habitats less suitable for aeʻo (Hawaiian stilt) by altering water depths and timing of water level fluctuations and altering salinity (USFWS 2011b). Avian botulism caused by bacteria known as *Clostridium botulinum* (type C) is a deadly disease that threatens aeʻo (Hawaiian stilt) (USFWS 2020b). Other emerging diseases that can potentially be a threat to aeʻo (Hawaiian stilt) are West Nile virus and avian influenza H5N1 or "bird flu" (USFWS 2011b). Even though there is one record of aeʻo (Hawaiian stilt) colliding with a powerline, there is no evidence that collision with utility structures is having a major impact on aeʻo (Hawaiian stilt) (Travers et al. 2019, 2023).

Presence in Plan Area

Aeʻo (Hawaiian stilt) are present throughout the area (Figure 3.2-3). They are numerous in large river valleys (e.g., Hanalei, Wailua, Lumahaʻi) and at reservoirs (USFWS 2011b). There is a considerable amount of movement of aeʻo (Hawaiian stilt) between Kauaʻi and Niʻihau, depending on flooding and rainfall (USFWS 2011a). Surveys of the statewide aeʻo (Hawaiian stilt) population conducted between 2012 and 2016 found that the 5-year minimum average population estimate on Kauaʻi was 1,932 (1,552–2,385) (Paxton et al. 2021). Long-term (1986–2016) and short-term (2006–2016) trends suggest that population sizes on Kauaʻi are increasing (Paxton et al. 2021).



Sources: ICF 2025; David et al. 2019; DOFAW 2021; USFWS 2011b

Figure 3.2-3. Distribution of Aeʻo (Hawaiian Stilt) on Kauaʻi

Koloa Maoli (Hawaiian Duck)

Listing Information

Koloa maoli (Hawaiian duck) is endemic to the MHI and part of the family Anatidae (*Anseriformes*). Koloa maoli (Hawaiian duck) was first listed as endangered under the ESA in 1967 (USFWS 1967). No critical habitat has been designated. This species is also listed as endangered under HRS Chapter 195D, Section 195D-4, Endangered and Threatened Species.

Distribution and General Behavior

Koloa maoli (Hawaiian duck) historically used a wide variety of natural and artificial wetland habitats including freshwater marshes, flooded grasslands, montane stock ponds, streams, forest swamplands, kalo patches, lotus (*Nelumbo nucifera*) farms, irrigation ditches, reservoirs, and mouths of larger streams between sea level and 9,900 feet (3,017.5 m) (USFWS 2011b). Koloa maoli (Hawaiian duck) are currently present on Niʻihau, Kauaʻi, Oʻahu, Maui, and Hawaiʻi, primarily in montane streams and marshlands (USFWS 2011a). The total population appears to be increasing based on biannual waterbird counts, primarily because of increases in its population on Kauaʻi. In the Plan Area, koloa maoli (Hawaiian duck) participate in seasonal movements, occurring in the lowland wetlands to more secluded habitats in the summer (USFWS 2011b).

Koloa maoli (Hawaiian duck) are opportunistic feeders, primarily feeding in wetlands and streams shallower than 9.4 inches (24 centimeters) deep (Engilis et al. 2020). They are strong flyers and are typically non-migratory, although some seasonal, altitudinal, and inter-island movements occur (Engilis and Pratt 1993).

Nesting and Breeding Behavior

Koloa maoli (Hawaiian duck) breed year-round, but primarily nest between March and June (USFWS 2011b). Nests are constructed on the ground near water, often in tall grass, and are made of vegetation and lined with feathers. Most chicks hatch between April and June (USFWS 2011a). Koloa maoli (Hawaiian duck) reach sexual maturity after a year. Nesting or molting peaks between June and August (USFWS 2011a).

Koloa maoli (Hawaiian duck) interbreed with mallards (*Anas platyrhynchos*) that have been introduced to the MHI. Pure koloa maoli (Hawaiian duck) occur primarily on Kauaʻi, which has low levels of hybridization (USFWS 2011b).

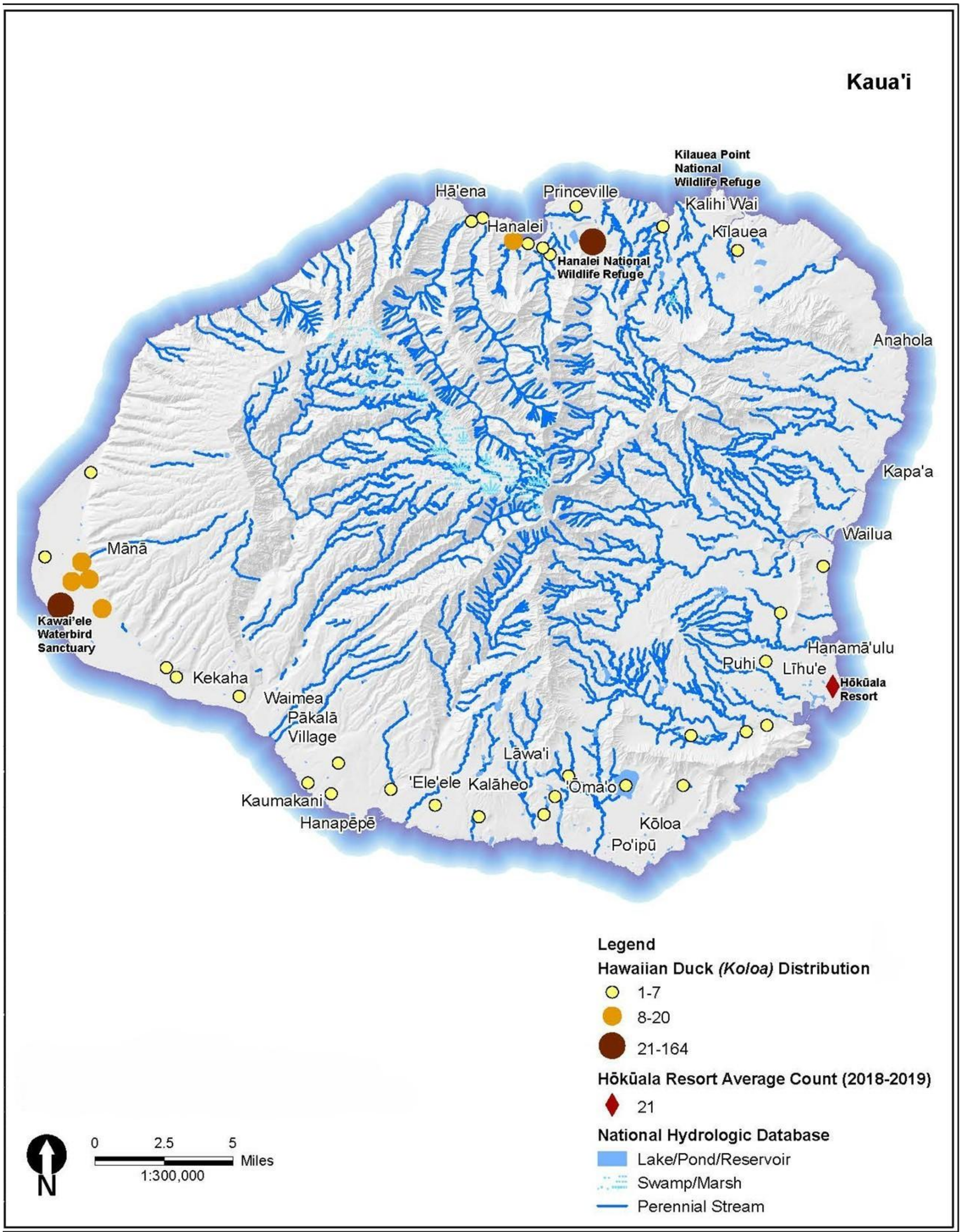
Threats

Similar to other Hawaiian waterbirds, threats to Hawaiian duck (koloa maoli) include predation by invasive mammals, loss of wetland habitat, environmental contaminants, and disease (USFWS 2011b). The largest threat to koloa maoli (Hawaiian duck) is hybridization with the invasive mallard that was introduced to the islands for sport hunting (USFWS 2011b). However, compared to Maui and Oʻahu where most of the ducks are mallard-Hawaiian duck (Koloa maoli) hybridization, there are fewer hybrids on Kauaʻi (Pyle and Pyle 2017). Although there are some instances of ducks colliding with powerlines, there is no evidence that collision with utility structures is having a major impact on Hawaiian duck (koloa maoli) (Travers et al. 2019, 2023).

Presence in Plan Area

Koloa maoli (Hawaiian duck) use lowland ponds and wetlands in the Plan Area to feed and loaf, and they nest along montane streams (USFWS 2011b). They primarily feed in managed wetlands and kalo ponds and use upper reaches of the Hanalei River watershed for roosting and potentially foraging. There are seasonal movements of birds from lowland wetlands to more secluded, ephemeral wetlands on Niʻihau in response to changes in precipitation, flooding, and drying (Engilis and Pratt 1993; USFWS 2011a; Engilis et al. 2020).

The koloa maoli (Hawaiian duck) population on Kauaʻi is substantially larger than on other islands (Figure 3.2-4) and is thought to be increasing (Paxton et al. 2021). The koloa maoli (Hawaiian duck) population is estimated to be approximately 2,200 individuals, with 2,000 true (non-hybrid) koloa maoli (Hawaiian duck) (Engilis et al. 2020); however, the state's biannual surveys typically do not include remote wetlands and streams, where an estimated greater than 50 percent of the Kauaʻi koloa maoli (Hawaiian duck) population is believed to occur.



Sources: ICF 2025; David et al. 2019; DOFAW 2021; USFWS 2011b

Figure 3.2-4. Distribution of Koloa Maoli (Hawaiian Duck) on Kaua'i

ʻAlae keʻokeʻo (Hawaiian Coot)

Listing Information

ʻAlae keʻokeʻo (Hawaiian coot) is a member of the rail family, Rallidae. Endemic to Hawaiʻi, ʻalae keʻokeʻo (Hawaiian coot) is listed as endangered under the ESA (USFWS 1970). There is no designated critical habitat. The species is also listed as endangered under HRS Chapter 195D, Section 195D-4, Endangered and Threatened Species.

Distribution and General Behavior

ʻAlae keʻokeʻo (Hawaiian coot) is endemic to the Hawaiian Islands. Historically, the species was present on all MHI except Lānaʻi and Kahoʻolawe. Currently, it is found on all the MHI except Kahoʻolawe (DLNR 2015). ʻAlae keʻokeʻo (Hawaiian coot) are typically found in coastal plains and coastal plain wetlands, and they prefer lowland wetland habitats that contain emergent plant growth interspersed with water (DLNR 2015). ʻAlae keʻokeʻo (Hawaiian coot) may use brackish wetlands, but they prefer freshwater wetlands (USFWS 2011b).

ʻAlae keʻokeʻo (Hawaiian coot) are generalists, feeding near the surface of water, by diving, or in mud or sand. They also feed on land, grazing on grass adjacent to wetlands (USFWS 2011b). Prey include seeds and leaves from aquatic plants, various invertebrates, and grass from nearby wetlands (USFWS 2011a; DLNR 2015). ʻAlae keʻokeʻo (Hawaiian coot) are rather sedentary and primarily partake in localized flights around existing wetland habitats. Longer-distance and intra-island movements may take place when resources are low and or/concentrated elsewhere.

Nesting and Breeding Behavior

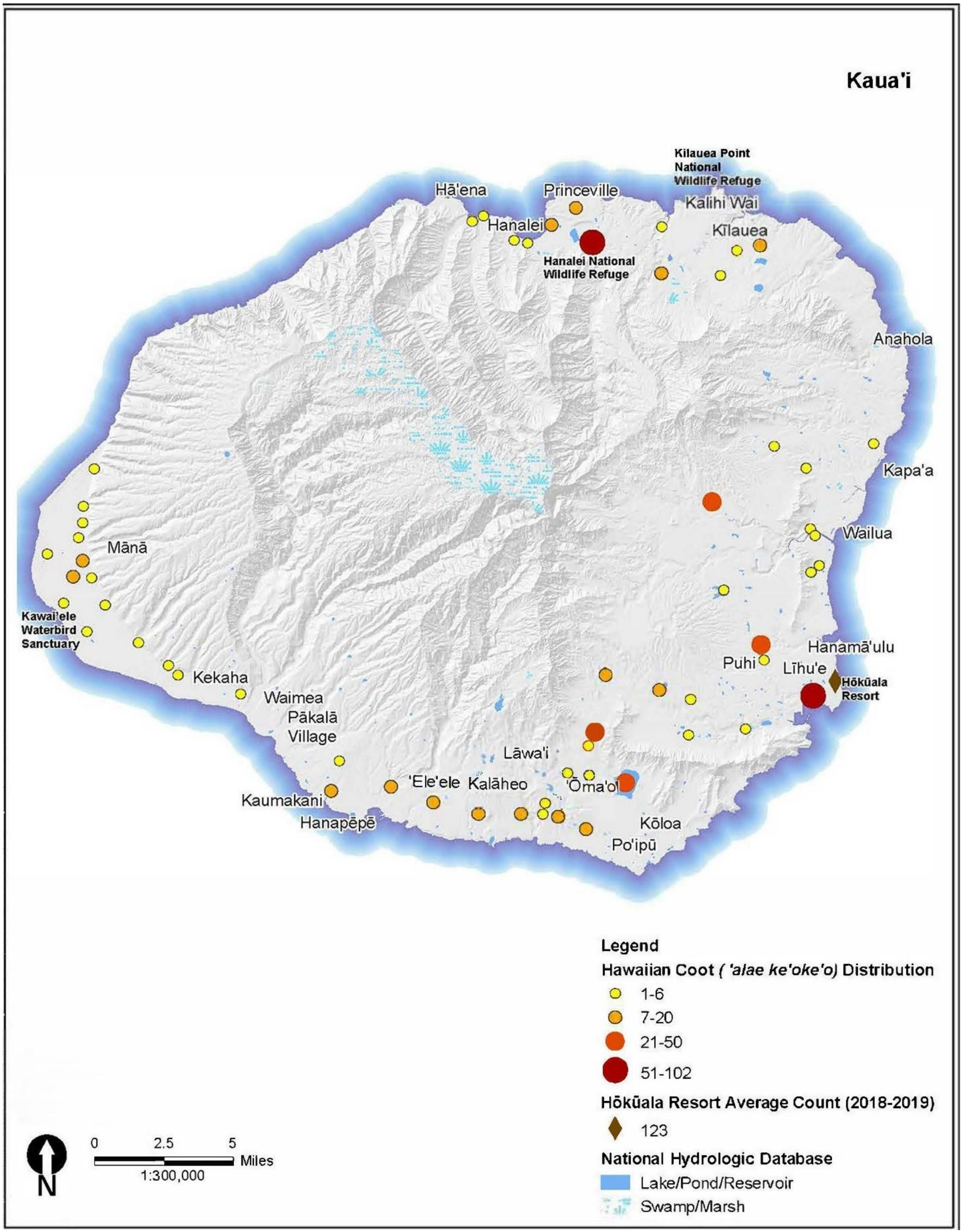
Nesting occurs in open freshwater and brackish ponds, shallow reservoirs, irrigation ditches, and small openings around marsh vegetation. They create different types of nests depending on the habitat. Floating nests are constructed with aquatic vegetation and may be found in open water or anchored to emergent vegetation (Byrd et al. 1985; USFWS 2011b). Open-water nests are more typically anchored and usually consist of mats of vegetation (Byrd et al. 1985; DLNR 2015). In emergent vegetation, nests are typically on platforms constructed from buoyant stems (Byrd et al. 1985). Nesting primarily occurs between March through September but can take place throughout the year depending on precipitation (Byrd et al. 1985; Engilis and Pratt 1993; DLNR 2015).

Threats

Threats to ʻalae keʻokeʻo (Hawaiian coot) are generally the same as those outlined for aeʻo (Hawaiian stilt) described above. In addition, Bumblefoot (ulcerative pododermatitis), a bacterial infection that causes foot inflammation and swelling in birds, is a threat to ʻalae keʻokeʻo (Hawaiian coot), with nearly 45 percent of banded birds at a wastewater facility on Molokaʻi being infected (USFWS 2011b). The infection is linked to exposure to toxins in the waters of the wastewater treatment facilities where the birds like to nest and forage. The incidence in birds on Kauaʻi is unknown (Draft HCP Appendix 3A).

Presence in Plan Area

Roughly 80 percent of the population of ʻalae keʻokeʻo (Hawaiian coot) are on Kauaʻi, Oʻahu, and Maui (DLNR 2015; USFWS 2011b). ʻAlae keʻokeʻo (Hawaiian coot) are primarily present in lowland valleys, including Hanalei, Lumahaʻi, and ʻŌpaekaʻa, and in reservoirs on Kauaʻi (Figure 3.2-5). They have occasionally been observed above 5,246 feet (1,500 m) in plunge pools. During wet years, ʻalae keʻokeʻo (Hawaiian coot) may disperse to Niʻihau. Surveys of the statewide population between 2012 and 2016 estimated there to be between 1,248 and 2,577 individuals on the MHI (Paxton et al. 2021).



Sources: ICF 2025; David et al. 2019; DOFAW 2021; USFWS 2011b

Figure 3.2-5. Distribution of ʻAlae keʻokeʻo (Hawaiian Coot) on Kauaʻi

ʻAlae ʻula (Hawaiian Common Gallinule)

Listing Information

ʻAlae ʻula (Hawaiian common gallinule) is a subspecies of common gallinule and is a member of the rail family, Rallidae. ʻAlae ʻula (Hawaiian common gallinule) were federally listed as endangered under the ESA in 1967 (32 *Federal Register* 4001 [March 11, 1967]) and critical habitat has not been designated. The species is also listed as endangered under HRS Chapter 195D, Section 195D-4, Endangered and Threatened Species.

Distribution and General Behavior

ʻAlae ʻula (Hawaiian common gallinule) was historically present on all the MHI except Lānaʻi and probably Niʻihau.' The species' current range is limited to Kauaʻi and Oʻahu (USFWS 2011b). Similar to ʻalae keʻokeʻo (Hawaiian coot), ʻalae ʻula (Hawaiian common gallinule) are primarily present in lowland areas, using natural ponds, freshwater marshes, streams, springs or seeps, lagoons, grazed wet meadows, kalo and lotus fields, reservoirs, sedimentation basins, sewage ponds, and drainage ditches. They appear to prefer lowland freshwater habitats, although they are occasionally observed in saline and brackish water areas (USFWS 2011a). Key habitat features include scattered dense stands of robust vegetation near open water, floating or barely emergent mats of vegetation, and water shallower than 3 feet (0.9 m). Their foraging typically occurs in dense emergent vegetation (USFWS 2011a).

ʻAlae ʻula (Hawaiian common gallinule) are rather sedentary but may disperse for breeding. ʻAlae ʻula (Hawaiian common gallinule) are considered non-migratory, and whether they are capable of inter-island movement is unknown. They normally swim or walk on aquatic vegetation and are often seen swimming across open water (DLNR 2015).

Nesting and Breeding Behavior

ʻAlae ʻula (Hawaiian common gallinule) nests year-round, with the most activity between March and August depending on water levels and vegetation (Bannor and Kiviat 2002). Chicks are covered with down and are capable of walking upon hatching but remain dependent on parents for several weeks (USFWS 2011b). ʻAlae ʻula (Hawaiian common gallinule) place their nests inconspicuously in dense emergent vegetation over shallow water. If emergent aquatic vegetation is lacking, nests may be placed on the ground, with tall cover nearby.

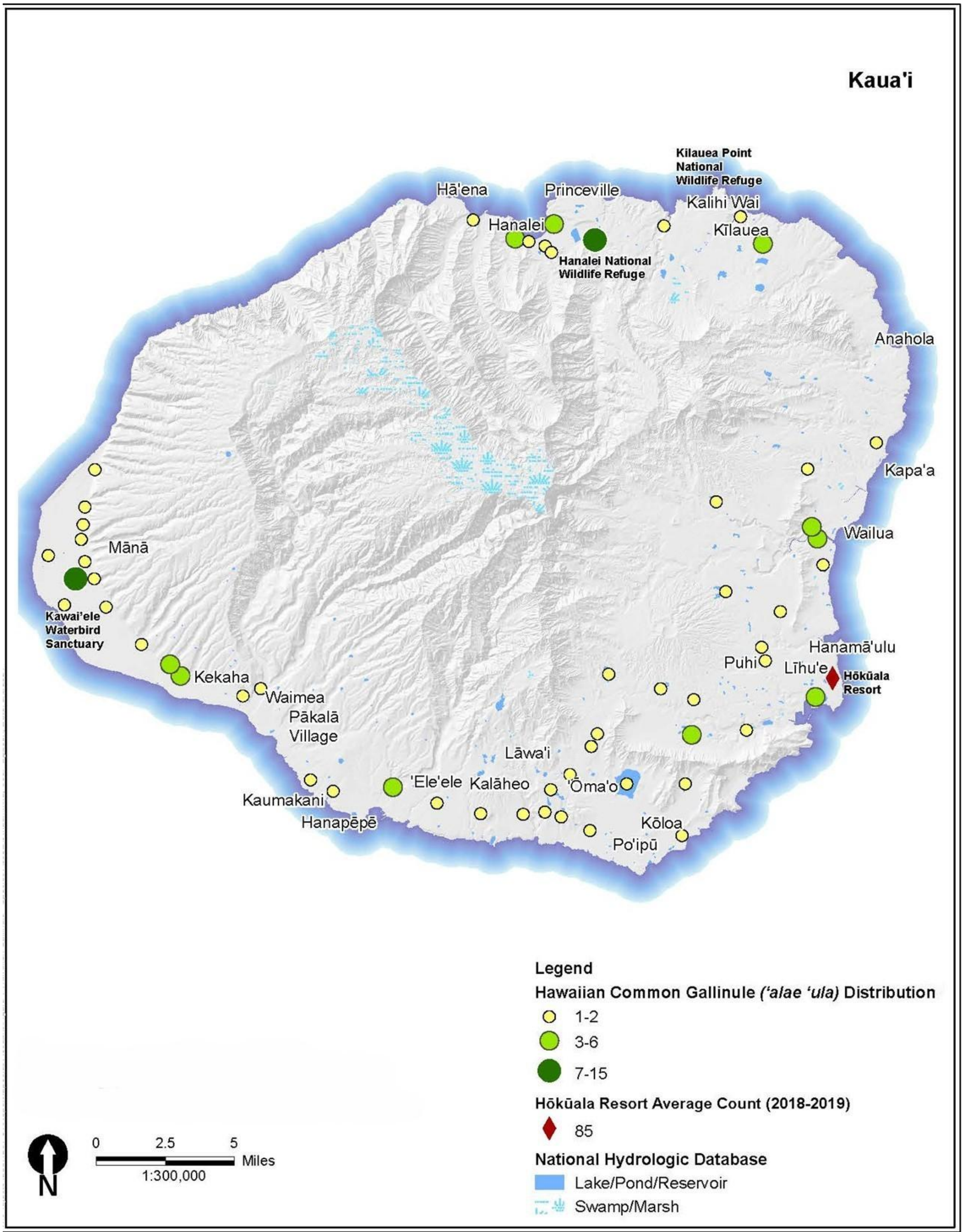
Threats

Predation by invasive mammals, wetland habitat loss and degradation, environmental contaminants, and disease, which threaten other Hawaiian waterbirds, are also a threat to ʻalae ʻula (Hawaiian common gallinule) (USFWS 2011b). Predation and habitat loss and degradation are probably the main threats to an increasingly stable population of ʻalae ʻula (Hawaiian common gallinule) (USFWS 2011b). In the Plan Area, there is no indication that overhead powerlines are a major threat to ʻalae ʻula (Hawaiian common gallinule) (Travers et al. 2019, 2023).

Presence in Plan Area

ʻAlae ʻula (Hawaiian common gallinule) are widely distributed throughout lowland wetlands and valleys below 410 feet (125 m) on Kauaʻi (DLNR 2015). The most sizable populations in the Permit Area are in the Hanalei and Wailua River Valleys, Waiakalua Reservoir, and Wilcox Ponds. They are also commonly seen in wet agricultural areas and present in lower numbers within the irrigation canals in Mānā in western Kauaʻi and in kalo fields (Figure 3.2-6) (USFWS 2011b).

Surveys between 2012 and 2016 indicated that the statewide population was small but relatively stable, and the minimum 5-year average was 927 (678–1,235) individuals (Paxton et al. 2021). The global long-term (1986–2016) and short-term (2006–2016) trends suggest an increasing population size for the ʻalae ʻula (Hawaiian common gallinule) population on Kauaʻi (Paxton et al. 2021).



Sources: ICF 2025; David et al. 2019; DOFAW 2021; USFWS 2011b

Figure 3.2-6. Distribution of ʻAlae ʻula (Hawaiian Common Gallinule) on Kauaʻi

Nēnē (Hawaiian Goose)

Listing Information

Nēnē (Hawaiian goose) is a medium-sized member of the avian family Anatidae. Nēnē (Hawaiian goose) was first listed as endangered under the ESA, then reclassified and downlisted from endangered to threatened in 2019 (USFWS 2019). Critical habitat has not been designated. The species is also listed as endangered under HRS Chapter 195D, Section 195D-4, Endangered and Threatened Species.

Distribution and General Behavior

Nēnē (Hawaiian goose) was once widely distributed among the MHI. The species' current distribution includes populations on Hawai‘i, Maui, and Kaua‘i; this distribution has been largely influenced by the location of release sites for those bred in captivity (USFWS 2004, 2018).

Nēnē (Hawaiian goose) use a range of habitats including coastal dune vegetation and nonnative grasslands, to sparsely vegetated lava flows, shrublands, and woodlands. Nēnē (Hawaiian goose) also inhabits highly altered landscapes such as pastures, agricultural fields, and golf courses, and its habitats typically receive fewer than 90 inches (229 centimeters) of annual rainfall (USFWS 2004, 2018).

Nēnē (Hawaiian goose) is non-migratory and makes daily movements between nesting and feeding areas. Nēnē (Hawaiian goose) are generalists and opportunistic, and their diet composition includes a range of nonnative and native vegetation (USFWS 2004, 2018).

Nesting and Breeding Behavior

Nesting typically occurs in leeward lowlands under 2,300 feet (700 m) in elevation during the winter months (USFWS 2004). Many nēnē (Hawaiian goose) nest in mid- and high-elevation sites (USFWS 2004). Nēnē (Hawaiian goose) nest on the ground. Nest sites range from beach strand, shrubland, and grasslands to lava rock, between coastal lowlands and more alpine areas (USFWS 2004). On Kaua‘i, most nesting areas are dominated by nonnative vegetation (DLNR 2015). Their nests are shallow and lined with plant materials and down, generally shaded by shrubs or other vegetation (USFWS 2004, 2018). Nēnē (Hawaiian goose) breeding season is rather long and most breed between October and March (USFWS 2004, 2018). Most eggs hatch in December or January (USFWS 2004, 2018).

Threats

As with other Hawaiian waterbirds, threats to nēnē (Hawaiian goose) are predation, habitat loss and degradation, environmental contamination, and disease. During periods of flightlessness (while growing flight feathers and molting in February–May), nēnē (Hawaiian goose) are particularly vulnerable to predation by invasive mammals that take their eggs, young birds, and even adults (USFWS 2011b). Open grasslands, pasturelands, and even roadsides where palatable grasses and other suitable plants are growing have allowed nēnē (Hawaiian goose) to forage and nest in lowland suburban and rural areas. However, threat of urbanization and land use conversion is ongoing and continues to threaten nēnē (Hawaiian goose) foraging and nesting habitat, which may lead to lower reproductive success and decline in population (USFWS 2019). Exposure to urban, agricultural, and human built environment exposes nēnē (Hawaiian goose) to injury or death from collisions (Banko et al. 1999); however, there is little evidence that overhead powerline collisions are having a large impact on nēnē (Hawaiian goose) (Travers et al. 2023b). Nēnē (Hawaiian goose) are also prone to avian botulism, caused by a neurotoxin produced by a common bacterium (*Clostridium botulinum*). By eating invertebrates containing the toxin, birds get infected and die of flaccid paralysis (USFWS 2011b). The possibility of West Nile virus or avian influenza reaching the Hawaiian Islands remains a potential threat to many birds including nēnē (Hawaiian goose).

Presence in Permit Area

On Kauaʻi, nēnē (Hawaiian goose) are primarily found using lowland habitats such as coastal wetlands year-round, with the exception of the Nā Pali Coast (USFWS 2004, 2018, 2019). There are four population centers on Kauaʻi, each resulting from the release of captive-bred and translocated individuals (USFWS 2004). The entire population on Kauaʻi is found between sea level and 600 feet (180 m), except for those on the Nā Pali Coast. Most nēnē (Hawaiian goose) on Kauaʻi are found in coastal wetlands at Hanalei and Hulēʻia National Wildlife Refuges, along the Nā Pali Coast, and in maintained wetlands and water features at resorts and golf courses in and around Līhuʻe. Their range has expanded as the population has increased. Nēnē (Hawaiian goose) are adapting to more urban settings, and their populations have steadily increased (USFWS 2004, 2019). The 2022 statewide population of nēnē (Hawaiian goose) totaled 3,862 individuals; of the 3,862, a total of 2,430 were on Kauaʻi (USFWS 2022).

3.2.2.3 Reptiles

Honu (Green Sea Turtle)

Listing Information

There are currently 11 DPSs of honu (green sea turtle) listed under the ESA (NMFS and USFWS 2016). The honu (green sea turtle) population is recognized as the federally listed threatened Central North Pacific DPS (CNPDPS) (NMFS and USFWS 2016). The CNPDPS of honu (green sea turtle) represents those that are known to complete their lifecycle in the Hawaiian Archipelago (NMFS and USFWS 2016; USFWS 2023). Critical habitat for honu (green sea turtle) for the five DPSs (including the CNPDPS) within U.S. jurisdictional lands and waters is proposed (USFWS 2023). On Kauaʻi specifically, critical habitat would include all nearshore waters of the island between 66 feet (20 m) deep to the mean high-water line (USFWS 2023). Honu (green sea turtle) is listed as threatened and is also protected by Chapter 195D of the HRS and Hawaiʻi Administrative Rules (HAR) Section 13-124.

Distribution and General Behavior

The geographic range of honu (green sea turtle) is the Hawaiian Archipelago and Johnston Atoll, which includes Kauaʻi and the Plan Area (USFWS and NMFS 2016). The Hawaiian Archipelago is the most geographically isolated chain of islands globally, and this is reflected by the distribution, range, and movements of the CNPDPS (Seminoff et al. 2015). A total of 17,536 individual honu (green sea turtle) were tagged between 1965 and 2013. With only three exceptions, the 7,360 recaptures of those tagged were within the Hawaiian Archipelago (Seminoff et al. 2015).

Honu (green sea turtle) use shoreline, nearshore, and oceanic habitats during different periods of its lifecycle. Honu (green sea turtle) spend the majority of their lives in open coastline and protected bays and lagoons (Seminoff et al. 2015). In these areas, juveniles and adults rely on marine algae and seagrass for food, although certain populations forage heavily on invertebrates (Jones and Seminoff

2013). This is the case for the CNPDPS during its oceanic life stage. Other studies have also shown that, during the oceanic period, honu (green sea turtle) were carnivorous with some omnivorous tendencies (Russell and Balazs 2009; Parker et al. 2011).

Nesting and Breeding Behavior

Honu (green sea turtle) display nesting and foraging site fidelity, returning to the same foraging areas at the end of each breeding season (USFWS 2023). They typically migrate between foraging areas in the MHI and nesting sites in the Northwestern Hawaiian Islands (NWHI).

When on the shoreline, honu (green sea turtle) use beaches with dune structures, native vegetation, and minimal artificial lighting for nesting (Witherington 1997; Lorne and Salmon 2007; Seminoff et al. 2015). The nesting season is typically from April through September. After arriving onshore, females dig a large depression in the sand. They dig a smaller hole where they lay soft-shelled eggs. Upon laying the final nest, the female returns to the ocean.

Approximately 2 months after eggs are laid, eggs hatch and hatchlings dig their way to the surface from the sand, typically en masse, and head to the ocean. This seaward movement generally occurs at night or in the early predawn hours. Hatchlings initially orient to the brightest horizon, which in areas without artificial lighting is the moonlit ocean (Witherington 1997; Witherington and Martin 2000; Seminoff et al. 2015). Once hatchlings reach the water, they remain in oceanic habitats until they reach a certain size and age range, around 10 to 15 years old, at which point they return to the highly productive coastal feeding areas to finish growing.

The primary nesting site for honu (green sea turtle) is in Lalo (French Frigate Shoals) in the NWHI where approximately 96 percent of nesting occurs. Individuals bask on beaches throughout the NWHI and MHI.

Threats

Global threats to honu (green sea turtle) that have contributed to its decline are attributed to a variety of anthropogenic threats (Seminoff et al. 2015). These include bycatch in fishing gear (the incidental capture of non-target species), pollution, interactions with recreational and commercial vessels, development and public use of beaches, climate change, artificial lighting, predation, disease, beach driving, and major storm events. The common offshore threats in Hawaiʻi include entanglement in fishing lines, interactions with fishing hooks, and interaction with marine debris (usually entanglement in nets) (Florida Fish and Wildlife Conservation Commission 2025). Green sea turtles (honu) have also been documented as occasionally being hit by boats in Kauaʻi (Wu 2020). Onshore, coastal development and construction, artificial lighting, vehicular and pedestrian traffic, beach pollution, tourism, and other human-related activities are threats to the basking and nesting population of honu (green sea turtle) in the MHI and adversely affect hatchling and nesting turtles on beaches where these threats are present.

Coastal lands associated with sandy beaches are prime real estate in the islands and construction here has resulted in the loss and degradation of honu (green sea turtle) basking and nesting habitat. Clearing of stabilizing beach vegetation causes erosion and use of heavy equipment on beaches can cause compaction or erosion, thereby degrading the habitat. Increased use of nesting beaches for recreational activities and driving on beaches is an increasing threat to honu (green sea turtle) (NMFS and USFWS 1998). Littering on these beaches also attracts destructive nonnative animals such as pigs.

Light pollution caused by artificial source of lighting at or near beaches has been shown to affect females by deterring them from coming ashore to nest or drawing them away from the ocean after they are done nesting. Artificial source of lighting is also often fatal to emerging honu (green sea turtle) hatchlings because they are attracted to light sources and drawn away from the water (Nelson Sella et al. 2006). Although there is scant documentation for adverse impacts from artificial lighting related to nesting on Kauaʻi, there has been some recent documentation of disoriented hatchlings moving toward inland light sources versus toward the water.

Marine debris is a known threat for honu (green sea turtle) in both terrestrial and marine environments. Marine debris poses a major entanglement threat to sea turtles and can result in serious injury or mortality; it also can cause damage to habitat (Wedding et al. 2008). Fishing line and gill net gear entanglement is one of the causes of honu (green sea turtle) strandings and mortality in the MHI (Francke 2013, 2014). Other threats to honu (green sea turtle) include predation, disease, and climate change; and predation of hatchlings by ghost crabs (*Ocypode* spp.), seabirds such as ʻiwa (great frigate birds), and fish (Balazs 1980; Balazs and Kubis 2007). Fibropapilloma disease affects honu (green sea turtle) because it results in internal and external tumors that can grow large enough to hamper swimming, vision, feeding, and potential escape from predators (Florida Fish and Wildlife Conservation Commission). Sea level rise resulting from climate change is an increasing threat to honu (green sea turtle) because it will result in increased erosion of nesting beaches and consequent loss of habitat (IPCC 2007).

Presence in Permit Area

Honu (green sea turtle) nests in the Permit Area. The abundance of nesting individuals of honu (green sea turtle) was calculated and summarized in Seminoff et al. (2015). About 0.02 percent (58 of 3,846) of the population is estimated to nest in the MHI, of which Kauaʻi is estimated to account for about 0.004 percent (16 of 3,846) of nester abundance (Seminoff et al. 2015).

In 2015, a map guide was developed that documents marine turtle nesting and basking sites throughout the Hawaiian Islands (Parker and Balazs 2015). A total of 20 nesting sites[2] were documented around Kauaʻi, and the average annual nesting density of honu (green sea turtle) at all Kauaʻi sites was very low, ranging from less than one (i.e., one nest every several years) to one to two nests annually between 2015 and 2020 (State of Hawaiʻi Division of Aquatic Resources 2020). Only two sites (Lāwaʻi Kai and Kīpū Kai), both of which are on the southern side of Kauaʻi, were described as having regular use (Parker and Balazs 2015; State of Hawaiʻi Division of Aquatic Resources 2020). Although nesting densities are indicated as low, there has been an increase in monitoring and surveying on the island, which has resulted in increased documentation of nest sites and incidental take incidents. There is not enough information available at this time to indicate whether this increase is due to an increasing amount of honu (green sea turtle) nesting on the island or if it is the result of increased monitoring and surveying efforts.

Between 2002 and 2015, nearshore surveys were conducted throughout the U.S. Pacific Islands to estimate honu (green sea turtle) densities at each island (Becker et al. 2019). The density of foraging and resting honu (green sea turtles) in Kauaʻi (0.18 individual per km/0.6 mi) is considered high with respect to islands throughout the archipelago (Becker et al. 2019; USFWS 2023). All nearshore waters around the Permit Area, particularly between the mean high water line to 66 feet (20 m)

[2] Nesting data reported from Kauaʻi are speculative due to the lack of systematic surveys. Estimates may also be skewed toward high-use beaches and beaches that regularly have resting seals (as this is how honu [green sea turtle] nests have been opportunistically found).

depth, contain important features for benthic foraging and resting (Becker et al. 2019; USFWS 2023).

3.2.3 Environmental Consequences

3.2.3.1 Seabirds

The environmental consequences for each alternative described in this section addresses impacts on the three covered seabirds: ʻaʻo (Newell's shearwater), ʻuaʻu (Hawaiian petrel), and ʻakēʻakē (band-rumped storm petrel). However, in this section, the term *seabirds* refers to ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel); ʻakēʻakē (band-rumped storm-petrel) is discussed separately because there are limited data on this species. A biological goal of the Draft HCP is to have a viable Kauaʻi metapopulation for ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) that is quantified as 2,500 breeding pairs and a total population size of 10,000 individuals of each species. A viable metapopulation is not defined for ʻakēʻakē (band-rumped storm-petrel). Due to limited data available on ʻakēʻakē (band-rumped storm-petrel) populations, it was not included in the modeling for Alternatives A through D. Trends for ʻakēʻakē (band-rumped storm-petrel) are expected to be like those of ʻaʻo (Newell's shearwater), because threats are similar for the two species.

Seabirds, including ʻaʻo (Newell's shearwater), ʻuaʻu (Hawaiian petrel), and ʻakēʻakē (band-rumped storm-petrel), are considered k-selected species (Furness 2012). For k-selected species, adult survival is generally high, the birds are long-lived, and annual reproductive output is low. Seabirds experience deferred maturity (Furness and Monaghan 1987), with long-term pair bonds formed around ages 4 to 5, before the first year of breeding together, which is typically age 6 or later (Ainley et al. 2020). ʻA'o (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) parents provide extensive care to the single offspring they produce, with both parents feeding chicks for 3 to 4 months before fledging (Ainley et al. 2020). Based on these life history characteristics, the direct loss of a breeding adult due to powerline collisions, fallout, or predation can have an impact beyond the loss of a single bird. When a parent is lost, especially during early chick-rearing, the likelihood of chick survival is low (Podolksy et al. 1998). Furthermore, the loss of a breeding adult results in the loss of future young being produced and surviving to reproduce themselves (reduces adding individuals to the population). Also, the second parent will need to invest years into establishing a new pair bond before successfully breeding again.

Habitat degradation due to invasive species related to KIUC's activities could result in indirect impacts on seabirds (e.g., vegetation preventing access to a burrow, mortality of a seabird that becomes tangled in vegetation). The direct and indirect losses described above can contribute to adverse population trends and hinder population recovery efforts.

Alternative A No Action

Under Alternative A, KIUC would not seek authorization for take of endangered seabirds and would continue operating existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. The Service and DLNR would not issue take authorization permits for the incidental take of covered seabirds. KIUC would not implement a comprehensive program to mitigate impacts on these species. Existing infrastructure modifications designed to reduce harm to ESA-listed species (e.g., powerline reconfiguration, bird flight diverters, lighting retrofits) and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would remain in place and be operational for their useful life. The powerline minimization measures would continue to reduce powerline collisions during the useful life of the infrastructure. Unauthorized take of seabird species would likely continue, because KIUC would not be able to avoid take of listed species, nor could it reduce and mitigate all impacts of the taking in order to obtain take authorization through formal permitting processes. Additionally, KIUC would not have Areas of Additional Conservation Commitments, meaning future streetlights and powerlines installed in defined areas of northwestern Kauaʻi could adversely affect seabirds (Draft HCP Appendix 4E).

Within the Draft HCP conservation sites, existing infrastructure such as predator exclusion fencing would remain in place, but maintenance and replacement of the infrastructure would not be required to continue. Additional conservation actions would not continue, including KIUC providing funding for programs to monitor seabirds and enhance their breeding habitat. This includes the likely cessation of KIUC-funded predator control measures, predator exclusion fencing, seabird social attraction initiatives, and invasive plant control. Consequentially, the conservation sites would be expected to revert to their pre-predator control status, which would result in increased predation levels and reduced reproductive success and long-term population viability and resilience of seabirds given their k-selected life histories. The seabird populations are expected to decline over time with reduced predator control measures.

Funding for the SOS program would be at the discretion of KIUC and is not projected to continue under Alternative A. The SOS program has alternate funding sources and may be able to operate at a reduced capacity, but the organization would rehabilitate substantially fewer seabirds with decreased funding. Additionally, the public outreach and education component of the SOS program would substantially decrease.

Under the No Action alternative, four of the five model scenarios indicate a decline in the ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) population over the 50-year permit term for the covered seabirds (Table 3.2-1). Only the flat-line scenario from the JCS model produced an increase in the ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) populations, with a growth rate of 1.54 percent per year at the end of the permit term and a net gain of 111 percent or more during the 50-year permit term. The increase is due to conservation actions occurring outside of the Draft HCP (e.g., predator exclusion fence for the Kauaʻi Seabird HCP Kahuama'a Seabird Preserve, ungulate fences on state lands, translocations of the two species to the Nihoku site at Kīlauea Point NWR). The worst-case and mid-point scenarios from the JCS model suggest a drastic population decline approaching zero, or to extinction or near extinction for both species. The PDM worse-case scenario also shows a decline in populations for both seabird species. While the ʻaʻo (Newell's shearwater) population reflected in the PDM worse-case scenario is viable in 2075 at 10,305 birds, it is projected to be declining by 1 percent per year at the end of the permit term (Table 3.2-2). Under the PDM worse-case scenario, the ʻuaʻu (Hawaiian petrel) population would have an 82-percent population decline over the permit term, resulting in 5,087 birds left by the end of the permit term. In addition, there would be a declining growth rate of -1.3 percent per year in 2075. For both seabird species, the PDM stable-trend scenario indicates a relatively modest rate of population decline. Under this scenario, the ʻuaʻu (Hawaiian petrel) population has an increasing 2-percent growth rate per year in 2025 and in 2075 has a declining growth rate of -0.3 percent per year, and the ʻaʻo (Newell's shearwater) population starts (2025) with an increasing growth rate of 1.9 percent per year and then ends (2075) by decreasing at -0.4-percent growth rate per year. The population decline of less than 10 percent for both species by 2075 suggests the population would be relatively stable over the permit term under this scenario (Table 3.2-1 and Table 3.2-2).

Based on the model outputs, ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) are likely to experience a population decline over the 50-year permit term under the No Action alternative. The already-completed minimization measures have contributed to a reduction in powerline collisions and reduced mortalities, although the reduction would persist only until the end of their useful life. Powerline reconfiguration (e.g., static line removal, which reduces the vertical profile of powerlines) would reduce collisions unless a static line is reinstated or the powerlines are modified. Diverters added to the powerlines would reduce collisions for the duration of the useful life of the diverter, which is estimated to be 5 years for light-emitting diode (LED) diverters and 10 years for reflective diverters. Existing streetlight shielding is expected to reduce light attraction and seabird fallout because the lights have a built-in shield. However, this may change if existing streetlights are replaced with structures without the built-in shield. Also, new streetlights may not have a shield. Furthermore, SOS program funding increases the likelihood of rescues and survival of the fallout seabirds, so higher mortality is expected if seabirds are not rescued and delivered to an accredited facility.

The population declines estimated by the models for ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) are likely due to the future lack of maintenance and replacement of the implemented minimization measures, and the cessation of funding and maintenance of the conservation areas, particularly predator control measures. Three of the five modeling scenarios estimate viable populations, as defined by the Draft HCP as 10,000 individuals, would exist by the end of the permit term. Without active predator control measures, the downward trend is expected to continue beyond the permit term, until eventual extinction of the covered seabird species.

For ʻakēʻakē (band-rumped storm-petrel) under the No Action Alternative, similar impacts (adverse and beneficial) are expected, but at a minimal level over the 50-year permit without implementation of the Draft HCP's conservation measures and due to the continued existence of threats (e.g., predators, light attraction).

Table 3.2-1. Alternative A Modeled Percent Change in ʻAʻo (Newell's Shearwater) and ʻUaʻu (Hawaiian Petrel) Populations

	JCS Model Population					PDM Population		
Species	**Year**	**Worst Case**	**Mid Point**	**Flat Line**	**Species**	**Year**	**Worse Case**	**Stable Trend**
NESH	2025[3]	14,249	20,633	33,821	NESH	2025	32,292	119,887
	2075	0	207	71,356		2075	10,305	108,915
% Change	--	-100%	-99%	111%	% Change	--	-68%	-9%
HAPE	2025	15,022	20,211	33,471	HAPE	2025	28,547	77,806
	2075	0	203	70,616		2075	5,087	72,629
% Change	--	-100%	-99%	111%	% Change	--	-82%	-7%

The JCS and PDM models are based on different assumptions and are therefore not directly comparable. The two models present a range of possible projections over the 50-year permit term.
HAPE = ʻuaʻu (Hawaiian petrel); NESH = ʻaʻo (Newell's shearwater)

[3] The JCS and PDM use a different starting population (USFWS 2025a; ICF 2025). Within their respective models, the starting populations of all scenarios begin with the same number but differ by the 2025 HCP start year. This is due to needing to project from the year the starting population number was derived to the year 2025 and the different assumptions of each scenario.

Table 3.2-2. Alternative A Modeled Percent Change in ʻAʻo (Newell's Shearwater) and ʻUaʻu (Hawaiian Petrel) Growth Rates (percentage per year)

	JCS Model Population					PDM Population		
Species	**Year**	**Worst Case**	**Mid Point**	**Flat Line**	**Species**	**Year**	**Worse Case**	**Stable Trend**
NESH	2025	-10.23	-8.40	1.44	NESH	2025	-2.80	1.90
	2075	0	-9.1	1.54		2075	-1.00%	-0.40%
HAPE	2025	-10.12	-8.47	1.46	HAPE	2025	-3.00%	2.00%
	2075	0	-9.08	1.54		2075	-1.30%	-0.30%

The JCS and PDM models are based on different assumptions and are therefore not directly comparable. The two models present a range of possible projections over the 50-year permit term.
HAPE = ʻuaʻu (Hawaiian petrel); NESH = ʻaʻo (Newell's shearwater)

Alternative B Proposed Action

Under Alternative B, the Service and DLNR would approve the Draft HCP and issue 50-year take authorizations to KIUC for incidental take of the covered seabirds. KIUC would implement the conservation strategy of the Draft HCP, including minimization measures to reduce seabird powerline collisions and light attraction, and implement predator control at the seabird conservation sites. Additionally, KIUC would follow the processes defined in the Area of Additional Conservation Commitments so that future infrastructure installed in a specifically defined area of northwestern Kauaʻi would not inhibit the goals and objectives of the Draft HCP (Draft HCP Appendix 4E). The Draft HCP relies on adaptive management as the permit term progresses. As more data on seabird populations are collected, the conservation strategy can be adapted to meet the biological goals and objectives of the Draft HCP.

KIUC has implemented several conservation measures to reduce powerline collisions and light attraction for seabirds on Kauaʻi. KIUC completed its island-wide powerline collision minimization plan for existing powerlines, including reconfiguring spans of powerline structures, installing flight diverters, and removing the majority of static wires. To reduce light attraction, KIUC retrofitted all streetlights and lights at its facilities with full-cutoff shields and dim exterior lights at the covered facilities during the seabird fledgling fallout season (September to December). Under Alternative B, KIUC would maintain all implemented minimization measures through the permit term and would follow similar minimization practices on new powerline spans and streetlights to the maximum extent practicable.

The SOS program has been funded by KIUC since 2003. Under Alternative B, KIUC would continue to fund the SOS program at a consistent level of $300,000 per year. The program rescues and rehabilitates covered seabirds and accepts injured and fallout birds found by the public. Rehabilitation is performed at an accredited animal rescue facility. The SOS program also informs and educates the public about anthropogenic risks to seabirds on Kauaʻi, which builds its volunteer network and public capacity to respond to and turn in downed seabirds.

Under Alternative B, KIUC would manage and enhance 12 conservation sites as part of its Draft HCP to support the breeding success of ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel), and in doing so also reduce predation of ʻakēʻakē (band-rumped storm-petrel). These sites, many of which have been part of KIUC's predator control and seabird monitoring efforts since 2011, would see continued implementation of predator control, invasive plant species management, and social attraction techniques. Predator control measures would target species like cats, rats, pigs, and barn owls with methods such as trapping, baiting, and fencing. KIUC would maintain existing predator exclusion fences at select sites and build an additional two fences by 2027. Social attraction strategies, including habitat restoration, artificial burrow installation, and playback of seabird calls, would be used to expand and establish seabird colonies, primarily ʻaʻo (Newell's shearwater), at the sites with predator exclusion fences. Invasive plant control would also be a priority, with ongoing management at key areas and additional efforts at other sites as needed.

Even with minimization measures fully implemented, incidental take of seabirds is expected. To develop a request for incidental take, KIUC used the PDM and specifically projected take numbers based on the stable-trend scenario and data from powerline monitoring (2013–2019). Over the 50-year permit term, KIUC requests the take of 329,724 ʻaʻo (Newell's shearwater) and 123,967 ʻuaʻu (Hawaiian petrel). Powerline strikes on existing and new infrastructure combined account for 98 percent of the ʻaʻo (Newell's shearwater) take (324,272 birds) and 99 percent of the ʻuaʻu (Hawaiian petrel) take (122,926 birds). Seabird fallout take, which is caused by light attraction due to streetlights and facility lights, is requested for 5,221 ʻaʻo (Newell's shearwater) and 286 ʻuaʻu (Hawaiian petrel) over the permit term. Conservation measures may have unintended consequences, specifically injury or mortality as a result of predator traps and collision with weatherports, and account for the remaining take request. The take of 272 ʻaʻo (Newell's shearwater) and 755 ʻuaʻu (Hawaiian petrel) is requested over the permit term to account for seabirds that are inadvertently caught in predator traps. The overall estimated annual take would be approximately 6,595 ʻaʻo (Newell's shearwater) and 2,479 ʻuaʻu (Hawaiian petrel).[4]

With the proposed action, the PDM stable-trend and JCS flat-line scenarios indicate there would be significant population increases during the 50-year permit term, while the PDM worse-case and JCS worst-case and mid-point model scenarios indicate moderate to severe population declines. Both the JCS flat-line and the PDM stable-trend scenarios show 50-year population increases of over 300 percent for ʻaʻo (Newell's shearwater). There is wider variation between the two stable model scenarios for ʻuaʻu (Hawaiian petrel), but both indicate significant population gains of about 240 percent for the JCS and nearly 600 percent for the PDM (Table 3.2-3).

None of the scenarios indicate ʻaʻo (Newell's shearwater) or ʻuaʻu (Hawaiian petrel) populations would go extinct under the proposed action (Table 3.2-3). The PDM worse-case and JCS worst-case and mid-point scenarios show the ʻaʻo (Newell's shearwater) populations would see a drastic decline of 20 to 45 percent. However, the population would shift from an initial negative growth rate of -9.86 to -2.8 percent to a positive growth rate of 0.68 to 1 percent annually by the end of the permit term (Table 3.2-4). Similarly, under the PDM worse-case and JCS worst-case and midpoint scenarios, the ʻuaʻu (Hawaiian petrel) population would decline by 39 to 67 percent; however, the annual growth rates would eventually begin increasing at 0.20 to 1.50 percent by the end of the permit term (Table 3.2-3 and Table 3.2-4). For ʻaʻo (Newell's shearwater), the JCS flat-line and PDM stable-trend scenarios show steep population increases of over 300 percent with an annual growth rate of 2.93 to 4 percent by the end of the permit term. ʻUaʻu (Hawaiian petrel) also shows a steep population increase under these scenarios of 240 to 599 percent with an annual increasing growth rate of 2.63 to 6 percent by the end of the permit term (Table 3.2-3 and Table 3.2-4).

[4] Annual take is an average, based on total take over the entire 50-year permit term divided by 50, and may not reflect actual take per year.

Results from all five model scenarios imply that the proposed action would have fewer adverse impacts than the No Action alternative for both ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel). The extremely large population gains under the proposed action PDM stable-trend and JCS flat-line scenarios are likely overestimated; however, they represent the upper bound of the population projections. Similarly, the JCS worst-case and PDM worse-case scenarios likely represent the extreme lower bound of the population projections. Together these model scenarios create a seabird population range where the population size is likely somewhere between the upper and the lower bound. Under the proposed action, a viable metapopulation of ʻaʻo (Newell's shearwater) would be present on Kauaʻi in 50 years for all modeled scenarios, except for the JCS worst-case scenario, which is projected to be 3 percent lower than the viable metapopulation target of 10,000 birds. The JCS worst-case scenario is a conservative estimate of the population projection in that it overestimates the impact of threats (e.g., powerline collisions, fallout due to light attraction). Therefore, although the target of 10,000 ʻaʻo (Newell's shearwater) appears to not be reached in this scenario, it is anticipated that the population estimate will be somewhere between this and the upper-bound scenarios. The worse-case population for the PDM model is 25,930, which is above the minimum viable population of 10,000 for ʻaʻo (Newell's shearwater). The ʻuaʻu (Hawaiian petrel) population could be expected to decline to a few thousand individuals, although the population is unlikely to become locally extinct in the permit term.

For ʻakēʻakē (band-rumped storm-petrel), benefits of the Draft HCP conservation strategy (e.g., including minimization measures to reduce powerline collisions and light attraction, funding the SOS program, implementing predator control at the seabird conservation sites and social attraction at the Honopū PF site) were estimated based on qualitative assumptions. Beneficial impacts include reducing powerline collisions in the Waimea Canyon area, reducing light attraction, facilitating rehabilitation and release of downed birds through the SOS program, likely increased survival due to predator control activities, and establishment of a protected colony within the Honopū PF.

Table 3.2-3. Alternative B Modeled Percent Change in ʻAʻo (Newell's Shearwater) and ʻUaʻu (Hawaiian Petrel) Populations

	JCS Model Population					PDM Population		
Species	**Year**	**Worst Case**	**Mid Point**	**Flat Line**	**Species**	**Year**	**Worse Case**	**Stable Trend**
NESH	2025	14,350	20,736	33,915	NESH	2025	32,293	119,887
	2075	9,722	11,451	136,849		2075	25,930	492,566
% Change	--	-32%	-45%	303%	% Change	--	-20%	310%
HAPE	2025	15,123	20,314	33,567	HAPE	2025	28,548	77,806
	2075	5,045	6,735	114,017		2075	17,401	543,672
% Change	--	-66%	-67%	240%	% Change	--	-39%	599%

The JCS and PDM models are based on different assumptions and are therefore not directly comparable. The two models present a range of possible projections over the 50-year permit term.
HAPE = ʻuaʻu (Hawaiian petrel); NESH = ʻaʻo (Newell's shearwater)

Table 3.2-4. Alternative B Modeled Percent Change in ʻAʻo (Newell's Shearwater) and ʻUaʻu (Hawaiian Petrel) Growth Rates (percentage per year)

	JCS Model Population					PDM Population		
Species	Year	Worst Case	Mid Point	Flat Line	Species	Year	Worse Case	Stable Trend
NESH	2025	-9.86	-8.14	1.59	NESH	2025	-2.80	1.90
	2075	0.98	0.68	2.93		2075	1.00	4.00
HAPE	2025	-9.77	-8.21	1.62	HAPE	2025	-3.00	2.00
	2075	1.50	1.13	2.63		2075	0.20	6.00

The JCS and PDM models are based on different assumptions and are therefore not directly comparable. The two models present a range of possible projections over the 50-year permit term.
HAPE = ʻuaʻu (Hawaiian petrel); NESH = ʻaʻo (Newell's shearwater)

Alternative C Additional Minimization

Alternative C would supplement the conservation measures of Alternative B by providing additional minimization measures to powerline spans, nighttime lighting, and funding for the SOS program. For select existing powerline spans, additional minimization measures include reconfiguration to reduce the vertical profile, removal of static wires, and installation of additional flight diverters. For new powerline spans, construction would only be in one horizontal plane (with select exceptions), and flight diverters would be installed on all layers of spans identified as high collision risk. For streetlights, the number of lumens emitted from lightbulbs would be reduced by using dimmers. This alternative would also increase funding to the SOS program by 50 percent, which would enable the SOS program to intake and rehabilitate seabirds beyond the proposed action and increase its rehabilitation capacity. This funding would expand outreach and education programs with the goal to increase the discovery rate of fallout seabirds.

With Alternative C, none of the model scenarios indicate that ʻaʻo (Newell's shearwater) or ʻuaʻu (Hawaiian petrel) populations would go extinct. The PDM stable-trend and JCS flat-line scenarios indicate there would be significant population increases during the 50-year permit term, and the PDM worse-case and JCS worst-case and mid-point model scenarios indicate minor to moderate population declines for both seabird species. For ʻaʻo (Newell's shearwater), both the JCS flat-line and the PDM stable-trend scenarios start with positive growth rates and end the permit term with even higher annual growth rates of 2.93 and 4.50 percent, respectively, and population increases over 300 percent. There is wider variation between these stable scenarios for ʻuaʻu (Hawaiian petrel), but both indicate high growth rate increases of 2.63 and 6.30 percent annually and population gains of 239 and 700 percent for the JCS and PDM, respectively, by the end of the permit term (Table 3.2-5 and Table 3.2-6).

For both seabird species, under the PDM worse-case and JCS worst-case and midpoint scenarios, the populations both start with steep declines and end the permit term with lower populations; however, the growth rates eventually shift slightly upward by the end of the permit term (Table 3.2-5 and Table 3.2-6). The JCS worst-case scenario is a conservative estimate of the population projection in that it overestimates the impact of threats (e.g., powerline collisions, fallout due to light attraction). Therefore, although the target of 10,000 ʻaʻo (Newell's shearwater) appears to not be reached in this scenario, it is anticipated that the population estimate will be somewhere between this and the upper-bound scenarios. The PDM model's worse-case scenario estimates a growth rate of 1.10 percent per year and 26,115 ʻaʻo (Newell's shearwater) by the end of the permit term (19-

percent decline), which is well above the viable metapopulation threshold. The ʻuaʻu (Hawaiian petrel) populations are estimated to have a more drastic decline, with an estimated 39- to 67-percent population decrease by 2075 but with an annual positive growth rate of 1.13 to 1.5 percent at the end of the permit term. Similarly, the PDM worse-case scenario ends with an estimated 17,525 ʻuaʻu (Hawaiian petrel) (39 percent decline) but also has a slightly positive growth rate of 0.2 percent at the end of the permit term (Table 3.2-5 and Table 3.2-6).

Overall, the additional minimization would have a minimal added benefit to both seabird species when compared to the proposed action. Population outcomes based on the five model scenario outputs are similar to the proposed action conclusions. Both species are not expected to become locally extinct with additional minimization, but ʻuaʻu (Hawaiian petrel) is expected to experience a steeper population decline than ʻaʻo (Newell's shearwater). The high population gains projected by the stable-trend (PDM) and flat-line (JCS) scenarios are unlikely. However, the anticipated minimal benefits of Alternative C are not anticipated to result in a negative impact over the 50-year permit term.

Under Alternative C, it is anticipated based on qualitative assumptions that the additional minimization would have a small degree of added benefits to ʻakēʻakē (band-rumped storm-petrel) when compared to the No Action alternative and proposed action. This is based on additional reduced take from added light and powerline minimization.

Table 3.2-5. Alternative C Modeled Percent Change in ʻAʻo (Newell's Shearwater) and ʻUaʻu (Hawaiian Petrel) Populations

	JCS Model Population					PDM Population		
Species	Year	Worst Case	Mid Point	Flat Line	Species	Year	Worse Case	Stable Trend
NESH	2025	14,357	20,745	33,918	NESH	2025	32,292	119,887
	2075	9,746	11,452	136,903		2075	26,115	550,998
% Change	--	-32%	-45%	303%	% Change	--	-19%	360%
HAPE	2025	15,128	20,322	33,568	HAPE	2025	28,547	77,806
	2075	5,070	6,735	114,065		2075	17,525	622,307
% Change	--	-66%	-67%	239%	% Change	--	-39%	700%

The JCS and PDM models are based on different assumptions and are therefore not directly comparable. The two models present a range of possible projections over the 50-year permit term.
HAPE = ʻuaʻu (Hawaiian petrel); NESH = ʻaʻo (Newell's shearwater)

Table 3.2-6. Alternative C Modeled Percent Change in ʻAʻo (Newell's Shearwater) and ʻUaʻu (Hawaiian Petrel) Growth Rates (percentage per year)

	JCS Model Population					PDM Population		
Species	Year	Worst Case	Mid Point	Flat Line	Species	Year	Worse Case	Stable Trend
NESH	2025	-9.84	-8.15	1.60	NESH	2025	-2.80	1.90
	2075	0.98	0.68	2.93		2075	1.10	4.50
HAPE	2025	-9.76	-8.21	1.62	HAPE	2025	-3.00	2.00
	2075	1.50	1.13	2.63		2075	0.20	6.30

The JCS and PDM models are based on different assumptions and are therefore not directly comparable. The two models present a range of possible projections over the 50-year permit term.
HAPE = ʻuaʻu (Hawaiian petrel); NESH = ʻaʻo (Newell's shearwater)

Alternative D Additional Mitigation

Alternative D would supplement the conservation measures of Alternative B by expanding the total acreage on which mitigation actions occur beyond what is proposed in the Draft HCP. Feral ungulates would be addressed by expanding control measures in the vicinity of the Draft HCP conservation sites and increasing the acreage of ungulate exclusion fencing, which would increase the quality of seabird habitat. Seabirds would benefit from expanded predator control methods in three additional conservation sites, including more trapping, installing predator-proof fences, and implementing social attraction methods. Predator control targeting cats, rodents, feral bees, and barn owls would be expanded within these three additional mitigation sites and to the limited acreage outside of conservation sites, which would reduce ingress and predation at the conservation sites.

Four of the five model scenarios suggest higher success rates for ʻaʻo (Newell's shearwater) population trends with additional mitigation (Table 3.2-7). Only the worse-case scenario of the PDM predicts a population decline of 15 percent. However, the population growth rate starts to increase by 1 percent annually by the end of the permit term. In contrast, the other scenarios predict population gains ranging from minor (4 percent) to extreme (378 percent). All model scenarios for ʻaʻo (Newell's shearwater) predict ending populations greater than 18,000 birds in 2075 (Table 3.2-7 and Table 3.2-8), which exceeds the minimum viable population target of 10,000 birds on Kauaʻi.

Under the PDM worse-case and JCS worst-case scenarios, predictions for ʻuaʻu (Hawaiian petrel) indicate moderate population declines of 34 and 35 percent, respectively. However, the growth rates under both scenarios shift from an initial negative growth rate of -9.7 to -3 percent to a positive growth rate of 0.3 and 1.24 percent annually by the end of the permit term. Similarly, under the JCS mid-point model scenario, the ʻuaʻu (Hawaiian petrel) population declines by 46 percent but ends the permit term with a growth rate trending upward annually by 1.06 percent (Table 3.2-7 and Table 3.2-8). The two stable-trend scenarios for ʻuaʻu (Hawaiian petrel) represent the extreme high end of the population's possible trend, with gains of 305 percent (JCS flat-line) and 770 percent (PDM stable-trend).

The model outputs for additional mitigation suggest Alternative D would have a more beneficial influence on both ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) populations by the end of the permit term when compared to the other alternatives. However, under the JCS worst-case and PDM worse-case model scenarios, a decline is predicted for ʻuaʻu (Hawaiian petrel) although an increase in growth rate would occur near the end of the permit term. The ʻuaʻu (Hawaiian petrel) 2075 populations are expected to be lower than the 2025 starting populations under the JCS worst-case and mid-point scenarios and the PDM worse-case scenario of Alternative D, while only the PDM worse-case scenario has a lower ending population for ʻaʻo (Newell's shearwater). Regardless, ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) are expected to experience higher populations at the end of the permit term in all model scenarios when compared to 2075 population projections in Alternatives A through C. This higher population number, particularly for ʻaʻo (Newell's shearwater), is due to the increased predator control in conservation sites that host more ʻaʻo (Newell's shearwater).

Under Alternative D, additional mitigation would provide more benefits to ʻakēʻakē (band-rumped storm-petrel) when compared to Alternatives A, B, and C. This is due to expanded predator control on the landscape beyond the scope of Alternative B resulting in less predation, which would result in increased survival of ʻakēʻakē (band-rumped storm-petrel).

Table 3.2-7. Alternative D Modeled Percent Change in ʻAʻo (Newell's Shearwater) and ʻUaʻu (Hawaiian Petrel) Populations

	JCS Model Population					PDM Population		
Species	Year	Worst Case	Mid Point	Flat Line	Species	Year	Worse Case	Stable Trend
NESH	2025	14,378	20,765	33,941	NESH	2025	32,292	119,887
	2075	18,109	21,597	162,003		2075	27,521	572,763
% Change	--	26%	4%	377%	% Change	--	-15%	378%
HAPE	2025	15,151	20,342	33,592	HAPE	2025	28,547	77,806
	2075	9,906	11,030	136,143		2075	18,860	676,565
% Change	--	-35%	-46%	305%	% Change	--	-34%	770%

The JCS and PDM models are based on different assumptions and are therefore not directly comparable. The two models present a range of possible projections over the 50-year permit term.
HAPE = ʻuaʻu (Hawaiian petrel); NESH = ʻaʻo (Newell's shearwater)

Table 3.2-8. Alternative D Modeled Percent Change in ʻAʻo (Newell's Shearwater) and ʻUaʻu (Hawaiian Petrel) Growth Rates (percentage per year)

	JCS Model Population					PDM Population		
Species	Year	Worst Case	Mid Point	Flat Line	Species	Year	Worse Case	Stable Trend
NESH	2025	-9.76	-8.07	1.60	NESH	2025	-2.80	1.90
	2075	1.23	0.97	1.64		2075	1.00	4.60
HAPE	2025	-9.70	-8.13	1.66	HAPE	2025	-3.00	2.00
	2075	1.24	1.06	2.94		2075	0.30	6.50

The JCS and PDM models are based on different assumptions and are therefore not directly comparable. The two models present a range of possible projections over the 50-year permit term.
HAPE = ʻuaʻu (Hawaiian petrel); NESH = ʻaʻo (Newell's shearwater)

3.2.3.2 Waterbirds

Alternative A No Action

Under Alternative A (No Action), the Draft HCP would not be implemented and the Service and DLNR would not issue take authorizations for the incidental take of the five covered waterbird species. Under Alternative A, KIUC would continue to operate existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. KIUC would not implement a comprehensive program to mitigate impacts on Covered Species. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. This means that all measures already in place by KIUC to avoid and minimize powerline collision impacts on waterbirds, which include reconfiguration of powerlines from vertical to a horizontal profile, removal of static wire, removal of 69-kilovolt transmission line in Mānā, and bird flight diverters on powerlines, would continue to benefit the covered waterbirds for the duration of their useful life under this alternative regardless of whether the Draft HCP is implemented. These minimization measures are expected to reduce waterbird powerline collisions by 90 percent in areas where powerlines and covered waterbirds occur until expiration of powerline diverter useful life.

Under Alternative A, the measure put in place by KIUC to minimize light attraction—full-cutoff shielded fixtures—will remain. However, because light attraction has not been documented to affect behavior and populations of covered waterbirds on Kauaʻi, Alternative A is not likely to have either a beneficial or adverse impact on covered waterbirds in this regard.

Under Alternative A, conservation or management actions described in the Draft HCP that require an annual commitment of funding and staff resources by KIUC would not be funded. Therefore, under Alternative A, KIUC would not contribute $300,000 annually to the SOS program on Kauaʻi. The SOS program is jointly supported by multiple agencies and organizations such as DLNR, University of Hawaiʻi, and KIUC and is the only facility on Kauaʻi that has a rehabilitation permit to rescue injured waterbirds, rehabilitate, and release them. Without annual contributions from KIUC, the SOS program may continue but would likely not have adequate funds to keep staff and maintain the facilities at full capacity. KIUC provides the majority of SOS program funding. Therefore, under Alternative A and without KIUC funding, the SOS program is not likely to offset the number of waterbirds taken by colliding with KIUC powerlines.

The above-discussed impacts combined with the fact that populations of all covered waterbirds are either stable or have been increasing over the last few decades (Paxton et al. 2022) on Kauaʻi suggest no significant impacts on the covered waterbird species' overall populations under Alternative A.

Alternative B Proposed Action

Under Alternative B, the Service and DLNR would approve the Draft HCP and issue the take authorization to KIUC for incidental take of covered waterbirds across the five species from KIUC's Covered Activities in the Permit Area over the 50-year permit term. Under Alternative B, KIUC would implement measures in the Draft HCP to avoid and minimize impacts on covered waterbirds when operating and maintaining existing and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lighting operations. These avoidance and minimization measures, which include removal of static wire, removal of 69-kilovolt transmission line in Mānā, and installation of bird flight diverters, have already been completed and are in place at KIUC's existing infrastructures. However, KIUC would also avoid construction of new transmission and distribution lines in high-collision zones in the Plan Area to the maximum extent possible.

These minimization measures are expected to contribute to about a 90-percent reduction in powerline collision of covered waterbirds for powerline spans that occur in areas where the covered waterbirds occur. The Mānā Plain and Hanalei regions have extensive wetlands, and waterbirds are among the most common birds moving through this region (Travers et al. 2016). Waterbirds in the Mānā Plain region are estimated to constitute a large portion of the detected collisions with powerlines (Travers et al. 2016). Because the span of powerlines that traverse the areas where waterbirds occur is a small portion (limited to the Mānā Plains and Hanalei spans) compared to KIUC's entire powerline system, Alternative B is likely to have significant beneficial but not adverse impacts on covered waterbirds with regard to powerline collision avoidance and minimization measures.

Under Alternative B, KIUC has already minimized light attraction by installing full-cutoff shielded fixtures for streetlights. However, because light attraction has not been documented to affect behavior and populations of the five covered waterbird species on Kauaʻi, Alternative B is not likely to have either a beneficial or adverse impact on covered waterbirds in this regard.

Under Alternative B, KIUC would contribute $300,000 annually to the SOS program. The SOS program rescues, rehabilitates, and releases grounded and injured birds including the covered waterbird species on Kauaʻi. It is estimated that 404 individuals of the covered waterbirds would be killed by powerline collisions over the 50-year term of the Draft HCP and that the SOS program alone is expected to completely offset this loss by rehabilitating 2,589 covered waterbirds. It is assumed these waterbirds would not be part of another entity's take. Alternative B, therefore, is expected to have a long-term beneficial impact on the five covered waterbird species.

Under Alternative B, KIUC would also implement conservation measures to manage habitat for covered seabird species. These conservation measures include predator control, predator exclusion fencing, social attraction, and invasive species management. However, these measures are not likely to benefit or harm covered waterbird species, because they are proposed to occur at and around the 12 conservations sites situated at the high-elevation Kalalau East to Upper Mānoa region in highly vegetated mountain slopes that are not suitable habitat for covered waterbird species.

Alternative C Additional Minimization

Because Alternative C includes activities covered under Alternative B, it would have similar impacts on covered waterbirds as Alternative B. Under Alternative C, KIUC would implement additional minimization measures (e.g., additional powerline reconfiguration, static wire removal, flight diverter installation) to further minimize risk of waterbird collision with KIUC's powerlines. Therefore, additional minimization under Alternative C is not anticipated to benefit the covered waterbirds and the impact of Alternative C on waterbirds would be the same as described for Alternative B. The additional lighting minimization measures under Alternative C are also not likely to affect covered waterbirds, because these species are diurnal and artificial lights have not been documented to affect their behavior and populations.

Under Alternative C, KIUC would increase funding to the SOS program by 50 percent ($450,000) beyond the $300,000 proposed annually in the Draft HCP to support rescue and rehabilitation of injured listed seabirds. Because this increased funding for the SOS program would not result in additional waterbirds being brought in for rehabilitation due to non-KIUC sources (e.g., botulism, vehicle collisions) compared to Alternative B, it would likely not have an (adverse or beneficial) impact on the covered waterbirds.

Alternative D Additional Mitigation

Because Alternative D includes activities covered under Alternative B, it would have similar impacts on covered waterbirds as Alternative B plus some additional benefits. Under Alternative D, KIUC would implement all avoidance and minimization measures (e.g., additional powerline reconfiguration, static wire removal, flight diverter installation) and conservation measures proposed under Alternative B. With regard to these activities, the impacts on covered waterbirds under Alternative D would be similar to those under Alternative B. In addition, under Alternative D, KIUC would increase the intensity of management actions proposed in the Draft HCP (Alternative B). Under Alternative D, conservation measures such as control of ungulates, barn owls, cats, and other predators would be expanded to hundreds of acres outside but in the vicinity of the conservation sites identified under Alternative B. Although these expanded mitigation measures in the vicinity of the conservation sites do not overlap waterbird habitats, overall, control of cats and barn owls that cover large areas and are known to prey on covered waterbirds is expected to have a slight beneficial effect on the covered waterbird populations. Furthermore, under Alternative D, KIUC would expand efforts to manage habitat for covered waterbirds within the Mānā Plain wetlands by expanding population monitoring and barn owl and other predator control efforts. Implementing conservation measures to control predators within the Mānā Plains area is expected to have a direct beneficial impact on covered waterbird species by increasing survival and reproductive success of listed waterbirds.

Overall, in comparison to the No Action alternative, Alternative D would likely have a significantly beneficial impact on covered waterbirds. Alternative D would also have significantly beneficial impacts on covered waterbirds compared to Alternatives B and C. As discussed above, this is primarily because under Alternative D, additional conservation management actions in Mānā Plains waterbird habitat are expected to increase survival and reproductive success of covered waterbirds.

3.2.3.3 Reptiles: Honu (Green Sea Turtle)

Alternative A No Action

Under Alternative A, KIUC would operate existing and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lighting, in accordance with historical practices; the take of ESA-listed honu (green sea turtle) would occur, but would not be mitigated. In locations where coastal streetlights are visible from suitable beach habitat, honu (green sea turtle) hatchlings may become disoriented by downward-facing lights on land and crawl toward these artificial light sources, where they may be eaten by predators or run over by cars, resulting in incidental take. Currently, measures implemented to minimize the impact of KIUC-operated streetlights on covered seabirds do not reduce streetlight visibility to honu (green sea turtle) hatchlings. KIUC has identified 29 KIUC-operated streetlights visible from suitable honu (green sea turtle) nesting habitat in the Plan Area as of 2020 (ICF 2025).

Without minimization or mitigation, the number of honu (green sea turtle) nests affected by KIUC streetlights is expected to be less than one per year. Observations of nesting have increased over the past 5 years (State of Hawaiʻi Division of Aquatic Resources 2020) and suggest that effects including incidental take of honu (green sea turtle) could increase over time if no action is taken. Under Alternative A, incidental take of honu (green sea turtle) would continue to occur.

Alternative B Proposed Action

Under Alternative B, the Service and DLNR would approve the Draft HCP and issue the take authorization to KIUC for incidental take of honu (green sea turtle) from KIUC's Covered Activities in the Permit Area over the permit term. KIUC would implement measures in the Draft HCP to avoid and minimize impacts on honu (green sea turtle) when operating existing and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lighting operations. Currently, measures implemented to minimize the impact of streetlights on covered seabirds do not reduce streetlight visibility to honu (green sea turtle) hatchlings. KIUC has identified 29 streetlights visible from suitable honu (green sea turtle) nesting habitat in the Plan Area as of 2020 (ICF 2025).

Under Alternative B, KIUC would operate existing and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lighting but implement a nest detection and shielding program to minimize and offset the effects of light attraction from KIUC streetlights on honu (green sea turtle). Nest shielding would initially be installed on seven beaches identified by KIUC, the Service, DLNR Division of Forestry and Wildlife, and State of Hawaiʻi Division of Aquatic Resources (DAR) as having suitable nesting habitat and KIUC streetlights that have been documented as being visible from that habitat. These measures would be implemented over the 50-year permit term unless KIUC is able to demonstrate to the Service, DLNR, and State of Hawaiʻi DAR that permanent modification of existing and future streetlights fully avoids take of honu (green sea turtle).

Additionally, streetlight minimization techniques and modifications would potentially be implemented to reduce light attraction of honu (green sea turtle) hatchlings at these sites and any additional streetlights identified throughout the permit term under Alternative B. These light-minimization techniques may include additional shielding or changes in wattage. If no practicable minimization measures can be agreed upon, KIUC would instead implement temporary nest shielding throughout the life of the permit term.

KIUC assumes that monitoring and minimization measures conducted under Alternative B would result in take avoidance for honu (green sea turtle) nests and provide a net benefit for the species. Those nests that have even the smallest potential to be affected by KIUC streetlights (mostly through disorientation, injury, or mortality of any hatchlings) would be protected by the nest detection and shielding program. In addition, on the beaches identified as having KIUC-operated streetlights visible from suitable honu (green sea turtle) nesting habitat, the entire length of the beach would be included in the nest detection and shielding program. Therefore, the nest shielding program would also protect honu (green sea turtle) affected by non-KIUC light sources.

Under Alternative B, KIUC would contribute $300,000 annually to the SOS program. The SOS program rescues, rehabilitates, and releases grounded and injured birds including the covered seabird and waterbird species on Kauaʻi, and is not expected to have an impact on honu (green sea turtle).

Under Alternative B, KIUC would also implement conservation measures to manage habitat for covered seabird species. These conservation measures include predator control, predator exclusion fencing, social attraction, and invasive species management. These measures are not likely to benefit or harm honu (green sea turtle), because they are proposed to occur at and around the 12 conservation sites situated at the high-elevation Kalalau East to Upper Mānoa region in highly vegetated mountain slopes that are not suitable habitat for honu (green sea turtle).

Alternative C Additional Minimization

Additional powerline collision minimization and additional lighting minimization measures proposed under Alternative C would reduce powerline collision risk and light attraction for both the covered seabirds and covered waterbirds but would have no effect on honu (green sea turtle).

Under Alternative C, increased funding to the SOS program would be employed to increase searches for injured birds and increase outreach efforts, which is expected to contribute to the increased measures to avoid and minimize take of covered birds, but would have no effect on honu (green sea turtle).

Alternative D Additional Mitigation

Implementation of additional mitigation under Alternative D would not alter adverse impacts on honu (green sea turtle) beyond those identified for Alternative B. Conservation measures such as control of ungulates and predators (e.g., barn owls, cats) would be expanded to hundreds of acres outside but in the vicinity of the conservation sites identified under Alternative B. These expanded mitigation measures in the vicinity of the conservation sites do not overlap with honu (green sea turtle) habitat overall and are not expected to have a direct beneficial or adverse effect on honu (green sea turtle).

Under Alternative D, KIUC would increase funding for the sea turtle program by 15 percent to expand the outreach effort by staff and the volunteer network and to implement a marine debris removal program for honu (green sea turtle). With this expanded capacity, there would be increased awareness by the public to maintain recommended distances and reduce human disturbance to basking sea turtles. Additionally, marine debris would be removed to reduce entanglement hazards, which may have a long-term beneficial impact on the population.

3.2.3.4 Comparison of Alternatives

Seabirds

Beneficial effects on seabirds under Alternative B would be greater in comparison to Alternative A due to implementation of the Draft HCP conservation strategy (e.g., including minimization measures to reduce powerline collisions and light attraction, funding the SOS program, implementing predator control at the seabird conservation sites and social attraction at the predator exclusion fence sites (i.e., Honopū, Pōhākea, Upper Limahuli Preserve, and Upper Mānoa Valley). The additional minimization under Alternative C would have a minimal added benefit to both seabird species when compared to Alternative B because population outcomes based on the five model scenario outputs are similar to the Alternative B conclusions. Alternative C is anticipated to have a small degree of added benefits to ʻakēʻakē (band-rumped storm-petrel) when compared to Alternative A and Alternative B based on additional reduced take from added light and powerline minimization. Alternative D would have greater beneficial effects on ʻaʻo (Newell's shearwater), ʻuaʻu (Hawaiian petrel), and ʻakēʻakē (band-rumped storm-petrel) when compared to Alternatives A, B, and C due to increased predator control.

Waterbirds

In comparison to the Alternative A, the covered waterbird species are expected to have greater long-term beneficial impacts under Alternative B. This benefit is primarily due to the sustained funding by KIUC to the SOS program for the 50-year term of the Draft HCP. Alternative C would be more beneficial to covered waterbirds than Alternative A. The impact of Alternative C on waterbirds would be the same as described for Alternative B because the additional minimization under Alternative C is not anticipated to benefit the covered waterbirds.

Reptiles

Minimization measures under Alternative B should prevent incidental take of honu (green sea turtle) from disorientation and would be anticipated to have short- and long-term beneficial impacts on honu (green sea turtle) in comparison to Alternative A. Overall, the potential for incidental take of honu (green sea turtle) would be less compared to Alternative A and completely offset under Alternative B. Alternative C is anticipated to have the same impact as Alternative B with regard to listed honu (green sea turtle). Alternative D would have the greatest beneficial impacts on honu (green sea turtle) because the additional mitigation implemented under Alternative D would expand mitigation efforts beyond the full offset expected under Alternative B to provide a net benefit to the species.

3.3 Other State and Federally Listed Species

This section describes the affected environment for other state- and federally listed species within the Permit Area and Plan Area. This section also analyzes the direct and indirect effects of the proposed action and alternatives on these species.

3.3.1 Methods

In addition to the nine species proposed for incidental take coverage and discussed in Section 3.2, *Covered Species*, there are other state- or federally listed species potentially present within the Permit and Plan Areas. These include mammals, reptiles, birds, invertebrates, and plants. Resources consulted to prepare the affected environment section included the Draft HCP, the 2015 SWAP (DLNR 2015), and EAs for other HCPs on Kauaʻi (USFWS 2011; DLNR and USFWS 2020).

Section 3.3.3, *Environmental Consequences*, assesses the impact of the proposed action (Alternative B), the No Action alternative (Alternative A), and two other action alternatives (Alternative C, Additional Minimization, and Alternative D, Additional Mitigation) on other listed species. The assumptions presented in Section 3.1.2 were applied when analyzing the impacts of each alternative on the species identified in this section.

3.3.2 Affected Environment

ESA-listed species potentially present in the Permit Area include one terrestrial mammal (ʻōpeʻapeʻa [Hawaiian hoary bat, *Lasiurus semotus*]), one marine mammal (ʻīlio-holo-i-kauaua [Hawaiian monk seal*, Neomonachus schauinslandi*]), one reptile (honuʻea [hawksbill sea turtle, *Eretmochelys imbricata*]), 13 birds (eight of which are reviewed in detail in Section 3.2, *Covered Species*), one snail (Newcomb's snail [*Erinna newcombi*]), three insects (e.g., Hawaiian picture-winged fly [*Drosophila musaphilia*]), 14 ferns and allies, and more than 100 flowering plants (USFWS 2023). In addition, ʻīlio-holo-i-kauaua (Hawaiian monk seal) also is protected under the federal Marine Mammal Protection Act (16 U.S.C. 1361–1407), which, except as exempted or in accordance with permits issued under the act, prohibits the take, including harassment, of marine mammals in waters or on lands under the jurisdiction of the United States.

3.3.2.1 Mammals

Only two mammals, both of which are listed under the ESA, are native to the Plan Area. These are ʻōpeʻapeʻa (Hawaiian hoary bat) and ʻīlio-holo-i-kauaua (Hawaiian monk seal). ʻŌpeʻapeʻa (Hawaiian hoary bat) is the only native land mammal of Hawaiʻi, and it is listed as endangered at the federal and state levels (USFWS 1998); however, there is no designated critical habitat. ʻŌpeʻapeʻa (Hawaiian hoary bat) is widespread on Kauaʻi. Minimal research has been conducted on this species' habitat requirements and population status, although it is known that ʻōpeʻapeʻa (Hawaiian hoary bat) roost in native and nonnative vegetation up to 30 feet (9 m) above the ground (DLNR 2015). They are solitary during the day when roosting but are primarily nocturnal. Depending on the time of year, ʻōpeʻapeʻa (Hawaiian hoary bat) forage around sunset. They consume a variety of native and nonnative night-flying insects such as moths, beetles, and crickets. Echolocation is the primary method for them to find prey. General activity levels may vary with altitude (DLNR 2015).

ʻĪlio-holo-i-kauaua (Hawaiian monk seal) is endemic to Hawaiʻi, is state- and federally listed as endangered, and is designated as depleted under the Marine Mammal Protection Act (50 CFR 216.15). Critical habitat has been designated and is addressed in Section 3.5, *Critical Habitat and Other Land Designations*. The majority of the species' population is in the NWHI, but there have been sightings in the Plan Area (NMFS 2007). The population is estimated to be around 1,600 seals (NOAA Fisheries 2024). ʻĪlio-holo-i-kauaua (Hawaiian monk seal) are benthic feeders and forage in waters up to 1,000 feet (305 m) deep (DLNR 2015). They are generally solitary, except on preferred beaches where they haul out in close proximity to one another. ʻĪlio-holo-i-kauaua (Hawaiian monk seal) can be observed hauling out on beaches in the Permit Area, are monitored closely by DAR and the National Oceanic and Atmospheric Administration (NOAA), and are protected by Seal Resting Areas, which include temporary signage and occasionally fencing that are similar in style to those used for honu (green sea turtle) shielding. ʻĪlio-holo-i-kauaua (Hawaiian monk seal) can give birth year around, but the peak season is March through August (NMFS 2007). A female ʻīlio-holo-i-kauaua (Hawaiian monk seal) gives birth to a single pup and there are approximately three to five pups born on Kauaʻi beaches each year, typically at remote locations where human activity is low (NMFS 2007). Mother and pup remain on the beach for an average of 5 to 7 weeks. For the first few weeks, both mother and pup remain primarily on the beach throughout day and evening hours. By the third or fourth week, mother and pup spend increasingly more time in the water and sleep on the beach at night, typically above the tide line.

3.3.2.2 Reptiles: Honuʻea (Hawksbill Sea Turtle)

Honuʻea (hawksbill sea turtle) was classified as endangered under the ESA in 1970 (35 *Federal Register* 8491). On May 22, 1998, National Marine Fisheries Service published a final recovery plan for the U.S. Pacific populations of honuʻea (hawksbill sea turtle; 63 *Federal Register* 28359) and in October 1998 designated critical habitat for the species around their nesting islands in Puerto Rico (63 *Federal Register* 46693).

Honuʻea (hawksbill sea turtle) is one of the rarest of the seven extant species of marine turtles, and their scarcity has been recognized by the United States and other nations, as well as international resource management institutions. Honuʻea (hawksbill sea turtle) inhabiting the Hawaiian Islands are extremely rare, with an average of fewer than 15 females documented nesting annually across the entire archipelago, primarily along the east coast of the island of Hawaiʻi, with small numbers reported on Maui, Molokaʻi, and Oʻahu (Seitz et al. 2012), making it possibly one of the smallest honuʻea (hawksbill sea turtle) populations in the world (Van Houtan et al. 2016). Nesting appears restricted to the MHI and research to date has documented the majority of nesting on the island of Hawaiʻi (HHTN 2018); between 1993 and 2018, only 0.1 percent of documented honuʻea (hawksbill sea turtle) nests were on Kauaʻi (Gaos et al. 2021).

While uncommon off Kauaʻi, honuʻea (hawksbill sea turtle) forage in coastal Hawaiian waters and nest on a few coasts within the archipelago; therefore, it is possible they could be present near the Plan Area.

3.3.2.3 Birds

A search on the Service's Information for Planning and Consultation online database (USFWS 2023) revealed a total of 13 ESA-listed birds present in the Plan Area, eight of which are reviewed in Section 3.2. Those ESA-listed birds not covered in the previous section include the threatened ʻiʻiwi (scarlet honeycreeper, *Drepanis coccinea*) and the endangered ʻakikiki (Kauaʻi creeper, *Oreomystis* *bairdi*), puaiohi (small Kauaʻi thrush, *Myadestes palmeri*), short-tailed albatross (*Phoebastria albatrus*), and ʻakekeʻe (Kauaʻi ʻākepa, *Loxops caeruleirostris*).

ʻIʻiwi (scarlet honeycreeper) is state-listed as endangered and federally listed as threatened under the ESA. ʻIʻiwi (scarlet honeycreeper) is endemic to Hawaiʻi. Critical habitat has been designated and primarily covers portions of native forests on the islands of Hawaiʻi, Maui, and Kauaʻi (87 *Federal Register* 79942–79975). They typically occur in mesic and wet forest habitat above 4,100 feet (1,250 m) elevation on the islands of Hawaiʻi, Maui, and Kauaʻi; and may occur at reduced densities below. ʻIʻiwi (scarlet honeycreeper) generally feed on nectar from a variety of flowers as well as small arthropods.

ʻAkikiki (Kauaʻi creeper) is state- and federally listed as endangered and is endemic to Kauaʻi. Critical habitat has been designated and is primarily in native forest habitat on Kauaʻi (75 *Federal Register* 18960). Their distribution is restricted to mesic and wet forests between 2,000 and 5,300 feet (600 and 1,600 m) in the Alakaʻi Plateau (Behnke et al. 2016). ʻAkikiki (Kauaʻi creeper) generally forages on trunks, branches, and twigs for insects, insect larvae, and spiders (Foster et al. 2000).

Puaiohi (small Kauaʻi thrush) is state- and federally listed as endangered and is endemic to Kauaʻi. Typically found in pairs, they reside in stream valleys and associated ridges of Alakaʻi Wilderness Preserve and adjacent montane forest at 3,450 feet (1,050 m) to 4,250 feet (1,300 m) elevation with greater than 236 inches (6 m) of rainfall per year. The diet of puaiohi (small Kauaʻi thrush) includes native fruits, insects, snails, and other invertebrates (Snetsinger et al. 1999). There is no critical habitat currently designated for puaiohi (small Kauaʻi thrush).

Short-tailed albatross is state- and federally listed as endangered. They are the largest seabird found in Hawaiʻi. Small numbers have nested on Midway and Kure Atoll in the NWHI and can occasionally be found among nesting mōlī (Laysan albatross, *Phoebastria immutabilis*) and kaʻupu (black-footed albatross, *Phoebastria nigripes*) (Pyle and Pyle 2017). Short-tailed albatross forage closer to land than other albatross species and are known to eat carrion from fishing boats, shrimp, squid, and fish. There is no critical habitat currently designated for short-tailed albatross. There are two records of short-tailed albatross being sighted on Kauaʻi in 2000 and 2006 (Pyle and Pyle 2017). They are not known to breed on Kauaʻi.

ʻAkekeʻe (Kauaʻi ʻākepa) is state- and federally listed as endangered and is endemic to Kauaʻi. ʻAkekeʻe (Kauaʻi ʻākepa) is found in native forests of the Alakaʻi swamp, upper Waimea, and Kōkeʻe regions where it inhabits lowland mesic and wet forests above 1,950 feet (600 m), although populations are densest above 3,600 feet (1,100 m). Most of its current range is within Kōkeʻe State Park and the Alakaʻi Wilderness Preserve where critical habitat has been designated (75 *Federal Register* 18960–19165). ʻAkekeʻe (Kauaʻi ʻākepa) is an ʻōhiʻa (*Metrosideros polymorpha*) specialist, preying on arthropods, primarily spiders, psyllids, and caterpillars inside leaves and flower buds of the plant.

3.3.2.4 Invertebrates

Peʻe peʻe paka ʻole (Kauaʻi cave wolf spider, A*delocosa anops*) and ʻuku noho ana (Kauaʻi cave amphipod, *Spelaeorchestia koloana*) are two of the endangered subterranean insects present in the Plan Area. Both of these insects are thought to be restricted to the Poʻipū and Kukuiʻula areas of the island (USFWS 2003) and can be found in mesocaverns and caves (USFWS 2003, 2011). There are roughly 272 acres (110 hectares) of designated critical habitat for these taxa within the Plan Area. Hawaiian picture-winged fly (*Drosophila musaphilia*) is an endangered fly endemic to the Plan Area.

Historically, it was known to be present at Mt. Kāhili (Alexander Reservoir) in the south and at two sites within Kōkeʻe State Park in the northwest. Occurring in mesic to wet forest, it breeds in fermenting sap fluxes of koa (*Acacia koa*) (DLNR and USFWS 2020).

Newcomb's snail (*Erinna newcombi*), a mollusk, is listed as threatened under the ESA and inhabits streams within the Permit Area. Its known range is limited to very small sites within six stream systems in north- and east-facing drainages in the Permit Area, including Kalalau Stream, Lumahaʻi River, Hanalei River, Waipaheʻe Stream (a tributary to Keālia Stream), Makaleha Stream (a tributary to Kapaʻa Stream), and the North Fork Wailua River (USFWS 2002).

3.3.2.5 Plants

There are more than 100 ESA-listed plants in the Permit Area that also have designated critical habitat. A large portion of these species are found in the mesic habitats on the western portion of the Permit Area, in the Alakaʻi Swamp region, in wet summit areas, and other regions with intact native vegetation (DLNR and USFWS 2020). The ESA-listed plants are routinely threatened by introduced feral ungulates, which are reviewed in Section 3.6, *Non-Listed Flora*. Listed plants are also outcompeted for resources by invasive plant species for limited resources. Nonnative forest pathogens, diseases, and insects are also a direct threat to listed plants. At least 99,200 acres (40,145 hectares) of the Plan Area are designated critical habitat for plant species (USFWS 2011). In addition to ESA-listed species, there are multiple rare plant species in the Permit Area.

3.3.3 Environmental Consequences

In addition to the nine species proposed for incidental take coverage and discussed in Section 3.2, *Covered Species*, there are other state- or federally listed species potentially present within the Permit and Plan Areas. As described in Draft HCP Appendix 1B, *Evaluation of Species Considered for Coverage*, KIUC evaluated all state- and federally listed species that could be present in the Plan Area for coverage. Draft HCP Appendix 1B presents the evaluation process and results of the process for each species considered. Attachments 1 and 2 to the appendix provide more detailed rationale for excluding particular species in the Draft HCP covered species list. Where necessary, the attachments also include avoidance and minimization measures that KIUC must implement to ensure take of listed species is avoided. Based on the results of the evaluation detailed in Draft HCP Appendix 1B, KIUC did not apply for incidental take authorization from DLNR or the Service for any of these species because the impacts are not reasonably likely to cause take. This section discusses impacts associated with the four alternatives on these other state and federally listed species.

3.3.3.1 Alternative A No Action

Under Alternative A, KIUC would operate existing and new infrastructure (powerlines, streetlights, and lights at facilities) that is under its ownership or direct control including powerlines, support structures, and lighting, in accordance with historical practices. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. KIUC would not implement the conservation strategy proposed in the Draft HCP. Impacts on other state- and federally listed species are addressed below.

Mammals

Listed mammals are ʻōpeʻapeʻa (Hawaiian hoary bat) and ʻīlio-holo-i-kauaua (Hawaiian monk seal). Under the No Action alternative, KIUC's continued operation of existing and new infrastructure (powerlines, streetlights, and lights at facilities) is unlikely to affect ʻōpeʻapeʻa (Hawaiian hoary bat). Powerlines do not pose a collision risk for the species because the species has excellent visual and echolocation abilities, and they fly at relatively low speeds. KIUC conducts vegetation management near powerlines to maintain adequate clearance. To avoid affecting bats while conducting vegetation management, KIUC will implement measures such as not trimming or removing vegetation during the pup-rearing season (June 1 to September 15) where vegetation is over 15 feet (4.6 m) tall (Appendix 1B, *Evaluation of Species Considered for Coverage*, in the Draft HCP). ʻŌpeʻapeʻa (Hawaiian hoary bat) is nocturnal and may be drawn to outdoor lighting to forage on a concentration of flying insects. However, this light attraction is benign and may be beneficial to ʻōpeʻapeʻa (Hawaiian hoary bat) because it facilitates the congregation of a food source. Therefore, based on the above, the No Action alternative may benefit ʻōpeʻapeʻa (Hawaiian hoary bat) and is not anticipated to have adverse impacts.

The terrestrial habitat used by ʻīlio-holo-i-kauaua (Hawaiian monk seal) is typically restricted to beaches along the coast. They are not known to be attracted to artificial lighting and do not come in contact with other KIUC infrastructure. Because ʻīlio-holo-i-kauaua (Hawaiian monk seal) is not attracted to artificial lighting and does not come in contact with other KIUC infrastructure, it is not likely that ʻīlio-holo-i-kauaua (Hawaiian monk seal) would be affected by KIUC's operation of existing (with modifications) or new infrastructure.

Reptiles: Honuʻea (Hawksbill Sea Turtle)

Similar to honu (green sea turtle), honuʻea (hawksbill sea turtle) hatchlings may become disoriented by downward-facing lights on land and crawl toward these artificial light sources where they may be eaten by predators or run over by vehicles, resulting in incidental take. However, honuʻea (hawksbill sea turtle) inhabiting the Hawaiian Islands are rare with an average of fewer than 15 females documented nesting annually across the entire archipelago and only 0.1 percent of documented hawksbill nests on Kauaʻi (Gaos et al. 2021). Therefore, KIUC's operation of existing (with modifications) or new infrastructure would not affect honuʻea (hawksbill sea turtle).

Birds

Of the 13 listed species of birds, eight are reviewed in detail in Section 3.2, *Covered Species*. Unlike the three seabird species for which coverage is being sought (which fly to and from their nesting colonies under the cover of darkness), all the other listed bird species except short-tailed albatross typically fly during the day. This, together with their acute vision, makes it unlikely that KIUC's existing or new infrastructure would affect these bird species, because they readily avoid colliding with utility lines and other powerline infrastructure Although short-tailed albatross may fly at night, they are not known to collide with infrastructure.

Short-tailed albatrosses may be affected by artificial lighting, although this observation has been limited to vessels fishing at night for squids when seabirds are foraging. Light attraction on land is expected to be less for short-tailed albatrosses than it is for the covered seabirds. KIUC has installed full-cutoff shielded fixtures on existing streetlights, and Alternative A assumes these would remain in place for their useful life. This reduces light attraction for the species. Short-tailed albatross are not known to breed on Kauaʻi; while they may migrate through the Plan Area, they are considered rare and not a resident species. Therefore, it is not likely short-tailed albatrosses would be affected by light attraction on Kauaʻi.

Invertebrates

Under Alternative A, KIUC would continue to operate existing (with modifications) and new infrastructure. KIUC's existing infrastructure does not occur within or near mesocaverns, caves, or streams inhabited by listed invertebrates (ʻuku noho ana [Kauaʻi cave amphipod], peʻe peʻe paka ʻole [Kauaʻi cave wolf spider], Newcomb's snail, *D. sharpi*, and *D. musaphilia*). Also, it is assumed that new infrastructure would avoid these habitats. Because existing and new infrastructure would avoid listed invertebrate habitat, Alternative A would not affect these species.

Plants

There are more than 100 listed plants in the Plan Area as well as multiple rare species. Under Alternative A, KIUC would continue to operate existing and new infrastructure, including powerlines, streetlights, and lighting at facilities. Operation of this infrastructure does not require ground disturbance; therefore, state- or federally listed plants would not be trampled or removed. In addition, it would not increase the presence or density of invasive plant species, feral ungulates, or pathogens, diseases, and insects that may affect listed plants. Therefore, listed plants would not be affected by operation of KIUC's existing and new infrastructure under Alternative A.

3.3.3.2 Alternative B Proposed Action

Under Alternative B, KIUC would implement Covered Activities defined as (1) powerline operations, including modifications; (2) lighting operations (facility lights and streetlights) and use of night lighting for repairs; and (3) implementation of the Draft HCP conservation strategy. KIUC would apply conservation measures such that the impact of the taking from Covered Activities is minimized and mitigated to the maximum extent practicable. Activities related to implementation of the Draft HCP conservation strategy at the seabird conservation sites may affect other listed species as discussed below.

Mammals

The analysis regarding the operation of existing and new infrastructure (powerlines, streetlights, lights at facilities, and use of night lighting for repairs) under Alternative A applies to Alternative B. Refer to the Alternative A discussion above for a description of the anticipated impacts from operation of existing and new infrastructure on other state- and federally listed species.

Management actions proposed under Alternative B to manage and enhance seabird breeding habitat and colonies at conservation sites have the potential to affect ʻōpeʻapeʻa (Hawaiian hoary bats) if woody vegetation is removed for the construction of predator exclusion fences during the bat pupping/rearing season. However, as a part of its commitment under Alternative B, KIUC would implement measures identified in Appendix 1B, *Evaluation of Species Considered for Coverage*, of the Draft HCP to ensure that take of ʻōpeʻapeʻa (Hawaiian hoary bats) does not occur in connection with vegetation management. For example, KIUC would refrain from vegetation trimming or removal during the pup rearing season (June 1 through September 15) where vegetation is over 15 feet (4.6 m) tall. Additionally, no barbed wire would be used for conservation fencing. With these operational controls in place, adverse impacts on ʻōpeʻapeʻa (Hawaiian hoary bats) are not likely.

Management actions proposed under Alternative B to implement a honu (green sea turtle) nest detection (biological monitoring) and shielding program (installation of light-proof fencing around sea turtle nests) could be a source of disturbance for ʻīlio-holo-i-kauaua (Hawaiian monk seal) if present, especially if a pup is present. Disturbance of seals may result in abandonment of a haul-out site or females abandoning preferred pupping habitat for suboptimal habitat (NMFS 2007). At this time there is a very low risk of conflict between honu (green sea turtle) shielding and ʻīlio-holo-i-kauaua (Hawaiian monk seal) pupping (ICF 2025). The beaches on Kauaʻi where female ʻīlio-holo-i-kauaua (Hawaiian monk seal) are known to pup do not overlap with the seven beaches identified with streetlights visible from potentially suitable honu (green sea turtle) habitat. In addition, beaches with streetlights are typically in areas with high levels of human activity and/or development. Because female ʻīlio-holo-i-kauaua (Hawaiian monk seals) are not known to pup on the seven beaches identified for the nest shielding program and typically avoid areas with high levels of human activity for pupping, it is unlikely that the nest shielding program would affect ʻīlio-holo-i-kauaua (Hawaiian monk seal) pupping.

Other ʻīlio-holo-i-kauaua (Hawaiian monk seal) (non-mother/pup pairs) may haul out to rest on the seven beaches identified with streetlights visible from potentially suitable honu (green sea turtle) habitat, but they do not remain on beaches for extended periods except when pupping and molting. Typically, ʻīlio-holo-i-kauaua (Hawaiian monk seals) haul out during the day to rest on the beach and return to the ocean at night to forage, but occasionally remain hauled out overnight. Seals commonly rest near the tide line to thermoregulate, but may move up the beach to rest. Because ʻīlio-holo-i-kauaua (Hawaiian monk seals) typically do not remain on beaches for extended periods of time, it is unlikely that the nest shielding program would conflict with ʻīlio-holo-i-kauaua (Hawaiian monk seal) resting on the beach.

In the rare event where ʻīlio-holo-i-kauaua (Hawaiian monk seals) are present or pupping on beaches identified for the nest shielding program and honu (green sea turtle) nests are identified within 50 feet (15 m) of a ʻīlio-holo-i-kauaua (Hawaiian monk seal) or 150 feet (46 m) of a ʻīlio-holo-i-kauaua (Hawaiian monk seal) mother and pup, KIUC will contact Kauaʻi DAR, NOAA, and USFWS at the time of detecting this proximity and coordinate with Kauaʻi DAR, NOAA, and USFWS on the best approach to implement based upon the situation for honu (green sea turtle) nest shielding to avoid any disturbance or disruption to nearby ʻīlio-holo-i-kauaua (Hawaiian monk seal) (ICF 2025). Therefore, monitoring and the nest-shielding program are not anticipated to have adverse impacts on ʻīlio-holo-i-kauaua (Hawaiian monk seal).

Reptiles: Honuʻea (Hawksbill Sea Turtle)

Management actions proposed under Conservation Measure 5 to implement a honu (green sea turtle) nest detection and shielding program could have beneficial impacts on honuʻea (hawksbill sea turtle). Increased biological monitoring as well as installation of light-proof fencing around sea turtle nests would benefit honuʻea (hawksbill sea turtle) nests if present; however, given the extremely uncommon nesting of honuʻea (hawksbill sea turtle) in the Plan Area, monitoring and nest fencing are not likely to affect honuʻea (hawksbill sea turtle).

Birds

Under Alternative B, KIUC would operate existing infrastructure with modifications, and new infrastructure in the future. As presented under Alternative A, effects on listed forest birds are not likely to occur. Short-tailed albatross may fly at night; however, this species is not known to collide with infrastructure, but is subject to light attraction. KIUC has installed full-cutoff shielded fixtures on existing streetlights, which would apply to new streetlights under Alternative B. This reduces light attraction for the species. Given this measure and the rarity of the species on Kaua‘i, light attraction effects on short-tailed albatross are not likely to occur.

Under Alternative B, management actions proposed under Conservation Measure 4 to manage and enhance seabird breeding habitat and colonies at conservation sites are not likely to affect other listed birds. Other listed forest-dwelling bird species in the Plan Area include ‘i‘iwi (scarlet honeycreeper), endangered ‘akikiki (Kaua‘i creeper), puaiohi (small Kaua‘i thrush), and ‘akeke‘e (Kaua‘i ‘ākepa). Of the four listed forest birds, only puaiohi (small Kaua‘i thrush) has been documented to have been unintentionally killed by a Goodnature A24 trap for rodents (Shiels et al. 2022). However, the four listed forest birds are not known to be present within the conservation sites. Therefore, it is unlikely that any of these species would accidentally be caught in a predator trap within the conservation sites. KIUC would implement minimization measures in the Avian Protection Plan (Appendix C) (i.e., Avoidance and Minimization Measure 1, *Avoid Impacts to Forest Birds and Pueo from Fence Construction at Conservation Sites*, and Avoidance and Minimization Measure 2, *Avoid Impacts to MBTA Protected Bird Species from Predator Traps or Collisions with Facilities at Conservation Sites*). With implementation of these measures, listed forest bird species are unlikely to be affected by implementation of the conservation strategy in the Draft HCP.

Invertebrates

Under Alternative B, KIUC would operate existing (with modifications) and new infrastructure. As presented for Alternative A, there is no mechanism for impacts on listed invertebrates (‘uku noho ana [Kaua‘i cave amphipod], pe‘e pe‘e paka ‘ole [Kaua‘i cave wolf spider], Newcomb’s snail, *D. sharpi*, and *D. musaphilia*) from this activity. Implementation of the Draft HCP conservation strategy under Alternative B is not likely to affect listed invertebrates because management actions would not occur in mesocaverns, caves, or streams inhabited by listed invertebrates.

Plants

Under Alternative B, KIUC would operate existing (with modifications) and new infrastructure in the future. As presented for Alternative A, this activity would not affect listed plants.

Under Alternative B, KIUC would implement a conservation strategy, including management actions proposed under Conservation Measure 4 to manage and enhance seabird breeding habitat and colonies at conservation sites. Construction of predator exclusion fence and artificial burrows, predator and invasive plant species removal, and seabird habitat enhancement would result in discrete areas of vegetation clearing and ground disturbance at conservation sites. As described in Draft HCP Appendix 1B, Attachment 2, *Measures to Avoid Adverse Effects on Listed Plant Species*, the following avoidance and minimization measures would be implemented as part of the proposed action to ensure conservation measures do not adversely affect listed plants: field surveys before finalizing fence alignments or locations for artificial burrows and before construction/installation to prevent damage or harm to rare plants; incorporation of rare species protocols (e.g., flagging plants, identifying buffer zones); coordination with a qualified botanist to implement measures ensuring Covered Activities would avoid adverse effects on listed plants; conducting a worker environmental awareness training for all staff prior to work activities within management areas near or within a listed plant species buffer; and incorporation of invasive species prevention and biosecurity measures to reduce the potential for inadvertent introduction of nonnative species.

With incorporation of avoidance and minimization measures, effects on listed plants from fencing, predator and invasive plant species removal, and seabird habitat enhancement are not likely to occur. Over the long term, listed plants may benefit from management actions if fencing and predator removal protect listed plants from depredation by rodents and degradation by ungulates.

3.3.3.3 Alternative C Additional Minimization

Alternative C would implement all the proposed activities of Alternative B along with additional minimization measures on existing powerline spans that have higher collision risk for covered seabirds to further reduce the collision risk. Alternative C would also implement additional minimization measures for new powerlines to reduce collision risk and for existing and new streetlights to reduce light attraction for seabirds. Alternative C would also increase funding to the SOS program. Impacts of Alternative C on other listed taxa are discussed below.

Mammals

The terrestrial habitat used by ʻīlio-holo-i-kauaua (Hawaiian monk seal) is typically restricted to beaches along the coast. They are not known to be attracted to artificial lighting and do not come in contact with other KIUC infrastructure. Because ʻīlio-holo-i-kauaua (Hawaiian monk seal) is not attracted to artificial lighting and does not come in contact with other KIUC infrastructure, it is not likely that ʻīlio-holo-i-kauaua (Hawaiian monk seal) would be affected by KIUC's operation of existing or new powerlines or streetlights with additional minimization applied. As described above for No Action (Section 3.3.3.1), powerlines do not pose a collision risk for ʻōpeʻapeʻa (Hawaiian hoary bat) because the species has excellent visual and echolocation abilities, and they fly at relatively low speeds. Therefore, additional minimization to reduce collision risk for seabirds is not likely to affect ʻōpeʻapeʻa (Hawaiian hoary bat).

Under Alternative C, KIUC would increase funding to the SOS program by 50 percent ($450,000) beyond the $300,000 proposed annually in the Draft HCP to support rescue and rehabilitation of injured listed seabirds. This increased funding would be employed to increase searches for injured birds and increase outreach efforts and would not affect listed mammals.

Reptiles: Honuʻea (Hawksbill Sea Turtle)

Alternative C is anticipated to have the same impact as Alternative B because this alternative involves the same activities as Alternative B with regard to listed honuʻea (hawksbill sea turtle). Because honuʻea (hawksbill sea turtle), an aquatic marine reptile, would not come in contact with overhead powerlines, additional powerline collision minimization proposed under Alternative C would reduce powerline collision risk for the covered seabirds but would have no effect on honuʻea (hawksbill sea turtle). Because there are so few honuʻea (hawksbill sea turtle) on Kauaʻi, any additional lighting minimization measures are not likely to affect this species.

Under Alternative C, increased funding to the SOS program would be employed to increase searches for injured birds and increase outreach efforts. Because this measure would contribute to the increased measures to avoid and minimize take of covered birds and rehabilitate covered bird species, it would have no effect on honuʻea (hawksbill sea turtle).

Birds

Alternative C would implement additional collision minimization measures on existing and new powerline spans and additional minimization measures for existing and new streetlights. The operation of powerlines with additional minimization is not likely to affect other listed bird species. The distribution of the listed forest birds on Kauaʻi (i.e., within the Alakaʻi Plateau, Alakaʻi Wilderness Preserve, Alakaʻi swamp, upper Waimea, and Kōkeʻe regions) limits the potential for these species to interact with KIUC's infrastructure. ʻIʻiwi (scarlet honeycreeper), endangered ʻakikiki (Kauaʻi creeper), puaiohi (small Kauaʻi thrush), and ʻakekeʻe (Kauaʻi ʻākepa) typically fly during daylight. This, together with their acute vision, makes it unlikely that additional minimization measures under Alternative C would affect listed forest bird species. Similar to Alternatives A and B, impacts from powerlines and lighting on short-tailed albatross under Alternative C are unlikely to occur because the species is not known to collide with infrastructure and is rare on Kauaʻi.

Invertebrates

KIUC's existing infrastructure does not occur within or near mesocaverns, caves, or streams inhabited by listed invertebrates (ʻuku noho ana [Kauaʻi cave amphipod], peʻe peʻe paka ʻole [Kauaʻi cave wolf spider], Newcomb's snail, *D. sharpi*, and *D. musaphilia*). Also, it is assumed that new infrastructure would avoid these habitats. Additional measures to minimize powerline collisions and light attraction under Alternative C are unlikely to affect listed invertebrates because operation of powerlines and streetlights with additional minimization would not disturb the mesocaverns, caves, or streams inhabited by these species.

Plants

Operation of powerlines and streetlights with additional minimization, and additional funding for the SOS program do not involve ground disturbance and would not affect listed plant species.

3.3.3.4 Alternative D Additional Mitigation

Beyond the covered activities proposed under Alternative B, KIUC would implement additional mitigation and conservation measures under Alternative D such as expanding control of ungulates, barn owls, and other predators to hundreds of acres outside, but in the vicinity, of the conservation sites identified under Alternative B. Additionally, KIUC would increase funding by 15 percent to expand outreach efforts and implement a marine debris removal program for honu (green sea turtle). Activities related to implementation of Alternative D would not affect other listed species as discussed below.

Mammals

Increased installation of ungulate and predator fences to manage and enhance seabird breeding habitat and colonies at additional conservation sites has the potential to affect ʻōpeʻapeʻa (Hawaiian hoary bat) if woody vegetation over 15 feet (4.6 m) is disturbed or removed for construction of predator exclusion fences during the bat pupping/rearing season. However, KIUC would implement measures identified in Appendix 1B, *Evaluation of Species Considered for Coverage*, of the Draft HCP to ensure that take of ʻōpeʻapeʻa (Hawaiian hoary bat) does not occur in connection with vegetation management. For example, KIUC would refrain from vegetation trimming or removal during the pup-rearing season (June 1 through September 15) where vegetation is over 15 feet (4.6 m) tall.

Additionally, no barbed wire would be used for conservation fencing. With these operational controls in place, adverse impacts on ʻōpeʻapeʻa (Hawaiian hoary bat) are not likely.

Increased honu (green sea turtle) outreach and implementation of a marine debris removal program under Alternative D could occur on the same beaches used by ʻīlio-holo-i-kauaua (Hawaiian monk seal) and could be a source of disturbance for ʻīlio-holo-i-kauaua (Hawaiian monk seal) if present. However, a 50-foot (15-m) separation distance from ʻīlio-holo-i-kauaua (Hawaiian monk seal) or a 150-foot (46-m) buffer from a mother with a pup, as recommended by NOAA and DLNR DAR, would be maintained during sea turtle outreach activities and marine debris removal activities. With implementation of the buffer distance recommended by NOAA and DLNR DAR, increased sea turtle outreach and marine debris removal are not likely to affect ʻīlio-holo-i-kauaua (Hawaiian monk seal).

Reptiles: Honuʻea (Hawksbill Sea Turtle)

Increased funding for a sea turtle program to expand outreach effort and to implement marine debris removal under Alternative D may have a positive impact for honuʻea (hawksbill sea turtle). Given the extremely rare nesting of hawksbills in the Permit Area, increased outreach for public awareness of basking sea turtles and marine debris removal under Alternative D are not likely to affect honuʻea (hawksbill sea turtle).

Birds

Under Alternative D, construction of additional ungulate and predator exclusion fencing, weatherports, helicopter landing zones, and artificial burrows; implementation of predator trapping; and invasive species removal have the potential to adversely affect other listed forest-dwelling species through nest loss from vegetation clearing. To fully avoid effects on other listed birds, avoidance and minimization measures in the Avian Protection Plan (Appendix C) (e.g., Avoidance and Minimization Measure 1, *Avoid Impacts to Forest Birds and Pueo from Fence Construction at Conservation Sites*, and Avoidance and Minimization Measure 2, *Avoid Impacts to MBTA Protected Bird Species from Predator Traps or Collisions with Facilities at Conservation Sites*) would be followed. With implementation of these avoidance and minimization measures, effects on other listed bird species are unlikely to occur.

Invertebrates

Implementation of additional mitigation under Alternative D is not likely to occur in mesocaverns, caves, or streams inhabited by listed invertebrates and Alternative D is not likely to affect listed invertebrates (ʻuku noho ana [Kauaʻi cave amphipod], peʻe peʻe paka ʻole [Kauaʻi cave wolf spider], Newcomb's snail, *D. sharpi*, and *D. musaphilia*).

Plants

Alternative D would increase the total acreage of mitigation effort beyond what is included in the proposed action. Vegetation and ground disturbance associated with the construction of additional ungulate and predator exclusion fencing, artificial burrows, weatherports, and helicopter landing zones, as well as predator and invasive plant species removal and seabird habitat enhancement, have the potential to affect listed plant species. Under Alternative D, the Service and DLNR assume that the same avoidance and minimization measures incorporated into the proposed action would also be implemented under Alternative D to ensure conservation measures do not adversely affect listed plants: field surveys before finalizing fence alignments or locations for artificial burrows and before construction/installation to prevent damage or harm to rare plants; incorporation of rare species protocols (e.g., flagging plants, identifying buffer zones); coordination with a qualified botanist to implement measures to avoid adverse effects on listed plants; conducting a worker environmental awareness training for all staff prior to work activities within management areas near or within a listed plant species buffer; and incorporation of invasive species prevention and biosecurity measures to reduce the potential for inadvertent introduction of nonnative species. With implementation of these avoidance and minimization measures, additional mitigation under Alternative D would not be likely to affect other listed plant species. To the extent that fenced areas include rare and listed plant species, if listed plants occur within fenced areas, Alternative D may protect listed plants from depredation by rodents and degradation by ungulates and over the long term have beneficial impacts on listed plants.

3.3.3.5 Comparison of Alternatives

Mammals

Alternative B would have greater potential to disturb listed mammals compared to Alternative A, which is not expected to have any impacts on other state- and federally listed species. Effects of Alternative C on listed mammals would be the same as described for Alternative B, because it primarily involves the same activities as Alternative B. Effects of Alternative D on listed mammals would be the same as described for Alternative B.

Reptiles: Honuʻea (Hawksbill Sea Turtle)

Alternative B would have greater potential to benefit listed honuʻea (hawksbill sea turtle) compared to Alternative A. Effects of Alternative C on listed honuʻea (hawksbill sea turtle) would be the same as described for Alternative B, because it primarily involves the same activities as Alternative B. Effects of Alternative D on listed honuʻea (hawksbill sea turtle) would be the same as described for Alternatives B and C.

Birds

Alternative B would have greater potential to benefit other listed birds compared to Alternative A. Alternatives B, C, and D do not vary in the level of impact on other listed birds.

Invertebrates

The proposed action (Alternative B) would have no effect on listed invertebrates and does not differ from Alternative A in this regard. Effects of Alternative C on listed invertebrates would be the same as described for Alternative B, because it primarily involves the same activities as Alternative B. Effects of Alternative D on listed invertebrates would be the same as described for Alternatives B and C.

Plants

Alternative B would have a greater potential to benefit listed plants compared to Alternative A. Effects of Alternative C on listed plants would be the same as described for Alternative B, because it primarily involves the same activities as Alternative B. In comparison to other alternatives, Alternative D would have the greatest potential to benefit listed plants.

3.4 Migratory Bird Species

This section describes the affected environment for migratory bird species listed under the Migratory Bird Treaty Act (MBTA) within the Permit and Plan Areas. This section also analyzes the direct and indirect effects of the proposed action and alternatives on these species.

3.4.1 Methods

In addition to the species proposed for incidental take coverage and discussed in Section 3.2, *Covered Species*, and other listed species discussed in Section 3.3, *Other State and Federally Listed Species*, there are other bird species listed under the MBTA within the Permit and Plan Areas. Resources consulted to prepare the affected environment section included the Draft HCP, the 2015 SWAP (DLNR 2015), and EAs for other HCPs on Kauaʻi (USFWS 2011; DLNR and USFWS 2020).

Section 3.4.3, *Environmental Consequences*, assesses the impact of the proposed action (Alternative B), the No Action alternative (Alternative A), and two other action alternatives (Alternative C, Additional Minimization, and Alternative D, Additional Mitigation) on migratory bird species. The assumptions presented in Section 3.1.2 were applied when analyzing the impacts of each alternative on the species identified in this section.

3.4.2 Affected Environment

The federal MBTA (16 U.S.C. 703–712) prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species and their parts, nests, and eggs without prior authorization by the Service. The list of protected migratory bird species is found in 50 CFR 10.13. KIUC prepared an Avian Protection Plan (Appendix C), in which Tables A1 and A2 list those MBTA species known to occur or migrate, or were observed accidentally or rarely on Kauaʻi. In addition to the ESA and MBTA-listed species, there are 10 birds found within the Permit Area that warrant special attention because they are on the Service's Birds of Conservation Concern List[5]: ʻapapane (*Himatione sanguinea*), noio (black noddy, *Anous minutus melanogenys*), kaʻupu (black-footed albatross), ʻanianiau (lesser ʻamakihi, *Hemignathus parvus*), kioea (bristle-thighed curlew, *Numenius tahitiensis*), ʻou (Bulwer's petrel, *Bulweria bulwerii*), ʻaoʻū (Christmas shearwater, *Puffinus nativitatis*), Kauaʻi ʻamakihi (*Hemignathus kauaiensis*), Kauaʻi ʻelepaio (monarch flycatcher, *Chasiempis sclateri*), and mōlī (Laysan albatross, *Phoebastria immutabilis*) (USFWS 2021). Most bird species native to Kauaʻi are considered migratory birds protected under the MBTA and the majority of the Birds of Conservation Concern are protected under the MBTA.[6]

Migratory or Birds of Conservation Concern forest birds are generally found in remnant montane mesic and wet native forests that are dominated by ʻōhiʻa and koa (DLNR 2015; DLNR and USFWS 2020). Similar to ESA-listed forest birds, threats to migratory or Birds of Conservation Concern native forest birds include predation, habitat degradation, and disease.

[5] The Service's Birds of Conservation Concern List identifies the migratory and non-migratory bird species (beyond those already federally designated as threatened or endangered) that represent the highest conservation priorities.
[6] Kauaʻi ʻelepaio is not an MBTA listed species.

The native pueo (Hawaiian short-eared owl, *Asio flammeus sandwichensis*) is present throughout the MHI, including Kauaʻi (Holt and Leasure 1993). It is state-listed on Oʻahu, but not listed at either the federal or state level in the Plan Area. Pueo (Hawaiian short-eared owl) nests on the ground and primarily consumes small mammals. Unlike other owls, pueo (Hawaiian short-eared owl) are active during the day, and at dusk and dawn. They are present from sea level to high elevations and across most habitat types (DLNR 2015). Pueo (Hawaiian short-eared owl) are primarily observed in grasslands, shrublands, and montane parklands.

Most waterbirds in the Permit Area are discussed in Section 3.2, *Covered Species*, except for ʻaukuʻu (black-crowned night-heron, *Nycticorax nycticorax*). ʻAukuʻu (black-crowned night-heron) are widely distributed throughout the MHI and are present in the Permit Area. Their preferred habitat is mountain streams, lowland ponds and estuaries, suburban/urban waterways, and aquaculture farms (Davis 1993).

Over 20 seabirds, in addition to those covered in Section 3.2, have been observed in the MHI (DLNR and USFWS 2020), many as breeders, and are present on Kauaʻi. Examples of those observed in the Plan Area include mōlī (Laysan albatross), ʻā (brown booby, *Sula leucogaster*), ʻā (red-footed booby, *Sula sula*), ʻuaʻu kani (wedge-tailed shearwater, *Ardenna pacifica*), koaʻe kea (white-tailed tropicbird, *Phaethon lepturus*), koaʻe ʻula (red-tailed tropicbird, *Phaethon rubricauda*), and ʻiwa (great frigatebird, *Fregata minor*). Primary threats to these seabirds are similar to those of the covered seabirds: predation by terrestrial predators, and habitat loss and degradation due to development and invasive species.

Several migratory shorebirds are seasonally present in the Permit Area. Examples include kōlea (Pacific golden-plover, *Pluvialis fulva*), ʻakekeke (ruddy turnstone, *Arenaria interpres*), ʻūlili (wandering tattler, *Heteroscelus incanus*), and kioea (bristle-thighed curlew, *Numenius tahitiensis*) (DLNR and USFWS 2020).

KIUC has coordinated with the Service to develop an Avian Protection Plan (Appendix C) to identify proposed measures to avoid or minimize potential impacts on all migratory avian species and evaluate potential effects on those species. In addition, the Draft HCP incorporates conservation measures to avoid, minimize, and mitigate potential impacts on Covered Species that are listed under the ESA. Many of the conservation measures in the Draft HCP are also expected to benefit other MBTA species not covered by the Draft HCP, and are referenced in the Avian Protection Plan.

3.4.3 Environmental Consequences

3.4.3.1 Alternative A No Action

Under Alternative A, KIUC would continue to operate existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. KIUC would not implement a comprehensive program to mitigate impacts on Covered Species. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. Migratory bird species including ʻaukuʻu (black-crowned night heron), kōlea (Pacific-golden plover, *Pluvialis fulva*), and pueo (Hawaiian short-eared owl) have been documented to collide with powerlines (Travers et al. 2023). Under Alternative A, these and other migratory bird species would likely be affected by powerline strikes, which could lead to adverse effects on those species. Light attraction has been documented to affect several migratory seabird species including ʻuaʻu kani (wedge-tailed shearwater), noio (black noddy), ʻou (Bulwer's petrel), ʻaoʻū (Christmas shearwater), koaʻeʻ kea (red-tailed tropicbird), mōlī (Laysan albatross), and kaʻupu (black-footed albatross). It is likely that these and other migratory seabird species would be adversely affected by light attraction.

Under Alternative A, conservation or management actions described in the Draft HCP that require an annual commitment of funding and staff resources by KIUC would not be funded. The SOS program is the only facility on Kauaʻi that has a rehabilitation permit to rescue injured seabirds, rehabilitate, and release them. Without annual contributions from KIUC, it is possible the SOS program would continue but may not have adequate funds to keep staff and maintain the facilities at full capacity. Therefore, under Alternative A, the SOS program is not likely to offset the number of migratory birds affected by light attraction and/or collision with KIUC powerlines.

The above-discussed impacts suggest long-term significant adverse impacts on migratory bird species would occur under Alternative A.

3.4.3.2 Alternative B Proposed Action

Under Alternative B, KIUC would implement Covered Activities as follows: (1) powerline operations including modifications; (2) lighting operations (facility lights and streetlights) and use of night lighting for repairs; and (3) implementation of the Draft HCP conservation strategy. Powerline modifications include measures designed to reduce powerline strikes of the covered birds. These measures are likely to also reduce the risk of strikes of other migratory bird species. Modifications to remove static wires from almost all of KIUC's powerline system would also reduce the number of other bird species collisions. The operation of bird flight diverters on much of KIUC's powerline system would make those powerlines more visible to other bird species, further reducing the risk of collisions. Alternative B is likely to have a beneficial impact on migratory bird species in this regard.

Under Alternative B, KIUC has already minimized light attraction by installing full-cutoff shielded fixtures for streetlights. Although not all migratory species are susceptible to disorientation or fallout, any measure that minimizes light visible to migratory bird species flying overhead will help reduce disorientation or fallout, and Alternative B is likely to have a beneficial impact on migratory bird species in this regard.

Management actions proposed under Alternative B to manage and enhance seabird breeding habitat and colonies at conservation sites also have the potential to affect migratory bird species. The proposed predator exclusion fence construction and implementation of predator trapping and invasive species removal have the potential to adversely affect migratory forest-dwelling species such as ʻapapane, Kauaʻi ʻamakihi, and ʻanianiau (lesser ʻamakihi) through nest loss from vegetation clearing to construct fences for mitigation actions proposed under Alternative B. However, by following minimization measures in the Avian Protection Plan (Appendix C; e.g., Avoidance and Minimization Measure 1, *Avoid Impacts to Forest Birds and Pueo from Fence Construction at Conservation Sites*, and Avoidance and Minimization Measure 2, *Avoid Impacts to MBTA Protected Bird Species from Predator Traps or Collisions with Facilities at Conservation Sites*), this can be fully avoided.

These conservation measures to enhance seabird breeding habitat have the potential to benefit some migratory seabird species by decreasing their risk of predation by removing introduced mammals (e.g., rats, cats, dogs) and barn owls and enhancing habitat quality by excluding ungulates (e.g., deer, goats, pigs). If other migratory seabirds colonize the conservation sites on their own, they would benefit from the eradication of predators within the unit and the removal of cats and barn owls from the general area. The native pueo (Hawaiian short-eared owl), as a ground-nesting bird, could benefit from the existence of a predator-free fenced area in which to breed.

KIUC's proposed support of the SOS program under Alternative B may provide additional long-term benefits to migratory seabird species through the retrieval, evaluation, rehabilitation, and release of live individuals of these species. Members of the public regularly turn in other downed or injured migratory seabird species in addition to the listed bird species. ʻUaʻu kani (wedge-tailed shearwater) and koaʻe kea (white-tailed tropicbird) are regularly turned into the SOS program, and other birds handled by the SOS program have included mōlī (Laysan albatross), noio (black noddy), and ʻiwa (great frigatebird). While the benefits of the SOS program cannot be quantified for other migratory seabirds, they are expected to be similar to those of Covered Species.

Over the long term, beneficial impacts on migratory bird species are anticipated under Alternative B. In comparison to existing conditions, Alternative B is likely to have a significant beneficial impact on migratory bird species with regard to powerline collision avoidance and minimized light attraction, as well as predator control at conservation sites.

3.4.3.3 Alternative C Additional Minimization

Because Alternative C includes activities covered under Alternative B with additional collision and lighting minimization measures applied, it would have similar impacts on migratory birds as Alternative B plus some additional benefits. This is because under this alternative, KIUC would implement measures (e.g., additional powerline reconfiguration, static wire removal, flight diverter installation) to further avoid and minimize risk of collision on existing powerlines. Implementing additional measures to avoid and minimize collisions for birds is expected to have a beneficial impact on migratory species such as ʻuaʻu kani (wedge-tailed shearwater), ʻaukuʻu (black-crowned night heron), kōlea (Pacific-golden plover), and pueo (Hawaiian short-eared owl) that have been documented to collide with powerlines.

Similarly, additional lighting minimization measures under Alternative C would likely benefit migratory seabird species such as ʻuaʻu kani (wedge-tailed shearwater), noio (black noddy), ʻou (Bulwer's petrel), ʻaoʻū (Christmas shearwater), koaʻeʻ kea (red-tailed tropicbird), mōlī (Laysan albatross), and kaʻupu (black-footed albatross), which are known to be affected by artificial light attraction.

Under Alternative C, KIUC would increase funding to the SOS program by 50 percent ($450,000) beyond the $300,000 proposed annually in the Draft HCP to support rescue and rehabilitation of injured listed seabirds. Because increased funding would be employed to increase searches for injured birds and increase outreach efforts, it is expected to have a significant beneficial impact on migratory seabird species such as ʻuaʻu kani (wedge-tailed shearwaters), noio (black noddy), ʻou (Bulwer's petrel), ʻaoʻū (Christmas shearwater), koaʻeʻ kea (red-tailed tropicbird), mōlī (Laysan albatross), and kaʻupu (black-footed albatross).

3.4.3.4 Alternative D Additional Mitigation

Under Alternative D, the increase of ungulate and predator exclusion fencing, weatherports, helicopter landing zones, artificial burrow construction, invasive species removal, and implementation of predator trapping have the potential to affect migratory bird species. These activities under Alternative D have the potential to adversely affect migratory forest-dwelling species such as ʻapapane, Kauaʻi ʻamakihi, and ʻanianiau (lesser ʻamakihi) through nest loss from vegetation clearing to construct fences for mitigation actions. However, by following minimization measures in the Avian Protection Plan (Appendix C; e.g., Avoidance and Minimization Measure 1, *Avoid Impacts to Forest Birds and Pueo from Fence Construction at Conservation Sites*, and Avoidance and Minimization Measure 2, *Avoid Impacts to MBTA Protected Bird Species from Predator Traps or Collisions with Facilities at Conservation Sites*), this can be fully avoided.

Over the long term, the proposed increase of mitigation activities under Alternative D have the potential to benefit migratory seabird species by decreasing their risk of predation by removing introduced mammals (e.g., rats, cats, dogs) and barn owls and enhancing habitat quality by excluding ungulates (e.g., deer, goats, pigs). If other migratory seabirds colonize the conservation sites on their own, they would benefit from the eradication of predators within the unit and the removal of cats and barn owls from the general area. The native pueo (Hawaiian short-eared owl), as a ground-nesting bird, could benefit from the existence of a predator-free fenced area in which to breed. Therefore, significant beneficial impacts on migratory bird species are anticipated under Alternative D.

3.4.3.5 Comparison of Alternatives

Alternative A would likely result in greater adverse impacts on migratory birds when compared to the other action alternatives because the conservation or management actions described in the Draft HCP that require an annual commitment of funding and staff resources by KIUC, notably the SOS program, would not be funded. Alternative B would have greater potential to reduce adverse impacts on migratory birds with respect to light attraction and fallout, powerline collision, and predation compared to Alternative A. Alternative C would have greater potential to reduce adverse impacts on migratory birds with respect to light attraction and fallout and powerline collision compared to Alternatives A and B. Alternative D would have the greatest potential to mitigate adverse impacts on migratory birds with respect to light attraction and fallout and powerline collision compared to Alternatives A, B, and C.

3.5 Critical Habitat and Other Land Designations

This section describes the affected environment for critical habitat and other land designations within the Permit and Plan Areas. This section also analyzes the direct and indirect effects of the proposed action and alternatives on these areas.

3.5.1 Methods

The online mapping tool available at the Service's Environmental Conservation Online System (USFWS 2025) was used to view critical habitat in the Plan Area. Using ArcGIS, the designated and proposed critical habitat spatial layer was overlaid in the Plan Area over the Permit Area encompassing KIUC facilities, transmission lines, street lights, and the 12 conservation areas. This provided an illustration (Figure 3.5-1) of the designated and proposed critical habitats that would be exposed to the proposed activities covered in the Draft HCP. The area of the critical habitat units and the species for which the critical habitat was designated or proposed were also gathered through the spatial overlay exercise in ArcGIS. Whether the other land designations overlapped the Permit Area was visually determined using a map of the Plan Area.

Section 3.5.3, *Environmental Consequences*, assesses the impact of the proposed action (Alternative B), the No Action alternative (Alternative A), and two other action alternatives (Alternative C, Additional Minimization, and Alternative D, Additional Mitigation) on critical habitat and other land designations. The assumptions presented in Section 3.1.2 were applied when analyzing the impacts of each alternative on the species identified in this section.

Multiple plant and animal taxa can be protected within a single critical habitat unit or other state-land designated area. Therefore, for the environmental consequences section, the impacts of the No Action and action alternatives were analyzed for the habitat to support groups (e.g., waterbirds, plants) and not individual species over the 50-year permit period of the Draft HCP.

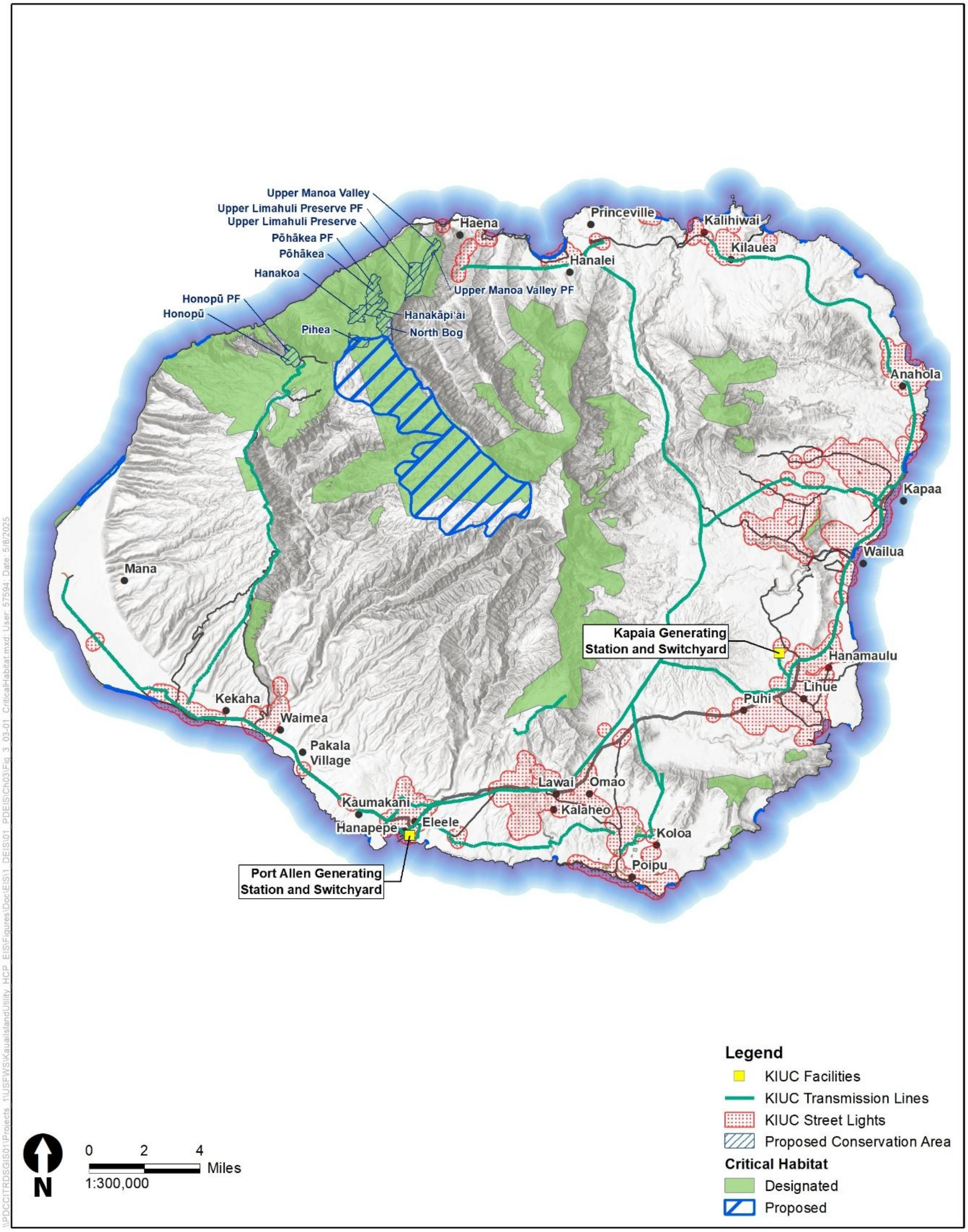
3.5.2 Affected Environment

Critical habitat on Kaua‘i has been designated under the ESA to protect over 90 listed species. For example, 4,479 acres (1,812 hectares) of riparian habitat and nearly 12 mi (20 km) of stream channel were designated as critical habitat in 2002 for Newcomb's snail; 52,549 acres (21,266 hectares) for 83 plants in 2003; 272 acres (110 hectares) for pe‘e pe‘e paka ‘ole (Kaua‘i cave wolf spider) and ‘uku noho ana (Kaua‘i cave amphipod) in 2003; 794 acres (321 hectares) for Hawaiian picture-winged fly in 2008; and 26,582 acres (10,757 hectares) for 44 plants, two birds (‘akeke‘e [Kaua‘i ‘ākepa] and ‘akikiki [Kaua‘i creeper]), and one fly (*Drosophila sharpi*) in 2010. Almost all designated critical habitat is found in uninhabited, remote areas (DLNR and USFWS 2020). There are currently 12, 541 acres (5,075 hectares) of proposed critical habitat for ‘i' iwi (*Drepanis coccinea*) and 370 acres (150 hectares) for honu (green sea turtle). Figure 3.5-1 depicts designated and proposed critical habitat, respectively, within the Plan and Permit Areas.

3.5.2.1 Other Land Designations

Land designations unrelated to designated critical habitat have relevance in the Permit Area because of their biological importance (Figure 3.15-3). For example, there are three NWRs in the Permit

Area: Hanalei NWR (923.66 acres [373.79 hectares]), Hulēʻia NWR (239.57 acres [96.95 hectares]), and Kīlauea Point NWR (178 acres [72 hectares]). There are also habitats mapped by the National Wetlands Inventory (NWI) in the Permit Area that are biologically important. Examples include estuarine and marine wetlands, freshwater emergent wetlands, freshwater forested shrub/wetlands, freshwater ponds, lakes, and rivers, as discussed in Section 3.8, *Hydrology and Soils*. Additionally, there are several NARs, which are protected areas established by the State of Hawaiʻi to preserve and protect unique ecosystems, native species, and critical habitats. These include Kōkeʻe NAR (4,380 acres [1,772 hectares]), Alakaʻi Wilderness Preserve (11,788 acres [4,773 hectares]), Hanapēpē NAR (755 acres [305 hectares]), Nā Pali Coast NAR (6,175 acres [2,500 hectares]), and Hulēʻia NAR (400 acres [162 hectares]).



Sources: ICF 2025; USFWS 2023

Figure 3.5-1. Designated and Proposed Critical Habitat

3.5.3 Environmental Consequences

3.5.3.1 Alternative A No Action

Under Alternative A, KIUC would continue to operate existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. KIUC would not implement a comprehensive program to mitigate impacts on Covered Species. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. KIUC powerlines, streetlights, and buildings mostly exist outside designated or proposed critical habitat and other land designations and have no direct impact on these areas, with the exception of KIUC streetlights that affect proposed critical habitat for honu (green sea turtle). While these streetlights are outside of proposed critical habitat for honu (green sea turtle), they exist near the coastline and compete with the natural light scape, which is critical to ensure the migration of honu (green sea turtle) hatchlings from their nest sites to the ocean. With multiple light sources, honu (green sea turtle) hatchlings become disoriented and do not find the ocean habitat that supports the next phase of their life cycle or crawl landwards to artificial light sources, where they can be eaten by predators or run over by vehicles. KIUC has identified a total of 29 streetlights that are currently visible from honu (green sea turtle) nesting habitat. Under Alternative A, this impact decreases the availability and quality of suitable nesting sites in proposed critical habitat for honu (green sea turtle) and would continue to occur.

3.5.3.2 Alternative B Proposed Action

Under Alternative B, the Service and DLNR would authorize incidental take of Covered Species from Covered Activities in the Permit Area including implementation of the conservation strategy over a 50-year permit term. Covered Activities include (1) powerline operations, including modifications, (2) lighting operations and use of night lighting for repairs, and (3) implementation of the Draft HCP conservation strategy.

Under Alternative B, proposed management actions to manage and enhance seabird breeding habitat and colonies at conservation sites would affect designated critical habitat for several species, primarily plants. All seabird conservation sites under Alternative B are within designated or proposed critical habitat; proposed management activities including predator exclusion fence and artificial burrow installation, invasive plant species removal, and seabird habitat enhancement would result in habitat modification and direct impacts on critical habitat including removal of critical habitat by clearing vegetation for the installation of fencing, artificial burrows, weatherports, and landing zones and causing ground disturbance. KIUC would implement BMPs during construction and maintenance of fences to reduce the risk of soil compaction, erosion, runoff, and sedimentation as described in Section 4.2.2.2 of the Draft HCP and implement measures to avoid impacts on listed plants and their habitat as described in Draft HCP Appendix 1B, Attachment 2, *Measures to Avoid Adverse Effects on Listed Plant Species*. Vegetation clearing and ground disturbance resulting from implementation of the Draft HCP would be localized and limited to select areas within the larger conservation sites, and are not anticipated to degrade critical habitat in the Permit Area. Over the long term, beneficial impacts on critical habitat are anticipated because the fencing and predator removal would minimize degradation of critical habitat by rodents and ungulates.

Management actions proposed under Alternative B to implement a honu (green sea turtle) nest detection and shielding program would also affect proposed critical habitat for honu (green sea turtles). The installation of light-proof fencing around sea turtle nests may be considered a short-term temporary impact on critical habitat because it would temporarily obstruct the pathway between nesting beaches and foraging grounds; however, given the temporary nature of fence installation, which will be removed after a nest hatches, and the low average nesting density of honu (green sea turtle), no significant effects on critical habitat are anticipated.

3.5.3.3 Alternative C Additional Minimization

Under Alternative C, KIUC would implement additional measures (e.g., additional powerline reconfiguration, static wire removal, flight diverter installation) to avoid and minimize risk of collision on existing powerlines that pose a medium to high collision risk to seabirds. Implementing additional measures to avoid and minimize collisions is not expected to result in new ground disturbance, vegetation removal, or additional impacts on critical habitat or other land designations.

The additional lighting minimization measures under Alternative C are not likely to affect critical habitat and other land designations, because the implementation of these measures is not expected to result in new ground disturbance, vegetation removal, or additional impacts.

Under Alternative C, KIUC would increase funding to the SOS program by 50 percent ($450,000) beyond the $300,000 proposed annually in the Draft HCP to support rescue and rehabilitation of injured listed seabirds; this is not expected to have a significant impact on critical habitat or other land designations.

3.5.3.4 Alternative D Additional Mitigation

Alternative D would be anticipated to have similar but larger-scale impacts on critical habitat and other land designations as Alternative B. Under Alternative D, additional mitigation measures would expand predator control in an additional 1,394 acres (564 hectares) and increase the area protected with ungulate fencing by 1,915 acres (775 hectares). This increase in fencing would result in approximately 3.8 acres (1.5 hectares) of additional site clearing and an additional 0.4 acre (0.2 hectare) of ground disturbance for installation of fence posts and mesh skirt compared to Alternative B. The construction of weatherports, helicopter landing zones, and conservation measures such as control of ungulates, barn owls, cats, and other predators would be expanded to hundreds of acres outside, but in the vicinity, of the conservation sites identified under Alternative B. These conservation sites are all within designated or proposed critical habitat and other land designations (e.g., NAR); proposed management activities including predator exclusion fence and artificial burrow construction, predator and invasive plant species removal, and seabird habitat enhancement would result in habitat modification and direct impacts on critical habitat via ground disturbance and clearing vegetation for the fence or artificial burrows. Avoidance and minimization measures would be incorporated during these activities to prevent unintentional damage or harm to the essential physical and biological features of critical habitat. Over the long term, significant beneficial impacts on critical habitat and other land designations are anticipated because the fencing and predator removal would protect critical habitat from degradation by rodents and ungulates.

3.5.3.5 Comparison of Alternatives

Alternative B would have a greater potential to enhance or benefit critical habitat and other land designations compared to Alternative A due to proposed management actions to manage and enhance seabird breeding habitat and colonies at conservation sites. Effects of Alternative C on critical habitat and other land designations would be the same as described for Alternative B, because it primarily involves the same activities as Alternative B. Overall, Alternative D would have the greatest long-term potential to reduce adverse impacts on critical habitat and other land designations due to additional ungulate exclusion fencing and conservation measures such as predator removal.

3.6 Non-Listed Flora

This section describes the existing conditions of non-listed flora or plants in the Permit and Plan Areas and analyzes the direct and indirect effects of the proposed action and alternatives on non-listed flora.

3.6.1 Methods

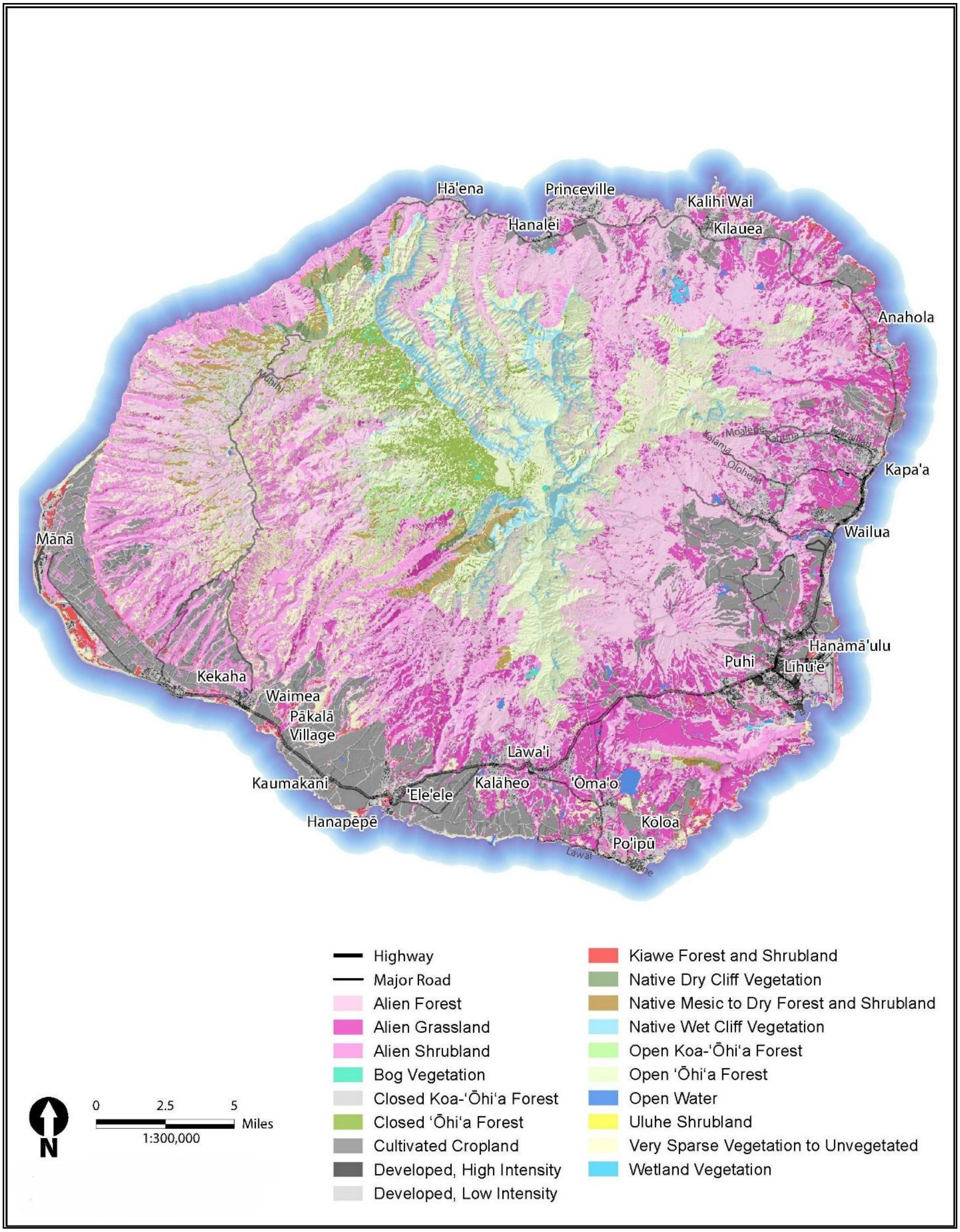
For developing Section 3.6.2, *Affected Environment*, for flora and vegetation, high-resolution land cover maps from the U S. Geological Survey Carbon Assessment of Hawaiʻi was used to describe the spatial distribution of the land cover types in the Plan Area. Additionally, relevant literature such as the *Manual of Flowering Plants for Hawaiʻi*, the chapter on the vegetation types in Hawaiʻi included in that manual, the Draft HCP, and findings from some botanical surveys on Kauaʻi were used to detail the vegetation and different types of plant taxa that are representative of those land cover types. Derived from these resources, the narrative developed below also includes discussion of whether the vegetation types are dominated by native or nonnative flora and provides examples of the plant species typically found in these vegetation types.

Section 3.6.3, *Environmental Consequences*, assesses the impact of the No Action alternative (Alternative A), proposed action (Alternative B), and two other action alternatives (Alternatives C and D) on the non-listed flora within the Plan and Permit Areas. Assumptions discussed in Section 3.1.2 were applied when analyzing the impacts on non-listed flora. Factors such as whether the non-listed flora are composed of native or nonnative plant species, the presence of rare native plants, and the duration (short versus long term) of impact were considered when analyzing how Covered Activities would affect the non-listed flora over the 50-year permit period of the Draft HCP.

3.6.2 Affected Environment

Kauaʻi is the oldest of the MHI (3 to 5 million years old). It has the highest proportion of single-island endemic taxa (i.e., species found only on Kauaʻi) that are rare (Sakai et al. 2002). The topography and habitats on Kauaʻi have become fragmented over time, forming geographic features that create reproductive isolation among species and support the formation of new species.

Existing vegetation and land cover types on Kauaʻi have been mapped by the U.S. Geological Survey Gap Analysis Program (Jacobi et al. 2017a). The U.S. Geological Survey Carbon Assessment of Hawaiʻi program has also produced high-resolution land cover maps that depict vegetation types and degrees of human disturbance to estimate current and future carbon stocks (Jacobi et al. 2017b). During preparation of the Draft HCP (ICF 2025), these spatial data were integrated to illustrate the land cover and vegetation types in the Permit Area (Figure 3.6-1), which are described below.



Sources: ICF 2025; USGS 2011, 2017

Figure 3.6-1. Vegetation and Land Cover Types in the Plan Area

The majority of the coastal, low-, and mid-elevation areas in the Permit Area are either developed or under agricultural use (cultivated cropland) and are predominantly dominated by alien vegetation. The alien vegetation includes grasslands, shrublands, and forests dominated by nonnative (and often invasive) plant species. Species such as molasses grass (*Melinis minutiflora*) and bushy beardgrass (*Anatherum tenuispatheum*) dominate the invasive grasslands in the wetter eastern areas, while grasses such as guinea grass (*Megathyrsus maximus*) and buffel grass (*Cenchrus ciliaris*) are abundant in the alien-dominated drier grasslands in the Permit Area (Wagner et al. 1999; NTBG 2008; Natural Area Reserves System 2011; Edmonds et al. 2016 as cited in ICF 2025; Nagendra 2017 as cited in ICF 2025).

In addition to alien grasslands, alien-dominated shrublands and forests cover the majority of the coastal, lowland, and mid-elevations of the Permit Area. While native species such as naupaka kahakai (beach naupaka, *Scaevola taccada*), ʻilima (*Sida fallax*), pōhinahina (beach vitex, *Vitex rotundifolia*), ʻakiʻaki (beach dropseed, *Sporobolus virginicus*), hala (screw pine, *Pandanus tectorius*), and ʻuhaloa (*Waltheria indica*) can be still be found in the coastal and lowland areas, the vegetation there is mostly dominated by invasive plant species such as kiawe (mesquite, *Prosopis pallida*), koa haole (white leadtree, *Leucaena leucocephala*), paina (ironwood, *Casuarina* spp.), kamani haole (false kamani, *Terminalia catappa*), wilelaiki (Christmas berry, *Schinus terebinthifolius*), and albizia (*Falcataria falcata*). Kiawe (mesquite) and koa haole (white leadtree) are widespread throughout the coastal and lowland areas of Kauaʻi, forming dense kiawe (mesquite) forests and koa haole (white leadtree) shrublands. Alien forests in the wetter areas are dominated by nonnative species such as java plum (*Syzygium cumini*), waiawī (strawberry guava, *Psidium cattleyanum*), kuava (guava, *Psidium guajava*), octopus tree (*Heptapleurum actinophyllum*), fire tree (*Morella faya*), ʻokaʻ kilika (silk oak, *Grevillea robusta*), ʻeukalikia (*Eucalyptus* spp.), and smothering vines such as in the genus *Passiflora*.

The very few remaining lowland rainforests (i.e., rainforests at lower elevation) are generally dominated by ʻōhiʻa (*Metrosideros* spp.) trees, with understories consisting of native trees including kōpiko (*Psychotria* spp.) and hame (*Antidesma platyphyllum*) (Cuddihy and Stone 1990 as cited in ICF 2025).

Native species–dominated forests are limited to the upper and steeper elevations in the central portion of the Permit Area primarily because these high-elevation, steep areas have not been compromised by conversion to pasture or farming (County of Kauaʻi 2012 as cited in ICF 2025). However, as described in Section 3.7.2.2, *Nonnative Fauna,* even these native forests in high-elevation, steeper areas are constantly under threat from the devastation caused by feral ungulates. Native mesic and montane forests are primarily dominated by ʻōhiʻa and/or koa trees as canopy species. In areas with deep soils above 3,000 to 4,000 feet (914 to 1,219 m), tall koa trees may emerge above the ʻōhiʻa canopy (Cuddihy 1989). Montane rainforests are multi-storied; the canopy tree species are normally ʻōhiʻa with hāpuʻu (tree ferns, *Cibotium* spp.) in the subcanopy and/or other smaller subcanopy species such as kāwaʻu (Hawaiian holly, *Ilex anomala*), ʻalani (*Melicope* spp.), kōlea (*Myrsine* spp.), and olomea (*Perrottetia sandwicensis*). Epiphytic mosses, liverworts, ferns, and silver-leaved lily paʻiniu (*Astelia* spp.) often cover larger trees. In pristine sections, the ground cover is dominated by native ferns and scattered shrubs such as kanawao (*Hydrangea arguta*) and pūkiawe (*Leptecophylla tameiameiae*). Native wet-cliff vegetation primarily occurs in the system of valleys that runs from the wet summit plateau region above the montane rainforests in the northern and central portions of the Permit Area. Native wet cliff vegetation is often dominated by the native uluhe fern (staghorn fern, *Dicranopteris linearis* and *Sticherus owhyhensis*).

As elsewhere in Hawaiʻi, the leeward slopes in the Permit Area are drier than the windward slopes and support limited native mesic, dry forest, and shrubland communities (Cuddihy 1989). These vegetation communities typically occur below the rainforests and higher mountain slopes. These communities differ from wet montane forests; there is a relative scarcity of hāpuʻu (tree ferns, *Cibotium* spp.) and epiphytes and an abundance of shrubs (e.g., pūkiawe) in the understory. The composition of native ferns in the ground cover also differs. The dominant trees are either ʻōhiʻa or koa, or a mixture of these two species for most of these forests. At a select few sites, mānele (Hawaiian soapberry, *Sapindus saponaria*) co-dominates in the ʻōhiʻa and koa mixed canopy. Forests become drier and less diverse, and appear more savanna-like at lower elevations (Cuddihy 1989). Dry cliff vegetation also occurs in the Permit Area, primarily on steep sections of interior canyons and northern seacliffs. Dry cliff vegetation supports listed endemic species such as ʻōlulu (*Brighamia insignis*). Uluhe fern (staghorn fern)–dominated shrublands typically occur in patches throughout the island on mountain slopes (Cuddihy and Stone 1990 as cited in ICF 2025).

There are numerous coastal estuarine and freshwater lowland wetlands present in the Permit Area to the west in the Mānā Plains, in the north (e.g., Hanalei Wildlife Refuge), and scattered along the southern shore (ICF 2025) (Figure 3.6-1). In addition, there are several artificial human-made wetlands such as reservoirs and ponds. Many of the coastal wetlands are dominated by invasive wetland plant species such as ʻākulikuli kai (pickleweed, *Batis maritima*), mangroves (*Rhizophora* spp.), nonnative *Cyperus* spp., and *Pluchea* spp. Native wetland plant species include ʻākulikuli (sea purslane, *Sesuvium portulacastrum*), ʻahuʻawa (Java sedge, *Cyperus javanicus*), ʻaeʻae (bacopa, *Bacopa monnieri*), and kaluhā (cosmopolitan bulrush, *Bolboschoenus maritimus*). Freshwater wetlands are also present at higher-elevation forested areas in the central region. Freshwater emergent wetlands primarily consist of aquatic plants including sedges (*Cyperus* spp.), rushes (*Mariscus* spp.), and bulrushes (*Schoenoplectiella* spp.). In the wettest regions of the montane zone, a specific type of wetland community known as bogs can be found (Cuddihy 1989). Bogs primarily occur near mountain summits in very wet, poorly drained places where water tends to collect. They are usually surrounded by more typical rainforest vegetation and are relatively small and uncommon in Hawaiʻi at large. They are characterized by sedges and grasses (*Oreobolus furcatus*, *Carex* spp., *Rhynchospora* spp., and *Dichanthelium* spp.) and stunted woody plants including naʻenaʻe (*Dubautia* spp.).

3.6.3 Environmental Consequences

3.6.3.1 Alternative A No Action

Under Alternative A, KIUC would continue to operate existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. KIUC would not implement a comprehensive program to mitigate impacts on Covered Species. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. KIUC would not implement the conservation strategy proposed in the Draft HCP. The operation of infrastructure would not result in ground disturbance; therefore, non-listed flora would not be trampled or removed. In addition, the operation of infrastructure would not increase the presence or density of invasive plant species, feral ungulates, or pathogens, diseases, and insects that may affect non-listed flora. Therefore, there would be no impact on non-listed flora under Alternative A.

3.6.3.2 Alternative B Proposed Action

Under Alternative B, the Service and DLNR would authorize incidental take of Covered Species from Covered Activities in the Permit Area including implementation of the conservation strategy over a 50-year permit term. Covered Activities include (1) powerline operations, including modifications, (2) lighting operations and use of night lighting for repairs, and (3) implementation of the Draft HCP conservation strategy.

The operation of existing and new infrastructure under Alternative B would not result in ground disturbance and would not affect non-listed flora. Under Alternative B, KIUC would implement a conservation strategy, including management actions proposed under Conservation Measure 4 to manage and enhance seabird breeding habitat and colonies at conservation sites. These activities have the potential to affect non-listed flora. Vegetation clearing and ground disturbance associated with construction of predator exclusion fence and artificial burrows, predator and invasive plant species removal, and seabird habitat enhancement have the potential to affect non-listed flora species. To the extent that native species occur within fenced areas, fencing would protect and enhance the plants' survival and propagation because fencing and predator removal would protect non-listed native flora from depredation by rodents and degradation by ungulates.

3.6.3.3 Alternative C Additional Minimization

Alternative C would implement additional minimization measures on existing and new powerlines to reduce collision risk for seabirds, implement additional lighting minimization for existing and new streetlights to reduce light attraction for seabirds, and increase funding to the SOS program. Alternative C is anticipated to have the same impact on non-listed flora as Alternative B because the operation of KIUC's infrastructure with additional minimization and additional funding for the SOS program would not result in additional ground disturbance or fence construction that could disturb or benefit non-listed native flora.

3.6.3.4 Alternative D Additional Mitigation

Under Alternative D, KIUC would increase the total acreage of mitigation effort beyond what is included in the proposed action to include expanded ungulate control, expanded predator exclusion fencing, weatherports, helicopter landing zones, artificial burrows, and social attraction outside, but in the vicinity, of the conservation sites identified in the Draft HCP. Additionally, KIUC would increase funding for the sea turtle nest detection and shielding program to provide more resources for the existing sea turtle volunteer program and to add marine debris removal to the scope of the existing volunteer program.

The increased mitigation effort proposed under Alternative D would result in impacts similar to those described under Alternative B, but over a greater area. As described for Alternative B, management actions proposed to manage and enhance seabird colonies and breeding habitat have the potential to affect non-listed flora through ground disturbance, fencing, and invasive plant species removal. Ground disturbance from the construction of ungulate and predator exclusion fencing, weatherports, helicopter landing zones, and artificial burrows could adversely affect non-listed native flora while fencing, removal of invasive plant species, and predator control would protect non-listed native flora from depredation by rodents and degradation by ungulates. Overall, Alternative D would have the greatest potential to benefit non-listed native flora. Alternative D would actively remove invasive, nonnative flora to the benefit of other non-listed native and rare flora.

3.6.3.5 Comparison of Alternatives

Alternative A would not result in impacts on non-listed flora. Alternative B would have greater potential to benefit non-listed native flora compared to Alternative A because Alternative B would actively remove invasive, nonnative flora, which would benefit other non-listed native and rare flora. Alternative C is anticipated to have the same impact on non-listed flora as Alternative B because the additional minimization and additional funding for the SOS program proposed would not result in additional ground disturbance or fence construction that could disturb or benefit non-listed native flora. Alternative D would have similar impacts to Alternative B but over a greater area due to the increased total acreage of mitigation effort.

3.7 Non-Listed Fauna

This section describes the existing conditions of non-listed fauna in the Permit and Plan Areas. Non-listed fauna includes native fauna and nonnative fauna (including nonnative birds, nonnative mammals, and introduced invertebrates), which are not listed species, and analyzes the direct and indirect effects of the proposed action and alternatives on such fauna.

3.7.1 Methods

Resources consulted to prepare the affected environment section include the Draft HCP, the 2015 SWAP (DLNR 2015a), and EAs for other HCPs on Kauaʻi (USFWS 2011; DLNR and USFWS 2020). The 2015 SWAP provided a comprehensive review of the status of a range of native terrestrial and aquatic species along with strategies for long-term conservation of these species and their habitats (DLNR 2015a). The SWAP identified the Species of Greatest Conservation Need. Regarding fauna that may be in the Plan Area, Species of Greatest Conservation Need included one terrestrial mammal, 77 birds, more than 5,000 known terrestrial invertebrates, and 20 anchialine-pond–associated fauna (DLNR 2015a). These Species of Greatest Conservation Need are all native fauna in need of conservation attention; those Species of Greatest Conservation Need that are not listed are described in this section, while those that are listed are discussed in Section 3.3, *Other State and Federally Listed Species*. Given the large volume of fauna species, this section does not address the affected environment at the species level; rather, the affected environment is mostly addressed for species types or groups: birds, mammals, and invertebrates. Hawaiʻi does not have native terrestrial reptiles and amphibians.

Section 3.7.3, *Environmental Consequences*, assesses the impact of the Covered Activities described in the Draft HCP on the fauna (other than the taxa discussed in Sections 3.2 and 3.3) for the following four alternatives: Alternative A (No Action)—the impacts if the HCP were not implemented; Alternative B (Proposed Action)—the impact if the proposed actions described in the Draft HCP were implemented; Alternative C (Additional Minimization)—the impacts if additional powerline minimization measures were implemented; and Alternative D (Additional Mitigation)—the impacts if additional conservation measures were implemented. All assumptions discussed in Section 3.1.2 were applied when analyzing the impacts on the fauna in this section. Factors such as whether the animals are native or nonnative and their habitat requirements were assessed under each of the alternative scenarios when analyzing impacts of the Covered Activities on native (other than covered and other listed species) and nonnative fauna over the 50-year permit period of the Draft HCP.

3.7.2 Affected Environment

Because the diversity of fauna throughout the Plan Area makes it challenging to cover all species, this section discusses representative groups and examples of native and nonnative fauna species in certain taxonomic categories.

3.7.2.1 Native Fauna

Hawaiʻi is home to the highest number of endemic forest birds in the United States. The Permit Area itself contains several state-endemic species of forest birds. These native migratory birds in the Permit Area are discussed in Section 3.4, *Migratory Bird Species.*

Insects are the dominant fauna in most terrestrial ecosystems, especially on isolated oceanic islands such as Kauaʻi (USFWS 2011). In Hawaiʻi, the original colonizing species evolved into thousands of new species and adapted to live in a diverse range of island habitats. Hawaiʻi is home to nearly 8,000 species of insects, 5,300 of which are endemic, 84 of which are indigenous, and over 2,600 of which are alien (USFWS 2011). Beetles (*Coleoptera* spp.), flies (*Diptera* spp.), bees and wasps (*Hymenoptera* spp.), and moths (*Lepidoptera* spp.) are the largest insect groups in the MHI.

The Permit Area itself contains a high diversity of these insects and other terrestrial invertebrates, many of which are understudied. Native insects evolved to have critical roles in the ecosystem as pollinators, food sources, and as part of nutrient cycling. Examples of notable invertebrates found specifically in the montane wet forests of Nā Pali include endemic seed bugs (*Nysius* spp.), members of an endemic lineage of spiders (*Tetragnatha* spp.), native damselflies (*Megalagrion* spp.), and long-legged fly (*Sigmatineurum napali*) (DLNR 2015b; DLNR and USFWS 2020).

3.7.2.2 Nonnative Fauna

A range of nonnative or alien fauna has been introduced into the Permit Area either accidentally or intentionally for a variety of reasons, including food and recreation. Some of the introduced fauna discussed in this section are invasive and threaten native flora and fauna. Native species are particularly susceptible to introduced species because they evolved without threats from introduced species and lack adaptations to withstand the competition introduced species bring.

Nonnative Birds

Numerous nonnative birds are present throughout the Permit Area, most of them intentionally introduced. These include barn owl (*Tyto alba*), warbling white-eye (*Zosterops japonicus*), hwamei or melodious laughing-thrush (*Garrulax canorus*), white-rumped shama (*Copsychus malabaricus*), common myna (*Acridotheres tristis*), northern cardinal (*Cardinalis cardinalis*), house finch (*Carpodacus mexicanus*), Japanese bush-warbler (*Cettia diphone*), feral fowl (*Gallus gallus*), zebra dove (*Geopelia striata*), nutmeg manikin (*Lonchura punctulata*), and red-crested cardinal (*Paroaria coronata*) (DLNR and USFWS 2020). Some nonnative birds such as warbling white-eye and most doves and pigeons are on the State of Hawaiʻi Injurious Wildlife list and are known to be harmful to agriculture, aquaculture, or indigenous wildlife or plants; or to constitute a nuisance or health hazard (DLNR 2015b). One major impact of nonnative birds is that they contribute to the dispersal of invasive flora by consuming fruit and spreading seeds via their droppings.

A selection of the nonnative birds are game species managed by DLNR and can be hunted during game bird hunting season. In the Permit Area, the following game birds can be hunted: ring-necked pheasant (*Phasianus colchicus*), grey and black francolin (*Ortygornis pondicerianus* and *Francolinus francolinus*), Erckel's francolin (*Geopelia erkelii*), barred dove (*Geopelia maugeus*), spotted dove (*Spilopelia chinensis*), Japanese and California quail (*Coturnix japonica* and *Callipepla* californica), and chukar partridge (*Alectoris chukar*) (DLNR 2023).

Barn owls were first introduced to control rat populations and are the only introduced owl in the state of Hawaiʻi. They are present within the Permit Area (e.g., Hono O Nā Pali Reserve, Limahuli Garden and Preserve) (NTBG 2008; Natural Area Reserves System 2011; DLNR 2015b). Barn owls are a notable predator of the covered seabird species (Raine et al. 2017a, 2017b, 2020). Their presence has been monitored since 2011 and population control efforts are ongoing in locations such as Upper Limahuli, North Bog, Pihea, Hanakāpiʻai, Hanakoa, Pōhākea, Pōhākea PF, Honopū, Honopū PF, and Upper Mānoa Valley conservation sites (KIUC 2019 as cited in ICF 2025).

Nonnative Mammals

Several nonnative mammals in the Permit Area are managed by DLNR. Examples of game mammals introduced to and present in the Permit Area include pigs (*Sus scrofa*), goats (*Capra hircus*), black-tailed deer (*Odocoileus hemionus columbianus*), sheep (*Ovis aries* and *Ovis musimon*), and feral cattle (*Bos taurus*). While game mammals are a valuable source of food and subsistence for local communities and are valued culturally and for outdoor recreation, these feral ungulates are also invasive and their behavior results in adverse direct and indirect impacts on native ecosystems and watersheds in the Permit Area.

Browsing and grazing by nonnative mammals result in physical damage to native plants that do not have defense mechanisms (e.g., thorns, toxins), because native flora in the Permit Area evolved in the absence of ungulates and large herbivores (NTBG 2008; Weller et al. 2011). Ungulates also cause physical damage by trampling and digging up native flora, compacting the soil and increasing soil erosion. Nonnative feral ungulates and game birds may also trample the nests of ground birds such as pueo (Hawaiian short-eared owl) (Raine et al. 2020). Introduced ungulates, pigs specifically, have contributed to a decline in the populations of ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) on Kauaʻi through habitat modification and depredation (Raine et al. 2020).

Feral ungulates in particular exacerbate the dispersal of invasive flora by spreading seeds of invasive plants that have attached to their coats. As such, they contribute to the conversion of native forests into alien forests as they browse and graze seedlings and saplings, preventing establishment of native plants. Of particular concern is the prevention of establishment of native plants by alteration of light regime, nutrient cycling, and faster and more effective colonization of newly disturbed areas by invasive plants compared to native taxa. The conversion of native to alien-dominated forests has also been shown to affect water-holding and recycling capacity of watersheds.

Some introduced mammals, including house mice (*Mus musculus*), rats (*Rattus* spp.), feral cats (*Felis silvestris*), and feral dogs (*Canis familiaris*), are predators of native animals (DLNR 2015b). These predators are widespread in the Permit Area and prey on seabirds, waterbirds, and forest birds (Raine et al. 2020). Introduced rodents including mice and rats are known to consume native plant fruits and seeds and new growth of endemic plants, thereby limiting recruitment and native forest regeneration and threatening reestablishment and survival of native flora. Rats also climb trees to prey on canopy-nesting bird species. In addition to predation, feral (and domestic) cat droppings can carry a lethal parasite (*Toxoplasma gondii*), which, in turn, can contaminate terrestrial and aquatic environments and is known to affect birds and mammals, including humans (DLNR 2015b).

Small Indian mongoose (*Herpestes javanicus*) is not yet established on Kauaʻi; however, they are widespread on other MHI, and the potential for establishment on Kauaʻi is a constant threat to the Plan Area. Individual mongooses have inadvertently been introduced to Kauaʻi from other islands and subsequently captured and removed. There are credible sightings from 2012 to the present that suggest they could eventually become established (KISC 2023). To date, five live individuals have been reported to be captured in the Plan Area: in 2012 near Līhuʻe airport and near Nāwiliwili port, in 2016 at Līhuʻe airport, and most recently in April 2023 near Nāwiliwili port (KISC 2023).

Introduced Invertebrates

The feral European honeybee (*Apis mellifera*) is an invasive species that represents a conservation issue for endangered seabirds breeding in the Hawaiian Islands (Raine and McFarland 2015; McKee 2022). These feral honeybees are descendants of domesticated European honeybees that escaped managed colonies. Feral European honeybees establish self-sustaining wild colonies and are known to take over active breeding burrows of ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) in the Plan Area, causing nest abandonment and death of chicks (Raine and McFarland 2015; McKee 2022; Raine et al. 2023).

There are also invasive ants that may affect nesting seabirds (e.g., *Wasmannia auropunctata* has been documented in the Plan Area), potentially causing nest abandonment (e.g., Feare 1999 as cited in Plentovich et al. 2009) in addition to increased energy expenditure of parent birds and reduction in hatching success, growth rate, and survival (Plentovich et al. 2009). Seabirds are particularly susceptible to adverse impacts from invasive ants because their nest sites are often in areas where there are abundant food sources for ants. Other invasive ants throughout the MHI (including the Plan Area) include big-headed ant (*Pheidole megacephala*) and tropical fire ant (*Solenopsis geminata*). Both of these latter species could cause short-term, adverse damage to seabird colonies and have been documented to lead to colony loss (Duffy 2010); however, the adverse effects on seabirds are challenging to detect (Plentovich et al. 2009).

3.7.3 Environmental Consequences

3.7.3.1 Alternative A No Action

Under Alternative A, KIUC would continue to operate existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. KIUC would not implement a comprehensive program to mitigate impacts on Covered Species. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. There are no empirical data that suggest existing KIUC infrastructure affects other non-listed birds, mammals, or invertebrates.

Under Alternative A, conservation measures described in the Draft HCP that require an annual commitment of funding and staff resources by KIUC would not be funded. The SOS program is the only facility on Kauaʻi that has a rehabilitation permit to rescue injured seabirds, rehabilitate, and release them. Without annual contributions from KIUC, it is possible the SOS program would continue but may not have adequate funds to keep staff and maintain the facilities at full capacity; however, this is not expected to have a significant impact on non-listed fauna.

The above-discussed impacts suggest no significant impacts on non-listed fauna species would occur under Alternative A.

3.7.3.2 Alternative B Proposed Action

Under Alternative B, KIUC would implement Covered Activities defined as (1) powerline operations, including modifications; (2) lighting operations (facility lights and streetlights) and use of night lighting for repairs; and (3) implementation of the Draft HCP conservation strategy. KIUC would apply conservation measures such that the impact of the taking from Covered Activities is minimized and mitigated to the maximum extent practicable. Activities related to implementation of the Draft HCP conservation strategy at the seabird conservation sites may affect non-listed fauna species as discussed below.

Native Birds

Impacts on native migratory birds in the Permit Area are discussed in Section 3.4, *Migratory Bird Species.*

Native Invertebrates

Under Alternative B, management actions proposed under Conservation Measure 4 to manage and enhance seabird breeding habitat and colonies at conservation sites have the potential to affect native invertebrates. Proposed predator exclusion fence or artificial burrow construction, predator control, invasive plant species removal, and seabird habitat enhancement at these sites would result in habitat loss and disturbance for native invertebrates. However, over the long term, positive impacts on native invertebrates would be anticipated because fencing would reduce disturbance from ungulates while enhancing invertebrate habitat; removal of predators, such as rats and mice, would reduce predation.

Nonnative Birds

Nonnative birds such as barn owls are on the State of Hawaiʻi Injurious Wildlife list and are known to be harmful to agriculture, aquaculture, or indigenous wildlife or plants; or to constitute a nuisance or health hazard (DLNR 2015b). Under Alternative B, management actions proposed to manage and enhance seabird breeding habitat and colonies at conservation sites would be implemented to actively remove barn owls to benefit covered bird species. The removal of barn owls would likely also benefit other listed and native species.

Alternative B would actively remove barn owls, which would benefit other listed and native species.

Nonnative Mammals

Similar to nonnative birds, nonnative mammals are also invasive and their behavior results in adverse direct and indirect impacts on native ecosystems and Covered Species in the Plan Area. Under Alternative B, management actions proposed in Conservation Measure 4 to manage and enhance seabird breeding habitat and colonies at conservation sites would be implemented to actively remove nonnative mammal species that predate on seabirds (e.g., cats, rats, mice, pigs, goats) to benefit covered bird species. The removal of these species would likely also benefit other listed and native species.

Alternative B would actively remove nonnative mammals that predate on seabirds, which would benefit other listed and native species.

Invasive Invertebrates

Similar to nonnative birds and mammals, invasive invertebrates such as feral honeybees have adverse direct and indirect impacts on native ecosystems and Covered Species in the Plan Area. Under Alternative B, management actions proposed in Conservation Measure 4 to manage and enhance seabird breeding habitat and colonies at conservation sites would be implemented to actively remove invasive feral bees to benefit covered bird species. The removal of feral bees will likely also benefit other listed and native species.

Alternative B would actively remove feral bees, which would benefit other listed and native species.

3.7.3.3 Alternative C Additional Minimization

Under Alternative C, KIUC would implement measures (e.g., additional powerline reconfiguration, static wire removal, flight diverter installation) to avoid and minimize risk of collision on existing powerlines in regions that pose a higher collision risk to seabirds. Implementing additional measures to avoid and minimize collisions is not expected to result in new ground disturbance, vegetation removal, or additional impacts on non-listed fauna. Alternative C would be anticipated to have similar impacts to those of Alternative B on other fauna because this alternative involves substantially the same activities as Alternative B (refer to Section 3.7.3.2, *Alternative B Proposed Action*).

Similarly, the additional lighting minimization measures under Alternative C are not likely to affect non-listed fauna, because the implementation of these measures is not expected to result in new ground disturbance, vegetation removal, or additional impacts.

Under Alternative C, KIUC would increase funding to the SOS program by 50 percent ($450,000) beyond the $300,000 proposed annually in the Draft HCP to support rescue and rehabilitation of injured listed seabirds; this is not expected to have a significant impact on other non-listed fauna.

3.7.3.4 Alternative D Additional Mitigation

Alternative D would be anticipated to have a similar but larger-scale impact on other fauna as Alternative B (refer to Section 3.7.3.2, *Alternative B Proposed Action*). Under Alternative D, the increase of ungulate and predator exclusion fencing, weatherports, helicopter landing zones, and artificial burrow construction, and implementation of predator trapping have the increased potential to affect non-listed fauna relative to Alternative B.

Under Alternative D, increased ungulate and predator exclusion fencing, weatherports, helicopter landing zones, artificial burrow construction, invasive species removal, and predator trapping may result in habitat loss and disturbance for native invertebrates. Over the long term, beneficial impacts on native invertebrates would be anticipated because fencing would protect them from disturbance by nonnative ungulates while enhancing habitat and reducing predators such as rats and mice.

Alternative D would directly affect several nonnative bird and mammal species through increased predator control and exclusion fence construction and active removal of feral bees to benefit covered bird species. The removal of feral bees would likely also benefit other listed and native species. Over the long term, significant adverse impacts on nonnative bird and mammal species as well as invasive insects are anticipated, but intended for the benefit of Covered Species, other listed species, and native species.

3.7.3.5 Comparison of Alternatives

Alternative B would have greater potential to benefit non-listed fauna compared to Alternative A due to the implementation of conservation measures. Alternative C is anticipated to have the same impact as Alternative B with regard to other non-listed fauna. Overall, Alternative D is anticipated to have a similar but larger-scale impact compared to Alternative B with regard to other non-listed fauna due to the increase in mitigation efforts and active removal of invasive species.

3.8 Hydrology and Soils

This section describes the existing conditions of water resources and wetlands and analyzes the direct and indirect effects of the proposed action and alternatives on water resources and wetlands.

3.8.1 Methods

Hydrology in the Permit Area is described using data from U.S. Geological Survey, the Service (NWI dataset), the State of Hawaiʻi Commission on Water Resource Management, and the Hawaiʻi Office of Planning and Sustainable Development. Soils in the Permit Area are described using data from the U.S. Department of Agriculture Soil Conservation Service and the University of Hawaiʻi. Impacts on hydrology and soils are assessed in terms of intensity, duration, and geographic extent, focusing on the potential for ground disturbance and erosion from predator and ungulate fencing maintenance and construction.

3.8.2 Affected Environment

Streams on all of the Hawaiian Islands respond rapidly to storm rainfall because drainage basins are small and the distance of overland flow is short (Juvik 1998). On Kauaʻi, most streams radiate out from the Waiʻaleʻale-Kawaikini massif in all directions, cutting through intrusive dikes that retard groundwater movement toward the ocean from high-rainfall areas in the interior. As a result, streams on Kauaʻi tend to receive large influxes of groundwater throughout their length as they descend toward the ocean, making the hydrology of Kauaʻi unlike other Hawaiian streams (ICF 2025). In comparison to the other islands, watersheds on Kauaʻi exhibit eroded features, such as deeper incised channels, complex stream networks with many tributary branches, and large riverine estuaries at the ocean interface (Wilson Okamoto 2008).

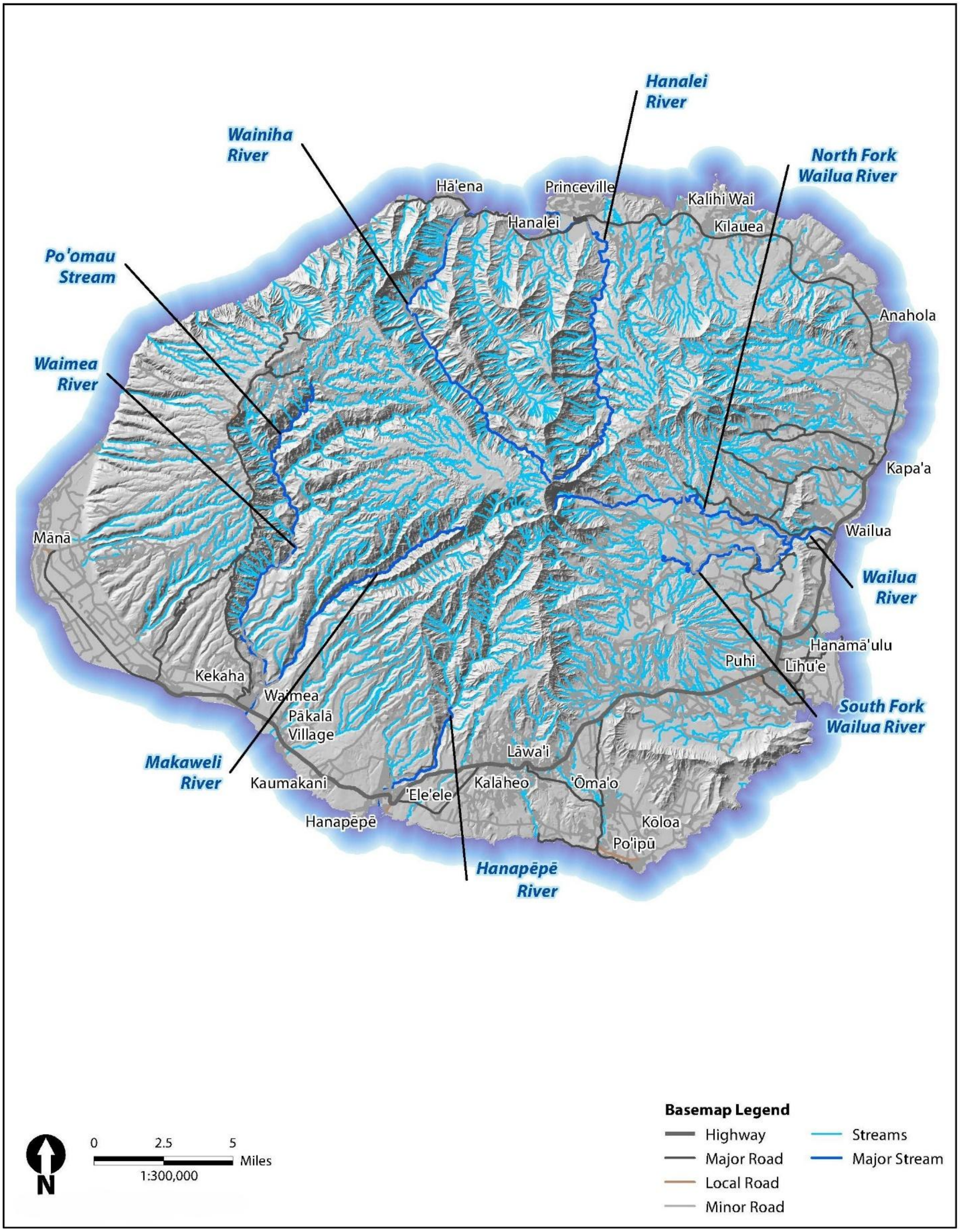
Figure 3.8-1 depicts the perennial rivers and streams on Kauaʻi. The Waimea River-Poʻomau Stream is the longest perennial stream on Kauaʻi at 19.5 mi (31.5 km) in length. Other major perennial streams on the island include the Makaweli River (15.1 mi [24.3 km]), Wainiha River (13.8 mi [22.2 km]), Hanapēpē River (13.3 mi [21.4 km]), and Wailua River (11.8 mi [18.9 km]). The Hanalei River has the highest average discharge on the island at 140 million gallons per day. The largest surface waterbody on Kauaʻi is the Waita Reservoir, which is 171.59 surface hectares (424 surface acres) and is on the southern side of the island near Kōloa (USGS 2023). There are approximately 6.2 mi (9.9 km) of intermittent streams and 6.0 mi (9.7 km) of perennial streams mapped within the proposed conservation sites described in the Draft HCP (USGS 2023).

There are various types of wetland classifications, not all of which are directly related to streamflow. Wetlands are valuable resources because they perform multiple ecosystem functions such as groundwater recharge, floodwater abatement, biological resource habitat, and the promotion of cycling, storage, and removal of nutrients (Wilson Okamoto 2008). Many wetlands in Hawaiʻi, including those on Kauaʻi, have been drained and converted to agricultural or urban land uses.

The NWI was established by the Service to conduct a nationwide inventory of wetlands to provide information on the distribution and type of wetlands and to aid in conservation efforts. To do this, the NWI developed a wetland classification system that is now the federal standard for classifying wetlands. Figure 3.8-2 depicts the distribution of wetlands and open water (i.e., lakes, reservoirs, and other impoundments) on Kauaʻi based on regional data from the NWI (USFWS 2020). Numerous estuarine and freshwater emergent wetlands skirt the lowlands of the island, along with human-made reservoirs and scattered ponds, all of which provide habitat for most of the covered waterbirds (ICF 2025). Freshwater wetlands are also present in forested areas of higher elevations. Alaka'i swamp (Figure 3.8-2) is a montane wet forest located on a high plateau and containing alpine bogs that support federally listed species; however, the Covered Species do not occur in these wetlands associated with Alaka'i swamp (ICF 2025). Within the conservation sites, only the Pihea site contains NWI-mapped wetlands (approximately 0.1 acre [0.04 hectare] is mapped as freshwater forested/shrub wetland) (USFWS 2020).

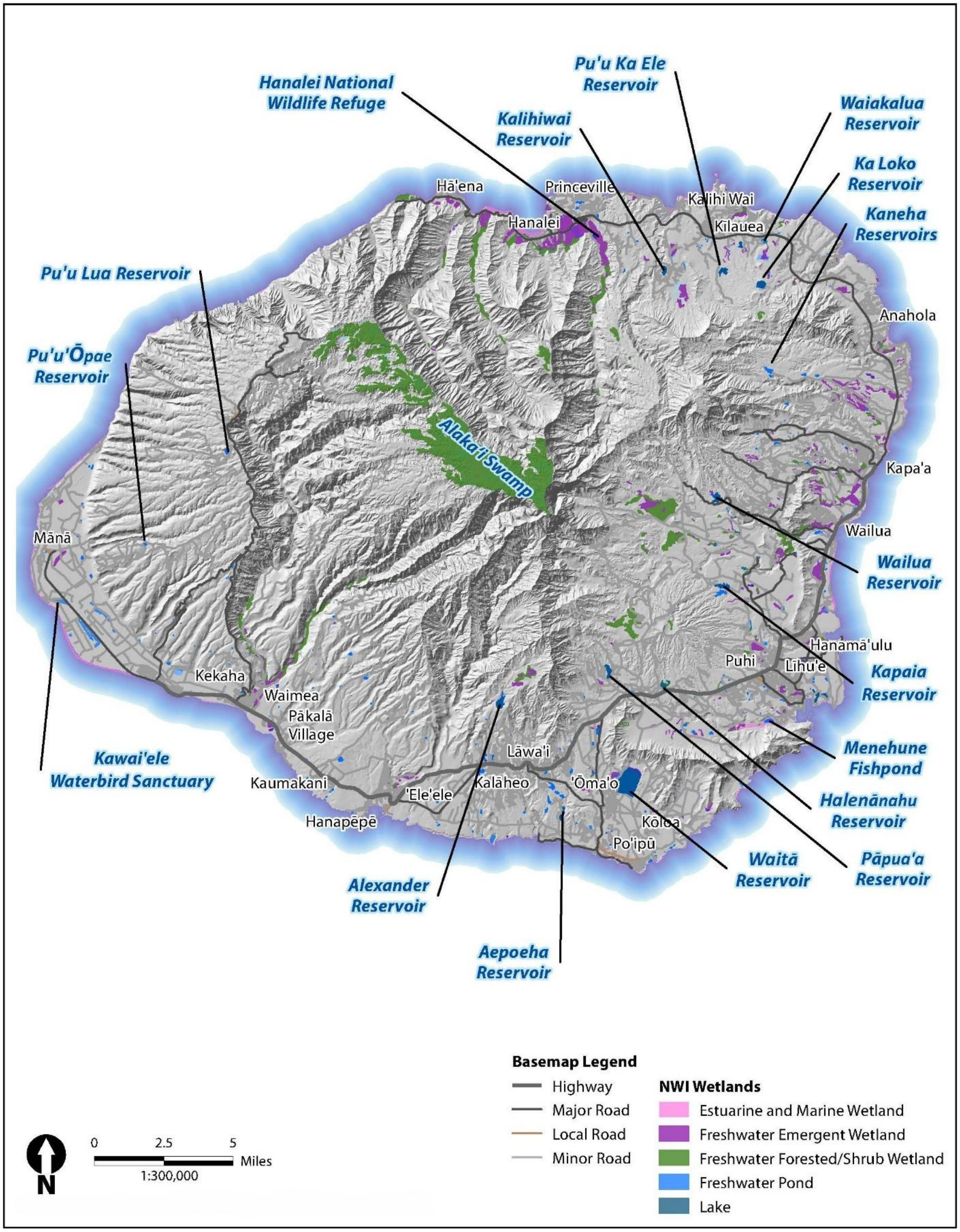
Floodplains in the Permit Area were assessed using official Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map data (FEMA 2025) and geospatial data from the DLNR Flood Hazard Assessment Tool (DLNR 2025). FEMA Flood Insurance Rate Maps are the official maps on which FEMA delineates special flood hazard areas for regulatory purposes under the National Flood Insurance Program. Special flood hazard areas are also known as 100-year floodplains, or areas that have a 1-percent annual chance of flooding. The majority of the Permit Area, including all conservation sites, is mapped Zone X: areas determined to be outside the 100- and 500-year floodplains. The Kapaia and Port Allen generating stations and switchyards are also mapped as Zone X. However, small portions of KIUC's existing powerlines and streetlights are within the mapped 100-year floodplain. The proposed action and action alternatives analyze operation of KIUC powerlines and lighting at existing facilities included in the Covered Activities. Construction activities related to new KIUC infrastructure (facilities, powerlines, and streetlights) are not Covered Activities. Therefore, no impacts on floodplains would occur from implementation of the Draft HCP.

Kauaʻi has 57 individually mapped soil units, reflecting the island's age and complex geology which contribute to its high diversity of soil types (University of Hawaiʻi 2014). Predominantly deep, nearly level to steep, well-drained soils that have a fine-textured or moderately fine-textured subsoil can be found in the lowland areas of Kauaʻi. The western half of the island also contains well-drained soils over basalt bedrock. Due to the island's geology, nearly all farm and ranch land on the island are on the low uplands along the coast. These low coastal uplands circle the island except for port of the northwest slope. Rugged areas in the central and northwestern portions of the island contain soils that are relatively shallow and rocky (U.S. Department of Agriculture 1973). Factors that influence soil erosion include soil texture, structure, length and percent of slope, vegetative cover, and rainfall or wind intensity. Soils most susceptible to erosion by wind or water are typified by bare or sparse vegetative cover, non-cohesive soil particles with low infiltration rates, and moderate to steep slopes. Wind erosion processes are less affected by slope angles but are highly influenced by wind intensity. The potential for soil erosion increases with increasing slope (NRDC 2021).



Source: ICF 2025; State of Hawaiʻi GIS 2018

Figure 3.8-1. Perennial Rivers and Streams of Kauaʻi



Sources: ICF 2025; USFWS 2020; HI Planning 2018

Figure 3.8-2. NWI-Mapped Wetlands of Kaua'i

3.8.3 Environmental Consequences

3.8.3.1 Alternative A No Action

Under Alternative A, KIUC would continue to operate existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. KIUC would not implement a comprehensive program to mitigate impacts on Covered Species. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. Operation of existing and new infrastructure without a comprehensive mitigation program would not result in new sources of ground disturbance and there would be no new impacts on hydrology and soils.

3.8.3.2 Alternative B Proposed Action

Under Alternative B, the Service and DLNR would authorize incidental take of Covered Species from Covered Activities in the Permit Area including implementation of the conservation strategy over a 50-year permit term. Covered Activities include (1) powerline operations, including modifications, (2) lighting operations and use of night lighting for repairs, and (3) implementation of the Draft HCP conservation strategy.

Under the proposed action, the potential for adverse impacts on hydrology and soils would be primarily associated with the construction of new predator exclusion fences at two conservation sites (2,259 linear feet [688.5 m] of fence at Upper Limahuli Preserve PF and 4,294 linear feet [1,308.8 m] of fence at Upper Mānoa Valley PF), installation of artificial burrows, and the maintenance of the four social attraction sites (Pōhākea, Honopū, Upper Limahuli, and Upper Mānoa Valley). The two new predator exclusion fences would result in a total of 2.9 acres (1.8 hectares) of site clearing and 0.3 acre (0.1 hectare) of ground disturbance for the installation of fence posts and mesh skirt. Maintenance of the fences at each of the four social attraction sites would involve replacing the fences up to two times during the 50-year permit term, cumulatively resulting in approximately 4.2 acres (1.7 hectares) of site clearing and 0.4 acre (0.2 hectare) of ground disturbance for installation of fence posts and mesh skirt each time that the fencing is replaced. Unlike the replacement of existing fences, the construction of new fencing could alter drainage patterns, concentrate surface flows, and increase runoff quantities and velocities, which could promote soil erosion to a greater degree when compared to fence replacement activities that would occur within the same areas disturbed during the initial fence installation. The installation and maintenance of artificial burrows at Upper Limahuli Preserve PF, Pōhākea PF, Honopū PF, and Upper Mānoa Valley PF would result in localized ground disturbance at social attraction sites and result in a minor and temporary increased potential for erosion. The powerline and lighting operations included as Covered Activities would not affect hydrology or soils because they would not result in ground disturbance, alter drainage or runoff, or result in increased potential for erosion.

Minor surface disturbances during construction and maintenance activities, such as the installation of fence posts, mesh skirts, and artificial burrows, have the potential to loosen and expose bare soils and increase the potential for sediment to be mobilized and carried in overland runoff to adjacent or nearby surface waters. While sedimentation into surface water would likely be a short-term occurrence during ground disturbing activities, the settling of sediments in surface waters may have long-term impacts. KIUC would access the conservation sites at North Bog, Pōhākea, Pōhākea PF, Hanakoa, Hanakāpīʻai, Upper Limahuli, Upper Limahuli PF, Upper Mānoa Valley, and Upper Mānoa Valley PF by helicopter utilizing existing landing zones, eliminating overland travel by vehicles and equipment and minimizing the potential for vegetation removal and surface disturbance. One or two new helicopter landing zones and weatherports may be constructed at Upper Mānoa Valley as part of the Draft HCP. The construction of new landing zones and weatherports would involve minor ground disturbance and would require vegetation removal. Vegetation removal and soil compaction are likely to result from operation and maintenance activities associated with the conservation strategy, exposing soil to the erosive forces of rain and overland stormwater runoff and causing indirect impacts beyond project footprints, especially in areas with steep terrain.

KIUC would reduce the risk of soil compaction, erosion, runoff, and sedimentation by avoiding impacts on surface waters through the application of BMPs during construction and maintenance activities as described in Section 4.2.2.2 of the Draft HCP. KIUC would incorporate fencing specifications to avoid or minimize adverse impacts on hydrology and soils. These would include avoidance of fence construction across streams, rivers, pools and other drainageways[7] and design specifications to minimize earthwork (ICF 2025). Fencing specifications of the conservation strategy require that the ground conditions next to the fence pose no risk of slumping or erosion. Fence post holes and fences would be constructed to prevent stormwater from passing through, using soil or fill to form a mound along the fence alignment. Therefore, the potential for erosion, runoff, and sedimentation would be minor and temporary during construction and maintenance (e.g., replacement) of the fences.

Construction and maintenance equipment used to implement the conservation strategy could result in accidental spills or leaks of petroleum products such as gasoline and hydraulic fluid onto the ground surface, potentially contaminating soils or reaching surface waters if not properly contained and cleaned up. Although the risk of a major spill is anticipated to be low, accidental spills have the potential to degrade water quality, kill or injure aquatic life, or adversely affect beneficial use of water resources, such as drinking water and recreational waters. A similar potential for impacts also applies to the storage, transport, and use of herbicides for the control of invasive plant species; however, the potential for adverse impacts on water resources and soils would be minimized through the implementation BMPs developed by the National Tropical Botanical Garden and others involved in control of invasive plant species in the wet upland forest (ICF 2025).

3.8.3.3 Alternative C Additional Minimization

Alternative C would result in similar impacts on hydrology and soils as Alternative B. Additional minimization measures associated with Alternative C would not result in additional ground disturbance, fence construction, maintenance, or change in invasive plant management when compared to Alternative B, the proposed action. As a result, Alternative C would be anticipated to result in similar impacts on hydrology and soils as Alternative B.

[7] Generally, this means a small gap at the top of a high (greater than 20 feet [6.1 m]) waterfall and/or a small gap at a pool immediately above the waterfall.

3.8.3.4 Alternative D Additional Mitigation

Alternative D includes additional mitigation measures that could adversely affect hydrology and soils beyond those included in the proposed action by expanding predator control in an additional 1,394 acres (564 hectares) and increasing the area protected with ungulate fencing by 1,915 acres (775 hectares). This increase in fencing would result in approximately 3.8 acres (1.5 hectares) of additional site clearing and an additional 0.4 acre (0.2 hectare) of ground disturbance for installation of fence posts and mesh skirt compared to Alternative B. Additionally, Alternative D would construct additional artificial burrows (at social attraction sites), landing zones, and weatherports to increase the total acreage of mitigation effort beyond what is included in Alternative B. As a result, Alternative D would result in greater impacts on hydrology and soils when compared to the other alternatives.

While Alternative D has the potential for greater adverse impacts on hydrology and soils when compared to the proposed action and Alternative C, the implementation of BMPs for erosion and fencing specifications as described in the Draft HCP conservation strategy could reduce potential impacts on hydrology and soils. Additionally, Alternative D includes a mitigation measure for habitat management actions for the Mānā Plain wetlands that would result in greater beneficial impacts on hydrology, soils, and wetland function, when compared to the other alternatives, by focusing additional management on 50 acres (20 hectares) of land managed by DLNR for the restoration and conservation of wetlands.

3.8.3.5 Comparison of Alternatives

The potential for adverse impacts on hydrology and soils would be greatest under Alternative D due to the additional acreage of site clearing and ground disturbance required for installation of fence posts and mesh skirt when compared to Alternatives B and C. The potential for adverse impacts on hydrology and soils would be similar between Alternatives B and C. Under all alternatives, impacts on hydrology and soils would be limited in degree, duration, and geographic extent due to the small acreages of ground disturbance and vegetation clearing required to implement the Draft HCP and because the application of BMPs during construction and maintenance activities (as described in Section 4.2.2.2 of the Draft HCP) would reduce the risk of soil compaction, erosion, runoff, and sedimentation.

3.9 Air Quality and Climate Change

This section describes the existing conditions of air quality, GHGs and carbon sequestration, and climate change and analyzes the direct and indirect effects of the proposed action and alternatives on air quality, GHGs and carbon sequestration, and climate change.

3.9.1 Methods

Air quality in the Plan Area is described using data from the U.S. Environmental Protection Agency (USEPA) and State of Hawaiʻi Department of Health. Air quality impacts are evaluated qualitatively and assessed by determining the potential for emissions from the implementation of the Covered Activities and conservation measures to lead to a violation of a National Ambient Air Quality Standards (NAAQS). The air quality study area encompasses the Plan Area to account for air pollutant emissions that may occur as a result of project activities.

Climate is characterized in this section by describing climate trends and projections globally and discussing the current climate for the Plan Area. Climate in the Plan Area is described using information provided in Appendix 7C to the Draft HCP and reports from the U.S. Global Change Research Program, Intergovernmental Panel on Climate Change, and the City and County of Honolulu Climate Change Commission. Climate impacts are evaluated qualitatively and assessed in terms of the likely GHG emissions associated with project activities. The study area for climate encompasses the Plan Area but is described in the context of the influence of regional and global meteorology and climatic trends.

3.9.2 Affected Environment

3.9.2.1 Air Quality

USEPA has established NAAQS for six air pollutants determined to be criteria pollutants (commonly emitted air contaminants that affect human health): carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter 10 and 2.5 microns or less in diameter (PM_{10} and $PM_{2.5}$), and sulfur dioxide (USEPA 2023a). Hawaiʻi has also set state-level standards for all six criteria pollutants, in addition to hydrogen sulfide (State of Hawaiʻi Department of Health 2023). Table 3.9-1 shows the federal and state ambient air quality standards.

Table 3.9-1. Federal and State Ambient Air Quality Standards

Criteria Pollutant	Averaging Time	Hawaiʻi Standards	National Standards[a] Primary	National Standards[a] Secondary
Carbon Monoxide	1 hour	9 ppm	35 ppm	None
	8 hours	4.4 ppm	9 ppm	None
Nitrogen Dioxide	1 hour	--	0.100 ppm	None
	Annual mean	0.04 ppm	0.053 ppm	0.053 ppm
Particulate Matter (PM_{10})	24 hours	150 μg/m^3	150 μg/m^3	150 μg/m^3
	Annual mean	50 μg/m^3	None	None

Criteria Pollutant	Averaging Time	Hawai‘i Standards	National Standards[a]	
			Primary	Secondary
Fine Particulate Matter ($PM_{2.5}$)	24 hours	--	35 μg/m³	35 μg/m³
	Annual mean	--	9.0 μg/m³	15.0 μg/m³
Ozone	1 hour	--	None[b]	None[b]
	8 hours	0.08 ppm	0.070 ppm	0.070 ppm
Sulfur Dioxide	1 hour	--	0.075 ppm	None
	3 hours	0.5 ppm	None	None
	24 hours	0.14 ppm	None	None
	Annual mean	0.03 ppm	None	0.010 ppm
Lead	Calendar quarter	1.5 μg/m³	None	None
	Rolling 3-month average	None	0.15 μg/m³	0.15 μg/m³
Hydrogen Sulfide	1 hour	0.025 ppm	None	None

Sources: National: 40 CFR 50; Hawai‘i: State of Hawai‘i Department of Health 2023
[a] National standards are divided into primary and secondary standards. Primary standards are intended to protect public health, whereas secondary standards are intended to protect public welfare and the environment.
[b] The federal 1-hour standard of 0.12 ppm was in effect from 1979 through June 15, 2005. The revoked standard is referenced because it was employed for such a long period and is a benchmark for some State Implementation Plans.
μg/m³ = micrograms per cubic meter; ppm = parts per million

Air quality is determined by measuring ground-level ambient (outdoor) air pollutant concentrations over certain time periods. USEPA designates geographic regions as nonattainment areas when measured concentrations of these air pollutants exceed the NAAQS for specific pollutants and time periods, and as attainment areas when pollutant levels are less than the NAAQS. USEPA designates former nonattainment areas that have reduced pollutant levels below the NAAQS as maintenance areas.

Hawai‘i was classified as attainment for all NAAQS in 2022. On Kaua‘i, air quality is generally considered good because of the island's isolated ocean location combined with persistent northeast trade winds and a lack of substantial industry. One monitoring station on Kaua‘i in Niumalu collects data and measures sulfur dioxide (SO_2). Monitoring for nitrogen dioxide (NO_2) and fine particulate matter ($PM_{2.5}$) was discontinued on March 31, 2022 (State of Hawai‘i Department of Health 2023). This station is considered a "special purpose monitoring" location intended to monitor pollutants from ships in the harbor.

From the start of 2022 until monitoring for $PM_{2.5}$ was discontinued, monthly maximum 24-hour $PM_{2.5}$ concentrations at the monitoring station in Niumalu ranged from a low of 4.0 micrograms per cubic meter to a high of 6.8 micrograms per cubic meter. The average for the entire year was 2.3 micrograms per cubic meter. At no time from 2020 to 2022 did the station measure SO_2 exceeding federal or state ambient air quality standards (State of Hawai‘i Department of Health 2022a, 2022b, 2023). No exceedances of the federal or state ambient air quality standards for NO_2 or $PM_{2.5}$ were identified from 2020 until monitoring for these pollutants was discontinued in 2022. Recorded averages of SO_2, NO_2, and $PM_{2.5}$ were well below federal and state ambient air quality standards (State of Hawai‘i Department of Health 2022a, 2022b, 2023).

KIUC's two generating stations (Port Allen and Kapaia) are the only notable sources of air pollutant emissions for which it is responsible. Port Allen and Kapaia operate under air permits issued by the State of Hawai‘i Department of Health. The permit for the Kapaia Power Station covers one 27.5-

megawatt (MW) combustion turbine generator, one 600-kilowatt (kW) black-start diesel engine generator, and three internal floating roof petroleum storage tanks. Other emission sources at the Kapaia Power Station that the State of Hawaiʻi Department of Health has deemed insignificant include one 141-kW diesel-fired pump engine, one 150-kW emergency diesel engine generator, and three fixed roof petroleum storage tanks. The Covered Source Permit for the Port Allen Generating Station is for the operation of Gas Turbine Generator Unit GT-1 (18.1 MW nominal), Gas Turbine Generator Unit GT-2 (22.845 MW nominal), a General Electric Heat Recovery Steam Generator, four 7.86-MW Diesel Engine Generators (Unit Nos. 6–9), and other smaller diesel-powered generating units.

3.9.2.2 Greenhouse Gases and Carbon Sequestration

The process known as the *greenhouse effect* keeps the atmosphere near Earth's surface warm enough for the successful habitation of humans and other life forms (USEPA 2023b). The greenhouse effect is created by sunlight that passes through the atmosphere. Some of the sunlight striking Earth is absorbed and converted to heat, which warms the surface. The surface emits a portion of this heat as infrared radiation, some of which is absorbed and re-emitted to the atmosphere by GHGs (USEPA 2023b). The principal anthropogenic (human-made) GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and certain fluorinated compounds, including sulfur hexafluoride, hydrofluorocarbons (HFC), and perfluorocarbons (USEPA 2023b). Human activities that generate GHGs increase the amount of infrared radiation absorbed by the atmosphere, thereby enhancing the greenhouse effect and amplifying the warming of Earth. In Hawaiʻi, the largest portion of GHG emissions is attributable to the energy sector, including stationary combustion, transportation, waste incineration, and oil and natural gas systems. In 2021, the energy sector contributed 86.7 percent of the state's total GHG emissions, significantly greater than the remaining three sectors (i.e., industrial processes and product use; agriculture, forestry, and other land use; and waste) combined (State of Hawaiʻi Department of Health 2024).

A carbon pool (or storage) is a system that has the capacity to both take in and release carbon. Transfer of carbon from the atmosphere to any other carbon pool is called *carbon sequestration* (IPCC 2021). Sequestration occurs in forests when plants photosynthesize CO_2 and convert it to carbon in plant biomass and soil (IPCC 2021). Live vegetation and the forest floor/soils typically accumulate carbon, while dead vegetation emits carbon into the atmosphere through cellular respiration and decomposition. The absolute quantity of carbon that has been sequestered and stored within the forest ecosystem at a specified time is called *forest carbon stock* (Forest Research 2024). A carbon pool is deemed a carbon sink if, during a given time interval, more atmospheric carbon flows into it than flows out of it.

Rising atmospheric concentrations of GHGs, in excess of natural levels, have resulted in increasing global surface temperatures—a process commonly referred to as *global warming*. Higher global surface temperatures have, in turn, resulted in changes to Earth's climate system including increases in ocean temperature and acidity, reduced sea ice, variable precipitation, and increases in the frequency and intensity of extreme weather events (IPCC 2023). Large-scale changes to Earth's system are collectively referred to as *climate change*, which is discussed in the following section in more detail.

3.9.2.3 Climate Change

The Intergovernmental Panel on Climate Change was established by the World Meteorological Organization and United Nations Environment Programme to assess scientific, technical, and socioeconomic information relevant to the understanding of climate change, its potential impacts, and options for adaptation and mitigation. Under the current nationally determined contributions of mitigation from each country until 2030, average global temperature is expected to rise approximately 3 degrees Celsius (°C) by 2100 and continue rising afterward (IPCC 2023). Evidence of long-term changes in climate over the 20th century includes the following (IPCC 2014, 2023):

- An increase of 1.09°C (1.96 degrees Fahrenheit [°F]) in Earth's global average surface temperature from 1850–1900 to 2011–2020
- An increase of 7.9 inches (0.2 m) in the global average sea level
- A decrease in arctic sea-ice cover at a rate of approximately 4.1 percent per decade since 1979, with faster decreases per decade in summer
- Decreases in the extent and volume of mountain glaciers and snow cover
- An overall decrease in growth of global agricultural productivity
- More frequent weather extremes such as droughts, floods, severe storms, and heat waves

Hawai'i is particularly vulnerable to climate change impacts due to its exposure and isolation, small size, low elevation (in the case of atolls), and concentration of infrastructure and economy along the coasts. Hawai'i faces numerous climate-related risks including water shortage, declining ecosystem function, and sea level rise impacts, such as coastal erosion, flooding, and saltwater intrusion (U.S. Global Change Research Program 2018).

Climate models, ranging in scale from Global Climate Models to Regional Climate Models, use future GHG emissions scenarios to better understand anticipated future climate conditions and temperature increases. The results of Regional Climate Models that have been statistically downscaled to show impacts in Hawai'i predict surface air temperature increases of 2 to 4°C (3.6 to 7.2°F) over land, more frequent extreme rainfall events, and increased rainfall disparity between wet windward sides and dry leeward sides of the islands (Zhang et al. 2016). Appendix 7C to the Draft HCP provides climate projections for the Island of Kaua'i, focusing on key hazards such as hurricanes, inland flooding, sea level rise, and wildfire. According to Appendix 7C, the likelihood of both hurricane landfalls and near-landfalls is projected to increase slightly, with the most intense hurricanes expected to become more frequent due to rising maximum sustained wind speeds. Inland flooding and extreme precipitation are projected to intensify, increasing flood risks, especially in low-lying areas such as Kekaha, Nāwiliwili Bay, and Hanapēpē Bay. Sea levels are anticipated to rise significantly faster than historically observed, particularly under higher-emissions scenarios, posing a substantial threat to coastal regions like Mānā. Droughts are projected to worsen, leading to greater wildfire risks, with potential increases in maximum wind speeds exacerbating wildfire intensity. Rising air temperatures, changes in wind and precipitation patterns, and sea level rise pose numerous threats to ecosystems and habitats. These include the loss of habitat for native species and increased threats from mosquito-borne diseases, extensive coral bleaching threatening marine ecosystems, and chronic coastal erosion affecting over 70 percent of beaches in Hawai'i, affecting both natural ecosystems and human communities (City and County of Honolulu Climate Change Commission 2018).

3.9.3 Environmental Consequences

3.9.3.1 Alternative A No Action

Under Alternative A, KIUC would continue to operate existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. KIUC would not implement a comprehensive program to mitigate impacts on Covered Species. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. Operation of existing and new infrastructure without a comprehensive mitigation program would not result in new sources of air emissions and there would be no new impacts on air quality or climate change.

3.9.3.2 Alternative B Proposed Action

Under Alternative B, the Service and DLNR would authorize incidental take of Covered Species from Covered Activities in the Permit Area including implementation of the conservation strategy over a 50-year permit term. Covered Activities include (1) powerline operations, including modifications, (2) lighting operations and use of night lighting for repairs, and (3) implementation of the Draft HCP conservation strategy.

Vehicle and helicopter trips associated with implementation of the conservation strategy would produce exhaust emissions of criteria pollutants, volatile organic compounds, hazardous air pollutants, and GHGs. Specifically, implementation of the conservation strategy would result in vehicle trips associated with seabird monitoring, predator control, social attraction, invasive species management, and night surveys for observational monitoring of all KIUC powerlines. Helicopters would be used for monthly inspections of the fence lines and to transport crew and materials to the conservation site for fence maintenance or replacement. These activities would result in approximately 1,200 vehicle trips and 245 helicopter trips annually, as described in Section 3.1.2. In addition, the transport of crew and materials required for installation of predator exclusion fences and predator eradication at Upper Limahuli PF and Upper Mānoa Valley PF would involve an estimated 67 helicopter trips in 2025 and 73 helicopter trips in 2027. Replacement of predator exclusion fences twice during the permit term would also require the transport of crew and materials to each of the four social attraction sites (Pōhākea PF, Honopū PF, Upper Limahuli PF, and Upper Mānoa Valley PF), resulting in an estimated total of 440 helicopter trips over the permit term.

Emissions from the internal combustion engines powering these vehicles and helicopters would add marginally to the volume of pollutants in the vicinity. These emissions would be temporally distributed over the permit term and would disperse substantially due to persistent northeast trade winds. Vehicle and helicopter trips associated with implementation of the conservation strategy would also be localized, mostly away from urban or residential areas. Moreover, as described in Section 3.9.2, there are no nonattainment or maintenance areas overlapping the Plan Area, and air quality is generally considered good on Kauaʻi. As a result, emissions from vehicle and helicopter trips associated with implementation of the conservation strategy are not likely to lead to a violation of ambient air quality standards or have a noticeable impact on long-term air quality or climate change in the region.

To the extent that changes in climate in the Plan Area would include increased occurrence of severe weather, infrastructure could be subjected to increased stress from high winds and extreme temperatures and precipitation. Project facilities would be designed to withstand predicted severe weather conditions and, therefore, generally are not expected to be affected by changes in the climate of the Plan Area. However, extreme weather events such as a Category 5 hurricane could damage project facilities. KIUC has pre-emptive measures and contingency plans in place in case an extreme weather event linked to climate change significantly damages project facilities.

3.9.3.3 Alternative C Additional Minimization

Alternative C would be anticipated to result in similar impacts on air quality and climate change as Alternative B. As stated in Section 3.1.2, additional minimization measures associated with Alternative C would not result in any new potential sources of air pollutant emissions compared to Alternative B. As a result, Alternative C would be anticipated to result in similar impacts on air quality resources as Alternative B.

3.9.3.4 Alternative D Additional Mitigation

Alternative D would be anticipated to result in similar impacts on air quality and climate change as Alternative B but would result in greater impacts on air quality due to the implementation of additional mitigation measures. Under Alternative D, implementation of ungulate suppression, predator control, and social attraction at three conservation sites (beyond what is proposed in the Draft HCP) would result in approximately 78 additional helicopter trips annually throughout the 50-year permit term. Because these additional emissions from helicopter trips would be distributed temporally over the permit term, localized geographically, and quickly dispersed, emissions associated with Alternative D are not likely to lead to a violation of ambient air quality standards.

3.9.3.5 Comparison of Alternatives

Under Alternative B, emissions from vehicle and helicopter trips would be greater than under Alternative A but are not likely to lead to a violation of ambient air quality standards or to have a noticeable impact on long-term air quality or climate change in the region. Alternative C would not introduce additional emissions compared to Alternative B and, therefore, would result in similar impacts on air quality and climate change as Alternative B. Alternative D would introduce additional emissions compared to Alternative B due to additional helicopter trips for expanded mitigation effort at conservation sites but, like Alternative B, is not likely to lead to a violation of ambient air quality standards or to have a noticeable impact on long-term air quality or climate change in the region.

3.10 Cultural Resources

This section describes the existing conditions of cultural resources and analyzes the direct and indirect effects of the proposed action and alternatives on cultural resources.

Cultural resources encompass human history, including archaeological sites, historic buildings, ethnographic resources, traditional cultural properties, and cultural landscapes. Cultural resources consist of the following four categories:

- Archaeological resources are those areas or locations (sites) where human activity measurably altered the earth or left deposits of physical remains, such as latte or pottery.
- Architectural resources or built properties are those standing buildings, dams, canals, bridges, and other structures that have historic, engineering, or aesthetic significance.
- Traditional cultural properties (properties of traditional and cultural importance) can include a building, structure, object, site, or district that is eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community.
- Resources of cultural importance are important traditional activities and practices such as hunting, gathering, farming, medicinal, and fishing practices.

3.10.1 National Historic Preservation Act

Under the National Historic Preservation Act (NHPA), section 106 requires a consultative process for federal agencies to identify and assess the effects of its undertaking on cultural resources, and section 110 requires federal agencies to establish preservation programs for the identification, evaluation, and preservation of historic properties. Cultural resources consist of historic properties eligible for the National Register of Historic Places (NRHP) and those cultural resources defined more broadly.

For purposes of section 106 of the NHPA, the proposed federal undertaking is the issuance of a permit exempting KIUC from ESA section 9 liability, where the take of ESA-protected species is incidental to, and not the purpose of, the applicant's otherwise lawful activities (see 16 U.S.C. 1539(a)(1)(B)), and all enumerated permit issuance criteria are met (16 U.S.C. §1539(2)(B); 50 CFR 17.22, 17.32). Because the ITP is a federal permit issued by the Service, its issuance and the permittee's Covered Activities described in the Draft HCP under the Service's direct jurisdiction constitute an undertaking under section 106 of the NHPA. The Covered Activities and conservation measures stipulated as a condition of the permit and described in the Draft HCP that have the potential to cause effects on historic properties are subject to review.

The study area for this analysis of impacts on cultural resources under NEPA is equivalent to section 106's area of potential effects (APE). The APE comprises all KIUC's existing infrastructure, which includes its powerlines, streetlights, and two generating facilities, as well as 12 conservation areas that could potentially detract from the integrity of the setting and feeling of cultural resources through visual, audible (noise), or atmospheric changes. This has been determined because the Draft

HCP's conservation measures require them to be modified (i.e., powerline collision minimization and light attraction minimization); therefore, visual changes would occur.

The Service formally initiated the NHPA section 106 process on December 18, 2024, by sending letters to the State Historic Preservation Officer (SHPO) and potential consulting parties that included a description of the undertaking; the APE; and the outcome of the Service's review of existing information on historic properties within the APE. The letters solicited knowledge from these parties of any other historic properties in the APE and requested that parties identify issues relating to the undertaking's potential to affect such properties. The Service's NHPA section 106 consultation initiation letter further requested assistance in determining and documenting the APE. More information regarding the NHPA section 106 process for this undertaking as well as a list of parties that were invited to be consulting parties is provided in Appendix A.

3.10.2 Cultural Impact Assessment and Ka Paʻakai Analysis

Review under the HEPA requires an assessment of potential impacts on cultural resources as well as consultation with traditional cultural practitioners familiar with the cultural resources and practices in the area that would be affected by the proposed action and alternatives. The purpose of a Cultural Impact Assessment (CIA) and Ka Paʻakai Analysis (Appendix D) is to identify and consult with individuals and organizations with expertise regarding traditional cultural resources, practices, and beliefs and to gather information on cultural resources, practices, or beliefs that have occurred or still occur in the Permit Area to inform the analysis of impacts on cultural resources. This is accomplished through consultation and background research using previously written documents, studies, and interviews. The types of cultural resources subject to assessment may include traditional cultural properties or other types of historic sites, both human-made and natural, that support cultural practices and beliefs.

The Hawaiʻi Environmental Advisory Council recommends the following protocol for conducting the CIA:

- Identify and consult with individuals and organizations with expertise concerning the types of cultural resources practices and beliefs found within the broad geographical area, e.g., district or ahupuaʻa;
- Identify and consult with individuals and organizations with knowledge of the area potentially affected by the proposed action;
- Receive information from or conduct ethnographic interviews and oral histories with persons having knowledge of the potentially affected area;
- Conduct ethnographic, historical, anthropological, sociological, and other culturally related documentary research;
- Identify and describe the cultural resources, practices, and beliefs within the potentially affected area; and
- Assess the impact of the proposed action, alternatives to the proposed action, and mitigation measures, on the cultural resources, practices and beliefs identified (State of Hawaiʻi 2012).

The purpose of the Ka Paʻakai Analysis is to assist the State of Hawaiʻi in fulfilling its obligation to protect "all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupuaʻa tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778, subject to the right of the State to regulate such rights" (Article XI, Section 7 of the Constitution of the State of Hawaiʻi). It requires that the following specific findings and conclusions be addressed:

1. The identity and scope of valued cultural, historical, or natural resources within the project area, including the extent to which traditional and customary native Hawaiian rights are exercised;
2. The extent to which those resources, including traditional and customary native Hawaiian rights, will be affected or impaired by the proposed action; and
3. The feasible action, if any, to be taken by the agency to reasonably protect native Hawaiian rights if they are found to exist.

Additional information on the methods and findings of the CIA and Ka Paʻakai Analysis are provided below and in Appendix D, and a list of individuals and organizations that were invited to consult is included in Appendix A, Table A-3.

3.10.3 Methods

Cultural resources in the Permit Area are described using information obtained through the CIA and Ka Paʻakai Analysis, through consultation under the NHPA section 106 process, and through archival research. Data sources include individuals or organizations with cultural expertise and/or knowledge of the Permit Area and vicinity as well as primary and secondary cultural and historical sources, historical maps and photographs accessed through the Cultural Surveys Hawaiʻi, Inc. (CSH) library, the Hawaiʻi State Archives, the Bishop Museum Archives, the University of Hawaiʻi at Mānoa's Hamilton Library, Ulukau: the Hawaiian Electronic Library, the State Historic Preservation Division Library, the State of Hawaiʻi Land Survey Division, the Hawaiian Historical Society, the Hawaiian Mission Houses Historic Site and Archives, Waihona ʻĀina Corporation's Māhele database, the Office of Hawaiian Affairs' Papakilo Database, and the AVA Konohiki Ancestral Visions of ʻĀina website.

During conduct of the CIA and Ka Paʻakai (Appendix D), CSH made multiple attempts to contact Native Hawaiian organizations, agencies, and community members as well as cultural and lineal descendants to identify individuals with cultural expertise and/or knowledge of the Permit Area and vicinity. A total of 73 individuals were invited to participate in consultation and eight individuals responded. Of those eight individuals, CSH was able to confirm and conduct two separate interviews, although only one of the interviews has been reviewed and approved by the interviewee.

Under the NHPA, a historic property is a particular type of cultural resource defined as a district, site, building, structure, or object that meets the specific criteria of the NRHP. Under NEPA, the consideration of cultural resources may also include non-NHPA eligible resources such as cemeteries, memorials, medicinal plants, and similar resources that hold special traditional, religious, or cultural significance.

Impacts on cultural resources are assessed in terms of intensity, duration, and geographic extent, focusing on the potential for ground disturbance that could result from the installation and maintenance of fencing, artificial burrows, weatherports, and landing zones during implementation of the conservation strategy. Implementation of the powerline and lighting operations included as Covered Activities would not result in ground disturbance that could affect archaeological resources; however, this analysis does consider potential visual effects associated with the modification of existing and new powerlines and streetlights.

3.10.4 Affected Environment

Research conducted for the CIA and Ka Paʻakai Analysis (Appendix D) found that 834 archaeological studies have been conducted on the island of Kauaʻi, all but 81 of which were conducted wholly or in part below the 500-foot (152.4-m) elevation contour line where most of the population lives. Fifty-one archaeological sites have been identified above 500 feet (152.4 m) in elevation and were reported in 41 of the 81 studies conducted in these areas. This suggests a relatively low site density in the uplands (CSH 2025). Site types for historic properties previously identified in whole or in part above 500 feet (152.4 m) in elevation include agricultural and habitation complexes, house sites, terrace walls, irrigation ditches and structures, Hawaiian stone artifacts, burials, and a *heiau* (see Table 11 in Appendix D).

Research on the archaeological studies in the lowlands (i.e., the areas below 500 feet [152.4 m] in elevation) indicate that historic properties are most likely to be found near where people lived before European contact in 1778, which was immediately along the coast and along the bottom of lands of river valleys. These areas include Hanalei Bay (and the Hanalei, Waiʻoli, and Waipā river valleys), Anahola Bay and river valley, Wailua valley, Nāwiliwili Bay and associated valleys, Kōloa along the coast and extending inland along the Waikomo Stream, Hanapēpē Bay and valley, and Waimea Bay and valley. The Nā Pali valleys have a greater density of historic properties than the small size of its population would typically indicate. The density of historic properties is anticipated to remain low in most of the rugged cliff and valley interior, the southwestern dissected uplands of Puʻu Ka Pele and Makaweli, the mauka Līhuʻe basin, and the Alakaʻi High Plateau (CSH 2025).

Community consultation and background research conducted as part of the development of the CIA and Ka Paʻakai Analysis identified the following cultural, historical, and natural resources where past and ongoing cultural practices (including traditional and customary Native Hawaiian rights) were and are being exercised within the Permit Area (CSH 2025):

1. Surfing
2. Farming, *kalo*, wetland and dryland
3. Deep-sea fishing
4. *Hula*
5. Salt production
6. Subsistence farming (fishponds)
7. Burials and *heiau*

CSH's full review of cultural resources and practices within the Permit Area that were identified through consultation and background research are fully described in the CIA and Ka Paʻakai Analysis (Appendix D).

3.10.5 Environmental Consequences

3.10.5.1 Alternative A No Action

Under Alternative A, KIUC would continue to operate existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. KIUC would not implement a comprehensive program to mitigate impacts on Covered Species. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. Existing fences and weatherports would not have effects on cultural resources because there is a lower expected occurrence of cultural sites above the 500-foot (152-m) elevation where the conservation sites are located. KIUC would continue to operate its existing and new infrastructure without a comprehensive mitigation program. Modifications to existing and new infrastructure, such as powerline diverters already installed for minimization, would continue to have visual effects on historic resources for the duration of their functional life. The visual impact of new powerlines would vary depending on the setting where new powerlines are sited and could range from being visually screened to being visually prominent.

3.10.5.2 Alternative B Proposed Action

Under Alternative B, the Service and DLNR would authorize incidental take of Covered Species from Covered Activities in the Permit Area including implementation of the conservation strategy over a 50-year permit term. Covered Activities include (1) powerline operations, including modifications, (2) lighting operations and use of night lighting for repairs, and (3) implementation of the Draft HCP conservation strategy.

Adverse effects on cultural resources can be characterized as those that result in the loss, degradation, or destruction of historic properties including properties listed on the NRHP or determined to be significant under HAR 13-275/284-6(d), traditional cultural properties, and cultural landscapes. Many effects on cultural resources are permanent because, once disturbed, a cultural resource cannot be restored to its original context. For a cultural resource to be eligible for listing on the NRHP, it must retain enough integrity to convey its significance. Effects on cultural resources from surface-disturbing activities, or activities that result in the alteration of a property’s viewshed if the view is a contributing factor to that property’s significance, can cause damage to or destruction of a site’s ability to convey its significance. Effects can occur from changes on the landscape that affect a visitor’s feeling or association of a site. Adverse effects on cultural resources can also occur under HRS 343 if implementation of the Draft HCP would hinder the ability of people to participate in or access any of the cultural, historical, and natural resources identified as cultural practices or beliefs in the CIA and Ka Paʻakai Analysis (Appendix D).

Under the proposed action, the potential for adverse effects on cultural resources would be primarily associated with the surface disturbance associated with construction of new predator exclusion fences at two conservation sites (2,259 linear feet [688.5 m] of fence at Upper Limahuli Preserve PF and 4,294 linear feet (1,308.8 m) of fence at Upper Mānoa Valley PF), installation of artificial burrows at two social attraction sites (Upper Limahuli Preserve PF and Upper Mānoa Valley PF), installation of two up to 500-square-foot (46.5-square-m) weatherports at Upper Mānoa Valley, and maintenance of the four social attraction sites (Pōhākea PF, Honopū PF, Upper Limahuli PF, and Upper Mānoa Valley PF). The two new predator exclusion fences would result in a total of 2.9 acres (1.2 hectares) of site clearing and 0.3 acre (0.1 hectare) of ground disturbance for the installation of fence posts and mesh skirt. Maintenance of the fences at each of the four social attraction sites would involve replacing the fences up to two times during the 50-year permit term, cumulatively resulting in approximately 4.2 acres (1.7 hectares) of site clearing and 0.4 acre (0.2 hectare) of ground disturbance for installation of fence posts and mesh skirt each time that the fencing is replaced. The installation of artificial burrows at Upper Limahuli Preserve PF and Upper

Mānoa Valley PF and maintenance at all four social attraction sites would result in localized ground disturbance at all four social attraction sites (Upper Limahuli Preserve PF, Pōhākea PF, Honopū PF, and Upper Mānoa Valley PF).

Minor surface disturbances during construction and maintenance activities at conservation sites (such as for the installation of fence posts, mesh skirts, and artificial burrows) could potentially affect cultural resources. However, impacts on cultural resources are not expected to occur due to the limited extent of proposed ground disturbance combined with a predicted low density of historic properties in the interior areas where the conservation sites are located. Clearing of vegetation for one or two new helicopter landing zones at Upper Mānoa Valley, and the powerline and lighting operations included as Covered Activities, are not anticipated to affect cultural resources because they would not result in ground disturbance.

Modification of powerlines and lights has the potential to cause visual effects on historic properties. Modification includes implementation of powerline collision minimization (powerline reconfiguration, installation of bird flight diverters, and wire exposure through vegetation management), light attraction minimization (installation of shielded streetlights, and dimming of exterior lights at KIUC facilities). The visual impact of new powerlines would vary depending on the setting where new powerlines are sited and could range from being visually screened to being visually prominent. Visual effects from the modification of powerlines and lights present a minimal change to existing infrastructure. These modifications are visible but would likely be indistinguishable by the casual observer. The degree of contrast of the visual modifications to the landscape is non-existent or minimal; therefore, it is unlikely that visual effects would alter characteristics of historic properties qualifying them for inclusion in or eligibility for the NRHP, assuming they were present.

Visual effects are also considered for the conservation measures, such as the construction and existence of predator-proof fencing on the landscape. There are no anticipated visual effects from predator-proof fencing because the CIA found that archaeological site distribution is relatively low in upland areas above 500 feet (152 m) elevation (Appendix D). Because the conservation areas are characterized as uplands above 500 feet (152 m), the potential for the presence of historic properties in the vicinity of the predator-proof fences is expected to be low.

Implementation of the Covered Activities is not anticipated to affect the cultural, historical, and natural resources identified as cultural practices or beliefs in the CIA and Ka Paʻakai Analysis (Appendix D) because these activities would not affect the ability of people to participate in or access any of these resources or practices. Fencing that will be maintained under the Draft HCP's conservation strategy does not preclude access to state lands; subsistence activities such as hunting and gathering remain permissible within fenced areas with appropriate permits, consistent with existing access rights irrespective of fencing. In addition, implementation of the Draft HCP would further the protection of native seabirds and native plants identified as valued cultural, historical, or natural resources in the Permit Area (Appendix D, Section 9.2) and KIUC's proposed implementation of powerline collision minimization and lighting minimization for streetlights and facilities is consistent with the recommended feasible actions to be taken to reasonably protect Native Hawaiian rights (Appendix D, Section 9.2.3). The CIA and Ka Paʻakai Analysis also identified the management of debris from KIUC's tree trimming as a source of adverse impacts on streams and nearshore marine resources. However, ongoing vegetation management for KIUC's powerlines is not a Covered Activity in the HCP, and is therefore outside the scope of the EIS.

Based on the above information and analysis, the Service preliminarily finds the undertaking will result in no adverse effect. This Finding of Effect is subject to change pending concurrence from the Hawai‘i SHPO and Native Hawaiian organizations. A final determination will be made and included in the Final EIS when it is published in the *Federal Register*.

3.10.5.3 Alternative C Additional Minimization

The operation of existing and new powerlines with additional collision minimization and the operation of existing or new streetlights with additional lighting minimization would not result in new sources of ground disturbance and would result in a change to existing infrastructure that would likely still be indistinguishable to the casual observer compared to Alternative B, the proposed action. As a result, the impacts of Alternative C on cultural resources would be similar to the impacts of Alternative B.

3.10.5.4 Alternative D Additional Mitigation

Alternative D includes additional mitigation that could adversely affect cultural resources: construction of additional artificial burrows at social attraction sites, landing zones, and weatherports; expanding predator control in an additional 1,394 acres (564 hectares) of three additional conservation sites beyond those included in the proposed action; and increasing the area protected with ungulate fencing by 1,915 acres (775 hectares). The increase in fencing would result in approximately an additional 0.4 acre (0.2 hectare) of ground disturbance for installation of fence posts and mesh skirt. Ground disturbance under Alternative D would be greater than under Alternatives B and C. However, similar to the other alternatives, impacts on cultural resources are not expected to occur under Alternative D due to the overall limited extent of proposed ground disturbance combined with a predicted low density of historic properties in the interior areas where the conservation sites are located. Similarly, there are no anticipated visual effects from additional mitigation because the archaeological site distribution is relatively low in upland areas above 500 feet (152 m) elevation where these actions would occur.

3.10.5.5 Comparison of Alternatives

The potential for adverse impacts on cultural resources would be greatest under Alternative D due to the additional acreage of ground disturbance required for installation of fence posts and mesh skirt when compared to Alternatives B and C. The potential for adverse impacts on cultural resources would be similar between Alternatives B and C. Under all alternatives, impacts on cultural resources are not expected to occur due to the small acreages of ground disturbance required to implement the conservation strategy and the predicted low density of historic properties in the interior areas where the conservation sites are located (Appendix D). The powerline and lighting operations included as Covered Activities in the Draft HCP would not cause ground disturbance or have the potential to damage a cultural site’s ability to convey its significance. Implementation of the Draft HCP under all action alternatives would also not affect the ability for people to participate in or access any of the cultural, historical, and natural resources identified as cultural practices or beliefs in the CIA and Ka Pa‘akai Analysis (Appendix D).

3.11 Socioeconomics

This section describes the existing conditions of socioeconomics and analyzes the direct and indirect effects of the proposed action and alternatives on socioeconomics.

3.11.1 Methods

The socioeconomic analysis in this section is based on a review of existing demographic, economic, and housing data, as well as electric utility rates on Kauaʻi. Primary data sources include the U.S. Census Bureau's 2020 data, County of Kauaʻi planning documents, and reports from state and local utilities. The analysis considers population distribution, income levels, poverty rates, housing characteristics and costs, and electric utility rates as factors in assessing potential environmental consequences of the proposed action and alternatives.

Key indicators such as household income distribution, poverty thresholds, and housing costs were reviewed to assess potential socioeconomic impacts resulting from future rate increases for electric power under each of the alternatives. Additionally, the concept of "electricity burden" was used to evaluate the proportion of income spent on utility costs, with special consideration given to lower-income households that could be disproportionately affected by any changes in electricity rates. Construction of KIUC infrastructure is not a Covered Activity in the Draft HCP and therefore implementation of the Covered Activities would not generate new construction employment. Operation of new or extended powerlines in new service areas is in response to requests for new electric service and follows growth, rather than inducing growth. Therefore, the effects of construction employment and induced growth on the local economy are not analyzed further in this section.

3.11.2 Affected Environment

3.11.2.1 Population

According to 2020 U.S. Census data, residential population on Kauaʻi was 73,810, about 10 percent higher than in 2010 (U.S. Census Bureau 2020a). The total island population represents 5 percent of the statewide population, making it the least populated of the state's four main counties (Honolulu, Maui, Kauaʻi, and Hawaiʻi, excluding Kalawao County). The majority of the population lives in towns situated around the island's perimeter, particularly along the eastern and southern coastlines, including Kapaʻa, Līhuʻe, and Kekaha. Smaller communities are found on the north shore of the island, such as Hāʻena, Hanalei, Princeville, and Kīlauea. There are no towns on the Nā Pali coast or in the mountainous interior. The County of Kauaʻi Planning Department expects most of the growth on the island through 2035 to be along the south shore (26 percent of total growth) and in Līhuʻe (47 percent of total growth) and anticipates lower growth on the north shore (County of Kauaʻi 2018).

3.11.2.2 Income and Poverty

Household Income

The distribution of household income by income bracket is summarized in Table 3.11-1. The mean household income in 2020 was $99,154 and the median household income was $82,818 (U.S. Census Bureau 2020c). Seventy-nine percent of households received earnings and 25 percent received retirement income other than Social Security. Forty percent of households received Social Security. The average income from Social Security was $19,445 (U.S. Census Bureau 2020d). These income sources are not mutually exclusive; that is, some households received income from more than one source.

Table 3.11-1. Kauaʻi County Household Income

Income Bracket	Percentage of Population
Less than $10,000	5.5%
$10,000 to $14,999	2.8%
$15,000 to $24,999	6.1%
$25,000 to $34,999	7.1%
$35,000 to $49,999	9.9%
$50,000 to $74,999	14.9%
$75,000 to $99,999	13.2%
$100,000 to $149,999	22.8%
$150,000 to $199,999	8.9%
$200,000 or more	8.7%
Median income (dollars)	**82,818**
Mean income (dollars)	**99,154**

Source: U.S. Census Bureau 2020c

Poverty Rate

Low-income populations are those that fall within the annual statistical poverty thresholds from the U.S. Census Bureau's Population Reports, Series P-60 on Income and Poverty (U.S. Census Bureau 2021). For the average household size in Kauaʻi (approximately three individuals), the 2020 poverty guideline was $21,720 (ASPE 2020). As shown in Table 3.11-2, approximately 8 percent of the Kauaʻi population had incomes at or below the official poverty line, compared to approximately 9 percent in the state of Hawaiʻi. Approximately 8 percent of children under 18 were below the poverty level in Kauaʻi, compared with approximately 12 percent in Hawaiʻi (Table 3.11-2; U.S. Census Bureau 2020e).

Table 3.11-2. Percent Below Poverty

Census Category	Hawaiʻi	Kauaʻi County
Total Population	9.3%	7.9%
Under 18 years	11.7%	9.0%
Under 5 years	13.0%	13.0%
5 to 17 years	11.2%	7.6%

Census Category	Hawai‘i	Kaua‘i County
Related children of householder under 18 years	11.2%	8.7%
18 to 64 years	8.7%	7.4%
65 years and over	8.3%	8.1%

Source: U.S. Census Bureau 2020e

3.11.2.3 Housing Characteristics and Costs

In 2020, Kaua‘i County had approximately 23,331 housing units. Of the total housing units, 85 percent were in single-unit structures and 15 percent were multi-unit structures; very few (less than 0.5 percent) were mobile homes. Sixty-five percent of units were owner occupied and 35 percent were renter occupied (U.S. Census Bureau 2020b).

In 2020, renters had median rental payments of $1,423 per month. The median monthly housing costs for homeowners with mortgages was $2,290. The average monthly housing cost reported by the 42 percent of the homeowners who did not have mortgages was $500. Thirty-three percent of owners with mortgages, 13 percent of owners without mortgages, and 37 percent of renters on Kaua‘i reported spending 35 percent or more of household income on housing (U.S. Census Bureau 2020f).

3.11.2.4 Electric Utility Rates

KIUC produces, purchases, transmits, distributes, and sells electricity on the island of Kaua‘i. Residential rates effective as of March 1, 2025, are as follows (KIUC 2025):

- Customer charge per customer per month: $11.42
- All kW-hour per month (add to customer charge): $0.39013 per kW-hour
- Minimum monthly charge: $13.50

The minimum monthly charge has remained the same since May 26, 2010, and the per-kW-hour charge has increased by 8 percent (from $0.37895) since May 26, 2010, due to the Hawaiian Public Utilities Commission’s Interim Decision and Order issued on November 27, 2023. Note that rates fluctuate monthly based on the Energy Rate Adjustment Clause calculation.

3.11.3 Environmental Consequences

3.11.3.1 Alternative A No Action

Under Alternative A, KIUC would continue to operate existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. KIUC would not implement a comprehensive program to mitigate impacts on Covered Species. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. However, future minimization actions and conservation measures described in the Draft HCP that are ongoing or planned and that require an annual commitment of funding and staff resources by KIUC would not occur.

Under Alternative A, KIUC incurred costs for early implementation projects that were completed during development of the Draft HCP. KIUC has already initiated rate increases in response to Draft HCP-related costs, filing a rate case in 2022 that resulted in a 7.95-percent interim rate increase, covering $4.91 million in operating costs and $14.15 million in Draft HCP-related capital projects completed to date (ICF 2025). This rate increase remains in effect until a final decision is issued by the Hawai‘i Public Utilities Commission.

It is expected that future electric utility rates under Alternative A would be less than under Alternative B. KIUC would increase rates in the future under Alternative A to offset inflation, but there would not be a need to generate revenue and increase rates in response to implementation of future minimization actions and conservation measures as under Alternative B. Any rate increases would disproportionately affect low-income households within KIUC’s service area because the cost of utilities represents a larger proportion of household income in low-income households.

3.11.3.2 Alternative B Proposed Action

Under Alternative B, the Service and DLNR would authorize incidental take of Covered Species from Covered Activities in the Permit Area including implementation of the conservation strategy over a 50-year permit term. Covered Activities include (1) powerline operations, including modifications, (2) lighting operations and use of night lighting for repairs, and (3) implementation of the Draft HCP conservation strategy.

The proposed action could result in increases in electric utility rates to recover costs associated with implementation of future minimization actions and conservation measures described in the Draft HCP. As described in Draft HCP Appendix 7B, future rate cases are likely as KIUC continues to recover costs associated with Draft HCP implementation and other operational needs, with estimates suggesting that the timing of future rate case requests could be as short as every 3 to 5 years, or as long as every 10 or more years (ICF 2025). It is expected that future electric utility rate increases under Alternative B would be greater than under Alternative A. KIUC would need to generate revenue to offset both the cost of inflation and the cost of implementing the Draft HCP, whereas under Alternative A KIUC would only need to offset inflation. Any rate increases would disproportionately affect low-income households within KIUC’s service area because the cost of utilities represents a larger proportion of household income in low-income households. Implementation of the Draft HCP under Alternative B would generate employment to maintain fencing and social attraction sites; to implement powerline minimization, predator and invasive species control, sea turtle nest detection and shielding, and the Draft HCP’s monitoring program; and to staff the SOS program that the Draft HCP would fund. Average annual expenditures to implement the Draft HCP are estimated at $8.6 million (HCP Appendix 7B). Employment and expenditures generated by implementation of the Draft HCP would have beneficial impacts on income and tax revenue and benefit the local economy.

3.11.3.3 Alternative C Additional Minimization

Under Alternative C, the impacts on electricity rates in Kaua‘i would likely exceed those of Alternative B due to the higher costs associated with implementing the additional minimization measures. Alternative C introduces the following additional minimization measures that would result in higher costs of implementation: additional collision minimization (i.e., additional powerline reconfiguration, static wire removal, flight diverter installation); additional lighting minimization for streetlights; and additional funding for the SOS program. These additional measures would translate to higher utility rates for customers over Alternatives A and B as KIUC seeks to recover these costs. The increases are likely to occur periodically over the life of the permit term. Any rate increases would disproportionately affect low-income households within KIUC’s service area because the cost of utilities represents a larger proportion of household income in low-income households. Implementation of additional powerline minimization under Alternative C would generate a higher level of employment, income, and tax revenue compared to the proposed action that would benefit the local economy.

3.11.3.4 Alternative D Additional Mitigation

Under Alternative D, the impacts on electricity rates in Kauaʻi would likely exceed those of Alternative B due to the higher costs associated with implementing the additional mitigation measures. Alternative D introduces the following additional mitigation measures that would result in higher costs of implementation: expanded predator control over an additional 1,394 acres (564 hectares); expanded fencing by 1,915 acres (775 hectares) near the proposed conservation sites; expanded predator control, habitat management, waterbird population monitoring, and barn owl control within Mānā Plain wetlands over 50 acres (20 hectares); and increased funding for sea turtle volunteer program to increase staffing, outreach, and add marine debris removal to the program. These additional mitigation measures would translate to higher utility rates for customers, as KIUC seeks to recover these costs. The exact percentage increase is unknown, but the increases are likely to occur periodically over the life of the permit term. Any rate increases would disproportionately affect low-income households within KIUC’s service area because the cost of utilities represents a larger proportion of household income in low-income households. Implementation of additional mitigation under Alternative D would generate a higher level of employment, income, and tax revenue compared to the proposed action that would benefit the local economy.

3.11.3.5 Comparison of Alternatives

Impacts on electricity rates in Kauaʻi would be greatest under Alternatives C and D due to costs that would be incurred by KIUC to implement additional minimization or additional mitigation beyond what is included in the proposed action (Alternative B). Rate increases to recover costs of implementing the Draft HCP would be lowest under the No Action alternative (Alternative A) because KIUC would only need to recover the cost of completing the early implementation projects prior to the permit term. Rate increases would disproportionately affect low-income households within KIUC’s service area because the cost of utilities represents a larger proportion of household income in low-income households. All action alternatives would benefit the local economy through employment, income, and tax revenue with the beneficial effects being greater under Alternatives C and D compared to Alternative B.

3.12 Public Infrastructure and Services

This section describes the existing conditions of public infrastructure and services and analyzes the direct and indirect effects of the proposed action and alternatives on public infrastructure and services.

3.12.1 Methods

This section analyzes the potential impacts of the proposed action and alternatives on the reliability of public infrastructure and services by evaluating power infrastructure, public roadways, and public transit. Implementation of the Draft HCP would not have direct or indirect impacts on public safety or educational facilities; therefore, these resources are not analyzed. Data sources include KIUC reports, local government transportation and infrastructure data, and relevant EAs. Impacts are characterized by intensity and duration.

3.12.2 Affected Environment

3.12.2.1 Power Infrastructure

Power infrastructure on Kauaʻi, managed by KIUC, relies on an extensive network of powerlines for electricity distribution. These powerlines distribute electric power generated at facilities such as the Port Allen Generating Station and Kapaia Power Generating Station to customers throughout the Permit Area. KIUC owns and operates approximately 171.3 mi (275.7 km) of transmission lines, 1,360 mi (2,189 km) of distribution lines, and 70 mi (113 km) of communication lines across Kauaʻi. The facilities composing KIUC's system, including the largely above-ground electrical transmission and distribution infrastructure, occur primarily within and between population centers around the island. Streetlights and powerlines, supported by poles or towers ranging from 25 feet (7.7 m) to over 100 feet (30.5 m) above ground, serve essential functions in delivering electricity to communities (ICF 2025).

3.12.2.2 Public Roadway System

The regional roadway system on Kauaʻi consists principally of two-lane roads connecting major developed areas on the island. These two-lane facilities vary in quality from a narrow, winding highway north of Hanalei to high-quality arterial highways, such as Kūhiō Highway, Kaumualiʻi Highway, and Kapule Highway. These highways serve as the primary belt road access between the island's towns and communities and are connected to a network of minor arterials and collector roadways that provide further local access.

On the west side of the island, Kaumualiʻi Highway is the regional highway but also operates as the local commercial corridor through Waimea and Kalāheo (CH2MHill 2014). Within Līhuʻe, Ahukini Road, Kapule Highway, and Nāwiliwili Road are classified as principal arterial roadways and provide local circulation to businesses, retail, and the airport and harbor. To the west of Līhuʻe, Kaumualiʻi Highway is the sole access to the west side of the island. It is a principal arterial between Līhuʻe and ʻŌmaʻo. From ʻŌmaʻo, the highway continues west through Hanapēpē and Waimea as a minor arterial and terminates at Barking Sands. Collector roadways, such as Waimea Canyon Road, Halewili Road, Koloa Road, ʻŌmaʻo Road, and Maluhia Road, extend from Kaumualiʻi Highway to provide local access (CH2MHill 2014). Kūhiō Highway is a principal arterial that provides access to Kapaʻa and Wailua north of Līhuʻe. From Kapaʻa, Kūhiō Highway continues around the northeastern perimeter of the island as a minor arterial through Anahola and Princeville. It is classified as a collector roadway from Hanalei to the west end of the road. While parallel local roads are available in some communities, Kūhiō Highway is the primary and sole access road between the north shore and Līhuʻe (CH2MHill 2014). The general network of the islands' highways and major, local, and minor roads is depicted on Figure 1-1.

Traffic operations can be described by volume-to-capacity (V/C) ratios and level of service (LOS). The V/C ratio measurement quantifies the relative vehicle demand versus the capacity of a facility. The capacity of a facility depends on a variety of factors including the number of lanes, the operating speed, and the number of driveways or intersections on a roadway. A V/C ratio of 1.0 indicates the vehicle demand is equal to the capacity of the facility, and generally correlates to LOS F, which is described as a breakdown in vehicular flow (CH2MHill 2014). Average daily traffic volumes on Kauaʻi are highest in and around Līhuʻe, which serves as the central hub of the island. Kaumualiʻi Highway on the west side of Līhuʻe carries over 33,000 vehicles per day (in both directions), while Kūhiō Highway to the north carries over 26,000 vehicles per day (HDOT 2023). Both of these segments have a V/C ratio of 1.0 or greater and operate at LOS F (CH2MHill 2014). Elsewhere on the island, roadways are typically operating at V/C ratios of less than 0.8 and LOS C or better[8] (CH2MHill 2014).

3.12.2.3 Public Transit System

The Kauaʻi Bus public transit system currently consists of six fixed-route transit lines, five of which offer service 7 days a week. All transit routes begin and end in Līhuʻe, the hub of transit service on Kauaʻi. The Mainline is composed of three routes that run along the perimeter of the island, from Kekaha in the southwest (via Kaumualiʻi Highway) to Hanalei (via Kūhiō Highway) on the north coast (connecting in Līhuʻe in the southeast). The Mainline also includes a commuter line that offers limited trips between Wailua and Līhuʻe on the East Side (essentially a shortened version of the route that continues to Hanalei). Headways on the Mainline range from every 30 to 60 minutes with service spanning from 5:30 a.m. to 10:40 p.m. (Nelson\Nygaard 2018).

3.12.3 Environmental Consequences

3.12.3.1 Alternative A No Action

Under Alternative A, KIUC would continue to operate existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. KIUC would not implement a comprehensive program to mitigate impacts on Covered Species. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. KIUC would continue to operate its existing and new infrastructure without a comprehensive

[8] LOS C means that freedom to maneuver within the traffic stream is noticeably restricted. At LOS B, there is reasonably free flow with only a slight restriction to maneuver within the traffic stream. LOS A represents free-flow operation where vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream (CH2MHill 2014).

mitigation program. There would be no new impacts on power infrastructure, public roadways, or public transit systems would occur.

3.12.3.2 Alternative B Proposed Action

Under Alternative B, the Service and DLNR would authorize incidental take of Covered Species from Covered Activities in the Permit Area including implementation of the conservation strategy over a 50-year permit term. Covered Activities include (1) powerline operations, including modifications, (2) lighting operations and use of night lighting for repairs, and (3) implementation of the Draft HCP conservation strategy.

Power Infrastructure

As described in Section 2.2.2.5, KIUC's island-wide powerline collision minimization plan will have already been completed prior to the start of the permit term, and the same or similar minimization techniques will be applied to all newly operated power lines throughout the duration of the 50-year permit term. Under Alternative B, the Covered Activities related to powerline and lighting operations would be conducted consistent with the description of the Covered Activities in Section 2.2.2.4. The operation of powerlines with minimization measures for avian collision and the operation of lighting for facilities, streetlights, and night repairs in a manner that would reduce light attraction would not affect the reliability and resilience of KIUC's power generation, transmission, or distribution within KIUC's service area.

Public Roadway System

The conservation sites at Honopū, Honopū PF, and Pihea would be accessed by vehicles for implementation of annual seabird monitoring, predator control, social attraction, and invasive plant species management. All compliance monitoring, take monitoring, and effectiveness monitoring for KIUC powerlines (as described in Chapter 6 of the Draft HCP) would also be conducted with vehicles. In total, an estimated 1,200 vehicle trips per year will be required to implement the Draft HCP under Alternative B. These vehicle trips would add to baseline levels of traffic on arterial highways and introduce reduced-speed truck traffic driving to transport fencing to helicopter departure points. Overall impacts on traffic would be negligible, with 1,200 vehicle trips per year equaling fewer than four trips per day on average. The traffic volume added as a result of implementing the Draft HCP would be less than 0.02 percent of the average daily traffic volumes of between 26,000 and 33,000 vehicles per day on the main arterial routes of Kaumuali‘i Highway and Kūhiō Highway. V/C ratios are not expected to change as a result of the additional vehicle trips needed to implement the Draft HCP.

Public Transit System

Implementation of the Covered Activities, conservation strategy, and monitoring program under the proposed action (Alternative B) would not affect public transit systems on Kaua‘i because activities that could result in lane closures or relocation of bus stops are not proposed as part of the proposed action. As described above, the number of vehicle trips needed to implement the Draft HCP would be low compared to existing vehicle traffic. LOS for bus transit routes is not expected to be affected by vehicle trips to implement the Draft HCP.

3.12.3.3 Alternative C Additional Minimization

Alternative C introduces the following additional minimization measures compared to Alternative B: additional powerline collision minimization for existing and new powerlines; additional lighting minimization for existing and new streetlights; and additional funding for the SOS program. Operation of powerlines and streetlights with additional minimization and increased funding for the SOS program would not affect the reliability of KIUC's power generation, transmission, or distribution system and there would be no impact on power infrastructure caused by implementation of additional minimization. Operation of powerlines and streetlights with additional minimization and increased funding for the SOS program would not increase the number of vehicle trips required for implementation of the conservation strategy or for annual monitoring of KIUC's powerlines, and impacts on public roadways and public transit would be similar to the impacts described for Alternative B.

3.12.3.4 Alternative D Additional Mitigation

Additional mitigation effort at conservation sites for expanded ungulate control, expanded predator control, and regional barn owl control, and expanded conservation effort on 50 acres of state land within the Mānā Plain wetlands would increase the number of vehicle trips required for the transport of staff and materials to areas where additional conservation effort would be directed. This would include additional vehicle trips for transporting staff and materials either directly to conservation sites or to helicopter departure points for subsequent transfer by helicopter to sites that are inaccessible by vehicle. Although vehicle trips would increase under Alternative D compared to Alternative B, given the low number of estimated vehicle trips (1,200 vehicle trips per year under Alternative B), the incremental increase in vehicle trips under Alternative D is not expected to result in impacts that are substantially different from those of Alternative B. Implementation of additional mitigation under Alternative D would not affect the reliability of KIUC's power generation, transmission, or distribution system and there would be no impact on power infrastructure.

3.12.3.5 Comparison of Alternatives

The proposed action and alternatives would not affect the reliability or resilience of KIUC's power generation, transmission, or distribution system and there would be no impact on power infrastructure. The potential impacts of vehicle trips to implement the Draft HCP on public roadways would be highest under Alternative D, followed by Alternatives B and C. However, given the expected low volume of vehicle trips under any of the action alternatives, adverse impacts on public roadways that would warrant mitigation (such as traffic controls) are not expected. Under Alternative A, the Draft HCP would not be implemented and there would be no impact on public roadways. None of the alternatives would result in the closure or relocation of public transit stops or public transit routes.

3.13 Recreation

This section describes the existing conditions of recreational resources and analyzes the direct and indirect effects of the proposed action and alternatives on recreation.

3.13.1 Methods

To analyze the potential impacts on recreation under each alternative, this section uses a combination of data sources, including recreational facility maps and environmental documents from the County of Kauaʻi, KIUC, and conservation organizations. Key factors considered include how the implementation of conservation measures could directly or indirectly affect recreational activities.

3.13.2 Affected Environment

The County of Kauaʻi operates and maintains 67 active parks and recreational facilities on the island, and these occupy a total of 487 acres (197 hectares) (County of Kauaʻi 2023). There are four districts in the county: Hanalei, Kawaihau, Kōloa-Kalāheo, and Waimea, with the Kawaihau District offering the largest recreational acreage (211.11 acres [85.43 hectares]) compared to the other three districts. All four districts offer a range of managed recreational facilities including beach parks; neighborhood parks with facilities such as pavilions, comfort stations, picnic areas, and sports fields; regional parks; and sports facilities like baseball fields, basketball courts, and tennis courts. In addition, there are nine golf courses in Kauaʻi, three of which are publicly owned, and four of which are privately owned (Go Hawaiʻi 2023).

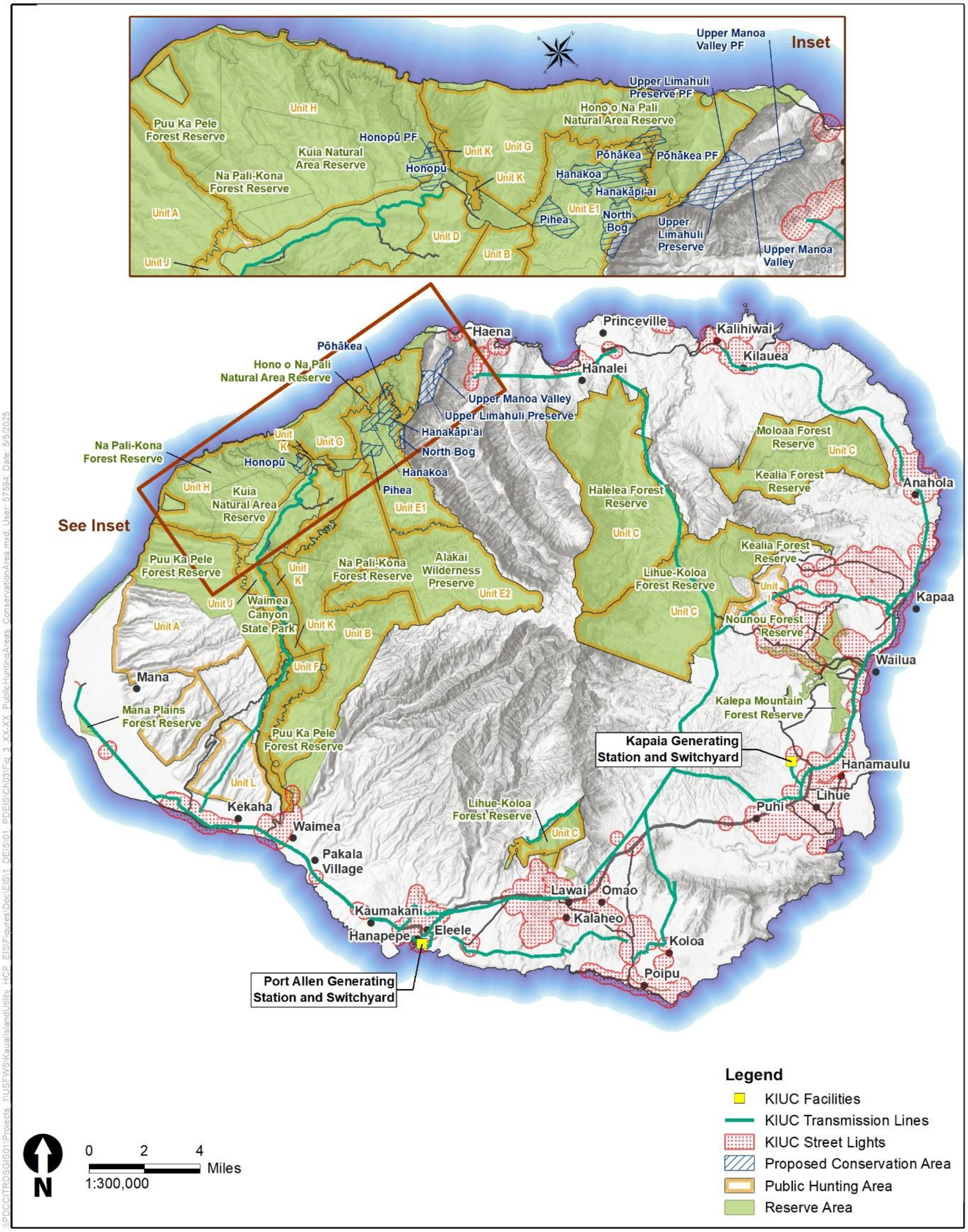
The Kīlauea Point National Wildlife Refuge is on the northernmost point of Kauaʻi and spans 203 acres (82 hectares) along the shoreline. The refuge is known for its diverse species, particularly seabirds (NOAA 2022). Recreation is limited within the wildlife refuge to reduce disturbance; however, fishing along the shoreline, photography, and birding are all permitted within certain areas of the refuge (USFWS 2023).

Most of the parks and recreational facilities described above utilize electricity from KIUC in multiple ways to enhance visitor experiences and support their operational needs. Lighting is a common application, illuminating sports fields, pathways, comfort stations, and pavilions for evening and nighttime activities. Comfort stations, including restrooms and shower facilities, rely on electricity for lighting, ventilation, and appliances like hand dryers. Sports facilities often employ lighting systems for night games and scoreboards. Campgrounds offer electrical hookups for campers and administrative buildings power lighting, office equipment, and maintenance tools.

DLNR-managed public hunting areas on Kauaʻi total approximately 100,000 acres (40,469 hectares) across 12 hunting units (Figure 3.13-1). Approximately 2,000 licensed hunters are registered with DLNR on Kauaʻi (DOFAW 2025a). In 2017, feral pigs were the most commonly harvested game mammal on Kauaʻi, with a total of 120 hunters and 3,524 hunting trips for feral pigs reported. A total of 57 hunters and a total of 611 trips for game bird hunting were reported in 2017, with ring-neck pheasant and Erckel's francolin being the most harvested game bird species on the island (DOFAW 2017).

The Hanakāpiʻai, Hanakoa, North Bog, Pihea, Pōhākea, and Pōhākea PF conservation sites are within hunting Unit E1 and the Honopū and Honopū PF are within hunting Unit H (Figure 3.13-1). The remaining conservation sites are on private land and are not open to public hunting. Public hunting is allowed within DLNR hunting units in accordance with DLNR's Administrative Rules at HAR § 13-5-2, Chapter 123. Hunting is allowed year-round in Unit E1 with an annual permit for feral goats, feral pigs, and black-tailed deer by firearms, archery, or dogs and knives. Hunting regulations for Unit H are the same as for Unit E1 except dogs are not permitted from August through November (HAR § 13-5-2, Chapter 123). In 2017, approximately 9 percent of hunters surveyed on Kauaʻi reported hunting on Kōkeʻe State Park (Unit H) and 5 percent reported hunting on the Nā Pali-Kona Forest Reserve and Hono O Nā Pali NAR (Unit E1) (DOFAW 2017). Fishing, gathering practices, and plum (*Prunus salicina*) picking may also occur on public lands where the Hanakāpiʻai, Hanakoa, North Bog, Pihea, Pōhākea, Pōhākea PF, Honopū, and Honopū PF conservation sites are located.

The conservation sites are primarily in remote locations away from high recreational activity and only accessible by helicopter or trail hiking on rugged terrain. Use of these sites for recreation is relatively low; however, both Honopū and Pihea are accessed by marked hiking trails and are frequently used by hikers. Regarding helicopter-based tourism on Kauaʻi, DLNR has advised helicopter tours to maintain an operational ceiling greater than 1,500 feet above ground level over conservation sites for the safety of resource staff on the ground and to avoid potential harassment of protected species by helicopter noise (DOFAW 2025b).



Sources: ICF 2025; Hawai'i State GIS Program 2025

Figure 3.13-1. Public Hunting Areas on Kaua'i

3.13.3 Environmental Consequences

3.13.3.1 Alternative A No Action

Under Alternative A, KIUC would continue to operate existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. KIUC would not implement a comprehensive program to mitigate impacts on Covered Species. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. KIUC would continue to operate its existing and new infrastructure without a comprehensive mitigation program. The Hanakāpīʻai, Hanakoa, North Bog, Pihea, Pōhākea, Pōhākea PF, Honopū, and Honopū PF conservation sites are open to public hunting and traditional gathering practices for community members with valid permits and licenses; walkovers and gates on existing ungulate fences would continue to provide public access at these sites under Alternative A. However, existing ungulate fencing has reduced the abundance of game within fenced areas of the conservation sites, reducing hunting incentive in these areas where game animals such as feral pigs and goats have been reduced. Additionally, there is no hunting incentive within the Pōhākea PF and Honopū PF conservation sites because ungulates and predators are not present within areas fenced with predator exclusion fence, and public access is restricted within the areas maintained as social attraction sites. Under Alternative A, these conditions for public hunting access and recreation would continue and there would be no new impacts on recreational facilities or activities.

3.13.3.2 Alternative B Proposed Action

Under Alternative B, the Service and DLNR would authorize incidental take of Covered Species from Covered Activities in the Permit Area including implementation of the conservation strategy over a 50-year permit term. Covered Activities include (1) powerline operations, including modifications, (2) lighting operations and use of night lighting for repairs, and (3) implementation of the Draft HCP conservation strategy.

In the long term, the implementation of conservation measures under Alternative B would result in long-term beneficial effects on recreation associated with the enjoyment of natural resources by protecting wildlife and natural areas. The reconfiguration of powerlines, removal of static wires, and installation of bird flight diverters would reduce seabird collisions, benefiting places like the Kīlauea Point National Wildlife Refuge, where birdwatching and photography are popular. Installing streetlights with full-cutoff shields would minimize light pollution, improving both wildlife protection and recreational facility lighting. Annual funding of $300,000 for the SOS program would support seabird rescue efforts, enhancing productivity and indirectly benefiting recreational activities such as birdwatching and wildlife photography.

Under the proposed action, the construction of new predator exclusion fences and the maintenance of social attraction sites at two conservation sites within Upper Limahuli Preserve and Upper Mānoa Valley would not affect public hunting, gathering practices, or other recreational activities because these areas are on private land. Similarly, the portion of the North Bog conservation site on private land is not open to public hunting. Impacts on gathering practices, game abundance, and public hunting opportunities from the maintenance of social attraction sites at the Pōhākea PF and Honopū PF conservation sites (within hunting units E1 and H, respectively) are not anticipated because access to these areas is already restricted. However, maintenance of existing ungulate exclusion fencing around the Hanakāpiʻai, Hanakoa, North Bog, Pihea, Pōhākea, and Honopū conservation sites could result in limited impacts on public hunting opportunities by reducing the abundance of pigs, deer, and goats in these areas. The Hanakāpiʻai, Hanakoa, a portion of North Bog, Pihea, Pōhākea, and Honopū conservation sites would occur within state parks, the NAR, and preserves. The implementation of management actions at conservation sites, such as fence maintenance and invasive plant species management, could result in the temporary disruption of recreational activities such as birdwatching and gathering practices in these areas. The proposed action would not affect plum picking or fishing on public land. There are no herbarium records for *P. salicina* within any areas identified for implementation of conservation measures under the proposed action and streams with trout fishing opportunities are within Waimea Canyon and outside of the conservation site boundaries.

The management and maintenance of the conservation sites could result in some temporary adverse effects due to helicopter noise on the recreational setting across the island and more specifically at the conservation sites when fences are being constructed or replaced and during regular transport of crews to conservation sites to implement the conservation strategy. However, these conservation sites are primarily in remote locations away from high recreational activity and only accessible by helicopter or trail hiking on rugged terrain. The conservation sites would also have long-term beneficial impacts on existing recreation facilities and activities across the island associated with the enjoyment of natural resources. The construction of new predator exclusion fences within the Upper Limahuli Preserve and Upper Mānoa Valley may be visible from helicopter tours but would not substantially detract from the scenic quality of the landscape.

The implementation of the honu (green sea turtle) nest detection and shielding program described under Conservation Measure 5 could result in temporary adverse effects on beachgoers and other beach-related recreational activities such as surfing, diving, and fishing. Nest shielding would be installed on the full length of seven beaches when active honu (green sea turtle) nests are detected. Light-proof fencing would be erected around the nest after approximately 45 days of incubation and would be removed after the honu (green sea turtle) hatchlings have emerged and entered the ocean (refer to Draft HCP Section 4.4.5.2 and Figures 4-12 a–g for additional information on beaches selected for nest shielding, including locations). Impacts of nest shielding on recreation would be short term and localized and would not restrict public access to beaches.

Alternative B is expected to result in short-term impacts on recreation as conservation management activities are implemented; however, it would also result in long-term beneficial impacts associated with the enjoyment of natural resources by protecting wildlife and natural areas.

3.13.3.3 Alternative C Additional Minimization

Alternative C would result in enhanced benefits to recreational activities like birdwatching and photography across the island. The additional minimization measures, such as increased use of bird flight diverters and the reduction of wire heights, would further reduce risks to seabirds and waterbirds as a result of population increases with more opportunities for recreational bird watchers. Additionally, the 15-percent reduction in light emission using dimmers would better protect seabird populations from light attraction, improving the overall environment for nature-based recreation. Potential effects on public hunting opportunities would be the same as described under Alternative B. Alternative C provides greater long-term benefits by further protecting natural resources found on Kauaʻi, resulting in greater beneficial effects on nature-based recreational experiences in the island's scenic and biodiverse areas compared to Alternative A or Alternative B.

3.13.3.4 Alternative D Additional Mitigation

Under Alternative D, the impacts on recreation would be similar to those under Alternative B, but with increased short-term disruptions due to the implementation of additional mitigation measures, including expanded predator and ungulate control fencing. The expanded predator control and habitat management efforts would occur away from developed recreational facilities. However, in some areas expanded predator control or habitat management would overlap with state parks, the NAR, and preserves. These regions are known for nature trails, hiking, and ecotourism, drawing visitors for activities such as birdwatching and photography. In these areas, visitors might experience minor short-term disturbances during the installation of fencing or the implementation of other management actions at conservation sites. In the long term, the increased areas enclosed by ungulate or predator exclusion fencing within the Hono O Nā Pali NAR would result in increased effects on recreational uses such as birdwatching, public hunting, and hiking when compared to Alternatives A and C. Expanded predator control, increased ungulate and predator exclusion fencing, and the construction of additional helicopter landing zones and weatherports would also result in a greater effects on public hunting opportunities and recreational uses when compared to Alternatives B and C.

In the long term, Alternative D would provide enhanced benefits for nature-based recreation in the areas where additional mitigation is occurring, as well as other parts of the island that may benefit from the increased protections of Covered Species. The expanded efforts to protect seabirds and waterbirds, along with enhanced habitat management in wetlands like the Mānā Plain, would create a more vibrant and diverse ecosystem, conserving more wildlife and improving the visitor experience in these areas. By increasing funding and resources for sea turtle conservation and predator control, Alternative D would contribute to the long-term preservation of the island's natural beauty, ensuring that both residents and tourists can continue to enjoy these unique recreational opportunities in a more ecologically sustainable environment. However, the increased acreage of areas enclosed by ungulate and predator fencing under Alternative D would result in long-term impacts on recreational uses within the state parks, NAR, and preserves.

3.13.3.5 Comparison of Alternatives

For all alternatives, powerline collision minimization, retrofitting streetlights to reduce light attraction, and establishing conservation sites to increase seabird productivity would have beneficial impacts on the quality and sustainability of wildlife-based recreational activities like birdwatching and photography across the island. The additional minimization proposed under Alternative C and the additional mitigation proposed under Alternative D would result in greater long-term benefits compared to Alternative B by further protecting the island's natural resources. Under all alternatives, short-term disruptions as a result of maintaining conservation sites and implementing mitigation measures are expected. The adverse impacts are expected to be the most under Alternative D due to the expanded predator and ungulate control fencing that may overlap with recreational uses within state parks, the NAR, and preserves. These impacts are expected to be less under Alternative B and Alternative C compared to Alternative D because there are fewer mitigation measures to implement and activities are primarily in remote locations away from high recreational activity; however, beneficial impacts would be reduced as well.

3.14 Scenic Resources

This section describes the existing conditions of scenic resources and analyzes the direct and indirect effects of the proposed action and alternatives on scenic resources.

3.14.1 Methods

This analysis evaluates the direct and indirect effects of infrastructure changes and conservation measures on scenic resources. Impacts are assessed in terms of intensity, duration, and geographic extent, focusing on visual changes to key landscapes from powerlines, streetlights, and conservation actions. The study uses site-specific maps and known scenic areas to qualitatively determine the effect of potential alterations to scenic resources.

3.14.2 Affected Environment

Kauaʻi, often called the "Garden Isle," is renowned for its scenic natural resources (Go Hawaiʻi 2023). One of its standout features is the Nā Pali Coast, characterized by towering cliffs and waterfalls accessible via hiking, boat tours, or helicopters. Another notable attraction is Waimea Canyon, often referred to as the "Grand Canyon of the Pacific," offering expansive views of deep gorges and diverse vegetation (Hawaiʻi State Parks n.d.). Hanalei Bay, a popular tourist destination, forms a crescent shape surrounded by mountains. Kauaʻi spans approximately 550 square mi (1,424 square km), with a high central plateau, including the peaks of Mt. Waiʻaleʻale and Mt. Kawaikini. This plateau features steep cliffs, incised valleys along the northern Nā Pali Coast, the 3,600-foot-deep (1,097-km-deep) Waimea Canyon, the broad Līhuʻe Basin in the southeastern quadrant, and extensive coastal plains (ICF 2025). Additionally, Spouting Horn and Kalalau Valley contribute to scenic natural resources on Kauaʻi.

The Kauaʻi County General Plan notes that the island's scenic resources attract visitors from across the world, particularly due to its preserved rural landscapes, beaches, and cultural diversity (County of Kauaʻi 2018). The substantial economic value of these resources is of note in the general plan and their protection and preservation is emphasized.

The facilities that make up KIUC's system, such as the largely above-ground electrical transmission and distribution system, are ubiquitous and are part of many scenic views and other visual resources (USFWS 2011) across the Island. Overall, KIUC infrastructure is most concentrated in the populated coastal regions, especially in the southeastern, southern, and eastern parts of Kauaʻi, with less coverage in the central mountainous and less populated regions of the island. These visual components include existing streetlights and powerlines supported by poles or towers that extend from 25 feet (7.6 m) to more than 100 feet (30.5 m) above ground (ICF 2025).

3.14.3 Environmental Consequences

3.14.3.1 Alternative A No Action

Under Alternative A, KIUC would continue to operate existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. This includes the expansion of KIUC-owned infrastructure in accordance with current plans and trends on Kauaʻi. The addition of new or extended powerlines to meet future demand could add power infrastructure in locations where it is not currently present or add wires to existing powerline circuits to increase capacity. KIUC would not implement a comprehensive program to mitigate impacts on Covered Species. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. The visual impact of new powerlines would vary depending on the setting where new powerlines are sited and could range from being visually screened to being visually prominent.

3.14.3.2 Alternative B Proposed Action

As discussed in Section 3.14.2, the renowned natural beauty on Kauaʻi is central to the island's identity and tourism economy. Under Alternative B, the Service and DLNR would authorize incidental take of Covered Species from Covered Activities in the Permit Area including implementation of the conservation strategy over a 50-year permit term. Covered Activities include (1) powerline operations, including modifications, (2) lighting operations and use of night lighting for repairs, and (3) implementation of the Draft HCP conservation strategy. The Covered Activities would have both beneficial and adverse impacts on the scenic environment as detailed below.

- **Reconfiguration of Powerlines**: As described in Section 2.2.2.5, KIUC's island-wide powerline collision minimization plan will have already been completed prior to the start of the permit term, and the same or similar minimization techniques will be applied to all newly constructed power lines throughout the duration of the 50-year permit term. New powerlines would be built to avoid long powerline spans across valleys and follow standards that include avoiding installation of static wire, minimizing powerline height, and minimizing vertical wire levels to the maximum extent practicable. These measures may also make new powerlines minimally intrusive to scenic resources, which would all result in beneficial impacts on scenic resources compared to Alternative A. The use of the bird flight diverters could be considered a minor adverse impact on scenic views due to the use of reflective or LED diverters that make powerlines more visible to birds as well as humans. However, LED diverters are not installed along roadways and in visual sight of neighborhoods; therefore, the visual impacts from this type of diverter would be lower. Overall, reconfiguration efforts would likely reduce visual clutter and have long-term beneficial impacts on the scenic environment by making powerlines less intrusive.
- **Measures to Minimize Light Attraction:** As described in Section 2.2.2.5, all existing KIUC streetlights have been retrofitted and converted to reduce light attraction of covered birds, and the same light minimization techniques will be applied to all new streetlights installed throughout the duration of the 50-year permit term. These measures to minimize light pollution have positive scenic impacts by reducing light pollution and preserving night sky visibility especially in rural and less developed areas.
- **Seabird Conservation Funding**: The SOS program is already underway, and under the proposed action KIUC would provide consistent funding for it. The program would have indirect beneficial impacts on scenic areas by supporting additional seabird rescue and rehabilitation and maintaining biodiversity in scenic regions such as the Nā Pali Coast, Waimea Canyon, and Hanalei Bay, preserving the natural beauty that attracts visitors to these areas.

- **Expanded Seabird Habitat Management**: Under the proposed action, KIUC would continue to manage existing conservation sites, construct two new predator exclusion fences, and replace all four predator exclusion fences at all sites up to two times during the 50-year permit term. The construction of new fences and replacement of existing fences could have short-term temporary impacts on scenic resources in the direct vicinity of the conservation sites. Viewer elevation and distance contribute to the potential impacts on scenic resources. Fence lines could be visible from farther away if the viewer is observing from a high-elevation lookout point, although vegetation screening would likely minimize impacts. Predator exclusion fences that may be visible from recreation areas would result in negligible to minor adverse impacts on scenic resources. The broader ecological improvements resulting from the conservation sites would result in long-term beneficial impacts that enhance the scenic value of the island's rural habitats and enhance the natural aesthetic and biodiversity of these regions.
- **Sea Turtle Conservation**: Under the proposed action, the implementation of a sea turtle nest detection and shielding program and implementation of practicable streetlight minimization techniques for green sea turtles would help protect the scenic coastal landscapes. The measures would reduce light pollution near key coastal regions, resulting in a beneficial impact on scenic values by minimizing light pollution and preserving night sky visibility. Nest shielding measures would have visual impacts on beachgoers; however, these are expected to be short term and localized to a small proportion of the total beach area. These measures would also result in long-term beneficial impacts on sea turtles, enhancing wildlife-based scenic resources.

3.14.3.3 Alternative C Additional Minimization

Under Alternative C, the impacts on scenic resources would be similar to those under Alternative B, but with increased visual disruptions due to the implementation of additional minimization measures such as additional reflective or LED flight diverters on high-risk powerline spans. However, LED diverters are not installed along roadways and in visual sight of neighborhoods; therefore, the visual impacts from this type of diverter would be negligible. In the long term, Alternative C would result in enhanced benefits to scenic resources that are enhanced by wildlife. Under Alternative C, the 15-percent reduction in light emissions using dimmers would result in greater reductions in light pollution, providing greater beneficial impacts on scenic resources in dark-sky and remote scenic areas. While there would be greater impacts on scenic resources from the implementation of additional minimization projects, Alternative C provides greater long-term benefits to scenic resources by further protecting natural resources across the island.

3.14.3.4 Alternative D Additional Mitigation

Under Alternative D, the impacts on scenic resources would be similar to those under Alternative B, but with increased visual disruptions due to the implementation of additional mitigation measures, including expanded predator and ungulate control fencing and construction of additional weatherports and helicopter landing zones. Scenic resources would experience minor short-term visual disturbances during construction of fencing or active management. In the long term, the visual changes from predator control, fencing, weatherports, and helicopter landing zones would have negligible impacts on scenic resources, though they may be visible from some more remote recreation areas (see Section 3.13, *Recreation*).

The additional mitigation associated with Alternative D would provide enhanced beneficial impacts on scenic resources in areas where additional mitigation is occurring, as well as other parts of the island that may benefit from the increased protections of Covered Species. The expanded efforts to protect seabirds and waterbirds, along with enhanced habitat management in wetlands like the Mānā Plain, would create a more vibrant and diverse ecosystem, conserving more wildlife and improving the scenic resources in these areas. By increasing funding and resources for sea turtle conservation and predator control, Alternative D would contribute to the long-term preservation of scenic resources on Kauaʻi. While short-term adverse impacts from the implementation of additional mitigation (e.g., fencing) may occur to scenic resources in remote areas, Alternative D would result in greater long-term beneficial impacts on scenic resources.

3.14.3.5 Comparison of Alternatives

Under Alternative A, there would be no new visual impacts beyond the existing infrastructure already present in scenic areas on Kauaʻi. Impacts under Alternative C and Alternative D would be similar to those described for Alternative B; however, additional short-term disruptions and long-term benefits would be expected from implementing additional mitigation measures. Implementing mitigation measures under Alternative C to further reduce light emissions would result in greater reductions in light pollution, providing greater beneficial impacts on scenic resources in dark-sky and remote scenic areas. The additional mitigation associated with Alternative D would provide island-wide benefits from the increased protection of Covered Species, seabirds, waterbirds, and sea turtles.

3.15 Land Use

This section describes the existing conditions of land use and analyzes the direct and indirect effects of the proposed action and alternatives on land use.

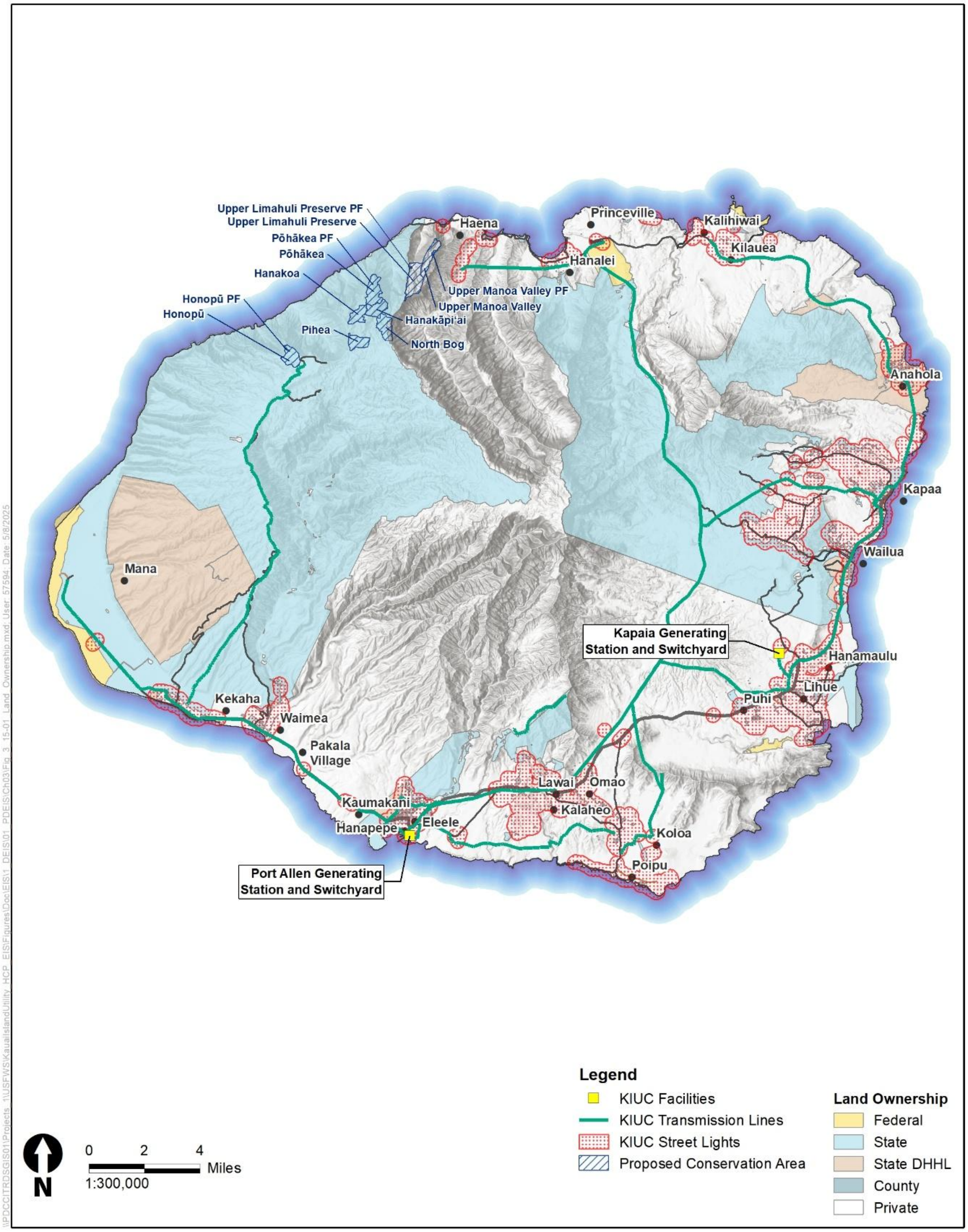
3.15.1 Methods

Land use data from the State of Hawai‘i were overlain with KIUC’s existing infrastructure and the conservation sites identified in the Draft HCP. Data from the State of Hawai‘i were also used to characterize state and county land use designations, conservations districts, and parks preserves, and natural reserves. To assess compatibility of the conservation strategy with existing and planned land uses, state regulations, the Kaua‘i County Code and Zoning Ordinance, and permitted uses were reviewed along with available management plans and relevant state regulations for the management of state parks, preserves, and NARs.

3.15.2 Affected Environment

On Kaua‘i, 55.0 percent of lands are privately owned, 43.8 percent are in state ownership, 0.9 percent are owned by the federal government, and 0.3 percent are owned by the County of Kaua‘i (Figure 3.15-1). The built environment consists of small, mostly rural communities along the coast margins and plains separated by expanses of open space and agricultural lands. Steep topography across much of Kaua‘i severely limits development in the interior of the island (ICF 2025). There are no incorporated cities on Kaua‘i.

Except for the Upper Limahuli Preserve and Upper Mānoa Valley conservation sites, all of the conservation sites identified in the Draft HCP are on parcels owned by the State of Hawai‘i (Figure 3.15-1). The Upper Limahuli Preserve and Upper Limahuli Preserve PF conservation sites are owned by the National Tropical Botanical Garden. The Upper Mānoa Valley and Upper Mānoa Valley PF conservation sites are in private ownership. All the conservation sites fall within the State Land Use Conservation District, which is designated conservation lands administrated by the State Board of Land and Natural Resources (Figure 3.15-2). Table 3.15-1 lists the parcel tax map key identification numbers, ownership, State Land Use District and subzone, and County of Kaua‘i zoning district for each conservation site.



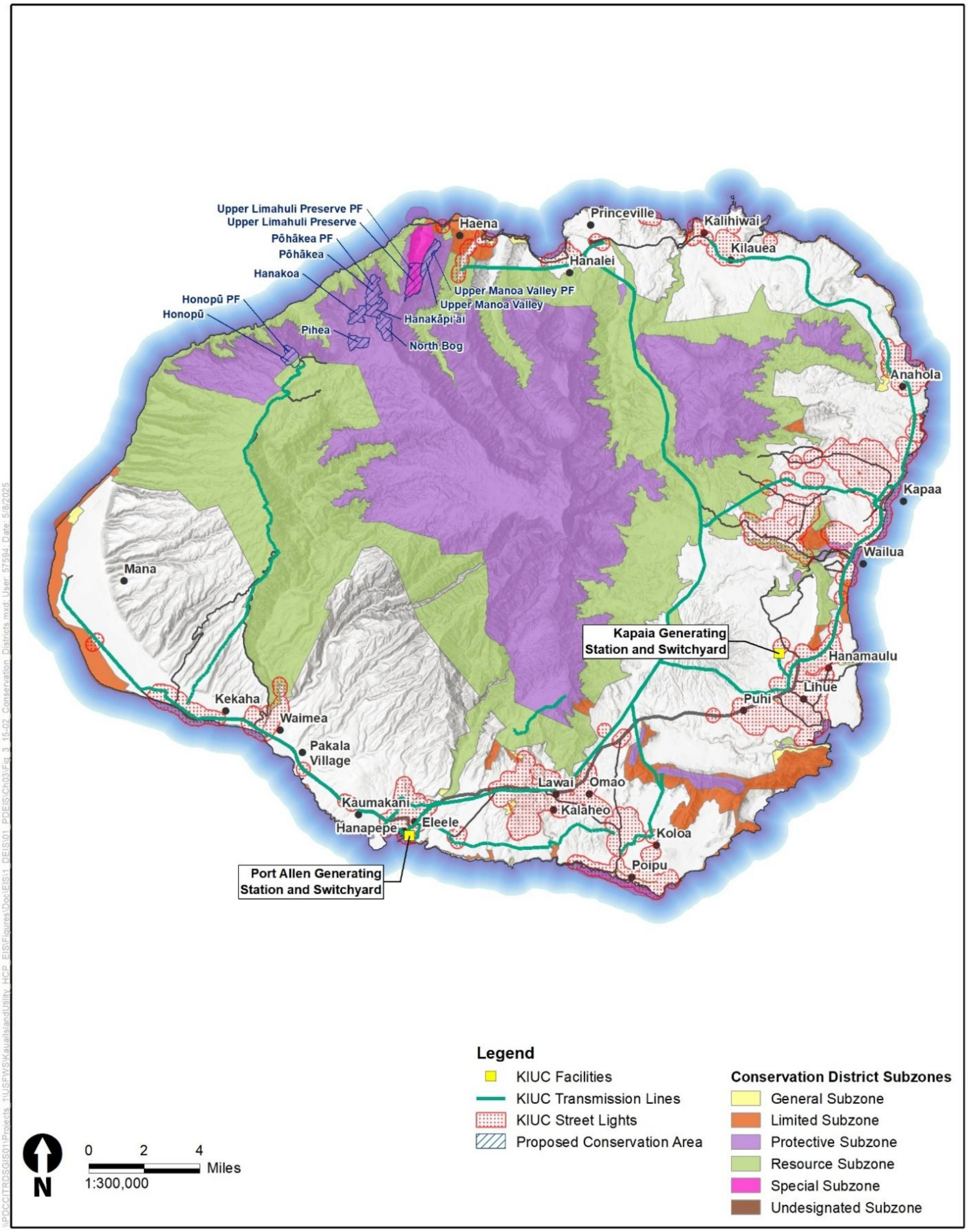
Sources: ICF 2025; Hawai'i State GIS Program 2023

Figure 3.15-1. Land Ownership on Kaua'i

Table 3.15-1. Conservation Site Ownership and State and County Land Use Designations

Conservation Site	Parcel TMK Identification Number	Landowner	State Land Use District	Conservation District Subzone	County of Kaua'i Zoning District
Upper Limahuli Preserve	590010030000, 580020020000, 590010010000, 590010210000,	Private nonprofit[1]	Conservation	Protective (P) and Special (S)	Conservation
Upper Limahuli Preserve PF	590010030000	Private nonprofit[1]	Conservation	Protective (P) and Special (S)	Conservation
North Bog	140010030000, 590010010000, 580010010000	State of Hawai'i and Private	Conservation	Protective (P)	Conservation
Pōhākea	590010010000	State of Hawai'i	Conservation	Protective (P)	Conservation
Pōhākea PF	590010010000	State of Hawai'i	Conservation	Protective (P)	Conservation
Honopū	590010010000, 590010160000	State of Hawai'i	Conservation	Protective (P) and Resource (R)	Conservation
Honopū PF	590010010000	State of Hawai'i	Conservation	Protective (P)	Conservation
Pihea	140010030000, 590010010000	State of Hawai'i	Conservation	Protective (P)	Conservation
Hanakoa	590010010000	State of Hawai'i	Conservation	Protective (P)	Conservation
Hanakāpi'ai	590010010000	State of Hawai'i	Conservation	Protective (P)	Conservation
Upper Mānoa Valley	590010210000	Private	Conservation	Protective (P)	Conservation
Upper Mānoa Valley PF	590010210000	Private	Conservation	Protective (P)	Conservation

Sources: Hawai'i State GIS Program 2023; County of Kaua'i 2023
PF = predator exclusion fence; TMK = tax map key



Sources: ICF 2025; Hawai'i State GIS Program 2023

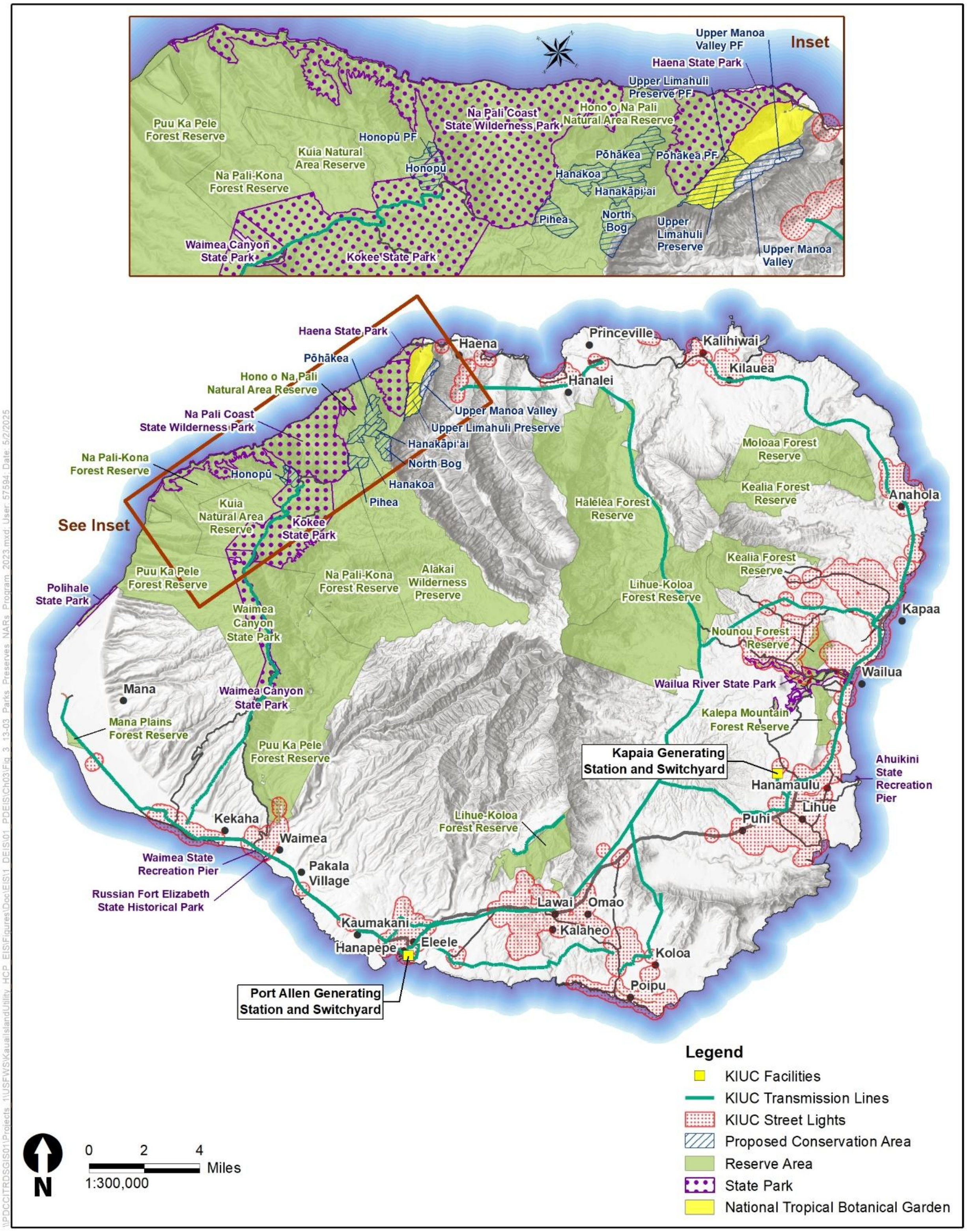
Figure 3.15-2. Conservation Districts

Uses within the State Land Use Conservation District are governed by rules promulgated by DLNR. DLNR's Administrative Rules at HAR § 13-5-10 set forth guidelines for classifying conservation lands into subzones. All of the conservation sites are within the Protective (P) subzone; portions of the Upper Limahuli Preserve, the Upper Limahuli Preserve PF, and the Honopū conservation sites are also within the Special (S) and Resource (R) subzones, respectively (Hawaiʻi State GIS Program 2023). The Protective (P) subzone encompasses "restricted watersheds; marine, plant, wildlife sanctuaries, significant historic, archaeological, geological, volcanological features and sites; and other designated unique areas" (HAR § 13-5-11). The Resource (R) subzone includes land valued for one or another type of resource, including parklands, areas deemed suitable for logging, recreational sites, and submerged lands not in any other subzone (HAR §13-5-13). The objective of the Special (S) subzone is to provide for areas possessing unique developmental qualities that complement the natural resources of the area (HAR §13-5-15).

Within the Protective (P) subzone the following uses or activities are allowed as permitted uses: research, recreational, and educational uses that do not require a physical facility; marine, plant, and wildlife sanctuaries and the establishment of wilderness and scenic areas; restoration of archaeological sites; removal of noxious plants; fishing and hunting; monitoring of natural resources; "occasional use" (defined as infrequent use not to exceed 7 days and causing no permanent change in the area where it occurs); and use by government agencies "where public benefit outweighs any impact on the conservation district" (HAR §13-5-23; Environment Hawaiʻi 1990). In the Resource (R) subzone, permitted activities include everything allowed in the Protective (P) subzones as well as emergency warning or telephone systems, flood erosion, or siltation control projects; the growing and harvesting or forest products (including logging)[9]; aquaculture; artificial reefs; and commercial fishing (HAR §13-5-24).

Six of the conservation sites are within state parks or Hono O Nā Pali NAR. Specifically, the Pihea, a portion of North Bog, Pōhākea, Pōhākea PF, Hanakoa, and Hanakāpiʻai sites are in the Hono O Nā Pali NAR, managed by DLNR; the Honopū site is part of the Kōkeʻe State Park, Nā Pali-Kona Forest Reserve, and Nā Pali Coast State Wilderness Park; and the Honopū PF site is within the Nā Pali-Kona Forest Reserve (Figure 3.15-3). The Kōkeʻe State Park and Nā Pali Coast State Wilderness Park are managed by the Division of State Parks and the Nā Pali-Kona Forest Reserve is managed by the DLNR Forest Management Section. The Upper Limahuli Preserve and Upper Limahuli Preserve PF sites are within the Limahuli Garden and Preserve, which is owned and managed by the National Tropical Botanical Garden, a not-for-profit institution dedicated to discovering, saving, and studying the world's tropical plants. The Upper Mānoa Valley and Upper Mānoa Valley PF sites are remote, undeveloped sites that are owned by a private landowner who has a long-standing interest in facilitating the implementation of conservation actions within his property in Upper Mānoa Valley. He has established the Upper Mānoa Valley Working Group, which consists of persons and organizations with specialized expertise and/or interest in conservation actions within Upper Mānoa Valley. Management goals, programs, and land use permitting requirements for these state parks, NARs, and preserves are summarized below. An analysis of the conservation measures under the Draft HCP and their consistency with the management of these areas is provided in Section 3.15.3, *Environmental Consequences*.

[9] The uses that are permitted under the Limited subzone are also allowed in the Resource (R) subzone.



Sources: ICF 2025; Hawai'i State GIS Program 2023

Figure 3.15-3. State Parks, Preserves, and Natural Area Reserves

3.15.2.1 Hono O Nā Pali NAR

The statewide NARs System was "established to preserve in perpetuity specific land and water areas which support communities, as relatively unmodified as possible, of the natural flora and fauna, as well as geological sites, of Hawaiʻi" (DOFAW 2023). Access, collection, research, and other regulated activities within NARs require a permit from DLNR. The 2011 Hono O Nā Pali Natural Area Reserve Management Plan (DOFAW 2011) describes the management program for the Hono O Nā Pali NAR. The reserve was established to protect perennial streams, riparian and ridgeline lowland and montane forests, rare plants, endemic stream fauna, and forest bird habitat. The primary threats to biodiversity and watershed integrity at the Hono O Nā Pali NAR are feral ungulates (wild, hoofed animals), especially feral pigs and feral goats; small, predatory mammals (feral cats and rats); and nonnative, invasive weeds. The overall management goal is to protect, maintain, and enhance the reserve's unique natural, cultural, and geological resources. Management programs have been developed to support this overall goal and include the following: (1) Infrastructure and Facilities; (2) Ungulate Management; (3) Weed Management; (4) Habitat Protection and Rare Species Restoration; (5) Monitoring; (6) Outreach and Education; (7) Fire Prevention and Response; (8) Enforcement; and (9) Partnership Collaboration (DOFAW 2011).

3.15.2.2 Kōkeʻe State Park

The Kōkeʻe and Waimea Canyon State Parks Master Plan (DLNR 2014) guides the management and development of the two adjoining Kōkeʻe and Waimea Canyon State Parks. The parks were officially established in 1952 in recognition of the unique environmental resources, abundant recreational opportunities, and rich natural heritage existing in the uplands of wester Kauaʻi. The parks occupy 6,182 acres (2,502 hectares), with Kōkeʻe State Park (where a portion of the Honopū site is located) encompassing 4,345 acres (1,758 hectares). The Kōkeʻe State Park is administered by the Division of State Parks in accordance with the goals, objectives, and guidance set forth in the Kōkeʻe and Waimea Canyon State Parks Master Plan.

3.15.2.3 Nā Pali-Kona Forest Reserve

The Nā Pali-Kona Forest Reserve Management Plan (DOFAW 2009) describes resource management planning and implementation strategies for the Nā Pali-Kona Forest Reserve and serves as a basis for future updates to accommodate evolving or additional objectives for the area, such as increased hunting opportunities and additional fencing projects. The Nā Pali-Kona Forest Reserve (where the entirety of the Honopū PF site and a portion of the Honopū site is located) was established by Governor's Proclamation in 1907 for the purpose of protecting the water supply to adjacent agricultural lands. The reserve is currently comprised of two non-contiguous areas of land totaling over 23,000 acres (9,307 hectares) of public land. The Nā Pali-Kona Forest Reserve is managed by DLNR with a principal management objective of maintaining highest quality native ecosystems habitat for threatened, endangered, and rare plants and animals and the associated watershed (DOFAW 2009).

3.15.2.4 Nā Pali Coast State Wilderness Park

The Nā Pali Coast Management Plan and Revised EIS (DLNR 1982) sets forth the overall park management and objectives for the 4,880-acre (1,975-hectare) Nā Pali Coast State Wilderness Park. DLNR manages the Nā Pali Coast State Wilderness Park in accordance with HAR §13-6-146 (Rules of the Hawaiʻi State Park System), which describes permitted and prohibited uses, permits, and commercial and private operations within state parks. Special use permits and access agreements are required for certain activities within state parks in accordance with HAR §13-6-146.

3.15.2.5 Limahuli Garden and Preserve and National Tropical Botanical Garden

The Master Plan for Upper Limahuli Preserve serves as the Management Plan for the Limahuli Garden and Preserve as required under HAR 13-5 and outlines the following conservation management activities: (1) feral ungulate fencing, (2) feral ungulate control, (3) rodent control, (4) feral cat control, (5) alien plant species control, (6) native plant restoration, and (7) native seabird monitoring. The plan also identifies the following essential infrastructure necessary to actively manage this remote area: (1) small tool storage/weather shelters to accommodate equipment and staff who have to camp in this often-wet area, (2) several (five to eight) remote helicopter landing zones, and (3) three to five computerized weather stations (NTBG 2008). The preserve is on private property and is not open for general public use. Access to the preserve by National Tropical Botanical Garden staff is always via helicopter; however, with climbing equipment, it is possible to approach Upper Limahuli from several directions. The Upper Limahuli area, including the Limahuli Garden and Preserve, is one of the least accessible areas of Kauaʻi due to the surrounding topography, and hunting is not known to occur in the area (NTBG 2008).

3.15.2.6 Kauaʻi County Code and Zoning Ordinance

Chapter 8 of the Kauaʻi County Code (as amended) sets forth the Comprehensive Zoning Ordinance for the County of Kauaʻi (County of Kauaʻi 2012). The purpose of the Comprehensive Zoning Ordinance is to provide the regulations and standards for land development and the construction of structures in the county. The zoning ordinance establishes land districts and delineates the respective types of permitted uses and development that can take place within those districts. The regulations and standards prescribed by the zoning ordinance are "intended to promote development that is compatible with the island's scenic beauty and environment and to preclude inadequate, harmful, or disruptive conditions that may prove detrimental to the social and economic wellbeing of the residents of Kauaʻi" (County of Kauaʻi 2012). KIUC facilities, existing transmission lines, and streetlights span all zoning districts governed by the ordinance.

3.15.3 Environmental Consequences

3.15.3.1 Alternative A No Action

Under Alternative A, KIUC would continue to operate existing (with modifications) and future infrastructure that is under its ownership or direct control including powerlines, support structures, and lights, in accordance with historical practices. KIUC would not implement a comprehensive program to mitigate impacts on Covered Species. Under Alternative A, flight diverters installed for powerline collision minimization and conservation measures involving construction of physical features (such as predator control fencing) that were completed by KIUC during development of the Draft HCP would not be maintained but would remain in place and be operational for their useful life. KIUC would continue to operate its existing and new infrastructure without a comprehensive mitigation program. There would be no new impacts on land uses. All conservation sites except for Upper Mānoa Valley PF would be established prior to issuance of the federal ITP and state ITL.

Under Alternative A, there would be no obligation to maintain the conservation sites in the absence of the federal ITP and state ITL.

3.15.3.2 Alternative B Proposed Action

Under Alternative B, the Service and DLNR would authorize incidental take of Covered Species from Covered Activities in the Permit Area including implementation of the conservation strategy over a 50-year permit term. Covered Activities include (1) powerline operations, including modifications, (2) lighting operations and use of night lighting for repairs, and (3) implementation of the Draft HCP conservation strategy.

Implementation of the Covered Activities and conservation strategy under Alternative B would not temporarily or permanently change existing land ownership, land designations, or land uses. As described in Section 3.15.2 and Table 3.15-1, all of the conservation sites under Alternative B are within the State Land Use Conservation District. Most selected conservation sites are within the Protective (P) subzone; portions of the Upper Limahuli Preserve, Upper Limahuli Preserve PF, and Honopū conservation sites are within the Special (S) and Resource (R) subzones, respectively. Therefore, implementation of mitigation measures within the conservation sites proposed under Alternative B would require a state Conservation District Use Permit from the Hawaiʻi Board of Land and Natural Resources for the use of Conservation District land.

The purpose of the Conservation District is to conserve, protect, and preserve the important natural and cultural resources of the state through appropriate management and use to promote their long-term sustainability and the public health, safety, and welfare (HAR §13-5-1). The conservation strategy under Alternative B would include biological goals and objectives and desired future conditions for each Covered Species. The implementation of conservation measures under Alternative B is anticipated to benefit Covered Species and their habitats through invasive plant species management, predator exclusion, predator control, and social attraction. Therefore, the conservation strategy under Alternative B would be consistent with the purpose of the Conservation District and the objective of the Protective (P) subzone, which is to "protect valuable natural and cultural resources in designated areas such as restricted watersheds, marine, plant and wildlife sanctuaries, significant historic, archaeological, geological, and volcanological features and sites, and other designated unique areas" (HAR § 13-5-11). Predator control, predator exclusion fencing, social attraction, and invasive plant species management within the Upper Limahuli Preserve PF conservation site under Alternative B would result in beneficial effects on land use by supporting the objective of the Special (S) subzone (Limahuli Valley Special Subzone) and benefiting the natural resources of the area in the long term. Additionally, the conservation strategy under Alternative B would result in beneficial effects on land use by satisfying the following identified land uses in the Protective (P) and Resource (R) subzones under HAR § 13-5-22 and HAR § 13-5-24: *P-4, Removal of Invasive Species* and *D-1, Public Purpose Uses*.

The conservation strategy under Alternative B would be consistent with, and complement, management guidance for the Hono O Nā Pali NAR, Nā Pali Coast State Wilderness Park, Kōkeʻe State Park, the Nā Pali-Kona Forest Reserve, the Limahuli Garden and Preserve, and the National Tropical Botanical Garden (see Sections 3.15.2.1, 3.15.2.2, 3.15.2.5, 3.15.2.4, and 3.15.2.5). More specifically, proposed management actions at each conservation site under Alternative B such as predator control, predator exclusion fencing, and invasive plant species management directly correspond to the existing management goals and programs for the Kōkeʻe and Waimea Canyon State Parks Master Plan, Nā Pali-Kona Forest Reserve Management Plan, Hono O Nā Pali NAR, and the Master Plan for the Upper Limahuli Preserve (refer to Chapter 5, *Consistency with Land Use and Resource Plans, Policies, and Controls*, for additional information). Therefore, Alternative B would result in long-term beneficial impacts on land use in these areas by supporting existing management programs to protect, maintain, and enhance natural resources.

Under Alternative B, powerline operation, modification, use of night lighting for repairs, and lighting operations (facility lights and streetlights) are anticipated to occur within areas where county and/or state agencies have reviewed and approved plans and deemed that the activities are appropriate and consistent with existing land uses in the area. These activities under Alternative B would be implemented in accordance with the regulations and standards contained in the Comprehensive Zoning Ordinance for land development and the construction of structures in the county. Due to the limited nature of work under Alternative B that is required for KIUC to implement the Covered Activities, any potential adverse effects on land use would be minor.

3.15.3.3 Alternative C Additional Minimization

Alternative C would result in impacts on land use that are similar to those of Alternative B. Additional minimization measures associated with Alternative C would not temporarily or permanently change existing land ownership, land designations, or land uses compared to Alternative B. As a result, Alternative C would be anticipated to result in similar impacts on land use as Alternative B.

3.15.3.4 Alternative D Additional Mitigation

Alternative D would result in similar impacts on land use as Alternative B but could result in greater long-term beneficial impacts on state parks, preserves, and the NAR. Additional mitigation measures associated with Alternative D would result in an increase of acreage enclosed by ungulate fencing by 1,915 acres (775 hectares) and increase the area where predator control would occur by 1,394 acres (564 hectares). Compared to Alternative B, Alternative D would also increase the intensity of management actions such as expanded predator control, habitat management, waterbird population monitoring, and barn owl control. Therefore, Alternative D would contribute to the management goals and programs for the Hono O Nā Pali NAR and Kōkeʻe State Park, resulting in greater beneficial effects than Alternative B. Additionally, the expanded predator control, habitat management, waterbird population monitoring, and barn owl control within the Mānā Plain wetlands under Alternative D would be consistent with DLNR management goals for the area and result in greater beneficial effects on 50 acres (20 hectares) of state-managed lands when compared to Alternative B.

3.15.3.5 Comparison of Alternatives

Under all alternatives, implementation of the Covered Activities and conservation strategy would not temporarily or permanently change existing land ownership, land designations, or land uses and would be consistent with the purpose of the Conservation District and the objective of the Protective (P) subzone. Additionally, all alternatives would result in beneficial effects on land use by supporting the objective of the Special (S) subzone (Limahuli Valley Special Subzone) and satisfy identified land uses in the Protective (P) and Resource (R) subzones, specifically *P-4, Removal of Invasive Species*, and *D-1, Public Purpose Uses*. The conservation strategy under all alternatives would also be consistent with, complement, and result in long-term beneficial impacts on land use in state parks, preserves, and the NAR by supporting existing management programs. Impacts on land uses would be the same across the alternatives except Alternative D could result in greater long-term beneficial impacts on state parks, preserves, and the NAR compared to Alternatives B and C by implementing additional mitigation measures that could contribute to the goals of existing management programs to a greater extent.

Chapter 4
Reasonably Foreseeable and Cumulative Effects

4.1 Introduction

This chapter presents the analysis of potential reasonably foreseeable effects of the proposed action and action alternatives on the human environment. In addition, this chapter discusses "cumulative effects" as defined by relevant legal authority.[1] Section 4.2 introduces past, present, and future actions within the study area. Section 4.3 evaluates the effects on the resources in the human environment that result from the proposed action when added to the effects of the actions described in Section 4.2.

4.1.1 Service

Council on Environmental Quality guidance dated February 19, 2025, states that "Federal agencies should analyze the reasonably foreseeable effects of the proposed action consistent with section 102 of NEPA, which does not employ the term 'cumulative effects'; NEPA instead requires consideration of 'reasonably foreseeable' effects, regardless of whether or not those effects might be characterized as 'cumulative'" (42 U.S.C. § 4332(2)(C)(i)). Department of Interior regulations at 43 CFR 46.30 define "reasonably foreseeable future actions" as federal and non-federal activities not yet undertaken, but sufficiently likely to occur, that a Responsible Official of ordinary prudence would take such activities into account in reaching a decision. These federal and non-federal activities that must be taken into account in the analysis of cumulative impacts include, but are not limited to, activities for which there are existing decisions, funding, or proposals identified by the Service.

4.1.2 DLNR

Hawaiʻi Administrative Rules (HAR) § 11-200.1-24(l) directs that the draft EIS should disclose the interrelationships and cumulative environmental impacts of the proposed action and other related actions. HAR § 11-200.1-2 defines a cumulative impact as "the impact on the environment that 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 the other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

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[1] Executive Order 14154, *Unleashing American Energy* (January 20, 2025), and a Presidential Memorandum, *Ending Illegal Discrimination and Restoring Merit-Based Opportunity* (January 21, 2025), require the Department of the Interior to strictly adhere to NEPA, 42 U.S.C. §§ 4321 et seq. Furthermore, such Order and Memorandum repeal Executive Orders 12898 (February 11, 1994) and 14096 (April 21, 2023). Because Executive Orders 12898 and 14096 have been repealed, complying with such Orders is a legal impossibility. The Service verifies that it has complied with the requirements of NEPA, including the Department of the Interior's regulations and procedures implementing NEPA at 43 CFR Part 46 and Part 516 of the Departmental Manual, consistent with the President's January 2025 Order and Memorandum. The Service has also voluntarily considered the Council on Environmental Quality's rescinded regulations implementing NEPA, previously found at 40 CFR Parts 1500–1508, as guidance to the extent appropriate and consistent with the requirements of NEPA and Executive Order 14154.

4.2 Past, Present, and Reasonably Foreseeable Future Actions

The analysis in this chapter considers those past, present, and reasonably foreseeable future actions and trends, the effects of which, when added to the incremental impact of the proposed action and alternatives, inform the assessment of foreseeable effects on the human environment in the study area. The study area for this analysis varies by resource as reflected in Chapter 3, *Affected Environment and Environmental Consequences*, unless otherwise noted.

The past, present, and reasonably foreseeable future actions considered in the cumulative effects analysis are described in Sections 4.2.1 through 4.2.4 below and shown on Figure 4-1. They include (1) other HCP/incidental take permits (ITP) on Kauaʻi, (2) federal actions, (3) federal, state, and private land management, (4) other conservation actions, (5) population growth and land development, and (6) actions to control avian influenza. In this EIS, the effects of climate change on environmental resources in the study area are discussed in Section 3.9, *Air Quality and Climate Change*. The potential for incremental effects of the Proposed Action and alternatives to result in cumulative effects on these environmental resources when combined with the effects of climate change is discussed in Section 4.3, *Reasonably Foreseeable and Cumulative Effects*.

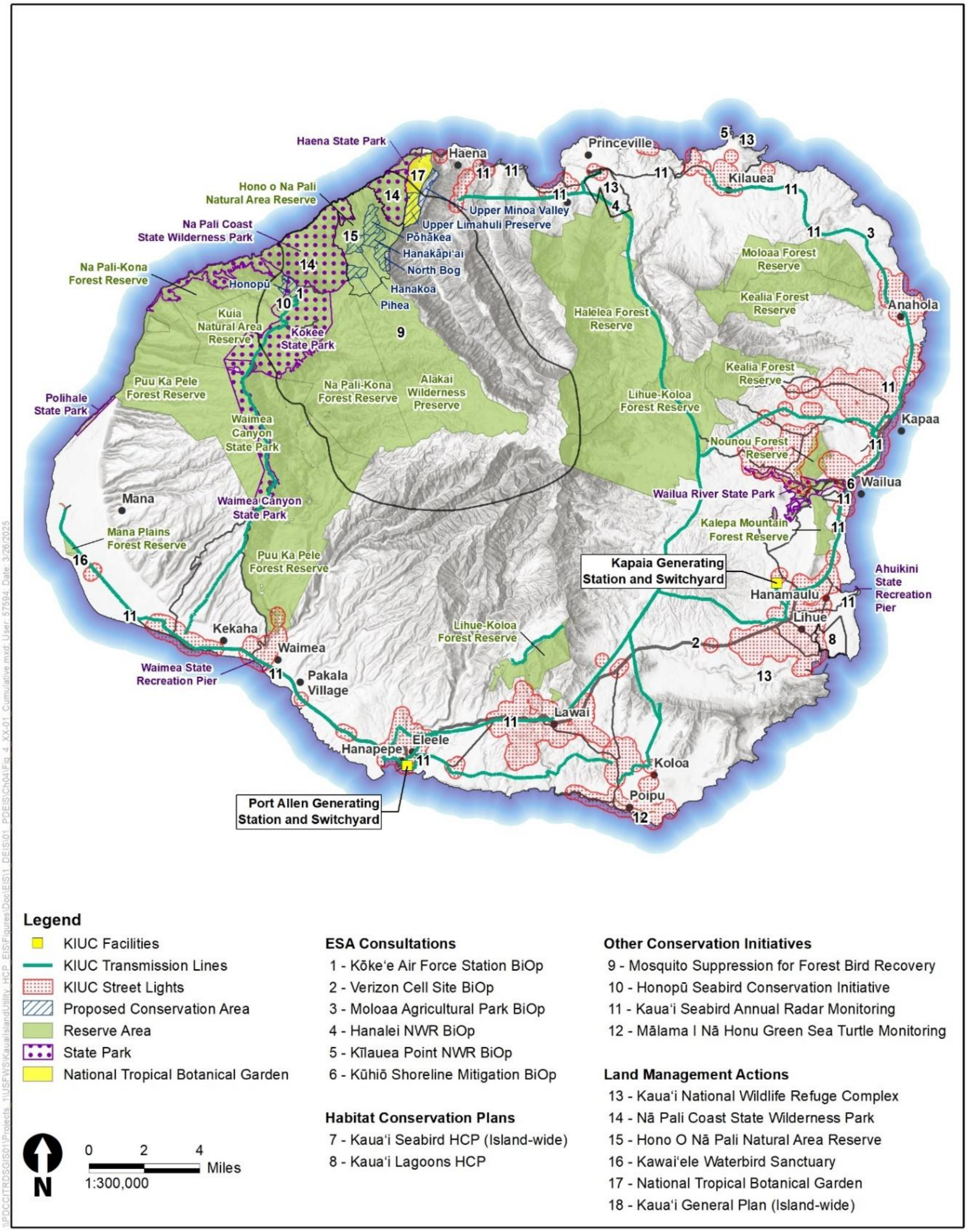
4.2.1 Other Habitat Conservation Plans

4.2.1.1 Kauaʻi Seabird Habitat Conservation Plan

The Service authorized an ITP for incidental take of three seabird species (ʻaʻo [Newell's shearwater, *Puffinus newelli*], ʻuaʻu [Hawaiian petrel, *Pterodroma sandwichensis*], and ʻakēʻakē [band-rumped storm-petrel, *Oceanodroma castro*]) on Kauaʻi associated with operation of artificial nighttime lighting at hotels and resorts, businesses, and government agencies. The structure of the Kauaʻi Seabird HCP enables multiple parties on Kauaʻi to each hold their own federal ITP and state incidental take license (ITL) for light attraction effects on the covered species at their particular facility under the coordinated framework of the Kauaʻi Seabird HCP. This framework takes advantage of economies of scale and enables a pooling of funding resources to collectively implement mitigation activities to achieve the conservation goals of the Kauaʻi Seabird HCP (DLNR and USFWS 2020).

The Kauaʻi Seabird HCP overlaps with the Draft HCP in geographic scope and in addressing the same three species of seabirds and honu (green sea turtle, *Chelonia mydas*). Under the Kauaʻi Seabird HCP, eight entities[2] whose actions have the potential to cause incidental take of the covered species submitted an application for an ITP and an ITL and received incidental take authorization in the form of a Participant Inclusion Plan.

[2] These entities include NCL (Bahamas Ltd.), The Princeville Resort Kauaʻi, Kauaʻi Marriott Resort, Kauaʻi Coffee Company, LLC, Sheraton Kauaʻi Resort (Starwood Resorts), County of Kauaʻi, Hawaiʻi Department of Transportation, and Alexander & Baldwin, Inc. The permit issued to Alexander and Baldwin, Inc. also covers its 11 subsidiaries and affiliates: A & B Properties Hawaii, LLC, Alexander & Baldwin, LLC, McBryde Sugar Company, LLC, McBryde Resources, Inc., Kukuiʻula Village, LLC, Kukuiʻula Development Company (Hawaii), LLC, KDC, LLC, ABP Waipouli, LLC, ABP LR1, LLC, ABP LR2, LLC, and ABP LR3, LLC.



Sources: ICF 2025, Hawai'i State GIS Program 2023

Figure 4-1. Other Past, Present, and Reasonably Foreseeable Actions in the Plan Area

Each Participant Inclusion Plan identifies minimization strategies to be implemented by the individual participant (permittee) at its respective facility. Minimization measures include adjusting lighting at facilities, implementing predator control, conducting seabird awareness training, and recovery, rehabilitation, and release of downed seabirds. The Participant Inclusion Plans also identify the level of funding the participant will provide to support implementation of Kauaʻi Seabird HCP conservation measures to mitigate for the effects of their unavoidable take of the covered species. Conservation measures identified in the Kauaʻi Seabird HCP include implementation of terrestrial predator–proof fencing, predator eradication, and social attraction at the Kahuamaʻa Seabird Preserve (DLNR and USFWS 2020).

The geographic scope (permit area) of the Kauaʻi Seabird HCP is the entire island of Kauaʻi. The Kauaʻi Seabird HCP has been developed to accommodate a maximum annual and 30-year take number for each of the covered seabirds (Table 4-1). The Kauaʻi Seabird HCP was developed to fully offset the take of the covered species that would result from the Covered Activities and result in a net benefit to the covered species.

Table 4-1. Maximum Annual and 30-year Take under the Kauaʻi Seabird HCP

		Maximum Annual Take		Maximum 30-year Take	
Species		**Mortality (lethal)**	**Injury (non-lethal)**	**Mortality (lethal)**	**Injury (non-lethal)**
ʻAʻo (Newell's shearwater)	Fledglings	30	45	900	1,350
	Adults or sub-adults	0.33	0.33	10	10
	Eggs/chicks	<0.1	0	2	0
ʻUaʻu (Hawaiian petrel)	Fledglings, adults, or sub-adults	2	2	60	60
	Eggs/chicks	0.33	0	10	0
ʻAkēʻakē (band-rumped storm-petrel)	Fledglings, adults, or sub-adults	1	1	30	30
	Eggs/chicks	0.1	0	3	0

Source: DLNR and USFWS 2020

4.2.1.2 Kauaʻi Lagoons Habitat Conservation Plan

As described in Section 1.2.2 of the Draft HCP, Kauaʻi Lagoons LLC received approval from the Service and DLNR for the Kauaʻi Lagoons HCP in 2012. This HCP covers short-term construction and long-term resort and golf course operations at the approximately 600-acre (242.8-hectare) Kauaʻi Lagoons Resort[3] in Līhuʻe. The Kauaʻi Lagoons ITP authorizes take from Covered Activities including new facility construction, general property operation and maintenance (including facility lighting), and public access and usage (e.g., driving, biking). The associated federal ITP and state ITL provide take authorization for ʻaʻo (Newell's shearwater), ʻuaʻu (Hawaiian petrel), ʻakēʻakē (band-rumped storm-petrel), aeʻo (Hawaiian stilt, *Himantopus mexicanus knudseni*), ʻalae keʻokeʻo (Hawaiian coot,

[3] In 2015, the name of Kauaʻi Lagoons Resort was changed to Hōkūala Resort. In 2019–2020, the Hōkūala Community Association requested a minor amendment to change the name of the Kauaʻi Lagoons Habitat Conservation Plan to the Hōkūala Habitat Conservation Plan. The minor amendment is pending further consideration by the Service and DLNR.

Fulica alai), ʻalae ʻula (Hawaiian common gallinule, *Gallinula galeata sandvicensis*), koloa maoli (Hawaiian duck, *Anas wyvilliana*), and nēnē (Hawaiian goose, *Branta sandvicensis*) (Table 4-2). The duration of the ITP and ITL is 30 years, and the geographic scope is restricted to the resort property (Kauaʻi Lagoons LLC 2012).

Kauaʻi Lagoons would fully offset take of the covered species and provide a net conservation benefit by implementing the following mitigation measures: onsite management and predator control for Hawaiian geese in the short term; funds for DLNR Division of Forestry and Wildlife (DOFAW) to provide predator control and support for Hawaiian geese translocation sites on other islands; onsite habitat enhancement, predator control, and management for covered Hawaiian waterbirds; and payment into the Kauaʻi Seabird HCP to conduct seabird colony predator control and management (USFWS 2012). The conservation program outlined in the Kauaʻi Lagoons HCP includes endangered species awareness training, implementation of construction and operations best management practices (BMP), use of construction and biological monitors, minimization of light-induced attraction at resort facilities, and management of onsite habitat for covered species (Kauaʻi Lagoons LLC 2012). The Kauaʻi Lagoons HCP and the Draft HCP address incidental take for the same seabird and waterbird species and include light attraction of listed seabirds as a Covered Activity. Although the Permit Areas for the Kauaʻi Lagoons HCP and the Draft HCP overlap, the locations of existing KIUC streetlights are distinct from lighting included in the Kauaʻi Lagoons Permit Area (Kauaʻi Lagoons LLC 2012).

Table 4-2. Maximum Levels of Incidental Take under the Kauaʻi Lagoons HCP (expressed as a per-year average, based on a 5-year running average)

Species	Direct Take (average per year)	Indirect Take (average per year)	Total Take (average per year)	Total Take (30-year period)
Nēnē (Hawaiian goose)	Years 1–4: 1.0 mortality or non-lethal injury Years 5–30: 0.33 mortality or nonlethal injury	Years 1–4: 0.36 mortality Years 5–30: 0.12 mortality	Years 1–4: 1.36 mortality or non-lethal Years 5–30: 0.45 mortality or non-lethal	17 mortality or non-lethal injury
ʻAlae ʻula (Hawaiian common gallinule)	1 mortality 1 non-lethal injury	0.325 mortality 0.0 non-lethal	1.325 mortality 1.0 non-lethal	40 mortality 30 non-lethal
ʻAlae keʻokeʻo (Hawaiian coot)	3 mortality 6 non-lethal injuries	0.675 mortality 0.0 non-lethal	3.675 mortality 6.0 non-lethal	110 mortality 180 non-lethal
Koloa maoli (Hawaiian duck)	1 mortality or non-lethal injury	0.2 mortality or non-lethal	1.20 mortality or non-lethal	36 mortality or non-lethal
Aeʻo (Hawaiian stilt)	1 mortality or non-lethal injury	0.27 mortality or non-lethal	1.27 mortality or non-lethal	38 mortality or non-lethal
ʻAʻo (Newell's shearwater)	1	0.0	1	27
ʻUaʻu (Hawaiian petrel)	<1	0.0	<1	1
ʻAkēʻakē (band-rumped storm-petrel)	<1	0.0	<1	<1

Source: Kauaʻi Lagoons LLC 2012

4.2.1.3 Kauaʻi Island Utility Cooperative Short-term Habitat Conservation Plan

The Service approved an ITP in 2011 for incidental take of ʻaʻo (Newell's shearwater), ʻuaʻu (Hawaiian petrel), and ʻakēʻakē (band-rumped storm-petrel) on Kauaʻi for KIUC's existing activities and specific planned activities and facilities for a 5-year permit term (Table 4-3). The corresponding HCP included a commitment to gather information relevant to long-term management needs for seabirds in order to inform planning beyond the 5-year permit term. The KIUC Short-term HCP overlaps with the Draft HCP in geographic scope and in addressing the same three species of seabirds.

The KIUC Short-term HCP covered incidental take associated with ongoing operation and maintenance activities at existing KIUC facilities including fossil-fuel-fired generating stations at Port Allen and Līhuʻe, the upper and lower Waiahi hydroelectric stations in the Wailua watershed, seven electrical substations and five switchyards located throughout the island, 171.3 miles (mi) (257.5 kilometers [km]) of electrical transmission lines, approximately 1,360 mi (2,189 km) of distribution wires (USFWS 2011a). The KIUC Short-term HCP also covered incidental take associated with the operation of approximately 3,100 streetlights owned and maintained by KIUC on behalf of the County of Kauaʻi. Limited incidental take was provided for a subset of future activities including new connections within existing service areas and electrical equipment additions to existing substations. Larger, planned activities that were sufficiently well defined such that construction and operational impacts could be estimated were also included in KIUC's take authorization under the KIUC Short-term HCP (USFWS 2011a).

It was anticipated that KIUC would fully offset take of covered species and provide a net conservation benefit by implementing the conservation measures outlined in the KIUC Short-term HCP including: (1) fully funding implementation of the Save Our Shearwaters (SOS) Program; (2) funding covered species colony management and predator control in both the Limahuli Valley and the Hono O Nā Pali Natural Area Reserve according to protocols developed by State of Hawaiʻi seabird biologists; (3) updating estimates of at-sea covered species populations that have not been updated since the 1990s; (4) funding a 2-year auditory survey to locate additional covered species breeding colonies that could be used for future mitigation; (5) funding development and implementation of an under-line monitoring program aimed at better understanding the amount of take of covered species caused by overhead utility structures; and (6) funding covered species colony management and predator control in the Wainiha Valley or another suitable location, should the ITP still be in effect during the fourth and fifth years (USFWS 2011b).

Specific activities undertaken for the KIUC Short-term HCP include predator control, invasive plant control, and seabird monitoring since 2011 at Upper Limahuli Preserve; predator control and seabird monitoring since 2012 at Pihea, Pōhākea, and North Bog; predator control and seabird monitoring since 2021 at Hanakoa and Hanakāpiʻai; predator control, invasive plant control, and seabird monitoring between 2015 and 2022 (and resumed again in 2024) at Upper Mānoa Valley; and predator control, maintenance and operation of the predator exclusion fence and social attraction site, and seabird monitoring since 2023 at Honopū. The above activities have resulted in significant increases in call rates and increased reproductive success for ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) (Raine et al. 2024).

Table 4-3. Take Authorized under the KIUC Short-term HCP (2011–2016)

	‘A‘o (Newell’s shearwater)				‘Ua‘u (Hawaiian petrel)[1]		‘Akē‘akē (band-rumped storm-petrel)[1]	
Take Categories	**Annual Mortalities**	**Annual Non-Lethal Downings**	**Total Mortalities**	**Total Non-Lethal Downings**	**Annual Mortalities**	**Total Mortalities**	**Annual Mortalities**	**Total Mortalities**
Powerlines								
Breeding Adult	17.3	0	86.5	0	2	10	2	10
Non-breeding Adult/Subadult	69.3	0	346.5	0	0	0	0	0
Indirect Chick	17.3	0	86.5	0	0	0	0	0
Light Attraction								
Fledgling	17.9	53.7	89.5	268.5	0	0	0	0

Source: USFWS 2011b

[1] ‘Ua‘u (Hawaiian petrel) represent less than 1 percent of the number of ‘a‘o (Newell’s shearwater) retrieved via the SOS Program on Kaua‘i, and even fewer ‘akē‘akē (band-rumped storm-petrel) are recovered. While similar approaches as those used to estimate the take of ‘a‘o (Newell’s shearwater) were not feasible for ‘ua‘u (Hawaiian petrel) and ‘akē‘akē (band-rumped storm-petrel), for the purposes of the KIUC Short-term HCP, the annual take authorized under the ITP was two birds of each species.

As part of the KIUC Short-term HCP, an acoustic monitoring system was developed by the Kaua'i Endangered Seabird Recovery Project to detect and monitor powerline strikes (KESRP 2017a). Between 2014 and 2016, the system detected a minimum of 1,000 strikes of covered species annually (KESRP 2015). As a result of the refined acoustic monitoring tool and methodology, the take of covered species was found to be much higher than initially projected and authorized under the KIUC Short-term HCP (KESRP 2017a). KIUC has continued to implement acoustic strike monitoring through the present to provide a more comprehensive view of the impacts of powerline strikes on seabirds. Monitoring results informed the development of the conservation measures included in the longer-term HCP, the take request, and KIUC's currently proposed minimization and mitigation efforts.

4.2.2 Federal Actions

Several federal actions involving artificial nighttime lighting, communication towers, access control, or predator exclusion are ongoing within the Permit Area that have the potential to affect one or more listed species. The biological opinions issued by the Service as part of section 7 of the ESA consultation for these projects include anticipated incidental take of listed species and describe conservation measures to be implemented to avoid and minimize take (Table 4-4).

Table 4-4. Covered Species Take for Ongoing Federal Projects

Ongoing Federal Project	Project Description	Covered Species Take	Conservation Measures
Project Name: Kōkeʻe Air Force Station[4] Federal Entity: U.S. Air Force Duration: 2017–foreseeable future	Continuing operations at Kōkeʻe Air Force Station and the Kōkeʻe Microwave Antenna Site	ʻAʻo (Newell's shearwater): up to 2 adults or fledglings and 1 egg/chick per year ʻUaʻu (Hawaiian petrel): up to 1 adult or fledgling and 1 egg/chick per year ʻAkēʻakē (band-rumped storm-petrel): up to 1 adult or fledgling and 1 egg/chick every 10 years	• Blackout period from April 1 to December 30 annually • Installation seabird monitoring April 1 to December 30 annually • Offsite predator control (colony dependent; annually) • Construct perimeter walking light path • SOS husbandry support (annually)
Project Name: Pacific Missile Range Facility (PMRF)[5] Federal Entity: U.S. Navy Duration: 2018–2068	Base-wide infrastructure, operations and maintenance activities at PMRF	ʻA'o (Newell's shearwater): up to 450 adults, 63 fledglings, and 63 chicks or eggs over 50 years	• Exterior lighting turned off during moonless nights during the seabird fledgling season • Full cut-off light fixtures on required security and safety lights • Base-wide predator control • Downed seabird monitoring during the fledgling season • Outreach, support, and use of seabird collection stations at Barking Sands

[4] USFWS 2016
[5] USFWS 2018

Table 4-4. Covered Species Take for Ongoing Federal Projects (continued)

Ongoing Federal Project	Project Description	Covered Species Take	Conservation Measures
Project Name: Pacific Missile Range Facility (PMRF)[6] Federal Entity: U.S. Navy Duration: 2025–2035	Base infrastructure operations at PMRF	Nēnē (Hawaiian goose): up to 4 individuals from aircraft strikes; up to an average of 3 nests per year and maximum of 7 nests in one year due to nest destruction in nest removal zone; up to 1 nest per year due to destruction near launch pads; up to 1 nest per year due to launch or live fire activity; up to 1 nest due to oxidation pond re-lining project; up to an average of 10 individuals per year and maximum of 15 individuals in one year due to vehicle strikes Aeʻo (Hawaiian stilt): up to 1 individual per year due aircraft strikes; up to 1 individual due to vehicle strikes ʻAlae ʻula (Hawaiian common gallinule): up to 1 individual per year due to aircraft strikes; up to 5 individuals per year due to vehicle strikes; up to 3 individuals due to incidental capture from predator control activities ʻAlae keʻokeʻo (Hawaiian coot): up to 1 individual per year from aircraft strikes; up to 1 individual from oxidation pond re-lining project; up to 2 individuals per year from vehicle strikes Koloa maoli (Hawaiian duck): up to 1 individual per year from aircraft strikes; up to 1 nest from oxidation pond re-lining project; up to 3 individuals per year from vehicle strikes; up to 3 individuals from predator control activities ʻŌpeʻapeʻa (Hawaiian hoary bat): up to 2 adults and 4 pups from emergency tree trimming; up to 4 individuals from entanglement in barbed wire	• Implement Bird/Wildlife Aircraft Strike Hazard (BASH) management activities • Hazing and nest removal near launch pads • Hazing and deterrents at the oxidation pond • Install traffic-calming measures, speed bumps, reduced speed limits, and signage at high collision risk areas on roadways • Outreach to inform PMRF staff and visitors about driving slowly and to be aware of collision risk with listed birds on roadways • Vegetation management to deter listed birds from high vehicle collision risk areas and unsuitable nesting areas on base • Nest surveys prior to vegetation maintenance and construction activities • Close hunting areas during listed bird breeding seasons or when increased activity of listed birds is observed • Avoid tree trimming during the bat pupping season (June 1–September 15) • Conduct follow up acoustic surveys for bats every 5 years • Bi-weekly surveys of road-accessible barbed wire fence lines for snagged bats • Bi-monthly surveys of all fence lines during bat fledging season (September–October)

[6] USFWS 2025

Table 4-4. Covered Species Take for Ongoing Federal Projects (continued)

Ongoing Federal Project	Project Description	Covered Species Take	Conservation Measures
Project Name: Mobile Communication Towers at Hanapēpē Armory[7] Federal Entity: Army National Guard Duration: 2023–2043	Placement and operation of two mobile high-frequency communication towers at the Hanapēpē Armory	ʻAʻo (Newell's shearwater): up to 1 adult every 3 years from collisions with project towers; up to 1 chick or egg every 12 years from its parents colliding with project towers ʻUaʻu (Hawaiian petrel): up to 4 adults every 3 years and a maximum of 2 adults in 1 year from collisions with project towers; up to 1 chick or egg every 3 years from its parents colliding with project towers ʻAkēʻakē (banned-rumped storm petrel): up to 1 adult every 10 years from collisions with project towers; up to 1 chick or egg every 20 years from its parent colliding with project towers	• Lights will be shielded and dimmed to levels compliant with safety and security concerns • Reflective tape and/or bird diverters will be installed on all tower guy wires while deployed • Annual funding to the National Fish and Wildlife Foundation to benefit seabird conservation efforts
Project Name: Verizon Wireless Halfway Bridge Cell Site[8] Federal Entity: Federal Communications Commission Duration: 2013–2033	Installation and operations of a 100-foot stealth monopole (pine tree tower) and associated infrastructure near Koloa, Kauaʻi	ʻAʻo (Newell's shearwater): up to 3 adults and up to 2 eggs/chicks over 20 years ʻUaʻu (Hawaiian petrel): up to 1 adult and up to 1 egg/chick over 20 years	• Construction timing: To occur during daylight hours only; equipment stored horizontally during nighttime hours to eliminate collision risk to seabirds. • Tower lighting: Monopole tower will be 100 feet (30 meters [m]) tall and not include lighting. • Compound lighting: Two lights mounted to H-frame used only during required maintenance visits. • Communication and powerlines: New power poles and utility lines not to exceed 25 feet (7.6 m). • Carcass searches: Verizon personnel will search for carcasses or evidence of downed birds a minimum of once per month.

[7] USFWS 2023a
[8] USFWS 2014

Table 4-4. Covered Species Take for Ongoing Federal Projects (continued)

Ongoing Federal Project	Project Description	Covered Species Take	Conservation Measures
Project Name: Moloaʻa Agricultural Park[9] Federal Entity: U.S. Department of Agriculture, Natural Resources Conservation Service Duration: 2015–2018	Implementation of a conservation plan to address resource concerns on irrigated cropland in Moloaʻa, Kauaʻi	Nēnē (Hawaiian goose): up to 3 adults over 3-year duration	• Netting construction: Activity ceased if a nēnē (Hawaiian goose) arrives during construction of the netting system. • Netting materials: Netting will be 0.79-inch (20-millimeter) by 0.79-inch (20-millimeter) mesh size and include reflective and/or visibility tape. • Monitoring of netting structures: Netting system monitored twice daily within the first week of each installation, followed by daily monitoring.
Project Name: Hanalei National Wildlife Refuge, Wetland Management and Waterbird Conservation Plan[10] Federal Entity: U.S. Fish and Wildlife Service Duration: 2020–foreseeable future	Implementation of the wetland management and water bird conservation plan and associated activities related to the cooperative agriculture agreement permitting for kalo farming and cooperative livestock grazing	Nēnē (Hawaiian goose): average of 1 nest every 3 years with maximum of 2 nests per year; average of 1 adult/gosling every 5 years with maximum of 1 adult/gosling per year from routine maintenance; average of 1 adult/gosling every 3 years with maximum of 3 adults/goslings per year from capture as a result of live-trapping; maximum of 1 adult/gosling every 8 years from harm or harassment leading to injury or death from incidental capture Koloa maoli (Hawaiian duck): average of 1 nest per year with maximum of 6 nests per year due to nest destruction; average of 1 nest with maximum of 4 nests per year due to harm or harassment; average of 2 nests per year with maximum of 2 nests per year due to kalo farming disturbance; average of 1 adult/duckling with maximum of 1 adult/duckling per year from routine	• General habitat management including maintaining rotational managed wetlands outside of peak breeding and molting seasons (March–August) and searching for waterbird nest/brood prior to upland habitat management • Integrated pest management (ongoing) • Cooperative kalo farming that includes reporting and not disturbing Hawaiian waterbird nests or broods • Cooperative grazing of livestock to managing and maintaining short grass conditions

[9] USFWS 2015
[10] USFWS 2020

Table 4-4. Covered Species Take for Ongoing Federal Projects (continued)

Ongoing Federal Project	Project Description	Covered Species Take	Conservation Measures
		maintenance; up to 1 adult/duckling every 3 years with maximum of 3 adults/ducklings per year from live-trapping; maximum of 1 adult/duckling every 8 years from harm or harassment leading to injury or death from incidental capture ‘Alae ‘ula (Hawaiian common gallinule): average of 1 nest with maximum of 4 nests per year due to nest destruction; average of 1 nest with maximum of 3 nests per year due to harm or harassment; average of 12 nests per year with maximum of 16 nests per year due to kalo farming disturbance; average of 1 adult/gosling every 5 years with maximum of 1 adult/gosling per year from routine maintenance; average of 9 adults/chicks per year with maximum of 29 adults/chicks per year from live-trapping; average of 1 adult/chick every 3 years with maximum of 1 adult/chick per year from harm or harassment leading to injury or death from incidental capture ‘Alae ke‘oke‘o (Hawaiian coot): Average of 1 nest per year with maximum of 1 nest per year due to kalo farming disturbance Ae‘o (Hawaiian stilt): average of 1 nest per year with maximum of 6 nests per year due to nest destruction; average of 1 nest every 3 years with maximum of 4 nests per year due to harm or harassment	

Table 4-4. Covered Species Take for Ongoing Federal Projects (continued)

Ongoing Federal Project	Project Description	Covered Species Take	Conservation Measures
Project Name: Kīlauea Point National Wildlife Refuge, Predator Exclusion Fence and Cat Eradication[11] Federal Entity: U.S. Fish and Wildlife Service Duration: 2021–foreseeable future	Installation of a predator exclusion fence and eradication of feral cats from Kīlauea Point	Nēnē (Hawaiian goose): up to 5 nests or families (2 adults, 2 goslings per family) from injury or mortality from nest disturbance due to construction; up to 2 nests, 2 adults, and 2 goslings from mortality due to construction; up to 6 adults and 6 goslings every 5 years from fence preventing non-flighted individuals from leaving the fenced area; up to 3 adult or gosling captures within first 5 years and up to 1 adult or gosling capture for remainder of project from live-trapping; up to 2 adults and 3 goslings within first 5 years and up to 1 adult and 3 goslings every 5 years for remainder of project due to injury or mortality from live-trapping	Multiple conservation measures are incorporated into the project description, including but not limited to: • Do not approach, feed, or disturb nēnē (Hawaiian goose). • If nēnē (Hawaiian goose) are observed during breeding season (September through April), survey prior to resuming any work. Repeat survey for 3 or more days. • If a nest is discovered within 150 feet (46 m) of work, cease all work immediately and contact appropriate staff for guidance. • Install a gate along the fence where there are high amounts of nēnē (Hawaiian goose) dispersing during non-flight stages (gosling and adult molting). • For other areas along fence, if nēnē (Hawaiian goose) are observed lingering, contact appropriate staff to open access gate.

[11] USFWS 2021

Table 4-4. Covered Species Take for Ongoing Federal Projects (continued)

Ongoing Federal Project	Project Description	Covered Species Take	Conservation Measures
Project Name: Kūhiō Highway Emergency Shoreline Mitigation[12] Federal Entity: Federal Highway Administration Duration: 2023–foreseeable future	Restoration of Kūhiō Highway and rehabilitation of the beach from impacts of a March 2021 storm	Hawksbill sea turtle (*Eretmochelys imbricata*): up to 1 adult and 1 nest over duration of project Honu (green sea turtle): up to 3 adults and 3 nests over duration of project	Many conservation measures are incorporated into the project design, including but not limited to: • Project footprints limited to the minimum area necessary to complete the project. • All construction plans will contain water pollution and erosion control measures. • Select construction personnel trained to be "competent observers" who will identify sea turtles and respond appropriately. • Biological surveys will be conducted within 3 days prior to initiating any construction on land. • Temporary plastic fences will be erected at the end of each workday to protect turtles from construction equipment. • Sea turtle monitoring will be performed by trained staff using detailed required methods.
Project Name: Kīlauea Point National Wildlife Refuge Geotechnical Investigation Project[13] Federal Entity: U.S. Fish and Wildlife Service Duration: Two consecutive days in February 2024	Conduct geotechnical investigations by digging (auger or geoprobe mounted on excavator) test holes to determine soil and subsurface conditions for planning improvements to certain areas of the refuge (e.g., entrance road, parking areas).	Nēnē (Hawaiian goose): up to 30 adults and 30 goslings or 15 nests	• Project personnel and contractors informed of presence of listed species on site. • Project personnel will minimize approaching nēnē (Hawaiian goose) and are restricted from feeding birds. • Surveys for nēnē (Hawaiian goose) nests conducted by biologist within and surrounding project area prior to any work during the breeding season (September through April). • Work ceased if nēnē (Hawaiian goose) nest discovered within 75 feet (22.86 m) of proposed work or a previously undiscovered nest found within the 75-foot (22.86-m) buffer after work begins

[12] USFWS 2023b
[13] USFWS 2024a

Table 4-4. Covered Species Take for Ongoing Federal Projects (continued)

Ongoing Federal Project	Project Description	Covered Species Take	Conservation Measures
Project name: Kīlauea Point Bicycle and Pedestrian Access Alternatives Project[14] Federal Entity: Federal Highway Administration Duration: 1 year (2025)	Improve existing bicycle and pedestrian path to connect downtown Kīlauea and the Kīlauea Point National Wildlife Refuge overlook. Improvements include but are not limited to: road realignment, installation of a mini-roundabout, installation of sidewalk, widening of an existing sidewalk, reconfiguration of parking area.	Nēnē (Hawaiian goose): up to 20 adults and 20 goslings or 10 nests	• Do not approach, feed, or disturb nēnē (Hawaiian goose). • A biologist with expertise in nēnē (Hawaiian goose) behavior will be on site for all construction activities during the breeding season (September through April). • All project personnel and subcontractors will be informed about the presence of listed species on site. • Onsite staff will be trained by the biologist to identify nēnē (Hawaiian goose) and the appropriate steps to take if nēnē (Hawaiian goose) are present. • Biologist will walk the area 2 weeks prior to work to identify nests in the area. Surveys will occur again the day before work begins.
Project name: Refuge Access Repair Project at Kīlauea Point National Wildlife Refuge[15] Federal Entity: U.S. Fish and Wildlife Service Duration: 2.5 months	Repair storm-damaged infrastructure. Work includes but is not limited to: slight widening of the main entrance road, replacement of the main waterline, replacement of a section of ungulate fencing, and safety-related improvements (e.g., enhance drainage and safety markings).	Nēnē (Hawaiian goose): up to 8 adults and 8 goslings or 4 nests	• Nēnē (Hawaiian goose) will not be approached, fed, or disturbed. • Construction limited to outside of the known peak nesting season for nēnē (Hawaiian goose) at Kīlauea Point National Wildlife Refuge. • If nēnē (Hawaiian goose) are observed loafing or foraging within the project area during the peak breeding season (October through March), a biologist familiar with nēnē nesting behavior will survey for nests in and around the project area prior to the resumption of any work. Surveys will be repeated after any subsequent delay of work of 3 or more days (during which the birds may attempt to nest). • All work will immediately cease if a nest is

[14] USFWS 2024b
[15] USFWS 2024c

Table 4-4. Covered Species Take for Ongoing Federal Projects (continued)

Ongoing Federal Project	Project Description	Covered Species Take	Conservation Measures
			discovered within a radius of 75 feet (22.86 m) of the proposed project, or a previously undiscovered nest is found within the 75-foot (22.86-m) radius after work begins.

4.2.3 Federal, State, and Private Land Management

4.2.3.1 Federal Land Management

Kauaʻi National Wildlife Refuge Complex

The Kauaʻi National Wildlife Refuge Complex consists of three National Wildlife Refuges (NWR) that are managed by the Service: Kīlauea Point NWR, Hanalei NWR, and Hulēʻia NWR. The focus of NWR management is to expand and enhance existing habitat for threatened and endangered species while combating the primary threats of invasive species and predators and allowing for public uses that are compatible with each NWR and the NWR System mission.

Kīlauea Point NWR was originally established to preserve and enhance migratory seabirds and threatened and endangered species. The refuge provides habitat for the threatened nēnē (Hawaiian goose), threatened ʻaʻo (Newell's shearwater), endangered ʻuaʻu (Hawaiian petrel), threatened Central North Pacific DPS of honu (green sea turtle), other migratory birds, and native coastal plant communities. The goals, objectives, and strategies for improving Kīlauea Point NWR conditions, including the types of habitat the NWR will provide, partnership opportunities, and management actions needed to achieve desired future conditions, are described in the Kīlauea Point National Wildlife Refuge Comprehensive Conservation Plan (USFWS 2016).

Wildlife and habitat management activities at Kīlauea Point NWR include weed control and outplanting native plants, mowing and weeding grassland-shrubland habitat for nēnē (Hawaiian goose), and controlling introduced predators. Biological programs also include banding and monitoring reproductive success and survival of seabirds and nēnē (Hawaiian goose) and the Nihoku Ecosystem Restoration Project (Nihoku), which constructed a 7-acre (2.8-hectare) predator-proof fence to protect native coastal ecosystems and provide a predator-free nesting area for native ground-nesting birds.

Translocation, social attraction, and monitoring of the threatened ʻaʻo (Newell's shearwater) and endangered ʻuaʻu (Hawaiian petrel) to the Nihoku site was initiated in 2015. Chicks for translocation were taken from conservation sites managed by KIUC through the KIUC Short-Term HCP. From 2015 to 2020, 86 ʻaʻo (Newell's shearwater) and 110 ʻuaʻu (Hawaiian petrel) were translocated to the site, with all ʻaʻo (Newell's shearwater) and 106 ʻuaʻu (Hawaiian petrel) fledging (Young et al. 2023). In 2023, nine translocated ʻuaʻu (Hawaiian petrel) and two ʻaʻo (Newell's shearwater) adults were found in burrows. Of the nine ʻuaʻu (Hawaiian petrel), there were three pairs, including two that hatched chicks for a second year in a row, with one fledging (Pacific Rim Conservation 2023). In addition to Nihoku, there is another location within Kīlauea Point NWR with ʻaʻo (Newell's shearwater) and is the only known coastal lowland population on Kauaʻi. This colony was established through a cross-fostering translocation project that occurred between 1978 and 1980 (Byrd et al. 1984). The colony supports fewer than 25 breeding pairs and appears to be decreasing. The Kauaʻi Endangered Seabird Recovery Project and Kīlauea Point NWR have monitored this population annually since 2006. Survey activities include locating and identifying ground calling birds; identifying active, historical, and potential burrows and occupancy status; and recording breeding success for each burrow (KESRP 2022).

Hanalei NWR was established under the ESA in 1972 to recover threatened and endangered species, including koloa maoli (Hawaiian duck), ʻalae keʻokeʻo (Hawaiian coot), ʻalae ʻula (Hawaiian common gallinule), aeʻo (Hawaiian stilt), and nēnē (Hawaiian goose). Hanalei NWR also provides habitat for the endangered ʻōpeʻapeʻa (Hawaiian hoary bat, *Lasiurus semotus*) and other native species, including migratory waterfowl and shorebirds. The Wetlands Management and Waterbird Conservation Plan for Hanalei NWR describes the processes needed to achieve the refuge's management objectives for the approximately 480 acres (194 hectares) of rotationally managed wetlands, loʻi kalo (wetland taro fields), ditches and dikes, fallow, riparian habitat, and associated uplands (USFWS 2020). Kalo farming has occurred within Hanalei NWR since the refuge was established and is a component of the overall management of lowland and wetland habitats within the refuge, as it helps satisfy life history conditions for threatened and endangered Hawaiian waterbirds.

Hulēʻia NWR provides habitat for 31 species of birds including koloa maoli (Hawaiian duck), ʻalae keʻokeʻo (Hawaiian coot), ʻalae ʻula (Hawaiian common gallinule), aeʻo (Hawaiian stilt), and nēnē (Hawaiian goose). The region was originally used for wetland agriculture but now consists of intensively managed wetlands that mimic the natural Hawaiian wetland systems to provide the necessary life history conditions for the threatened and endangered bird species. Ongoing management practices also include the management of invasive plant and animal species and the construction and maintenance of protected wetlands.

Southern House Mosquito Suppression for Forest Bird Recovery

Native forest birds are affected by avian malaria, avian pox, and other diseases transmitted by nonnative southern house mosquitos (*Culex quinquefasciatus*). This project intends to suppress the mosquito population within an area of 59,204 acres (23,959 hectares) in northern Kauaʻi that includes the Kōkeʻe State Park, Hono O Nā Pali Natural Area Reserve (NAR), Kuʻia NAR, Nā Pali Coast State Wilderness Park, Nā Pali-Kona Forest Reserve, Alakaʻi Wilderness Preserve, and private lands (DOFAW and USFWS 2023). DLNR and the Service are releasing lab-raised male southern house mosquitos with a strain of *Wolbachia*, a bacteria critical to mosquito reproduction, that is incompatible with *Wolbachia* strains present in the wild mosquito population. When the wild and lab-raised mosquitoes breed, their offspring are infertile and the mosquito population is unable to reproduce and persist in a localized area. Implementation of the project would reduce the prevalence of mosquito-borne diseases within the above areas that overlap with the Permit Area. The covered seabirds are affected by diseases transmitted by the mosquito (e.g., avian pox) (Sprague pers. comm.). Reducing the southern house mosquito population will limit the spread of avian diseases and promote the recovery and health of covered seabirds within the project area while also reducing the transmission of avian diseases in covered seabirds.

4.2.3.2 State Land Management

Nā Pali Coast State Wilderness Park

The Nā Pali Coast State Wilderness Park is owned by the State of Hawaiʻi and managed by the Division of State Parks. The Division of State Parks manages access to and use of the hiking trails and camp sites within Nā Pali Coast State Wilderness Park through a system of advanced reservations for entry via Hāʻena State Park and overnight camping permits (DLNR 2023). Developed facilities within the Nā Pali Coast State Wilderness Park are limited and visitor use is focused along the main coastal Kalalau Trail and interior Hanakāpiʻai Trail, Hanakoa Falls Trail, and Kalalau Valley Trail.

Honopū Seabird Conservation Initiative

The Honopū Seabird Conservation Initiative is designed to improve the baseline ecological condition of three federally and State of Hawaiʻi–listed endemic seabirds on the island of Kauaʻi: ʻaʻo (Newell's shearwater), ʻuaʻu (Hawaiian petrel), and the Hawaiʻi DPS of ʻakēʻakē (band-rumped storm-petrel). The 264-acre (107-hectare) project area is within Honopū Valley and includes DLNR-managed lands, Kōkeʻe State Park (Division of State Parks), and Nā Pali-Kona Forest Reserve (DOFAW). The Honopū Seabird Conservation Initiative is a joint effort among the Navy Region Hawaiʻi Pacific Missile Range Facility, Service, DOFAW, and National Fish and Wildlife Foundation to establish effective predator control (i.e., ungulate fence, predator-proof fence, and predator control outside of the fences) in Honopū Valley and social attraction sites (currently one site set up for ʻaʻo [Newell's shearwater] and another for ʻakēʻakē (band-rumped storm-petrel]). The predator control program would focus on invasive species including rats (*Rattus* spp.), feral cats (*Felis catus*), feral pigs (*Sus scrofa*), other ungulates, and barn owls (*Tyto alba*) (U.S. Navy et al. 2019), which are known predators of listed seabirds.

Hono O Nā Pali Natural Area Reserve

The NAR System is based on the concept of protecting ecosystems, rather than single species, and seeks to protect the best remaining examples of the state's unique ecosystems. Hono O Nā Pali NAR occupies 3,579 acres (1,448 hectares) and was established to protect perennial streams, riparian and ridgeline lowland and montane forests, rare plants, endemic stream fauna, and forest bird habitat. The primary threats to biodiversity and watershed integrity at Hono O Nā Pali NAR are feral ungulates (wild, hoofed animals), especially feral pigs and feral goats (*Capra hircus*), small predatory mammals (feral cats and rats), and nonnative, invasive weeds.

Management of Hono O Nā Pali NAR is guided by the *Hono O Nā Pali Natural Area Reserve Management Plan* (DOFAW 2011). The overall management goal is to manage threats to the integrity, diversity, and functioning of Hono O Nā Pali NAR ecosystems so that the unique natural resources are protected, maintained, and enhanced. The management program includes programs related to infrastructure and facilities, ungulate management, weed management, habitat protection and rare species restoration, fire prevention and response, monitoring, outreach and education, enforcement, and partnership collaboration. Long-term management of the Hono O Nā Pali NAR provides multiple benefits to the state including protection of the island's water resources and undeveloped open space. The natural communities within the reserve provide habitat for a diverse range of native plants and animals, from rare birds to endemic invertebrates, preserving biodiversity in Hawaiʻi (DOFAW 2011). Seabird management is ongoing in the Hono O Nā Pali NAR and the Hono O Nā Pali NAR contains sections of pig fences combined with steep terrain that prevent ingress of pigs into the NAR (DOFAW 2020). While ungulate eradication is still ongoing within Hono O Nā Pali NAR, the reduced numbers help limit the risk of pigs entering seabird colonies. As part of the KIUC Short-term HCP (2011–2016), KIUC funded predator control and seabird monitoring activities at three conservation sites within Hono O Nā Pali NAR, including feral cat trapping at specific sites within and near known breeding colonies, rat-baiting within known breeding colonies, barn owl removal, and seabird breeding success monitoring (KIUC 2011).

Since 2016, KIUC has continued funding seabird colony management within Hono O Nā Pali NAR, and has expanded these efforts by increasing the number of conservation sites. The North Bog, Pōhākea, Pōhākea Predator Fence (PF), Pihea, Hanakoa, and Hanakāpiʻai conservation sites included in the Draft HCP are in the Hono O Nā Pali NAR that is managed by DLNR.

Kawaiʻele Waterbird Sanctuary, Mānā Plain Conservation Area

The Kawaiʻele Waterbird Sanctuary is run by DLNR for waterbird management. The wetland restoration project at the Kawaiʻele Waterbird Sanctuary has restored and enhanced approximately 40 acres (16 hectares) of wetlands. Within the Mānā Plain Conservation Area, adjacent to the Kawaiʻele Waterbird Sanctuary, the Mānā Plain Conservation Project has restored approximately 50 acres (20.23 hectares), with an additional 50 acres (20.23 hectares) planned when additional funding is acquired. The Kawaiʻele Waterbird Sanctuary and the Mānā Plain Conservation Area are important feeding and nesting areas for endemic threatened and endangered waterbird species including koloa maoli (Hawaiian duck), ʻalae ʻula (Hawaiian common gallinule), aeʻo (Hawaiian stilt), and nēnē (Hawaiian goose). In addition to restoring wetlands, the restoration project includes re-establishing a variety of native aquatic and terrestrial plants, ilima (*Sida fallax*), widgeon grass (*Ruppia maritima*), makaloa (smooth flatsedge, *Cyperus laevigatus*), and the endangered ʻohai (*Sesbania tomentosa*), which have cultural importance and are important resources for nesting and foraging waterbirds (DOFAW 2014).

4.2.3.3 Private Land Management

National Tropical Botanical Garden

The Upper Limahuli conservation site proposed in the Draft HCP is within the Limahuli Garden and Preserve that is owned and managed by the National Tropical Botanical Garden. Limahuli Garden and Preserve highlights native and culturally significant species in an authentic Hawaiian landscape. The management goal for Limahuli Garden and Preserve is the ecological and cultural restoration of Limahuli Valley using ancestral resource management practices. The collections maintained by Limahuli Garden and Preserve include extensive assemblages of native Hawaiian plant species, including rare varieties of crop plants cultivated by the early Hawaiians (NTBG 2023). As part of a comprehensive ungulate removal and management program, the Upper Limahuli Preserve has an existing ungulate fence surrounding the entire boundary (ICF 2025). Additionally, as described in the Draft HCP, the Upper Limahuli Preserve conservation site includes removal of other predators (feral cats, rodents, barn owls, feral honey bees), an invasive plant control and monitoring program, and a seabird monitoring program (ICF 2025). The Upper Limahuli Preserve PF conservation site includes the construction of a predator exclusion fence, predator eradication within the fence, installation of artificial burrows, social attraction, and ongoing colony and predator monitoring. The management actions for the Upper Limahuli Preserve and Upper Limahuli Preserve PF conservation sites are described in Section 2.2.2, *Alternatives Analyzed in Detail, Alternative B: Proposed Action*.

4.2.4 Other Conservation Actions

4.2.4.1 Kauaʻi Endangered Seabird Recovery Project, Annual Radar Monitoring

Beginning in 1993, radar surveys have been conducted annually to monitor the population trend of listed seabird populations on Kauaʻi, specifically ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel). Surveys are conducted at 15 sites distributed along the coast of Kauaʻi, except for the northeastern portion of the island. As part of the 2022 survey season, all 15 sites were surveyed at least once, and the busiest sites were surveyed up to three times between June and mid-July (KESRP 2023). Surveys were conducted using a Furno FAR-1518BB marine radar unit mounted horizontally on top of a vehicle, with a 15-inch (38-centimeter) radar monitor inside the vehicle. From 1993 to 2013, radar survey results showed a steep population decline of 78 percent for ʻuaʻu (Hawaiian petrel) and 94 percent for ʻaʻo (Newell's shearwater) with the populations at a low level, with neither species populations increasing nor decreasing over a 10-year timeframe thereafter (KESRP 2017b; Raine et al. 2017). The most recent radar data monitoring report found no significant (positive or negative) trend in the abundance for either species from 2010 through 2022 (Sahin 2023).

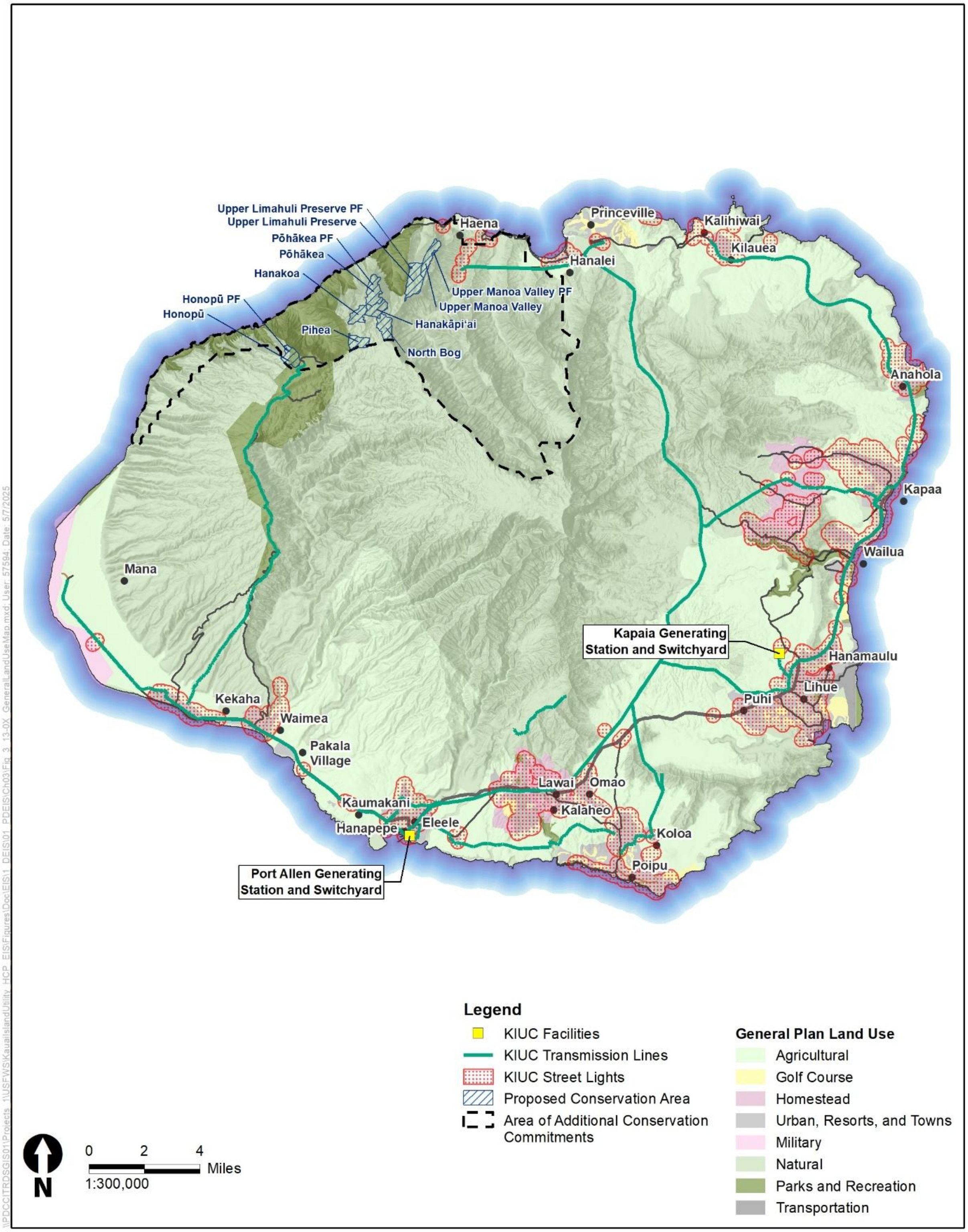
4.2.4.2 Mālama I Nā Honu, Green Sea Turtle Nesting and Basking Monitoring and Community Outreach

Mālama I Nā Honu is a non-profit organization that receives funding and support from the Service and National Oceanic and Atmospheric Administration. The organization works with Service, National Oceanic and Atmospheric Administration, and State of Hawaiʻi Division of Aquatic Resources biologists on Kauaʻi and utilizes community volunteers to monitor both honu (green sea turtle) nesting and basking and to prevent intentional or inadvertent harassment. Monitoring of basking sea turtles takes place throughout the year and every night during the hatching season at Poʻipū Beach. Volunteers conduct public outreach and inform community members about honu (green sea turtle) conservation efforts. Additionally, the program has volunteers walk certain beaches across Kauaʻi each week to monitor nesting and nestling emergence and respond to events that affect nesting activity.

4.2.5 Population Growth and Land Development

Kauaʻi County grew from 58,463 residents in 2000 to 71,000 in 2015. Total population for the county is projected to increase to 88,013 by 2035, representing a forecasted increase of 22 percent between 2015 and 2035, or approximately 1 percent a year. Although growth is spurred by both natural increase and in-migration, the forecasted growth rate is lower and more stable compared to previous decades. Changing demographics suggest an aging population with limited ability to maintain the levels of natural growth experienced in the last two decades (County of Kauaʻi 2018). For the Draft HCP, KIUC estimated that an additional 360 mi (579.4 km) of new wires could be placed in operation over the 50-year permit term to service new homes and businesses that are developed outside of the existing network or to increase capacity on existing poles or towers in response to increasing demand caused by population growth. This represents a 24-percent increase from the existing 1,531 mi (2,464 km) of powerlines and would represent an average of 7 mi (11.3 km) of new powerlines per year for 50 years (ICF 2025).

Figure 4-2 shows land designations consistent with the Kauaʻi Future Land Use Map in *Kauaʻi Kākou: Kauaʻi County General Plan* (County of Kauaʻi 2018). The Future Land Use Map represents the development pattern needed to accommodate projected growth and support the 2035 Vision and Goals of the general plan. The Future Land Use Map aligns with the general plan's policies by directing growth to existing communities through infill and mixed-use development.



Sources: ICF 2025; County of Kaua'i 2018

Figure 4-2. County of Kaua'i General Plan: Future Land Use Map

The general plan envisions limiting growth to the north of the Wailua Bridge due to congestion concerns and directing the majority of growth to the Līhuʻe and South Kauaʻi planning districts. Additional growth is allocated to the Waimea-Kekaha, Hanapēpē-ʻEleʻele, East Kauaʻi, and North Shore planning districts based on historic and natural increase trends. A majority of the island is designated as natural in the Future Land Use Map. These areas have either limited development potential or are not suitable for development due to topography, hazard vulnerability, sensitive resources, and other constraints. They include all State Land Use Conservation District lands and some County Open Zoning District land. These areas include the many ridges, waterfalls, river valleys, and rugged coastlines of the island that compose its open spaces (County of Kauaʻi 2018) and those areas identified as mitigation sites in the Draft HCP (ICF 2025). Note that there is no overlap between areas where future growth and development are planned and the Area of Additional Conservation Commitments as defined in the Draft HCP, as shown on Figure 4-2.

4.2.6 Avian Influenza

The H5N1 influenza A virus, first identified in birds in 1996, has been circulating globally and has been widely detected in the United States since 2021. The virus poses a significant threat to wildlife, especially bird populations (e.g., seabirds, waterbirds), leading to mass mortalities in regions such as South America and the United Kingdom. In Hawaiʻi, the first detection of H5N1 was confirmed on November 15, 2024, in a backyard poultry flock in central Oʻahu. Additionally, low-level detections of the virus were found in wastewater samples from Kauaʻi, suggesting the virus may be present on the island, although no confirmed cases in birds, dairy cows, or humans have been reported in Kauaʻi to date.

In response, the Hawaiʻi Department of Health, alongside the Department of Agriculture and the Centers for Disease Control and Prevention, has been actively monitoring the situation. Their efforts include tracking human influenza cases, monitoring wastewater, and participating in various programs such as the National Poultry Improvement Plan for routine sampling of poultry. They also conduct testing of wild bird specimens and lactating cows entering the state. While the exact strain of H5N1 in the wastewater samples cannot be confirmed, ongoing surveillance aims to prevent further spread of the virus in both animals and humans in Hawaiʻi.

4.3 Reasonably Foreseeable and Cumulative Effects

4.3.1 Covered Species

4.3.1.1 Seabirds

The impacts on seabirds from past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include effects on individual seabirds and their potential reproductive output, as well as the quality and quantity of available breeding habitat on Kauaʻi.

The covered seabirds are affected by both oceanic and land conditions, because they feed on ocean resources and breed on land. In the foreseeable future, climate change is projected to affect oceanic food webs worldwide, which subsequently affects the food sources of the covered seabirds. Fisheries have past, present, and future impacts on seabirds, because the commercial tuna longline fishery has been and will remain an important industry in Hawaiʻi. Some seabirds, including ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel), associate with large predatory fishes such as tuna; some species of tuna have already become commercially depleted, and future tuna stocks may be similarly affected. Subsequently, covered seabirds could be further affected in the foreseeable future by direct fishing activities such as overfishing and line entanglement, and secondary effects such as derelict fishing gear entanglements or prey food depletion.

Invasive flora and fauna can degrade habitat quality of colony sites and both indirectly and directly affect seabird survival. Invasive plant species can destabilize seabird burrows, facilitate erosion, and encourage invasive fauna to access these areas. Invasive animal species, such as rats, cats, barn owls, feral honey bees, and ungulates, can directly and indirectly affect seabirds with predation and breeding habitat degradation. In areas where seabirds are monitored, human activity to find seabird burrows can inadvertently cause trails that lead predators to seabird breeding sites. Outside of conservation areas, the impacts on seabird habitat caused by invasive species in the past, present, and foreseeable future can be devastating, particularly from predation by introduced animals that are not managed. Federal land management actions in the past, present, and foreseeable future are implemented to protect seabirds outside conservation areas. One such example is the establishment and future management of the Nihoku predator exclusion fence and continued cat eradication efforts at Kilauea Point NWR. These actions have a positive influence on ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel), because translocation and social attraction increase seabird populations in a protected area.

Significant amounts of powerline collision minimization measures were not implemented by KIUC until 2020. This in addition to the underestimated amount of powerline collisions prior to 2014 has likely affected the overall status of the covered seabirds. While unminimized and exposed powerlines pose the primary threat for seabirds related to infrastructure collisions, large vertical infrastructure such as microwave antenna towers or cell towers have been identified as areas of potential take into the foreseeable future. As presented in Section 4.2.2, Federal Actions, conservation measures have been implemented pursuant to section 7 of the ESA to reduce the potential for take at these infrastructure sites.

Light pollution is caused by multiple entities, both public and private. The Draft HCP addresses light from KIUC-operated streetlights and KIUC covered facility lighting. Additionally, KIUC publishes links on its website with outdoor lighting guidelines from DOFAW and the Dark Sky Society, and provides funding to SOS for community outreach and education that increases general public awareness about light attraction and resulting fallout. These HCP actions do not address light sources from other entities. Kauaʻi County encourages public participation in light pollution reduction, but it is not presently mandated. A future Kauaʻi County lighting ordinance could aim to reduce light pollution from all sources to protect seabirds from fallout, which includes turning off unnecessary lights, shielding light sources, and using motion sensor lighting. While this ordinance option was deemed infeasible in 2020 in the County of Kauaʻi Seabird Habitat Conservation Program Participant Inclusion Plan, the County is considering adding advisory language to certain building and permit forms to inform applicants that property owners must comply with federal and state endangered species requirements. Continuation of the SOS Program and community participation can help save seabirds that experience fallout.

Low levels of H5N1 avian influenza virus were detected in Kauaʻi County wastewater samples in late 2024 and early 2025 (DOH 2025). No cases of avian influenza were confirmed on Kauaʻi as of this publication, although H5N1 can be considered as a foreseeable threat to seabirds. Avian influenza can cause severe illness with a high mortality rate among certain bird populations and can spread quickly in colonial and social birds.

The incremental effects of the proposed action and alternatives, when added to the effects described above, would contribute to cumulative effects on seabirds, both adverse and beneficial. The potential for adverse cumulative effects on seabirds would be greatest under the No Action alternative due to the implemented minimization measures not being maintained into the future, and the reduction or halting of predator control and management at seabird conservation sites. The potential for beneficial cumulative effects on seabirds would be greater under the proposed action (Alternative B) and Alternative C than under the No Action alternative, because the established and additional minimization measures would be maintained during the 50-year permit term and be applied to future infrastructure. Furthermore, predator control at conservation sites would improve seabird survival, which supports reproductive success of seabirds. The potential for beneficial cumulative effects on seabirds would be greatest under Alternative D because additional predator control on expanded acreage would benefit seabird habitat inside and outside of conservation areas. All alternatives would have the potential for both adverse and beneficial effects on seabirds, although viable metapopulations of ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) are expected to persist under Alternatives B through D.

4.3.1.2 Waterbirds

The cumulative impacts on waterbirds from past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include effects on individual birds, populations, and habitat quality and quantity.

The past and ongoing actions at the Kauaʻi Lagoons HCP project and several other federal actions listed in Table 4-4 could result in incidental take for the covered waterbird species, which could cumulatively have an adverse effect on the population of these covered waterbirds on Kauaʻi. However, these cumulative impacts on covered waterbird species are expected to be minimized through various past and ongoing conservation measures implemented by these projects. These measures include managing agricultural wetland habitats outside of the waterbird breeding season (so as to not disturb and cause nest abandonment), employing integrated pest management, reporting and not disturbing waterbird nests in kalo farms, not approaching and feeding nēnē (Hawaiian goose), and ceasing activity in a buffer surrounding a reported nest.

The Kawaiʻele Waterbird Sanctuary, Mānā Plain Conservation Area has collectively restored 90 acres (36 hectares) of wetlands. In the future, it is reasonably foreseeable that after securing funding, an additional 50 acres (20 hectares) of wetland habitat would be restored at this site. Additionally, the Hanalei NWR is a 917-acre (371-hectare) protected area situated in the Hanalei River Valley on the north shore of Kauaʻi. The primary mission of Hanalei NWR is to conserve and enhance endangered waterbird populations by providing high-quality habitat including managed wetlands and traditional kalo farming areas. These restored wetlands would have cumulative beneficial impacts on waterbirds because they increase the availability of important feeding and nesting habitat, which may improve the waterbirds' reproductive success and enhance the local and overall population of covered waterbirds on Kauaʻi.

Botulism, caused by the bacterium *Clostridium botulinum*, poses a significant threat to listed waterbirds. The bacteria thrive in warm, stagnant, nutrient-rich waters, often found in wetlands and taro fields that waterbirds inhabit. When birds ingest the toxin through contaminated food or water, it causes paralysis and often death and can lead to substantial mortality events, affecting already vulnerable waterbird populations. Conservation efforts focus on monitoring wetlands, managing water quality, removing carcasses to prevent spread of toxins, and treating birds at the SOS facility to reduce risk. Funding the SOS Program via the HCP aids rehabilitation and release of covered waterbirds affected by botulism.

Foreseeable future growth and land development in the Plan Area is expected to occur in lowland suburban areas, such as Wailua, Hanapēpē, Waimea, and Kekaha. It is reasonably foreseeable that the development would not occur in wetland habitats and therefore would not have an adverse cumulative impact on Hawaiian waterbirds.

The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, would result in beneficial cumulative effects on covered waterbirds. Compared to the No Action alternative and the other alternatives (B and C), the potential for beneficial cumulative effects is greatest under Alternative D because there would be predator control, habitat management, waterbird population monitoring, and barn owl control on 50 acres (20 hectares) of state land within the Mānā plain wetlands.

4.3.1.3 Reptiles: Honu (Green Sea Turtle)

The cumulative impacts on honu (green sea turtle) from past, present, and reasonably foreseeable future actions discussed above, combined with those impacts occurring under the proposed action and alternatives, include effects on habitat quality.

Artificial lighting and the loss of suitable nesting habitat associated with construction and operation in the Permit Area are primary past and present factors that have affected honu (green sea turtle) and will likely continue to adversely affect honu (green sea turtle). Past and present activities causing these effects include land management actions, conservation measures, Covered Activities, disturbance from beach recreation, development near or on beaches, and facility construction associated with the Kūhiō Highway Emergency Shoreline Mitigation.

Foreseeable future land development and other land use activities in the vicinity of honu (green sea turtle) nesting habitat may result in further loss of suitable nesting habitat and increased artificial light attraction for honu (green sea turtle). To the extent that management actions minimize artificial lighting near honu (green sea turtle) nesting habitat, the likelihood of decreased habitat quality would be reduced or offset.

Monitoring projects and habitat protections provided by nonprofit organizations (e.g., Mālama i nā Honu) and other HCPs would improve habitat quality for honu (green sea turtle) through biological monitoring and minimization of artificial lighting.

The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, would result in a cumulative effect on honu (green sea turtle), both adverse and beneficial as described above. The potential for adverse cumulative effects is greatest under Alternative A due to unmitigated artificial lighting impacts on honu (green sea turtle). The potential for beneficial cumulative effects is greatest under Alternative D due to the increase in funding by 15 percent for KIUC's nest detection and shielding program to increase capacity and add a marine debris removal program.

4.3.2 Other State- and Federally Listed Species

The cumulative impacts on other state- and federally listed species from past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include effects on habitat quality and quantity.

Construction and operation of past activities in the Permit Area (e.g., land management actions, conservation measures, Covered Activities, facility construction associated with the Kauaʻi Lagoons HCP and federal projects listed in Table 4-4) have resulted in habitat loss or degradation and disturbance for other state- and federally listed species.

Foreseeable future development and other land use activities may result in further disturbance and loss or degradation of habitat. Recreational use of the Permit Area and coastline may also result in increased disturbance to listed species such as ʻilio holo i ka uaua (Hawaiian monk seal, *Neomonachus schauinslandi*) and honuʻea (hawksbill turtle, *Eretmochelys imbricata*). Conversely, biological monitoring efforts and habitat protections provided by other HCPs could improve habitat quality by protecting, enhancing, or restoring habitat.

The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, would result in a cumulative effect on other listed species, both adverse and beneficial as described above. The potential for adverse cumulative effects is greatest under Alternative D because there would be more predator fencing construction within habitat for other listed species and the greatest potential for habitat loss and disturbance; however, adverse effects of increased fence construction can be minimized through compliance with BMPs. Over the long term, the potential for beneficial cumulative effects is greatest under Alternatives C and D compared to Alternative B due to the increase in conservation measures and funding for monitoring organizations (e.g., SOS).

4.3.3 Migratory Bird Species

The cumulative impacts on migratory bird species from past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include effects on habitat quality and quantity.

Construction and operation of past activities in the Permit Area (e.g., land management actions, conservation measures, Covered Activities, facility construction associated with the Kauaʻi Lagoons HCP and federal projects listed in Table 4-4) have resulted in habitat loss or degradation and disturbance for migratory bird species. Additionally, several migratory bird species have been documented to collide with structures and powerlines.

Restoration projects and habitat protections and conservation provided by other HCPs would improve habitat conditions for migratory bird species by protecting, enhancing, and restoring habitat. Predator and invasive species management measures would also result in beneficial effects on migratory bird species by reducing predation and competition for critical resources in their habitats.

The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, would result in a cumulative effect on migratory bird species, both adverse and beneficial. The potential for adverse cumulative effects on migratory bird species would be the greatest under Alternative A due to the lack of minimization for powerline collision and light attraction and lack of conservation measures to remove predators and invasive species. The potential for adverse cumulative effects on migratory bird species would be less under Alternatives B and C because there would be minimization measures implemented to reduce light attraction and powerline collision, as well as conservation measures including predator and invasive species removal. The potential for adverse cumulative effects on migratory bird species and their habitat would be least under Alternative D. While there would be more predator fencing construction within habitat for migratory bird species and more potential for habitat loss and disturbance, the adverse effects of increased fence construction can be minimized through compliance with avoidance and minimization measures in the Avian Protection Plan (Appendix C) (e.g., Avoidance and Minimization Measure 1, *Avoid Impacts to Forest Birds and Pueo from Fence Construction at Conservation Sites*, and Avoidance and Minimization Measure 2, *Avoid Impacts to Migratory Bird Treaty Act Protected Bird Species from Predator Traps or Collisions with Facilities at Conservation Sites*). Over the long term, the potential for beneficial cumulative effects would be greatest under Alternative D.

4.3.4 Critical Habitat and Other Land Designations

The impacts on federally designated critical habitat and other land designations from past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include effects on habitat quality and quantity.

Construction and operation of past activities in the Permit Area (e.g., land management actions, conservation measures, Covered Activities, grazing, habitat management associated with state and federal lands such as Kauaʻi NWR Complex and Hono O Nā Pali Natural Area Reserve) have resulted in habitat loss or degradation in critical habitat and other land designations.

Restoration projects and habitat protections and conservation provided by other HCPs would improve critical habitat and other land designations by protecting, enhancing, and restoring habitat. Predator and invasive species management measures would also result in beneficial effects on critical habitat and other land designations by reducing predation on native flora and fauna.

The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, would result in a cumulative effect on critical habitat and other land designations, both adverse and beneficial. The potential for short-term adverse cumulative effects on critical habitat and other land designations would be greatest under Alternative D due to the proposed increase of ungulate and PF construction and subsequent increased potential for habitat loss and disturbance. However, the adverse effects of increased fence construction can be minimized through compliance with BMPs. With implementation of BMPs, the potential for beneficial cumulative effects would be greatest under Alternative D over the long term.

4.3.5 Non-Listed Flora

The cumulative impacts on non-listed flora from past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include effects on individual native and nonnative plants, populations, and habitat quality and quantity.

Past activities in the Permit Area have resulted in both beneficial and adverse impacts on non-listed flora. Vegetation clearing, ground disturbance, and excavation associated with construction of predator exclusion fences resulted in habitat loss or degradation for nonnative plants. These management activities have resulted in direct adverse impacts on nonnative plants by removal and reduction of their growth and spread. Conversely, these activities in the Permit Area may have benefited non-listed native plants in the long run by facilitating improved growth and recruitment following removal of competing nonnative species.

Activities that are ongoing and reasonably likely to continue in the foreseeable future include conservation measures through HCPs (e.g., construction of predator exclusion fences, invasive plant species removal); federal actions discussed in Table 4-4 (integrated pest management at Hanalei NWR); and various habitat protection and restoration actions by federal, state, and private land management entities described in Section 4.2.3 (rat baiting and predator control, ungulate exclusion, weeding, and habitat restoration using native species). These actions can have a cumulative adverse impact on nonnative plants (e.g., removal of the plants) in the Permit Area but are likely to have long-term beneficial impacts on native plants. Long-term, adverse impacts on nonnative flora due to continuation of these actions are in the form of minimizing growth and spread and reducing population size. Beneficial impacts on non-listed native plans are improved growth and recruitment and enhanced local population size.

Reasonably foreseeable land development in the Plan Area will be limited to lowland urban and suburban areas. These activities that would result in habitat loss and degradation are expected to affect nonnative plants more than native plants because the lowland urban and suburban areas are dominated by nonnative and invasive plant species.

The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, would result in a cumulative effect on non-listed flora, both adverse and beneficial. Compared to the No Action alternative and the other action alternatives (B and C), the potential for beneficial cumulative effects on non-listed native plants would be the greatest under Alternative D because this alternative would protect the largest acreage of habitat in high-elevation conservation areas by establishing fenced enclosures to control ungulates, control predators, and manage vegetation. The potential for adverse cumulative effects on nonnative plants would also be the greatest under Alternative D because of the implementation of additional measures in place to control nonnative and invasive plant species.

4.3.6 Non-Listed Fauna

The cumulative impacts on non-listed fauna from other past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include effects on habitat quality and quantity.

Construction, clearing, excavation, and vegetation management associated with construction and operation of past activities in the Permit Area (e.g., land management actions, conservation measures, Covered Activities, and facility construction associated with the Kauaʻi Lagoons HCP and federal projects listed in Table 4-4) have resulted in habitat loss or degradation and disturbance for non-listed native species. Conversely, many of these past activities have enabled nonnative or invasive species to survive in disturbed habitat.

Restoration projects and habitat protections and conservation provided by other HCPs would improve habitat for native fauna by protecting, enhancing, and restoring habitat. Predator and invasive species management measures would also result in beneficial effects on native fauna by reducing predation and competition for resources with nonnative or invasive fauna.

The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, would result in a cumulative effect on non-listed fauna, both adverse and beneficial. The potential for adverse cumulative effects on non-listed fauna would be the greatest under Alternative A due to the lack of minimization for powerline collision and light attraction and the lack of conservation measures to remove predators and invasive species. The potential for adverse cumulative effects on non-listed fauna would be less under Alternatives B and C because there would be minimization measures implemented to reduce light attraction and powerline collision, as well as conservation measures including predator and invasive species removal. The potential for adverse cumulative effects on non-listed fauna and their habitat would be least under Alternative D. While there would be more predator fencing construction within habitat for non-listed fauna and more potential for habitat loss and disturbance, the adverse effects of increased fence construction can be minimized through compliance with BMPs. Over the long term, the potential for beneficial cumulative effects would be greatest under Alternative D.

4.3.7 Hydrology and Soils

The cumulative impacts on hydrology and soils from past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include erosion, soil compaction, runoff, and sedimentation. The impact mechanisms and types of impacts that would have a cumulative effect on hydrology and soils would be like those described in Section 3.8, *Hydrology and Soils*. For example, clearing, grubbing, grading, excavation, and vegetation management associated with construction and operation of past activities in the Permit Area have affected hydrology and soils (e.g., land management actions, conservation measures, Covered Activities, facility construction associated with the Kauaʻi Seabird HCP and the Kauaʻi Lagoons HCP). Similar activities from reasonably foreseeable future actions may similarly affect hydrology and soils. To the extent that impacts from the actions described in Section 4.2 occur within the same areas of the Covered Activities and conservation strategy of the Draft HCP, there could be an adverse cumulative effect on hydrology and soils. However, cumulative effects on hydrology and soils are expected to be minimized through compliance with state and federal laws and regulations that protect water and soils (e.g., Clean Water Act sections 401, 402, and 404; State of Hawaiʻi regulations and permits for grading, grubbing, and excavation activities). The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, would result in an adverse cumulative effect on hydrology and soils. The incremental contribution of the proposed action and alternatives to cumulative adverse effects would be greatest under Alternative D due to the additional acreage of site clearing and ground disturbance required for installation of fence posts and mesh skirt when compared to Alternatives B and C.

4.3.8 Air Quality and Climate Change

The cumulative impacts on air quality and climate change from past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include increased emissions and fugitive dust. The impact mechanisms and types of impacts that would have a cumulative effect on air quality and climate change would be similar to those described in Section 3.9, *Air Quality and Climate Change*. For example, vehicle and helicopter trips associated with implementation of the conservation strategy would generate criteria pollutants, volatile organic compounds, hazardous air pollutants from engine exhaust, greenhouse gases, and fugitive dust from disturbed earth surfaces. Similar activities from reasonably foreseeable future actions may similarly affect these resources. However, cumulative impacts on air quality are expected to be minimized through compliance with state and federal laws and regulations that protect air quality (e.g., national and state ambient air quality standards). The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, would result in cumulative adverse effects on air quality and climate change. The potential for adverse cumulative effects on air quality and climate change would be greatest under Alternative D due to additional helicopter emissions associated with expanded mitigation effort at conservation sites; however, cumulative emissions of the proposed action and alternatives in combination with other reasonably foreseeable actions are not expected to lead to a violation of ambient air quality standards or to have a noticeable impact on long-term air quality or climate change in the region.

4.3.9 Cultural Resources

Adverse cumulative effects on cultural resources can be characterized as those that result in the loss, degradation, or destruction of historic properties including properties listed on the National Register of Historic Places or determined to be significant under HAR 13-275/284-6(d), traditional cultural properties, and cultural landscapes. The impact mechanisms and types of impacts that would have a cumulative effect on cultural resources would be similar to those described in Section 3.10, *Cultural Resources*. Ground disturbance would occur at the conservation sites under Alternatives B and D for the installation of fencing, weatherports, landing zones, and artificial burrows, and for management actions related to predator control and invasive plant control. Other past, present, and reasonably foreseeable future actions within the same NARs would also result in localized ground disturbance. For example, prior construction and ongoing maintenance of predator and ungulate exclusion fences, weatherports, helicopter landing zones, artificial burrows, and general management have occurred within the same conservation areas. However, cumulative impacts on cultural resources are not expected to occur due to the overall limited extent of cumulative ground disturbance that would result from management actions at conservation areas combined with a predicted low density of historic properties in the interior areas where the conservation areas are located. Other past, present, and reasonably foreseeable future actions that result in ground disturbance in the vicinity of KIUC's infrastructure (i.e., powerlines, streetlights, and generating stations) would not result in cumulative impacts on cultural resources in combination with the proposed action and alternatives because operation of KIUC's infrastructure with minimization for collision and light attraction would not cause ground disturbance. In addition, it is assumed that other reasonably foreseeable actions in the Permit Area would comply with state and federal laws and regulations that protect cultural resources and practices (e.g., National Historic Preservation Act section 106, HEPA, HRS Chapter 6E) such that these actions would avoid or minimize adverse effects on cultural resources and practices.

4.3.10 Socioeconomics

The cumulative impacts on socioeconomics from past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include effects on electric utility rates in Kaua'i. Forecast population growth and land development would likely cause KIUC to expand its infrastructure (including power generation, electric power transmission, and distribution) to meet growing demand and to request rate increases to recover the cost of new capital improvements as well as inflation over the 50-year permit term. These reasonably foreseeable rate increases for capital improvements and inflation would be in addition to any rate increases required to cover the cost of implementing KIUC's earlier Short-term HCP as well as the Draft HCP over the 50-year permit term. KIUC's recent 2025 rate adjustments to fund HCP-related activities and other operational needs illustrate the potential for rising electricity costs. The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, would result in an adverse cumulative effect on socioeconomics through increased electricity rates. The potential for adverse cumulative effects on utility rates would be greatest under Alternatives C and D due to costs that would be incurred by KIUC to implement additional minimization or additional mitigation beyond what is included in the proposed action. Rate increases caused by the cumulative effect of the proposed action and alternatives in combination with other reasonably foreseeable actions would disproportionately affect low-income households within KIUC's service area because the cost of utilities represents a larger proportion of household income in low-income households.

4.3.11 Public Infrastructure and Services

The cumulative impacts on public infrastructure and services from past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include impacts on the reliability of power infrastructure, impacts on traffic on public roadway systems, and effects on public transit systems such as traffic on bus routes. For example, the Kūhiō Highway Emergency Shoreline Mitigation project involves road restoration and rehabilitation, which could result in short-term adverse impacts on public roadways and public transit during construction due to increased traffic but would have long-term beneficial impacts after the project is completed by improving roadways. Similarly, the Verizon Wireless Halfway Bridge Cell Site would introduce additional infrastructure to include a cell tower, power poles, and power and communication wires that would add to the aboveground power infrastructure that is owned and operated by KIUC, resulting in long-term beneficial impacts on public infrastructure and services after the project is completed due to increased reliability of power infrastructure. Adverse effects of road restoration and rehabilitation may include increased traffic delays, lane closures, and relocation of public transit stops during construction. Beneficial effects would include enhanced infrastructure reliability and resilience after the project is complete. Forecasted population growth is expected to increase demand for power infrastructure, public roadways, and public transit over the 50-year permit term. KIUC's Draft HCP anticipates the need to add power infrastructure over the permit term to address future demand. Increased demand for public roadways and public transit over the permit term would similarly be addressed through long-term state and county transportation planning. The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, could result in a cumulative effect on public infrastructure and services that is both adverse and beneficial. There is a potential for short-term adverse cumulative effects on public roadway systems or public transit systems and a potential for long-term beneficial cumulative effects on public infrastructure and services as new infrastructure is built to address the forecasted increase in demand. Cumulative impacts on public infrastructure and services would be similar between the proposed action and alternatives because the alternatives would not affect forecast growth or future demand for public infrastructure and services.

4.3.12 Recreation

The cumulative impacts on recreation from past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include effects on the enjoyment of recreational resources, particularly nature-based recreational experiences. For example, construction of projects such as the Verizon Wireless Halfway Bridge Cell Site could result in short-term adverse impacts including interruptions to lighting and electricity-dependent recreational facilities or adverse impacts on the setting of recreational resources. Many of the reasonably foreseeable future actions described in Section 4.2 would have long-term beneficial impacts on recreation facilities and activities associated with the enjoyment of natural resources, including implementation of conservation plans and land management efforts described in Section 4.2.3. For example, the proposed Kīlauea Point Bicycle and Pedestrian Access project would improve the existing bicycle and pedestrian path to connect downtown Kīlauea Town and the Kīlauea Point NWR overlook along Kīlauea Road. Additionally, the project would improve the parking configuration and flow of personal vehicles, transit vehicles, bicyclists, and pedestrians at the Kīlauea Point NWR overlook. While there would be potential adverse impacts during the 1-year construction period due to noise and visual intrusion, overall, the project would have beneficial impacts on recreation by increasing safety and access to the overlook. The maintenance of existing ungulate fencing at the conservation sites on state lands would not block or limit community access. Ungulate fencing is designed to protect native ecosystems from impacts caused by invasive ungulates, while allowing continued access for hunting and traditional gathering practices. Community members with valid permits and licenses would continue to be able to enter these public areas to hunt and gather, as they would have before. Fencing protected areas would enhance these spaces by improving habitat conditions, supporting the long-term sustainability of traditional gathering practices by ensuring the resource is preserved for future generations. New predator fencing under the proposed action would not contribute short- or long-term adverse effects on recreational uses of state lands because they would be constructed on private lands at the Upper Limahuli Preserve PF and Upper Mānoa Valley PF conservation sites. The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, would result in short-term adverse effects on recreational resources and long-term beneficial effects on recreational resources associated with the enjoyment of natural resources. Cumulative impacts on recreation would be similar to the effects described for the proposed action and alternatives in Section 3.13.3.5. Impacts associated with implementing mitigation measures are expected to be less under Alternatives B and C as compared to Alternative D because there are fewer measures, which are primarily in remote locations away from high recreational activity; however, beneficial impacts would be fewer as well.

4.3.13 Scenic Resources

The cumulative impacts on scenic resources from past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include effects on the scenic environment from infrastructure, light emissions, and conservation actions. For example, the Kūhiō Highway Emergency Shoreline Mitigation project involves road and beach rehabilitation, which may temporarily result in adverse visual impacts during construction but provide long-term beneficial visual impacts on coastal aesthetics. Similarly, the Verizon Wireless Halfway Bridge Cell Site would introduce additional power infrastructure, which could result in adverse physical impacts on scenic resources (such as tree clearing) during construction and visual impacts on scenic resources during operation. Implementation of conservation plans and activities could result in minor adverse physical and visual impacts on scenic resources from things like predator-control fencing but should have long-term beneficial impacts that enhance the scenic value of the island's rural habitats and enhance the natural aesthetic and biodiversity. The land management efforts described in Section 4.2.3 would result in ecological improvements that would enhance the scenic value of the island's rural habitats over the long term. The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, would result in short-term adverse effects on scenic resources and long-term beneficial effects on scenic resources. Cumulative impacts on scenic resources would be similar between the proposed action and alternatives; however, additional short-term disruptions and long-term benefits would be expected from implementing the additional mitigation measures described under Alternatives C and D.

4.3.14 Land Use

The cumulative impacts on land use from past, present, and reasonably foreseeable future actions, combined with those impacts occurring under the proposed action and alternatives, include effects such as changes to existing land ownership, land designations, or land uses. The impact mechanisms and types of activities that would affect land use from these other actions are like those occurring from the Covered Activities (see Section 3.15, *Land Use*). Construction-related activities could affect land resources through changes in land use from leases, easements, or land ownership; conflicts with land use compatibility where new uses are established as a result of construction; and temporary and long-term changes in the physical and natural environment that may affect other existing land uses. Generally, past, present and reasonably foreseeable future actions, including federal actions, population growth, and land development, could contribute to short- and long-term cumulative impacts on land use, including the potential loss of public and private lands used for other uses, such as agriculture. Past development trends on Kauaʻi indicated the potential for substantial residential growth in the form of single-family homes on large lots to occur on the agricultural and open zoning districts in the county (County of Kauaʻi 2018). In 2018, the county developed the Future Land Map as part of *Kauaʻi Kākou: Kauaʻi County General Plan* to avoid and reverse development and land use trends that could contribute to cumulative impacts on the rural character of Kauaʻi (County of Kauaʻi 2018). The plan's strategy focuses development, uses, and density within and around existing towns with the goal of preserving agricultural land and open spaces between towns. Therefore, cumulative impacts on land use are expected to be minimized through compliance with existing land use plans and zoning laws and regulations that govern land use. The incremental effects of the proposed action and alternatives, when added to the effects of past, present, and reasonably foreseeable future actions, would result in adverse cumulative effects on land use. The potential for adverse cumulative impacts on land use would be similar among the proposed action and alternatives because implementation of the conservation strategy under any of the action alternatives would not fundamentally change how public or private lands are managed at conservation sites. Fencing implemented under the HCP's conservation strategy does not preclude access to state lands; subsistence activities such as hunting and gathering remain permissible within fenced areas with appropriate permits, consistent with existing access rights irrespective of fencing. Furthermore, none of the alternatives would induce the land use changes associated with forecasted growth.

Chapter 5
Consistency with Land Use and Resource Plans, Policies, and Controls

Pursuant to Hawaiʻi Administrative Rules 11-200.1-24(j), Sections 5.1 through 5.10 below evaluate the consistency of the proposed action with state land use and resource plans, policies, and controls for the affected area (defined as the Permit Area for this action). Consistency with requirements for compliance with NEPA, HEPA, the ESA, and HRS Chapter 195D are addressed throughout this EIS. Consistency with requirements of cultural resource laws and regulations are addressed in Section 3.10, *Cultural Resources*, and Appendix A, *Consultation and Coordination*.

5.1 Hawaiʻi State Plan

The Hawaiʻi State Plan establishes a statewide planning system that outlines state goals, objectives, and policies. It is the goal of the state, under the Hawaiʻi State Planning Act (HRS 226), to achieve the following:

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

Specific objectives and policies of the Hawaiʻi State Plan that pertain to the Draft HCP conservation strategy include:

- Section 226-11(a)(1): Prudent use of land-based, shoreline, and marine resources.
- Section 226-11(a)(2): Effective protection of unique and fragile environmental resources in Hawaiʻi.
- Section 226-11(b)(1): Exercise an overall conservation ethic in the use of natural resources.
- Section 226-11(b)(2): Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.
- Section 226-11(b)(4): Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.
- Section 226-11(b)(6): Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaiʻi.
- Section 226-12(b)(1): Promote the preservation and restoration of significant natural and historic resources.
- Section 226-12(b)(4): Protect those special areas, structures, and elements that are an integral and functional part of ethnic and cultural heritage.

- Section 226-13(a)(1): Maintenance and pursuit of improved quality in land, air, and water resources in Hawaiʻi.
- Section 226-13(b)(2): Promote the proper management of land and water resources in Hawaiʻi.
- Section 226-13(b)(3): Promote effective measures to achieve desired quality in surface, ground, and coastal waters.

Implementation of the Draft HCP conservation strategy would further the goals of the Hawaiʻi State Plan and would be complementary to the state's objectives for the physical environment listed above because it would implement measures to protect and benefit eight federally and state-listed seabirds and waterbirds, and one federally and state-listed turtle (see Section 2.2.2.3, *Covered Species*). The KIUC conservation strategy is designed to implement measures that would provide a net benefit to each species and avoid, minimize, and mitigate the impact of the taking of Covered Species from Covered Activities. The Draft HCP conservation strategy also includes biological goals and objectives for each Covered Species, which broadly describe desired future conditions and how they would be achieved. The conservation sites were carefully planned and selected to be compatible with the needs of the covered seabirds and the character of the surrounding areas. The Service and DLNR provided extensive input into the selection and design of proposed conservation sites and provided recommendations based on detailed studies of topography, presence of existing breeding colonies, threats of light attraction and powerline collisions, and suitable breeding habitat modeling.

The risk of adverse effects on the physical environment would be reduced by application of best management practices during construction and maintenance activities at conservation sites (see Section 3.8.3.2, *Alternative B Proposed Action [Hydrology and Soils, Environmental Consequences]*). For example, fencing specifications that would avoid or minimize adverse impacts on hydrology and soils include avoidance of fence construction across streams, rivers, pools, and other drainageways and design specifications to minimize earthwork.

5.2 State Land Use Law

The State Land Use Law, HRS Chapter 205, was originally adopted by the State Legislature in 1961. This law established an overall framework of land use management whereby all lands in the state of Hawaiʻi are classified into one of four land use districts: Urban, Agricultural, Conservation, and Rural. As detailed in Section 3.15, *Land Use*, all of the conservation sites identified in the Draft HCP fall within the State Land Use Conservation District. The purpose of the Conservation District is to conserve, protect, and preserve the important natural and cultural resources of the state through appropriate management and use to promote their long-term sustainability and the public health, safety, and welfare (Hawaiʻi Administrative Rules §13-5-1). The conservation strategy presented in the Draft HCP would be consistent with the purposes of the Conservation District and its Protective and Special subzones (refer to Section 3.15.3 for additional information).

5.3 Kauaʻi County General Plan

Kauaʻi Kākou, the 2018 Kauaʻi County General Plan, set priorities for managing growth and community development over a 20-year planning period (County of Kauaʻi 2018). The plan provides guidance on future actions related to land use and development regulations, urban renewal programs, and capital improvement expenditures. Nineteen policies address key issues for Kauaʻi residents concerning existing issues and anticipated growth. Policies from the Kauaʻi County General Plan relevant to the Draft HCP conservation strategy include, but are not limited to, the following:

- Policy #8: Protect the Scenic Beauty of Kauaʻi
- Policy #12: Protect our Watersheds
- Policy #15: Respect Native Hawaiian Rights and Wahi Pana
- Policy #16: Protect Access to Treasured Places on Kauaʻi

Relating to specific sections of the general plan, the *Threatened and Endangered Species Objective* to “protect the flora and fauna unique to Kauaʻi and Hawaiʻi and to mitigate the impact of invasive species” (County of Kauaʻi 2018) would be directly supported by the Draft HCP conservation strategy. The conservation strategy would manage designated areas on the landscape for the benefit of Covered Species, including implementation of invasive plant control within the conservation sites and implementation of a honu (green sea turtle, *Chelonia mydas*) nest detection and shielding program. Because the conservation strategy is designed to achieve the biological goals and objectives for the Draft HCP’s Covered Species, it would also align with the general plan’s objective to save natural heritage on the island and support the continued presence of ʻaʻo (Newell’s shearwater, *Puffinus newelli*) and ʻuaʻu (Hawaiian petrel, *Pterodroma sandwichensis*), which are specifically mentioned in the general plan. As noted in Section 3.2, the conservation strategy would manage and enhance 12 conservation sites to support the breeding success of ʻaʻo (Newell’s shearwater) and ʻuaʻu (Hawaiian petrel), and to benefit ʻakēʻakē (band-rumped storm-petrel, *Hydrobates castro*).

5.4 County of Kauaʻi Comprehensive Zoning Ordinance

The Comprehensive Zoning Ordinance for the County of Kauaʻi provides regulations and standards for land development and the construction of buildings and other structures in the County of Kauaʻi (County of Kauaʻi 2012). These regulations and standards are intended to regulate development to ensure its compatibility with the overall character of the island. The zoning code can also specify the permissible uses and intensity in the State Land Use Districts consistent with the State Land Use law (HRS Chapter 205). As detailed in Section 3.15.2, KIUC powerline operation, retrofit, use of night lighting for repairs, and lighting operations (facility lights and streetlights) are anticipated to occur within areas where county and/or state agencies have reviewed and approved plans and deemed that the activities are appropriate and consistent with existing land uses in the area. All of the conservation sites fall within the State Land Use Conservation District. The conservation strategy and Covered Activities are anticipated to be permissible uses that would be implemented in accordance with the regulations and standards contained in the Comprehensive Zoning Ordinance for land development and the construction of structures in the county.

5.5 Hono O Nā Pali Natural Area Reserve Management Plan

The 2011 Hono O Nā Pali Natural Area Reserve (NAR) Management Plan (DOFAW 2011) describes the management program for the Hono O Nā Pali NAR. The overall management goal of the Hono O Nā Pali NAR Management Plan is to manage threats to the integrity, diversity and functioning of Hono O Nā Pali NAR ecosystems so that the unique natural resources are protected, maintained, and enhanced (DOFAW 2011). Six conservation sites occur within the Hono O Nā Pali NAR: Pihea, North Bog, Pōhākea, Pōhākea Predator Fence (PF), Hanakoa, and Hanakāpiʻai. Sections of ungulate fencing combined with steep terrain that is considered not traversable by pigs are located in portions around the perimeter of Hono O Nā Pali NAR. Ungulate eradication is ongoing, but ungulate populations are heavily reduced. At all of these conservation sites, predator control and invasive plant control would occur under the HCP. The existing Hono O Nā Pali ungulate exclusion fence sections were constructed by the DLNR Division of Forestry and Wildlife in 2012 to restrict ungulates from entering the NAR and the DLNR Division of Forestry and Wildlife maintains these fences; all other actions have been conducted by KIUC since 2012. Proposed conservation strategies at these six conservation sites directly correspond to the existing management goals and programs for the Hono O Nā Pali NAR and would be consistent with, and complement, management guidance contained in the Hono O Nā Pali NAR Management Plan.

5.6 Kōkeʻe and Waimea Canyon State Parks Master Plan

The primary goals of the Kōkeʻe and Waimea Canyon State Parks Master Plan include preservation and management of existing natural resources and facilities, and perpetuation of the existing character of the parks by maintaining the areas unique native ecosystems, vistas, trails, and historic cultural landscapes (DLNR, Division of State Parks 2014). The following goal from the Kōkeʻe and Waimea Canyon State Parks Master Plan is relevant to the Draft HCP conservation strategy:

- Goal 1: Natural Resources – To protect, preserve, and restore the unique natural environments of Kōkeʻe and Waimea Canyon, enhance human understanding and appreciation of the native ecosystems of Hawaiʻi and introduced species, and ensure the continued existence of the unique flora and fauna in Hawaiʻi for their own sake and for the benefit of future generations in Hawaiʻi.

Specific natural resources management guidance from the Kōkeʻe and Waimea Canyon State Parks Master Plan that are relevant to the Draft HCP conservation strategy include:

- Develop and implement restoration plans for natural plant communities.
- Continue and expand invasive species control, including control of jungle fowl.
- Update and improve administrative rules and lease conditions to protect natural resources and improve enforcement rules.

The proposed Honopū conservation site is the only conservation site within the Kōkeʻe State Park. The conservation strategy for the Honopū conservation site would be consistent with and support the goals and management guidance outlined in the Kōkeʻe and Waimea Canyon State Parks Master Plan. An existing ungulate fence at Honopū would be maintained and invasive plant species control would occur on an as-needed basis, resulting in benefits to natural resources in Kōkeʻe State Park that would further the overall master plan goal of preserving, managing, and maintaining the park's existing natural resources and unique ecosystems.

5.7 Nā Pali-Kona Forest Reserve Management Plan

The Nā Pali-Kona Forest Reserve Management Plan is intended to describe short-term resource management planning and implementation strategies and to serve as a basis for future updates to accommodate evolving or additional objectives such as increased hunting opportunities and additional fencing projects (DOFAW 2009). Management priorities of the plan are divided into eight categories: Watershed Values (aquifer recharge and erosion control); Resource Protection (fire, insects, and disease); Invasive Species Control (incipient and established plants and animals); Threatened and Endangered Species Management (federally listed, state listed, and rare plants and animals); Native Ecosystems (landscape level protection); Game Animal Management (areas managed for public hunting and/or habitat enhancement for game animals); Commercial Activity (income-generating activities such as timber and tours, among others); and Additional Public Activity (non-income-generating uses, such as recreation, cultural activities, personal gathering, educational or research activities, and events, among others) (DOFAW 2009). The following management priorities of the Nā Pali-Kona Forest Reserve Management Plan are relevant to the Draft HCP conservation strategy and are consistent with the objectives of the Honopū and Honopū PF conservation sites, both of which occur in the Nā Pali-Kona Forest Reserve:

- Invasive Species Control: Control of both incipient and established plants and animals.
  - Invasive plant control is focused on conducting regular ground and aerial surveys, continuing work with Kōkeʻe Resource Conservation Program and volunteers, and supporting biological control efforts. Support efforts to prevent establishment of potential ecosystem changing invasive species.
  - Invasive animal control is focused on the detection and reduction of rodent and feral cat populations.
- Threatened, Endangered, and Rare Species Management
  - Rare plant conservation is focused on protecting and enhancing populations of extant species by monitoring wild populations, collecting propagation materials for ex situ propagation and/or seed storage, surveying appropriate areas for additional populations, mitigation of threats as needed (fenced exclosures, feral animal control, alien weed suppression), and reintroduction of individuals in appropriate protected areas within and outside of the forest reserve.
  - Rare animal conservation consists of protecting native forest birds (puaiohi recovery project and Kauaʻi forest bird surveys), surveying for native seabird nesting sites, and working with the Hawaiʻi Bat Research Cooperative to conserve ʻōpeʻapeʻa (Hawaiian hoary bat, *Lasiurus semotus*).
- Native Ecosystem Management: Native habitat protection and restoration is focused on protecting portions of the Alakaʻi by working with Kauaʻi Watershed Alliance on fencing and supporting research projects that address ecosystem issues specific to the forest reserve.

The conservation strategy for the Honopū and Honopū PF conservation sites would be consistent with and directly support the management priorities listed above from the Nā Pali-Kona Forest Reserve Management Plan. At the Honopū PF conservation site, the conservation strategy is designed to directly benefit rare seabirds and their habitats through the maintenance of existing predator fencing that would exclude introduced terrestrial predators including feral cats, rats, pigs, and goats. Social attraction techniques consisting of the removal of unsuitable vegetation and replanting of native species, installation of artificial burrows, and broadcasting of calls during peak breeding season (April through mid-August) are anticipated to enhance populations of the targeted seabirds (ʻaʻo, Newell's shearwater) and native plants. Additionally, invasive plant species control at Honopū and Honopū PF conservation sites would be consistent with the Nā Pali-Kona Forest Reserve Management Plan management priorities for invasive species control and threatened, endangered, and rare species management.

5.8 Nā Pali Coast Management Plan

The Nā Pali Coast Management Plan and Revised EIS (DLNR 1982) describes overall management for the Nā Pali Coast State Wilderness Park, including management guidance and objectives for recreation, park boundaries, resource management, visitor use, and services. A portion of the Honopū conservation site is within the Kalalau Unit of the Nā Pali Coast State Wilderness Park. Nā Pali Coast Management Plan management guidance for the Kalalau Unit is focused on visitor use management and recreation resource management for activities such as camping, hiking, and hunting. Existing conservation actions at the Honopū site include maintenance of an existing ungulate exclusion fence, predator control, and invasive plant control. The ungulate fence and initial predator control measures at the site were initiated by other entities in 2022; KIUC began conducting fence maintenance, predator control, and invasive plant control in 2023 (ICF 2025). The KIUC conservation strategy at the Honopū site would include continued predator control and invasive plant species management. Additionally, under the Draft HCP, KIUC has committed to funding long-term acoustic monitoring at 20 sites throughout the Nā Pali coast. Since 2014, acoustic sensors have been deployed at 14 sites, but funding has been inconsistent between years. Long-term, systematic monitoring in this area for the length of the permit term would increase the availability of data and allow more reliable detection of seabird distribution and abundance trends in the future. These actions would be consistent with existing activities and the overall management guidance outlined in the Nā Pali Coast Management Plan, which include objectives to preserve native flora and address grazing impacts from goats.

Chapter 6
Other Impacts

Per the United States Department of the Interior's NEPA Procedures at 43 CFR § 46.415 and Hawaiʻi Administrative Rules 200.1-24, this chapter covers the following topics that the EIS must include: any adverse environmental effects that cannot be avoided should the proposal be implemented; the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity; and any irreversible or irretrievable commitments of resources that would be involved in the proposal should it be implemented. Conclusions for these specific impact topics are based on information and analysis contained in Chapter 3, *Affected Environment and Environmental Consequences*, and Chapter 4, *Reasonably Foreseeable and Cumulative Effects*.

6.1 Unavoidable Adverse Effects

Any adverse effects associated with the alternatives are described in Chapter 3, *Affected Environment and Environmental Consequences*. As described in Section 3.1.2, *Analysis Assumptions*, the construction of powerlines, minimization features, or streetlights are not Covered Activities in the Draft HCP and therefore are not analyzed in the EIS. Construction activities analyzed in the EIS are specific to implementation of the conservation strategy, and include two predator exclusion fences, an estimated 30 artificial burrows, and up to two helicopter landing zones and weatherports, which are applicable to Alternatives B, C, and D and additional ungulate and predator exclusion fencing under Alternative D. These construction activities are Covered Activities. The impacts associated with these construction activities could result in unavoidable adverse effects on resources such as flora, critical habitat, hydrology, and soils but would be conducted in accordance with best management practices described in the Draft HCP to minimize adverse impacts as summarized in Section 3.8.3.2, *Alternative B Proposed Action* (*Hydrology and Soils, Environmental Consequences*). Unavoidable adverse effects on air quality could result from an estimated 1,200 vehicle trips and 245 helicopter trips on an annual basis from implementation of Alternatives B, C, and D, and an additional 78 helicopter trips annually for only Alternative D. However, impacts on air quality from Alternatives B, C, and D are not likely to lead to a violation of ambient air quality standards or have a noticeable impact on long-term air quality or climate change in the region. Implementation of Alternatives B, C, and D would also have unavoidable adverse socioeconomic effects resulting from rate increases for electric power to cover the cost of implementing the HCP. Rate increases would disproportionately affect low-income households because electricity costs account for a larger proportion of household income within low-income households. Although implementation of Alternatives B, C, and D would reduce impacts on the Covered Species compared to the No Action alternative, unavoidable adverse impacts due to incidental take of the Covered Species is still expected to occur under the proposed action and the action alternatives.

6.2 Relationship Between Short-term Uses and Long-term Productivity

As required by NEPA, agencies preparing an EIS must analyze and disclose "the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (42 U.S.C. 4332(2)(C)(iv)). Implementation of the conservation strategy under Alternatives B, C, or D would involve short-term use of the environment due to ground disturbance; the use of raw materials for fencing, predator control, invasive species control, and social attraction; and the use of fuel to transport staff and materials to conservation sites and to implement long-term monitoring. Impacts from the short-term uses of the environment are described in the relevant environmental consequences sections of Chapter 3. Implementation of Alternatives B, C, or D would have beneficial impacts on the long-term productivity of the environment by ensuring net benefits to the federally and state-listed species that are covered by the Draft HCP, as described in Section 3.2, *Covered Species*.

6.3 Irreversible and Irretrievable Commitments of Resources

As required by NEPA, agencies preparing an EIS must analyze and disclose "any irreversible and irretrievable commitments of federal resources that would be involved in the proposed agency action should it be implemented" (42 U.S.C. 4332(2)(C)(v)). At this time, it is not expected that federal resources would be involved in the implementation of the proposed agency action, which is the issuance of an ESA section 10(a)(1)(B) incidental take permit for Covered Activities proposed in the Draft HCP. However, non-federal resources would be utilized if the proposed action or action alternatives are implemented due to the implementation of the Draft HCP's Covered Activities. Therefore, for the purposes of this analysis, the Service defines irreversible commitments as decisions affecting nonrenewable resources or commitments that cannot be reversed. The term *irreversible* describes the loss of future options and applies to the impacts of using nonrenewable resources or resources that are renewable only over a long period of time. The use of raw materials and fuel described in Section 6.2 would represent irreversible commitments of resources under Alternatives B, C, and D. The Service further defines *irretrievable* commitments of resources as the long-term or permanent loss of a resource such as destruction of a cultural resource site, loss of soil productivity, or extinction of a species. These types of impacts under Alternatives B, C, and D would be avoided and minimized to the extent possible. Although mortality of individual Covered Species during Covered Activities could occur, the purpose of the Draft HCP is to ensure these losses would not result in permanent adverse changes at the population level or significantly and adversely alter population dynamics. Alternatives B, C, and D would slow or reverse the decline of the Covered Species compared to Alternative A (No Action) and avoid the irretrievable commitment of the Covered Species.

Chapter 7
List of Preparers

7.1 U.S. Fish and Wildlife Service

Name	Project Role	Qualifications
Koa Matsuoka	Pacific Islands Fish and Wildlife Office; EIS Lead Biologist	MS, Conservation Biology, 6 years of experience
Leila Nagatani	Pacific Islands Fish and Wildlife Office; KIUC HCP Lead Biologist	BS, Wildlife Biology, 18 years of experience
Amy Defreese	Pacific Regional Office; Section 10 Biologist	ME, Water Resources Planning; 15 years of experience
Kate Freund	Pacific Regional Office; Conservation Planning Branch Manager	MEM, Environmental Management; 17 years of experience
Emma Gosliner	Pacific Regional Office; NEPA Coordinator	MPA, Environmental Science and Policy; 7 years of experience
Alton Exzabe	Section 106 Lead	BA, Anthropology, 22 years of experience

7.2 ICF

Name	Project Role	Qualifications
Hova Woods	Project Director, QA/QC	MPA, Environmental Policy and Science; 24 years of experience
Tanya Copeland	Project Manager	MS, Biology (Ecology and Evolution); 24 years of experience
Rebecca Jost	Deputy Project Manager, Cumulative Effects	MA, Environmental Science; 9 years of experience
Alex Bartlett	Water Resources and Wetlands, Land Use	BS, Environmental Studies; 19 years of experience
David Ernst	Air Quality	MCRP, Environmental Policy; 45 years of experience
Kelsey Hartfelder	Air Quality	BS, Environmental Science; 6 years of experience
Gray Jones	Socioeconomics, Public Infrastructure and Services, Recreation, Scenic Resources	BA, Environmental Sociology; 8 years of experience
Jenna Wheaton	Cultural Resources	BA, Anthropology; 13 years of experience
Brent Read	GIS	MS, Watershed Science; 24 years of experience

Name	Project Role	Qualifications
Dave McKenzie	GIS	BA, Geography; 15 years of experience
Saadia Byram	Editing	32 years of experience

7.3 H.T. Harvey & Associates

Name	Project Role	Qualifications
Shahin Ansari	Flora, Fauna, Covered Species, Other Listed Species and Critical Habitat	PhD, Botany; 25 years of experience
Sophie Bernstein	Flora, Fauna, Covered Species, Other Listed Species and Critical Habitat	MS, Marine Science; 6 years of experience
Steve Rottenborn	Flora, Fauna, Covered Species, Other Listed Species and Critical Habitat	PhD, Biological Sciences; 30 years of experience
Ilana Nimz	Seabirds	MS, Conservation Biology; 14 years of experience

Chapter 8
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8.7 Chapter 6, Other Impacts

None cited.

Appendix A
Consultation and Coordination

A.1 Required Permits and Approvals

Permits and approvals required for implementation of the Draft HCP are listed in Table A-1.

Table A-1. Permits and Approvals Required for Draft HCP

Permit or Approval	Jurisdiction	Description
Federal		
Incidental Take Permit	Service	Required for incidental take of federally listed species covered in the Draft HCP.
State		
Incidental Take License	DLNR	Required for incidental take of state listed species covered in the Draft HCP.
Natural Area Reserve Research Permit	DLNR	Annual renewal required for ongoing and planned management actions in natural area reserves undertaken by KIUC's contractors.
Natural Area Reserve System Special Use Permits	DLNR	Required activities within the Natural Area Reserve System that involve groups of more than 10 people or activities outside of personal recreation, including research.
Conservation District Use Permit	DLNR	Required for use of lands classified as conservation district.
Forest Reserve Special Use Permits	DLNR	Required for activities within a forest reserve other than camping, hunting, research, Hawaiian traditional and customary practices, or collecting forest items.
Hawaiʻi State Park System Special Use Permit	DLNR	Required for certain activities within state parks including scientific research and gathering of forest products.
Land Agreements		
Land Access and Management Agreement	National Tropical Botanical Garden	A land access and management agreement with National Tropical Botanical Garden is needed for implementation of the Draft HCP at Upper Limahuli Preserve.
Land Access and Management Agreement	State of Hawaiʻi	Land access and management agreement with State of Hawaiʻi is needed for implementation of the Draft HCP on conservation sites on state lands.
Conservation Easement/ Land Access Agreement	Private landowner	Conservation easement and land access agreement with private landowner is needed for implementation of the Draft HCP at Upper Mānoa.

A.2 Early Consultation for EIS and Environmental Impact Statement Preparation Notice Distribution List

Pursuant to Hawaiʻi Administrative Rules §11-200.1-23, KIUC initiated early consultation for preparation of the EIS with publication of the Hawaiʻi Environmental Policy Act (HEPA) Environmental Impact Statement Preparation Notice (EISPN) in *The Environmental Notice* on June 8, 2022, and distribution of the HEPA EISPN by mail to the agencies, organizations, and other interested parties identified in Table A-2.

Table A-2. Distribution List for the HEPA EISPN

HEPA EISPN Distribution List	Comments Received
Federal Agencies	
U.S. Army Corps of Engineers, Honolulu District	
U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office	
U.S. Navy, Pacific Missile Range Facility	
State of Hawaiʻi Agencies	
Department of Agriculture	
Agribusiness Development Corporation	
Department of Accounting and General Services	X
Department of Business, Economic Development & Tourism	
Hawaiʻi State Energy Office	
Office of Planning and Sustainable Development	
Department of Hawaiian Home Lands	
Department of Health	
Clean Water Branch	
Clean Air Branch	
Department of Land and Natural Resources	
Land Division	X
Office of Conservation and Coastal Lands	
State of Hawaiʻi Commission on Water Resources	
State Historic Preservation Division	
Division of Aquatic Resources	
Division of Forestry and Wildlife	
Engineering Division	
Division of State Parks	
Department of Transportation	X
Office of Hawaiian Affairs	
County of Kauaʻi Agencies	
Office of Economic Development	
Department of Parks and Recreation	
Department of Public Works, Engineering Division	

HEPA EISPN Distribution List	Comments Received
Department of Water, Water Resources and Planning	
Kauaʻi County Planning Department	
Kauaʻi County Farm Bureau	
Kauaʻi Chamber of Commerce	
Elected Officials	
State Senate Representative, Ronald D. Kouchi, District 8	
State House Representative, James Kunane Tokioka, District 15	
State House Representative, Dee Morikawa, House District 16	
State House Representative, Nadine K. Nakamura, House District 14	
Mayor Derek S.K. Kawakami, Office of the Mayor	
Council Chair, Arryl Kaneshiro, Kauaʻi County Council	
Council Vice Chair, Mason K. Chock, Kauaʻi County Council	
Councilmember, Bill DeCosta, Kauaʻi County Council	
Councilmember, Luke Evslin, Kauaʻi County Council	
Councilmember, Bernard P. Carvalho, Jr., Kauaʻi County Council	
Councilmember, Felicia Cowden, Kauaʻi County Council	
Councilmember, KipuKai Kualiʻi, Kauaʻi County Council	
Councilmember, Nalani K. Kaauwai Brun, Kauaʻi County Council	
Community Institutions and Organizations	
Kauaʻi Visitors Bureau	
Kauaʻi Economic Development Board, Inc.	
Kauaʻi Planning & Action Alliance	
Earthjustice	X
Hallux	
National Tropical Botanical Garden	
Hanalei Watershed Hui	
Kauaʻi Forest Bird Recovery Project	
American Bird Conservancy	
Public Repositories	
Hawaiʻi State Public Library	
Lihue Public Library	

A.3 Consultation for Cultural Impact Assessment

The individuals and organizations identified in Table A-3 were invited to consult on the Cultural Impact Assessment prepared for the KIUC HCP EIS.

Table A-3. Distribution List Receiving Consultation Letter for the Cultural Impact Assessment

Name	Affiliation
Ahuna, Dan	OHA, Kauaʻi Island Representative
Albao, Liberta Hussey	Pelekikena, Queen Debra Kapule Hawaiian Civic Club

Name	Affiliation
Battad, Kahu Jade Waiʻaleʻale	
Blake, Ted	Kamaʻāina
Ching, Milton	Cultural Monitor
Chun, Malia	Program Coordinator, Nā Pua Noʻeau – Kauaʻi
Chun, Sean	Lāʻau lapaʻau
Faye, Chris	Kōkeʻe Natural History Museum
Flores, Peleke	
Fu, Jessica Kaui	Pelekikena, Hanalei Hawaiian Civic Club
Hewett, Kumu Kawaikapuokalani Frank Loea Lehua	Kumu Hula, Ka Hula o ʻIlima, Kahuna lāʻau lapaʻau
Hob, Osterlund	Founder, Kauaʻi Albatross Network
Hoʻokano, Canon	
Ida, Gerald	Chair, Kauaʻi Historic Presevation Commission
Kahalekai, Kauilani	Musician, Kahu, KNIBC Puna Rep.
Kaiaokamalie, Lea	County of Kauaʻi Planning Department
Kalama, Kumu Nathan	Kumu Hula
Kaohelauliʻi, John	Kauaʻi Native Hawaiian Chamber of Commerce
Kaohi, Althea	Historian, Former Director, West Kauaʻi Visitor Center
Kauaʻi Museum	
Kauka, Sabra	Hawaiian Studies Kumu
Kekua, Kehaulani	Kumu Hula, Hālau Palaihiwa o Kaipuwai
Kinimaka-Alquiza, Kapu	Kumu Hula
Kualiʻi, Kipukai	Council Member
Makua, Kaina	Aloha Aina Poi Company
Mālama Hūleʻia	
Moriarty, Linda	Interim President, Kauaʻi Historical Society
Muraoka, Beverly	Kumu Hula, cultural practitioner, and former entertainer at Coco Palms Hotel
Ofisa, Coty “Buffy”	Kamehameha Schools Resource Center
Pavao-Jardin, Kumu Leinaʻala	Kumu Hula, Hālau Ka Lei Mokihana o Leinaʻala
Peters, Sarah	Pelekikena, Kaumualiʻi Hawaiian Civic Club
Robinson, Bruce	
Rogers, Alohilani	Cultural Education Specialist, Kawaikini New Century Public Charter School
Soma, Dirk	Former member of Kauaʻi Native Hawaiian Chamber of Commerce
Sproat-Beck, Stacy	Executive Director, Waipā Foundation
Topolinski, Kumu Kahaʻi	Kumu Hula, Ka Pā Hula Hawaiʻi
Trask, Mauna Kea	Former County Attorney and Cultural Historian
Vidinha, Kahu Wayne	Ke Akua Mana Church
Wichman, Charles “Chipper” R.	President, National Tropical Botanical Garden
Wichman, Randy	Former President of Kauaʻi Historical Society

A.4 National Historic Preservation Act Section 106 Consultation

Section 106 of the National Historic Preservation Act of 1966 (NHPA), as amended (16 U.S.C. 470f), established the Advisory Council on Historic Preservation, State Historic Preservation Officers, and the National Register of Historic Places (NRHP) and mandates that federal agencies consider an undertaking's effects on cultural resources that are listed or eligible for listing on the NRHP (see 36 CFR Part 800). Historic properties are "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR 800.16)."

The Advisory Council on Historic Preservation is authorized by section 211 of the NHPA to issue regulations to govern implementation of section 106 of the NHPA. These regulations, "Protection of Historic Properties" (36 CFR Part 800), establish the process that federal agencies must follow in order to consider the effects of their undertakings on historic properties and provide the Advisory Council on Historic Preservation its required opportunity to comment. Section 106 establishes a four-step review process by which historic properties are given consideration during the conduct of federal undertakings and requires that agencies consult with the State Historic Preservation Officer to determine if the agency's undertaking could affect historic properties. The Service is the lead federal agency for the section 106 undertaking. The Service initiated section 106 consultation with the State Historic Preservation Officer and consulting parties in letters dated December 18, 2024, that included a description of the undertaking, the undertaking's proposed area of potential effects, and information on existing historic properties within the area of potential effects. The letters asked whether parties have knowledge of other historic properties in the area of potential effects and requested that parties identify issues relating to the undertaking's potential to affect such properties. The section 106 consultation letter was distributed to the invited consulting parties identified in Table A-4.

Table A-4. NHPA Section 106 Invited Consulting Parties

NHPA Section 106 Distribution List	Comments Received
ʻAha Mālama Corp.	
ʻĀina Momona	
Aloha Aina Poi Company	
Association of Hawaiian Civic Clubs	
Council for Native Hawaiian Advancement	
County of Kauaʻi Planning Department	X
E Ola Kākou Hawaiʻi	X
Hālau Ka Lei Mokihana o Leinaʻala	
Hālau Palaihiwa o Kaipuwai	
Hale Halawai ʻOhana O Hanalei	
Hale Mua Cultural Group	
Hanalei River Heritage Foundation	X

NHPA Section 106 Distribution List	Comments Received
Historic Hawaiʻi Foundation	X
Hui Hana Paʻakai o Hanapēpē	
Hui o Laka	
Kamehameha Schools Resource Center	
Kauaʻi Albatross Network	
Kauaʻi Historic Preservation Commission	
Kauaʻi Historical Society	
Kauaʻi Museum	
Kauaʻi Native Hawaiian Chamber of Commerce	
Kauaʻi Sea Farm	
Kaumualiʻi Hawaiian Civic Club	
Kiaʻi Kanaloa	
Ke Akua Mana Church	
Koʻolau Foundation	
Mahamoku ʻOhana Council	
Mālama Anahola	
Mālama Hulēʻia	
Nā Kuleana o Kānaka ʻŌiwi	
Na Moʻokūpuna O Wailua	
Nā Pali Coast ʻOhana	
National Tropical Botanical Garden	
Office of Hawaiian Affairs	X
The Nature Conservancy	
Queen Debra Kapule Hawaiian Civic Club	
Waipā Foundation	

Native Hawaiian organizations that responded and the Service provided comments to:

- County of Kauaʻi Planning Department
- E Ola Kākou Hawaiʻi
- Hanalei River Heritage Foundation
- Office of Hawaiian Affairs
- Hui o Laka
- Historic Hawaiʻi Foundation

The Service has provided responses to comments continuing the section 106 process. The Service is in the process of drafting correspondence to present a finding of effect, which will be distributed to consulting parties.

NEPA states that federal agencies shall take into consideration impacts on the natural environment, including cultural resources, with respect to an array of resources, and that alternatives must be considered.

Appendix B
Scoping Summary

B.1 Scoping Process

The Service and DLNR conducted concurrent scoping processes for the public to provide input on preparation of the joint federal/state EIS to evaluate the impacts of issuing a federal incidental take permit (ITP) and state incidental take license (ITL), collectively known as *take authorizations*, and implementation of the Draft HCP.

The purpose of the scoping phase is to invite the public, other government agencies, the scientific community, Native Hawaiian organizations and entities, industry, and other interested parties (herein referred to as *interested parties*) to provide meaningful input to be considered in preparation of the EIS.

All members of the public, including any interested parties, were encouraged to submit comments on the scope of analysis, alternatives, and suggestions on data or information that should be considered in the EIS. The scoping period began on June 8, 2022 and ended on July 8, 2022.

The Service published a Notice of Intent (NOI), in compliance with NEPA, in the *Federal Register* on June 8, 2022 (Docket No. FWS-R1-ES-2022-0068). A copy of the NOI is available online: https://www.regulations.gov/document/FWS-R1-ES-2022-0068-0001.

DLNR published an Environmental Impact Statement Preparation Notice (EISPN) on June 8, 2022, initiating preparation of an EIS under HRS Chapter 343. A copy of the EISPN is included as Attachment B-1 to this appendix and is also available online: https://files.hawaii.gov/dbedt/erp/Doc_Library/2022-06-08-KA-EISPN-Kauai-Island-Utility-Cooperative-Habitat-Conservation-Plan.pdf.

A virtual public scoping meeting for the NEPA NOI and Hawaiʻi Environmental Policy Act (HEPA) EISPN was held on June 28, 2022, from 5:00 p.m. to 7:00 p.m. Hawaiʻi Standard Time. The virtual scoping meeting included presentations, a question-and-answer session, and an opportunity to provide oral comments. No comments were received during the virtual public scoping meeting.

Written public comments received on either the NEPA NOI or the HEPA EISPN that suggested alternatives, information, or analyses are summarized in Section B.2. Section B.3 includes excerpts of substantive comments received on the NEPA NOI organized by commenter. The Service reviewed all comments submitted on the NEPA NOI for consideration in developing the Draft EIS; however, NEPA and the Department of the Interior's NEPA Procedures (43 CFR 46) do not direct the Service to provide a written response in the Draft EIS.

Pursuant to Hawaiʻi Administrative Rules § 11-200.1-24, a Draft EIS prepared for compliance with HRS Chapter 343 should include reproductions of written comments received on the HEPA EISPN and responses to all substantive comments received on the HEPA EISPN during the public comment period. Because it is an applicant action, KIUC is responsible for responding to substantive comments received on the HEPA EISPN. Reproductions of written comments submitted on the HEPA EISPN are included in Attachment B-2 and KIUC's responses to substantive comments on the HEPA EISPN are included in Section B.4, Table B-1.

B.2 Submitted Alternatives, Information, and Analysis

This section summarizes the alternatives, information, and analyses (presented in that order below) submitted by state agencies, Native Hawaiian organizations and entities, and local governments and other public commenters during the scoping process for consideration in developing the EIS (Hawaiʻi Administrative Rules 11-200.1-23).

Comments received in federal and state scoping processes included the following suggestions on alternatives.

- The Draft EIS should evaluate alternatives to avoid or minimize take to include:
  - Undergrounding existing powerlines
  - Reconfiguring powerlines: lower and shield powerlines with vegetation (e.g., trees and bushes), visible structures, and geographic features (e.g., mountains and hillsides)
  - Facing all lighting downward and installing full cut-off shields on all existing and future lighting
  - Adjusting the color of lighting to minimize short-wavelength light and reduce overall lighting brightness/intensity
  - Turning off lights during fledgling periods in high-risk areas, installing timer switches on outdoor lighting to allow automatic switch-off when lights are not in use, and removing unnecessary light
- The Draft EIS should evaluate alternatives for compensation of take to include:
  - The eradication of invasive predators on all KIUC properties, including around power poles, streetlights, and solar arrays
  - The funding of a program to eliminate or modify sources of outdoor light that attract shearwaters on properties that are not part of KIUC's operations
  - Funding for the rescue and rehabilitation of injured protected species
  - The restoration of degraded habitat and creation of refugia that provide nesting habitat free of lights, powerlines, and predators
  - The creation of new, protected colonies using assisted-colonization techniques such as social attraction and chick translocation within predator-proof fences, focusing on the locations with the greatest remaining concentrations of seabirds
- The Draft EIS should evaluate alternatives for implementation and effectiveness monitoring to include:
  - The support of ongoing, independent third-party research and monitoring of protected species, including evaluating the effectiveness of implemented measures, identifying new hotspots, and pursuing adaptive management strategies
- The U.S. Environmental Protection Agency (USEPA) recommends that the Service explore and objectively consider a full range of alternatives and evaluate in detail all reasonable alternatives that fulfill the plan's purpose and need. USEPA encourages selection of alternatives that protect,

restore, and enhance the environment, and supports efforts to identify and select alternatives that maximize environmental benefits that avoid, minimize, and/or otherwise mitigate environmental impacts. USEPA is available to assist the Service in alternatives development, if needed.

- USEPA also recommends that the Draft EIS present the environmental impacts of the proposed action and alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision-maker and the public (40 CFR 1502.14 (b)). Describe how each alternative was developed, how it addresses plan objectives, and how it will be implemented. Quantify the potential environmental impacts of each alternative to the greatest extent (e.g., acres of habitat affected, change in water quality) and clearly delineate differences in impacts among alternatives analyzed. USEPA also recommends comparing the costs and benefits of each of the alternatives, including the costs for required mitigation measures. Furthermore, discuss reasons for eliminating alternatives to the proposed action (40 CFR 1502.14 (a)).

The following supplemental information (i.e., supplemental materials or references) was submitted during scoping for consideration by the lead and cooperating agencies in developing the EIS.

- Report titled *Mortality of Newell's Shearwaters caused by collisions with urban structures on Kauai*, Podolsky et al. (1998), regarding the mortality rate of adults, subadults, and fledglings caused by collisions with powerlines between 1993–1994
- Report titled *The status and population trends of the Newell's Shearwater on Kauai: Insights from modeling,* Ainley et al. (2001), regarding the status of endemic ʻaʻo (Newell's shearwater, *Puffinus newelli*) populations on Kauaʻi
- Report titled *New insights into the status of the Hawaiian Petrel on Kauai*, Ainley et al. (1997), regarding the status of ʻuaʻu (Hawaiian petrel, *Pterodroma sandwichensis*) populations on Kauaʻi
- Report titled *Future directions in conservation research on Petrels and Shearwaters*, Rodriguez et al. (2019), regarding important threats to petrels and shearwaters according to the International Union for Conservation of Nature Red List of threatened species to identify gaps to be filled to improve conservation and management of petrels
- Report titled *Declining populations trends of Hawaiian Petrel and Newell's Shearwater on the island of Kauaʻi, Hawaii, U.S.A*., Raine et al. (2017), regarding populations trends on both ʻuaʻu (Hawaiian petrel) and ʻaʻo (Newell's shearwater)
- Report titled *Managing the Effects of Introduced Predators on Hawaiian Endangered Seabirds*, Raine et al. (2020), regarding the effects of multiple introduced predators (feral cats, black rats, pigs, and barn owls) on ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel) on the island of Kauaʻi
- Report titled *Post-release survival of fallout Newell's shearwater fledglings from a rescue and rehabilitation program on Kauaʻi Hawaiʼi*, Raine et al. (2020), regarding the survival rates of fledglings released to sea compared to survival rates of chicks fledged naturally from the mountains of Kauaʻi
- Report titled *The Breeding phenology and distribution of the Band-Rumped Storm-Petrel* Oceanodroma Castro *on Kauaʻi and Lehua Islet, Hawaiian Islands*, Raine, McKown, and Holmes (2017), regarding filling gaps in knowledge of the breeding phenology and population

distribution of ʻakēʻakē (band-rumped storm-petrel, *Hydrobates castro*) on the island and Kauaʻi and Lehua Islet.

- Report titled *Seabird mortality induced by land-based artificial lights*, Rodriguez et al. (2016), regarding the current literature of seabird attraction to light to identify information gaps and proposed measures to address mortality of seabirds due to artificial lighting

No analyses were submitted during scoping for consideration in developing the EIS.

B.3 Federal Comments

Comments were submitted through Regulations.gov on Docket No. FWS-R1-ES-2022-0068. Five comment letters were received regarding the NEPA NOI from the following individuals or organizations:

- David Henkin, Earthjustice
- Jason Gerdes, U.S. Environmental Protection Agency
- Richard Podolsky, Individual
- Perry White, Individual
- Anonymous

The following are excerpts from comments submitted regarding the NEPA NOI providing substantive comments on the scope, analysis, or alternatives to consider in the development of the EIS. The Service reviewed and considered all comments submitted on the NEPA NOI during development of the Draft EIS. Note that NEPA and the Department of the Interior's NEPA Procedures (43 CFR 46) do not direct the Service to provide a written response to scoping comments in the Draft EIS, and therefore the Service has not responded to comments on the NEPA NOI.

B.3.1 Comments Received

1. **Commenter: David Henkin, Earthjustice**

   Comments from Earthjustice were submitted on both the NEPA NOI and the HEPA EISPN. Earthjustice's comments on alternatives are summarized above and all substantive verbatim comments provided by Earthjustice are presented in Table B-1 below.

2. **Commenter: Jason Gerdes, U.S. Environmental Protection Agency**

   Comment #1:

   In the DEIS, we recommend describing the threat to resources as a whole, presented from the perspective of the resource instead of from individual management activities. Identify how resources, ecosystems, and communities in the vicinity of the planning area have already been, or will be, affected by past, present, or future activities. The DEIS should also consider the combined impacts associated with these activities characterized in terms of their response to change and capacity to withstand stresses. The evaluation should focus on resources of concern or resources that are "at risk" and/or are significantly impacted by the proposed planning and management activities before mitigation. Describing a suite of potential mitigation measures, under jurisdiction of the Service, project proponents, and others, can serve to alert other agencies or officials about potential protective measures that can be implemented.

Comment #2:

When evaluating effects, we recommend using existing environmental conditions as the baseline for comparing impacts across all alternatives, including the no action alternative. This provides an important frame of reference for quantifying and/or characterizing magnitudes of effects and understanding each 2 alternative's impacts and potential benefits. This is particularly important when there are environmental protections in place that are based on current conditions, such as total maximum daily loads (TMDLs) for impaired creek segments. The DEIS should present impacts to resources as a comparison to the existing conditions baseline using a consistent method of measuring project impacts for all alternatives. By utilizing existing environmental conditions as a baseline, future changes to environmental resources can be more accurately measured for all alternatives, including the no action alternative. We recommend that the Service consider the following when defining baseline conditions:

- Verify that historical data (e.g., data five years or older) are representative of current conditions.
- Include resources directly impacted by the project footprint within the geographic scope of analysis, as well as the resources indirectly (or secondarily) impacted by the project (40 CFR 1508.1(g)(1)).

Comment #3:

We recommend the following measures to mitigate construction emissions of fugitive dust, oxides of nitrogen, and volatile organic compounds and to include these measures in all construction contracts.

<u>Fugitive Dust Source Controls:</u>

- Stabilize disturbed areas by covering and/or applying water or chemical/organic dust palliative where appropriate. This applies to both active and inactive sites during workdays, weekends, holidays, and windy conditions.
- Phase grading operations where appropriate and operate water trucks for stabilization of surfaces under windy conditions.
- When hauling material and operating non-earthmoving equipment, prevent spillage and limit speeds to 15 miles per hour (mph). Limit speed of earth-moving equipment to 10 mph.

<u>Mobile and Stationary Source Controls:</u>

- Reduce unnecessary idling from heavy equipment.
- Prohibit engine tampering to increase horsepower, except when meeting manufacturer's recommendations.
- Lease or buy newer, cleaner equipment using the best available emissions control technologies.
    - Use lower-emitting engines and fuels, including electric, liquified gas, hydrogen fuel cells, and/or alternative diesel formulations, if feasible.

- On-Highway Vehicles - On-highway vehicles should meet, or exceed, the U.S. EPA exhaust emissions standards for model year 2010 and newer heavy-duty on-highway compression-ignition engines (e.g., drayage trucks, long haul trucks, refuse haulers, shuttle buses, etc.).
- Nonroad Vehicles & Equipment - Nonroad vehicles and equipment should meet, or exceed, the U.S. EPA Tier 4 exhaust emissions standards for heavy-duty nonroad compression-ignition engines (e.g., nonroad trucks, construction equipment, cargo handlers, etc.).

<u>Administrative Controls:</u>

- Coordinate with appropriate air quality agencies to identify a construction schedule that minimizes cumulative impacts from other planned projects in the region, if feasible.
- Prepare an inventory of all equipment prior to construction and identify the suitability of add-on emission controls for each piece of equipment before groundbreaking.
- Develop a construction traffic and parking management plan that minimizes traffic interference and maintains traffic flow and avoid routing truck traffic near sensitive land uses to the fullest extent feasible.
- Locate diesel engines, motors, and equipment staging areas as far as possible from residential areas and other sensitive receptors (e.g., schools, daycare centers, hospitals, senior centers, etc.).
- Reduce construction-related trips of workers and equipment, including trucks.
- Identify all commitments to reduce construction emissions and quantify air quality improvements that would result from adopting specific air quality measures.
- Identify where implementation of mitigation measures is rejected based on economic infeasibility.

Comment #4:

The EPA recommends that the DEIS include a discussion of reasonably foreseeable climate change impacts in the planning area—such as changes in precipitation patterns, hydrology, vegetation distribution in respective watersheds, and temperature—and the potential effect of these impacts on said resources. This could help inform the development of measures to improve the resilience of the HCP. If projected changes could notably exacerbate the environmental impacts of the plan, the EPA recommends these impacts also be considered as part of the NEPA analysis.

We also recommend the DEIS include a discussion of how climate change may affect the covered species and the habitats on which they depend. The proposed period of incidental take coverage will likely be a time of considerable change in the planning area. We recommend, therefore, the HCP include, and the DEIS detail, provisions to monitor and reassess climate change effects on a range of issues, including: the status of covered species, including the distribution of species throughout the planning area; the success of restoration efforts; and the need for new or expanded conservation lands. We recommend that the Service develop a robust monitoring and adaptive management plan to account for, mitigate, and adapt to, the effects of climate change on the covered species (and the habitats that sustain these populations) throughout the period of ITP coverage.

Comment #5:

The DEIS should provide a complete hydrologic characterization of the planning area. We recommend the Service require a baseline analysis of water quality, as discussed above, including collection of dissolved oxygen, temperature, and other parameters that are considered naturally occurring. Water quality monitoring data should be collected at enough frequency and duration to capture natural fluctuations due to seasonal changes in hydrology. These data may be used for comparison to changes in water quality as a result of implementation of management activities. Discuss all direct, indirect, and cumulative impacts to surface water and groundwater quality and quantity from the proposed management activities.

We further recommend that the DEIS:

- Demonstrate how the action and no action alternatives will be consistent with EPA-approved water quality standards for the State of Hawaii.
- Evaluate (and quantify if feasible) potential mitigation measures and their effectiveness at mitigating water quality and quantity impacts, discuss any limitations or drawbacks of these mitigation measures, and address how their effectiveness will be monitored. We recommend inclusion of a detailed mitigation plan that describes in detail proposed mitigation measures and identifies responsible parties and funding. We recommend providing clear commitments to carry out proposed mitigation measures in the DEIS, where this is known.
- Discuss adaptive management monitoring programs that will be implemented before and after proposed actions to determine potential impacts on water quality and beneficial uses.
- In assessing the current and future water needs in respective basins in the planning area, consider all stressors on the system, including surface water withdrawal and groundwater pumping.

Comment #6:

In the DEIS, describe aquatic habitats in the planning area (e.g., habitat type, plant and animal species, functional values, and integrity) and the environmental consequences of the proposed alternatives on these resources. Impacts to aquatic resources should be evaluated in terms of the areal (acreage for wetlands) or linear extent (for streams) to be impacted and by the functions they perform. In addition, discuss whether the proposed activities within the planning area would result in discharge of dredged or fill materials into surface waters of the United States. If so, a CWA Section 404 permit from the U.S. Army Corps of Engineers may be required. The DEIS would need to describe this permit application process and recommended measures to protect aquatic resources from impacts resulting from the proposed activities. In addition, disclose any floodplain impacts and actions to be taken to minimize related impacts. See CWA Section 404 and Executive Order 11988 on Floodplain Management.

Comment #7:

We suggest the DEIS provide adequate information to assess the potential impacts to migratory birds from covered activities, including tower and pole replacement and extensions and/or relocations of existing transmission and distribution lines. Additionally, we suggest the Service include activity-specific best practices to avoid, minimize, or mitigate bird mortality. Discuss how the poles and towers replacements over the term of the HCP would impact migratory birds and describe how these replacements would conform to the practices described in the Suggested Practices for Avian Protection on Power Lines Manual5 developed by the Avian Power Line Interaction Committee.

Comment #8:

In DEIS, include measures that are consistent with Executive Order 13112 on Invasive Species. We suggest including any existing Service direction for noxious weed management, a description of current conditions, and best management practices, which will be utilized to prevent, detect, and control invasives in the planning area. Discuss measures that would be implemented to reduce the likelihood of introduction and spread of invasive species within the proposed planning area. We encourage the Service to promote integrated weed management, with prioritization of management techniques that focus on non-chemical treatments first, and mitigation to avoid herbicide transport to surface or ground waters. Early recognition and control of new infestations is critical to stop the spread of the infestation and avoid wider future use of herbicides, which could correspondingly have more adverse impacts on biodiversity, water quality and fisheries.

Comment #9:

In the Service's preparation of the environmental justice analysis, we encourage consideration of two specific resources: 1) CEQ's Environmental Justice: Guidance Under the National Environmental Policy Act report 6 and 2) the Federal Interagency Working Group on Environmental Justice and NEPA Committee's Promising Practices for Environmental Justice Methodologies in NEPA Reviews report. These documents provide information on applying environmental justice methodologies that have been established in federal NEPA practice.

In obtaining data for the environmental justice analysis to determine the presence of minority and low-income populations, we encourage the Service to use EPA's EJScreen and/or the most recent American Community Survey from the U.S. Census Bureau (i.e., Five-Year Date Profile Estimates for 2013-2019). To best illustrate the presence of a minority population, we recommend the Service analyze block groups, the smallest geographical unit that the U.S. Census Bureau publishes data for. We caution using larger tracts in the analysis, such as counties or cities, as these may dilute the presence of minority populations. After the Service has determined if minority and low-income populations exist in the planning area, we recommend that the DEIS discuss whether these communities would be potentially affected by individual or cumulative actions of the proposed plan. We also recommend addressing whether any of the alternatives would cause any disproportionate adverse impacts, such as higher exposure to toxins; changes in existing ecological, cultural, economic, or social resources or access; cumulative or multiple adverse exposures from environmental hazards; or community disruption.

If it is determined that minority and low-income populations may be disproportionately impacted, describe in the DEIS the measures taken by the Service to fully analyze the environmental effects of the action on minority communities and low-income populations and identify potential mitigation measures. In the DEIS, discuss potential environmental justice concerns, such as air quality, water quality, noise, vibration, odors, etc. Include any environmental justice issues raised during scoping meetings. Clearly define the "reference community" and the "affected community." These definitions are used to determine whether there are disproportionately high and adverse human health or environmental impacts by comparing the impacts to the affected community with the impacts to the reference community. A well-defined affected community will accurately reflect the demographic characteristics of the populations likely to be adversely impacted by the proposed plan. A well-defined reference community will reflect the characteristics of the general population (e.g., municipal, regional, state).

Comment #10:

It is important that formal government-to-government consultation take place early in the scoping phase of the planning process to ensure that all issues are adequately addressed in the DEIS. In the DEIS, summarize the results of tribal consultation and identify the main concerns expressed by tribes (if any), and how those concerns were addressed. We also recommend identifying any protection, mitigation, and enhancement measures identified by tribes.

Comment #11:

In the DEIS, discuss how the Service would avoid or minimize adverse effects on the physical integrity, accessibility, or use of cultural resources or archaeological sites, including traditional cultural properties (TCPs), throughout the planning area. Clearly discuss mitigation measures for archaeological sites and TCPs. We encourage the Service to append any Memoranda of Agreements to the DEIS, after redacting specific information about these sites that is sensitive and protected under Section 304 of NHPA. We also recommend providing a summary of all coordination with tribes and with the SHPO/THPOs, including identification of NRHP eligible sites and development of a Cultural Resource Management Plan.

In the DEIS, address the existence of Indian sacred sites in the planning area that may be considered spiritual sites by regional tribal nations. Discuss how the Service would ensure that the proposed action would avoid or mitigate for the impacts to the physical integrity, accessibility, or use of sacred sites.

Comment #12:

The EPA recommends that the DEIS discuss how the HCP relates to, and will be integrated with, federal, state, tribal, and local land use plans in the planning area. The EPA recommends that the Service address all types of land use plans in the area, including formally adopted documents for land use planning, conservation, zoning, and related regulatory requirements, as well as plans not yet developed that have been proposed by the appropriate government body in a written form.

Comment #13:

The proposed HCP will impact a variety of resources for an extended period of time. As a result, we recommend that the plan be designed to include an environmental inspection and monitoring program to ensure compliance with all mitigation measures and assess their effectiveness. In the DEIS, describe the monitoring program and how it will be used as an effective feedback mechanism (i.e., adaptive management) so that any needed adjustments can be made to the HCP to meet environmental objectives throughout the life of the plan. We also recommend that the DEIS describe a mechanism to consider and implement additional mitigation measures.

B.4 Comments on the HEPA EISPN

Comments were submitted via U.S. mail or email to:

- Attention: KIUC HCP EISPN
  Department of Land and Natural Resources
  1151 Punchbowl Street
  Kalanimoku Building
  Honolulu, HI 96813
- Dawn Huff
  Attention: KIUC HCP EISPN
  Kauaʻi Island Utility Cooperative
  4463 Paheʻe Street, Suite 1
  Līhuʻe, HI 96766-2000

Five comment letters were received on the HEPA EISPN from the following:

- Hawaiʻi Department of Accounting and General Services
- Hawaiʻi Department of Transportation
- Hawaiʻi DLNR Land Division
- Hawaiʻi DLNR Division of Aquatic Resources
- Earthjustice

Reproductions of written comments received on the HEPA EISPN are included as Attachment B-1. Pursuant to Hawaiʻi Administrative Rules 11-200.1-9, the Draft HCP is an applicant action requiring environmental review because it requires one or more approvals prior to implementation and involves the use of state lands. Because it is an applicant action, KIUC is responsible for responding to comments received on the HEPA EISPN. Excerpts of substantive comments received on the HEPA EISPN and KIUC's responses are presented in Table B-1 below. The Service did not issue responses to comments received on the HEPA EISPN or scoping comments on the NEPA NOI. NEPA and the Department of the Interior's NEPA Procedures (43 CFR 46) do not direct the Service to provide a written response to scoping comments in the Draft EIS. Additionally, NEPA does not require the Service to respond to comments made in response to the HEPA EISPN that refer to the federal NEPA process. In accordance with the Department of Interior's NEPA Procedures, the Service will respond to future substantive comments submitted on the Draft EIS in the Final EIS.

Table B-1. KIUC Responses to Comments on the HEPA EISPN

#	Individual or Organization	Comment	KIUC Response
1	State of Hawai'i Department of Transportation	Airports Division (HDOT-A): All projects within 5 miles from Hawaii State airports are advised to read the Technical Assistance Memorandum (TAM) for guidance with development and activities that may require further review and permits. The TAM can be viewed at this link: http://files.hawaii.gov/dbedt/op/docs/TAM-FAA-DOT-Airports_08-01-2016.pdf	Thank you for your comment. Operation of KIUC's existing powerlines and streetlights is consistent with Federal Aviation Administration Order 5190.6B. The locations and designs of future streetlights and powerlines are unknown at this time and would be determined in response to requests submitted by another entity (typically the county or state, but may also be private developers). The entity requesting power that requires new lines or streetlights would need to undergo consultation on permitting and other regulatory requirements but KIUC may participate in this type of consultation depending on the scope of the project. KIUC is aware of the referenced TAM and would participate in consultation with the Hawai'i Department of Transportation if future streetlights and powerlines fall within the parameters defined in the TAM.
2	Hawai'i Department of Land and Natural Resources Engineering Division	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	Thank you for your comment. EIS Section 3.6, *Hydrology and Soils*, includes information on floodplains in the Permit Area using official Federal Emergency Management Agency FIRM and DLNR FHAT data. The majority of the Permit Area, including all conservation sites, is mapped as Zone X (areas determined to be outside the 100- and 500-year floodplains). Small portions of KIUC's existing transmission lines and streetlights are within the mapped 100-year floodplain. The proposed action and action alternatives do not propose construction of new KIUC infrastructure (facilities, powerlines, and streetlights). Therefore, no impacts on floodplains would occur under the Draft HCP.

#	Individual or Organization	Comment	KIUC Response
		research flood hazard information. If there are questions regarding the local flood ordinances, please contact the applicable County NFIP coordinating agency below.	
3	Hawaiʻi Department of Land and Natural Resources Division of Aquatic Resources	Thank you for providing DAR the opportunity to comment on the KIUC Habitat Conservation Plan Environmental Impact Statement. We request to be informed of, if not involved in, the process of making decisions regarding mitigation measures and effects on green sea turtles in Kauai. DAR frequently deals with green sea turtles on the beaches of Kauai and we have experience and insight into some of the potential impacts.	Thank you for your comment. The Draft HCP includes a collaborative decision-making process among KIUC, the Service, DLNR, and State of Hawaiʻi Division of Aquatic Resources to adjust the conservation strategy as needed throughout the Permit Term to meet the Draft HCP's biological goals and objectives. Draft HCP Sections 4.4.5, 4.4.6, Chapter 6, *Monitoring and Adaptive Management Program*, and Chapter 7, *Plan Implementation*, describe coordination that will occur with State of Hawaiʻi Division of Aquatic Resources during implementation of the conservation strategy and adaptive management related to sea turtle nest detection, monitoring, and reporting. KIUC consulted with State of Hawaiʻi Division of Aquatic Resources in coordination with DLNR Division of Forestry and Wildlife and the Service on the development of the HCP conservation strategy for honu (green sea turtle, *Chelonia mydas*).
4	Hawaiʻi Department of Land and Natural Resources Division of Boating & Ocean Recreation	We have no objections.	Comment acknowledged.
5	Hawaiʻi Department of Land and Natural Resources Land Division	We have no comments.	Comment acknowledged.
6	Hawaiʻi Department of Accounting and General Services	Thank you for the opportunity to comment on the subject project. We have no comments to offer at this time as the proposed project does not directly impact any of the Department of Accounting and General Services' projects or existing facilities.	Thank you for confirming that the proposed project does not directly affect any of the Department of Accounting and General Services' projects or existing facilities.
7	Earthjustice	We note flaws in the scoping process that have constrained the public's opportunities for meaningful	Thank you for your comment. As a public utility responsible for the production, purchase, transmission,

#	Individual or Organization	Comment	KIUC Response
		engagement. Initially, the Federal Register's description of "Covered Activities" provides insufficient detail to allow for meaningful public feedback on the EIS's scope, violating the National Environmental Policy Act's ("NEPA's") requirement that agencies preparing an EIS "[m]ake diligent efforts to involve the public in preparing and implementing their NEPA procedures" and to "[s]olicit appropriate information from the public." 40 C.F.R. § 1506.6(a), (d). The notice states that "[t]he proposed covered activities will include … [o]peration and maintenance of future powerlines and lighting[,]" 87 Fed. Reg. at 34,898–99, but does not provide any information regarding the location or extent of this new infrastructure, the expected timeframe for KIUC to develop the new infrastructure, or anticipated effects of these developments on any listed species' habitat or breeding grounds. The notice is similarly vague about what activities are included in KIUC's "continued operation, maintenance, and retrofit of existing powerlines and lighting at certain facilities[,]" id. at 34,898 (emphasis added), as well as what and where "measures associated with KIUC's conservation strategy" will be implemented. Id. at 34,899. The notice's vague and cursory mention of KIUC's covered activities precludes the public from identifying likely impacts, let alone proposing specific alternatives or suggesting appropriate mitigation measures that the Service should consider in its environmental review of KIUC's LTHCP. Given that the Service may grant an ITP for only a defined project, see 50 C.F.R. §§ 17.22(b)(1)(i), 17.32(b)(1)(iii)(A) (incidental take application must include "[a] complete description of the activity sought to be authorized"), it should have provided more information on KIUC's proposed actions to allow the public a meaningful opportunity to provide input.	distribution, and sale of electricity on the island of Kauaʻi, KIUC is regulated by the State of Hawaiʻi Public Utility Commission and is required to provide and ensure the availability of electrical service on Kauaʻi. When there is no additional capacity or space available on existing poles or towers to fulfill the demand for electric power, KIUC must construct new powerline corridors with new poles or towers. KIUC strives to place new powerlines in an existing right-of-way adjacent to existing power poles or towers. However, there are many cases where this is not feasible owing to engineering safety standards of clearance, narrow rights-of-way or land use constraints that do not allow a wider corridor. In these instances, KIUC would construct a new powerline (with new poles or towers) in a new right-of-way. KIUC will also need to expand the system of distribution lines over the Permit Term to service new homes and businesses that are developed outside of the existing network of distribution lines. The locations where new powerlines and distribution lines may be constructed over the 50-year Permit Term are not known at this time. To address this uncertainty, Draft HCP Appendix 4E, *Review of New Powerlines and Streetlights in Northwestern Kauaʻi*, describes the process to be undertaken with the Service and DLNR to ensure that future KIUC infrastructure in a specifically defined Area of Additional Conservation Commitments in northwestern Kauaʻi will not inhibit the ability of the Draft HCP to achieve the biological goals and objectives. Additional information on KIUC's Covered Activities and conservation strategy can be found in Chapter 2 of the EIS and in the Draft HCP (ICF 2025).

#	Individual or Organization	Comment	KIUC Response
8	Earthjustice	The obsolete information in the only draft of the LTHCP that is currently available does not make up for the deficient scoping notice. At the June 22, 2022, scoping meeting, KIUC indicated that a revised LTHCP will not be available for public review until the fourth quarter of this year, after the close of the scoping comment period. The most recent version of the LTHCP that the public can access is a "Preliminary Discussion Draft" from January 2018. This version is substantially outdated, making it impossible for the public to provide constructive scoping comments on the actions that KIUC now proposes to undertake. For example, the 2018 discussion draft covered only three protected seabird species: Newell's Shearwater (Puffinus newelli); Hawaiian Petrel (Pterodroma sandwichensis); and Band-rumped Storm-Petrel (Oceanodroma castro). According to the Federal Register notice, the LTHCP will now cover a total of nine species, including five waterbirds and the green sea turtle. See 87 Fed. Reg. at 34,898. Nowhere does the Service explain why it has concluded that KIUC's proposed activities will now adversely affect three times as many imperiled species. The Service's failure to provide adequate information to the public regarding the LTHCP that is currently under consideration prevents the scoping process from serving its intended purpose: "identifying the significant issues and eliminating from further study non-significant issues." 40 C.F.R. § 1501.9(a).	Draft HCP Appendix 1B, *Evaluation of Species Considered for Coverage*, describes the evaluation process that KIUC completed to determine which federally and state-listed species in the Plan Area should be covered in the federal and state take authorizations. As a result of this evaluation, KIUC identified nine species as meeting the criteria for inclusion as Covered Species in the Draft HCP. The criteria and rationale for selection or exclusion of each species considered for coverage are summarized in Draft HCP Appendix 1B with additional supporting information regarding exclusion of ʻōpeʻapeʻa (Hawaiian hoary bat, *Lasiurus cinereus semotus*) provided in Draft HCP Appendix 1B, Attachment 1.
9	Earthjustice	To ensure the continued survival of the protected seabird species and hold out any hope for these species' future recovery, KIUC must be required to continue, for the entire duration of the LTHCP, implementation of measures to minimize the toll that KIUC's operations inflict on seabird populations, as well as efforts to mitigate unavoidable take. KIUC's Short-Term Habitat Conservation Plan and ITP expired in 2016. Since then,	KIUC is requesting take authorization from the Service and DLNR for a Permit Term of 50 years. The *Permit Term* represents the period over which KIUC is authorized to incidentally take the Covered Species in conjunction with implementing the Draft HCP. All conservation actions outlined in the Draft HCP must also be completed within the Permit Term.

#	Individual or Organization	Comment	KIUC Response
		KIUC has continued operating its powerlines and lighting without a permit authorizing its take of the thousands of imperiled seabirds it has killed or injured. See 81 Fed. Reg. 44,316, 44,317 (July 7, 2016) ("a minimum of 1,012 and 1,002 seabird collision events" detected in 2014 and 2015, respectively).	The Draft HCP conservation strategy is the program that KIUC will implement over the Permit Term to contribute to the recovery of the Covered Species, fully offset the impacts of the taking of the Covered Activities on each Covered Species, and provide a net benefit to the Covered Species.
		Since 2016, KIUC's minimization efforts have included static wire removal, reflective and LED diverter deployment, some powerline reconfigurations, and retrofitting of some streetlights. Mitigation efforts include funding conservation work (e.g., predator control, vegetation control, and monitoring), as well as providing funding for Save Our Shearwaters (SOS), a seabird rehabilitation program for shearwaters and petrels. While these efforts are a good start, the ITP/ITL and HCP must require KIUC to continue implementing both take minimization and mitigation measures through the entirety of the proposed ITP/ITL permit term. While it may not be feasible to expect KIUC to address all problematic infrastructure up-front, the LTHCP is expected to span 30 years, see 87 Fed. Reg. at 34,898, and KIUC should be required to prioritize and implement take minimization over the full life of the requested permit, including powerline reconfiguration and undergrounding, rather than rely solely on mitigation after initial minimization projects are completed. To that end, the EIS should consider a range of alternatives that require KIUC to continue both minimizing and mitigating take through the full 30-year duration of the ITP/ITL.	All the minimization projects included in KIUC's island-wide minimization plan for existing powerlines (described under Conservation Measure 1 in Draft HCP Section 4.4.1) were completed in 2024, prior to the start of the Permit Term. The completion of minimization measures prior to permit issuance means that the benefit of increased recruitment to the breeding population is expected from the outset of the Permit Term, without delay. Minimization will continue to be an important tool throughout the Permit Term for new lines and for existing lines in situations where minimization is not as effective as estimated or where powerline monitoring indicates a significant increase in strikes compared with the estimated strike rate. Similarly, measures implemented to minimize light attraction from streetlights (as described under Conservation Measure 2 in Draft HCP Sections 4.4.2.1 and 4.4.2.2) were implemented prior to the start of the Permit Term and all future streetlights installed by KIUC will utilize the same light minimization features. The proposed action, No Action alternative, and action alternatives (Alternative C and Alternative D) would each require implementation of minimization and mitigation throughout the Permit Term.
10	Earthjustice	NEPA requires the Service to consider all impacts to listed species—direct, indirect, and cumulative—associated with KIUC's powerlines and lighting infrastructure. 40 C.F.R. § 1508.1(g)(1)-(3). These impacts include, but are not limited to, "ecological (such as the effects on natural resources and on the	The KIUC HCP EIS considers the direct, indirect, and cumulative impacts of the proposed action, No Action alternative, and each of the action alternatives (Alternative C and Alternative D). However, growth-inducing effects and other effects related to induced changes in land use, population, or growth rates are not

#	Individual or Organization	Comment	KIUC Response
		components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health[.]" Id. § 1508.1(g)(4). According to the Federal Register, KIUC intends to operate, maintain, and retrofit existing infrastructure as well as construct and operate future powerlines and lighting. See 87 Fed. Reg. at 34,898–99. In addition to evaluating the potential direct effects of these activities, which include powerline collisions, light attraction, and habitat degradation, the Service should also assess the indirect effects of these actions, including "growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems." 40 C.F.R. § 1508.1(g)(2). The Service should evaluate how the operation and maintenance of existing and future infrastructure might indirectly impact any habitat, food resources, or other conditions related to the survival or recovery of the covered species. Growth inducing effects related to the operation, maintenance, and retrofitting of existing infrastructure, as well as the construction and operation of future powerlines and lighting, should be considered, especially if the growth inducing effects will take place in natural areas that are currently undeveloped. The Service should also assess whether KIUC's infrastructure—both existing and prospective—will increase light attraction in areas that are particularly sensitive for the protected seabird species (e.g., fledgling flyways or areas that currently have limited artificial lighting).	anticipated to result from implementation of the proposed action or alternatives. KIUC considered growth projections to arrive at an estimate of the number of new streetlights and miles of new powerlines that could be put into operation during the 50-year Permit Term. However, KIUC's extension of electric power and/or streetlights to service new homes and businesses is in response to electric power demand and/or service requests and is a response to growth (rather than being the cause of growth). Therefore, growth-inducing effects are not analyzed in the EIS. As noted above, Draft HCP Appendix 4E, *Review of New Powerlines and Streetlights in Northwestern Kauaʻi*, describes the process to be undertaken with the Service and DLNR to ensure that future KIUC infrastructure in a specifically defined Area of Additional Conservation Commitments in northwestern Kauaʻi (that includes natural areas that are currently undeveloped) will not inhibit the ability of the Draft HCP to achieve the biological goals and objectives.
11	Earthjustice	In evaluating cumulative effects, the Service must consider "effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency … or	EIS Section 4.2 outlines the other past, present, and reasonably foreseeable future actions that could contribute to both beneficial and adverse cumulative effects in combination with the proposed action and alternatives. Other projects that may contribute to

#	Individual or Organization	Comment	KIUC Response
		person undertakes such other actions." 40 C.F.R. § 1508.1(g)(3). Accordingly, the Service should evaluate the impacts of other human activities with adverse effects on the protected wildlife, such as the introduction of alien predators, habitat destruction, and other sources of light attraction (e.g., solar panels, nearby residential and business buildings, cars, and temporary lighting used for construction projects).	cumulative effects with the proposed action and alternatives include implementation of other HCPs on Kauaʻi for the take of listed seabirds; federal actions involving artificial nighttime lighting, communication towers, access control, or predator exclusion that are ongoing within the Permit Area and that have the potential to affect one or more listed species; federal, state, and private land management; other conservation actions; and forecast growth and land development consistent with the Kauaʻi County General Plan.
12	Earthjustice	In its environmental review of the KIUC LTHCP, the Service must consider a full range of alternative approaches to satisfy the ESA's requirements to minimize and mitigate harm to listed species to the "maximum extent practicable" and to avoid jeopardy. See 16 U.S.C. § 1539(a)(2)(B)(ii), (iv). While there has been historical pushback by KIUC to undergrounding current and future powerlines, KIUC has been aware of the need to bury powerlines for decades and should have prepared and funded an undergrounding program years ago. As mentioned previously, KIUC should be required to continue to invest in take minimization efforts through the entire life of the 30-year LTHCP, including potentially expensive and complex projects like undergrounding. Accordingly, the Service must consider all relevant circumstances, such as the duration of the proposed ITP/ITL, in determining what minimization and mitigation measures are "practicable." See 16 U.S.C. § 1539(a)(2)(B)(ii).	The KIUC HCP EIS analyzes the proposed action, the No Action alternative, and two action alternatives that prescribe additional minimization on powerlines (Alternative C) and additional mitigation at conservation sites (Alternative D). Other alternatives that the Service considered but dismissed from detailed analysis are described in EIS Section 2.3. This includes an alternative that would underground transmission lines where past monitoring demonstrated the highest concentration of bird strikes. The Service reviewed this alternative and concurred with KIUC's determination in the Draft HCP that it would be infeasible and cost prohibitive to reduce take of the covered birds by moving underground substantial segments of KIUC's high-risk powerlines that cause take.
13	Earthjustice	The Service's analysis should also reflect that a central component of the proposed action is maintaining KIUC's currently illegal infrastructure. Contrary to the Service's current thinking on the required "no action" alternative, the Service should not "assume that KIUC would operate and maintain existing and future powerlines and lighting in accordance with current practice." 87 Fed. Reg.	As noted above, all the minimization projects included in KIUC's island-wide minimization plan for existing powerlines that are proposed as part of the Draft HCP were completed by the end of 2024. This includes 114.8 miles (184.7 kilometers) of bird flight diverters installed, 82.8 miles (133.3 kilometers) of static wire removed, three powerline reconfiguration projects

#	Individual or Organization	Comment	KIUC Response
		34,898. In absence of an ITP/ITL, KIUC is likely to be sued to put an end to its ongoing, excessive, and illegal take of imperiled seabirds.	totaling 7.8 miles (12.5 kilometers), and removal of a section of 69-kilovolt transmission line in Mānā. The EIS analysis assumes minimization projects already completed by KIUC would remain in place and be operational for their useful life under Alternative A (No Action), Alternative B (Proposed HCP), Alternative C (Additional Minimization), and Alternative D (Additional Mitigation). The Draft HCP also describes conservation measures to be implemented at conservation sites, some of which have already been completed and some of which are ongoing or planned. The EIS analysis assumes that conservation measures involving construction of physical features such as predator-control fencing that were completed prior to commencement of the Permit Term would remain in place under all EIS alternatives. The EIS analysis assumes that conservation measures described in the Draft HCP that are ongoing or planned and that require an annual commitment of funding and staff resources by KIUC would continue under Alternative B (Proposed HCP) and Alternatives C and D but would not continue under Alternative A (No Action). See EIS Section 3.1.2 for a more detailed explanation of the EIS analysis assumptions.
14	Earthjustice	Since KIUC cannot operate without both federal and state ITP/ITLs, the more demanding incidental take standard imposed under state law, which mandates that the "cumulative impact of the [authorized] activity … provide[] net environmental benefits," Haw. Rev. Stat. § 195D-4(g)(8), informs the analysis of what alternatives are "practicable" under the ESA and, thus, should be considered in the draft EIS. The Service should also bear in mind that KIUC cannot secure an ITL under Hawaiʻi law unless the associated HCP "will increase the likelihood of recovery of the endangered or threatened species that are the focus of the plan," id. § 195D-21(b)(1)(B), and "minimize[s] and mitigate[s] all negative impacts, including without limitation the	Comment acknowledged. The Draft HCP has been prepared to meet both federal and state issuance criteria for incidental take authorization.

#	Individual or Organization	Comment	KIUC Response
		impact of any authorized incidental take." Id. § 195D-21(b)(2)(C); see also id. § 195D-4(g)(4) ("The plan shall increase the likelihood that the species will survive and recover"); id. § 195D-30 ("All habitat conservation plans … shall be designed to result in an overall net gain in the recovery of Hawaii's threatened and endangered species").	
15	Earthjustice	In Light Of The Foregoing, The Draft EIS Should Evaluate the Following Take Minimization Alternatives: • Underground existing powerlines (see Attachments 1; 6); • Re-configure powerlines: lower and shield powerlines with vegetation (e.g., trees and bushes), visible structures (e.g., bridges), and geographic features (e.g., mountains and hillsides) (see Attachments 1; 2; 6); • Face all lighting downward and install full cut-off shields on all existing and future lighting) (see Attachments 1; 2; 4; 6); • Adjust the color of lighting to minimize short wave-length light and reduce overall lighting brightness/intensity (see Attachments 1; 4; 6); and • Turn off lights during fledging periods in high-risk areas, install timer switches on outdoor lighting to allow automatic switch-off when lights are not in use, and remove unnecessary lights (see Attachments 1; 4; 6). The Draft EIS Should Also Evaluate the Following Take Mitigation Alternatives: • Eradicate invasive predators on all KIUC properties, including around power poles, streetlights, and solar arrays (see Attachments 1–6); • Fund a program to eliminate or modify sources of outdoor light that attract shearwaters on properties that are not part of KIUC's operations (e.g., solar panels, nearby residential and business buildings,	EIS Section 2.2 describes the four-step alternatives-development process that was undertaken for the KIUC HCP EIS: 1. The Service and DLNR identified alternatives to screen, including alternatives raised during the 30-day public scoping period for the EIS, the 60-day public review period for the Draft HCP, or through internal agency scoping. In addition, the Service and DLNR considered the alternatives to take developed by KIUC and described in the Draft HCP. 2. The Service and DLNR screened the suggested alternatives to assess whether the suggested alternative would meet the purpose and need, would be technically and economically feasible, would have different impacts compared to the proposed action, and would contain sufficient detail to support a comparative evaluation. In some cases, suggested alternatives were determined to already be included in the proposed action. 3. Based on the results of Step 2, the Service and DLNR determined whether the suggested alternative should be carried forward as an EIS alternative analyzed in detail or be dismissed from detailed analysis. 4. The Service and DLNR then further reviewed the suggested alternatives carried forward for detailed analysis to determine which suggested alternatives could be combined to develop a reasonable range of action alternatives for the EIS.

#	Individual or Organization	Comment	KIUC Response
		cars, and temporary lighting used for construction projects) (see Attachments 1; 4; 6); • Fund the rescue and rehabilitation of injured protected species (see Attachments 1; 2; 4; 6); • Restore degraded habitat and create refugia free of lights, powerlines, and predators that provide nesting habitat (e.g., artificial nest burrows) (see Attachments 1; 2; 5; 6); • Create new, protected colonies using assisted-colonization techniques such as social attraction and chick translocation within predator-proof fences, focusing on the locations with the greatest remaining concentrations of seabirds (see Attachments 1; 2; 6); and • Support ongoing, independent third-party research and monitoring of the protected species, including evaluating the effectiveness of implemented measures, identifying new hotspots, and pursuing adaptive management strategies (see Attachments 1; 2; 3; 4; 6).	Based on this review, the alternatives analyzed in detail in this EIS include Alternative A (No Action), Alternative B (Proposed HCP), Alternative C (Additional Minimization), and Alternative D (Additional Mitigation). A description of each EIS alternative is provided in EIS Section 2.2. Alternatives that the Service and DLNR considered but eliminated from detailed study are described in EIS Section 2.3.

Attachment B-1: Environmental Impact Statement Preparation Notice

ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE FOR THE KAUAʻI ISLAND UTILITY COOPERATIVE HABITAT CONSERVATION PLAN KAUAʻI, HAWAIʻI

Applicant

Kauaʻi Island Utility Cooperative
4463 Paheʻe Street, Suite 1
Lihuʻe, HI 96766-2000

Accepting Authority

State of Hawaiʻi
Board of Land and Natural Resources
Kalanimoku Building
1151 Punchbowl Street
Honolulu, HI 96813

Scoping Process and Dates

This notice initiates a 30-day public scoping period for the Kauaʻi Island Utility Cooperative (KIUC) Habitat Conservation Plan (HCP) Environmental Impact Statement (EIS) that will commence June 8, 2022, and end July 8, 2022.

To help protect the public and limit the spread of COVID-19, one virtual public scoping meeting will be held on June 28, 2022, at 5 p.m. Registration for the virtual public scoping meeting may be completed here: https://us02web.zoom.us/webinar/register/WN_aw4mkokBSM-w4ntaS-c7FQ or by emailing hcp@kiuc.coop. The virtual public scoping meeting is open to the public and free to attend.

All comments on this notice will be considered if received or postmarked on or before July 8, 2022. All comments received are a part of the public record. All personal identifying information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.

Addresses

Please submit copies of your comments with the subject line "KIUC HCP EIS Preparation Notice (EISPN)" to both the State of Hawaiʻi Department of Land and Natural Resources (DLNR) and KIUC. Transmission of comments to DLNR and KIUC must be via U.S. Mail to the addresses below:

Attention: KIUC HCP EISPN
Department of Land and Natural Resources
1151 Punchbowl Street
Kalanimoku Building
Honolulu, HI 96813

Dawn Huff
Attention: KIUC HCP EISPN
Kauaʻi Island Utility Cooperative
4463 Paheʻe Street, Suite 1
Lihuʻe, HI 96766-2000

For Further Information, Contact:

For more information on the project, please contact Katherine Cullison at the DLNR Division of Forestry and Wildlife or Dawn Huff at Joule Group, LLC (representing KIUC) by phone, Monday through Friday from 8:00 a.m. to 5:00 p.m. (Hawaiʻi Standard Time), or by email.

Katherine Cullison, Conservation Initiatives Coordinator
Division of Forestry and Wildlife
Department of Land and Natural Resources
1151 Punchbowl Street, Room 325
Honolulu, HI 96813
(808) 223-0459
dofaw.hcp@hawaii.gov

Dawn Huff, KIUC Project Manager
Kauaʻi Island Utility Cooperative
4463 Paheʻe Street, Suite 1
Lihuʻe, HI 96766-2000
(808) 354-0302
hcp@kiuc.coop

Description of the Proposed Action

KIUC is a not-for-profit, tax-exempt cooperative association governed by a publicly elected nine-member Board of Directors. As a public utility responsible for the production, purchase, transmission, distribution, and sale of electricity on the Island of Kauaʻi (Kauaʻi), KIUC is regulated by the State of Hawaiʻi Public Utility Commission and is required by law to provide and ensure the availability of electrical service on Kauaʻi. KIUC is entirely owned by its members, which total approximately 34,000 ratepayers.

To ensure reliable electrical service to Kauaʻi, KIUC owns and operates a variety of electrical utility facilities. These facilities include fossil-fuel-fired, hydroelectric, and solar generating facilities; 17 substations and switchyard;, and approximately 1,487 circuit miles of transmission and distribution lines. KIUC also purchases power from several independent power producers and transmits power that it obtains from these sources through its electrical transmission system.

KIUC operates, maintains, and retrofits powerlines and communication wires, maintains streetlights and nighttime outdoor lighting at KIUC facilities, and uses night lighting to restore power if power outages occur at night. Operations include transmission, distribution, communication wires and supporting structures such as poles, towers, lattice structures, and H-frames. Lighting includes streetlights and exterior building lights at two KIUC facilities (Port Allen Generating Station and Kapaia Generating Station).

KIUC intends to implement the KIUC HCP to cover activities including continued operation, maintenance, and retrofit of existing and new powerlines and communication wires; use of lighting at facilities; and use of nighttime lighting for repairs. The proposed HCP identifies on-going impacts to three federally- and state-listed seabirds associated with powerline collisions and fallout caused by artificial nighttime lighting from streetlights and two facilities. The proposed HCP also identifies impacts to five federally- and state-listed waterbirds associated with powerline collisions. Artificial nighttime lighting from some streetlights is also expected to affect the hatchlings of the federally- and state-listed green sea turtle that become disoriented after hatching on beaches.

The impacts identified in the HCP from KIUC facilities and operations are considered "take" of the nine species addressed by the HCP. The take of species protected by the federal Endangered Species Act (ESA) and its state law equivalent, the Hawaiʻi Revised Statutes (HRS) Chapter 195D, incidental to otherwise lawful activities, is prohibited unless authorized. KIUC is applying for authorization under the ESA via an incidental take permit (federal ITP) issued by the U.S. Fish and Wildlife Service (USFWS). KIUC is applying for authorization under the HRS for an incidental take license (state ITL) issued by the DLNR, Division of Forestry and Wildlife. This permit and license are referred to collectively as the *take authorizations*.

Existing and future activities for which KIUC is seeking take authorization under the HCP are called the "covered activities". KIUC's proposed covered activities include activities related to powerline operation and retrofit (including modifications that change wire height, add new powerlines, or expose wires), operation of new or extended powerlines, use of night lighting for repairs or restoration of power, lighting at two facilities, and continued operation of existing and new streetlights.

KIUC's proposed conservation strategy includes implementation of conservation measures within existing breeding colonies of covered seabird species or at sites with suitable habitat for establishing new breeding colonies of covered seabird species. Proposed conservation measures include construction and maintenance of predator exclusion fences, predator control within and outside of the predator exclusion fences, social attraction to attract covered seabirds to new nesting colony sites within the fenced areas, and selective invasive plant species control. The proposed conservation strategy also includes extensive measures to reduce powerline collisions of the seabirds and waterbirds addressed by the HCP. The proposed conservation strategy also includes conservation measures to reduce disorientation of green sea turtle hatchlings by streetlights near beaches.

Alternatives to the Proposed Action

The Draft EIS will include a reasonable range of alternatives that may include but are not limited to variations in the level of permitted take, the length of the permit term, and alternative conservation minimization and mitigation measures. A No Action Alternative, in which USFWS and DLNR would not grant the take authorizations that KIUC has requested, will also be analyzed. Other reasonable alternatives that could meet the purpose and need for the action may be developed in response to scoping comments.

Required Permits and Approvals

KIUC is requesting a federal ITP from USFWS and a state ITL from DLNR, respectively. Issuance of a federal ITP is an action subject to review under the National Environmental Policy Act (NEPA), as amended, and use of State lands and other land within the conservation district for implementation of portions of the HCP conservation strategy is subject to review under HRS Chapter 343. Applications for a federal ITP and state ITL are supported by an HCP that describes, among other things, the anticipated effects of the proposed taking of listed species; how those effects on the affected species will be avoided, minimized, and mitigated; and how the HCP will be funded.

Affected Environment and Location Map

The HCP Plan Area is the area in which all covered activities and conservation measures will occur. Because KIUC operates an island-wide system exclusively on Kaua‘i and is proposing conservation measures in remote areas of the island, the KIUC HCP Plan Area covers the full geographic extent of Kaua‘i (see Figure 1).

Nine species are covered in this HCP and are referred to as *covered species* (Table 1). The covered species were selected based on their listing status and potential for the covered activities to result in take as defined by the ESA and HRS Chapter 195D.

Table 1. Covered Species

English Name	Hawaiian Name	Scientific Name	Status[a] (Federal/State)
Newell’s shearwater	‘a‘o	*Puffinus auricularis newelli*	T/T
Hawaiian petrel	‘ua‘u	*Pterodroma sandwichensis*	E/E
Band-rumped storm-petrel[b]	‘akē‘akē	*Oceanodroma castro*	E/E
Hawaiian stilt	ae‘o	*Himantopus mexicanus knudseni*	E/E
Hawaiian duck	koloa maoli	*Anas wyvilliana*	E/E
Hawaiian coot	‘alae ke‘oke‘o	*Fulica alai*	E/E
Hawaiian common gallinule	‘alae ‘ula	*Gallinula galeata sandvicensis*	E/E
Hawaiian goose	nēnē	*Branta sandvicensis*	T/E
Green sea turtle[b]	honu	*Chelonia mydas*	T/T

[a] Status:

E = Listed as endangered under the ESA or HRS Chapter 195D.

T = Listed as threatened under the ESA or HRS Chapter 195D.

[b] Hawai‘i distinct population segment.

The seabirds covered in the KIUC HCP include Newell’s shearwater (‘a‘o) (*Puffinus auricularis newelli*), Hawaiian petrel (‘ua‘u) (*Pterodroma sandwichensis*), and the Hawai‘i distinct population segment of the band-rumped storm-petrel (‘akē‘akē) (*Oceanodroma castro*). Newell’s shearwater (‘a‘o) is state- and federally listed as threatened and is endemic to the Hawaiian Islands. Kaua‘i supports approximately 90 percent of the total Newell’s shearwater (‘a‘o) population. The majority of the Newell’s shearwater (‘a‘o) breeding areas are in the northwestern portion of the island of Kaua‘i in mountainous areas within deep valleys and along the edges of steep ridges. The Hawaiian petrel (‘ua‘u) is state- and federally listed as endangered; once abundant and widely distributed across Hawai‘i, the majority of the breeding population is now found on Kaua‘i, Maui, and Lāna‘i, with smaller populations on Hawai‘i. Hawaiian petrel (‘ua‘u) is nearly extirpated on O‘ahu and Moloka‘i. The band-rumped storm-petrel (‘akē‘akē) is also state- and federally listed as endangered; no band-rumped storm-petrel (‘akē‘akē) nests have been located on Kaua‘i but, based on auditory survey data, breeding likely occurs at several locations on Kaua‘i, primarily in the steep cliff areas of the Nā Pali coast and within Waimea Canyon. The covered seabirds are pelagic, spending most of their time at sea and coming to land only to breed. During the non-breeding season they travel well away from Hawai‘i in the tropical Pacific. During the breeding season (March through December), the seabirds return to land, where they nest in burrows beneath ferns and tree roots in dense forest and on steep slopes and cliffs.

Waterbirds covered in the KIUC HCP are the Hawaiian stilt (ae‘o) (*Himantopus mexicanus knudseni*), Hawaiian duck (koloa maoli) (*Anas wyvilliana*), Hawaiian coot (‘alae ke‘oke‘o) (*Fulica alai*), Hawaiian common gallinule (‘alae ‘ula) (*Gallinula galeata sandvicensis*), and Hawaiian goose (nēnē) (*Branta sandvicensis*). The covered waterbirds are endemic to Hawai‘i and are state- and federally listed as endangered, except for Hawaiian goose (nēnē), which was federally downlisted to threatened in January 2020 (84 *Federal Register* 69918). With the exception of the Hawaiian goose (nēnē), the covered waterbird species are associated only with wetlands and open water habitat in Kaua‘i. Hawaiian geese (nēnē) use a wide variety of habitats including coastal dune vegetation and grasslands, sparsely vegetated lava flows, shrublands, and woodlands in areas that typically have less than 90 inches (228.6 centimeters) of annual rainfall. The Hawaiian goose (nēnē) also inhabits highly altered landscapes such as pastures, agricultural fields, and golf courses.

Green sea turtle (honu) (*Chelonia mydas*) is state- and federally listed as threatened. Most green sea turtles spend most of their lives in coral reefs along coastlines and in protected bays and lagoons. On shore, green sea turtles rely on beaches characterized by intact dunes, lack of artificial lighting, and normal beach temperatures for nesting.

Determination to Prepare an EIS and Reasons Supporting the Determination

USFWS has determined that approval of KIUC's HCP and issuance of a federal ITP is an action that is subject to review under NEPA. USFWS, as the lead federal agency, has further determined that it will prepare an EIS for the action under consideration. The EIS will be prepared in compliance with the requirements of NEPA (42 U.S. Code 4321 et seq.), its implementing regulations (40 Code of Federal Regulations Parts 1500–1508), other applicable regulations, and USFWS procedures for compliance with those regulations.

The State of Hawaii DLNR has determined that KIUC's use of State lands and other land within the conservation district for implementation of portions of the HCP conservation strategy is subject to review under HRS Chapter 343 and has further determined that an EIS should be prepared. DLNR will be the accepting authority for the state EIS, which will be prepared in compliance with HRS Chapter 343 and Hawai‘i Administrative Rules Chapter 11-200.1.

In accordance with HRS Chapter 343-5(h), because this action is subject to review under both NEPA and HRS Chapter 343, USFWS, DLNR, and KIUC are cooperating to reduce duplication between federal and state requirements by preparing a joint federal/state EIS with concurrent public reviews.

The authorizations that KIUC is requesting have the potential to have significant effects on covered species because the requested authorizations would allow the incidental take of species listed as endangered or threatened under the ESA and HRS Chapter 195D. Therefore, DLNR has decided to move directly to preparation of an EIS without first preparing an Environmental Assessment. USFWS expects to initiate the federal EIS scoping process with a Notice of Intent (NOI) in the *Federal Register* concurrent with publication of the EISPN.

The joint federal/state EIS will examine in detail the potential adverse and beneficial effects of approving the KIUC HCP, issuing a federal ITP and state ITL, and fully implementing the HCP. The EIS will assess the potential for direct, indirect, and cumulative effects on the human, natural, and cultural environment and identify mitigation measures for adverse effects.

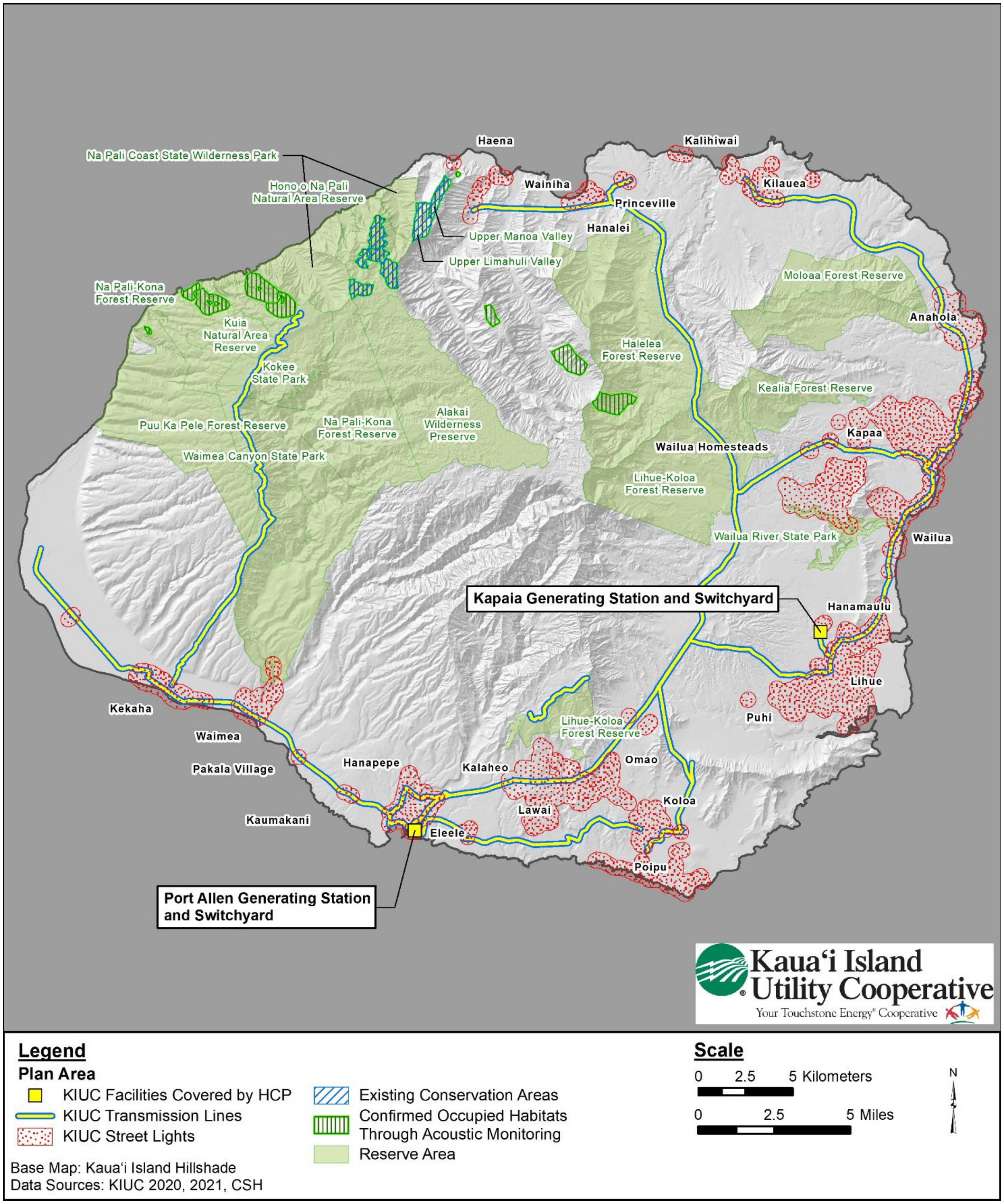

Figure 1. Map of Kaua'i showing KIUC facilities covered by the HCP, existing conservation areas, and occupied habitats confirmed through acoustic monitoring

Attachment B-2: Public Comments Received on the Environmental Impact Statement Preparation Notice

DAVID Y. IGE
GOVERNOR

JADE T. BUTAY
DIRECTOR

Deputy Directors
ROSS M. HIGASHI
EDUARDO P. MANGLALLAN
EDWIN H. SNIFFEN

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
DIR 0574
STP 8.3424

July 6, 2022

VIA EMAIL: dofaw.hcp@hawaii.gov

TO: SUZANNE D. CASE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

ATTN: KATHERINE CULLISON, CONSERVATION INITIATIVES COORDINATOR
DIVISION OF FORESTRY AND WILDLIFE
DEPARTMENT OF LAND AND NATURAL RESOURCES

FROM: JADE T. BUTAY
DIRECTOR OF TRANSPORTATION

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN) FOR THE KAUAI ISLAND UTILITY COOPERATIVE (KIUC) HABITAT CONSERVATION PLAN (HCP)

The State of Hawaii Department of Transportation (HDOT) has reviewed the subject EISPN and understands the KIUC is proposing to develop and implement the KIUC HCP to cover activities throughout the Island of Kauai including continued operations, maintenance, and retrofit of existing and new powerlines and communication wires; use of lighting at facilities; and use of nighttime lighting for repairs. The proposed HCP will identify on-going impacts to three federally- and state-listed seabirds, five federally- and state-listed waterbirds and the hatchlings of federally- and state- listed green sea turtles.

HDOT has the following comments:

Airports Division (HDOT-A)

All projects within 5 miles from Hawaii State airports are advised to read the Technical Assistance Memorandum (TAM) for guidance with development and activities that may require further review and permits. The TAM can be viewed at this link: http://files.hawaii.gov/dbedt/op/docs/TAM-FAA-DOT-Airports_08-01-2016.pdf.

Highway Division (HDOT-HWY)

Based on the information provided, the proposed project does not appear to directly or indirectly impact the State highway system. Therefore HDOT-HWY has no comments.

If there are any questions, please contact Mr. Blayne Nikaido of the HDOT Statewide Transportation Planning Office at (808) 831-7979 via email at blayne.h.nikaido@hawaii.gov.

c: Dawn Huff, KIUC Project Manager – KIUC (**VIA EMAIL**: hcp@kiuc.coop)

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

July 08, 2022

LD 0600

Department of Land and Natural Resources
Kalanimoku Building
1151 Punchbowl Street
Honolulu, HI 96813

Via email: dofaw.hcp@hawaii.gov

Dawn Huff
Kaua'i Island Utility Cooperative
4463 Pahe'e Street, Suite 1
Lihu'e, HI 96766-2000

Via email: hcp@kiuc.coop

Attention: KIUC HCP EISPN

To Whom It May Concern:

SUBJECT: KIUC HCP EIS Preparation Notice
Kaua'i Island Utility Cooperative Habitat Conservation Plan
Port Allen Generating Station & Switchyard and Kapaia Generating Station & Switchyard, Island of Kauai, Hawaii

Thank you for the opportunity to review and comment on the subject project. The Land Division of the Department of Land and Natural Resources (DLNR) distributed copies of your request to DLNR's various divisions for their review and comment.

Enclosed are responses/comments received from our (a) Engineering Division, (b) Division of Boating and Ocean Recreation, and (c) Land Division, Kauai District. Should you have any questions, please feel free to contact Barbara Lee via email at *barbara.j.lee@hawaii.gov*. Thank you.

Sincerely,

Russell Tsuji

Russell Y. Tsuji
Land Administrator

Attachment
cc: Central Files

DAVID Y. IGE
GOVERNOR OF HAWAII

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

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

June 22, 2022

LD 0600

MEMORANDUM

FROM: ~~TO:~~ **DLNR Agencies:**
X Div. of Aquatic Resources *(via email: kendall.l.tucker@hawaii.gov)*
X Div. of Boating & Ocean Recreation *(via email: richard.t.howard@hawaii.gov)*
X Engineering Division *(via email: DLNR.engr@hawaii.gov)*
X Div. of Forestry & Wildlife *(via email: rubyrosa.t.terrago@hawaii.gov)*
__ Div. of State Parks
X Commission on Water Resource Management *(via email: DLNR.CWRM@hawaii.gov)*
X Office of Conservation & Coastal Lands *(via email: sharleen.k.kuba@hawaii.gov)*
X Land Division – Kauai District *(via email: alison.neustein@hawaii.gov)*

Russell Tsuji

TO: ~~FROM:~~ Russell Y. Tsuji, Land Administrator
SUBJECT: **Environmental Impact Statement Preparation Notice**
Kaua'i Island Utility Cooperative Habitat Conservation Plan
LOCATION: Port Allen Generating Station & Switchyard and Kapaia Generating Station & Switchyard
Island of Kauai, Hawaii
APPLICANT: Kaua'i Island Utility Cooperative

Transmitted for your review and comment is information on the above-referenced project. Please review the attached information and submit any comments by the internal deadline of **July 06, 2022** to *barbara.j.lee@hawaii.gov* at the Land Division.

If no response is received by the above due date, we will assume your agency has no comments at this time. Should you have any questions about this request, please contact Barbara Lee at the above email address. 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: Jun 29, 2022

Attachments
Cc: Central Files

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/Russell Y. Tsuji
Ref: Environmental Impact Statement Preparation Notice
Kaua'i Island Utility Cooperative Habitat Conservation Plan
Location: Port Allen Generating Station & Switchyard and Kapaia Generating Station & Switchyard Island of Kauai, Hawaii
Applicant: Kaua'i Island Utility Cooperative

<u>COMMENTS</u>

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:

- <u>Oahu</u>: City and County of Honolulu, Department of Planning and Permitting (808) 768-8098.
- <u>Hawaii Island</u>: County of Hawaii, Department of Public Works (808) 961-8327.
- <u>Maui/Molokai/Lanai</u> County of Maui, Department of Planning (808) 270-7139.
- <u>Kauai</u>: County of Kauai, Department of Public Works (808) 241-4849.

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

Date: Jun 29, 2022

LD 685

DAVID Y. IGE
GOVERNOR OF HAWAII

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

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

RECEIVED
LAND DIVISION
2022 JUN 29 AM 10: 06
DEPT. OF LAND & NATURAL RESOURCES STATE OF HAWAII

June 22, 2022

LD 0680

MEMORANDUM

~~TO:~~ FROM

DLNR Agencies:
X Div. of Aquatic Resources *(via email: kendall.l.tucker@hawaii.gov)*
X Div. of Boating & Ocean Recreation *(via email: richard.t.howard@hawaii.gov)*
X Engineering Division *(via email: DLNR.engr@hawaii.gov)*
X Div. of Forestry & Wildlife *(via email: rubyrosa.t.terrago@hawaii.gov)*
__ Div. of State Parks
X Commission on Water Resource Management *(via email: DLNR.CWRM@hawaii.gov)*
X Office of Conservation & Coastal Lands *(via email: sharleen.k.kuba@hawaii.gov)*
X Land Division – Kauai District *(via email: alison.neustein@hawaii.gov)*

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

SUBJECT: **Environmental Impact Statement Preparation Notice**
Kaua'i Island Utility Cooperative Habitat Conservation Plan

LOCATION: Port Allen Generating Station & Switchyard and Kapaia Generating Station & Switchyard
Island of Kauai, Hawaii

APPLICANT: Kaua'i Island Utility Cooperative

Transmitted for your review and comment is information on the above-referenced project. Please review the attached information and submit any comments by the internal deadline of **July 06, 2022** to *barbara.j.lee@hawaii.gov* at the Land Division.

If no response is received by the above due date, we will assume your agency has no comments at this time. Should you have any questions about this request, please contact Barbara Lee at the above email address. Thank you.

BRIEF COMMENTS:

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

Signed: [signature]
Print Name: Richard Howard
Division: DOBOR
Date: 6/28/2022

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

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

June 22, 2022

LD 0600

MEMORANDUM

TO: **DLNR Agencies:**
X Div. of Aquatic Resources *(via email: kendall.l.tucker@hawaii.gov)*
X Div. of Boating & Ocean Recreation *(via email: richard.t.howard@hawaii.gov)*
X Engineering Division *(via email: DLNR.engr@hawaii.gov)*
X Div. of Forestry & Wildlife *(via email: rubyrosa.t.terrago@hawaii.gov)*
__Div. of State Parks
X Commission on Water Resource Management *(via email: DLNR.CWRM@hawaii.gov)*
X Office of Conservation & Coastal Lands *(via email: sharleen.k.kuba@hawaii.gov)*
X Land Division – Kauai District *(via email: alison.neustein@hawaii.gov)*

Russell Tsuji

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: **Environmental Impact Statement Preparation Notice**
Kaua'i Island Utility Cooperative Habitat Conservation Plan
LOCATION: Port Allen Generating Station & Switchyard and Kapaia Generating Station & Switchyard Island of Kauai, Hawaii
APPLICANT: Kaua'i Island Utility Cooperative

Transmitted for your review and comment is information on the above-referenced project. Please review the attached information and submit any comments by the internal deadline of **July 06, 2022** to *barbara.j.lee@hawaii.gov* at the Land Division.

If no response is received by the above due date, we will assume your agency has no comments at this time. Should you have any questions about this request, please contact Barbara Lee at the above email address. Thank you.

BRIEF COMMENTS:

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

Signed: Alison Neustein
Print Name: Alison Neustein
Division: DLNR, KDLO
Date: 6/28/2022

Attachments
Cc: Central Files

LD 0600

ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE FOR THE KAUA'I ISLAND UTILITY COOPERATIVE HABITAT CONSERVATION PLAN KAUA'I, HAWAI'I

Applicant

Kaua'i Island Utility Cooperative
4463 Pahe'e Street, Suite 1
Lihu'e, HI 96766-2000

Accepting Authority

State of Hawai'i
Board of Land and Natural Resources
Kalanimoku Building
1151 Punchbowl Street
Honolulu, HI 96813

Scoping Process and Dates

This notice initiates a 30-day public scoping period for the Kaua'i Island Utility Cooperative (KIUC) Habitat Conservation Plan (HCP) Environmental Impact Statement (EIS) that will commence June 8, 2022, and end July 8, 2022.

To help protect the public and limit the spread of COVID-19, one virtual public scoping meeting will be held on June 28, 2022, at 5 p.m. Registration for the virtual public scoping meeting may be completed here: https://us02web.zoom.us/webinar/register/WN_aw4mkokBSM-w4ntaS-c7FQ or by emailing hcp@kiuc.coop. The virtual public scoping meeting is open to the public and free to attend.

All comments on this notice will be considered if received or postmarked on or before July 8, 2022. All comments received are a part of the public record. All personal identifying information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.

Addresses

Please submit copies of your comments with the subject line "KIUC HCP EIS Preparation Notice (EISPN)" to both the State of Hawai'i Department of Land and Natural Resources (DLNR) and KIUC. Transmission of comments to DLNR and KIUC must be via U.S. Mail to the addresses below:

Attention: KIUC HCP EISPN
Department of Land and Natural Resources
1151 Punchbowl Street
Kalanimoku Building
Honolulu, HI 96813

Dawn Huff
Attention: KIUC HCP EISPN
Kaua'i Island Utility Cooperative
4463 Pahe'e Street, Suite 1
Lihu'e, HI 96766-2000

For Further Information, Contact:

For more information on the project, please contact Katherine Cullison at the DLNR Division of Forestry and Wildlife or Dawn Huff at Joule Group, LLC (representing KIUC) by phone, Monday through Friday from 8:00 a.m. to 5:00 p.m. (Hawai'i Standard Time), or by email.

Katherine Cullison, Conservation Initiatives Coordinator
Division of Forestry and Wildlife
Department of Land and Natural Resources
1151 Punchbowl Street, Room 325
Honolulu, HI 96813
(808) 223-0459
dofaw.hcp@hawaii.gov

Dawn Huff, KIUC Project Manager
Kaua'i Island Utility Cooperative
4463 Pahe'e Street, Suite 1
Lihu'e, HI 96766-2000
(808) 354-0302
hcp@kiuc.coop

Description of the Proposed Action

KIUC is a not-for-profit, tax-exempt cooperative association governed by a publicly elected nine-member Board of Directors. As a public utility responsible for the production, purchase, transmission, distribution, and sale of electricity on the Island of Kaua'i (Kaua'i), KIUC is regulated by the State of Hawai'i Public Utility Commission and is required by law to provide and ensure the availability of electrical service on Kaua'i. KIUC is entirely owned by its members, which total approximately 34,000 ratepayers.

To ensure reliable electrical service to Kaua'i, KIUC owns and operates a variety of electrical utility facilities. These facilities include fossil-fuel-fired, hydroelectric, and solar generating facilities; 17 substations and switchyard;, and approximately 1,487 circuit miles of transmission and distribution lines. KIUC also purchases power from several independent power producers and transmits power that it obtains from these sources through its electrical transmission system.

KIUC operates, maintains, and retrofits powerlines and communication wires, maintains streetlights and nighttime outdoor lighting at KIUC facilities, and uses night lighting to restore power if power outages occur at night. Operations include transmission, distribution, communication wires and supporting structures such as poles, towers, lattice structures, and H-frames. Lighting includes streetlights and exterior building lights at two KIUC facilities (Port Allen Generating Station and Kapaia Generating Station).

KIUC intends to implement the KIUC HCP to cover activities including continued operation, maintenance, and retrofit of existing and new powerlines and communication wires; use of lighting at facilities; and use of nighttime lighting for repairs. The proposed HCP identifies on-going impacts to three federally- and state-listed seabirds associated with powerline collisions and fallout caused by artificial nighttime lighting from streetlights and two facilities. The proposed HCP also identifies impacts to five federally- and state-listed waterbirds associated with powerline collisions. Artificial nighttime lighting from some streetlights is also expected to affect the hatchlings of the federally- and state-listed green sea turtle that become disoriented after hatching on beaches.

The impacts identified in the HCP from KIUC facilities and operations are considered "take" of the nine species addressed by the HCP. The take of species protected by the federal Endangered Species Act (ESA) and its state law equivalent, the Hawai'i Revised Statutes (HRS) Chapter 195D, incidental to otherwise lawful activities, is prohibited unless authorized. KIUC is applying for authorization under the ESA via an incidental take permit (federal ITP) issued by the U.S. Fish and Wildlife Service (USFWS). KIUC is applying for authorization under the HRS for an incidental take license (state ITL) issued by the DLNR, Division of Forestry and Wildlife. This permit and license are referred to collectively as the *take authorizations*.

Existing and future activities for which KIUC is seeking take authorization under the HCP are called the "covered activities". KIUC's proposed covered activities include activities related to powerline operation and retrofit (including modifications that change wire height, add new powerlines, or expose wires), operation of new or extended powerlines, use of night lighting for repairs or restoration of power, lighting at two facilities, and continued operation of existing and new streetlights.

KIUC's proposed conservation strategy includes implementation of conservation measures within existing breeding colonies of covered seabird species or at sites with suitable habitat for establishing new breeding colonies of covered seabird species. Proposed conservation measures include construction and maintenance of predator exclusion fences, predator control within and outside of the predator exclusion fences, social attraction to attract covered seabirds to new nesting colony sites within the fenced areas, and selective invasive plant species control. The proposed conservation strategy also includes extensive measures to reduce powerline collisions of the seabirds and waterbirds addressed by the HCP. The proposed conservation strategy also includes conservation measures to reduce disorientation of green sea turtle hatchlings by streetlights near beaches.

Alternatives to the Proposed Action

The Draft EIS will include a reasonable range of alternatives that may include but are not limited to variations in the level of permitted take, the length of the permit term, and alternative conservation minimization and mitigation measures. A No Action Alternative, in which USFWS and DLNR would not grant the take authorizations that KIUC has requested, will also be analyzed. Other reasonable alternatives that could meet the purpose and need for the action may be developed in response to scoping comments.

Required Permits and Approvals

KIUC is requesting a federal ITP from USFWS and a state ITL from DLNR, respectively. Issuance of a federal ITP is an action subject to review under the National Environmental Policy Act (NEPA), as amended, and use of State lands and other land within the conservation district for implementation of portions of the HCP conservation strategy is subject to review under HRS Chapter 343. Applications for a federal ITP and state ITL are supported by an HCP that describes, among other things, the anticipated effects of the proposed taking of listed species; how those effects on the affected species will be avoided, minimized, and mitigated; and how the HCP will be funded.

Affected Environment and Location Map

The HCP Plan Area is the area in which all covered activities and conservation measures will occur. Because KIUC operates an island-wide system exclusively on Kaua'i and is proposing conservation measures in remote areas of the island, the KIUC HCP Plan Area covers the full geographic extent of Kaua'i (see Figure 1).

Nine species are covered in this HCP and are referred to as *covered species* (Table 1). The covered species were selected based on their listing status and potential for the covered activities to result in take as defined by the ESA and HRS Chapter 195D.

Table 1. Covered Species

English Name	Hawaiian Name	Scientific Name	Status[a] (Federal/State)
Newell's shearwater	'a'o	*Puffinus auricularis newelli*	T/T
Hawaiian petrel	'ua'u	*Pterodroma sandwichensis*	E/E
Band-rumped storm-petrel[b]	'akē'akē	*Oceanodroma castro*	E/E
Hawaiian stilt	ae'o	*Himantopus mexicanus knudseni*	E/E
Hawaiian duck	koloa maoli	*Anas wyvilliana*	E/E
Hawaiian coot	'alae ke'oke'o	*Fulica alai*	E/E
Hawaiian common gallinule	'alae 'ula	*Gallinula galeata sandvicensis*	E/E
Hawaiian goose	nēnē	*Branta sandvicensis*	T/E
Green sea turtle[b]	honu	*Chelonia mydas*	T/T

[a] Status:

E = Listed as endangered under the ESA or HRS Chapter 195D.

T = Listed as threatened under the ESA or HRS Chapter 195D.

[b] Hawai'i distinct population segment.

The seabirds covered in the KIUC HCP include Newell's shearwater ('a'o) (*Puffinus auricularis newelli*), Hawaiian petrel ('ua'u) (*Pterodroma sandwichensis*), and the Hawai'i distinct population segment of the band-rumped storm-petrel ('akē'akē) (*Oceanodroma castro*). Newell's shearwater ('a'o) is state- and federally listed as threatened and is endemic to the Hawaiian Islands. Kaua'i supports approximately 90 percent of the total Newell's shearwater ('a'o) population. The majority of the Newell's shearwater ('a'o) breeding areas are in the northwestern portion of the island of Kaua'i in mountainous areas within deep valleys and along the edges of steep ridges. The Hawaiian petrel ('ua'u) is state- and federally listed as endangered; once abundant and widely distributed across Hawai'i, the majority of the breeding population is now found on Kaua'i, Maui, and Lāna'i, with smaller populations on Hawai'i. Hawaiian petrel ('ua'u) is nearly extirpated on O'ahu and Moloka'i. The band-rumped storm-petrel ('akē'akē) is also state- and federally listed as endangered; no band-rumped storm-petrel ('akē'akē) nests have been located on Kaua'i but, based on auditory survey data, breeding likely occurs at several locations on Kaua'i, primarily in the steep cliff areas of the Nā Pali coast and within Waimea Canyon. The covered seabirds are pelagic, spending most of their time at sea and coming to land only to breed. During the non-breeding season they travel well away from Hawai'i in the tropical Pacific. During the breeding season (March through December), the seabirds return to land, where they nest in burrows beneath ferns and tree roots in dense forest and on steep slopes and cliffs.

Waterbirds covered in the KIUC HCP are the Hawaiian stilt (ae'o) (*Himantopus mexicanus knudseni*), Hawaiian duck (koloa maoli) (*Anas wyvilliana*), Hawaiian coot ('alae ke'oke'o) (*Fulica alai*), Hawaiian common gallinule ('alae 'ula) (*Gallinula galeata sandvicensis*), and Hawaiian goose (nēnē) (*Branta sandvicensis*). The covered waterbirds are endemic to Hawai'i and are state- and federally listed as endangered, except for Hawaiian goose (nēnē), which was federally downlisted to threatened in January 2020 (84 *Federal Register* 69918). With the exception of the Hawaiian goose (nēnē), the covered waterbird species are associated only with wetlands and open water habitat in Kaua'i. Hawaiian geese (nēnē) use a wide variety of habitats including coastal dune vegetation and grasslands, sparsely vegetated lava flows, shrublands, and woodlands in areas that typically have less than 90 inches (228.6 centimeters) of annual rainfall. The Hawaiian goose (nēnē) also inhabits highly altered landscapes such as pastures, agricultural fields, and golf courses.

Green sea turtle (honu) (*Chelonia mydas*) is state- and federally listed as threatened. Most green sea turtles spend most of their lives in coral reefs along coastlines and in protected bays and lagoons. On shore, green sea turtles rely on beaches characterized by intact dunes, lack of artificial lighting, and normal beach temperatures for nesting.

Determination to Prepare an EIS and Reasons Supporting the Determination

USFWS has determined that approval of KIUC's HCP and issuance of a federal ITP is an action that is subject to review under NEPA. USFWS, as the lead federal agency, has further determined that it will prepare an EIS for the action under consideration. The EIS will be prepared in compliance with the requirements of NEPA (42 U.S. Code 4321 et seq.), its implementing regulations (40 Code of Federal Regulations Parts 1500–1508), other applicable regulations, and USFWS procedures for compliance with those regulations.

The State of Hawaii DLNR has determined that KIUC's use of State lands and other land within the conservation district for implementation of portions of the HCP conservation strategy is subject to review under HRS Chapter 343 and has further determined that an EIS should be prepared. DLNR will be the accepting authority for the state EIS, which will be prepared in compliance with HRS Chapter 343 and Hawai'i Administrative Rules Chapter 11-200.1.

In accordance with HRS Chapter 343-5(h), because this action is subject to review under both NEPA and HRS Chapter 343, USFWS, DLNR, and KIUC are cooperating to reduce duplication between federal and state requirements by preparing a joint federal/state EIS with concurrent public reviews.

The authorizations that KIUC is requesting have the potential to have significant effects on covered species because the requested authorizations would allow the incidental take of species listed as endangered or threatened under the ESA and HRS Chapter 195D. Therefore, DLNR has decided to move directly to preparation of an EIS without first preparing an Environmental Assessment. USFWS expects to initiate the federal EIS scoping process with a Notice of Intent (NOI) in the *Federal Register* concurrent with publication of the EISPN.

The joint federal/state EIS will examine in detail the potential adverse and beneficial effects of approving the KIUC HCP, issuing a federal ITP and state ITL, and fully implementing the HCP. The EIS will assess the potential for direct, indirect, and cumulative effects on the human, natural, and cultural environment and identify mitigation measures for adverse effects.

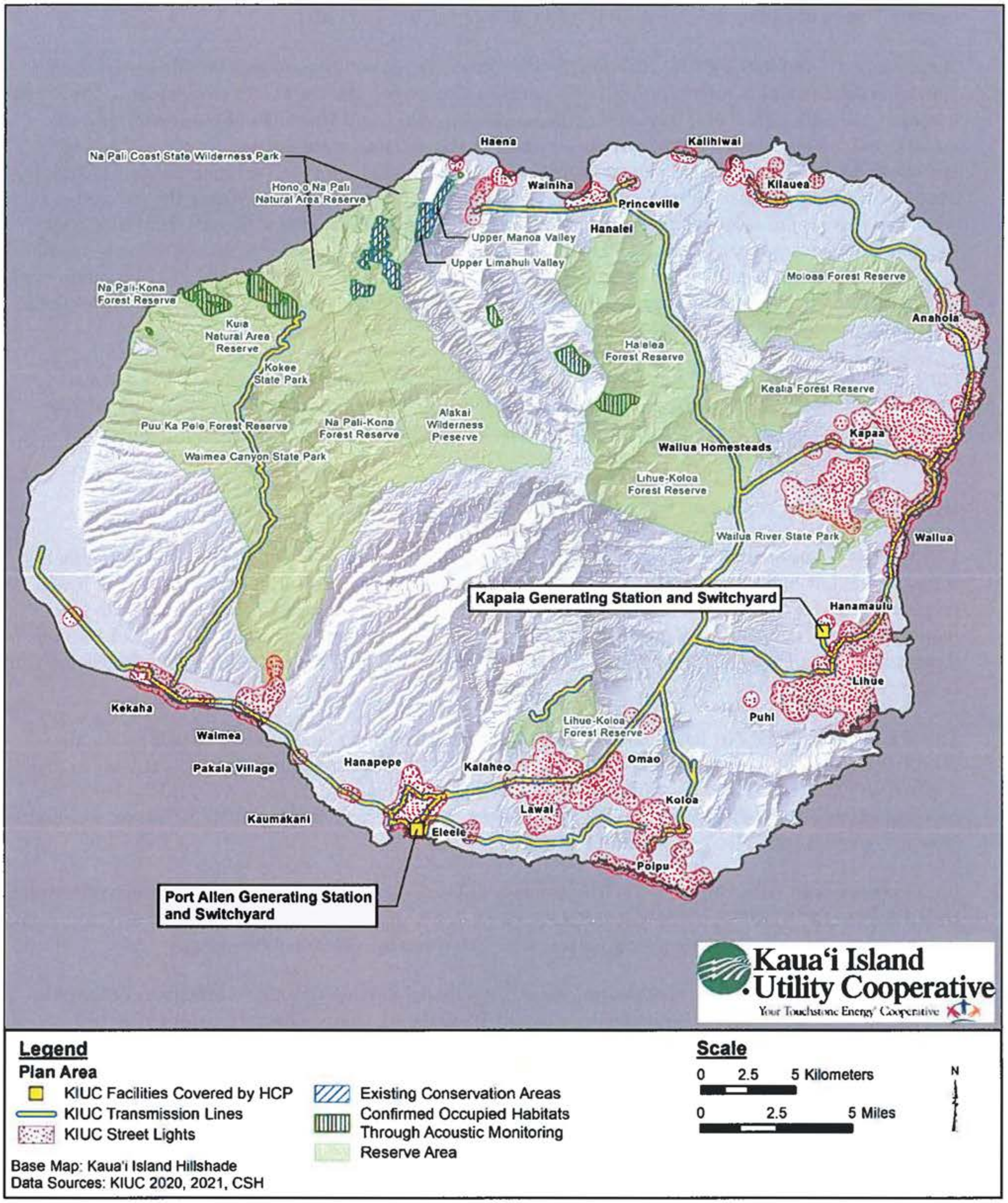

Figure 1. Map of Kaua'i showing KIUC facilities covered by the HCP, existing conservation areas, and occupied habitats confirmed through acoustic monitoring

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

June 22, 2022

LD 0600

MEMORANDUM

TO: **DLNR Agencies:**
X Div. of Aquatic Resources *(via email: kendall.l.tucker@hawaii.gov)*
X Div. of Boating & Ocean Recreation *(via email: richard.t.howard@hawaii.gov)*
X Engineering Division *(via email: DLNR.engr@hawaii.gov)*
X Div. of Forestry & Wildlife *(via email: rubyrosa.t.terrago@hawaii.gov)*
__ Div. of State Parks
X Commission on Water Resource Management *(via email: DLNR.CWRM@hawaii.gov)*
X Office of Conservation & Coastal Lands *(via email: sharleen.k.kuba@hawaii.gov)*
X Land Division – Kauai District *(via email: alison.neustein@hawaii.gov)*

Russell Tsuji

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: **Environmental Impact Statement Preparation Notice**
Kaua'i Island Utility Cooperative Habitat Conservation Plan
LOCATION: Port Allen Generating Station & Switchyard and Kapaia Generating Station & Switchyard
Island of Kauai, Hawaii
APPLICANT: Kaua'i Island Utility Cooperative

Transmitted for your review and comment is information on the above-referenced project. Please review the attached information and submit any comments by the internal deadline of **July 06, 2022** to *barbara.j.lee@hawaii.gov* at the Land Division.

If no response is received by the above due date, we will assume your agency has no comments at this time. Should you have any questions about this request, please contact Barbara Lee at the above email address. Thank you.

BRIEF COMMENTS:

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

Signed: (R)
Print Name: Ryan Okano for Brian J. Neilson
Division: Aquatic Resources
Date: Jul 8, 2022

Attachments
Cc: Central Files

DAVID Y. IGE
GOVERNOR OF
HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF AQUATIC RESOURCES
1151 PUNCHBOWL STREET, ROOM 330
HONOLULU, HAWAII 96813

Date: 7/7/2022
DAR # AR0202

MEMORANDUM

TO: Brian J. Neilson
DAR Administrator

FROM: Heather Ylitalo-Ward HY, Aquatic Biologist

SUBJECT: KIUC HCP EIS Preparation Notice (EISPN)

Request Submitted by: Kauai Island Utility Cooperative

Location of Project: Kauai Island

Brief Description of Project:

KIUC intends to implement the KIUC HCP to cover activities including continued operation, maintenance, and retrofit of existing and new powerlines and communication wires; use of lighting at facilities; and use of nighttime lighting for repairs. The proposed HCP identifies on-going impacts to three federally- and state-listed seabirds associated with powerline collisions and fallout caused by
artificial nighttime lighting from streetlights and two facilities. The proposed HCP also identifies impacts to five federally- and state-listed waterbirds associated with powerline collisions. Artificial nighttime lighting from some streetlights is also expected to affect the hatchlings of the federally- and state-listed green sea turtle tat become disoriented after hatching on beaches

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: (signature) Date: Jul 8, 2022

Brian J. Neilson
DAR Administrator

DAR# AR0202

Brief Description of Project

KIUC's proposed conservation strategy includes implementation of conservation measures within existing breeding colonies of covered seabird species or at sites with suitable habitat for establishing new breeding colonies of covered seabird species. Proposed conservation measures include construction and maintenance of predator exclusion fences, predator control within and outside of the predator exclusion fences, social attraction to attract covered seabirds to new nesting colony sites within the fenced areas, and selective invasive plant species control. The proposed conservation strategy also includes extensive measures to reduce powerline collisions of the seabirds and waterbirds addressed by the HCP. The proposed conservation strategy also includes conservation measures to reduce disorientation of green sea turtle hatchlings by streetlights near beaches.

The joint federal/state EIS will examine in detail the potential adverse and beneficial effects of approving the KIUC HCP, issuing a federal ITP and state ITL, and fully implementing the HCP. The EIS will assess the potential for direct, indirect, and cumulative effects on the human, natural, and cultural environment and identify mitigation measures for adverse effects.

DAR# AR0202

Comments

Thank you for providing DAR the opportunity to comment on the KIUC Habitat Conservation Plan Environmental Impact Statement. We request to be informed of, if not involved in, the process of making decisions regarding mitigation measures and effects on green sea turtles in Kauai. DAR frequently deals with green sea turtles on the beaches of Kauai and we have experience and insight into some of the potential impacts.

DAVID Y. IGE
GOVERNOR

CURT T. OTAGURO
COMPTROLLER

AUDREY HIDANO
DEPUTY COMPTROLLER

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

(P)22.105

JUN 14 2022

Dawn Huff
KIUC HCP EISPN
Kauai Island Utility Cooperative
4463 Pahee Street, Suite 1
Lihue, Hawaii 96766-2200

Dear Ms. Huff:

Subject: Environmental Impact Statement Preparation Notice for KIUC Habitat Conservation Plan Kauai, Hawaii

Thank you for the opportunity to comment on the subject project. We have no comments to offer at this time as the proposed project does not directly impact any of the Department of Accounting and General Services' projects or existing facilities.

If you have any questions, your staff may call Ms. Gayle Takasaki of the Planning Branch at (808) 586-0584.

Sincerely,

CHRISTINE L. KINIMAKA
Public Works Administrator

GT:mo
c: Department of Land and Natural Resources
Eric Agena, DAGS KDO

EARTHJUSTICE

July 8, 2022

Via Federal eRulemaking Portal

www.regulations.gov
Docket No. FWS–R1–ES–2022–0068

Via U.S. Mail

Department of Land and Natural Resources
Attn: KIUC HCP EISPN
1151 Punchbowl Street
Kalanimoku Building
Honolulu, HI 96813

Dawn Huff
Attn: KIUC HCP EISPN
Kaua'i Island Utility Cooperative 4463 Pahe'e Street, Suite 1
Lihu'e, HI 96766-2000

Re: Scoping for Environmental Impact Statement for the Kauai Island Utility Cooperative Habitat Conservation Plan, Kauai, HI, 87 Fed. Reg. 34,897 (June 8, 2022)

To Whom It May Concern:

Earthjustice submits these comments on behalf of Hui Hoʻomalu i ka ʻĀina, Conservation Council for Hawaiʻi, Center for Biological Diversity, and the American Bird Conservancy, in response to the U.S. Fish and Wildlife Service's request for public input on the scope of the environmental impact statement ("EIS") for issuance of an Endangered Species Act ("ESA") incidental take permit for activities covered under the Kauai Island Utility Cooperative's ("KIUC's") long-term habitat conservation plan ("LTHCP"). See 87 Fed. Reg. 34,897 (June 8, 2022).

These comments also respond to the State of Hawaiʻi Department of Land and Natural Resources' ("DLNR's") May 27, 2022, environmental impact statement preparation notice initiating review of the Service's EIS for issuance of an incidental take license ("ITL") under Hawaiʻi Revised Statutes chapter 195D. See https://files.hawaii.gov/dbedt/erp/Doc_ Library/2022-06-08-KA-EISPN-Kauai-Island-Utility-Cooperative-Habitat-Conservation-Plan.pdf (last visited July 3, 2022).

As discussed below, we have concerns regarding deficiencies in the Service's public scoping process that precluded meaningful public participation. We also provide general comments addressing the appropriate scope of the Service's and DLNR's environmental review of KIUC's LTHCP. We urge the Service and DLNR to ensure that the EIS considers a range of alternatives that require KIUC to minimize and mitigate the take of critically imperiled seabirds on Kauaʻi over the full life of the LTHCP.

The Service's Public Scoping Notice Was Insufficient To Allow For Full Public Participation.

At the outset, we note flaws in the scoping process that have constrained the public's opportunities for meaningful engagement. Initially, the Federal Register's description of "Covered Activities" provides insufficient detail to allow for meaningful public feedback on the EIS's scope, violating the National Environmental Policy Act's ("NEPA's") requirement that agencies preparing an EIS "[m]ake diligent efforts to involve the public in preparing and implementing their NEPA procedures" and to "[s]olicit appropriate information from the public." 40 C.F.R. § 1506.6(a), (d). The notice states that "[t]he proposed covered activities will include … [o]peration and maintenance of future powerlines and lighting[,]" 87 Fed. Reg. at 34,898–99, but does not provide any information regarding the location or extent of this new infrastructure, the expected timeframe for KIUC to develop the new infrastructure, or anticipated effects of these developments on any listed species' habitat or breeding grounds. The notice is similarly vague about what activities are included in KIUC's "continued operation, maintenance, and retrofit of existing powerlines and lighting at certain facilities[,]" id. at 34,898 (emphasis added), as well as what and where "measures associated with KIUC's conservation strategy" will be implemented. Id. at 34,899.

The notice's vague and cursory mention of KIUC's covered activities precludes the public from identifying likely impacts, let alone proposing specific alternatives or suggesting appropriate mitigation measures that the Service should consider in its environmental review of KIUC's LTHCP. Given that the Service may grant an ITP for only a defined project, see 50 C.F.R. §§ 17.22(b)(1)(i), 17.32(b)(1)(iii)(A) (incidental take application must include "[a] complete description of the activity sought to be authorized"), it should have provided more information on KIUC's proposed actions to allow the public a meaningful opportunity to provide input.

Next, the obsolete information in the only draft of the LTHCP that is currently available does not make up for the deficient scoping notice. At the June 22, 2022, scoping meeting, KIUC indicated that a revised LTHCP will not be available for public review until the fourth quarter of this year, after the close of the scoping comment period. The most recent version of the LTHCP that the public can access is a "Preliminary Discussion Draft" from January 2018. This version is substantially outdated, making it impossible for the public to provide constructive scoping comments on the actions that KIUC now proposes to undertake. For example, the 2018 discussion draft covered only three protected seabird species: Newell's Shearwater (*Puffinus newelli*); Hawaiian Petrel (*Pterodroma sandwichensis*); and Band-rumped Storm-Petrel

(*Oceanodroma castro*). According to the Federal Register notice, the LTHCP will now cover a total of nine species, including five waterbirds and the green sea turtle. See 87 Fed. Reg. at 34,898. Nowhere does the Service explain why it has concluded that KIUC's proposed activities will now adversely affect three times as many imperiled species.

Overall, the Service's failure to provide adequate information to the public regarding the LTHCP that is currently under consideration prevents the scoping process from serving its intended purpose: "identifying the significant issues and eliminating from further study non-significant issues." 40 C.F.R. § 1501.9(a).

The Service Must Ensure That KIUC's Take Minimization And Mitigation Measures Continue Long-Term And Address The Full Severity of Annual Take Of Imperiled Seabirds.

To ensure the continued survival of the protected seabird species and hold out any hope for these species' future recovery, KIUC must be required to continue, for the entire duration of the LTHCP, implementation of measures to minimize the toll that KIUC's operations inflict on seabird populations, as well as efforts to mitigate unavoidable take. KIUC's Short-Term Habitat Conservation Plan and ITP expired in 2016. Since then, KIUC has continued operating its powerlines and lighting without a permit authorizing its take of the thousands of imperiled seabirds it has killed or injured. See 81 Fed. Reg. 44,316, 44,317 (July 7, 2016) ("a minimum of 1,012 and 1,002 seabird collision events" detected in 2014 and 2015, respectively).

Since 2016, KIUC's minimization efforts have included static wire removal, reflective and LED diverter deployment, some powerline reconfigurations, and retrofitting of some streetlights. Mitigation efforts include funding conservation work (e.g., predator control, vegetation control, and monitoring), as well as providing funding for Save Our Shearwaters (SOS), a seabird rehabilitation program for shearwaters and petrels. While these efforts are a good start, the ITP/ITL and HCP must require KIUC to continue implementing both take minimization and mitigation measures through the entirety of the proposed ITP/ITL permit term. While it may not be feasible to expect KIUC to address all problematic infrastructure up-front, the LTHCP is expected to span 30 years, see 87 Fed. Reg. at 34,898, and KIUC should be required to prioritize and implement take minimization over the full life of the requested permit, including powerline reconfiguration and undergrounding, rather than rely solely on mitigation after initial minimization projects are completed. To that end, the EIS should consider a range of alternatives that require KIUC to continue both minimizing and mitigating take through the full 30-year duration of the ITP/ITL.

The Service Must Ensure That All Environmental Impacts Of KIUC's LTHCP Are Fully And Openly Disclosed And Analyzed In Its EIS, Together With A Comprehensive Range Of Alternatives.

Given the inadequacies of the public notice of KIUC's proposal, the public cannot provide detailed comments about the appropriate scope of the Service's environmental review. We nevertheless provide the following general comments:

1. The Draft EIS Must Assess All Potential Impacts To The Covered Species And Affected Environment.

NEPA requires the Service to consider all impacts to listed species—direct, indirect, and cumulative—associated with KIUC's powerlines and lighting infrastructure. 40 C.F.R. § 1508.1(g)(1)-(3). These impacts include, but are not limited to, "ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health[.]" Id. § 1508.1(g)(4).

According to the Federal Register, KIUC intends to operate, maintain, and retrofit existing infrastructure as well as construct and operate future powerlines and lighting. See 87 Fed. Reg. at 34,898–99. In addition to evaluating the potential direct effects of these activities, which include powerline collisions, light attraction, and habitat degradation, the Service should also assess the indirect effects of these actions, including "growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems." 40 C.F.R. § 1508.1(g)(2). The Service should evaluate how the operation and maintenance of existing and future infrastructure might indirectly impact any habitat, food resources, or other conditions related to the survival or recovery of the covered species. Growth inducing effects related to the operation, maintenance, and retrofitting of existing infrastructure, as well as the construction and operation of future powerlines and lighting, should be considered, especially if the growth inducing effects will take place in natural areas that are currently undeveloped. The Service should also assess whether KIUC's infrastructure—both existing and prospective—will increase light attraction in areas that are particularly sensitive for the protected seabird species (e.g., fledgling flyways or areas that currently have limited artificial lighting).

In evaluating cumulative effects, the Service must consider "effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency … or person undertakes such other actions." 40 C.F.R. § 1508.1(g)(3). Accordingly, the Service should evaluate the impacts of other human activities with adverse effects on the protected wildlife, such as the introduction of alien predators, habitat destruction, and other sources of light attraction (e.g., solar panels, nearby residential and business buildings, cars, and temporary lighting used for construction projects).

2. The Draft EIS Must Consider A Full Range of Alternate Approaches To Satisfy the ESA's Mandates To Minimize And Mitigate Harm To The "Maximum Extent Practicable."

In its environmental review of the KIUC LTHCP, the Service must consider a full range of alternative approaches to satisfy the ESA's requirements to minimize and mitigate harm to listed species to the "maximum extent practicable" and to avoid jeopardy. See 16 U.S.C. § 1539(a)(2)(B)(ii), (iv). While there has been historical pushback by KIUC to undergrounding current and future powerlines, KIUC has been aware of the need to bury powerlines for decades and should have prepared and funded an undergrounding program years ago. As mentioned previously, KIUC should be required to continue to invest in take minimization efforts through the entire life of the 30-year LTHCP, including potentially expensive and complex projects like undergrounding. Accordingly, the Service must consider all relevant circumstances, such as the duration of the proposed ITP/ITL, in determining what minimization and mitigation measures are "practicable." See 16 U.S.C. § 1539(a)(2)(B)(ii).

The Service's analysis should also reflect that a central component of the proposed action is maintaining KIUC's currently illegal infrastructure. Contrary to the Service's current thinking on the required "no action" alternative, the Service should not "assume that KIUC would operate and maintain existing and future powerlines and lighting in accordance with current practice." 87 Fed. Reg. 34,898. In absence of an ITP/ITL, KIUC is likely to be sued to put an end to its ongoing, excessive, and illegal take of imperiled seabirds.

3. The Requirement Under Hawaiʻi Law That KIUC's Activities Provide "Net Environmental Benefits" Informs What Alternatives Are "Practicable" Under The ESA.

Since KIUC cannot operate without both federal and state ITP/ITLs, the more demanding incidental take standard imposed under state law, which mandates that the "cumulative impact of the [authorized] activity … provide[] net environmental benefits," Haw. Rev. Stat. § 195D-4(g)(8), informs the analysis of what alternatives are "practicable" under the ESA and, thus, should be considered in the draft EIS. The Service should also bear in mind that KIUC cannot secure an ITL under Hawaiʻi law unless the associated HCP "will increase the likelihood of recovery of the endangered or threatened species that are the focus of the plan," id. § 195D-21(b)(1)(B), and "minimize[s] and mitigate[s] all negative impacts, including without limitation the impact of any authorized incidental take." Id. § 195D-21(b)(2)(C); see also id. § 195D-4(g)(4) ("The plan shall increase the likelihood that the species will survive and recover"); id. § 195D-30 ("All habitat conservation plans … shall be designed to result in an overall net gain in the recovery of Hawaii's threatened and endangered species").

4. In Light Of The Foregoing, The Draft EIS Should Evaluate the Following Take **Minimization** Alternatives:

- Underground existing powerlines (see Attachments 1; 6);
- Re-configure powerlines: lower and shield powerlines with vegetation (e.g., trees and bushes), visible structures (e.g., bridges), and geographic features (e.g., mountains and hillsides) (see Attachments 1; 2; 6);
- Face all lighting downward and install full cut-off shields on all existing and future lighting) (see Attachments 1; 2; 4; 6);
- Adjust the color of lighting to minimize short wave-length light and reduce overall lighting brightness/intensity (see Attachments 1; 4; 6); and
- Turn off lights during fledging periods in high-risk areas, install timer switches on outdoor lighting to allow automatic switch-off when lights are not in use, and remove unnecessary lights (see Attachments 1; 4; 6).

5. The Draft EIS Should Also Evaluate the Following Take **Mitigation** Alternatives:

- Eradicate invasive predators on all KIUC properties, including around power poles, streetlights, and solar arrays (see Attachments 1–6);
- Fund a program to eliminate or modify sources of outdoor light that attract shearwaters on properties that are not part of KIUC's operations (e.g., solar panels, nearby residential and business buildings, cars, and temporary lighting used for construction projects) (see Attachments 1; 4; 6);
- Fund the rescue and rehabilitation of injured protected species (see Attachments 1; 2; 4; 6);
- Restore degraded habitat and create refugia free of lights, powerlines, and predators that provide nesting habitat (e.g., artificial nest burrows) (see Attachments 1; 2; 5; 6);
- Create new, protected colonies using assisted-colonization techniques such as social attraction and chick translocation within predator-proof fences, focusing on the locations with the greatest remaining concentrations of seabirds (see Attachments 1; 2; 6); and
- Support ongoing, independent third-party research and monitoring of the protected species, including evaluating the effectiveness of implemented measures, identifying new hotspots, and pursuing adaptive management strategies (see Attachments 1; 2; 3; 4; 6).

We appreciate the opportunity to provide these scoping comments. Please feel free to contact us if you have any questions or would like to discuss any of the issues raised above. I can be reached by telephone (808-599-2436) or email (dhenkin@earthjustice.org).

Sincerely,

David L. Henkin
Staff Attorney

Attachments

List of Attachments

1. **Attachment 1:** Arcos et al., *Future Directions in Conservation Research on Petrels and Shearwaters*, 6 Frontiers in Marine Science 1 (2019).
2. **Attachment 2:** Raine et al., *Declining Population Trends of Hawaiian Petrel and Newell's Shearwater on the Island of Kaua'i, Hawaii, USA*, 119 American Ornithological Soc'y 405 (2017).
3. **Attachment 3:** Raine et al., *Managing the Effects of Introduced Predators on Hawaiian Endangered Seabirds*, 84 J. of Wildlife Mgmt. 425 (2019).
4. **Attachment 4:** Raine et al., *Post-release Survival of Fallout Newell's Shearwater Fledglings From a Rescue and Rehabilitation Program on Kaua'i, Hawai'i*, 43 Endangered Species Rsch. 39 (2020).
5. **Attachment 5:** Raine et al., *The Breeding Phenology and Distribution of the Band-Rumped Storm-Petrel Oceanodroma Castro on Kaua'i and Lehua Islet, Hawaiian Islands*, 45 Marine Ornithology 73 (2017).
6. **Attachment 6:** Rodríguez et al., *Seabird mortality induced by land-based artificial lights*, 31 Conservation Biology 986 (2017).

frontiers in Marine Science

REVIEW
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doi: 10.3389/fmars.2019.00094

Future Directions in Conservation Research on Petrels and Shearwaters

OPEN ACCESS

Edited by:
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Shearwaters and petrels (hereafter petrels) are highly adapted seabirds that occur across all the world's oceans. Petrels are a threatened seabird group comprising 124 species. They have bet-hedging life histories typified by extended chick rearing periods, low fecundity, high adult survival, strong philopatry, monogamy and long-term mate fidelity and are thus vulnerable to change. Anthropogenic alterations on land and at sea have led to a poor conservation status of many petrels with 52 (42%) threatened species based on IUCN criteria and 65 (52%) suffering population declines. Some species are well-studied, even being used as bioindicators of ocean health, yet for others there are major knowledge gaps regarding their breeding grounds, migratory areas or other key aspects of their biology and ecology. We assembled 38 petrel conservation researchers to summarize information regarding the most important threats according to the IUCN Red List of threatened species to identify knowledge gaps that must be filled to improve conservation and management of petrels. We highlight research advances on the main threats for petrels (invasive species at breeding grounds, bycatch, overfishing, light pollution, climate change, and pollution). We propose an ambitious goal to reverse at least some of these six main threats, through active efforts such as restoring island habitats (e.g., invasive species removal, control and prevention), improving policies and regulations at global and regional levels, and engaging local communities in conservation efforts.

Keywords: management, marine environment, marine predator, population dynamics, Procellariiformes, research priorities, seabird conservation, threats

INTRODUCTION

Humans have transformed ecosystems on an unprecedented global scale, driving a growing number of species to decline and extinction (Jenkins, 2003). The increasing human population living along coasts is putting a severe burden on marine and coastal environments through urban development, infrastructure for energy production and transport, fisheries, eutrophication, ocean acidification and invasion by alien species (Barnosky et al., 2016). Thus, it is not surprising that seabird populations have declined faster than other bird taxa during last decades (Croxall et al., 2012; Paleczny et al., 2015).

Seabirds are top predators and a significant component of marine ecosystems, making them key indicators of marine ecosystem functioning (including climate change). Changes and fluctuations in seabird population sizes, ranges, foraging ecology and breeding success have been used to detect environmental changes, document direct threats (e.g., poaching) and monitor success or failure of conservation management policies in protected areas and beyond (Lescroël et al., 2016; Dunlop, 2017).

The Order Procellariiformes (Class Aves) is one of the most endangered avian groups (Croxall et al., 2012) and the percentage of threatened species is higher than Aves overall (**Figure 1**). They are one of the most adapted groups of seabirds to the marine environment, traveling long distances and spending most of their lives over vast open oceans. In this review, we focus on the 124 species of three out of four families from the Order Procellariiformes: Procellaridae (petrels and shearwaters), Oceanitidae (southern storm-petrels), and Hydrobatidae (northern storm-petrels) (BirdLife International, 2018a), hereafter collectively referred to as "petrels."

Petrels are colonial, nesting in cavities, crevices and burrows predominantly on isolated and inaccessible islands; most visit their colonies at night (Brooke, 2004a). These habits are thought to be mainly an attempt to avoid predation and piracy (Martin, 2017). These cryptic behaviors combined with their relative small size and high mobility at sea make petrels one of the most poorly known seabird groups, although some shearwater species are well studied. Petrels are perfect examples of slow species (Sæther and Bakke, 2000), exhibiting extended chick rearing periods, low fecundity (single egg clutch per breeding attempt), delayed maturity, long life spans, high adult survival, strong philopatry, monogamy, and long-term mate fidelity (Brooke, 2004a). They are highly adapted to exploit the marine environment and to cope with stable biological communities on breeding habitats (Brooke, 2004a). However, the exponential increase of the human population has resulted in stress and habitat transformation throughout natural petrel ecosystems. The poor conservation status of many petrel species (BirdLife International, 2018a), the importance of some as biodindicators (van Franeker and Law, 2015) and their regular role as keystone species in ecosystems (Brooke, 2004b) have resulted in many becoming flagships for research and conservation by both professional and citizen scientists.

Here, we take advantage of the experiences of seabird scientists working on petrels all over the world to review and synthesize threats that need to be addressed in future research, identify information gaps, and propose the most critical research needs to improve the conservation and management of petrels (including shearwaters, diving petrels, and storm-petrels).

MATERIALS AND METHODS

We follow the taxonomy of the International Union for Conservation of Nature (IUCN) Red List of threatened species (BirdLife International, 2018a). We based this review on the 124 petrel species from three families of Order Procellariiformes: Procellariidae (including diving petrels *Pelecanoides*), Oceanitidae, and Hydrobatidae (BirdLife International, 2018a) and on the expertise of 38 petrel researchers from 34 institutions from 10 countries. We

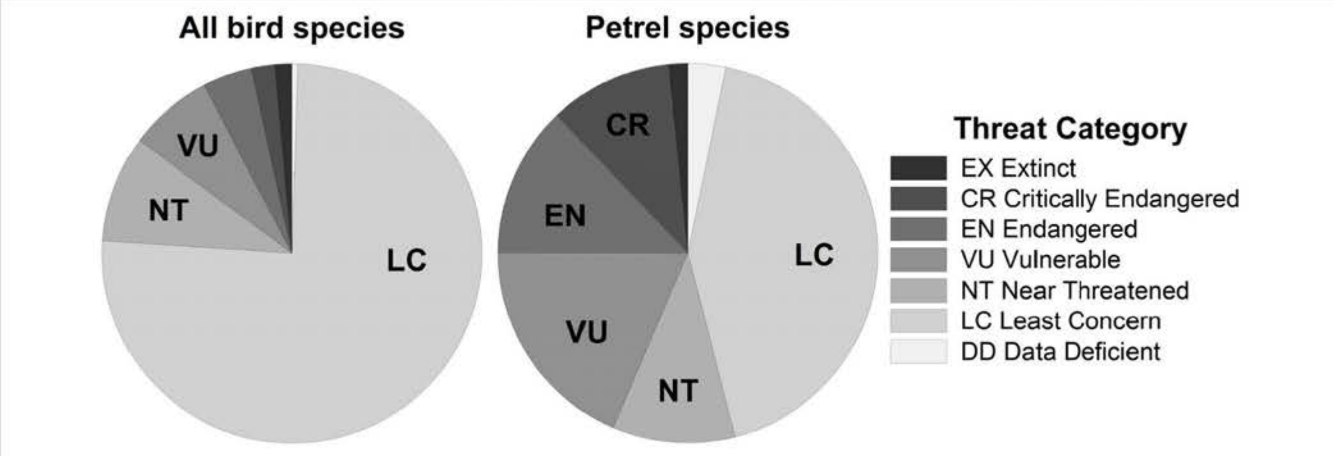

FIGURE 1 | The percentage of species categorized by IUCN threat category for birds (left; n = 11,126 species) and for petrels (right; Procellariidae, Oceanitidae, and Hydrobatidae families; n = 124 species). Data from the IUCN Red List (BirdLife International, 2018a).

also used data from the BirdLife International Data Zone[1] compiled and regularly updated by BirdLife Partners, scientists, ornithologists, conservationists and birdwatchers. Species are rated into the seven IUCN threat categories: Data Deficient (DD), Least Concern (LC), Near Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR), and Extinct (EX). VU, EN, and CR species are referred to as threatened.

The assessment of threats followed the threat classification scheme of the IUCN (2012). This scheme defines threats as "the proximate human activities or processes that have impacted, are impacting, or may impact the status of the taxon being assessed. Direct threats are synonymous with sources of stress and proximate pressures" (IUCN, 2012). Each of the known threats were broken down into sections and written by groups of two to seven experts, showcasing impacts and potential solutions to the problems facing petrels worldwide. We subdivided the threat category "Biological resource use" into "bycatch" (stressor was "direct mortality by fisheries"), "overfishing" (stressor was "indirect ecosystem effects" of biological resource use, e.g., competition with fisheries or food depletion, and availability of fishery discards), and "human exploitation" (stressors were hunting, trapping, or harvesting). The category "Invasive and other problematic species, genes, and diseases" was partitioned into "invasive species," "problematic native species," and "diseases"; and "light pollution" was split from other forms of "pollution." This gave a list of 12 threats: (1) invasive species, (2) light pollution, (3) bycatch, (4) human exploitation, (5) problematic native species, (6) climate change and severe weather, (7) residential and commercial development, (8) pollution, (9) disturbance, (10) energy production and mining, (11) overfishing, and (12) diseases. These threats were ordered in the text by the number of species affected according to the BirdLife International database (**Figure 2**). Some sections may overlap slightly given the multiple impacts of some activities. BirdLife International staff (led by MPD and RM) assessed (1) the timing of each threat (i.e., ongoing; past, likely to return; past, unlikely to return; future); (2) threat extent or scope (i.e., the proportion of the total population affected: minority; majority; whole); and (3) threat severity (i.e., the rate of population decline caused by the threat within its scope: Very rapid declines; Rapid declines; Slow, significant declines; Negligible declines; Causing/Could cause fluctuations) (IUCN, 2012). Finally, we classified for each species the impact of each ongoing threat in four levels based on scope and severity, from "very high" to "low" (**Table 1**; Garnett et al., 2018). In addition, we comment on two aspects we consider crucial for petrel conservation: improved understanding of petrel biology and ecology, and the role of an accurate taxonomy to develop taxon lists for conservation.

[1]http://www.datazone.birdlife.org

TABLE 1 | Impact scoring system of each threat for species following the methodology of Garnett et al. (2018).

Scope/ severity	Very rapid declines	Rapid declines	Slow, significant declines or causing/could cause fluctuations	Negligible declines
Whole	Very high	High	Medium	Low
Majority	Very high	High	Medium	Low
Minority	High	Medium	Medium	Low

INVASIVE SPECIES

Invasive species are non-native organisms whose introduction causes significant environmental harm. Invasive mammals are the most harmful of all threats to petrels (**Figure 2**). For some species, this threat is ongoing, high in scope and severity, and causing very rapid population declines, affecting several species across their entire range. Invasive mammals impact at least 78 petrel species, a critical contributing factor in all four species classified as extinct or possibly extinct since 1500 (Large St Helena Petrel *Pterodroma rupinarum*, Small St Helena Petrel

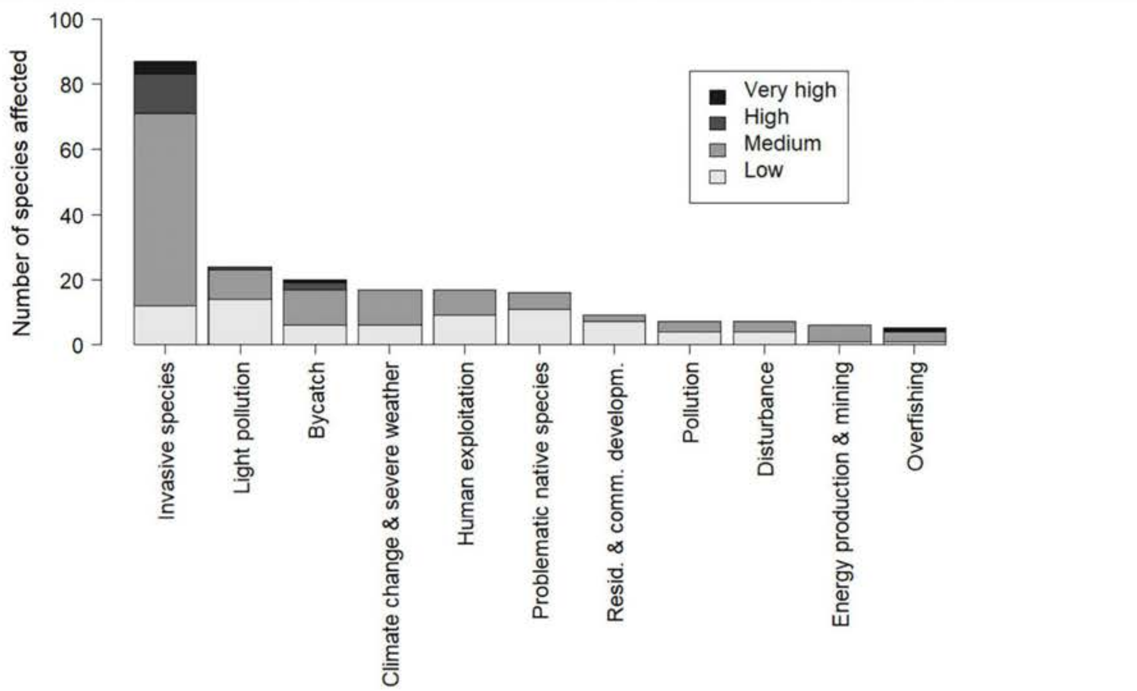

FIGURE 2 | Threats to petrels sorted by the number of species affected according to BirdLife International (2018a).

Bulweria bifax, Jamaican Petrel *P. caribbaea*, and Guadalupe Storm-Petrel *Hydrobates macrodactylus*) (BirdLife International, 2018a). Invasive mammals are present on 171 (55%) of the 313 breeding islands of the 42 species classified as threatened on the IUCN Red List and 22 of those species occur with invasive mammals across their entire breeding range (Spatz et al., 2014).

Predation by invasive mammals – including by mice, rats, cats, pigs, and dogs – is a crucial threat, mainly where adult mortality occurs, driving colony extirpations, population declines and ultimately a higher risk of extinction. Rats (*Rattus norvegicus, R. rattus,* and *R. exulans*) are the most widespread invasive species affecting petrels (**Figure 3**), estimated to occur on 80% of the world's island groups (Atkinson, 1985). Rats can prey on eggs, chicks, and adults, the relative severity depending on the size classes of the petrel. Smaller burrow-nesting species (<300 g) are most vulnerable (Jones et al., 2008), putting them at high risk of extinction. House mice *Mus musculus* have only recently been recognized as significant seabird predators – mainly of chicks and seldom adults – typically on islands where they are the only invasive mammal (Wanless et al., 2007; Caravaggi et al., 2018). Mice currently threaten at least six endangered or critically endangered petrel species. Cats *Felis catus*, both feral and free-ranging, or domestic and subsidized by humans, can also be significant predators of adult seabirds and chicks, including multiple threatened species (Bonnaud et al., 2011; **Figure 3**).

Introduced herbivores, including lagomorphs and ungulates, represent a threat primarily through destruction of breeding habitat, including alteration or trampling of burrows, compaction of soil, loss of vegetation leading to substrate instability and erosion (both of which can cause mortality for birds in burrows), or competition with petrels for burrows (Brodier et al., 2011; Shaw et al., 2011). Ungulates and pigs can also depredate petrels (Furness, 1988; Madeiros et al., 2012).

Invasive invertebrates, plants, and birds can also present threats to petrel populations. Invasive tramp ants can be particularly damaging, e.g., yellow crazy ants *Anoplolepis gracilipes* on islets off Oahu leading to Wedge-tailed Shearwater *Ardenna pacifica* nest abandonment, increased risk of chick mortality and ultimately colony decline. Invasive plants can threaten breeding habitat by changing vegetation structure, limiting access to burrows, or entangling individuals leading to injury or death, e.g., strawberry guavas *Psidium cattleyanum* impacting Hawaiian Petrels *P. sandwichensis* (VanZandt et al., 2014). Raptors introduced to islands have contributed to non-native predation and mortality, such as Masked Owl *Tyto novaehollandiae* predation on Little Shearwaters *P. assimilis* and Black-winged Petrels *Pterodroma nigripennis* on Lord Howe Island (Milledge, 2010), and Barn Owls *Tyto furcata* on multiple petrel species in Hawaii (Raine et al., 2017).

Invasive species can also induce indirect threats on petrels by affecting island ecosystems, including changes in community composition or trophic interactions among introduced and native species (Russell, 2011). An example is the case of invasive mice, overwintering Burrowing Owls *Athene cunicularia* and threatened Ashy Storm-Petrels *Hydrobates homochroa* on the Farallon Islands.

One of the most effective conservation actions has been the eradication of invasive species from islands. Worldwide, eradications have been attempted on more than 1200 islands with a success rate of 85%, thereby eliminating critical threats

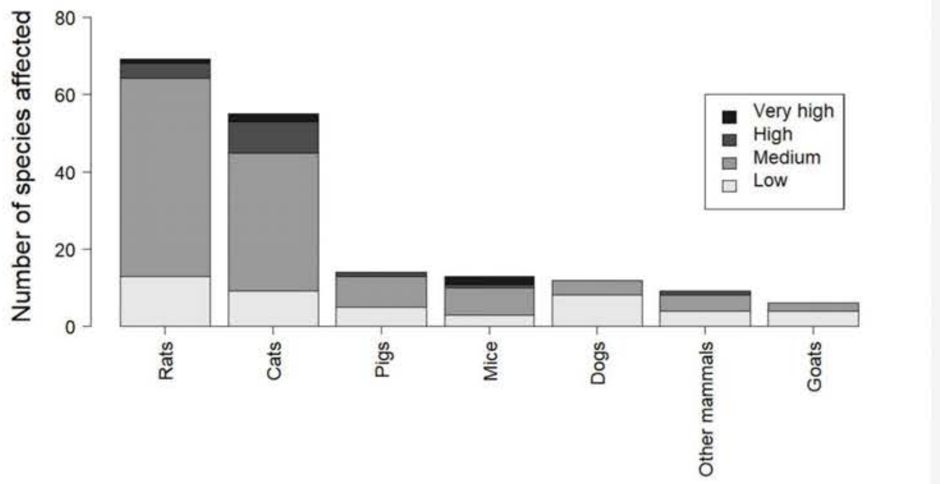

FIGURE 3 | Number of petrel species (Procellariidae, Oceanitidae, and Hydrobatidae families) affected by introduced mammalian species according to BirdLife International database.

provided the islands remain free of threatening invasives (Jones et al., 2016). A review of 151 populations of 69 seabird species, including 28 petrel species, found a positive annual population growth rate (λ) of 1.119 (1.161 for petrels) after successful eradication (Brooke et al., 2018). The growth rate for many petrel populations is faster than the biological limit, indicating that recruitment of new breeders to these islands may play a key role in the re-establishment of some populations after an eradication (Harper, 1983; Smith et al., 2006; Bourgeois et al., 2013). Some important petrel breeding islands are not considered technically or socio-politically feasible to implement eradications due to their size or human population. Alternative conservation strategies to mitigate invasive mammals include sub-island actions such as predator-proof fencing to create predator-free environments, and localized control to reduce but not eliminate threats (Spatz et al., 2017).

The most critical future action remains to tackle the threat of invasive mammals, coupled with improved biosecurity for pest-free islands (Spatz et al., 2014). In many jurisdictions this requires strengthening of legislation and adequate resource allocation for monitoring and enforcement. Eradicating invasive mammals wherever technically feasible is key. Many suitable islands occur in countries and territories with limited precedent (e.g., Peru), requiring partnerships with land management agencies to undertake trial projects, and establish appropriate strategies (Russell et al., 2017a).

Eradicating and controlling invasive mammals from human-settled islands is a critical new conservation frontier for protecting several globally threatened species (e.g., Isla Floreana to protect Galapagos Petrel *Pterodroma phaeopygia*). This requires consideration of new technical challenges, such as commensal food waste, ensuring safe water supply, etc. As a result, strong local partnerships are required to understand social acceptability and alignment with community goals (Glen et al., 2013; Russell et al., 2018). Continued research and application of other restoration tools, including predator-proof fencing and reintroductions, invasive plant management, habitat restoration, and artificial nest construction, are required to protect remnant colonies on islands, and to achieve gains in efficacy and efficiency of pest control (Kappes and Jones, 2014). Improved reporting of conservation outcomes and knowledge transfer among seabird practitioners remains a key recommendation, including workshops, exchange programs, online databases and reporting in open access media. Investment in transformative innovations are also required (Campbell et al., 2015), that may allow unparalleled conservation goals such as Predator Free New Zealand (Russell et al., 2015).

LIGHT POLLUTION

The use of artificial light at night, and the consequent increasing light pollution, is a major threat to biodiversity worldwide (Kyba et al., 2017). Light attraction and disorientation is a very well-documented behavior of petrels across the world, including coastal and insular communities (Reed et al., 1985; Troy et al., 2013; Rodríguez et al., 2015b), ships at sea (Glass and Ryan, 2013), and oil platforms (Montevecchi, 2006; Ronconi et al., 2015), with fog and rainy conditions exacerbating impacts. The life history of most petrel species includes underground nesting (95% of species), nocturnal flight around the colony, and underwater diving, with physiological and behavioral adaptation to low-light conditions. Artificial lights can confuse them, resulting in injury or mortality via collision with structures or the ground, or becoming "grounded." Grounded birds are unlikely to be able to regain flight, and unless rescued, typically die from dehydration or starvation, or are killed by cats and dogs or run over by cars (Podolskyi et al., 1998; Rodríguez et al., 2012b, 2017c; Deppe et al., 2017). Impacts are particularly evident on islands with human communities, with fledglings affected during maiden flights to sea, especially during darker moon phases (Telfer et al., 1987; Le Corre et al., 2002; Rodríguez and Rodríguez, 2009; Fontaine et al., 2011; Rodríguez et al., 2014, 2015a).

Petrels are among the most at-risk seabirds from light pollution; at least 56 petrel species are affected, including 24 globally threatened species (Rodríguez et al., 2017b). In many cases, the light attraction is implicated in the long-term decline of petrel populations and can result in the grounding of more than thousands of individuals annually (Rodríguez et al., 2012c; Gineste et al., 2016; Raine et al., 2017). The increase in the number of grounded birds is often linked to an increase in light pollution levels of coastal areas (Rodrigues et al., 2012; Troy et al., 2013). Artificial light can not only affect birds breeding nearby but also birds flying over lighted areas to colonies many kilometers away, and even birds that have successfully fledged can be drawn back in from the sea (Montevecchi, 2006; Rodríguez et al., 2014, 2015b; Syposz et al., 2018).

Conservation actions include avoidance (turn off lights, part night lighting) and minimization (limit number of lights, shield lights, and prevent skyward light spill) during fledging periods in high-risk areas (Reed et al., 1985). Rescue campaigns recover a proportion of affected fledglings each year, though there is little data on post-release survivorship. Priority actions for future research include (1) testing avoidance and minimization measures at affected sites via education, light ordinance and enforcement, (2) investigating light characteristics (e.g., spectra and intensity) to reduce threat (Reed, 1986; Rodríguez et al., 2017a; Longcore et al., 2018), and (3) documenting rescued bird fate to assess the merit and effectiveness of rescue programs.

BYCATCH

Fisheries bycatch (incidental mortality of non-target organisms in fishing gear) causes more than 500,000 seabird deaths annually, although this is expected to be a gross underestimate due to poor reporting rates from many fisheries (Žydelis et al., 2013). Procellariiformes are among the most caught groups, particularly albatrosses, but medium-size and large petrels also are affected, including several threatened species (Anderson et al., 2011; Žydelis et al., 2013). Diving abilities, foraging and social behavior, species size, and prey preferences are among the main factors influencing bycatch risk. Medium to large species foraging gregariously appear to be the most widely affected. The type of gear and the particularities of each fishery are also critical (Lewison et al., 2014). Demersal longline fisheries, which use relatively small hooks and bait, may be particularly dangerous for medium-sized petrels (Laneri et al., 2010; Cortés et al., 2017), while pelagic longline fisheries also cause extensive bycatch, mainly affecting medium-large-sized petrels (e.g., *Macronectes* and *Procellaria* petrels) that swallow the larger hooks and bait (Anderson et al., 2011; Yeh et al., 2013). Birds tend to get hooked or entangled during line setting, when the line is sinking, with the risk of bycatch increasing for deep diving species, as they can reach the bait at greater depths farther from the vessel. Diving species can facilitate access to non-diving seabirds, including petrels, by retrieving baited hooks to the surface from depth (Jiménez et al., 2012; Melvin et al., 2013, 2014). Gillnets can also cause entanglements and mortality by drowning. This gear type mainly affects proficient diving seabirds such as seaducks, cormorants and auks, but some diving or scavenging petrels are also caught incidentally (Žydelis et al., 2013). In trawl fisheries, petrels mostly collide with cables attached to the trawl net, while proficient divers (e.g., *Puffinus* and *Ardenna* shearwaters) may also be caught in the net during setting or hauling (González-Zevallos and Yorio, 2006; Sullivan et al., 2006, 2018; Maree et al., 2014). However, mortalities from cable collisions are difficult to quantify, leading to underestimates. Finally, there is increasing evidence of shearwater bycatch by purse-seine fisheries, particularly those targeting small pelagic fish. When birds are attracted to the shoaling fish, they can be injured or drowned during the closing and hauling of the net. Purse-seine bycatch has been reported with proficient divers such as the Balearic Shearwater *Puffinus mauretanicus* in Portugal, the Pink-footed Shearwater *Ardenna creatopus* in Chile, and the Flesh-flooted Shearwater *Ardenna carneipes* in Australia (Oliveira et al., 2015; Baker and Hamilton, 2016; Suazo et al., 2017).

Estimates of bycatch scale up to the thousands for some petrels, but population level effects are not as well-known as for albatrosses. Because petrels are long-lived species and their population dynamics are sensitive to changes in adult survival, petrel bycatch must be regarded as a severe threat (as for albatrosses). Recent evidence from the Mediterranean indicates that bycatch is the main factor driving the decline of the critically endangered Balearic Shearwater (45% of adult mortality) (Genovart et al., 2016). Bycatch also has a strong negative impact on *Calonectris* shearwaters demography, while adult survival is negatively related to exposure to bycatch risk (Ramos et al., 2012; Genovart et al., 2017, 2018). On the other hand, bycatch may differentially affect individuals within populations. Some studies show biases between sexes or age classes (Gianuca et al., 2017; Cortés et al., 2018), and behavioral traits of individual birds might also influence bycatch risk (Patrick and Weimerskirch, 2014; Tuck et al., 2015).

Seabird bycatch can be significantly reduced by applying operational and/or technical mitigation measures, some of which can be applied to multiple gear types (ACAP, 2014). A widely used operational measure is avoiding offal discharge or any discards during setting and hauling operations to avoid attracting scavenging seabirds. Night setting could reduce the bycatch of species that mainly forage by day (Barry Baker and Wise, 2005; Cortés and González-Solís, 2018), although many petrels present varying degrees of nocturnal foraging (Dias et al., 2012). Technical measures such as bird scaring lines (*tori* or streamer lines) and fast-sinking longlines also reduce bycatch significantly (ACAP, 2017). Bird-scaring lines, widely used in longline and trawl fisheries, exclude birds from the area astern of the vessel where bycatch risk is greatest. Fast sinking longlines (with attached or integrated weights) limit the time and distance astern that birds can access baited hooks. An extreme case is that of Chile, where demersal longlines were changed to a heavily weighted vertical longline configuration, which reduced bycatch to practically zero (Moreno et al., 2008). For pelagic longlines, hook-shielding devices have proved effective (Sullivan et al., 2018). Gillnet bycatch poses the greatest challenge at present, as few proven technical or operational measures have been identified. So far acoustic deterrents (pingers), visual panels and LEDs have been tested with varying results (Martin and Crawford, 2015; Mangel et al., 2018).

A collaborative approach involving fishermen is essential to mitigate bycatch. Their experience is highly valuable to develop practical and effective mitigation measures, and their acceptance is crucial for successful implementation (Wanless and Maree, 2014). Best practice mitigation measures should be safe, simple, easy to implement, technically feasible, cost-effective, and where possible should not reduce fishing profits (ACAP, 2014, 2017; Rouxel and Montevecchi, 2018). Moreover, such measures should not increase the bycatch of other marine biota. Experiences such as those of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) show how the problem may be tackled effectively with minimal effects in the fishing activity. Implementation of mandatory technical mitigation measures and seasonal closures over the past two decades reduced seabird bycatch from several thousands to tens of seabirds annually in most CCAMLR longline fisheries (Waugh et al., 2008).

Despite the attention that seabird bycatch has received in recent decades, there are still several knowledge gaps to address (Kirby and Ward, 2014). First, information on the extent of bycatch remains patchy due to the absence of onboard observers or data collection protocols in most fisheries. This gap is greater in artisanal fisheries, where a large number of vessels and the diversity of practices make systematic data gathering extremely difficult (Lewison et al., 2014). Improved observer program coverage and protocols, combined with self-reporting protocols and electronic monitoring (e.g., video monitoring) are critical to solving bycatch. Second, few studies are underway to explore the link between bycatch and petrel demography, which is a necessary step to understand the problem and to take the most appropriate conservation actions. Monitoring programs on the breeding performance of affected species should be promoted, as should monitoring initiatives to collect information on dead birds to assess bycatch mortality relative to other causes of mortality, as well as to understand how different components of the population are affected. Third, the adoption of mitigation measures requires raising awareness and building trust among fishermen to develop the most appropriate solution on a case-by-case basis. Developing toolkits of proven measures, from which fishermen choose the most appropriate combination for them, could be the most direct path to reduction of petrel mortality in world fisheries (Melvin et al., 2019).

HUMAN EXPLOITATION

Humans have been hunting petrels for food for centuries (Anderson, 1996), with devastating consequences for some species (e.g., Rando and Alcover, 2008). Breeding petrels are particularly vulnerable to harvesting as they typically breed synchronously and in large colonies, where adults, eggs, and chicks can easily be accessed (Hunter et al., 2000). Many petrels were also deliberately caught at sea for human consumption, and this practice continues in some areas. Although most hunting practices have ended, either due to regulation or the extinction of the species, some species may remain at risk.

Species such as the Short-tailed *Ardenna tenuirostris* and Sooty Shearwaters *A. grisea* are nowadays harvested. Approximately 360,000 ± 40,000 Sooty Shearwater chicks are estimated to be taken annually around Stewart Island/Rakiura, New Zealand, for commercial or personal use (Newman et al., 2009). Harvesting of Short-tailed Shearwater is managed for 'recreational' (private) and 'commercial' (indigenous) exploitation in Tasmania, with 52,000 ± 13,400 chicks taken annually for recreational use in the 2009–2017 period (DPIPWE, 2014, 2018). There are no public data on indigenous harvest, and the extent of chick poaching is unknown (Skira et al., 1996).

In the Atlantic Ocean, harvesting of petrels has occurred for generations at the Azores, Canary Islands and Selvagem Grande (Granadeiro et al., 2006; Lopez-Darias et al., 2011) and at the Tristan islands (Richardson, 1984), although currently only Great Shearwaters *Ardenna gravis* can be legally exploited. In the northeast Atlantic, the hunt was historically focused on the most abundant species, Cory's Shearwater *Calonectris borealis*, and direct persecution may have been the major cause of a 90% reduction in the population size until the 1970s, when hunting was banned (Granadeiro et al., 2006; Lopez-Darias et al., 2011). Illegal hunting of this species still occurs on the Canary Islands to an unknown extent (Lopez-Darias et al., 2011). Unquantified numbers of Great and Sooty Shearwaters along the Atlantic coast of Canada and of Scopoli's and Yelkouan Shearwaters *Puffinus yelkouan* in Malta are also illegally shot from boats (Merkel and Barry, 2008; BirdLife International, 2018a).

Regulations on quotas, as those from New Zealand, Australia, or the Arctic, have probably helped to reduce extinction risk. Future research must prioritize quantifying the impact of poaching relative to other threats, particularly on islands with small populations.

PROBLEMATIC NATIVE SPECIES

Under natural conditions, interactions between native species and petrels should not be a conservation challenge. However, anthropogenic impacts can alter native species populations leading to effects of conservation concern. The best documented interactions types are predation on, competition with, or modification of the nesting habitat of petrels. Problematic native species have been mentioned as potential or real threats for about 20 petrel species (16 out of them threatened; BirdLife International, 2018a).

Like invasive species, native species can prey on petrels. Populations of several gull species (*Larus* spp.) are increasing due to anthropogenic factors (e.g., food supplementation), leading to higher predation pressure on petrels and their eggs and chicks (Vidal et al., 1998). For endangered Ashy Storm-Petrels, the Western Gull *Larus occidentalis* seems to be at least partly responsible for keeping numbers low at South Farallon, Santa Barbara, and Anacapa Islands (Ainley, 1995; Chandler et al., 2016). Heavy predation pressure by large

Larus gulls is thought to be contributing to declines of some Leach's Storm-Petrel populations in Atlantic Canada (Robertson et al., 2006). Paradoxically, however, regional populations of large gulls have also declined over the last several decades coincident with fishery closures and consequent removal of discards (Regular et al., 2013). In the Azores, some adults of the vulnerable Monteiro's Storm-Petrel *Hydrobates monteiroi* are killed by resident Yellow-legged Gulls *Larus michahellis* (Oliveira, 2016). This gull species also preys on vulnerable Deserta Petrels *Pterodroma deserta* (IUCN, 2018a). Some individual gulls specialize in feeding on petrels. On Selvagem Islands, where its declaration as a reserve has led to increases in petrel numbers (see Human exploitation), a small gull colony (<20 pairs) consumes up to five petrel species (60% of the consumed biomass; Matias and Catry, 2010). Breeding habitat transformations can also lead to changes in interspecific interactions including predation. In the Mediterranean, the Yellow-legged Gull preys on European Storm-Petrels *Hydrobates pelagicus* at higher rates at sites illuminated by nearby coastal cities than sites facing the sea, i.e., unaffected by coastal light pollution (Oro et al., 2005). In this instance, after the selective culling of 16 specialized gull individuals, storm-petrel survival and breeding success increased by 16 and 23%, respectively (Sanz-Aguilar et al., 2009). Another case of predation by native species on petrels regulated by anthropogenic factors is from Farallon Islands, where the presence of invasive mice provides a reliable food source for migrating Burrowing Owls during autumn, which may encourage more owls to overwinter. When mouse populations crash in winter, Burrowing Owls switch prey to globally threatened Ashy Storm-Petrels (Chandler et al., 2016).

The predation conducted by native or vagrant owls is concerning for some fragile small populations of the smallest petrel species. For example, resident Long-eared Owls *Asio otus* kill up to 40 adult Monteiro's Storm-petrels per year, which has a population of 295–999 mature individuals (Bolton et al., 2008; BirdLife International, 2018a). Extreme cases are associated with vagrant individuals such as a single Snowy Owl *Bubo scandiacus* which consumed 5% of endangered Bermuda Petrels *Pterodroma cahow* before it was eradicated (Madeiros et al., 2012; BirdLife International, 2018a), a Short-Eared Owl *Asio flammeus* which fed almost exclusively on Monteiro's Storm-Petrels killing 1–2 individuals per night during 2 weeks on Praia islet, Azores (Bried, 2003) or vagrant falcons *Falco* spp. which could extinguish the threatened population of Macgillivray's Prions *Pachyptila macgillivrayi* at Saint Paul Island (Jiguet et al., 2007).

Competition among seabirds for nesting habitat is another threat. Although the particular nesting habitat preferences of each petrel species helps to avoid burrow competition (Bourgeois and Vidal, 2007; Troy et al., 2016), some species share nesting habitat and fiercely compete for nesting sites. In such cases, larger species tend to monopolize available burrows (Ramos et al., 1997; Sullivan et al., 2000). Several storm-petrel species have reduced breeding success because of the presence of larger petrels (McClelland et al., 2008; Sato et al., 2010), and Tahiti *Pseudobulweria rostrata* and Providence Petrel *Pterodroma solandri* chicks are killed or ejected from burrows by Wedge-tailed Shearwaters *A. pacifica* (Villard et al., 2006; Priddel et al., 2010). The recovery of the Bermuda Petrel was initially hampered by competition from White-tailed Tropicbirds *Phaethon lepturus* for nest-sites until baffles were built in front of burrows (Madeiros et al., 2012; BirdLife International, 2018a) and Little Penguins occasionally kill Gray-faced Petrels (Friesen et al., 2016).

Native non-seabird species can modify the nesting habitat of petrels such as soil erosion by expanding populations of Antarctic fur seal *Arctocephalus gazella* in the breeding habitat of the White-chinned Petrels *Procellaria aequinoctialis* at South Georgia (Berrow et al., 2000).

Much of the available information on direct predation or competition for burrows by native species is anecdotal, with scant information for most species. Current evidence suggests that native species have little effect on breeding success, except for some highly threatened species (Gummer et al., 2015) or in some exceptional circumstances under unnatural conditions (Pierce, 1998). Identifying problematic species and assessing their demographic impacts on petrels is a priority. Until such information is obtained and following a precautionary principle, some measures with low impact to other species could be taken. For example, burrow competition and predation could be reduced for small petrels by installing artificial nests that exclude larger species (Libois et al., 2012; Gummer et al., 2015). This action has increased productivity of Monteiro's and European Storm-Petrels (Bolton et al., 2004; Libois et al., 2012). For species returning later than competitors to breeding grounds, blocking burrows early in the season could ensure availability of burrows to threatened species that return later to shared colonies (Gardner and Wilson, 1999).

CLIMATE CHANGE AND SEVERE WEATHER

The effects of climate change on petrels involve multiple pathways and can be direct, through increases in thermoregulation costs or loss of habitat, or indirect, through changes in the structure and functioning of marine (and terrestrial) ecosystems ultimately affecting food availability (Ramírez et al., 2016) and predation (McClelland et al., 2018).

Increasing sea or air temperatures have generally detrimental consequences for petrels (**Figure 4**). Warm temperatures are often associated with poorer body condition (Peck et al., 2004; Connan et al., 2008; Riou et al., 2011) and lower breeding success (Inchausti et al., 2003; Nevoux and Barbraud, 2006). Negative effects on survival and population size have also been reported (Veit et al., 1997; Barbraud and Weimerskirch, 2003; Jenouvrier et al., 2003). However, some studies have reported positive relationships between increasing temperatures and petrel vital rates or abundance (Thompson and Ollason, 2001; Jenouvrier et al., 2005; Slater and Byrd, 2009; Soldatini et al., 2014). The effects of warming temperature are often assessed using large-scale climate indices (**Supplementary Material**). In such cases, the relationships between changes in these large-scale indices and local temperatures are not always straightforward (Descamps et al., 2016), making their interpretation difficult (Oro, 2014). Sea-ice loss in polar

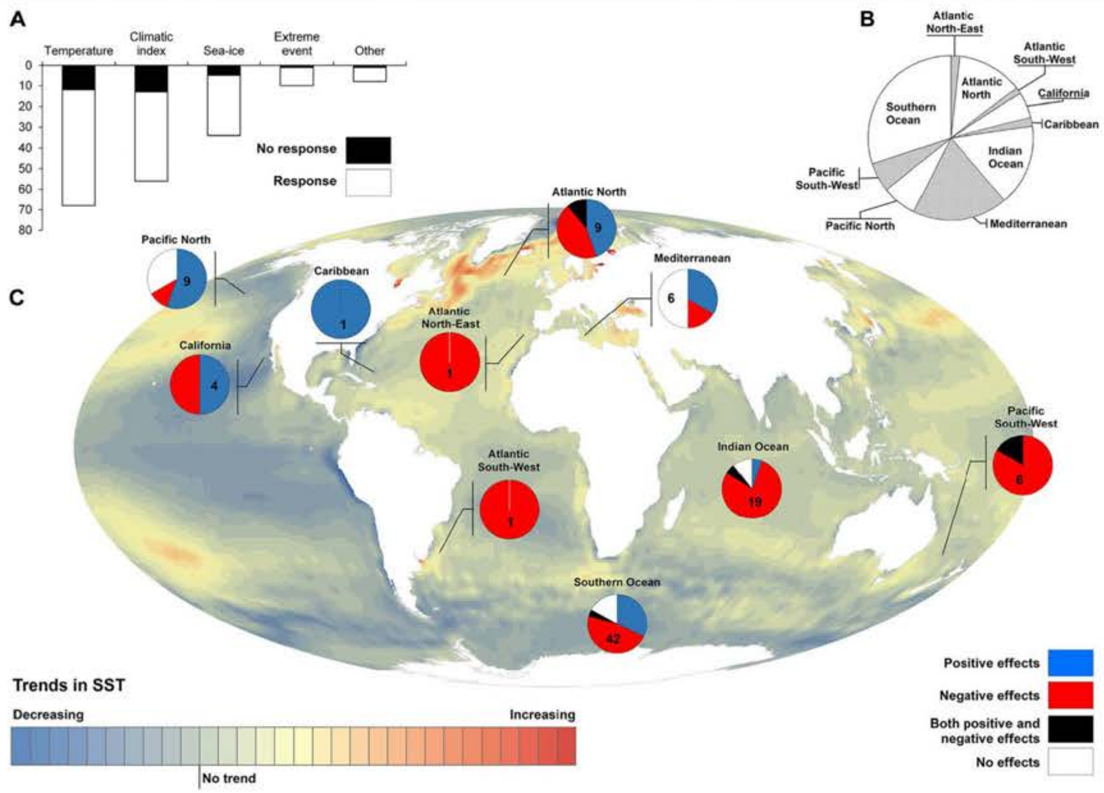

FIGURE 4 | Reported seabird responses to climate driven environmental changes. We compiled 64 studies (**Supplementary Material**) reporting up to 176 cases in which petrel and shearwater species responded (any kind of response, 144) or not (32) to environmental features such as air or sea temperatures, large-scale climatic indexes, sea-level or extreme weather events **(A)**. These responses were grouped geographically to elucidate the spatial heterogeneity in the distribution of reported responses **(B)**. Responses that could be directly interpreted as a benefit or a threat for seabirds (e.g., changes in breeding performance or survival rates; but not in breeding phenology or distribution) when facing climate driven environmental changes (e.g., increasing temperatures and extreme weather events or decreasing extents of sea-ice; but not large-scale climatic indices) were selected and grouped geographically to show the spatially explicit effects of climate change on petrel and shearwater populations; colored background represents the pixel-basis long-term (1983–2014) trend in sea surface temperature (SST) (Ramírez et al., 2017a) **(C)**.

environments is a direct consequence of climate warming that has important consequences for polar ecosystems (Post et al., 2013; Descamps et al., 2017; Ramírez et al., 2017b). The effects of sea-ice decline on petrels appear quite different than those of increasing temperatures (**Supplementary Material**). Overall, the consequences of climate warming on petrels are complex and can vary among species and even populations within species. They may be a function of, for example, the life-history trait (Barbraud and Weimerskirch, 2001), the period of the breeding cycle (Jenouvrier et al., 2005; Olivier et al., 2005; Waugh et al., 2015) or the rate of warming (Mauck et al., 2018).

Increasing extreme events represent one of the most imposing aspects of climate change that can affect petrels (Jentsch et al., 2007). Few studies have quantified their impacts on seabird individuals and populations but it seems clear that extreme events like snow storms or hurricanes strongly affect the survival, reproduction and movements of petrels (Franeker et al., 2001; Quillfeldt, 2001; Descamps et al., 2015). Some of these impacts may be exacerbated by ongoing sea-level rise for petrels that nest in low lying coastal zones. Rising sea level will reduce the availability of suitable breeding sites (Reynolds et al., 2015) that could also be susceptible to flooding associated with storms and hurricanes (Cadiou et al., 2010; Madeiros et al., 2012). In fact, 17 threatened petrel species are at high or medium risk of inundation due to sea level rise at their breeding sites (Spatz et al., 2017).

Ocean warming and acidification can affect trophic pathways from primary producers to upper-trophic levels through simplification of marine communities or changes in the abundance of prey (Burrows et al., 2011; García Molinos et al., 2015). Such climate-driven changes in seabirds' diets, and their ultimate consequences on population parameters (e.g., breeding performance) are very often assumed but rarely confirmed (Connan et al., 2008).

Studies of the impact of climate change on seabirds are geographically biased toward higher latitudes (Poloczanska et al., 2016; Keogan et al., 2018; see also **Figure 4** and **Supplementary Material**) and little is known about tropical species. Even in polar regions, there is a clear bias toward specific areas (e.g., Adélie Land in Antarctica) that are not necessarily the ones where climate change has been the most pronounced. Further studies should also address the role of intrinsic sources of variation in petrel responses to climate change such as age, sex, breeding state, or physical condition (Oro, 2014). Together with an understanding of the at-sea ecology and spatial distribution of seabirds (particularly for the smaller or rarer species), there is an urgent need to unravel the mechanisms linking climate and vital rates to identify the right spatial and temporal scale of climate effects and their link with changes in food availability. Acknowledging the non-linearity in climate change effects, their potential long-lasting consequences (i.e., carry-over effects) and their interactions with additional stressors (Darling and Côté, 2008; Montoya et al., 2017) is also necessary. Maintaining and promoting long-term studies is key to fill most of these knowledge gaps.

Climate change seems unlikely that it will stop or slow down in the coming decades. However, even if there is no real conservation measure to dampen the effects of climate change at the scale of a species or population, the reduction of human stressors operating locally (e.g., bycatch, invasive species or human-induced loss of breeding habitats) has been proposed as a more achievable way of retaining ecosystems within a "safe operating space" (Sensu; Rockström et al., 2009), where they remain resilient to ongoing climate change (Roberts et al., 2017; Ramírez et al., 2018).

RESIDENTIAL AND COMMERCIAL DEVELOPMENT

As human population continues to increase, land conversion can seriously impact numerous petrel species. The most obvious threat is the direct destruction of breeding habitat, particularly in coastal areas. Coastal habitats are desirable locations for residential communities, are more densely populated, and are developed at a faster rate than hinterland areas (Small and Nicholls, 2003; Neumann et al., 2015). These coastal sites also provide critical nesting habitat for many petrels. Urbanization can completely destroy colonies – either directly killing nesting birds in the process or significantly reducing breeding ranges. Breeding habitat also can be degraded or disturbed simply by being in close proximity to housing and commercial units and their associated artificial lighting, resulting in reduced reproductive success and lower survival rates.

Development also requires significant infrastructure; road systems, power plants, powerline networks, wind farms, oil platforms, communication towers, which leads to increased light pollution and noise pollution. Powerline networks and other tall structures increase collision risk – particularly if these span flyways from the sea to breeding colonies. Nocturnal seabirds are particularly at risk, as powerlines are difficult to detect at night. This is a poorly studied problem, but the impacts of powerline collisions on seabirds can be high enough to impact at a population-level (Raine et al., 2017). Often this is a hidden impact, as dead birds can be very hard to find, particularly as the terrain under lines is often not realistically searchable, may be scavenged and may not die immediately under the lines but could die of injuries kilometers away (Costantini et al., 2017). Quantitative approaches are needed to better estimate total mortality associated with powerlines (Costantini et al., 2017), but mitigative measures, such as buried lines, lowering and modifying existing lines, shielding by trees, rescue campaigns, and reduction of light attraction should be implemented to reduce risks (Rodríguez et al., 2017b).

Philopatric petrels could become victims of other threats, such as light pollution or introduced predators (see previous sections), once their natal or breeding grounds have been converted. Noise pollution is another consequence of urbanization and development. Its effects on petrels have not been assessed, though it has been suggested that can attract some individuals to dangerous areas (Miles et al., 2010).

Lastly, residential development will also result in a concomitant increase in the presence of introduced predators. These can be free-ranging house pets, unwanted feral animals, feral colonies fed by humans, or animals raised as livestock. The proximity of residential or commercial developments to petrel colonies can therefore also have a knock-on impact by introducing large numbers of these predators into the environment.

POLLUTION

Petrels are at risk to many types of marine pollution. Here we consider plastic, contaminant, oil, and radio-active sources of pollution.

Plastic Pollution – Ingestion and Entanglement

A candlestick in the gut of a Wilson's Storm-Petrel *Oceanites oceanicus* was the first report of a seabird ingesting a man-made item (Couch, 1838). Since then hundreds of seabird species have been reported to ingest marine litter (Kühn et al., 2015). While petrels are vulnerable to plastic entanglement in ghost nets such as fishing gear or other large debris items (Ryan, 2018); they are particularly vulnerable to ingesting plastics because they feed at the surface where plastics float, and they retain ingested plastics for long periods due to the constricted structure of their pyloric valve (Ryan, 2015). Indeed the only official seabird monitoring program for marine plastics focuses on Northern Fulmars *Fulmarus glacialis* as a biological indicator in the North Sea (van Franeker et al., 2011; Provencher et al., 2017), although many other long-term studies collect data on the issue. Intergenerational transfer of plastics among seabirds have been demonstrated in petrels, illustrating how seabirds may be affected by marine plastics (Ryan, 1988; Carey, 2011a; Rodríguez et al., 2012a). Plastic ingestion could damage or block the digestive tract, reduce stomach volume and transfer chemical compounds both endogenous or absorbed while plastic items drifts at sea (Tanaka et al., 2015; Provencher et al., 2018). Petrels are particularly at risk from plastic-related toxins because they retain plastics in their stomach for protracted periods, giving the chemicals sufficient time to transfer into the birds (Tanaka et al., 2015). However, population level impacts from plastics have yet to be shown. This may be a function of the lack of long-term coordinated study efforts to date (Rochman et al., 2016; Avery-Gomm et al., 2018), but impact probably is only significant for individuals with large plastic loads, which comprise only a small proportion of birds even among species where virtually all individuals contain some ingested plastic (Ryan, 2019).

While the removal of marine debris could reduce entanglement mortality, plastic ingestion is a greater conservation concern for petrels. Given that plastic items larger than 5 mm account for more than 75% of plastic mass at sea (Lebreton et al., 2018), removing them from the environment now will have a major beneficial impact in future by preventing them from degrading into microplastics. Unfortunately, no coordinated international agreement on plastics exists to reduce the release of plastics into the environment (Borrelle et al., 2017). As clean-up efforts continue and plastic reduction policies come into effect, assessing if and how these measures reduce the impacts of plastics on vulnerable species such as petrels is critical to evaluating these approaches.

Contaminants

Anthropogenic environmental contaminants, including heavy metals and persistent organic pollutants (hereafter, POPs), can be taken up by and cause negative impacts to marine wildlife. Given that such contaminants have global distributions and some contaminants, such as mercury and POPs, tend to bio-magnify up food chains, petrels may be globally vulnerable to accumulating high levels of contaminants (Mallory and Braune, 2012). Negative effects vary by contaminant, species, and concentration but can include behavioral changes, physical deformities, mortality, and reduced reproductive success.

Contaminant accumulation (e.g., mercury, POPs, organochlorine pesticides, PCBs, and perfluorinated compounds) has been documented in several species (Braune et al., 2010; Carravieri et al., 2018; Escoruela et al., 2018). Blévin et al. (2013) reported mercury contamination in all 21 species of sympatric breeding seabird species at Kerguelen, nine of which are procellarids with documented bio-magnification according to trophic position. Petrels can also be exposed to heavy metals and contaminants via plastic ingestion (Tanaka et al., 2015; Lavers and Bond, 2016; Provencher et al., 2018). Future research priorities include evaluating: (1) the use of petrels as bio-monitors of contaminant levels in marine systems and the role of regulations on contaminant loads; (2) the implications of variability in contaminant levels in tissues throughout their annual cycle; and (3) the impact of contaminants, including those leached from ingested plastic debris, on vital rates.

Oil Pollution

The episodic nature of oil spills, blowouts and discharges are both chronic and acute in nature. Magnitude of oil impacts are determined by spill locations, duration, and more importantly, the spatial-temporal overlap with seasonal bird distributions (Burger, 1993). Quantification of these impacts is difficult, especially for pelagic birds where carcass detection and collection can be challenging or impossible. Chronic oil spills kill tens of thousands of seabirds each year in eastern Canada (Wiese and Robertson, 2004), although petrels accounted for less than 0.4% of the carcasses collected during the Deep Water Horizon blowout in the Gulf of Mexico (Haney et al., 2014b). Petrels are largely unreported in other major oil spills worldwide (ICES, 2005; Munilla et al., 2011) although possibly owing to spill location and timing but potentially due to undetected mortality.

Birds that survive initial oiling are vulnerable to hypothermia because of a decline in the waterproof properties of feathers when oil clumps and sticks to feathers. A reduction in body condition and reduced foraging opportunities can result in dehydration and mobilization of energy stores leading to starvation (Crawford et al., 2000). Birds that survive may also attempt to preen oil off, resulting in significant ingestion leading to a series of oil-induced diseases, such as aspergillosis, cachexia, haemolytic anemia, ulceration of the stomach, and immuno-suppressant effects (Crawford et al., 2000). In addition, indirect effects on habitat and prey could be severe (Zabala et al., 2011).

Assessment of oil spill impacts will require better estimates of at-sea distribution and abundance of petrel species which can be used in exposure probability models (Wilhelm et al., 2007; Haney et al., 2014a,b); damage assessment models may be informed further by telemetry data now being collected for some of the smallest petrel species (Pollet et al., 2014) which are difficult to detect and identify during surveys, especially during spills. Future work on oil spills in the vicinity of colonies should consider short- and medium-term management solutions and ecosystem restoration to mitigate the impacts of oil spills on petrels. For example, ship rats were eradicated from the Rakiura Titi Islands in New Zealand as compensation for the Command Oil Spill off California (McClelland et al., 2011).

Radioactivity

During the Fukushima nuclear disaster in 2011, reactor cooling waters were diverted into the Pacific Ocean (Reardon, 2011; Buesseler, 2014). Trans-equatorial migrants, such as Flesh-footed Shearwaters foraging within the contaminated marine zone (Reid et al., 2013) were likely exposed to radioactive isotopes, including caesium-137, which has a 30 year half-life, may bio-accumulate in seabird prey, and can be incorporated into animals' bodies via the dermis or ingestion (Buesseler, 2014). The consequences of radioactive isotopes incorporated into the food chain could include reproductive failure, mutations, and stunted growth in seabirds (Buesseler, 2014). However, no formal research has been specifically conducted in petrels. Long-term monitoring is needed to determine the extent of these contaminant burden and if there are individual, sub-population or population-level impacts for exposed birds.

DISTURBANCE

Human disturbance can have detrimental effects on wildlife including petrels (Carney and Sydeman, 1999; Carey, 2009). Given that petrels are highly pelagic seabirds, disturbance by humans is more frequent on land at breeding areas. Thus, all evidence of human disturbance on petrels comes from breeding colonies, mainly related with research or recreational activities.

Handling of eggs, chicks, and adults during research or burrow access hatches can lead to negative effects on breeding rates (Blackmer et al., 2004; Carey, 2009), although other studies did not find such effects (Vertigan et al., 2012). For example, manipulating the smaller species at egg stage could result in clutch abandon. Even the presence of observers during the hatching period can produce lower hatching and breeding success, as observed in Northern Fulmars (Ollason and Dunnet, 1980). Physiological effects have also been reported. Nest manipulations and human approaches by a single person on foot caused considerable increases in heart rates and modified energy expenditure during incubation of surface-nesting Northern Giant Petrels *Macronectes halli* (de Villiers et al., 2006).

In the Mediterranean, European Storm-Petrels were not chronically stressed (measured by adrenocorticotropic hormone levels) by the presence of tourist boats inside a tourist-exposed breeding cave, but birds breeding in undisturbed caves could be more susceptible to novel stressors (Soldatini et al., 2015). Nestling mortality was higher in areas exposed to high visitor pressure than remote areas at the Shetland Islands (Watson et al., 2014). Noise pollution may have a short-term negative effect on parental care and chick provisioning behavior of Scopoli's Shearwaters (Cianchetti-Benedetti et al., 2018a).

In comparison with other seabirds like penguins and albatrosses, there are fewer field studies describing effects of human disturbance on breeding biology and physiology of petrels. Underground nesting behavior of petrels, which might make them less susceptible to human disturbance owing to the absence of direct visual contact, could explain the few studies (Watson et al., 2014). Long-term studies on anthropogenic stress will contribute to understanding the extent of consequences of human activities on animal populations, especially those of rare or endangered species (Carney and Sydeman, 1999; Carey, 2009).

ENERGY PRODUCTION AND MINING

Energy production and mining are highly lucrative industries with potential to impact pelagic seabirds offshore and at colonies. Direct impacts kill individuals, while indirect influences can modify movement behavior and remove or alter foraging and nesting habitats as detailed in previous sections.

Mining, Quarrying, and Other Terrestrial Infrastructure

Loss or degradation of breeding habitat through mining and quarrying is a threat for at least six IUCN Red-listed petrel species; for three overall impact is assessed as medium. For the endangered Peruvian Diving Petrel *Pelecanoides garnotii*, which burrows in thick guano, guano extraction is thought to have precipitated the massive historical declines along the Chilean and Peruvian coasts, and the extraction continues today, albeit at lower intensity (BirdLife International, 2018a). Nickel mining occurs within current and former breeding locations of the Tahiti Petrel, where feasibility of chick translocation as a means of mitigating the impact of mining is being investigated (BirdLife International, 2018a). For the critically endangered Beck's Petrel *Pseudobulweria becki*, locating nesting colonies within the Bismarck Archipelago and Solomon Islands is paramount, as mining, logging and agriculture are rapidly removing forest nesting habitat (Bird et al., 2014). The impact and numbers of affected species worldwide by other mining operations is unknown. Permanent habitat loss likely precludes mitigation strategies, so conservation efforts should identify vulnerable colonies and limit development near these sites.

Offshore Oil and Gas

Impacts of offshore hydrocarbon development on seabirds have been poorly studied and specific information related to effects on petrels is extremely sparse, often anecdotal (Ronconi et al., 2015). Impacts include mortality associated with attraction to and collisions with platforms, lights and flares (Wiese et al., 2001; Montevecchi, 2006), increased exposure to oil (Fraser et al., 2006; Wilhelm et al., 2007), and potential changes to at-sea distribution of birds using habitats around platforms and drilling rigs (Baird, 1990; Burke et al., 2012).

Attraction to artificial night-lighting associated with offshore hydrocarbon platforms and ships is a major risk for petrels (see Light pollution section). In the northwest Atlantic, Leach's Storm-Petrels *Hydrobates leucorhous* collide with and strand on offshore platforms (Ellis et al., 2013), and mortality assessments associated with attraction to both structure and flares is urgently needed (Hedd et al., 2018). Light attraction on migration and wintering grounds also requires study, e.g., in the oil and gas exploration and production fields off North-West and West Africa which provides important non-breeding habitat for several species (Pollet et al., 2014; Grecian et al., 2016). In the Falkland Islands, where there is a developing offshore hydrocarbon industry and regionally significant populations of petrels, data gaps around the distribution and movement of small petrels limit risk assessment for this vulnerable group (Blockley and Tierney, 2017; Augé et al., 2018). Best-practice recommendations include filling seasonal data gaps for distribution and abundance of vulnerable species, establishing monitoring and management plans at the outset of industrial development, and deploying independent observers on offshore platforms to quantify the occurrences and mortality of seabirds (Burke et al., 2012; Ronconi et al., 2015; Blockley and Tierney, 2017).

Oil and gas platforms and drill rigs also produce discharged water containing hydrocarbons and greasy drilling fluids that compromise seabird feather structure (O'Hara and Morandin, 2010), possibly contributing to cumulative mortality (Fraser et al., 2006; Ellis et al., 2013). Mitigation of this mortality is likely unfeasible for most platform operations, but cumulative impacts should be considered with environmental impact assessments and monitoring.

Renewable Energy

Marine and coastal renewable energy developments may also represent threats to petrels. Overall, the potential impacts of renewable energy installations on small petrels, whether positive or negative, are poorly understood.

Offshore wind farms may affect petrels directly via collision and displacement (Garthe and Hüppop, 2004; Cook et al., 2018). However, formal assessments conclude that impact risks are low for petrels (Furness et al., 2013; Bradbury et al., 2014), partly because of their low flight costs and flight altitudes below the arc of most turbines. Such studies are restricted to a small number of (mostly North-European) sites, therefore further work is needed to quantify the potential and realized risk on shearwaters and petrels over a much broader range of locations and species.

Land-based wind farms may also impact some species, particularly those breeding at high altitudes or inland, as they commute from terrestrial colonies to marine foraging areas. Land-based wind turbines are among potential threats for Newell's Shearwater *Puffinus newelli* (BirdLife International, 2018a). For all species, the impact of collisions is either unknown or assessed as negligible-low.

Wave-powered energy installations have extremely low collision and displacement potential for flying birds, but are a direct collision risk to diving species (Grecian et al., 2010). Currently, most wave-powered devices are located in shallow coastal waters, whereas petrels frequently forage in pelagic waters, meaning minimal risks of impact. Research could, however, be targeted on understanding the diving behavior of some coastal small tubenoses in areas where wave-powered devices may be constructed.

Offshore wind farms and wave-powered energy installations may also indirectly impact petrels via changes in ocean habitat and foraging conditions. These processes are not well understood, but available research suggests that such indirect effects are beneficial (Inger et al., 2009). For instance, wind farms might act as *de facto* Marine Protected Areas (Campbell et al., 2014) and petrels could benefit from such effects, but formal research is lacking.

At-sea distribution during the breeding season, and particularly the non-breeding season, is poorly known for many species, and consequently so is our ability to assess spatial risk from the traditional (oil and gas) and renewable (wind, tidal) energy sectors. Current technology allows both fine-scale and year-round tracking of even the smallest species. Filling the research gaps about petrel seasonal marine distribution will improve our ability to assess potential impacts and should be a focus moving forward.

OVERFISHING

Food Depletion

Food depletion herein is considered to be the adverse consequence of human extractive activities (fisheries) influencing prey availability by direct exploitation with an implicit competition between fisheries and seabirds for forage fish (pelagic fish, crustaceans, and cephalopods) (Furness, 2006; Cury et al., 2011; Grémillet et al., 2018).

Among threatened species, two endangered (Peruvian diving-petrel and Hutton's Shearwater *Puffinus huttoni*) and one critically endangered species (Balearic Shearwater) have been identified to be affected following IUCN assessments. There is evidence of the relationship between forage fish availability and breeding success in some species (Louzao et al., 2006). Prey reduction could adversely affect breeding success (Bourgeois and Vidal, 2008; Sommer et al., 2009) and species' survival through increasing mortality from incidental bycatch. Low food availability may increase attraction to vessels, and thus, increase bycatch (Laneri et al., 2010; Soriano-Redondo et al., 2016).

Fishing activities can also affect petrel populations by reducing pelagic marine predator populations (e.g., *Thunnus* spp.) and therefore reducing their feeding opportunities, as tuna drive pelagic fishes to the ocean surface making them available to foraging seabirds. Only one endangered species (Newell's Shearwater) has been shown to be affected by the removal of subsurface predators, through an increase of foraging effort at sea (Mitchell et al., 2005), although few studies have properly addressed this issue.

For most petrels, there is no evidence of the (in)direct effects of food depletion. Understanding the processes by which competition with fisheries may affect seabird foraging ecology and life-history traits are essential to quantify the interactions and impacts (Bertrand et al., 2012).

Proposed conservation actions could be directed to promote sustainable fishery management by studying both the forage fish and tuna populations to assess the degree of (over-)exploitation, and thus potentially limiting fish catches to secure prey availability and feeding opportunities. Fisheries could be also limited within specific seabird foraging grounds to secure prey availability in these localized areas through adaptive marine protected areas (Bertrand et al., 2012; Sherley et al., 2018). Other research actions should be directed to assess the impact of food depletion on the foraging ecology, breeding performance and survival by implementing long-term population monitoring (Arcos, 2011; Karris et al., 2018).

Discards

Discards provide important food for petrels, with the potential to support high numbers of scavengers, influencing movement and demography. Global fisheries produce ~10 million tons of discards each year (Zeller et al., 2018), providing an important energetic subsidy for some species (Bicknell et al., 2013; Oro et al., 2013). Discards in the North Sea potentially supported ~3.2 million Northern Fulmars annually during the 1990s (Garthe et al., 1996). Even Critically Endangered species such as the Balearic Shearwater may make extensive use of this resource, amounting up to 40% of their energy requirements (Arcos and Oro, 2002), which is likely reinforced by the overexploitation of their natural prey. Discard volumes are decreasing globally (Zeller et al., 2018), with the potential to impact upon currently dependent species, at least in the short-term (Genovart et al., 2018).

Discard availability can shape shearwater movement ecology when trawling activity provides a predictable foraging resource every weekday (Bartumeus et al., 2010). Northern Fulmars alter their at-sea movements even when they are as far as 35 km from a fishing boat (Pirotta et al., 2018). Furthermore, discard availability can alter seabird life-history traits (Bicknell et al., 2013), such as inter-annual variation in breeding performance

(Louzao et al., 2006) or survival due to seabird interactions with multiple fishing gears. In the absence of discarding, Scopoli's Shearwaters might switch from trawlers that generate considerable discards (with minimal bycatch) to long-liners which have a higher bycatch risk (Laneri et al., 2010; Soriano-Redondo et al., 2016; Cianchetti-Benedetti et al., 2018b). Such broad-scale impacts on seabird movement and bycatch risk are important in the context of understanding individuals' behaviors, and in terms of marine spatial planning and conservation.

While most work on discard use by petrels is focussed on breeding birds, fisheries waste may also be important during non-breeding periods (Meier et al., 2017). Understanding fisheries interactions during the non-breeding period is important as this period typically represents >60% of the annual cycle. Further research is required to determine the extent to which movement of other species throughout the annual cycle is influenced and in what manner by fisheries. Only a limited understanding of the extent to which scavenging varies among and within species is currently available. A review of species-specific and regional differences in discard use is required to better understand the incidence and implications of discard use.

DISEASES

Although disease emergence is recognized as a major threat for conservation, current knowledge on the ecology, epidemiology, and evolution, of infectious diseases in petrels, remains very limited. Transmission (both direct and vector-borne) of bacteria and viruses has been documented in other species of Procellariiformes, with sometimes devastating effects on the reproductive success of endangered species, e.g., *Pasteurella multocida* – the avian cholera causative agent – in Yellow-nosed albatrosses *Thalassarche carteri* (Jaeger et al., 2018). In petrels, Puffinosis has been recorded in Manx Shearwater *Puffinus puffinus* more than 30 years ago (Brooke, 2013), but the drivers of pathogen transmission are yet to be clearly determined. Negative effects associated with petrel infestation by ticks and other blood-parasites would also require further investigation (Dietrich et al., 2011). Studies on the mechanisms involved in transmission dynamics (e.g., population structure, environmental factors), but also on host-pathogen and pathogen-pathogen interactions (e.g., host susceptibility, co-infections with synergistic or antagonistic interactions) are required to fully assess the extent of pathogens and parasite transmission in petrels, and their consequences on conservation.

GENERAL BIOLOGY KNOWLEDGE

Effective conservation actions and assessments require well-documented knowledge on breeding biology, habitat use, as well as on population trends of the species that we aim to conserve or use as environmental indicators of the marine ecosystem. These specific fields of research are not often addressed for many petrel species, including both knowledge acquired on land in colonies and knowledge acquired at-sea during foraging trips, migration, and pelagic distribution. Indeed, despite a few extensive monographs on the petrels' breeding biology (Warham, 1990, 1996; Brooke, 2004a), there are still major gaps in the aforementioned areas of research for many species. For example, only a few petrels are currently considered as well-known species: Cory's Shearwater being the most studied species among the petrels, and Northern Fulmar (Fisher, 1952), Manx Shearwater (Brooke, 2013), and European Storm-Petrel (Lockley, 1983) providing the few specific monographs currently available. Therefore, we review here the current knowledge gaps in the breeding biology, habitat requirements, population size, and trends that could help in understanding the current conservation status of petrels and shearwaters.

Difficulties in Investigating Petrels on Land

The biology and ecology of petrels and shearwaters, especially the smaller species, can be challenging to study due to their specific behavior and nesting habits. First, some of these species are very sensitive to handling, such as most storm-petrels and small shearwaters, for which handling adults at specific time periods (e.g., incubation) can result in nest abandonment (Carey, 2011b). Second, most species usually visit their colonies exclusively at night, with only about 15% of petrel species attending their colony during daylight. Third, they often nest underground, in deep and inaccessible burrows, some of them excavated in soft soils, including sand. Fourth, they breed in remote locations, such as offshore islands, island summits or inaccessible cliffs. Thus, reaching burrows or colonies is sometimes difficult, e.g., tropical cliff-nesting petrels such as the Black-capped Petrel (Jodice et al., 2016). Indeed, colonies of, at least, eight species of petrels are only partly known: Elliot's (or White-vented) Storm-Petrel *Oceanites gracilis*, Pincoya Storm-Petrel *O. pincoyae*, New Zealand Storm-Petrel *Fregetta maoriana*, Hornby's Storm-Petrel *Hydrobates hornbyi*, Heinroth's Shearwater *Puffinus heinrothi*, Fiji Petrel *Pseudobulweria macgillivrayi*, Beck's Petrel *Pseudobulweria beckii*, and Jouanin's petrel *Bulweria fallax*. Until very recently, some species were even considered extinct (Shirihai, 2008). Rediscovery of lost species could still be possible, e.g., the Jamaican Petrel *Pterodroma caribbaea* and the Guadalupe Storm-Petrel *H. macrodactylus*. Thus, the secretive breeding habits of petrels, not only hinder accurate our understanding of their breeding biology and their population estimates (see below), but also the identification of nesting areas and potential threats affecting these pelagic species on land.

Challenges to Understanding Ecology at Sea

Recent advances in miniaturization of tracking devices (e.g., in light-level geolocators, accelerometers, GPSs, and PTT-Argos devices) have provided detailed knowledge on the at-sea distribution and the foraging ecology of many petrels (Ramos et al., 2017; Hedd et al., 2018) as well as our understanding of their behavioral flexibility to deal with a changing environment (Dias et al., 2011). The number of datasets collected for petrels increased exponentially between

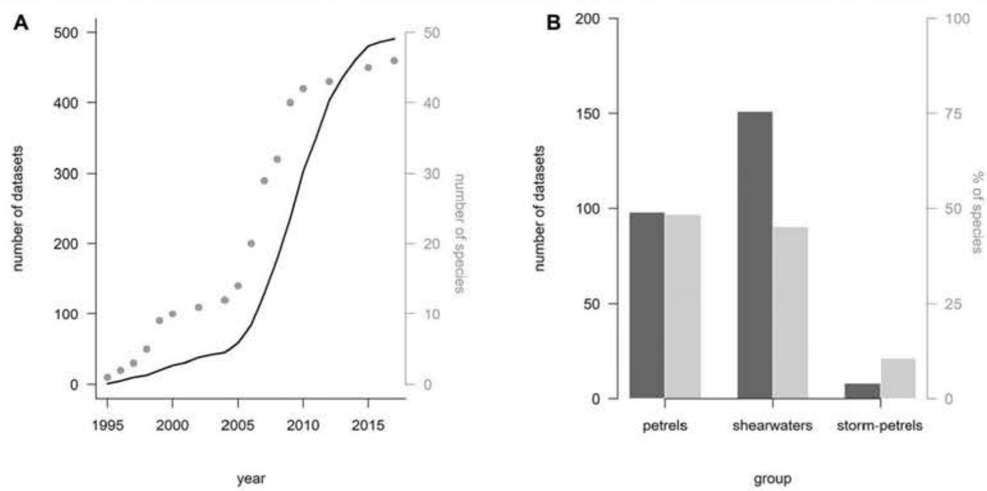

FIGURE 5 | (A) Cumulative number of datasets (i.e., data collected for a single species in a given colony and with a specific type of device – GPS, PTT-Argos or GLS) collected between 1995 and 2018 (line), and cumulative number of species tracked during the same period (points). **(B)** Number of datasets per petrel groups (black bars) and respective percentages of species (gray bars). Data held (April 2018) in the Seabird Tracking Database (BirdLife International, 2018b).

2005 and 2015 (BirdLife International, 2018b; **Figure 5**). In the same period, we saw an increase of the number of tracked species (**Figure 5**). Currently, the Seabird Tracking Database managed by BirdLife International holds data for 46 species. However, caveats remain for the spatial ecology of some of the rarest species as well as the smallest ones, i.e., most storm-petrels, diving petrels and some prions. From almost 500 datasets collected in the Seabird Tracking Database for petrels and shearwaters, only eight are for storm-petrels (Leach's and Band-rumped Storm-Petrels). A particular challenge is lack of information on juvenile survival and biology at sea (Afán et al., 2019; Weimerskirch et al., 2019). As tracking technology use is growing in small petrel species and immatures, we foresee this data gap will be addressed, at least at some extent, over the next 5 years.

Species distribution models (SDMs) can delineate habitat preferences of a given population based on spatial, count and tracking data (Guisan et al., 2013). SDMs enable researchers to draw species suitability maps based on the habitat preferences of certain populations. In this regard, important foraging grounds and habitat use for a given species may not be identified adequately by tracking a single (or a few) population(s), as dispersed populations across international boundaries will likely provide a more comprehensive picture of space/habitat use of the species (Ramos et al., 2013). This information is certainly needed to properly delineate key conservation areas and to inform conservation planning in the vast marine ecosystem. Finally, the use of intrinsic markers on the smallest species, such as stable isotope analysis (SIA), can ascertain specific features of their feeding and foraging ecology (Ramos and González-Solís, 2012). For instance, SIA of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) on specific feathers have unraveled the year-round feeding ecology of the smallest seabirds breeding in the Atlantic Ocean (Quillfeldt et al., 2005; Hedd and Montevecchi, 2006; Paiva et al., 2018).

Challenges to Count and Estimate Population Size and Trends

Poor estimates limit our ability to accurately measure and report on status and trends, though these parameters are essential to develop conservation actions. Producing accurate estimates of population sizes or trends has proven extremely difficult, especially for nocturnal nest-burrowing seabirds (Sutherland and Dann, 2012). This is mainly because most of these species (a) breed in inaccessible colonies (e.g., cliffs) on remote islands, (b) nest in deep burrows, cavities or screes, (c) have nocturnal habits at breeding colonies, (d) share same breeding places with other species (more than 12 species may breed on a single island), and (e) have clumped colonial distributions so hard to extrapolate. Therefore, ensuring, assessing and counting their presence becomes difficult if not impossible (Pearson et al., 2013). Census techniques rarely account for inaccurate detection and habitat selection for nesting (Rayner et al., 2007; Whitehead et al., 2014). Detectability of nocturnal burrow-nesting seabirds can benefit from using both visual and acoustic detection (Barbraud and Delord, 2006). Records of the vocal activity of seabirds obtained from autonomous acoustic devices may be promising tools to detect occurrences or estimate population sizes of secretive species on remote islands, although such information requires validation to determine its value as a measure of abundance (Borker et al., 2014). Radar could be useful for estimating distribution and population trends, particularly for species breeding inland (Raine et al., 2017). Complementarily, SDMs can allow estimating suitable habitat for nesting, and, therefore, predicting nest density in a given area. Finally, integrating and combining these techniques (i.e., correction for detectability and SDMs) appears to be the best solution for providing reliable estimates of distribution, abundance and trends for these species (Oppel et al., 2014; Russell et al., 2017b).

Next Priorities

The key priorities to fill the gap in our knowledge of petrel biology include: (a) *Identifying breeding localities of rare and threatened species*. This does not mean necessarily finding the breeding colonies but at least the general breeding locations (e.g., island, mountain), to evaluate the extent of the colony, the approximate size and numbers of colonies, and their current threats. Several species are currently data deficient (all are storm-petrels). (b) *Collecting data on at-sea distribution for less studied taxa or populations*. Though improving, our current knowledge of the foraging ranges and distribution at sea is far from complete, especially for the south Pacific taxa, and for the juveniles of most species. (c) *Standardized surveys to assess population trends*. Censuses could be based on visual and/or acoustic detections, but they should be repeatable. (d) *Searching for possibly extinct petrels*. Unsuccessful searches for Guadalupe Storm-Petrel as well as Jamaican Petrel have already been conducted, but there is still hope for finding them. For instance, evidence of *Pterodroma hasitata* breeding on Jamaica has been found, so the survival of *P. caribbaea* is possible (Shirihai et al., 2010).

Finally, it should be stressed that knowledge on the breeding biology, especially for the rarest species, should not be targeted at any cost and unnecessary disturbances should be avoided. A sound evaluation of the costs and benefits of visiting breeding colonies, excavating burrows, or fitting tracking devices should be conducted for any threatened species before engaging in such operations.

TAXONOMY

Taxonomy is tightly linked with conservation (Mace, 2004). Species concepts are extensively debated (De Queiroz, 2007), and so defining which populations should be recognized as distinct taxa, and therefore added to and assessed on species lists, such as the IUCN Red List and the Convention on International Trade in Endangered Species (CITES), can be difficult. However, this endeavor is necessary because 'species' are critical units for wider conservation planning and legislation (Mace, 2004; Ely et al., 2017).

The taxonomy of many petrels is still unresolved. The reasons for obscure and confusing taxonomy result from systematic decisions being based almost exclusively on morphological characters (biometrics and coloration), and many petrel groups are morphologically cryptic, i.e., similar in their external appearance (Brooke, 2004a). Two major factors can limit morphological change even between genetically divergent populations: use of non-visual reproductive signals, and constraints on morphology due to adaptation within a niche (Bickford et al., 2007). Behavioral cues used by petrels for reproductive isolation are mainly vocal, given that most species are nocturnal on their breeding grounds, and so differences in their calls are likely a better indicator of reproductive isolation than differences in morphology (Bretagnolle, 1989, 1995; Curé et al., 2010, 2016).

Procellariiformes have a well-developed sense of smell which facilitates finding their way to specific colonies (Brooke, 2004a; Gagliardo et al., 2013), and could therefore play a role in philopatry. Strong philopatry reduces genetic mixing between colonies and could also generate genetic divergence without morphological change. Their keen olfaction also appears to be used for individual recognition (Bonadonna, 2009; Bonadonna and Sanz-Aguilar, 2012). So we could hypothesize a role for scent in reproductive isolation, again without morphological change. This idea is untested and would be difficult to apply in experiments to determine levels of reproductive isolation between colonies (Zidat et al., 2017).

Many seabird populations diverge genetically without the presence of physical barriers to gene flow (Friesen, 2015). Divergence is often driven by adaptation to foraging in different ocean regimes, breeding phenology, and philopatry (Friesen et al., 2007; Gómez-Díaz et al., 2009; Friesen, 2015; Taylor et al., 2018). The lack of recognition that divergence can occur without physical barriers to gene flow until relatively recently, coupled with low morphological divergence, may have hindered recognition of seabird species. Indeed, recent recognition of cryptic species in petrels has flourished: for example *C. borealis* (Zidat et al., 2017), *H. monteiroi* (Bolton et al., 2008), *Pelecanoides whenuahouensis* (Fischer et al., 2018), and *P. bannermani* (Kawakami et al., 2018).

Testing for direct indicators of reproductive isolation between colonies of petrels, e.g., using playback experiments, is a good way of investigating species boundaries under the biological species concept (Bretagnolle, 1989; Bretagnolle and Lequette, 1990). However, these methods can be time consuming and logistically difficult (Bolton, 2006). Such experiments can and should continue to be carried out when possible. However, we encourage both academic researchers and applied conservation biologists to collect DNA samples of hard to sample and little known petrels to collaborate with conservation geneticists, as molecular investigation will be valuable for systematic and conservation biology. The shrinking costs of high-throughput DNA sequencing will continue to resolve the taxonomy of cryptic petrel lineages, such as for example Monteiro's Storm-Petrel (Bolton et al., 2008), Bryan's Shearwater *Puffinus bryani* (Pyle et al., 2011), and the Gray-faced Petrel *Pterodroma gouldi* (Wood et al., 2016).

A recent and ensuing debate about approaches to global taxonomy, especially regarding conservation practices, is bringing this issue to the forefront of the conservation priorities (Garnett and Christidis, 2017; Hollingsworth, 2017; Lambertz, 2017; Thomson et al., 2018). With many articles calling for more recognition, funding and training for taxonomic research (Mace, 2004; Ely et al., 2017), we hope to see a renewed vigor in the field of systematics given its relevance for applied conservation.

SYNTHESIS

Effective conservation requires well documented knowledge (Simberloff, 1998). However, the cryptic behavior of petrels at breeding grounds (i.e., nocturnal colony visits, underground nesting, remote, and inaccessible reproduction areas), their small size, and their high mobility at sea hinder and, in some cases, prevent their study, management and conservation (Brooke, 2018). The petrel use of vast areas of the ocean does not help either, as it puts them under different regulations of many national and international jurisdictions, and boundaries (Lascelles et al., 2014; Harrison et al., 2018). Thus, there are major knowledge gaps in many species' basic biology and our research is highly segregated by country and species, usually biased to the richest countries and to the most common, large body-sized species. A total of 16 out of 124 petrel species have unknown population status, and six out them are threatened (BirdLife International, 2018a). Under this scenario, assessing the importance of threats is subjective and probably biased by our knowledge on species or threats. Despite all these difficulties, ranking or prioritization lists have important implications for conservation and management.

TABLE 2 | Measures and future research needs to reduce the severity of threats to petrels around the world.

Threat	What can be done? Management	What is needed? Research	Reference
Invasive species	Eradicate (or control) introduced species. Exclude introduced species using fences. Increase awareness of invasive species impacts to reduce species introductions. Raise awareness and liaise with animal right movements	Increase acceptance of eradication and control by policymakers and the public	Jones et al., 2016
Light pollution	Turn off artificial lighting (or minimize its use). Reduce light intensity. Adapt light sources to avoid skyward emissions. Reduce or eliminate blue emissions from LEDs spectra	Decrease impact on population. Increase impact of mitigation measures, i.e., rescue campaigns. Determine sensitivity to intensity, spectra (wavelengths) and spatial distribution of lights. Implement seasonal adjustments to light use during fledging and migration periods	Rodríguez et al., 2017a,b; Longcore et al., 2018
Bycatch	Implement proper monitoring programs to assess incidental catch in fishing gear: consider different approaches, ideally combined (e.g., observers, logbooks, video and/or monitoring). Develop educational programs for fishers. Raise awareness and generate trust by collaborative work among fishers and conservationists	Quantify bycatch in different types of fishing gear. Assess mitigation gear modifications and fishing and scaring techniques. Provide a toolkit with multiple mitigation options, to encourage fishers to use the most convenient option in each situation	ACAP, 2014, 2017; Hedd et al., 2016; Tarzia et al., 2017
Human exploitation	Develop regulations and control. Raise awareness in local communities	Assess illegal rates of hunting	Lopez-Darias et al., 2011
Problematic native species	Exclude larger species using specifically designed artificial nests. Remove problem individuals when proven necessary	Conduct long-term monitoring. Assess population impacts of pressure from native species	
Climate change and severe weather	Support long-term research programs (e.g., population trends, breeding success, diet, and foraging)	Assess impacts of climatic conditions on biological traits (breeding success, trophic level, and mass mortality events). Model future projections	
Residential and commercial development	Bury power lines (or shield by planting trees). Minimize upward and lateral light emissions. Restrict/ban development in sensitive areas	Quantify nesting habitat lost (or transformed) and model future projections	
Pollution	Ban unnecessary use of plastic. Conduct regular beach and marine cleanups. Develop and implement prevention policies for spills and acute events, including response plans. Raise awareness and promote reduction, reutilization and recycling	Investigate plastic ingestion impacts on individuals and populations	Avery-Gomm et al., 2018
Disturbance	Minimize disturbances at terrestrial and marine protected areas	Estimate impacts of ecotourism in protected areas and researcher disturbance	
Energy production and mining	Use independent observers at energy facilities to monitor impacts	Conduct systematic monitoring of seasonal seabird occurrences and mortality at offshore platforms and facilities	Burke et al., 2012
Overfishing	Employ ecosystem-based fisheries management	Estimate the forage fish and sub-surface predator biomass required to sustain the viability of petrel populations. Assess the combined effect of overfishing and discard reduction on petrel populations	Cury et al., 2011
General biology of rare secretive species	n/a	Determine population sizes and breeding parameters. Assess threats and relative impacts	BirdLife International, 2018a
Taxonomy	n/a	Clarify taxonomic status	Friesen, 2015

In typical long-lived species such as petrels, the most pernicious threats must be those causing direct adult mortality. Given the extreme vulnerability of petrels on land due to their limited terrestrial locomotion, the introduction of invasive mammalian predators seems to be their most severe threat, occurring on over 50% of petrel breeding islands, impacting at least 78 petrel species and being a key contributing factor in the extinction of some petrel species (BirdLife International, 2018a). Other invasive species, such as invertebrates, plants, birds, and non-predatory mammals, threaten petrel populations by changing community composition, trophic interactions or habitat (Russell et al., 2017a).

As human demands on seafood increases, fisheries-related threats are expected to increase, even more if no correctional actions are taken (**Table 2**). Bycatch mortality seems to be already critical for some threatened medium-large species, although more information is urgently required on smaller petrel species. However, proper management could buffer the impact of the increase of seafood demand (Moreno et al., 2008; Waugh et al., 2008) and actions can be already put in practice to minimize it (**Table 2**). In addition, food depletion by overfishing could have also important consequences by reducing prey populations or mutualist predators during fishing such as tunas or cetaceans. Therefore, a better management of fisheries, with an ecosystem-based approach, is essential for the sustainability of this activity and the well-being of the marine ecosystem in the long term.

With human settlement on islands and the increase in density and development, loss and alteration of breeding habitat is expected to increase. Permanent habitat loss likely precludes mitigation strategies, so conservation efforts should identify vulnerable colonies and limit development near these sites. One of the main alterations of petrel breeding habitat is light pollution, which affects at least 56 petrel species (Rodríguez et al., 2017b), although impact is low for many of them (**Figure 2**). However, for some species with restricted breeding grounds on small islands densely inhabited by humans, this threat must be offset to reduce impacts on population dynamics by the high light-induced mortality of fledglings (Fontaine et al., 2011; Griesemer and Holmes, 2011; Gineste et al., 2016).

Global threats such as climate change or plastic pollution are impossible to address meaningfully without collaboration and commitment at a global scale to achieve stabilization of greenhouse gas concentrations in the atmosphere and reduction in the amount of plastic produced and released in the environment. Although our understanding is generally limited with regards to their impact on petrel populations, at least in the case of microplastics (Avery-Gomm et al., 2018), it is likely that there will be population-level consequences for many petrel species. Evidence indicates that climate change may affect petrel survival or reproduction through changes in the food chain (and thus prey availability) and an increase in extreme weather events, while plastics can cause mortality by ingestion and entanglement. Local or national agencies could also enhance ecosystem resilience to these global stressors by managing interacting stressors that operate at local or medium-scales, e.g., fisheries or sources of pollution (Ramírez et al., 2018). There is still a considerable lack of knowledge regarding thresholds of petrel stressors, and the manner in which these thresholds are lowered by additional stressors. In this regard, long-term studies, monitoring programs, and conservation plans will certainly improve our understanding of the thresholds of interacting stressors and the patterns and mechanisms by which these stressors are impacting petrels.

An ambitious goal to reverse the population declines is to address at least some of these six main threats (invasive species, bycatch, overfishing, light pollution, climate change, and plastic pollution). Tackling these main threats through active efforts such as restoring island habitats (e.g., invasive species removal, control and prevention), improving policies and regulations at global and regional levels, and engaging local communities in conservation efforts, will maximize opportunities to reverse the population declines of most petrel species. Raising awareness among general public will be crucial to drive changes in political will. Until such global decisions are collaboratively engaged by the international community, and scientists find responses to critical research questions, many actions can be already taken with the current knowledge (**Table 2**). Meanwhile, the improvement of communication and information exchanges between scientists and stakeholders are essential to help develop effective conservation strategies and activities to prevent petrel population declines and species extinctions (Croxall et al., 2012). This effort has already been enhanced by important knowledge sharing tools such as the Seabird Tracking Database, the Threatened Island Biodiversity Database, and the various IUCN databases (BirdLife International, 2018a,b; IUCN, 2018b). In addition, the bio-logging revolution, i.e., the miniaturization of tracking or logging devices and the development of new ones, which has enabled seabird researchers to answer questions that 20 years ago would have been unanswerable (Brooke, 2018), will continue to reveal the secret life of the most enigmatic, small-sized, shy petrels in the near future. The clear message that emerges from this review is the continued need for research and monitoring to inform and motivate effective conservation at the global level.

DATA AVAILABILITY

The datasets analyzed for this study can be found at BirdLife Data Zone (www.datazone.birdlife.org) and IUCN Red List of Threatened Species (www.iucnredlist.org).

AUTHOR CONTRIBUTIONS

AR and AC conceived and designed the review. AR, MPD, and FR analyzed the data. MPD and RM contributed to data collection. JMA, VB, MPD, NDH, ML, JP, AFR, FR, BR, RAR, and RST led the topic research sections. All authors contributed to writing, and accepted a compiled version produced by AR and AC.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmars.2019.00094/full#supplementary-material

TABLE S1 | Reported effects of climatic environmental features on petrels and shearwaters.

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RESEARCH ARTICLE

Declining population trends of Hawaiian Petrel and Newell's Shearwater on the island of Kauaʻi, Hawaii, USA

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ABSTRACT

The island of Kauaʻi, Hawaii, USA, holds a large breeding populations of the endangered Hawaiian Petrel (*Pterodroma sandwichensis*) and a majority of the world population of the threatened Newell's Shearwater (*Puffinus newelli*). We evaluated island-wide population trends of both species. For Newell's Shearwaters, we considered radar counts at 13 sites between 1993 and 2013 and annual island-wide tallies of fledglings retrieved after being grounded by light attraction in 1979–2015 (Save Our Shearwaters [SOS] program). For Hawaiian Petrels, we considered radar counts alone. Radar data indicated a 78% decline overall in numbers of Hawaiian Petrels (at an average rate of ~6% per year) and a 94% decline overall in numbers of Newell's Shearwaters (at an average rate of ~13% per year) during the survey period. Most (92%) radar sites showed significant declines of Newell's Shearwaters across the entire survey period, as did 62% of sites for Hawaiian Petrels. The SOS recovery effort collected 30,522 Newell's Shearwater fledglings between 1979 and 2015. When we compared this dataset in pre- and post-Hurricane Iniki (September 1992) periods, we found a significant downward trend after Hurricane Iniki, similar to the trend seen in the radar data. The large-scale declines found in this study are not surprising, considering the significant threats facing both species on Kauaʻi, which include powerline collisions, light attraction, introduced predators, and habitat modification—threats which were potentially exacerbated after Hurricane Iniki. Improved conservation initiatives and an increased understanding of the various threats facing the 2 species are key to reversing these declines.

Keywords: seabird, Hawaiian Petrel, monitoring, Newell's Shearwater, population trends, radar

Tendencias poblacionales decrecientes para *Pterodroma sandwichensis* y *Puffinus newelli* en la Isla de Kaua'i

RESUMEN

La isla de Kaua'i alberga grandes poblaciones reproductivas de la especie en peligro *Pterodroma sandwichensis* y la mayoría de la población mundial de la especie amenazada *Puffinus newelli*. Evaluamos las tendencias poblacionales de dos maneras para ambas especies en toda la isla. Para *P. newelli*, consideramos los conteos de radar en 13 sitios entre 1993–2013 y recuentos anuales en toda la isla de volantones recuperados después de ser atraídos con luz a tierra entre 1979–2015 (Programa Salve Nuestras Pardelas [SNP]); para *P. sandwichensis*, consideramos solamente los conteos de radar. Los datos de radar indican una disminución global del 78% en el número de individuos de *P. sandwichensis* (a una tasa promedio anual de 6%) y una disminución global del 94% en el número de individuos de *P. newelli* (a una tasa promedio anual de 13%) durante el período de muestreo. La mayoría (92%) de los sitios de radar mostraron disminuciones significativas para *P. newelli* a lo largo de todo el período de muestreo, así como para el 62% de los sitios para *P. sandwichensis*. El esfuerzo de recuperación del programa SNP colectó 30,522 volantones de *P. newelli* entre 1979 y 2015. Cuando comparamos este set de datos entre los períodos previo y posterior al Huracán Iniki (septiembre 1992), encontramos una tendencia decreciente significativa luego del Huracán Iniki, similar a la tendencia vista en los datos de radar. Las disminuciones a gran escala encontradas en este estudio no son sorprendentes, considerando las amenazas significativas que enfrentan las especies en Kaua'i, que incluyen colisiones con líneas eléctricas, atracción de la luz, depredadores introducidos y modificación del hábitat– amenazas que se han visto potencialmente exacerbadas luego del Huracán Iniki. Es fundamental contar con iniciativas de conservación mejoradas y con un mejor entendimiento de las múltiples amenazas que enfrentan las dos especies para revertir esta disminución.

Palabras clave: aves marinas, monitoreo, *Pterodroma sandwichensis*, *Puffinus newelli*, radar, tendencias poblacionales

INTRODUCTION

The Hawaiian island of Kaua'i holds internationally important populations of 2 endangered seabird species—the Hawaiian Petrel (*Pterodroma sandwichensis*; 'Ua'u in Hawaiian) and the Newell's Shearwater (*Puffinus newelli*; 'A'o in Hawaiian). The Newell's Shearwater was thought to be extinct until it was rediscovered in 1947, and was only confirmed to be breeding on Kaua'i 2 decades later, in 1967 (Sincock and Swedberg 1969). Kaua'i holds a significant proportion of the breeding population of the Hawaiian Petrel (Ainley et al. 1997) and the majority of the remaining breeding populations of Newell's Shearwater (Harrison 1990, Day and Cooper 1995, Spear et al. 1995).

Both species share threats common to Hawaiian birds, including collisions with powerlines (Cooper and Day 1998, Podolsky et al. 1998, Ainley et al. 2001, Travers et al. 2014); attraction of fledglings to artificial lights, where they then die after grounding due to predation, collisions with infrastructure, dehydration, and starvation (Reed et al. 1985, Telfer et al. 1987, Ainley et al. 1997, Cooper and Day 1998, Rodríguez et al. 2017); predation by introduced predators, particularly feral cats (*Felis cattus*), feral pigs (*Sus scrofa*), Barn Owls (*Tyto alba*), black rats (*Rattus rattus*), and Polynesian rats (*Rattus exulans*; Ainley et al. 2001, Hodges and Nagata 2001, Raine and Banfield 2015a, 2015b); diseases such as avian pox and avian malaria (Warner 1968, Simons 1985, VanderWerf and Young 2016); and habitat modification within breeding colonies due to invasive plants and pigs (Duffy 2010, VanZandt et al. 2014). These seabirds also undoubtedly face threats at sea that, while poorly known, are recognized to be important issues for similar species worldwide and could include marine pollution (Sileo et al. 1990, Derraik 2002), plastic ingestion (Kain et al. 2016), overfishing (Ainley et al. 2014), and the effects of climate change and fisheries bycatch (Gilman et al. 2008). Based on a combination of many of these factors, the Hawaiian Petrel is listed under the U.S. Endangered Species Act as Endangered and the Newell's Shearwater as Threatened (USFWS 1983). On the IUCN Red List, the Hawaiian Petrel is listed as Vulnerable (BirdLife International 2016a) and the Newell's Shearwater as Endangered (Birdlife International 2016b).

Most breeding colonies of both species are concentrated in areas that are remote and difficult to access, particularly in the northwestern section of Kaua'i (Ainley and Holmes 2011, Kaua'i Endangered Species Recovery Program [KESRP], http://kauaiseabirdproject.org/index.php/the-birds/). However, monitoring population trends is critical for an understanding of the current conservation needs of the 2 species and to assess whether the significant population declines of the Newell's Shearwater described between 1993 and 2001 (Day et al. 2003a) have continued. It is equally important to assess long-term population trends for the Hawaiian Petrel because recent genetic work has indicated strong genetic differentiation between populations on the islands of Hawaii and Kaua'i (Wiley et al. 2012), increasing the importance of understanding the population trends of this species at an island level. Remote nesting sites and nocturnal habits make it challenging to monitor these populations, but radar has proved to be a highly effective method (e.g., Day and Cooper 1995, Cooper and Day 2003, Day et al. 2003a, 2003b, Gauthreaux and Belser 2003, Burger et al. 2004, Cooper et al. 2006, Bertram et al. 2015). This technique also has been used extensively in the past for surveying both Hawaiian Petrels and Newell's Shearwaters on most of the southeastern Hawaiian Islands, including Kaua'i (Day and Cooper 1995, Reynolds et al. 1997, Cooper and Day 2003, Day et al. 2003a, 2003b, Swift and Burt-Toland 2009). Here, we combine radar data used by Day et al. (2003b) and more recent data from contemporary radar surveys to assess long-term trends for the 2 species on Kaua'i.

We also use a second, complementary dataset to assess long-term population trends of Newell's Shearwaters based on the "fallout" of fledglings collected over 37 yr by the "Save Our Shearwaters" (SOS) program on Kaua'i. The SOS is a citizen conservation program created by the State of Hawaii's Department of Land and Natural Resources, Division of Forestry and Wildlife, in 1979; its primary focus has been to collect and release seabirds grounded by light pollution, which fledgling Newell's Shearwaters are particularly affected by (Reed et al. 1985, Telfer et al. 1987, Ainley et al. 1997, Cooper and Day 1998). Hawaiian Petrels also are found by the project, but in such low numbers annually that they do not provide useful trend data.

The objectives of this study were threefold. First, we assessed whether the long-term population decline of the Newell's Shearwater found in previous studies continued in the following 2 decades. Second, we assessed whether the Hawaiian Petrel followed a similar declining trend on Kaua'i. These analyses update those presented in Ainley et al. (2001) and Day et al. (2003b). Finally, we used the most recent radar data collected to assess the contemporary distribution of the 2 species on the island, to allow us to focus future conservation planning and effort.

METHODS

Visual Sampling

We conducted visual sampling at 6 of the radar survey sites (Kekaha, Waimea, 'Ele'ele, Wailua, Keālia, and Hanalei; Figure 1) in 2012 and 2013 to count and identify all birds passing overhead. Observers detected birds and, during daylight hours, used binoculars as needed for identification purposes. After dark, night-vision goggles (model PVS-7, Generation 3, 40° field of view, 1× magnification; U.S.

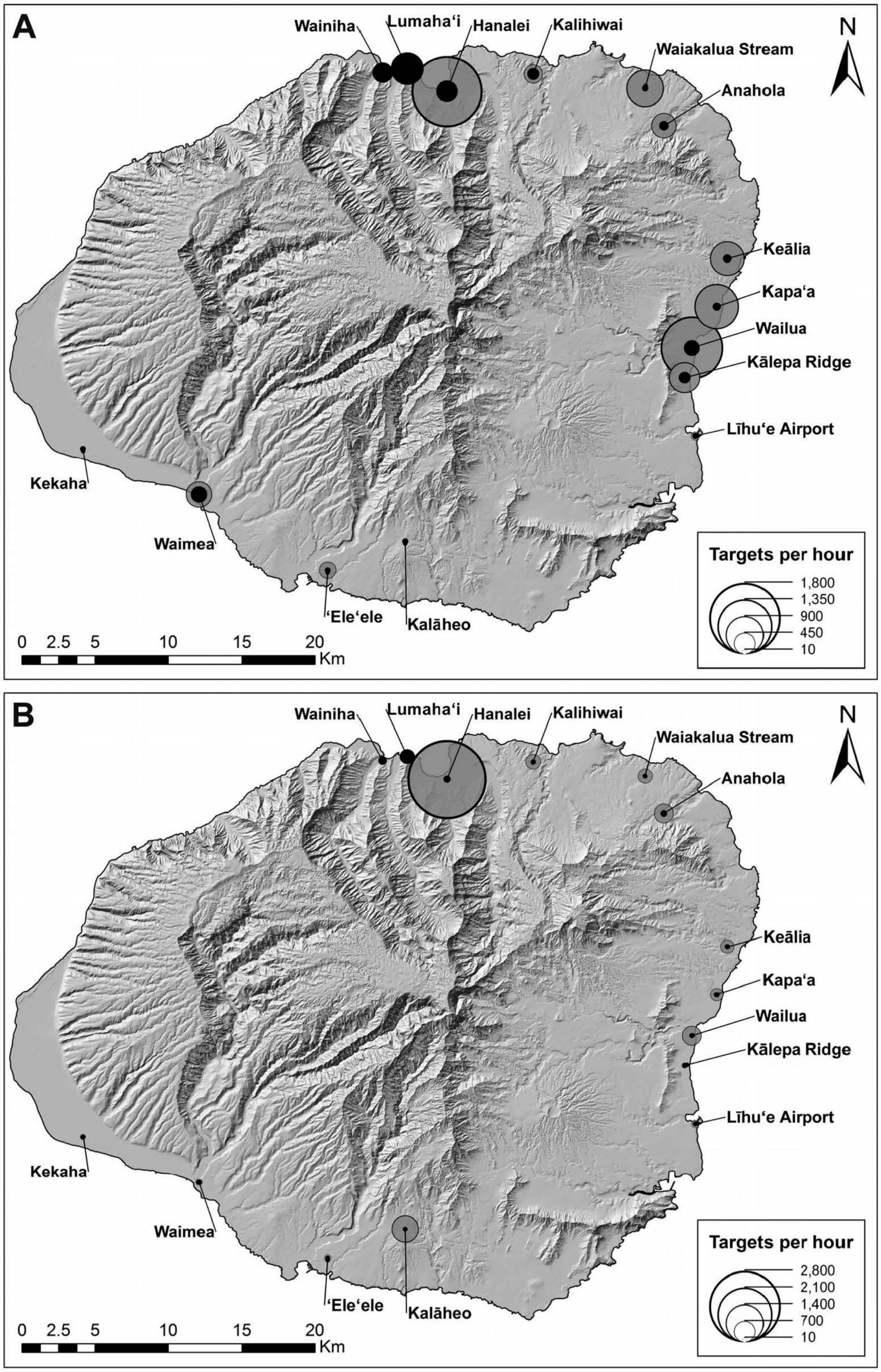

FIGURE 1. (**A**) Mean movement rate (targets hr^{-1}) of radar targets during session 2 (Hawaiian Petrel) recorded at each survey site on Kauaʻi Island, Hawaii, USA, in 1993 (gray circles) and 2013 (black circles). (**B**) Mean movement rates (targets hr^{-1}) of radar targets during sessions 3 and 4 combined (Newell's Shearwater) recorded at each survey site on Kauaʻi Island in 1993 (gray circles) and 2013 (black circles). See Figure 2 for explanation of radar sessions. Note that no data are available for Wainiha and Lumahaʻi in 1993. Contemporary breeding distributions of both species are now concentrated in the northwest of the island.

Night Vision, Roseville, California, USA) were used to identify and count birds passing overhead. Near-infrared illuminators (Raymax 300 Platinum; Raytec, Ashington, Northumberland, UK) were used to increase night-vision capabilities and helped to ensure consistent light levels and night-vision monitoring across sites and nights that varied in ambient light levels. We standardized the area sampled by only counting birds that flew between 2 measured points (adjacent power poles). All birds that flew between the poles were included, regardless of flight altitude (i.e. birds flying high, but between the poles, were also counted). The monitoring distance was deliberately kept narrow (100–200 m) so that observers could effectively monitor the entire airspace, regardless of light levels or optical tool being used, thus ensuring that detection distance was not biased toward daylight hours or a particular species. Visual surveys were conducted in the same manner as radar surveys (see below), starting 15 min before sunset and running for 2 hr, divided into 4 consecutive 30-min sampling sessions (sessions 1–4). Unlike the radar surveys, they were conducted continuously throughout the whole 2-hr period. Surveys were conducted by the same 3 observers in both years.

Birds were identified to species whenever possible by observers trained in identification techniques for all species likely to be found on Kaua'i. Birds were counted only if they were deemed to be in transit—that is, flying in a direct and steady route over a long distance (the same characteristics used for radar surveys). We did not count birds observed to take off or land. Species, time, and flight direction were noted using voice recorders to allow the visual observers to watch the sky continuously. We used these data to assess when peak movement rates occurred for Hawaiian Petrels and Newell's Shearwaters.

Radar Sampling

On Kaua'i, ornithological radar has been used to monitor the summer movement patterns of Hawaiian Petrels and Newell's Shearwaters at 13 sites since 1993 (Figure 1), with repeat surveys occurring in 1999–2001, 2004–2010, and 2012–2013. In 1999, we added 2 radar sites on the North Shore (Lumaha'i and Wainiha) to obtain more data from the northern part of the island, where some of the largest populations of these species remain (Ainley and Holmes 2011, http://kauaiseabirdproject.org/index.php/the-birds/, R. Day and B. Cooper personal observations). Following Day and Cooper (1995), radar sites were located at the mouths of all accessible major drainages around the island. The only area on Kaua'i that was not covered by these surveys was the northwestern part of the island (the Nāpali coast, where Newell's Shearwater colonies are known to exist; http://kauaiseabirdproject.org/index.php/the-birds/nesh-fact-sheet/), due to its inaccessibility to a truck-mounted radar unit.

Radar operation and target identification followed the protocol outlined in Day and Cooper (1995) and Day et al. (2003b). We used an FR1510MK3 radar unit (FURUNO, Camas, Washington, USA) mounted horizontally on top of a truck and tilted upward at an angle of 10°, with a 38.1-cm (15-in) radar screen inside the vehicle. This was an X-band radar transmitting at 9.410 GHz, with a peak power output of 12 kW (10 kW in 1993). The pulse setting was set to 0.07 μsec, the antenna spun at a rate of 24 rpm, and the range setting was 1.5 km.

Surveys were conducted each year from late May to mid-July. Based on burrow-monitoring data from colonies on Kaua'i, this period covered the egg laying, incubation, and early hatching stages of both species on the island (http://kauaiseabirdproject.org/index.php/the-birds/). Surveys prior to 2006 started at 1900 hours (typically 10–25 min before sunset). For analysis we recalculated these data from 15 min before sunset for 2 hr. Surveys from 2006 onward started 15 min prior to sunset, thus standardizing the 2-hr survey period to timing of sunset, avoiding bias associated with variability in available light. From 2006 onward, we also surveyed a subset of 7 of the 13 sites on 3 nonconsecutive nights to estimate among-night variation in movement rates; for these surveys, the average number of targets over the 3 surveys was used in regression analyses. Due to the 1-mo period in which all surveys had to be conducted, we could not survey all sites for 3 nights each.

Each survey consisted of 4 consecutive 30-min sampling sessions (sessions 1–4). We used the first 5 min of each sampling session to collect weather data, then counted targets for 25 min. Targets were recorded only when moving at a velocity $\geq$48 km hr^{-1}, which is the ground-speed of >99% of all Newell's Shearwaters and Hawaiian Petrels unless they are climbing steeply, and also excluded other bird species potentially flying in the area during the radar period (Day and Cooper 1995). For all targets recorded, we collected time, number of targets, cardinal transect crossed (north, south, east, west), flight direction (to the nearest 10°), minimum distance from the radar truck (to the nearest 100 m), velocity (to the nearest 8 km hr^{-1}), and flight behavior (straight-line, erratic, or circling; for examples of these flight behaviors, see Day et al. 2015:370). For analysis, we only included targets flying inland.

The only exceptions to this protocol were at the 3 northernmost sites (Hanalei, Lumaha'i, and Wainiha), where steep terrain lies immediately adjacent to the ocean. Here, visual observations have indicated that seabirds transiting over these areas need to gain elevation rapidly, and thus appear to fly more slowly than elsewhere on Kaua'i (Day and Cooper 1995, Ainley et al. 1997). At these sites, the projected speed on radar can sometimes appear to be <48 km hr^{-1} because the radar's 2-dimensional screen projects only horizontal distance covered and not total horizontal plus vertical distances combined. At these 3 sites, targets moving at 40 km hr^{-1} were also included when their behavior indicated that they were seabirds moving inland.

Clear plastic transparencies were overlaid on the radar screen, and major features of topography, radar shadows, and bird traffic were drawn in most years of radar surveys. These transparences were compared for all sites between the earlier surveys and surveys after 2006 to assess whether there were any significant changes in radar coverage that might have affected counts of targets. The only site where radar coverage changed was Hanalei, where the location of the survey site had to be moved to the east ~1.5 km because the original location eroded into the sea. To account for this change, the subsequent data collection strategy required using only half of the radar screen to ensure that only the portion of the original flyway covered in earlier surveys was sampled. To test any impact on results, we undertook analyses with and without the Hanalei site.

We did not survey when rain or other forms of clutter such as insects obscured potential radar targets (i.e. if >20% of the display screen was obscured for more than 1 min). During these conditions, we stopped surveys until conditions improved. If <10 min of sampling time (excluding the collection of weather data) was conducted between 15 and 45 min after sunset, we canceled the entire sampling session and returned the following day.

"Save Our Shearwaters" Data

The SOS program is a state-run project based at the Kaua'i Humane Society. The ongoing project collects and releases endangered seabirds and other bird species. The SOS program was initiated in 1979; thus, it represents a continuous dataset of 37 yr, with 30,552 fledgling Newell's Shearwaters collected to date. We used this second, independent dataset to assess long-term population trends of Newell's Shearwaters from fledglings collected annually. Adults are less attracted to lights on the coast (Ainley et al. 2001, Duffy 2010), and are only sporadically recovered by SOS. Likewise, too few Hawaiian Petrel fledglings or adults are collected every year to allow for any meaningful trend analysis.

Data Analyses

We conducted all statistical analyses with Excel 2013 (Microsoft, Redmond, Washington, USA) and SPSS Statistics 23 (IBM, Armonk, New York, USA).

For the radar data, we calculated linear regressions on log-transformed data to test for change in mean movement rates by year over the 20-yr period and for each site individually over the entire 20-yr period, and used paired *t*-tests to compare mean movement rates at each site between the first and last years of the study. We conducted linear regression analyses on log-transformed data with and without the Hanalei radar site. We also conducted the linear regression analysis with and without data from 1993, the year after Hurricane Iniki devastated Kaua'i. Day and Cooper (1995) and Day et al. (2003a) suggested that seabird populations may have had unusually high productivity in 1993 following the poor 1992 breeding season caused by the hurricane, potentially resulting in abnormally high numbers that year.

For the SOS data, we calculated linear regressions on log-transformed data to test for changes in the numbers of fledgling Newell's Shearwaters collected by the project every fallout season during 2 periods: (1) 1979 to 1991 (pre-Hurricane Iniki), and (2) 1992–2015 (post-Hurricane Iniki).

We present the slope for site-specific regressions by back-transforming the slope from regression equations. For all tests, we used $\alpha = 0.05$ for statistical significance. Means are presented ± sandard error (SE).

RESULTS

Visual Data

Observers recorded 1,279 birds during visual surveys between May and October of 2012 and 2013. Of these, 114 were identified as Hawaiian Petrels, 678 were Newell's Shearwaters, and 487 were nonseabird targets, including 347 Cattle Egrets (*Bubulcus ibis*), 124 songbirds of various species, and 16 Hawaiian Ducks (*Anas wyvilliana*). Bird movements during session 1 consisted primarily of non-seabird targets, which were the numerically dominant birds in the sky between 15 min before and 20 min after sunset; they composed 95% of all targets during session 1. No Hawaiian Petrels were observed prior to sunset, and only 6% and 14% of all Hawaiian Petrels were recorded by 10 and 15 min after sunset, respectively. No Newell's Shearwaters were observed prior to 20 min after sunset. By 21 min after sunset, all movement was numerically dominated by either Hawaiian Petrels or Newell's Shearwaters (Figure 2). Peak movement of Hawaiian Petrels was centered on the end of civil twilight (23 min after sunset), when the sun is 6° below the horizon, whereas the peak movement of Newell's Shearwaters was centered on nautical twilight (52 min after sunset), when the sun is 12° below the horizon.

We excluded session 1 data from further analysis because it contained mainly nontarget bird species and did not encompass the movement periods of petrel and shearwater targets, apart from the very end of that session, when Hawaiian Petrels began moving. Session 2 constituted the vast majority of Hawaiian Petrel targets and included the peak period of this species' inbound movements (with Newell's Shearwater movements beginning toward the end

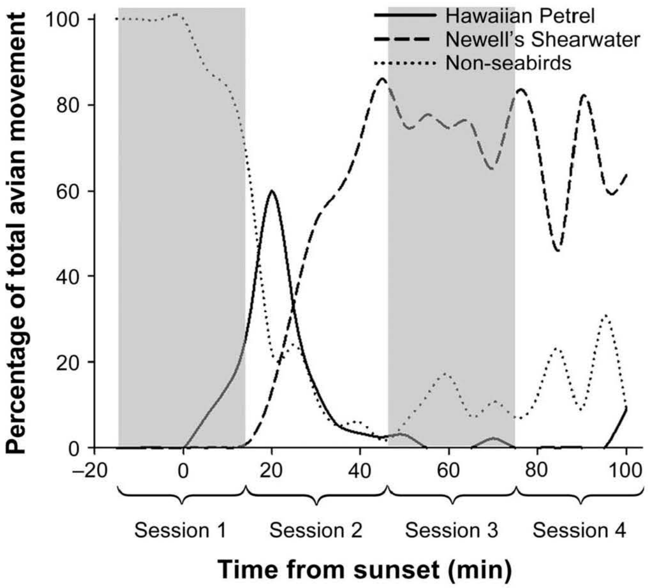

FIGURE 2. Percentages of avian movement by time, based on visual observations, on Kaua'i Island, Hawaii, USA, 2012–2013. Sampling (visual and radar surveys) started 15 min before sunset and ran for 2 hr, divided into 4 consecutive 30-min sampling sessions. Shaded and unshaded areas depict, in order, session 1 (which was excluded from all further analysis because it consisted almost entirely of nontarget species), session 2, session 3, and session 4.

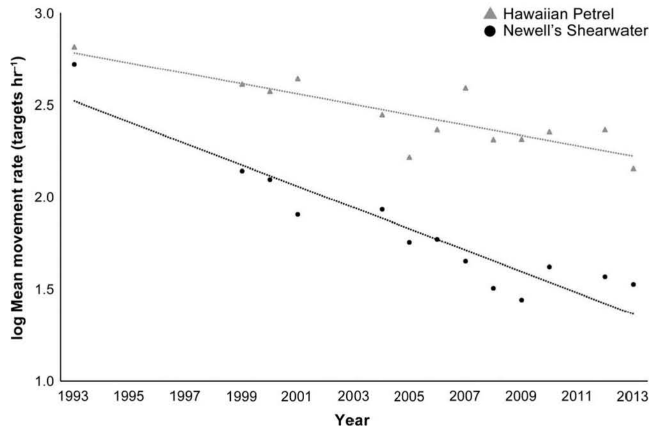

FIGURE 3. Linear regressions of log-transformed mean movement rates (targets hr^{-1} from 13 sites surveyed since 1993) recorded by radar during session 2 (Hawaiian Petrel) and sessions 3 and 4 combined (Newell's Shearwater). See Figure 2 for explanation of sessions.

of the session). Sessions 3 and 4 consisted almost exclusively of Newell's Shearwaters. We used data from session 2 to assess trends in radar detections for Hawaiian Petrels and data from sessions 3 and 4 to assess trends in radar detections for Newell's Shearwaters. Because similar patterns in the timing of movements of both species were recorded on Kaua'i in the 1990s (Day and Cooper 1995), we assume that species-specific timing of movement did not change over the time series.

Radar Trends—Hawaiian Petrel

Movement rates of Hawaiian Petrels in 2013 were highest on the North Shore (Figure 1A). The 3 sites with the highest movement rates in 2013 were Hanalei, Wainiha, and Lumaha'i, all on the North Shore. The 3 sites with the lowest movement rates were 'Ele'ele, Kekaha, and Kalāheo, all on the South Shore. To examine the change in passage rates from 1993 to 2013, we included the 13 sites surveyed over the entire study period (i.e. excluding Lumaha'i and Wainiha, which were not surveyed in 1993). The overall mean movement rate across all 13 sites combined dropped ~78%, from 654 ± 145 targets hr^{-1} in 1993 to 143 ± 36 targets hr^{-1} in 2013. A paired t-test revealed a significant decline for individual sites ($t_{24} = 3.43$, $P < 0.002$).

A linear regression showed a strongly significant decline over the period 1993–2013 ($y = -0.028x + 2.811$, $r^2 = 0.71$, $F_{11} = 26.26$, $P < 0.001$; Figure 3). Back-transforming the slope gave a lambda of 0.938, or an average decline of ~6% per year. The same decline remained significant when Hanalei was removed from the analysis ($F_{11} = 21.14$, $P = 0.001$). Removing 1993 as a potential outlier from the analysis also did not change the relationship ($F_{10} = 12.44$, $P = 0.005$). Eight of 13 (62%) sites showed significant declines across the entire study period (Table 1). Three southern sites (Kalāheo, Waimea, and Kekaha) did not show significant differences in movement rates over the time period, presumably because movement rates at these sites were already low when the surveys began in 1993.

Radar Trends—Newell's Shearwater

As with Hawaiian Petrels, movement rates of Newell's Shearwater in 2013 were highest on the North Shore (Figure 1B). The 3 sites with the highest movement rates in 2013 were Lumaha'i, Wainiha, and Hanalei, all on the North Shore. The 3 sites with the lowest movement rates were 'Ele'ele, Kalāheo, and Kekaha, all on the South Shore. To examine the change in passage rates from 1993 to 2013, we included the 13 sites surveyed over the entire study period (excluding Lumaha'i and Wainiha). The overall mean movement rate across all 13 sites dropped ~94% from 524 ± 207 targets hr^{-1} in 1993 to 34 ± 9 targets hr^{-1} in 2013. A paired t-test revealed a significant decline for individual sites ($t_{24} = 2.37$, $P = 0.03$).

A linear regression on the log-transformed data showed a strongly significant decline over the period 1993–2013 ($y = -0.058x + 2.577$, $r^2 = 0.88$, $F_{11} = 81.64$, $P < 0.001$; Figure 3). Back-transforming the slope gave a lambda of 0.875, or an average decline of ~13% per year. The same decline remained statistically significant when the Hanalei site was removed from the analysis ($F_{11} = 54.30$, $P < 0.001$). Removing 1993 as a potential outlier from the analysis also

TABLE 1. Results of individual site linear regressions of log-transformed radar targets recorded during session 2 (Hawaiian Petrel) and sessions 3 and 4 combined (Newell's Shearwater) on Kaua'i Island, Hawaii, USA, between 1993 and 2013. *ns* = not significant. See Figure 2 for explanation of sessions.

	Hawaiian Petrel			Newell's Shearwater		
Site	Slope	r^2	*P*	Slope	r^2	*P*
Hanalei	0.925	0.72	<0.001	0.833	0.85	0.001
Kalihiwai	0.956	0.62	0.002	0.811	0.68	0.001
Waiakalua Stream	0.889	0.61	0.005	0.822	0.51	0.01
Anahola	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
Keālia	0.926	0.61	0.002	0.870	0.82	<0.001
Kapa'a	0.943	0.61	0.002	0.922	0.43	0.02
Wailua	0.940	0.36	0.03	0.881	0.52	0.008
Kālepa Ridge	*ns*	*ns*	*ns*	0.919	0.59	0.01
Līhu'e Airport	0.953	0.31	0.06	0.896	0.61	0.005
Kalāheo	*ns*	*ns*	*ns*	0.839	0.54	0.01
'Ele'ele	0.917	0.44	0.01	0.855	0.62	0.001
Waimea	*ns*	*ns*	*ns*	0.911	0.35	0.03
Kekaha	*ns*	*ns*	*ns*	0.911	0.64	0.02

indicated a significant negative relationship between 1999 and 2013 ($F_{10} = 48.35$, $P < 0.001$). Twelve of 13 (92%) sites showed statistically significant declines across the entire study period (Table 1).

SOS Fallout Data

A total of 30,552 Newell's Shearwater fledglings was collected by the SOS program between 1979 and 2015. Before Hurricane Iniki in 1992, annual numbers varied between 2,235 and 1,141 (average: 1,511 ± 79), but with no trend ($r^2 = 0.003$, $F_{11} = 2.26$, $P > 0.05$; Figure 4). From 1992 (the year of Hurricane Iniki) to 2015, numbers declined strongly, from 955 to 157 annually ($r^2 = 0.91$, $F_{22} = 250.25$, $P < 0.001$; Figure 4).

DISCUSSION

Long-term monitoring data are critical for making informed decisions about threatened species (Yoccoz et al. 2001), and monitoring should be undertaken over biologically relevant timeframes (Beltran et al. 2014). For long-lived species with low fecundity, like many seabirds, decades of repeated measurements may be required before biological trends become evident. We were able to use 21 yr of radar data and 37 yr of data on fledglings rescued by the SOS program to assess trends in the abundance of 2 endangered seabirds on the island of Kaua'i. Ornithological radar surveys provided insights into the annual numbers of adult Hawaiian Petrels and Newell's Shearwaters flying from the ocean to inland breeding grounds during the peak seasonal period of incubation. Likewise, analysis of trends from the 37-yr dataset of the SOS program highlighted changes in the numbers of fallout-related fledglings of Newell's Shearwaters (i.e. reproductive output). These 2 datasets offered an island-scale view over multiple generations, allowing us to determine population trends and the current conservation status of these 2 species.

Radar data clearly indicated that both seabird species have experienced long-term population declines across the island during the last 21 yr, regardless of whether data from the (possibly) high production year of 1993 were included in the analysis. By stratifying these data into periods that encapsulated nightly movement patterns for each species, we were able to conclude that the decline was not restricted to Newell's Shearwaters but was also occurring in Hawaiian Petrels. For survey session 2, which included most of the Hawaiian Petrel movements recorded during visual surveys, radar sites experienced a 78%

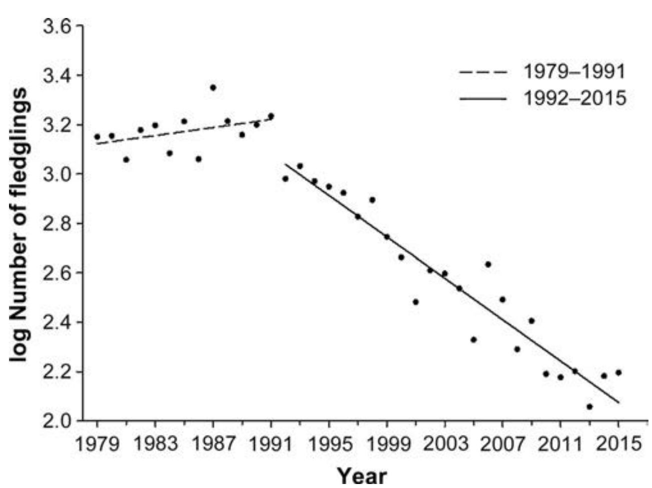

FIGURE 4. Linear regressions showing the annual numbers of fledgling Newell's Shearwaters recovered by the "Save Our Shearwaters" program on Kaua'i Island, Hawaii, USA, before Hurricane Iniki (1979–1991) and from the year of the hurricane onward (1992–2015).

reduction in radar targets between 1993 and 2013. For sessions 3 and 4 combined, which encompassed the movements of most of the Newell's Shearwaters, radar sites experienced a 94% reduction in radar targets over the same period. These patterns were true both for the entire 21-yr period and for 1999 onward (i.e. with the initial, possibly high, production year of 1993 removed). In all instances, radar detections were recorded primarily at radar sites in the western part of northern Kaua'i, particularly in the Wainiha, Lumaha'i, and Hanalei valleys. This part of Kaua'i is known to be the primary remaining stronghold of both species on the island. In contrast, radar sites in the southern parts of the island recorded few targets. Several formerly large colonies in these areas, such as those at Kalāheo and Kaluahonu, have declined dramatically in recent decades and now face localized colony extinction (A. Raine and N. Holmes personal observations).

For the Newell's Shearwater, the markedly steep decline is consistent with earlier published work (i.e. Ainley et al. 1997, 2001, Day et al. 2003b). For the Hawaiian Petrel, however, the results of our analyses differ from those of Day et al. (2003a), who suggested that populations of this species had possibly increased over the period 1993–2001. Our revised results reflect the reanalysis of the early dataset to ensure that the starting times for all radar sessions were standardized relative to sunset. This approach standardized the radar data on a nightly basis, and thus changed the overall time periods encompassed by the radar sessions. As highlighted by our data collected by visual observers, 95% of the session 1 radar data was composed of nontarget birds, and thus data from this session were excluded. Session 2 clearly encapsulated the peak of inbound movements of Hawaiian Petrel targets, and sessions 3 and 4 primarily captured Newell's Shearwater movements. Therefore, we suggest that our reanalysis of the data more accurately reflects Hawaiian Petrel trends through time. That the Hawaiian Petrel population on Kaua'i is suffering a decline comparable with that of the Newell's Shearwater is not surprising. On Kaua'i, this species nests in habitats similar to those used by the Newell's Shearwater and faces the same suite of threats.

The decline in radar-based population counts for both species is dramatic and indicates 2 decades of decline on Kaua'i. The decline in radar-based counts of Newell's Shearwaters is also mirrored in the numbers of fledgling Newell's Shearwaters recovered by the SOS program since its inception in 1979. In the 1980s, the project was processing on average 1,495 fledglings yr ^{1}, with a high of 2,235 fledglings in 1987. That number has declined since then by an order of magnitude, with an average of only 146 fledglings yr ^{1} processed since 2010. The SOS data also suggest that the decline may have commenced in earnest after Hurricane Iniki hit the island in 1992. While it is unlikely that the hurricane itself caused direct mortality of adults, as it struck the island during the day while adults were out at sea, it could have had knock-on effects on these seabird populations. These effects could include increased impacts of introduced predators (by opening up ingress routes into the remote interior), habitat modification (by encouraging the spread of introduced plants into the interior), and powerline collisions (due to infrastructure change, or the removal of considerable vegetation shielding powerlines after large trees were blown over).

It is appropriate to assess whether other factors may be responsible for the apparent trends. For the radar data, methodologies and equipment capabilities have remained constant throughout the time series, radar operators have been trained with the same protocols, and vegetation and topography have remained constant at all but one site (i.e. there have been no significant changes in tree heights that could have added new radar shadows to the sites). Only the Hanalei site changed to some degree, and overall population trends were the same with or without this location. Thus, we do not expect our results to be an artifact of methodology or survey site changes over time.

For the SOS data, an alternative hypothesis is that reduced numbers of Newell's Shearwater fledglings collected over time reflect reduced light pollution threat (i.e. levels of light pollution have decreased over time, thereby decreasing fallout). Although it is true that, in recent years, some private businesses and Kaua'i County itself have decreased light pollution in certain areas through shielding, removed "problem" lights where many birds were grounded, and reduced overall light intensity (particularly during the fledging period), recent analyses of light levels on the island of Kaua'i continue to show high levels of artificial light around coastal areas (Troy et al. 2011, 2013). Hence, there still are very few places on Kaua'i where a fledgling seabird would not be exposed to artificial light as it headed out to sea (Troy et al. 2013). In addition, the correlation of radar as a second independent dataset counters this hypothesis and strongly indicates that the decline of Newell's Shearwater is a real trend.

During our study period, several conservation projects to benefit both species were undertaken, such as control of introduced predators and powerline- and light-minimization projects; however, significant threats still exist. Predator control will reduce predation, but will not eliminate it (Cromarty et al. 2002), and mortality does still occur at seabird colonies receiving this conservation intervention, albeit at a lower rate (Raine and Banfield 2015a, 2015b). Both species are also targeted regularly by introduced Barn Owls, which are frequently seen hunting for seabirds over breeding colonies when the 2 focal species are returning inland to their burrows (A. Raine, N. Holmes, R. Day, and B. Cooper personal observations).

Recent monitoring of powerline collisions in key areas indicates that this remains a critical threat to the species as well, particularly at cross-island powerlines (Ainley et al. 2001, Travers et al. 2016). Therefore, while each of these conservation actions represent an important positive contribution toward the recovery potential of these threatened seabirds, they must be increased in scope, scale, and impact to reverse the declines and allow recovery.

Radar surveys will continue to be an important method for assessing island-wide population trends for both species on Kauaʻi into the future. The inclusion of the Nāpali Coast (which is known to hold large colonies of Newell's Shearwater; A. Raine and N. Holmes personal observations) in future radar surveys would be an important addition to this monitoring program. This area is inaccessible to radar mounted on trucks, but could be surveyed by slinging in a radar unit via helicopter and then mounting it on a tripod. Likewise, the SOS program represents both an important monitoring technique and a conservation tool for rehabilitating and releasing downed fledglings that face a high risk of mortality from predation, being run over by cars, or dehydration and starvation if they are not recovered and released at sea.

Conservation efforts should focus on reducing powerline collisions and light-attraction issues, controlling introduced predators, and creating protected colonies within predator-proof fences, and should focus on the locations with the greatest remaining concentrations of birds in northwestern Kauaʻi. This effort should include the installation of predator-proof fences encompassing colonies in upper montane areas wherever logistically feasible, and the creation of new colonies within predator-proof fences using assisted-colonization techniques, such as social attraction and chick translocation (Miskelly et al. 2009), in more accessible areas, such as the recent Nihoku Ecosystem Restoration Project at Kīlauea National Wildlife Refuge on the northern shore of Kauaʻi. Continued and long-term investment in conservation actions at both montane colonies and lowland translocation sites is critical for the success of these important conservation measures. Finally, refugia free of lights, powerlines, and predators should also be considered via the eradication of introduced predators and assisted colonization techniques at locations such as Lehua Islet and Mokuʻaeʻae Rock Islet, to ensure that a component of the population can persist in areas free of nonnative predators, powerlines, and artificial light sources.

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Research Article

Managing the Effects of Introduced Predators on Hawaiian Endangered Seabirds

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ABSTRACT Introduced predators are one of the greatest threats facing seabirds worldwide. We investigated the effects of multiple introduced predators on 2 endangered seabirds, the Newell's shearwater (*Puffinus newelli*) and the Hawaiian petrel (*Pterodroma sandwichensis*), on the island of Kaua'i, Hawai'i, USA. Between 2011 and 2017, we recorded 309 depredations of which 35.6% were by feral cats, 50.2% by black rats (*Rattus rattus*), 10.4% by pigs (*Sus scrofa*; feral pigs), and 3.9% by barn owls (*Tyto alba*). Cats were the most destructive of the predators because they killed more breeding adults than chicks, which had repercussions on breeding probability in following years. Cats and rats were also the most prevalent of all the predators, depredating birds at all of the sites under consideration regardless of how remote or inaccessible. We also considered the effectiveness of predator control over the study period. Reproductive success at all sites increased once predator control operations were in place and depredations by all species except barn owls decreased. Furthermore, we modeled population trajectories for all sites with and without predator control. Without predator control, population trajectories at all sites declined rapidly over 50 years. With predator control operations in place, populations at all sites increased; thus, controlling introduced predators at endangered seabird colonies is important for their management.

KEY WORDS *Felis catus*, Hawaiian petrel, introduced predators, Kaua'i, Newell's shearwater, *Pterodroma sandwichensis*, *Puffinus newelli*, *Rattus*, seabird.

Introduced predators have been identified as one of the most significant causes for the decline of seabird populations on islands worldwide (Courchamp et al. 2003, Croxall et al. 2012, Doherty et al. 2016, Dias et al. 2019, Rodríguez et al. 2019). Whereas the species vary on an island by island basis, the most destructive and well-known introduced seabird predators are feral cats (*Felis catus*), rats (*Rattus* spp.), and pigs (*Sus scrofa*; feral pigs). Feral cats are considered to be a particularly destructive introduced predator in the Pacific (Hess and Banko 2006, Hess et al. 2009, Duffy and Capece 2012) and have a clearly identified effect on seabird populations worldwide (Imber et al. 1994, Johnston et al. 2003, Bonnaud et al. 2012) and indirect effects that include spreading fatal diseases such as toxoplasmosis (*Toxoplasmosis gondii*; Medina et al. 2014). Examples of the effect of rats include direct depredation of seabird eggs (Jones et al. 2005), chicks (Thibault 1995, Igual et al. 2006, Caut et al. 2008), and in smaller species, even adults (Moors and Atkinson 1984, Bertram 1995, Martin et al. 2000). Lastly feral pigs have been identified as the primary predator responsible for the near extinction of multiple seabird species including the Bermuda cahow (*Pterodroma cahow*; Carlile et al. 2012, Madeiros et al. 2012) and the rapid decline of others (Harris 1970, Cuthbert et al. 2001, Cuthbert and Davis 2002).

Cats, rats, and pigs are the main introduced predators threatening seabird populations on the Hawaiian Islands, but several other mammalian species have been identified as being significant threats. These include the small Indian mongoose (*Herpestes javanicus*; Munro 1941, Harrison 1990, Hays and Conant 2007) and feral or domestic dogs (Byrd and Telfer 1979, Byrd et al. 1985, Towns et al. 2011). Ironically, it was because of a hunting dog depredation incident that the breeding grounds of the Newell's shearwater (*Puffinus newelli*) were rediscovered on Kaua'i, Hawai'i, USA, in 1967 (Sincock and Swedberg 1969). Lastly, the barn owl (*Tyto alba*) is the only non-native avian predator present in the Hawaiian Islands. Introduced to Kaua'i by the Hawaiian Department of Agriculture in the 1960s to control rats (Tomich 1962, Au and Swedberg 1966), it has become a serious threat to seabird species across the Hawaiian island chain (Byrd and Telfer 1980, Raine et al. 2019).

Recent historical population trends show a 94% population decline for Newell's shearwater and a 78% decline for Hawaiian petrel (*Pterodroma sandwichensis*) on Kaua'i between 1993 and 2013 (Raine et al. 2017) and their range

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has contracted across the Hawaiian Islands. The reason for these declines are particularly because of collisions with powerlines (Cooper and Day 1998, Podolsky et al. 1998, Ainley et al. 2001, Raine et al. 2017, Travers et al. 2019), the attraction of fledglings to artificial lights (Reed et al. 1985, Telfer et al. 1987, Ainley et al. 1997, Cooper and Day 1998), and habitat modification within breeding colonies due to invasive plants and pigs (Duffy 2010, VanZandt et al. 2014). This combination of factors has led to the Hawaiian petrel being globally listed under the International Union for Conservation of Nature Red List as vulnerable (BirdLife International 2019*a*) and the Newell's shearwater being listed as endangered (BirdLife International 2019*b*).

To assess the effect of introduced predators on these species, we considered data from 7 years of seabird monitoring at 6 remote seabird management sites in the northwest sector of the island of Kauaʻi. We evaluated the key predators affecting the species, quantified the long-term effect to the colonies by introduced predators, and considered the effectiveness of predator control operations within the colonies.

STUDY AREA

We collected data between 2011 and 2017 at 6 endangered seabird colonies on the island of Kauaʻi, the northern-most island within the Main Hawaiian Islands. Sites included the Upper Limahuli Preserve (a 153-ha fully protected conservation area owned by the National Tropical Botanical Gardens) and 5 sites in Hono O Nā Pali Natural Area Reserve (NAR; a large 1,448-ha conservation area owned by the State of Hawaii): Pihea, Pōhākea, North Bog, Hanakāpīʻai, and Hanakoa (Fig. 1). All were located within the northwestern portion of Kauaʻi, at an elevation of between 500 m and 1,300 m above sea level. All sites consisted of intact wet montane forest, criss-crossed with deep drainages, narrow ridgelines, and steep valley walls, and were dominated by native species such as 'Ohi'a (*Metrosideros polymorpha*), lapalapa (*Cheirodendron platyphyllum*), and tree ferns (*Cibotium* spp.) in the canopy and large patches of uluhe fern (*Dicranopteris linearis*) in the understory. The climate was tropical, with an average annual precipitation of 263–398 cm. Mean July temperature across the 6 sites was 18°C, and mean January temperature was 14.9°C.

All sites had ongoing seabird monitoring projects coupled with active management, consisting primarily of predator control operations, which varied in terms of date when control started and techniques used. Upper Limahuli Preserve was protected by an ungulate-proof fence (and was thus free of feral pigs) and had predator control operations

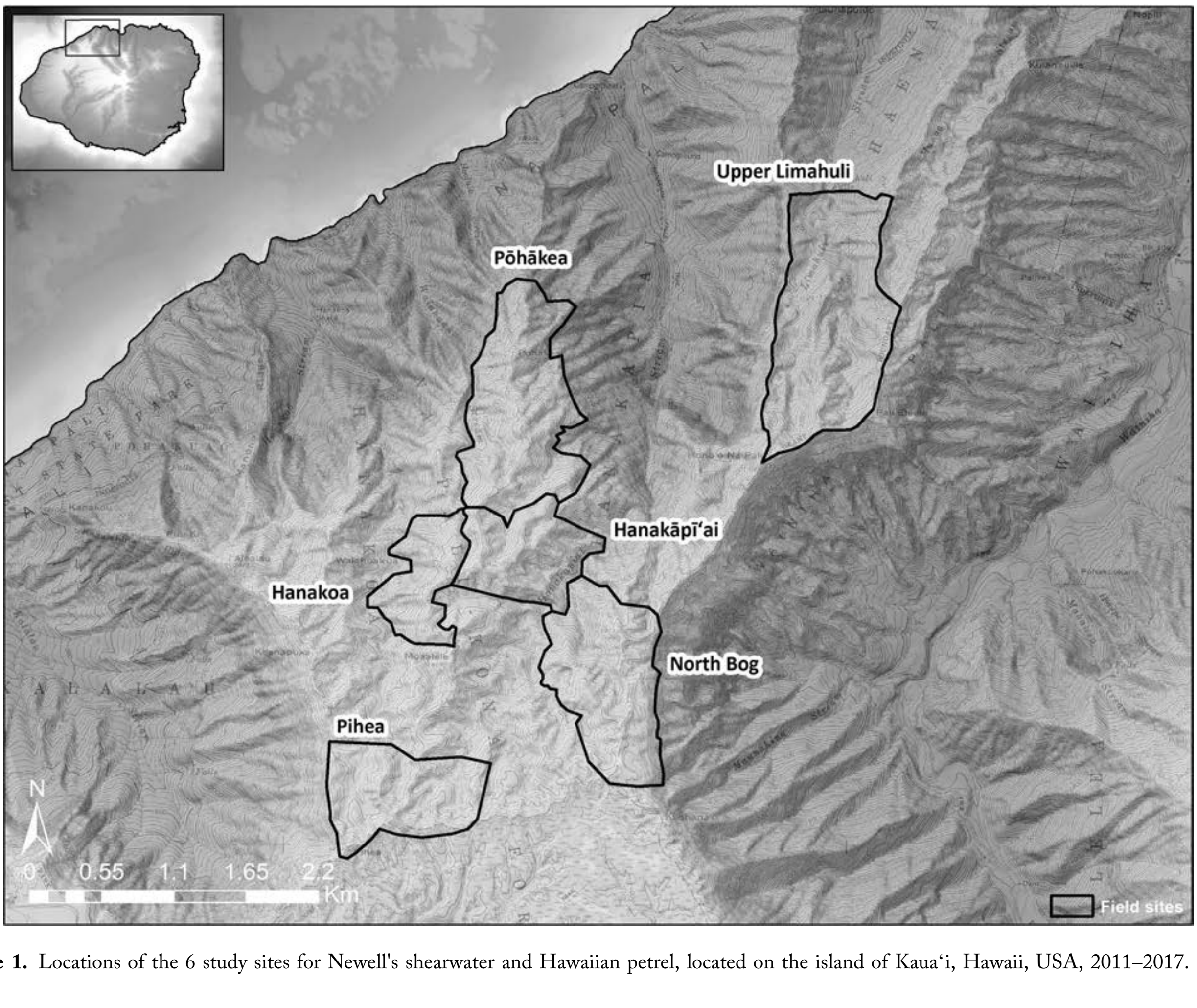

Figure 1. Locations of the 6 study sites for Newell's shearwater and Hawaiian petrel, located on the island of Kauaʻi, Hawaii, USA, 2011–2017.

in place since 2011, with the project increasing in scope, staff time, and available trapping techniques each year to the present day (2019). The 5 sites in Hono O Nā Pali NAR were protected on 1 side by a large ungulate-proof fence that separated the NAR from the adjacent Alakaʻi Swamp and more recently installed wing fences that cut off all other access routes to pigs, but as of 2019 the area is not entirely free of pigs (although active pig control, through the use of snares and hunts, has been ongoing since 2013). Predator control operations began at 3 of the NAR sites (Pihea, Pōhākea, and North Bog) in 2012, whereas at Hanakāpīʻai and Hanakoa predator control began in mid-2016.

METHODS

Throughout this study we acted in accordance with the guidelines for the ethical use of wild birds in research as outlined by the North American Ornithological Council (Fair et al. 2010). All work was conducted under State Migratory Bird Master Permit (MB673451-0) and Section 6 Co-operative Agreement between the United States Fish and Wildlife Service and the State of Hawaii Division of Land and Natural Resources.

Burrow and Camera Monitoring

All sites have been part of a long-term seabird monitoring project, with Upper Limahuli starting in 2011, Pihea, North Bog, and Pōhākea in 2012, and Hanakāpīʻai and Hanakoa in 2015. We undertook colony monitoring trips nearly monthly throughout the breeding season from March to December, with site access either by foot (Pihea) or helicopter (Upper Limahuli, North Bog, Pōhākea, Hanakāpīʻai, Hanakoa).

We searched each site for active seabird burrows throughout the study period. We marked all burrows located within each colony with a unique identification tag (colored and numbered cattle ear tags) and recorded their locations using a handheld global positioning system (GPS; Garmin Rino 650, Olathe, KS, USA). We identified each burrow to species wherever possible, although in some cases where burrows were too convoluted to see the bird, we recorded the species as unidentified procellariid because it could have been either Newell's shearwater or Hawaiian petrel. During burrow checks, we inspected each burrow to assess breeding status. For deep burrows where direct visual inspection was not possible, we used a handheld camera (Panasonic LUMIX, Olympus Tough TG-3 or TG-4, Olympus America Inc, Center Valley, PA, USA) in an attempt to take photos into the back of the burrow to assess burrow contents.

At each check, we made notes on any signs of activity within or around the nest. This included the presence of adult, egg, or chick; scent, signs of digging, or trampling; or presence of feathers, guano, or egg shell. We calculated reproductive success annually for each site by dividing the number of burrows where a chick successfully fledged by the number of burrows where we confirmed breeding. This represented a subset of burrows because breeding did not occur at some burrows (i.e., inactive burrows, prospectors) and could not be confirmed at others because of the depth of the burrow or inconclusive sign.

We also recorded any signs of depredation such as a dead adult or chick in front of burrow or inside burrow, chewed feathers, egg shells, or the presence of scats or prints that indicated that a predator had been in the vicinity of the nest. In instances where we located a seabird carcass, we photographed it, and removed it for further inspection. Wherever possible, we identified the predator involved in the depredation event to species based on the disposition of the carcass, injuries sustained, portions of the carcass consumed, and other field characteristics. We attributed depredations to feral cats if there were large chunks eaten out of the body of the carcass, the back of the head was consumed, and if feathers were strewn about the depredation area. We identified rat depredations if there were gnaw marks on eggs, if small chicks were dragged out of burrows but only partially consumed (differentiating them from cats, which would eat small chicks whole), or if chicks were killed inside the burrow but not dragged out. We identified instances as barn owl depredations if the carcass was lying on its back with the keel stripped neatly of flesh, and if the head was entirely missing, or if the carcass was lying on the top of vegetation. Lastly, we identified events as pig depredations if the burrow was dug up, or if we found carcasses with multiple bones broken and severe trauma caused to the carcass in general. We also recorded incidences of depredation (or signs of introduced predators) away from known nesting burrows when we observed them during trips to each area, with locations logged using a handheld GPS. We reported all depredation events immediately to predator control teams to help direct predator control activities.

We monitored a subset of ≥30 burrows at each colony using cameras (Reconyx Hyperfire PC900s, Hyperfire HP2X and/or Reconyx Ultrafire XP9s, Holmen, WI, USA), with the number deployed at each site based on availability of camera units. We mounted cameras on poles located 1–1.5 m away from the burrow entrance, with the camera pointed directly at the burrow mouth to catch all activity (seabird and predator) at the burrow mouth. We set cameras on a rapid-fire setting (motion sensor activated, with a trigger speed of 0.2 seconds in the latest models). We switched out memory cards each month and reviewed images to look for seabird and predator activity. Data collected on predators included date, time, species, predator activity (passed burrow, investigated burrow, entered burrow), and depredation events.

Predator Control Techniques

Predator control operations at the project sites increased in scope, intensity, trap hours, and available techniques each year throughout the study. Most sites (apart from Hanakāpīʻai and Hanakoa) had some level of predator control in the first year of monitoring, although these operations were greatly limited. For the purposes of the comparisons carried out in this study, we considered the results of the first year of seabird monitoring at each site as being typical of a seabird colony on Kauaʻi where no or extremely limited predator control operations were occurring (i.e., yr zero), and the results of the last year as being typical of areas with high-level predator control operations (i.e., yr 2017). The techniques outlined below were all used in high-level predator control operations on Kauaʻi in 2017.

We used walk-in live-capture traps (Tomahawk Live Trap, Hazelhurst, WI, USA) at all sites and checked and rebaited traps every 1–2 days. We typically set traps on or near a trail with the base of the trap covered with leaves and dirt to simulate the trail surface. We camouflaged traps with leaves, sticks, and ferns or left them uncovered. We used 76-cm and 91-cm live-cage traps with both single and double door designs. Double door traps were primarily unbaited, and set in trails (blind set). Single door traps were baited with a variety of baits including scent and food-based lures. Cats were the primary target of the larger traps (the mesh size allowed rodents to escape), whereas the smaller traps targeted cats and rodents (but may have been less appealing to larger cats).

Body-grip traps (Belisle Trap, Belisle Pieges, Canada) are spring-driven lethal traps targeted at cats, although they are also capable of capturing rats. We set body-grip traps with bait or as blind sets and used them only in certain areas deemed to be seabird safe (i.e., it was unlikely that a seabird would be present on the ground in the area). We disabled body-grip traps during certain times of year to avoid harm to seabirds. We used body-grip traps at all sites, primarily 220 or 280 size.

Goodnature® A24 traps (goodnature, Sonoma, CA, USA) are a proprietary, self-resetting, lethal rodent trap (targeted at black rat [*Rattus rattus*], Polynesian rat [*R. exulans*], brown rat [*R. norvegicus*], and house mouse [*Mus musculus*]) and are powered by carbon dioxide cartridges. We set A24s preferably at the base of a tree approximately 10 cm off the ground but also used a wooden stake if no suitable trees were present. These traps can be triggered up to 24 times before needing a new carbon dioxide cartridge, although at all sites, we typically refreshed bait before the carbon dioxide cartridge was empty. We set A24s in grids around key seabird areas with supplemental trapping near burrows. We used different baits over the years, but in the most recent year all traps had the auto-lure pumps installed using the chocolate bait formula.

Snap traps included Victor® Easy Set® Rat Traps (BM205, Woodstream Corporation, Lancaster, PA, USA) soaked in linseed oil to weatherproof the wood, and Ka Mate Medium Snap Traps (MT01, Ka Mate Traps, Nelson, New Zealand). We added snap traps to trapping stations to provide supplemental rodent control. We deployed snap traps only inside seabird-safe enclosures built in-house out of fluted polypropylene plastic boxes or hardware cloth cages. We baited snap traps with a variety of pastes and solid baits.

Population Trend Modeling

We evaluated the effectiveness of predator control operations within the 6 sites using 2 population simulation models (with and without predator control) through the program Vortex 10 (Lacy et al. 2005). Model inputs used a combination of biological variables already known for the 2 seabird species through data collected by the Kauaʻi Endangered Seabird Recovery Project (KESRP) if available and, when these were not available, biological variables from previously published works on Newell's shearwater and Hawaiian petrel, or biological variables from closely related procellariid species (predominantly Manx shearwater [*Puffinus puffinus*] and short-tailed shearwater [*Puffinus tenuirostris*]). Although the 2 study species differed in terms of certain aspects of their breeding ecology, we combined Newell's shearwater and Hawaiian petrel; thus, model outputs relate to the 2 endangered seabirds as a single unit for the purposes of modeling. We considered this to be a reasonable approach for assessing the large-scale effects of predator management within our study sites because the species-specific inputs into the model were very similar and the 2 species breed close to each other within the study area; thus, the effects of introduced predators were likely to be similar.

In the population model, we considered the reproductive system to be long-term monogamous in which males and females had an age of first reproduction equal to 6. We assumed this was the earliest age both species would return to breed and successfully fledge a chick based on previously published works on Hawaiian petrel (Simons 1984) and Newell's shearwater (Ainley et al. 2001). We selected a maximum lifespan of 36 years, which represents the maximum age observed among similar shearwater species (Bradley et al. 1989) and this age also represented the maximum age of reproduction in both sexes. We set the maximum number of broods per year and the maximum number of progeny per brood to 1. We set the default sex ratio to 1:1 because there are no data to suggest a sex bias in the population.

When calculating reproductive rate, we considered all monitored burrows across all sites where there was >1 year of data and followed them annually after the first confirmed breeding attempt to assess the likelihood that breeding was attempted in the following year. We determined that 98.6% of the time established breeders initiated breeding in the following year (i.e., most birds never skipped a year). The only time breeding was not attempted in the following year in our data set was if 1 of the pair was known to have been depredated, which was assessed by the presence of a depredation event outside or inside the burrow. To account for this, we assumed that if 1 of the pair disappeared (through predation or old age), then breeding was not attempted in the following year. We thus adjusted the reproductive rate by multiplying 98.6% by the annual survival rate (92.4%, see below) minus the site-specific percentage of adults predated each year after the predation scenario took effect. For the predator control management scenario, this resulted in a final annual site-specific reproductive rate of 88.8–91.1% and for the no predator control scenario a reproductive rate of 83.9–91.1%. This is similar to the 89% described for Hawaiian petrels by Simons (1984).

We set survival to breeding age at 25.0% based on data obtained from a satellite tracking project on Newell's shearwater fledglings (KESRP, unpublished data). This low juvenile survival is similar to that calculated previously for Hawaiian petrel (Simons 1984) and that published for other seabirds (Hudson 1985, Mougin et al. 2000). We applied an adult annual survival rate of 92.4% after reaching breeding age based on the average of adult survival rates presented in a number of studies undertaken on Manx shearwater (Harris 1966, Perrins et al. 1973, Brooke 1977) and Hawaiian petrel (Simons 1984, 1985). Site fidelity among seabirds is typically high (Warham 1980; e.g., Manx shearwater [Harris 1966, 1972; Perrins et al. 1973], streaked shearwater [*Calonectris leucomelas*; Sugawa et al. 2014]). The juveniles of some shearwater species, however, do appear to exhibit a degree of emigration to new breeding colonies (e.g., short-tailed shearwater [Serventy and Curry 1984]) and there may even be a degree of difference between sexes (Ristow et al. 1990, Thibault 1993). To take into account this interspecies variation, we used a site fidelity of 90% to account for returning juveniles in our model. Initial population sizes at each site were based on current breeding population estimates for both species combined (Raine et al. 2018) to get the total number of breeding adults in each colony and then using 0.637 as the proportion of the population that was of breeding age (Ainley et al. 2001) to get the number of non-breeders at each site.

Using the above variables, we used population simulation models to consider the effectiveness of predator control by considering 2 scenarios: population trajectories at each site without predator control using depredation rates recorded at each site prior to the implementation of fully functioning predator control operations (yr 1 of monitoring) and population trajectories at each site with a fully functioning predator control project in place using depredation rates in the most recent year of monitoring (yr 2017). For both scenarios, we assessed depredation as harvest to isolate its effect on seabird populations from general mortality. We calculated rates as 2 types: rates of depredation at breeding age (adults) and rates of depredation prior to breeding age (egg or chick depredations).

Finally, to account for the fact that cats continue to appear with regularity at predator control sites (because there are currently no predator-proof fences in any of these areas) and occasionally kill birds before being caught, we also added a CATastrophe element to the model for both scenarios. In this event, cats killed birds at 15% of all burrows at the site. This is the highest level of cat depredation ever recorded over the last 3 years across the 4 longest term management sites. Of these depredations, 62.7% involved the depredation of an adult and 37.3% of a chick (see Results). For modeling purposes for sites with predator control, we set the interval of a CATastrophe at 12 years (because this occurred at 1 of 4 sites in a 3-yr period, as outlined above), whereas for sites without predator control we set the interval for this event at 3 years (because this event occurred at the Pōhākea site once over a 3-yr period). We set the interval as more frequent for sites without predator control because cats are recorded at all management sites every year, and if there is no predator control, a CATastrophe is much more likely to occur in any given year.

Aside from differing rates of depredation (harvest) and different starting populations at each site, all other model inputs were identical. We ran each simulation for 500 iterations over 50 years. We omitted inputs related to genetics, state variables, density dependence, and population supplementation to focus attention solely on the effects of introduced predators. Likewise, because the point of the exercise was to isolate the effects of predator control, we did not attempt to model the effects of other threats to the species, which are significant and include powerline collisions (considered to be the biggest cause of mortality of endangered seabirds on Kaua'i; Raine et al. 2017, Travers et al. 2019) and light attraction. Thus the results of the models should be considered as an assessment of the effect of predator control only.

RESULTS

By the end of 2017, we monitored 1,071 seabird burrows annually across the 6 colonies, consisting of 160 Newell's shearwater, 588 Hawaiian petrel, and 323 unidentified procellariid burrows. We confirmed 309 endangered seabirds as killed by introduced predators over the 7-year study period, consisting of 57 Newell's shearwaters, 208 Hawaiian petrels, and 44 unidentified procellariids. Of the 309 depredations, 110 (35.6%) were by cats, 155 (50.2%) by black rats, 32 by pigs (10.4%), and 12 (3.9%) by barn owl.

Predators targeted different age classes of seabirds (Fig. 2). Cats depredated adults (62.7%) and chicks (37.3%), black rats depredated chicks (79.4%) and eggs (20.6%), barn owls depredated only adults (100.0%), and pigs destroyed entire burrows, eating adults (68.6%), chicks (3.1%), and eggs (28.1%). The level of depredation caused by different predator species also varied between sites. At Pihea, Pōhākea, and Hanakoa, cats caused the most depredations (59.1%, 50.0%, and 48.8%, respectively), whereas at Hanakāpī'ai and North Bog black rats were the most prevalent predators (82.6% and 73.5%, respectively). Only cats and black rats caused depredations at all 6 sites, whereas pigs and barn owls each caused depredations at 66.6% of sites.

Of the 309 depredations, 159 occurred at burrows where we monitored the burrow in the year immediately after the depredation occurred; thus, we could assess subsequent breeding activity. In the case of burrows depredated by black rats, the majority were active in the year following depredation (chick depredated: 93.5%, egg depredated: 94.7%) and the majority had breeding attempts (chick depredated: 88.3%, egg depredated: 84.2%). In the case of burrows depredated by cats, 93.8% were active and 87.5% had breeding attempts the following year if the chick was depredated, but only 58.8% were active and 35.3% had breeding attempts if an adult was depredated. Only 14.3% of burrows destroyed by pigs were active in the following year and in only 1 of these was there a breeding attempt (7.1%).

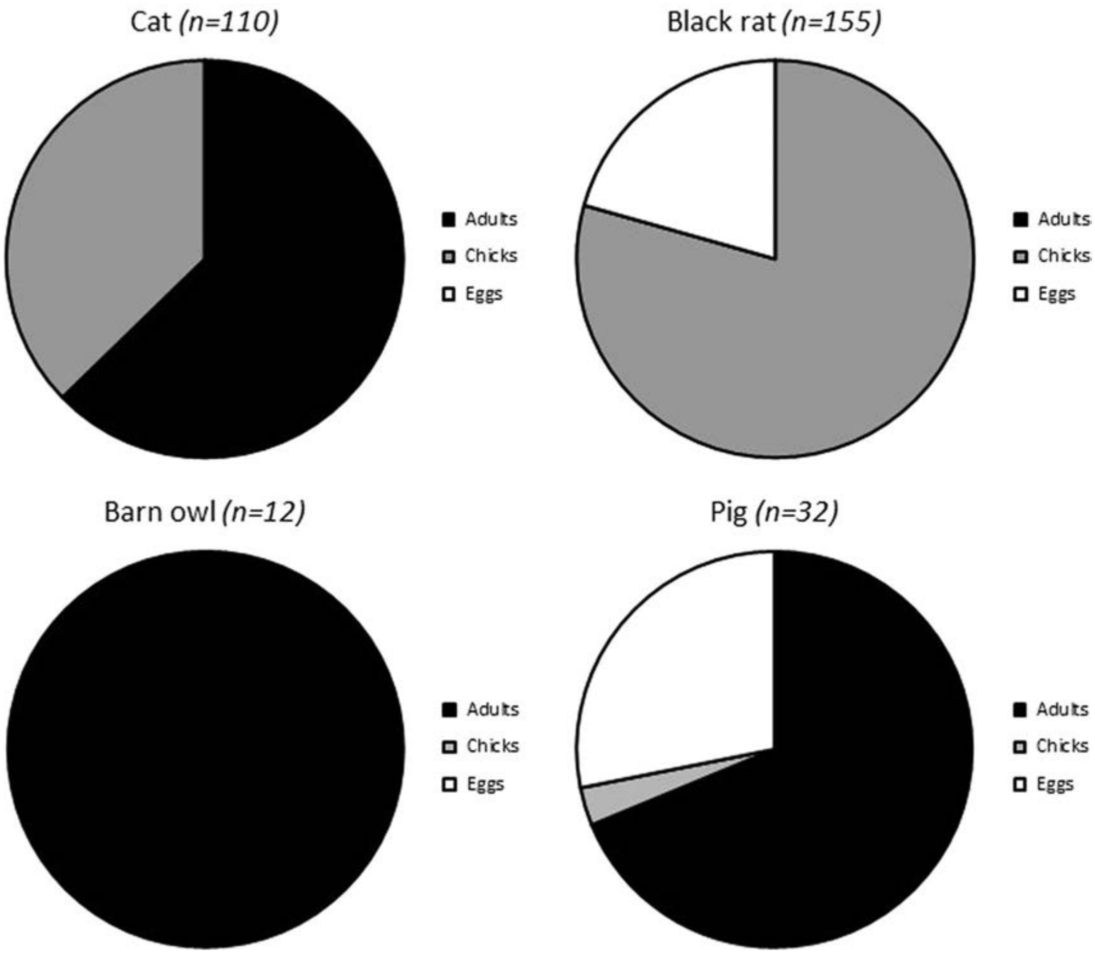

Figure 2. Age classes of Newell's shearwater and Hawaiian petrel (both species combined) targeted by different introduced predators at 6 monitored colonies on Kaua'i, Hawaii, USA, 2011–2017.

Effectiveness of Predator Control

Depredated seabirds were found at all 6 study sites on the very first visit to the area, indicating that introduced predators were present at all sites prior to human visitation and the initiation of management and monitoring activities. To consider the overall effectiveness of predator control, we compared the percentage change in reproductive success rate at monitored burrows at each site in the first year of monitoring (yr zero) with the most recent year when predator control operations were most refined (yr 2017). Reproductive success rate increased at all sites by a mean of 48.5% (range = 22.5–100.0%) for Hawaiian petrel and 35.8% (28.8% and 42.9%, respectively, for the 2 sites with monitored burrows of this species) for Newell's shearwater. We also compared the percentage of burrows depredated by each of the predator species between year zero and year 2017. The percentage of burrows depredated in 2017 was significantly lower than in year zero for cats (percent change; −68.1%, $\chi_1^2 = 5.03$, $P = 0.025$), black rats (percent change; −86.2%, $\chi_1^2 = 23.21$, $P \leq 0.001$), and pigs (percent change; −100.0%, $\chi_1^2 = 15.09$, $P \leq 0.001$; Fig. 3). We considered barn owls separately because we recorded very few depredations directly at a burrow and the majority were of kills found on trails or on top of vegetation. The number of barn owl kills ($n = 8$) was highest in 2017 when compared with all other years of monitoring (range = 0–1), although this could not be tested statistically due to the small sample size.

Population modeling indicated if colonies did not receive predator control, population trends for all sites showed a rapid decline (Fig. 4; stochastic r, $\bar{x} = -0.039$, min. = −0.027, max. = −0.059). If colonies received predator control at the current 2017 level, all populations increased over the 50-year period (Fig. 5; stochastic r, $\bar{x} = 0.050$, min. = 0.002, max. = 0.015).

DISCUSSION

Introduced predators are a serious conservation challenge for seabird species around the world, and Kaua'i is no exception. We recorded depredations of endangered seabirds at all of the study sites on the very first visit to the site before the advent of trails, or any human activity. For example, the first expedition to the Pihea site in 2012 recorded 5 freshly killed adult Hawaiian petrels, all depredated by cats. The first expedition to Hanakāpī'ai recorded multiple depredations of both seabird species by 3 different predators: black rats, cats, and pigs. Therefore, it is clear that the threat of introduced predators is widespread throughout even the

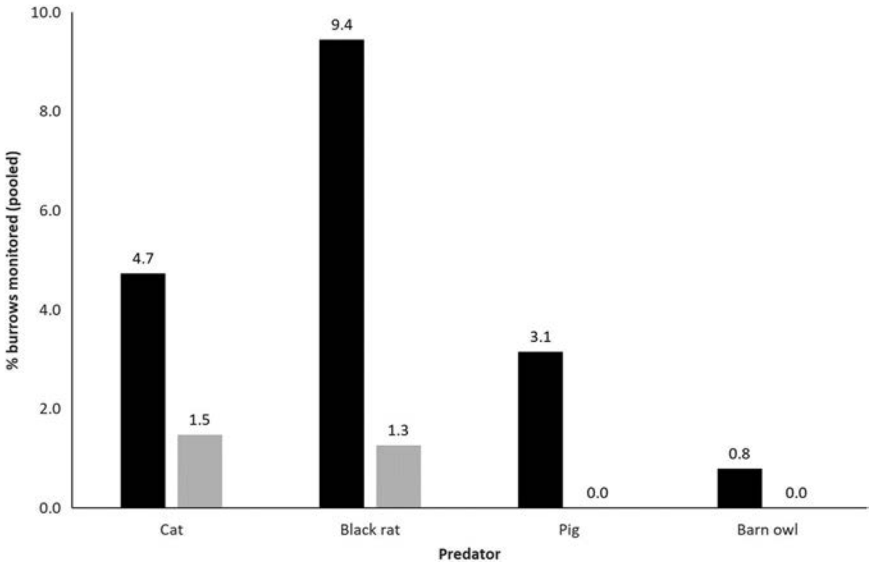

Figure 3. Percentage of Newell's shearwater and Hawaiian petrel burrows monitored (pooled across sites) that were depredated by each introduced predator species on Kaua'i, Hawaii, USA, 2011–2017 in the first year of monitoring at each site (black bars) and the most recent year of monitoring (2017, gray bars).

most remote seabird colony, regardless of site accessibility and location.

Predator control operations are critical to preventing the loss of seabird colonies on Kaua'i and these operations are an integral facet of seabird management on the island. The effectiveness of these predator control operations within managed colonies was evident; at all sites, reproductive success increased significantly from the year of first monitoring to the most recent year, whereas depredations decreased (apart from barn owl). Population modeling also demonstrated the importance of predator control. Without predator control, all colonies declined. Conversely, populations increased over time with predator control. As these modeled projections show, leaving colonies without management invariably led to population declines towards extinction.

The most destructive of the introduced predators were cats. Cats caused depredations at all sites and were

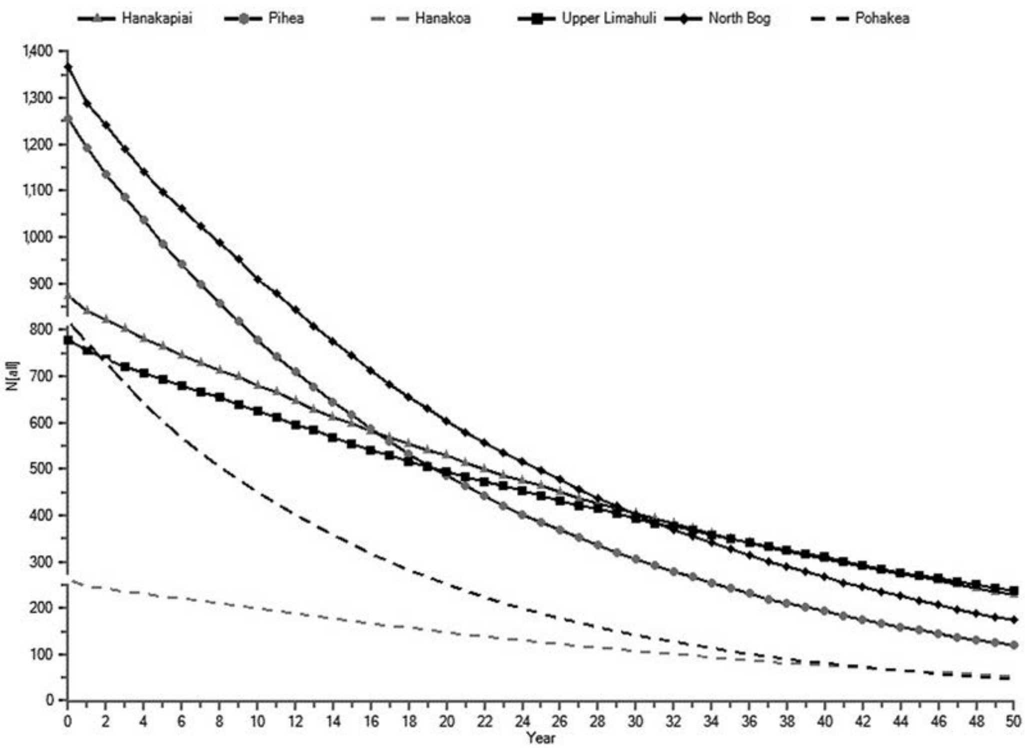

Figure 4. Population growth rates (N[all]; Newell's shearwater and Hawaiian petrel combined) as projected by the program Vortex at all colonies on Kaua'i, Hawaii, USA, if no predator control was undertaken (i.e., based on predation rates the first year predator control began). Models should be viewed as the response of the colonies to predators only.

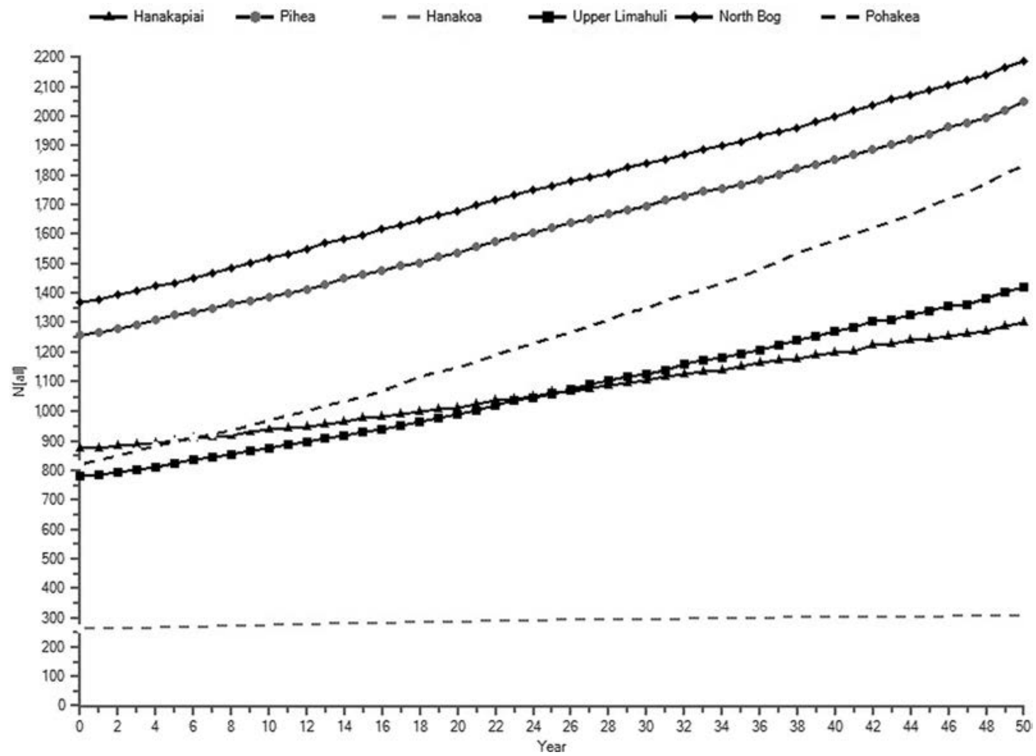

Figure 5. Population growth rates (N[all]; Newell's shearwater and Hawaiian petrel combined) as projected by the program Vortex at all colonies on Kaua'i, Hawaii, USA, if predator control continued at the existing 2017 level. Models should be viewed as the response of the colonies to predator control only.

responsible for 35.6% of all recorded depredations. Cats targeted breeding adults more than other age classes, which highlights the damage this species can do on endangered seabird populations. As can be seen in the modeling inputs of this and other studies (Simons 1984), breeding adults contribute more to population trends than any other cohort. Burrows where adults were depredated were much less likely to be active in the following year, and even less likely to initiate breeding. Because none of the managed colonies are currently protected by a predator-proof fence, cats continue to be recorded at every colony every year and notably begin to appear on burrow and trail cameras within seabird colonies just as the seabird season begins.

Predation by cats is exacerbated by their large home range (Fitzgerald and Karl 1986, Smucker et al. 2000, Edwards et al. 2001, Bengsen et al. 2012) meaning a single individual can affect multiple colonies and a single cat can easily depredate a large number of birds in a very short period of time (Borroto-Paez and Perez 2018). In 1 instance at Upper Limahuli in 2014, we identified the same cat on 9 different seabird burrow cameras over the course of a single day and the cat killed a Newell's shearwater chick at 1 of them. In another instance in Pōhākea in 2015, a cat killed birds at 15% of all monitored burrows over a couple of weeks; this same cat subsequently raised a litter of kittens in 1 of the Newell's shearwater burrows where it had killed both adults, and we saw the cat on camera later in the season bringing its kittens to other active burrows to hunt birds. Cats have been identified as a key predator of other native bird species, including forest birds such as the endangered Palila (*Loxioides bailleui*; Laut et al. 2003) and waterbirds such as the Hawaiian moorhen (*Gallinula galeata sandvicensis*), Hawaiian duck (*Anas wyvilliana*), nēnē (*Branta sandvicensis*), and Hawaiian coot (*Fulica alai*; Baker et al. 2019). Cat control is an effective conservation tool for seabirds in other parts of the world (Cooper et al. 1994, Nogales et al. 2004, Bellingham et al. 2010, Rauzon et al. 2011).

In terms of numbers, black rats resulted in the highest number of depredations and were also recorded at all 6 sites. Black rats always targeted chicks or eggs. Unlike burrows where the adults were depredated by cats, burrows where there was a depredation by black rats were normally active the following year and the pairs in these burrows attempted to breed in the following year. Black rats are a known predator of seabirds and other bird species throughout the world and are a common target of rat eradication projects (Thibault 1995, Martin et al. 2000, Towns and Broome 2003, Jones et al. 2008, Jones and Kress 2012).

Although feral pig depredations were not as common as those of cats and black rats, when they did occur they were devastating. Pig depredations typically involved the destruction of the entire burrow, which the pigs excavated to access whatever was inside. Once the burrow was excavated, the pigs ate adults, chicks, or eggs and burrows were rarely active again. In the rare cases where adults returned to breed in pig-destroyed burrows, adults and chicks became more vulnerable to future depredation because they had lost structural integrity (and thus protection) of the burrow.

Lastly, barn owls represent a particularly difficult threat to address because they are not dissuaded by fences or traditional predator control operations and can have large home ranges, meaning they can target multiple colonies. Although the number of depredations by this species were comparatively low, they were the 1 predator for which depredations increased over the study period. Depredations by this species are also hard to locate because they are generally not found near burrows (meaning they are probably under-represented in the data set). We hypothesize 2 main reasons for this. Barn owls could be targeting birds in mid-air on their way back to their burrows and forcing them toward the ground where they are presumably easier to kill (we observed this behavior on several occasions on Kaua'i and Lāna'i) or targeting non-breeding birds. Barn owl depredations of adults are rarely associated with burrows and it is possible that many depredations could involve non-breeding birds, which, while attempting to attract mates, may inadvertently draw attention to themselves from owls through vocalizations and conspicuous ground activity.

This study has demonstrated the serious effects of introduced predators on endangered seabirds on Kaua'i and the importance of predator control in alleviating these effects. In addition to the predator control techniques used in this study, other management techniques are important to consider. Ideally, the most important seabird colonies should also be fenced. Installation of ungulate-proof fences are important to protect native seabirds and entire watersheds. Strategically protecting key colonies with predator-proof fences can be even more effective. Other management tools, such as the use of landscape-level toxicants (including diphacinone and brodificaum for rats [Towns and Broome 2003, Keitt et al. 2015] and paraaminopropiophenone [PAPP] for cats [Campbell et al. 2011, Johnston et al. 2011, Eason et al. 2014]) should also be carefully considered. Combined with a predator-proof fence, large-scale eradication efforts can bring longer-lasting predator reduction results, although their use may not be appropriate in all circumstances. Lastly, biosecurity at ports and docks should be considered as a first line of defense for predator control throughout the Hawaiian islands to prevent the introduction of new predators to the islands or the spread of existing predators such as the small Indian mongoose to mongoose-free islands like Kaua'i.

MANAGEMENT IMPLICATIONS

Intensive predator control projects are vital and effective in seabird breeding colonies, and can rapidly improve the population trajectories of seabirds breeding at these sites. Conversely, stopping or reducing predator control can have serious consequences for the colonies, causing rapid declines towards extirpation. Predator control operations need to be constant throughout the year, need to have sufficient funding to maintain them annually into the future, and need to have access to all effective predator control techniques. They also need to be coupled with a solid seabird monitoring strategy to ensure that management actions are effective. Furthermore, each introduced predator represents its own set of challenges and has its own population-level effects on seabird populations. Therefore, predator control operations need to be specifically designed to target each introduced predator species within the colony and require an individually tailored management response. With well-planned predator control and seabird monitoring operations in place within critical seabird colonies, endangered seabird populations on Hawai'i can persist and increase into the future.

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Post-release survival of fallout Newell's shearwater fledglings from a rescue and rehabilitation program on Kaua'i, Hawai'i

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ABSTRACT: Light attraction impacts nocturnally active fledgling seabirds worldwide and is a particularly acute problem on Kaua'i (the northern-most island in the main Hawaiian Island archipelago) for the Critically Endangered Newell's shearwater *Puffinus newelli*. The Save Our Shearwaters (SOS) program was created in 1979 to address this issue and to date has recovered and released to sea more than 30 500 fledglings. Although the value of the program for animal welfare is clear, as birds cannot simply be left to die, no evaluation exists to inform post-release survival. We used satellite transmitters to track 38 fledglings released by SOS and compared their survival rates (assessed by tag transmission duration) to those of 12 chicks that fledged naturally from the mountains of Kaua'i. Wild fledglings transmitted longer than SOS birds, and SOS birds with longer rehabilitation periods transmitted for a shorter duration than birds released immediately or rehabilitated for only 1 d. Although transmitter durations from grounded fledglings were shorter (indicating impacts to survivorship), some SOS birds did survive and dispersed out to sea. All surviving birds (wild and SOS) traveled more than 2000 km to the southwest of Kaua'i, where they concentrated mostly in the North Pacific Equatorial Countercurrent Province, revealing a large-scale annual post-breeding aggregation zone for fledgling Newell's shearwaters. While there was reduced survival among birds undergoing rehabilitation, SOS remains an important contribution toward the conservation of Newell's shearwater because a proportion of released birds do indeed survive. However, light attraction, the root cause of fallout, remains a serious unresolved issue on Kaua'i.

KEY WORDS: Rehabilitation · Survival · Shearwater · Tracking · Light attraction

1. INTRODUCTION

Light attraction is a well-known threat to seabirds, particularly for fledglings, and has been shown to affect more than 50 burrow-nesting petrel species worldwide (Rodríguez et al. 2017b, 2019). The impact of light attraction can lead to the grounding of large numbers of fledglings on their first flight out to sea from their burrows (known as 'fallout'), with examples including Manx shearwater *Puffinus puffinus* in Scotland (Syposz et al. 2018), Atlantic puffin *Fratercula arctica* in Canada (Wilhelm et al. 2013), multiple species in the Canary Islands (Rodríguez & Rodríguez 2009), short-tailed shearwaters *Ardenna tenuirostris* in Australia (Rodríguez et al. 2014), and multiple species on Reunion Island (Le Corre et al. 2002, 2003).

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Fledgling mortality from fallout can occur for a number of reasons, including injuries sustained from colliding with human infrastructure, depredation by cats and dogs, being struck by cars, or succumbing to dehydration and starvation (Rodríguez et al. 2012). The grounding phenomenon has led to the establishment of multiple rescue programs designed to recover, rehabilitate, and release grounded birds to the sea. These programs usually rely on citizen involvement and often involve significant public participation and community outreach (Rodríguez et al. 2017c).

On the island of Kauaʻi, in the Hawaiian Archipelago, 2 endangered seabird species — Newell's shearwater *Puffinus newelli* and Hawaiian petrel *Pterodroma sandwichensis* — are vulnerable to light attraction. Historically, fallout of Newell's shearwater fledglings on Kauaʻi was extremely high, with thousands of birds grounded each year throughout the 1980s and 1990s (Reed et al. 1985, Telfer et al. 1987, Raine et al. 2017). Both species also face numerous other conservation threats throughout the main Hawaiian Islands, including high levels of mortality due to powerline collisions (Cooper & Day 1998, Podolsky et al. 1998, Ainley et al. 2001, Travers et al. 2017) and the impacts of introduced predators such as cats, rats, barn owls *Tyto alba*, and pigs (Simons 1985, Raine et al. 2019, 2020). Cumulative impacts on land together with suspected threats at sea have led to the Hawaiian petrel being globally listed by the IUCN as Endangered (BirdLife International 2018) and Newell's shearwater being listed as Critically Endangered (BirdLife International 2019). Furthermore, both species are known to be in sharp decline on Kauaʻi, with recent historical population trends showing a 94% decline for Newell's shearwaters and a 78% decline for Hawaiian petrels between 1993 and 2013 (Raine et al. 2017).

To address the issue of light attraction and subsequent fallout, the State of Hawaiʻi Division of Land and Natural Resources created the Save Our Shearwaters (SOS) program in 1979. The SOS program is one of the longest-running seabird rescue programs in the world and relies heavily on public participation, with residents encouraged to pick up downed seabirds and place them in aid stations located around the island. During the fallout season (late September to mid-December), aid stations are checked every morning by SOS staff. SOS personnel examine all fledglings at the aid stations and then either release them that day or take them to the care facility for rehabilitation and subsequent release. Between 1979 and 2019, SOS processed more than 31 812 Newell's shearwaters (of which 30 552 [96%] were fledglings).

One key knowledge gap for SOS is post-release survival. Although the value of SOS for animal welfare is clear (i.e. grounded birds cannot simply be left to die after anthropogenic grounding), rehabilitation efficacy has not been evaluated. Recovered and released birds may have reduced survival rates due to a greater likelihood that they were compromised by factors including undetected injuries, decreased health parameters (weight, hydration), or secondary complications (e.g. exposure to disease, or compromised waterproofing) (Rodríguez et al. 2017c). Despite such compromising factors, we expected that at least a proportion of the birds recovered by the SOS program would survive and thus contribute to the overall population of the species. Through time, SOS has also improved its evaluation, treatment, release criteria, and captive care protocols to increase the chances of post-release survival for seabirds released by the program. Understanding post-release survival was identified as a critical research element for SOS, particularly due to the importance of the program in 2 Kauaʻi-specific Habitat Conservation Plans currently in preparation. To date, the only information on post-release survival was from band recoveries, of which there have been very few. From 1979–2017, only 24 adult and sub-adult recoveries among birds banded by SOS in previous years were documented (mostly dead birds killed by collisions with powerlines). Ainley et al. (1995) reported only 1 banded SOS bird from 39 burrows monitored at the Kalaheo colony in 1992 and 1993, despite the Kalaheo area being a fallout hotspot. Similarly, of 235 Newell's shearwater burrows currently monitored by the Kauaʻi Endangered Seabird Recovery Project (https://kauaiseabirdproject.org/; KESRP) on Kauaʻi, only 1 bird rehabilitated from the SOS program has ever been found (KESRP unpubl. data). This low band recovery rate has led to questions being raised as to whether birds recovered, rehabilitated, and released by SOS survive.

We recognize that band recoveries are insufficient for assessing the efficacy of Newell's shearwater rehabilitation. Shearwaters are especially philopatric and typically recruit to their natal colonies (Harris 1966, Perrins et al. 1973, Warham 1980). Band returns likely are rare because few colonies are actively monitored at the individual burrow level (and thus efforts to relocate SOS-banded birds are limited). Also, most monitored colonies are located in the north-west of Kauaʻi, where fledglings are presumably less likely to be affected by fallout because there are fewer sources of artificial light (although it is possible that birds can be attracted to light sources anywhere on Kauaʻi; see Troy et al. 2011, 2013). Furthermore, bird banding and handling in colonies is not a primary objective, and most band recoveries are from mortalities collected opportunistically under powerlines. Powerline mortalities are rarely detected due to terrain, dense vegetation, and the fact that most birds hitting powerlines do not drop immediately under the lines themselves (Podolsky et al. 1998, Travers et al. 2017).

In this study, we evaluated post-release survival of Newell's shearwaters by using satellite transmitters to track the transmission duration and movements at sea among fledglings recovered and released by SOS compared with birds that fledged directly from their burrows, presumably without incident. The principal objectives were to assess whether SOS birds survived after release and to consider any differences between apparent survival rates of birds from these 2 study groups.

2. MATERIALS AND METHODS

2.1 Morphometrics and tag attachment

Between 2014 and 2018, we tagged and evaluated transmission duration among 50 fledgling and 4 breeding adult Newell's shearwaters. Tags attached to fledglings were split between 38 birds collected by the SOS program and 12 birds captured by hand at burrows located in the Upper Limahuli Preserve (ULP, Fig. 1). ULP (153 ha) is located in north-western Kaua'i and is owned and managed in perpetuity as a

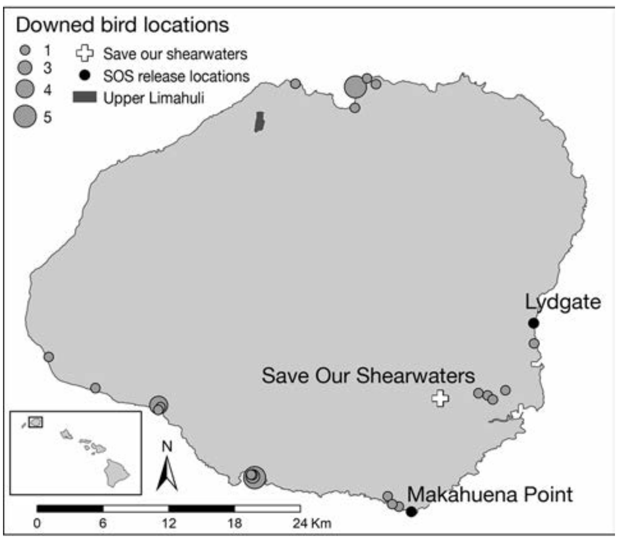

Fig. 1. Island of Kaua'i, Hawai'i, showing location of Upper Limahuli Preserve, Save Our Shearwaters Program (SOS) building location, 2 SOS release locations (Lydgate and Makahuena Point), and all downed bird (fallout) locations (where known) for birds used in this study

Conservation Area by the National Tropical Botanical Gardens (Kaua'i, Hawai'i). The site holds the largest monitored colony of Newell's shearwaters in the world and is actively managed to protect the species and co-occurring Endangered Hawaiian petrels. The site is also located in a relatively dark portion of the island, with limited artificial lighting and powerlines on the adjacent coast; therefore, birds from this colony are considered less susceptible to light-induced fallout and powerline collisions. We weighed all study birds (±1.0 g) and collected morphometric measurements (wing chord, tarsus, head–bill length, bill width at proximal end of nares, and bill depth at proximal end of nares, all ±1.0 mm). All birds handled were banded with a stainless steel band (Bird Banding Lab band size 4 or 4A, depending on tarsus width).

After measuring and banding, birds were held by experienced seabird handlers and their heads were covered by a lightweight cloth to shield them from light and keep them calm during tag attachment. We attached modified satellite transmitters (Microwave Technology; BirdSolar PTT 100, 9.5 g transmitters [hereafter, tags]). Tags were potted to withstand hydrostatic pressure expected during occasional dives that can reach depths >50 m (T. Joyce unpubl. data) and further modified with the addition of 4 copper suture tubes, resulting in a tag weight of 11–12 g. The modified tags were the lightest, depth-resistant units available and were 2.2–3.4% of shearwater body mass (depending on the bird tagged), below the maximum recommended mass of 5% for devices attached to procellariid seabirds (Phillips et al. 2003). The tag profile (~2.5 cm^2) represented approximately 3% of the frontal area of a Newell's shearwater. We acknowledge that the increase in cross-sectional area would, to some degree, have affected the hydrodynamics of the tagged birds. Ropert-Coudert et al. (2007) found that tag placement (3.4% of frontal area) on little penguins *Eudyptula minor* had little effect on diving performance compared with effects of tag size. Yet, from a hydrodynamic perspective, modeling results on seals have shown that tag position can cause variation in drag by up to 11% and that tag shape is also important (Kay et al. 2019). Shearwaters rely on long-distance flights, but also spend appreciable time foraging underwater. For shearwaters, tag placement presents complex trade-offs regarding drag, weight burden, and balance (see also Vandenabeele et al. 2012, 2014). In anticipation of potentially long-distance flights, we preferred to attach the tags consistent with the bird's center of mass (Fig. 2) to minimize interference with flight, balance, and behavior (Healy et al. 2004, Vandenabeele et al. 2014).

Fig. 2. Newell's shearwater in a rehabilitation pool at the Save Our Shearwaters facility, showing satellite tag placement

Most tags were programmed to transmit continuously every 60 s, but 14 tags in 2016 were delivered by the supplier with a pre-programmed, default 'on-off' duty cycle where tags cycled on for 10 h and off for 48 h. We employed the same technique in all 4 years, with tags attached by the same individual (A.F.R.) in all years except in year 1 when tags were attached by A.F.R. and J.A. We used a suture-tape-glue attachment technique following Newman et al. (1999) and modified by J.A. for petrels and shearwaters (MacLeod et al. 2008, Adams et al. 2012, Jodice et al. 2015). Specifically, several feathers on the central, dorsal surface between the scapulae were lifted and 1 strip (0.5 × 2.0 cm) of waterproof tape (Tesa® 4651) was inserted adhesive-side-up and wrapped over on itself to secure several feathers. The tape served to mark the location where the center of the tag would sit and also provided a non-feather surface to glue (Loctite® 421) the tag to the tape for added stability. We used 4 sterile surgical sutures (2-0 Prolene monofilament, non-absorbable sutures, Ethicon) to attach the transmitter to the skin. For each suture, the skin below the tag's custom suture tubes was pinched using the thumb and forefinger, a sterile 21 gauge × 3.8 cm hypodermic needle was inserted through the pinched skin, and the suture was then threaded through the needle. When the needle was removed, the suture was retained under a 17 mm wide section of skin (equivalent to the width of the base of the tag). The sutures were then threaded back through the tubes at the base of the tag and secured snug to the skin and feathers with 4 surgical square knots. Care was taken to ensure that each suture was snug to minimize risk to the bird for entanglement.

2.2. SOS treatment groups

We classified fledglings that passed through the SOS program according to 3 levels of rehabilitation: same-day release (no rehabilitation, N = 17 birds), 1-day rehabilitation (N = 10), and ≥2-day rehabilitation (N = 11). Same-day release birds were not transported to the SOS facility but instead were released by SOS staff after inspection (see details below) at 1 of 2 release sites after their morning work recovering downed birds. Number of fledglings tagged in each year (2014 = 12, 2016 = 12, 2017 = 19, 2018 = 7) varied because of funding constraints, the small number of tags available in any given year, and the uncertainty that additional funding would be available to deploy tags in each following year of the study. Therefore, while we were not able to allocate tags equally to each treatment group in any given year, during the 4 yr period we allocated tags to maintain appropriate replication overall among the 3 SOS treatment groups.

We selected fledglings from the 3 SOS treatment groups for tagging if they met standard release requirements outlined in the SOS Operations Manual (Anderson 2019). Selected birds had to be free from apparent injuries, in good body condition (at least a 2 ('Normal – indicates a well fleshed bird') on a 3-point scale, quantifying amount of muscle covering the keel), display normal mentation, pass a 'flap test' (where the body of the bird is held gently and firmly with both hands with the wings free, the bird is allowed to flap, while strength and symmetry are assessed), and individuals had to have non-damaged/non-contaminated plumage. If birds spent time in rehabilitation, they had to be confirmed to be waterproof after spending time in conditioning pools. Birds also had to be able to consistently maintain their temperature above 100°F (~37.78°C) and below 106°F (~41.11°C) when housed on cold water for 8–10 h) and have blood values (packed cell volume, total protein, and glucose) within the normal range for the species (Work 1996, Anderson 2019). We did not tag birds determined to be 'marginal' (i.e. severely compromised due to injuries or heavily damaged feathers) because we assumed additional stress of adding tags might increase variability or potentially bias tracking duration. Therefore, the results of this study apply specifically to birds that met the standard release requirements set out by SOS and do not entirely represent the population of released birds because a small proportion of birds released by SOS each year (0–2, M. Bache pers. comm.) were considered 'marginal'. After handling and tag attachment, we introduced tagged birds to the SOS rehabilitation pool to assess attachments, monitor behavior, and ensure that birds were waterproof. Based on weather and prevailing wind, we released all tagged fledglings according to SOS release protocols at 2 standard SOS release sites: Makahuena Point (south shore of Kaua'i) and Lydgate Beach (east shore of Kaua'i) (Fig. 1).

2.3. ULP wild fledglings

We tagged 12 fledglings (6 in 2016, 1 in 2017, and 5 in 2018) in ULP using the same attachment method outlined above. Similar to the SOS group, the number of fledglings tagged in each year varied because of funding constraints and the small number of tags available in any given year. Chicks were tagged in mid-October as close to estimated fledging as possible (Newell's shearwaters on Kaua'i typically fledge from late September to mid-November, with a peak in mid-October; Ainley et al. 2019). To prevent the tags from snagging on the burrow entrance, we chose fledglings from wide-mouthed burrows and attached tags as near to fledging as possible to reduce the amount of time individuals were likely to spend in the burrow with their tag. We did not use mass and general condition to select individuals for tagging and assumed individuals represented natural fledgling body condition during 2016–2018. Because it is extremely unlikely that any fledglings banded or tagged would ever be re-sighted again to assess survival, we also tagged 4 individual adult breeding birds from 4 different known burrows in ULP in 2016 and 2018 (2 birds in each year) to evaluate potential tag effects and assist us with interpretation of survival among fledglings by comparing tag duration and tag sensor patterns of the adults (described in Section 2.3). These burrows associated with the tagged adults were part of an established monitoring program and had been followed annually for at least 2 yr prior to this study and throughout the study itself. We re-captured these site-faithful birds during subsequent breeding seasons to evaluate their condition and verify band numbers to confirm tag attachments had failed and tags were indeed lost at sea.

2.4. Assessing fate of tagged birds

For this study, we assessed survival rate through the duration of tag transmission, because it was not possible to determine the actual fate of each bird at sea. Therefore, as a proxy for survival, we compared tag transmission duration (days at sea) between wild birds and SOS birds, and among the 3 SOS rehabilitation groups. Furthermore, the tags had an activity sensor in the form of a tilt switch orientated horizontally within the base of the tag. As the bird tilted back and forth during flight, the sensor increased in increments from 1 to 255 then re-set to 1 again. If the bird was not moving for extended periods of time (i.e. if it was floating on the water), the sensor maintained a constant integer that, when graphed versus time, appeared as a flat line or as an incremental series of flat lines. For all tags programmed to transmit continuously (excluding 2016, see Section 2.1), we evaluated tilt switch integers graphically to assess the behavior of the bird before the tag stopped transmitting. If the integers continued to increment through time consistent with the pattern observed throughout the tag's deployment, we considered this indicative of the tag falling off during normal movement behavior. If incrementation slowed down (e.g. we observed a stair-step pattern indicating periods with constant integer values through time) or ceased (e.g. we observed a prolonged flatline of constant integer value) preceding the loss of tag transmission, we considered this to be a period of inactivity, with the terminal flatline pattern in particular more likely indicating a moribund condition preceding presumed mortality.

2.5. Statistical analyses

Throughout the study, a total of 15969 post-filtered location fixes were recorded for all fledglings combined. Unfiltered locations were initially processed by Argos Kalman filtering (Lopez & Malarde 2014), and locations of class Z were omitted. Remaining location fixes were further filtered using the Douglas Argos Filter (Douglas et al. 2012), through the Movebank website (www.movebank.org, Kranstauber et al. 2011), using the MAXREDUN threshold of 15 km. All mapping and spatial analyses related to tracking data and the generation of movement metrics used ArcGIS 10.3.1 (ESRI) or R statistical programming language version 3.6.0. Metrics generated for each bird included maximum straight-line distance reached from Kaua'i (km), total distance traveled (km), final latitude, final longitude, and mean speed (m s^{-1}). Distances were calculated using the 'distHaversine' function in the R package 'geosphere' (Hijmans 2017), and speed was calculated for each tracking point as the distance from the previous point divided by the interval between timestamps. Because several birds crossed the 180th meridian, the final longitude for these birds was rescaled by adding 180 minus the observed degrees east longitude (as an integer) to 180. All statistical analyses were performed using SPSS version 26 (IBM) or R version 3.6.0. We chose non-parametric tests instead of comparable parametric tests to account for certain statistical assumptions (i.e. normality of residuals and homogeneity of variance) and unequal sampling across groups and years. Comparisons were made between rehabilitation groups across years and between years within groups (Kruskal-Wallis test), between groups with all years pooled (Mann-Whitney *U*-test), and transmission duration between groups using chi-squared tests. A p-value of <0.05 was considered significant, and p-values were adjusted for multiple comparisons using the Benjamini-Hochberg false discovery rate method (Benjamini & Hochberg 1995); post hoc comparisons (where applicable) were carried out using the Dunn test for multiple comparisons.

2.6. Ethics statement

We conducted this study according to the guidelines for the ethical use of wild birds in research outlined by the North American Ornithological Council (Fair et al. 2010). All work was conducted under State Migratory Bird Master Permit (MB673451-0) and Section 6 Co-operative Agreement between the US Fish and Wildlife Service and the State of Hawaiʻi Division of Land and Natural Resources. All tag attachment and banding work for this project was authorized by the USGS Bird Banding Lab Permit DOFAW Master Permit 08487-I with an Experimental Authorization.

3. RESULTS

In total, we tagged 12 wild fledglings, 4 breeding adults, and 38 fledglings recovered by the SOS program (17 same-day release birds, 10 one-day rehabilitation, and 11 ≥2-day rehabilitation birds). Among SOS fledglings that spent more than 1 d in rehabilitation, the average stay at the facility was 5.3 d (range = 2–14 d). One bird in the ≥2-day group was originally released by SOS (banded but not tagged) and subsequently found back on land after 2 d. This individual was rehabilitated for 2 more days, after which it was tagged, released, and included in this study. Of 38 SOS birds tagged, 35 flew and headed directly out to sea immediately after release. Two of the remaining 3 (all from 2014) were blown over the edge of the release site and landed in the water after a very short glide. Neither was seen flying after landing in the water and both were last observed swimming out to sea. The third bird, released at Lydgate Beach, initially flew strongly out to sea, but was attacked by a great frigatebird *Fregata minor.* After a series of attacks, the shearwater landed in an area of high surf, and was not seen regaining flight. However, all 3 birds were subsequently recorded transmitting on the day after their release, indicating that all 38 (100%) survived immediate release and were free-ranging at sea. All 12 ULP birds fledged and subsequently transmitted at sea, indicating that all (100%) survived immediate (24 h) post-fledging and were free-ranging at sea.

3.1. Post-release and post-fledging dispersal

All fledglings (from all groups and all 4 years) traveled toward a region of the central Pacific, southwest of the Hawaiian Islands (bounded by 5° S–10° N, 164° E–162° W, Fig. 3). This area is influenced by the Inter-Tropical Convergence Zone (approximately 5°–15° N) and the frontal zone that separates the westward-flowing North Equatorial Current from the eastward-flowing North Equatorial Counter Current (i.e. Pacific Equatorial Divergence and extending into the Pacific Warm Pool ecological provinces; Longhurst 2010). A large core area (761 000 km^2; 20% fixed kernel density contour at 9 km with a 250 km smoothing factor/search radius) of concentration for all locations determined after 14 d at sea was centered over the western half of the North Pacific Equatorial Countercurrent Province (Fig. 3). We compared movement metrics between wild fledglings (all years combined) with all SOS birds (all treatment groups and years pooled; Table 1). There was no significant difference between wild and SOS fledglings (SOS treatment groups pooled) for straight-line distance (Mann-Whitney *U*-test, U = 207.00, p > 0.05). Similarly, there was no significant difference between wild vs. SOS fledglings for total distance traveled (U = 200.00, p > 0.05), final latitude (U = 284.00, p > 0.05), final longitude (U = 244, p > 0.05), or mean flight speed (U = 224.00, p > 0.05). For SOS birds, we also considered differences among the 3 SOS treatment groups for movement metrics. Although there were no significant differences among the 3 SOS treatment groups for maximum straight-line distance (Kruskal Wallis test, χ^2 = 3.936, df = 2, p > 0.05), final longitude (χ^2 =

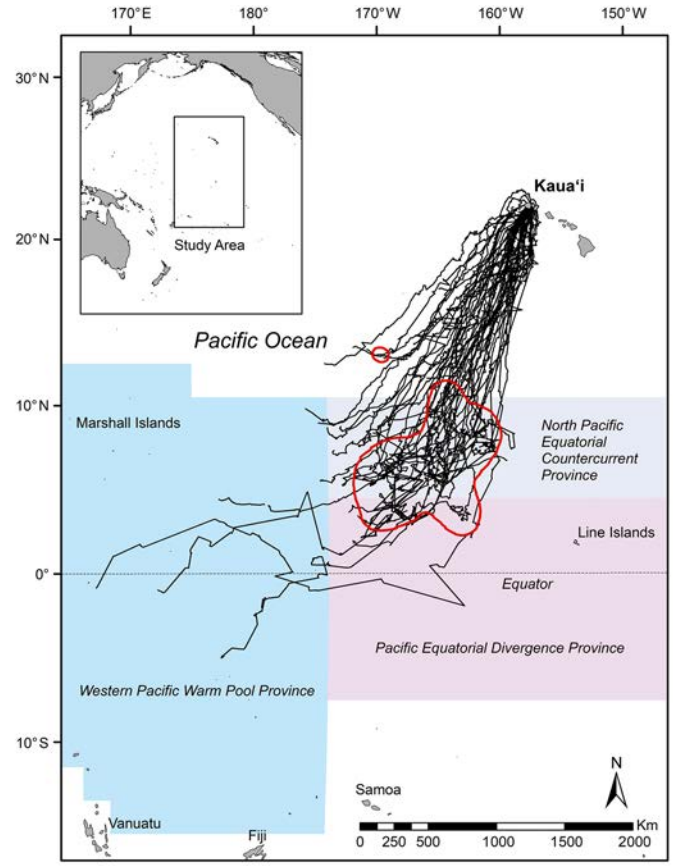

Fig. 3. Overview of tracks for all 50 Newell's shearwater fledglings tracked during this study (all years combined) and superimposed over 3 discrete oceanographic provinces (i.e. Longhurst Provinces) described by Longhurst (2010). Red line indicates 20% fixed kernel density contour at 9 km with a 250 km smoothing factor/search radius) of concentration for all locations determined after 14 d at sea. Inset shows study area within the greater central-western Pacific Ocean

0.86, df = 2, p > 0.05), or mean speed traveled (χ^2 = 0.30, df = 2, p > 0.05), the total distance traveled was significantly less for birds in the ≥2-day rehabilitation group than for birds in the 1-day rehabilitation group (χ^2 = 7.74, df = 2, p = 0.021; Dunn test, Z = 2.78, p = 0.016). Birds in the ≥2-day rehabilitation group also stopped transmitting at significantly more northern latitudes than same-day release birds (χ^2 = 6.43, df = 2, p = 0.040; Z = 2.42, p = 0.047).

3.2. Tag transmission duration

For all tagged fledglings, we evaluated tag duration between wild fledglings and SOS fledglings (all SOS treatment groups pooled). Wild fledglings transmitted for significantly longer than SOS birds (wild: 33.7 ± 8.6 d, SOS: 20.6 ± 1.9 d; Mann-Whitney U-test, U = 138.5, p < 0.05). Furthermore, while there was no significant difference between the number of wild birds and SOS birds (pooled) still transmitting on Day 7 and on Day 14, significantly more wild birds were still transmitting after 21 d than SOS fledglings (chi-squared test, χ^2 = 8.9, df = 2, p = 0.01). We then compared wild fledglings to birds in each of the SOS treatment groups (Table 2). Wild fledglings (ULP) had significantly longer average transmission duration than any other fledgling group, whereas birds in the SOS ≥2-day group had the shortest average transmission duration (Kruskal Wallis test, χ^2 = 10.5, df = 3, p < 0.05) (Fig. 4).

We also evaluated groups according to the proportion of tags still transmitting after 7, 14, and 21 d (Fig. 5). After 21 d, 28.9% of SOS birds (29.4% same-day release, 50.0% 1-day rehabilitation, and 9.1% ≥2-day rehabilitation) and 50.0% of wild fledglings were still transmitting. There were disproportionally more birds in the wild group transmitting after 21d and disproportionally fewer birds in the ≥2-day group transmitting after 14 and 21 d than expected (chi-squared test, χ^2 = 28.6, df = 6, p <0.001). For the 4 adult birds tagged in 2016 and 2018, average transmission duration was 82.3 d (min = 71 d, max = 100 d). All 4 were observed at their burrows apparently unharmed in the following year without their tags. We evaluated activity sensor patterns for all birds with pre-programmed con-

Table 1. Summary statistics for movement metrics calculated for Newell's shearwaters: wild fledglings (all years combined) and Save Our Shearwaters (SOS) rehabilitated fledglings (all treatment groups and years pooled)

Measurement	Group	n	Mean	Min	Max
Maximum straight-line distance (km)	SOS	38	2057	169	4395
	Wild	12	2425	1469	4019
Total distance traveled (km)	SOS	38	3149	317	6932
	Wild	12	3860	1691	8501
Final latitude (degrees)	SOS	38	8.25	−0.84	21.38
	Wild	12	5.40	−4.99	11.66
Final longitude (degrees)	SOS	38	−170.8	−192.50[a]	−160.90
	Wild	12	−172.9	−188.06	−163.32
Mean speed (m s^{-1})	SOS	38	3.81	1.35	7.30
	Wild	12	3.97	2.13	6.49

[a]Rescaled by adding 180 minus the observed degrees east longitude (as an integer) to 180

Table 2. Tag durations for Newell's shearwater treatment groups

Treatment group	n	Average ±SE	Range transmission (d)
Same-day release	17	22.6 ± 3.8	3–71
1 d rehabilitation	10	22.7 ± 2.3	12–36
≥2 d rehabilitation	11	15.6 ± 1.1	7–22
Wild fledgling	12	33.8 ± 8.6	12–111
Wild adult	4	82.3 ± 6.8	71–100

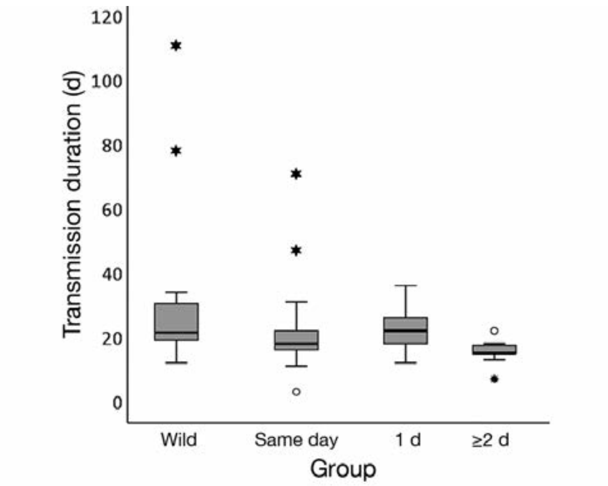

Fig. 4. Median tag duration (with first and third quartiles) of the 3 Save Our Shearwaters (SOS) rehabilitated fledgling groups and the wild fledglings tagged during this study. Whiskers are the maximum and minimum values, with outliers provided as circles and extremes as asterisks. Tag durations were significantly different, with wild fledglings having the longest transmission duration and birds in the SOS ≥2-day group the shortest (Kruskal Wallis test, $\chi^2 = 10.5$, df = 3, $p < 0.05$)

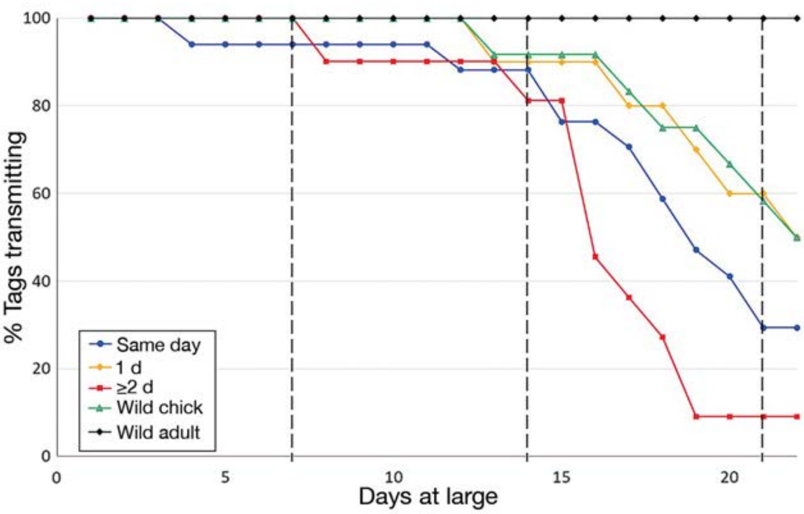

Fig. 5. Percentage of tags still transmitting in each of 5 groups: (1) Save Our Shearwaters (SOS) same day, (2) SOS 1-day rehabilitation, (3) SOS ≥2-day rehabilitation, (4) Upper Limahuli Preserve (ULP) fledglings, and (5) ULP adults. Vertical dashed lines indicate 7, 14, and 21 d

tinuous transmission setting (i.e. all tags except 2016). Of 38 tags with continuous transmission, the 2 deployed on adult birds demonstrated uninterrupted 'normal' activity patterns until the tag ceased to transmit. Of 36 remaining tags on fledglings, 4 (11.1%) demonstrated uninterrupted 'normal' activity patterns until the tag ceased to transmit, 36.1% indicated decreased activity (i.e. stair-step pattern) prior to final transmission, and 52.8% exhibited a flat-line pattern consistent with limited activity and potential morbidity. There were significantly more wild fledged birds where the sensor activity terminated abruptly or slowed down prior to final transmission, and significantly fewer wild fledglings where the sensor values flat-lined compared with birds in the SOS group (Table 3, chi-squared test, χ^2 = 39.9, df = 2, p <0.001).

3.3. Testing for year effects

Because tags were unequally distributed among groups in each year, our ability to quantify year effects was limited. Although we acknowledge a small sample size, we evaluated interannual differences for birds in the same-day release treatment group (n = 17) and for birds in the 'wild group' because birds in these groups were tagged in 3 of the 4 years (same-day group: 2014, 2016, and 2017; wild group: 2016, 2017, and 2018). There was no significant difference among years for maximum straight-line distance (Kruskal-Wallis test, $\chi^2 = 0.12$, df = 2, p > 0.05), total distance traveled (χ^2 = 3.33, df = 2, p > 0.05), final latitude ($\chi^2 = 1.40$, df = 2, p > 0.05), final longitude (χ^2 = 1.30, df = 2, p > 0.05), or mean speed (χ^2 = 0.64, df = 2, p > 0.05). Similarly, for wild chicks, we found no significant difference among years for maximum straight-line distance ($\chi^2 = 1.88$, df = 2, p > 0.05), total distance traveled (χ^2 = 0.61, df = 2, p > 0.05), final latitude (χ^2 = 0.74, df = 2, p > 0.05), final longitude (χ^2 = 3.12, df = 2, p > 0.05), or mean speed ($\chi^2 = 3.109$, df = 2, p > 0.05).

3.4. Body condition

Lastly, among the 3 SOS groups, we evaluated if body condition (mass and size [weight divided by wing chord]) before release was related to transmis-

Table 3. Activity sensor patterns for all tags where activity sensor pattern data were available, showing the percentage of birds in each group (wild adults, wild fledglings, and Save Our Shearwaters [SOS] rehabilitated fledglings [pooled]) within each of 3 activity sensor patterns

Group	n	Stop (%)	Decreased activity (%)	Flat line (%)
Wild adults	2	100	0	0
Wild fledglings	6	16.7	66.6	16.7
SOS fledglings	30	10	30	60

sion duration. There was no difference among the 3 groups for either mass (Kruskal Wallis test, $\chi^2 = 1.56$, df = 2, p > 0.05) or size ($\chi^2 = 1.4$, df = 2, p > 0.05). Pooling all 3 SOS groups, there was no relationship between mass before release and transmission duration ($y = 0.0045x + 19.25$, $R^2 = 0.0001$, $F = 0.002$, df = 1, p > 0.05, mean ±SE = 441.3 ± 0.8 g, variance = 125.9 g), or between size and transmission duration ($y = -4.86x + 29.20$, $R^2 = 0.003$, $F = 0.086$, df = 1, p > 0.05, mean = 1.9 ± 0.005, variance = 0.004).

4. DISCUSSION

The primary aim of this study was to evaluate post-release survival of fledgling Newell's shearwaters after fallout, and recovery, rehabilitation, and release by the SOS program. As the efficacy of the program was unknown, understanding the fate of these birds is important when evaluating the conservation value of the program for the species. While the conservation value of rehabilitation programs has previously been considered indirectly (e.g. Gineste et al. 2017), our results offer a rare insight into the survival of rehabilitated seabirds after release.

Our results demonstrate that a proportion of rehabilitated birds do indeed survive after release; however, prolonged rehabilitation or severity of fallout-related injuries negatively impacted survival. Wild fledglings transmitted for longer than SOS birds, and SOS birds with longer rehabilitation periods transmitted for shorter durations than birds released immediately or rehabilitated for only 1 d. These differences may have resulted in part from a number of reasons, including undetected injuries or secondary complications such as exposure to disease, parasites, or compromised waterproofing (Rodríguez et al. 2017c). Interestingly, birds that spent only 1 d in rehabilitation had greater apparent survival (although this was not statistically significant) than those released on the same day. Although birds spending only 1 d in rehab may have been in better condition than birds that required longer rehab, rehabilitation efforts might consider taking birds into rehabilitation for a day to rehydrate and undertake a more thorough inspection for potential injuries (although this has to be weighed in the context of available space and resources within the program).

SOS birds that survived the critical early stages at sea after release traveled toward the same first wintering grounds as naturally fledging birds, indicating that their natural dispersal patterns were not altered by the rehabilitation process. All fledglings in all years headed directly to an area encompassing the North Pacific Equatorial Counter Current and Pacific Equatorial Divergence Provinces, and extending into the Western Pacific Warm Pool Province), bounded by 4°–13° N, 165°–178° W. This is an area of elevated relative oceanic productivity and food availability that supports a large biomass of skipjack tuna *Katsuwonus pelamis* (Bell et al. 2013), which are known to feed in association with Newell's shearwaters (Ainley et al. 2014). The annual concentration of our tagged birds in this region may indicate an important large-scale zone of aggregation used annually by fledgling Newell's shearwaters from Kaua'i. Previous boat-based surveys also recorded Newell's shearwaters in the eastern portion of the area identified by our tracking study (Joyce et al. 2013). Assessing potential threats within this region, including marine pollution (Sileo et al. 1990, Derraik 2002, Kain et al. 2016), overfishing (Ainley et al. 2014, Morra et al. 2019), effects of climate change (Bell et al. 2013), and bycatch (Gilman et al. 2008, Rodríguez et al. 2019), are important to consider for the conservation of this species.

It is important to address the degree to which our results could have been influenced by tagging effects and to acknowledge that carrying tags may impose burdens such as drag (Kay et al. 2019) and compromised balance (Vandenabeele et al. 2014)) to the shearwaters in this study. Although tracking technology is widely used and important for seabird research and conservation globally (Burger & Shaffer 2008), some studies have found varying impacts on survival or behavior (Massey et al. 1988, Wanless et al. 1988, Phillips et al. 2003, Elliott et al. 2012). Although smaller and lighter satellite tags are available for non-diving seabirds, to minimize impact on individual Newell's shearwaters, we used the lightest depth-reinforced satellite tags available that were less than the maximum recommended mass for devices intended for procellariid seabirds (Phillips et al. 2003). Furthermore, we opted to attach tags in a position on the body which minimized interference with flight, balance, and behavior (Healy et al. 2004, Vandenabeele et al. 2014). All 4 (100.0%) adult shearwaters tagged for this study were re-sighted at their burrows in the following year without their tags, indicating that tag attachment did not impact the survival of the only cohort where we could directly measure survival rates.

It is also important to consider our results within the context of the life history of this species. Among seabirds, naturally fledging shearwaters and petrels have relatively low survival rates in the first year of their lives, followed by relatively high survival rates once they reach adulthood (Perrins et al. 1973, Warham 1980, Serventy & Curry 1984, Harrison 1990, Mougin et al. 2000). Weimerskirch et al. (2019) found that up to 50% of all tagged fledgling Barau's petrels *Pterodroma baraui* died immediately after reaching the sea due to compromised waterproofing. For the closely related Manx shearwaters, only 33.3% of fledged chicks were estimated to survive to breeding age (Brooke 1977), and for Hawaiian petrels (breeding in the same areas as Newell's shearwaters), survival rate to breeding age was estimated to be as low as 27.0% (Simons 1984). The apparently low survival rates for fledglings in this study are not wholly unexpected, but rather they are somewhat consistent with those published for other closely related species.

The outcome of our results should also be considered in the context of light attraction — the root cause for fledgling fallout — which remains a serious issue on Kauaʻi (Ainley et al. 2001, Troy et al. 2011, 2013, Raine et al. 2017). The number of grounded seabirds recovered by SOS is a fraction of the number of birds that actually fall out in any given year. For example, members of the public are very unlikely to collect dead birds, but studies have found that a large proportion of fallout birds are already dead when encountered. On Kauaʻi, one study (Podolsky et al 1998) found that 43% of fallout fledglings were dead, and none of the 44 dead shearwaters found, tagged, and left in place in 1993 and 1994 were ever reported to SOS (Ainley et al. 1995, Podolsky et al. 1998). A similar study in Australia found that 39% of grounded short-tailed shearwaters were either dead or dying (Rodríguez et al. 2014). Furthermore, grounded birds typically try to hide in small dark places where they are only found with concerted search efforts. Previous authors have suggested that discovery rate could be 50.0% of grounded live birds (Ainley et al. 2001); from our own observations, the discovery rate is probably even lower. Furthermore, of birds that are found, a proportion are never released because they die in care from severe injuries (i.e. during the last 5 yr [2014–2018], an average of 6.4% of Newell's shearwaters died or were euthanized because their injuries were too severe [SOS unpubl. data]) which is similar to other programs, such as those on Réunion Island (Le Corre et al. 2002). The overall impact of light attraction and grounding of Newell's shearwaters is therefore still of major concern.

Conservation efforts focused on Newell's shearwaters on Kauaʻi will benefit by reducing the impacts of light attraction to this Critically Endangered seabird. A wide range of options are available to address this issue, including light shielding (which alone reduced fallout by 40% at one Newell's shearwater fallout hotspot on Kauaʻi in the 1980s; Reed et al. 1985), switching outdoor lighting to appropriate seabird-friendly light types (Rodríguez et al. 2017a), perhaps adjusting spectral qualities like intensity and color (Longcore et al. 2018), installing timer switches on outdoor lighting to allow automatic switch-off when lights are not in use, significantly reducing lights during the peak fledging period (which for all endangered seabird species runs from late September to mid-December on Kauaʻi), adopting a light ordinance for the county with appropriate enforcement (especially in new construction zones or redevelopments, as this is currently lacking), targeted education campaigns and mitigation efforts through the creation of Habitat Conservation Plans to offset the impact of individual entities and businesses (e.g. the Kauaʻi Seabird Habitat Conservation Plan that was accepted in May of 2020). Furthermore, our tracking study could be expanded by having larger and equal sample sizes for all groups in multiple years. This would help to strengthen the results presented in this paper. However, preventing seabirds from being grounded in the first place, by targeting light attraction, is likely the most effective conservation action.

In conclusion, while our results provide evidence of reduced survivorship for rehabilitated fledglings compared with wild fledglings, a proportion of rehabilitated birds did survive release and migrated successfully toward their first wintering grounds. Grounded birds not recovered by SOS are highly unlikely to survive due to a range of factors including depredation by introduced predators (such as cats or dogs), collisions with cars, or exposure and starvation due to an inability to reach the sea (Le Corre et al. 2002). The SOS program therefore remains an important component of the overall conservation efforts for this species, and the maintenance of this program, in conjunction with concerted efforts to reduce light pollution on the island of Kauaʻi, will benefit Newell's shearwaters.

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THE BREEDING PHENOLOGY AND DISTRIBUTION OF THE BAND-RUMPED STORM-PETREL *OCEANODROMA CASTRO* ON KAUA'I AND LEHUA ISLET, HAWAIIAN ISLANDS

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ABSTRACT

RAINE, A.F., BOONE, M., McKOWN, M. & HOLMES, N. 2017. The breeding phenology and distribution of the Band-rumped Storm-petrel *Oceanodroma castro* on Kaua'i and Lehua Islet, Hawaiian Islands. *Marine Ornithology* 45: 73–82.

The Band-rumped Storm-petrel (BRSP) *Oceanodroma castro* has a large breeding range, spanning the warmer portions of both the Atlantic and Pacific Oceans. The Hawaiian population is one of the most cryptic and under-studied seabird species in the archipelago, and its breeding phenology and distribution are poorly known. We used several methods, including human auditory surveys, automated acoustic surveys, mist-netting, and data from a seabird rescue and rehabilitation program to assess the breeding phenology and distribution of BRSP on the island of Kaua'i and adjacent Lehua Islet. Our data show that the species arrives at breeding colonies on Kaua'i in late May, with birds fledging from late September to mid-November. Unlike BRSP breeding populations in the Galápagos, Azores, and Madeira, a winter breeding population was not apparent. Breeding colonies were found to be concentrated along the Na Pali coast, particularly within canyons from the Kalalau Valley to Polihale, as well as the Waimea Canyon. These areas are characterized by sparsely vegetated, very steep cliffs. Small pockets of BRSPs were also encountered in some of the wetter and heavily vegetated valleys associated with exposed rocky cliff faces. A large concentration of storm-petrel activity was also recorded on the southeastern slopes of Lehua Islet. A model created to predict Kaua'i-wide distribution indicated that the key predictive variables, found in 85% of all models, were average rainfall, EVI (Enhanced Vegetation Index to assess broad vegetation types), and slope. Identifying this species' breeding phenology, range, and habitat requirements is a key step to inform conservation efforts for BRSPs elsewhere in the archipelago. In that regard, much work remains to be done.

Key words: Hawai'i, Storm-petrel, *Oceanodroma*, breeding phenology, distribution

INTRODUCTION

The Band-rumped Storm-petrel (BRSP) *Oceanodroma castro* has a widespread breeding distribution across tropical and subtropical latitudes of the Atlantic and Pacific oceans (Boersma & Groom 1993, del Hoyo *et al.* 1992, Slotterback 2002). Because of its extensive breeding distribution, the geographic isolation of many of the breeding populations, and the geographic variation in a number of morphological characteristics, some researchers believe that BRSP could consist of several subspecies or even separate species (Harris 1969, Bolton 2007, Friesen *et al*. 2007). Indeed, based on morphology, vocalizations, and genetic analysis, the summer breeding form of what had formerly been considered BRSP from the Azores has since been identified as a distinct species — Monteiro's Storm-petrel *O. monteiroi* (Bolton *et al.* 2007). A global phylogeny assessment, using DNA sequence variation in the mitochondrial control region, has further lent support to the concept that there could be multiple species involved (Smith *et al.* 2007). This possibility is further strengthened by the breeding phenology of different populations. In the Galápagos (Snow & Snow 1966, Harris 1969, Smith & Friesen 2007), Azores (Monteiro & Furness 1998, Bolton 2007), and Madeira (Nunes 2000), two distinct breeding seasons — summer and winter — representing different populations are often found at the same location (see also Friesen *et al*. 2007). Within the Hawaiian Islands, BRSP is a rare and poorly known species, and how it fits within the complex of subpopulations is unknown (Duffy 2010). Because of its rarity in the Hawaiian Islands, the species is listed as "Endangered" by the State of Hawai'i and the US Fish and Wildlife Service (USFWS 2016). The species faces a number of threats throughout its Hawaiian range, including depredation by introduced predators such as rats *Rattus* sp., cats *Felis cattus,* and Barn Owls *Tyto alba* (Harrison 1990, Galase *et al.* 2016, Raine *et al.* 2017), all of which are present throughout the Hawaiian islands, as well as by light attraction (which is known to affect other storm-petrel species; Wiese *et al.* 2001, Montevecchi 2006).

BRSPs may once have been widespread and common throughout the main Hawaiian Islands, as deduced by bones found in middens on Hawai'i, O'ahu, and Moloka'i, which in turn suggests that these birds may have been part of the diet of early Polynesians (Olson & James 1982, Harrison 1990). However, the present-day distribution is uncertain. Potential breeding records span most islands, including Kaua'i (Wood *et al.* 2002), Maui, Hawai'i (Banko *et al.* 1991, Galase *et al.* 2016), Lehua Islet (VanderWerf *et al.* 2007), and Kaho'olawe (Hawai'i Heritage Program 1992). There are no records of the species' habitation on any of the northwestern Hawaiian islands, although there are occasional records at sea (Pyle & Pyle 2009). The vast majority of recent records consist of auditory and visual detections of subadult/adult birds, with the most compelling including (i) the skull of a probable juvenile found on Lehua Islet (VanderWerf *et al.* 2007), and (ii) high levels of activity within Pohakuloa Training Area on Hawai'i. Included in the latter is camera footage of a bird entering an apparent burrow entrance on multiple occasions and the predated remains of a probable chick (Galase *et al.* 2016).

In this paper, we consider the current known distribution of BRSP on Kaua'i (Fig. 1), which is thought to have the largest breeding population in the main Hawaiian islands (Wood *et al.* 2002). We also assess the species' breeding phenology on Kaua'i through the use of automated acoustic sensors, banding records, and data on fledglings collected after light-attraction incidents by the Save Our Shearwaters project. These data are also used to assess whether there could be a summer and winter breeding population. Lastly, we consider records from adjacent Lehua Islet.

METHODS

Human auditory surveys

Between 2006 and 2016, standardized auditory surveys were undertaken by trained observers to identify breeding colonies of threatened and endangered seabirds, including BRSP, on Kaua'i and Lehua Islet. Auditory surveys were carried out 2.0 h after sunset and 1.5 h starting two hours before sunrise, with participants also using night-vision goggles (US Night Vision PVS-7 Gen 3). Surveys were not conducted during full moon periods, as nocturnally active seabirds tend not to be vocal at that time.

Surveys were split into 30-min sessions, with 5 min allotted for the collection of weather data, 25 min for auditory surveying, and 5–10 min for concurrent night-vision surveying. Surveyors were instructed to record all seabird calls (classified as a single unbroken note or series of notes) heard, as well as visual observations during the survey period. For any records, data were collected on time, species, direction and distance from observer, and the behavior of the bird (with particular attention paid to circling and ground-calling).

At the end of surveys, observers created polygons on field maps identifying overall coverage and where seabird activity was apparent. Polygons were categorized as the following three types: "hotspot-heavy," "hotspot-light," and "ground-calling." Ground-calling polygons constituted those in which birds were confirmed calling from the ground (as opposed to from the air), as this is indicative of breeding activity. "Hotspot-heavy" and "hotspot-light" were defined as polygons where there was aerial calling only, with "heavy" denoting continuous calling during the survey and "light" denoting sporadic calling.

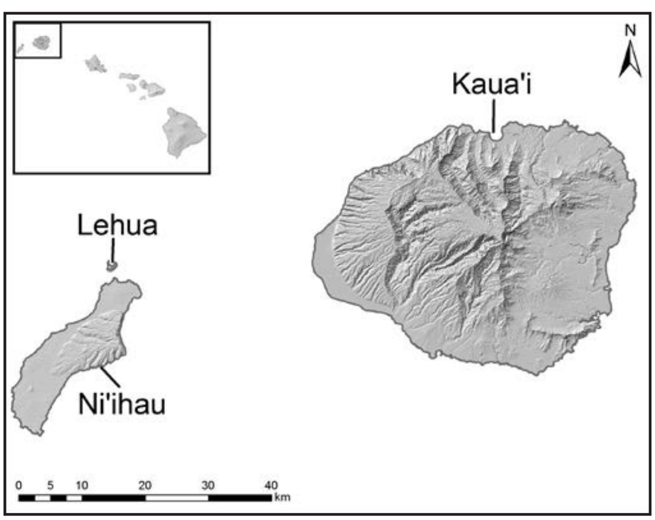

Fig. 1. Map of Kaua'i and Lehua Islet, and their location within the main Hawaiian islands.

Automated acoustic sensors

Between 2011 and 2016, 88 automated acoustic sensors (SongMeter SM2+, Wildlife Acoustics Inc., Concord, MA) were deployed at 69 locations around Kaua'i and 19 locations on Lehua Islet. These sites were known from previous human auditory surveys to hold significant breeding populations of threatened and endangered seabirds, including in some cases BRSP. In most years, acoustic recorders were deployed in April and recovered in September. In 2015, however, six units also operated during winter in areas along the Na Pali coast where previous efforts had identified the highest call rates of BRSP. In all cases, recorders were deployed at least 250 m apart, to prevent the same call being reported concurrently on more than one automated acoustic sensor.

Recorders were powered by four D-cell alkaline batteries and recordings were stored on a 32 GB secure digital (SD) memory card. All recorders were fitted with two omnidirectional microphones, oriented horizontally, and recorded in stereo at a sampling rate of 22.05 kHz. Recorders were deployed using two methods. In more accessible areas, units were deployed by hand and were either mounted on poles 30 cm above the ground or placed directly on the ground, where rocks or stakes were used to stabilize the recorder vertically. Units were oriented to shelter sensor microphones from prevailing winds, and to keep them well away from moving branches and leaves. In rugged and inaccessible areas (such as the Na Pali coast and the steep sides of some of the larger valleys), units were deployed via helicopter. In this case, units were placed in a specially designed wooden box with a large handle and wooden stabilizers, and deployed (and recovered) using a grappling hook.

Units were programmed to record 1 min every 5 min for 5 h after sunset, and 1 min every 10 min for 5 h before sunrise. Programming was undertaken using the SMCONFIG software package. Ground-deployed units were checked once every other month. At each check, SD cards were collected and all batteries changed. Microphones were also checked for functionality, and, if a microphone was malfunctioning, it was immediately replaced. For helicopter-deployed units, recorders were recovered after two months, when SD cards and batteries were switched out, and were then redeployed as needed.

Banding sessions

Between 2012 and 2016, six banding sessions were undertaken targeting BRSPs. These were carried out at two sites where storm-petrel activity had previously been recorded: Nualolo Aina and Waimea Canyon. Banding was undertaken on 22 and 23 August 2012, 4 September 2013, 11 September 2013, 27 June 2016, and 4 August 2016. In all cases, two mist nets (four shelf, 2.6 m × 12 m, 38 mm mesh polyester) were set along ridge lines. Tapes broadcasting BRSP calls were used to attract birds to the nets. Sessions started at sunset and continued for 3–5 h. All individuals caught were assessed for the presence of a brood patch and scored as "none," "full," or "re-feathering." In storm-petrels, re-feathering of brood patches starts a week after hatching (Harris 1969). Captured birds were then fitted with a uniquely numbered, stainless steel bird band and released.

Save Our Shearwaters data

The "Save Our Shearwaters" (SOS) Program, run by the State of Hawai'i, was initiated in 1979 and is currently based at the Kaua'i Humane Society. The program collects seabirds picked up by citizens, and, after assessment of body condition, bands and releases them from coastal locations. A small number of fledgling BRSPs have been collected since the program's inception, as they are sometimes attracted to artificial lights. We used these data to assess the fledging period, as actual nest sites have yet to be found and monitored on the island. We considered only those birds positively identified by SOS personnel as hatch-year BRSPs (based on presence of down and/or immaculate and unworn flight and tail feathers) for this analysis.

Data analysis

Automated acoustic sensors. Automated analysis of field recordings was carried out with custom detection and classification software. The software automates the identification of potential storm-petrel calls in field recordings with a machine-learning technique known as deep neural networks (DNNs). DNNs is a powerful new machine-classification tool used in speech-recognition (Deng *et al.* 2013) and image-recognition applications (Ciresan *et al*. 2012, Krizhevsky *et al.* 2012).

Our approach split all field recordings into 2-s sound clips and 256 frequency bins within each clip. A total of 10 spectro-temporal features were measured within each frequency bin, and feature scores were stored for each clip. A control dataset for training and testing DNN classification results was then created by taking a uniform sample from all 2-s clips on recordings from all field sites, to collect a total of 12 917 clips. All sound clips in the control dataset were manually labeled to note the presence or absence of storm-petrel calls in each clip. The resulting control dataset contained labeled examples of 1 508 positive events (vocalizations from target species), and 11 409 negative events (i.e., examples of other sounds from the soundscape at all survey sites) to train and test the performance of DNNs. The resulting DNN classification model learned which combination of spectro-temporal features best differentiated storm-petrel calls from other sounds. The model returns a probability that each 2-s clip contains a storm-petrel call. The BRSP classification model correctly detected 85% of the storm-petrel calls on the test dataset (i.e., 15% of calls in the test dataset were not detected), and 94% of the events flagged by the model were BRSP calls (i.e., 6% of detections were false positives) at the classification threshold set for this analysis. The trained BRSP classification model was applied to classify potential storm-petrel calls on raw data from all field recordings in the survey, and all events flagged as probable BRSP calls were manually reviewed by an analyst.

Breeding distribution modeling. Polygons showing known distribution of BRSPs were mapped using ArcMap 10.2.2. A presence–absence map was created by overlaying a 250 m grid across the island using the Create Fishnet tool in ArcGIS. Each grid cell was categorized as "present" if it satisified at least one of the following criteria: (i) automated acoustic sensors recorded greater than 0.5 calls/h during June or July; (ii) human auditory surveys noted activity categorized as "Hotspot-heavy," "Hotspot-light," or "Ground-calling" (as outlined above) in an area; and (iii) presence of a brood patch was confirmed on caught individuals. Remaining cells were considered "absent" if audio-recording units, human auditory surveys, or banding was attempted but no BRSP evidence was found.

We collected seven predictors of BRSP presence: (i) elevation, (ii) slope, (iii) aspect x, (iv) aspect y, (v) vegetation cover, (vi) annual rainfall, and (vii) presence of rock. We calculated elevation, slope, and aspect from the Landfire 2010 dataset for Kaua'i (http://landfire.gov). Aspect was split into x and y vectors by converting degrees to radians and multiplying the aspect by sin (x vector) and cosin (y vector). Annual rainfall was downloaded from the State of Hawai'i Office of Planning (http://planning.hawaii.gov/gis/download-gis-data) at a resolution of 250 m. Presence of rock was derived by downloading the 2015 NRCS USDA Soil Survey for Kaua'i (http://websoilsurvey.sc.egov.usda.gov). We used rocky outcrop as a measurement of bare rock, defined as an area where 90% of the cell is free of vegetation. To measure vegetation cover, we used the Enhanced Vegetation Index (EVI) downloaded from the State of Hawai'i Office of Planning. EVI measures the green reflectance of vegetation measured from the MODIS VI satellite, and accounts for canopy characteristics by also accounting for soil characteristics and atmosphere aerosol. Thus, its results are robust in regions with high biomass like Kaua'i (Huete *et al.* 2002). We averaged all variables except slope into each 250 m^2 cell using the Zonal Statistics tool. For slope, the maximum recorded slope was recorded for each grid square.

Using boosted regression trees (BRT; Buston & Elith 2011, Hijmans & Elith 2012), we developed a correlation matrix across all predictors that showed no significant interactions (<0.60 correlation), so all variables were included in model fitting. Seven parameters were considered in the model (EVI, mean rainfall, elevation, slope, aspect u, aspect v, and elevation). BRTs were fitted in R (R Development Core Team 2016 Version 3.4), using the *gbm.step* function in the *dismo* package. This function attempts to increasingly fit larger tree size until a minimum convergence in predictive error is achieved using cross-validation. Anything under 10 000 trees was considered acceptable. Test data showed that a *lr* of 0.005, *tc* of 2, and 3 300 trees minimized predictive deviance; therefore, these were used to fit the final model. We then fit the final model to the entire island of Kaua'i using the *predict* function in R.

Considering the small size of Lehua Islet, we did not attempt to model distribution of the species there, but simply mapped call rates recorded on acoustic recording devices deployed during the study period.

RESULTS

Breeding phenology

Colony attendance. To assess colony attendance patterns, in 2015 automated acoustic sensors were deployed at six sites where storm-petrel activity had been recorded in previous years. Sensors were deployed by helicopter on 7 April 2015 and recovered on 19 February 2016 (with several trips between the two time periods to switch SD cards and batteries). The first storm-petrel detection during this period was on 22 May and the last on 1 October. No calling activity was detected by any sensor during winter. Calling activity peaked in June and August and diminished through the end of September (Fig. 2). Nightly calling activity peaked between 70 min and 130 min after local sunset (Fig. 3).

Prevalence of brood patch. A total of 36 adult BRSPs were caught over the six banding sessions. Brood patches were recorded on 94.6% of birds caught, evident in all banding sessions from 27 June to 11 September (Table 1). During the late August banding session,

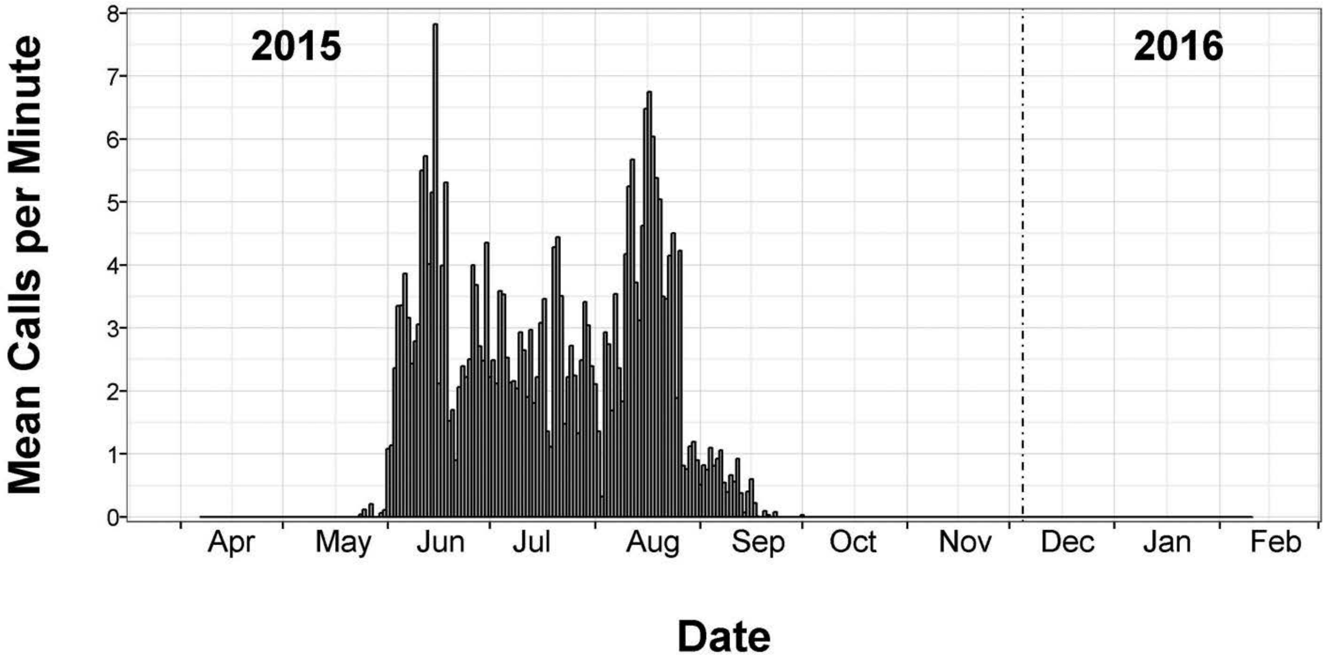

Fig. 2. Mean Band-rumped Storm-petrel vocal activity rates at six survey sites on Kaua'i over the 2015–2016 automated acoustic survey period (from 70 min to 130 min after sunset). Black line at 0 shows survey nights without activity (i.e., April to late May 2015 and October 2015 to mid-February 2016).

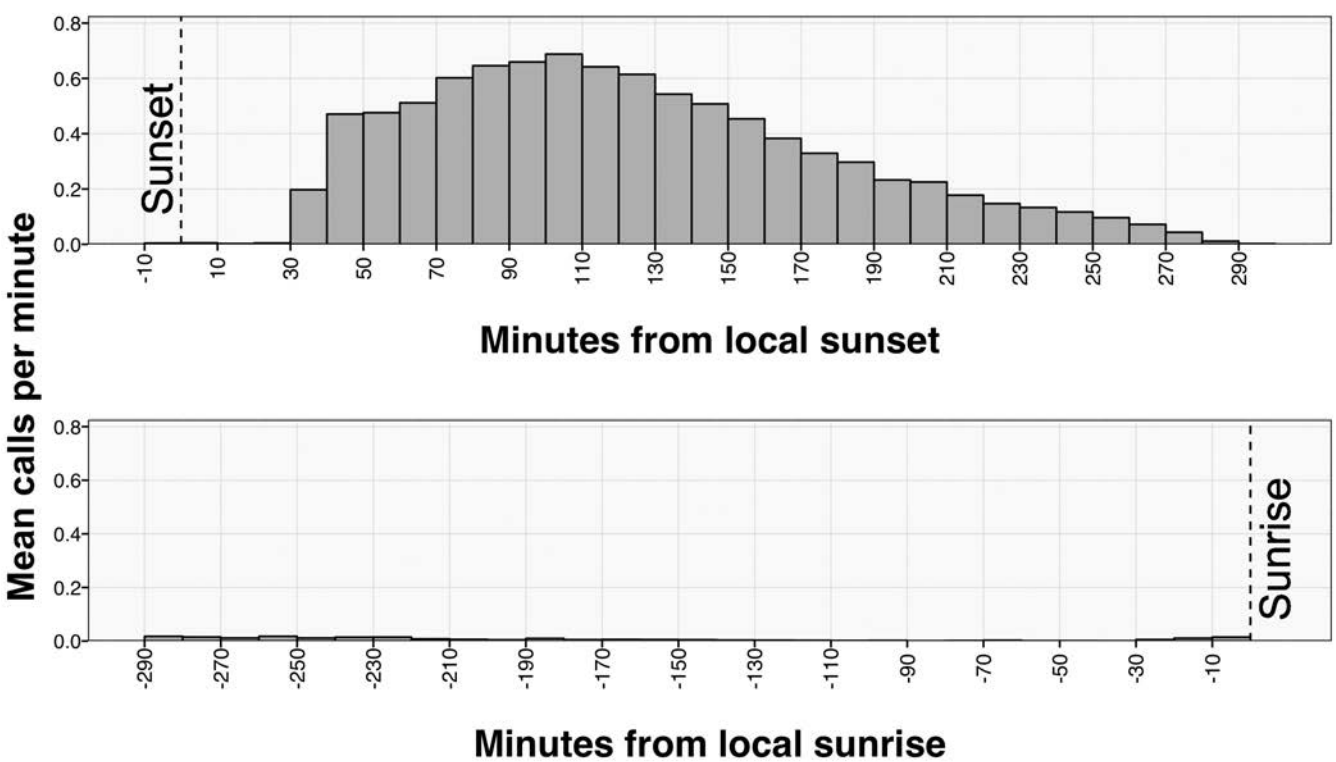

Fig. 3. Band-rumped Storm-petrel vocal activity over an average survey night.

TABLE 1
Prevalence of brood patches on Band-rumped Storm-petrels caught on Kaua'i

Date	Year	n	Percentage		
			None	Full	Re-feathering
27 Jun	2016	9	22.0	78.0	
4 Aug	2016	1		100.0	
22 Aug	2012	15		80.0	20.0
4 Sep	2013	9		33.3	66.7
11 Sep	2013	1		100.0	

20% of individuals had brood patches, and these were starting to re-feather; of the 10 birds caught in the two September sessions, 60% had re-feathering brood patches.

Fledging period. A total of 23 hatch-year BRSPs were recorded in the SOS database, with records starting in September and continuing into November. They were deemed to be hatch-year birds owing to the presence of down and/or immaculate and unworn flight and tail feathers. The majority of records of fledglings (78.3%) were recorded during October. The earliest bird identified as hatch-year was on 11 September (which was an outlier by 27 d from the next earliest bird), and the latest was on 23 November.

TABLE 2
Breeding phenology of Band-rumped Storm-petrels in Kaua'i

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				Arrival							
				Egg laying	Egg laying	Egg laying					
					Incubation	Incubation	Incubation				
						Guard	Guard	Guard			
								Fledging	Fledging	Fledging	

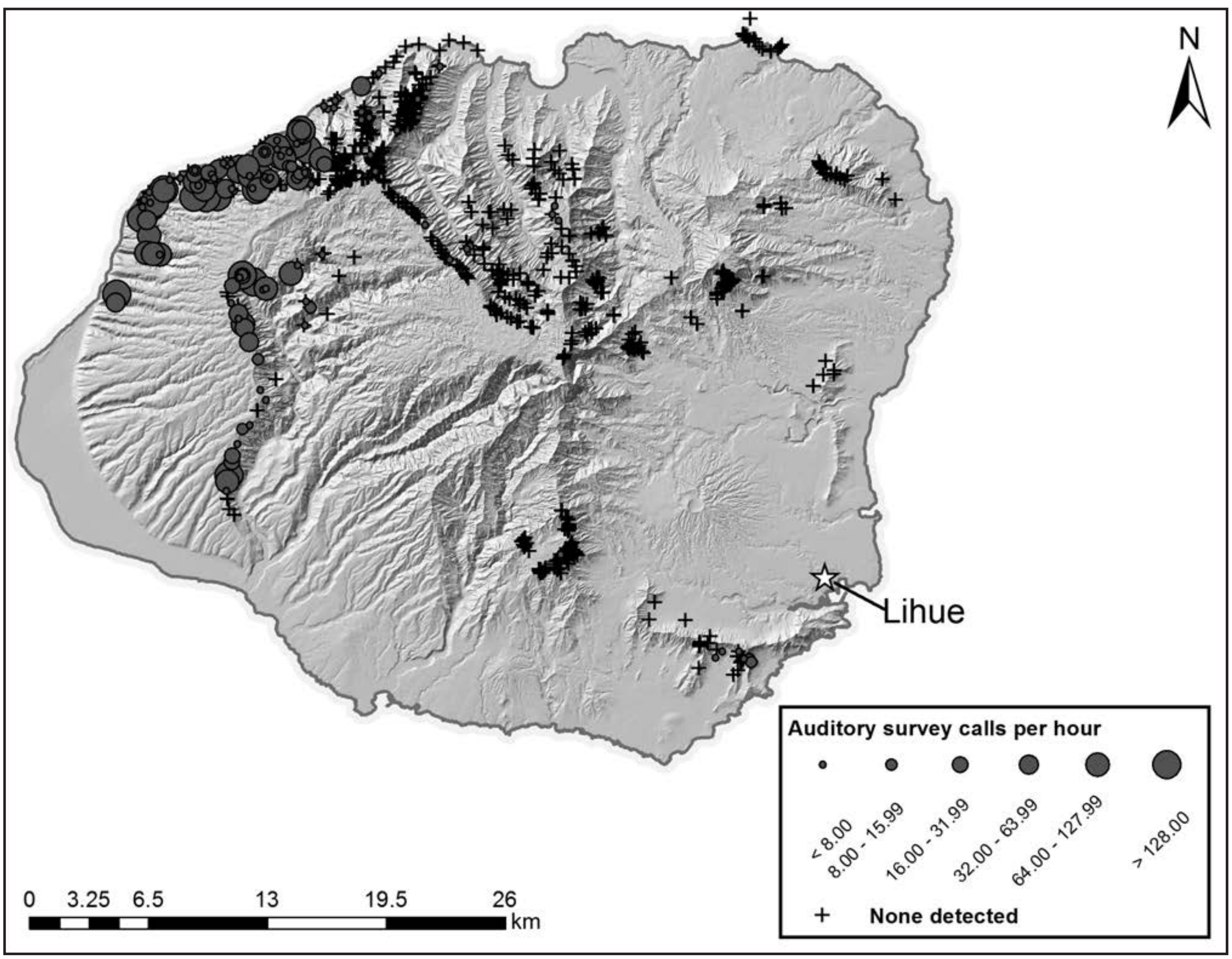

Fig. 4. Band-rumped Storm-petrel call rates detected during auditory surveys, 2006–2015, on Kaua'i.

Overall breeding phenology. According to Harris (1969), incubation in BRSP lasts 42 d and the fledging period is 70–78 d. Breeding seasons for this species (both winter and summer populations) in Madeira last 6–7 mo (Nunes 2000). Based on this and the data provided above, the breeding phenology of the BRSP on Kaua'i is estimated as follows (Table 2). Birds start arriving in late May, with egg-laying in mid-June. Incubation continues until the beginning of August. Birds fledge in October, with the last birds fledging toward the end of November, after which all BRSPs depart breeding sites and head to unknown wintering grounds.

TABLE 3
Relative influence of seven predictors among 3300 models fit using boosted regression trees

Variable	Relative influence
Rain	29.39
Enhanced Vegetation Index	27.76
Slope	15.61
Elevation	9.44
Aspect x	6.36
Rock	6.10
Aspect y	5.33

CONTEMPORARY BREEDING DISTRIBUTION – KAUA'I

A map of known contemporary breeding distribution of the BRSP was created, based on data collected from 1942 human auditory surveys (amounting to 3712 h of observations) and all automated acoustic sensors. The highest call rates were found along the Na Pali coast and Waimea Canyon, with the highest call rate being 769 calls/h on 13 June 2012 at Nu'alolo Aina (Fig. 4).

Modeled breeding distribution — Kaua'i

Of the seven variables considered in the model, average rainfall, EVI, and slope were the most influential, found in 85% of all models. The relative influence of each predictor to the overall model was estimated and scaled out of 100 (Table 3). Elevation was slightly influential, while aspect x and y and percentage of rock were incorporated in <6% of models each. BRSP presence was predicted in areas of low rainfall, low EVI (low to no vegetation), and slopes >40°. The area under the curve for the final model was 0.95, which was calculated by cross-validation of the data using the *gbm.step* function. Finally, these data were used to model the predicted distribution of the species across Kaua'i (Fig. 5).

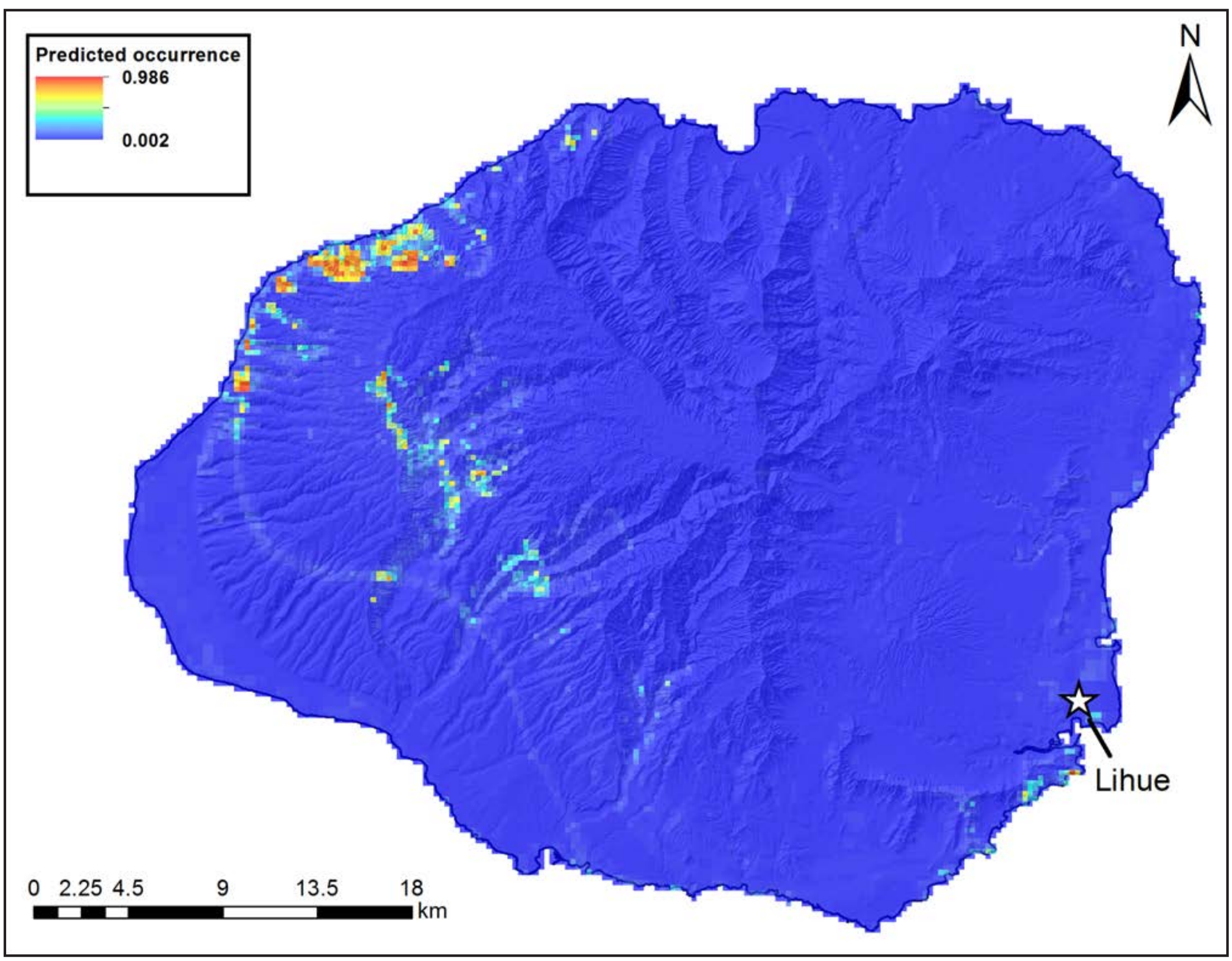

Fig. 5. Predicted distribution of the Band-rumped Storm-petrel on Kaua'i.

Contemporary breeding distribution — Lehua Islet

Maps were created to assess BRSP breeding distribution by considering data from all acoustic sensors deployed on the islet between 2013 and 2015 (n = 19). Records indicated that storm-petrel calling was detected at 31.6% of sites, with the majority of activity on the southeastern slope of the islet (Fig. 6). Human auditory surveys were subsequently conducted in the areas where acoustic sensors detected the highest call rates. Surveyors reported multiple sightings of low flying BRSPs, many of which vocalized constantly as they flew low over the ground.

DISCUSSION

On Kaua'i, BRSPs were found predominantly along the northwestern coast, with concentrations in the narrow valleys of the Na Pali coast as well as the sheer walls of the Waimea Canyon in the southwestern region of the island. Interestingly, small colonies were also found within some of the larger, more vegetated valleys, such as Lumahai and Wainiha, where they were associated with rocky cliff faces. Modeling the distribution of this species indicated an association with such steep, sparsely vegetated cliff faces. On Lehua Islet, the species was mainly concentrated on the southeastern slopes, with very little activity elsewhere. The area where storm-petrels were recorded on Lehua Islet is also very sparsely vegetated and steeply sloping, showing a similarity to preferred habitat on Kaua'i; the distribution of the species on Lehua could also be limited by the presence of introduced Polynesian Rats *Rattus exulans*.

BRSPs were found to be summer breeders on Kaua'i, with no evidence of a winter breeding population. An exclusively summer breeding season is similar to that found for the species in Japan (Monteiro & Furness 1988), but is unlike breeding populations in the Galápagos, where the breeding season is bimodal (Snow & Snow 1966, Harris 1969, Smith & Friesen 2007). On Kaua'i, birds arrive in late May and fledge in October to mid-November. One very early fledgling was listed in SOS records as being found on 11 September 1997, 27 d earlier than any other fledgling in the database; the only other fledgling recorded in that year was found in mid-October. It is possible that this bird was incorrectly identified by SOS staff as a fledgling, or that it was from a very early breeding pair. Whatever the case, it is the only outlier and presumably is not indicative of the normal schedule for the breeding season on Kaua'i.

The current breeding distribution of BRSPs on Kaua'i and Lehua Islet is likely due to a combination of available habitat, constrained by predation pressure from introduced predators. On Kaua'i, the depredated remains of a BRSP were found in 2013 in Nualolo Aina on the Na Pali coast with injuries consistent with Barn Owl *Tyto alba* depredation (Raine, unpubl. data). Indeed, the Barn Owl is a known predator of seabirds on Kaua'i, where it also targets Newell's Shearwater *Puffinus newelli* (Ainley *et al.* 2001), Hawaiian Petrel *Pterodroma sandwichensis* (Raine unpubl. data), Bulwer's Petrel *Bulweria bulwerii*, and Wedge-tailed Shearwater *Ardenna pacifica* (Raine *et al.* 2017). Further evidence of Barn Owls hunting storm-petrels includes the fact that Barn Owls were regularly attracted by broadcasts of storm-petrel calls during banding sessions; Barn Owls were often the first birds to arrive at the banding sites. Barn Owls have also been recorded predating storm-petrels on islands in the Gulf of California (Velarde *et al.* 2007) and off California (Mills 2016).

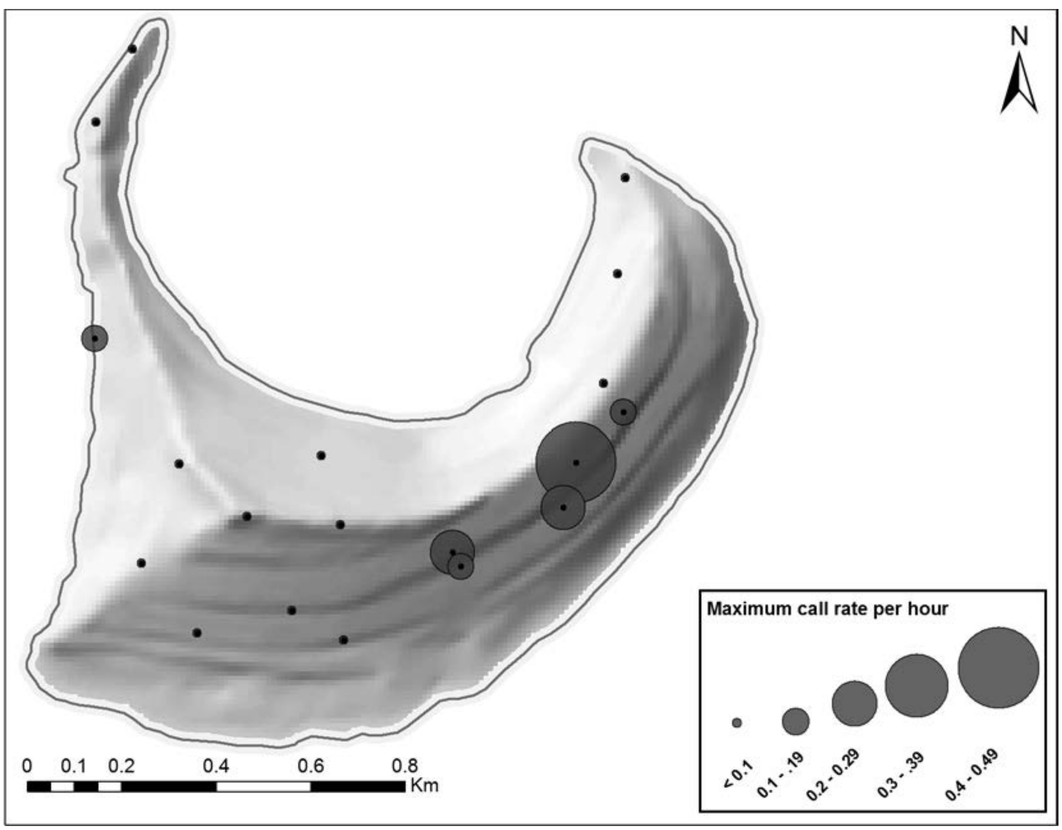

Fig. 6. Maximum call rates of Band-rumped Storm-petrel recorded on automated acoustic recorders (black dots) deployed on Lehua Islet (2013, 2014, and 2015).

Storm-petrels in general are particularly vulnerable to introduced mammalian predators such as Black Rats *Rattus rattus*, Polynesian Rats, and cats *Felis catus* (Rauzon *et al.* 1985, Scott *et al.* 1988, Harrison 1990, Martin *et al.* 2000, Slotterback 2002, Towns *et al.* 2006, Jones *et al.* 2008). On Hawai'i, at a newly discovered BRSP colony at Pohakuloa Training Area, two depredated carcasses were discovered, one of which was thought to be a chick (Galase *et al*. 2016). Cameras monitoring potential breeding sites there recorded rats entering a suspected burrow entrance on multiple occasions, and cat scat was also found within the study area. Throughout the Hawaiian Islands and central Pacific islands, introduced predators are a key threat to all ground-nesting seabirds (Simons 1985, Harrison 1990, Hodges & Nagata 2001, Ainley *et al.* 2001, Rauzon 1985). BRSPs face this same threat, with no known contemporary breeding population occurring in a predator-free habitat.

Light attraction, which seriously affects other seabirds on Kaua'i (Telfer *et al.* 1987, Reed *et al.* 1985, Duffy 2010), also appears to affect BRSPs, although there is a relatively small number of fallout fledglings in the SOS database. This could be due to a number of factors. First, the species is currently concentrated predominantly along northwest coast, but artificial lights are concentrated on the opposite coast (Troy *et al.* 2011). Second, although light attraction among other storm-petrels is well known (e.g., Wiese *et al.* 2001, Montevecchi 2006), this species may be less affected by artificial lights. Lastly, its small size and habit of rapidly looking for hiding places once on the ground could render it less likely to be found by the general public. This could make it an under-reported species within the SOS program.

Determining the breeding phenology and distribution of BRSPs is a key first step in co-ordinating conservation efforts to better protect this species' population on Kaua'i and adjacent Lehua Islet. Controlling introduced avian and mammalian predators in the current core areas of its breeding distribution should be considered a priority, considering how vulnerable the species is to predation. The eradication of rats from Lehua Islet, for example, would remove a key threat from this breeding location, particularly if it were carried out in tandem with ongoing efforts to control Barn Owls on the islet. Adding artificial nest burrows may also help increase breeding success in certain areas, such as Lehua Islet, by increasing available breeding habitat (as has been shown with other *Ocenodroma* species, e.g., McIvery 2016). Undertaking larger-scale studies, similar to what we report herein, on other Hawaiian islands should be considered a priority. Lastly, the uncertainty of the overall genetic composition of *Oceanodroma castro* across its entire Atlantic and Pacific distribution is currently a limiting factor in identifying which populations are in most urgent need of conservation action. If, indeed, there are several unique genetic forms across the current broad distribution of BRSPs, identifying these will help to focus conservation action.

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Conservation Biology

Review

Seabird mortality induced by land-based artificial lights

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Abstract: *Artificial lights at night cause high mortality of seabirds, one of the most endangered groups of birds globally. Fledglings of burrow-nesting seabirds, and to a lesser extent adults, are attracted to and then grounded (i.e., forced to land) by lights when they fly at night. We reviewed the current state of knowledge of seabird attraction to light to identify information gaps and propose measures to address the problem. Although species in families such as Alcidae and Anatidae can be grounded by artificial light, the most affected seabirds are petrels and shearwaters (Procellariiformes). At least 56 species of Procellariiformes,*

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more than one-third of them (24) threatened, are subject to grounding by lights. Seabirds grounded by lights have been found worldwide, mainly on oceanic islands but also at some continental locations. Petrel breeding grounds confined to formerly uninhabited islands are particularly at risk from light pollution due to tourism and urban sprawl. Where it is impractical to ban external lights, rescue programs of grounded birds offer the most immediate and employed mitigation to reduce the rate of light-induced mortality and save thousands of birds every year. These programs also provide useful information for seabird management. However, these data are typically fragmentary, biased, and uncertain and can lead to inaccurate impact estimates and poor understanding of the phenomenon of seabird attraction to lights. We believe the most urgently needed actions to mitigate and understand light-induced mortality of seabirds are estimation of mortality and effects on populations; determination of threshold light levels and safe distances from light sources; documentation of the fate of rescued birds; improvement of rescue campaigns, particularly in terms of increasing recovery rates and level of care; and research on seabird-friendly lights to reduce attraction.

Keywords: disorientation, illumination, light pollution, orientation, petrel, rescue campaign

Mortalidad de Aves Marinas Producida por Luces Artificiales Terrestres

Resumen: *Las luces artificiales nocturnas causan una mortalidad alta de aves marinas, uno de los grupos de aves en mayor peligro de extinción a nivel mundial. Los polluelos de aves marinas que anidan en madrigueras, y en menor medida los adultos, son atraídos y forzados a aterrizar por las luces cuando vuelan de noche. Revisamos el estado actual del conocimiento sobre la atracción de las aves marinas por la luz para identificar vacíos de información y proponer medidas para resolver el problema. Aunque las especies de familias como Alcidae y Anatidae pueden ser forzadas a aterrizar por la luz artificial, las aves marinas más afectadas son los petreles y las pardelas (Procellariiformes). Por lo menos 56 especies de Procellariiformes, más de un tercio (24) de ellas amenazadas, son propensas al aterrizaje atraídas por las luces. Las aves marinas forzadas a aterrizar han sido halladas en todo el mundo, principalmente en islas oceánicas, pero también en algunas localidades continentales. Los sitios de anidación de los petreles confinados anteriormente a islas deshabitadas están particularmente en riesgo de sufrir contaminación lumínica debido al turismo y al crecimiento urbano. En donde no es práctico prohibir las luces externas, los programas de rescate de las aves accidentadas ofrecen la mitigación más inmediata y empleada para reducir la tasa de mortalidad inducida por la luz y salvar a miles de aves cada año. Estos programas también proporcionan información útil para el manejo de aves marinas. Sin embargo, estos datos están típicamente fragmentados, sesgados y son inciertos, y pueden llevar a estimaciones inexactas del impacto y a un entendimiento pobre del fenómeno de la atracción de las aves marinas por la luz. Creemos que las acciones necesarias de mayor urgencia para mitigar y entender la mortalidad de aves marinas producida por la luz son: la estimación de la mortalidad y los efectos sobre la población; la determinación de umbrales de niveles de luz y de distancias seguras a las fuentes de luz; el estudio del destino de las aves rescatadas; la mejora de las campañas de rescate, particularmente en términos de incrementar las tasas de recogida y el nivel de cuidado; y la investigación sobre las características de la luz para reducir la atracción de las aves marinas.*

Palabras Clave: campaña de rescate, contaminación lumínica, desorientación, iluminación, orientación, petrel

Introduction

The alteration of natural light levels in the environment, or light pollution, has increased dramatically over the last century and has led to the loss of natural nightscapes worldwide (Bennie et al. 2015; Gaston et al. 2015*a*) and affected, for example, individuals' health, populations' time partitioning, interspecific interactions, reproduction, movements, and community structure, thereby causing cascade effects on ecosystem functioning (Longcore & Rich 2004; Gaston et al. 2014, 2015*b*). Accordingly, light pollution is recognized as a great threat to biodiversity (Hölker et al. 2010). One of the most severe ecological consequences of light pollution is light-induced mass fatality events.

Seabirds are among the most endangered groups of birds globally, and Procelariiformes (hereafter petrels) has one of the highest proportions of threatened species (Croxall et al. 2012). The principal threats at sea are commercial fishery operations (e.g., competition and by-catch) and pollution (e.g., oil spills, marine-debris ingestion, and entanglement). On land introduced predators and habitat loss can severely impact breeding colonies (Croxall et al. 2012). The widespread and ever-growing use of artificial light at night is an increasing threat to seabirds. Burrow-nesting petrels are attracted to artificial lights at night, become disorientated, and are forced to land (Imber 1975). This phenomenon, called *fall-out* (Reed et al. 1985), can cause mass-mortality events (Telfer et al. 1987; Ainley et al. 2001; Le Corre et al.

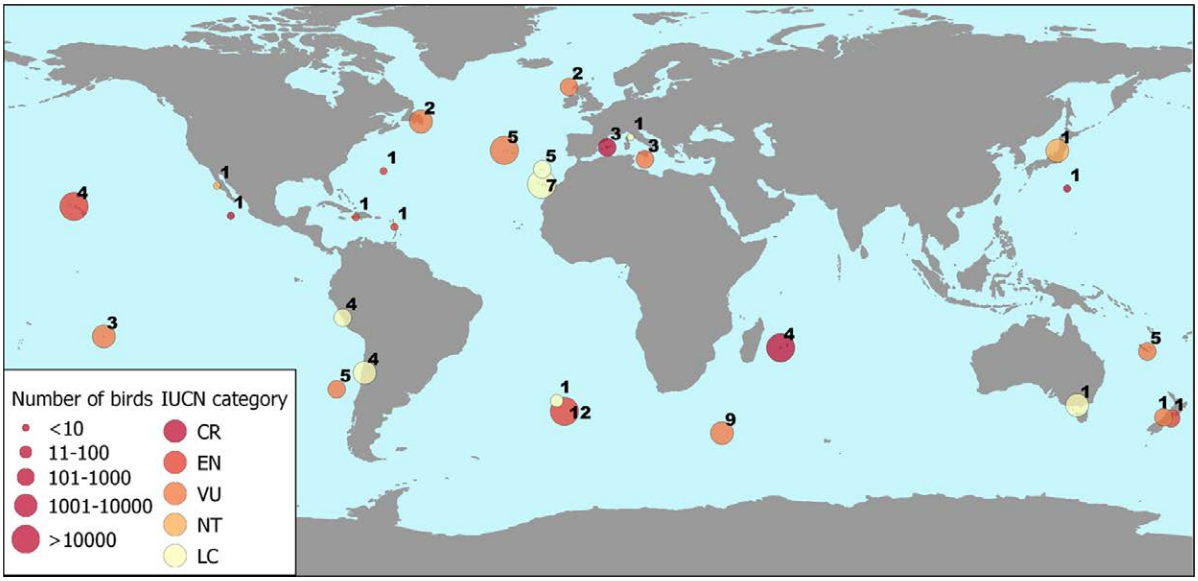

Figure 1. Locations where attraction of seabird fledglings to lights has been reported (numbers, number of species affected; circle size, proportional to number of grounded birds; CR, critically endangered; EN, endangered; VU, vulnerable; NT, near threatened; LC, least concern).

2002; Rodríguez & Rodríguez 2009; Rodríguez et al. 2014). Light-induced grounding can be fatal due to collisions with human-made structures (e.g. buildings, electric wires and pylons, fences, or posts) or the ground. Even if uninjured, grounded birds may be unable to take off again and are vulnerable to predation; vehicle collisions (Rodríguez et al. 2012*b*, 2014); starvation or dehydration (Rodríguez et al. 2012*b*); and poaching (some people eat grounded birds) (M.L-C., personal observation).

We reviewed the state of knowledge and the global impact of seabird mortality induced by land-based artificial light. Specifically, we focused on the global distribution and scale of impacts to seabird species; what is known after four decades of seabird rescue and rehabilitation campaigns worldwide; and what information is needed to better assess and mitigate this growing threat.

Information Sources

To determine the taxonomic diversity of seabirds affected by lights, we consulted the IUCN Red List of Threatened Species website (IUCN 2016) and searched for species affected by light pollution. We refined our search with the terms Aves and light pollution (within excess energy, pollution, and threats categories). We found 15 species assessments: 13 petrels, 1 auklet, and 1 thrush (Supporting Information). We also searched Web of Science for peer-reviewed literature on seabird attraction to light by combining targeted keyword searches (light pollution, artificial light*, seabird*, marine bird*, light*, mortality, attraction, and disorientation). We classified publications as of interest if they dealt with seabird mortality induced by artificial lights and as terrestrial or marine, depending on whether mortality, attraction, or disorientation was caused by land- or marine-based lights. Twenty-one of the 100 publications that emerged from our search at Web of Science dealt with light-induced mortality of seabirds. Fourteen publications were classified as terrestrial and 7 as marine (Supporting Information). Our list was not exhaustive, but it reflected the information available for different taxa. To expand our search, we examined the references in the publications of interest, as well as their citations, and found 9 additional publications.

Rescue efforts (defined as actions taken to recover birds grounded by light attraction, mitigate threats associated with light-induced grounding [road kills, predation, dehydration, starvation, or poaching], and release birds to the ocean) constitute an information source because data collection has been instituted for some projects. We used the internet and social media (Google, Facebook, and Twitter) to search for programs in which citizens are encouraged to rescue and report on grounded birds. We asked them for information on the number of species and individuals, proportion of ages, proportion of the population affected, and mortality rates.

Location, Species, and Age of Grounded Birds

We found that light-induced fatality of seabirds has been recorded on at least 47 islands worldwide, on three continental locations, and across all oceans (Fig. 1).

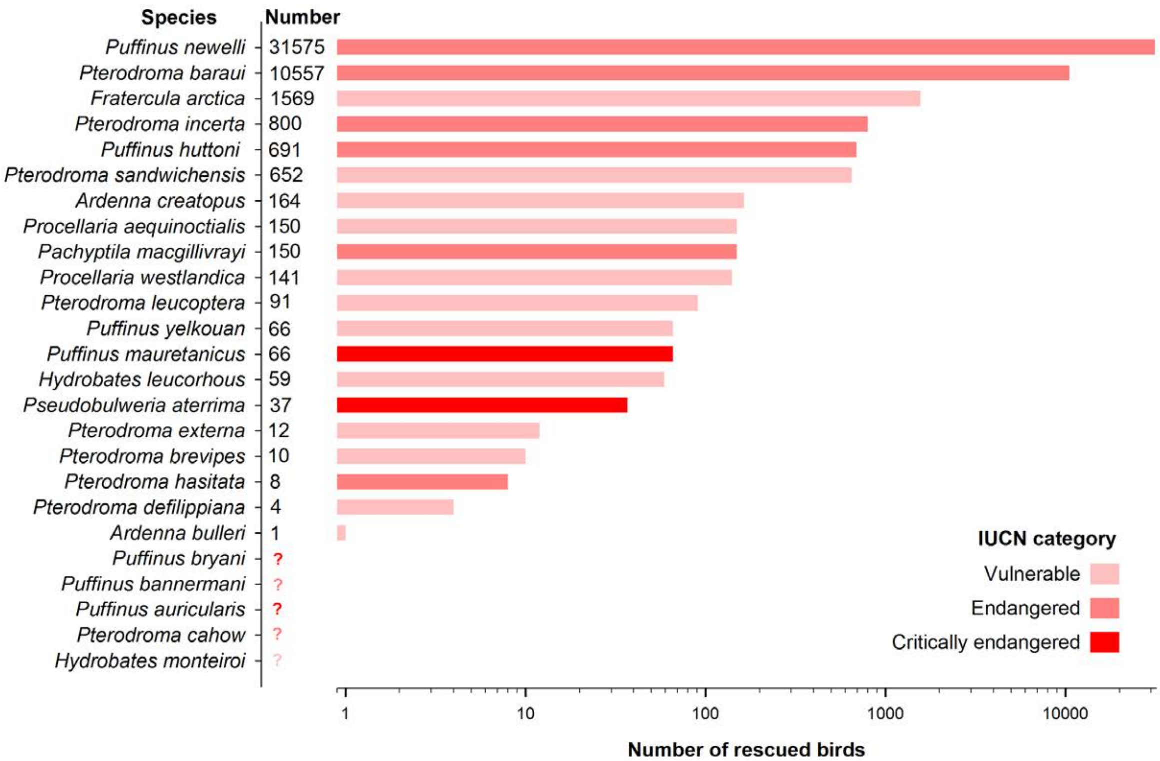

Figure 2. Threatened seabirds (IUCN 2014) affected by light-induced mortality on land (numbers on y-axis, number of grounded birds dead and alive; question mark, species reported to be grounded by light but without quantification).

This phenomenon affects mainly burrow-nesting petrel species (Procellariidae, Hydrobatidae, and Oceanitidae), although other seabirds such as auklets and puffins (Alcidae) and eiders (Anatidae) can also be affected (Dick & Donalson 1978; Whitworth et al. 1997; Merkel & Johansen 2011; Wilhelm et al. 2013). The disproportionate effect on petrels was supported by the scant information on other species. Only 1 of 14 publications classified as terrestrial, and 2 of 15 IUCN species assessments dealt with species other than petrels. Fifty-six of 113 burrow-nesting petrel species have been recorded grounded by lights, an estimate more than double the number reported in previous publications (Reed et al. 1985) and four times higher than the number of species for which this is listed as a problem by IUCN. Twenty-four seabird species subject to light-induced grounds are globally threatened (Fig. 2 & Supporting Information). Attraction to and disorientation by lights of seabirds at sea have also been reported (7 studies report light mortality, attraction, or disorientation at sea), primarily in association with lights being used for fisheries purposes (Ryan 1991; Black 2005; Merkel & Johansen 2011; Glass & Ryan 2013) but also with lights on oil platforms (Wiese et al. 2001; Day et al. 2015; Ronconi et al. 2015). Light-induced mortality at sea is difficult to document (Montevecchi 2006); thus, assessments may be underreported relative to estimates of land-based mortality.

Of the 14 studies focused on light-induced fatalities on land, all documented a greater number of fatalities of fledglings than of adults. Most seabirds affected are fledglings grounded during their first flights from their natal nests toward the ocean. The percentage of affected fledglings in relation to all grounded birds (i.e., fledglings + adults) varies among species from 68% to 99% (Table 1). Rescue programs that target fledglings and collect data on age probably underestimate the number of adults involved, but at most sites it appears fewer adults are affected (Table 1). Thus, presumably, the main functional consequence of light-induced fatality on land is reduced survival after fledging. However, rescue programs should ensure that adults are not ignored by not restricting rescues to the fledging season and by quantifying adult mortality. At sea, light attraction may involve adults and juveniles because some events occur outside fledging periods. None of the 7 marine studies considered the age of birds.

Reasons for Light-Induced Grounding

The reasons for seabird attraction to and disorientation by lights are not well known. Three hypotheses have been proposed. First, artificial light is perceived by birds as a

Table 1. Comparison of results of campaigns to rescue seabirds grounded by artificial light.[a]

Island	Species	Fledglings (%)[b]	Light-grounded fledglings (%)[c]	Mortality of grounded birds (%)[d]	Number of birds rescued[e]	Years[e]	Source
Tenerife, Canary Is.	*Calonectris borealis*	96.4	45.4–60.5; 14	4.8	9,231	9	Rodríguez & Rodríguez 2009; Rodríguez et al. 2015*b*
	Puffinus lherminieri	90.3	20.9–46.9	4.9	144	9	Rodríguez & Rodríguez 2009
	Bulweria bulwerii	68	6.4–8.6	11.8	340	9	Rodríguez & Rodríguez 2009
Reunion Is.	*Pterodroma baraui*	98.9	20–40	10	1,643	4	Le Corre et al. 2002
	Puffinus balloni	82.2; 95	10–17	7.9; 12	13,221	20	Le Corre et al. 2002; Gineste et al. 2016
São Miguel, Azores	*Calonectris borealis*	n.a.	16.7	14	769	2	Rodrigues et al. 2012
Faial, Azores	*Calonectris borealis*	n.a.	19.7	4	1,236	1	Fontaine et al. 2011
Kauai, Hawaii	*Puffinus newelli*	97	15	9; 43[g]	11,767	8	Telfer et al. 1987; Ainley et al. 2001
Pico, Azores	*Calonectris borealis*	n.a.	15.2	8	1,547	1	Fontaine et al. 2011
Robison Crusoe Is.	*Ardenna creatopus*	73.7	0.5–1.1	41	164	4	P. Hodum, personal observation
Phillip Is., Australia	*Ardenna tenuirostris*	n.a.	0.39–0.70	39[g]	8,871	15	Rodríguez et al. 2014
Balearic Is.	*Puffinus mauretanicus*	n.a.	0.38–0.7	8.5	66	15	Rodríguez et al. 2015*a*
	Calonectris diomedea	n.a.	0.26–0.49	8.5	199	15	Rodríguez et al. 2015*a*
	Hydrobates pelagicus	n.a.	0.09–0.27	8.5	39	15	Rodríguez et al. 2015*a*
Tahiti	*Pseudobulweria rostrata*	95	n.a.	9	981	11	L. Faulquier, personal observation
Newfoundland	*Fratercula arctica*[f]	n.a.	n.a.	8.2	522	2	Wilhelm et al. 2013
Antofagasta region	*Hydrobates hornbyi*	n.a.	n.a.	5	1,122	7	C. Guerra-Correa, personal observation

[a] *Values separated by a semicolon are estimates of different studies listed at the end of the row.*
[b] *Percentage of fledglings in relation to the total number of grounded birds (i.e., including adults and fledglings).*
[c] *Percentage of fledglings grounded by lights in relation to the total of fledglings annually produced by the population. Ranges are given because of different breeding population size estimates (maximum and minimum).*
[d] *Reported as dead or dying during the rescue.*
[e] *The number of birds and number of years of data collection are given to provide an idea of the reliability and robustness of the values in the table.*
[f] *Not a petrel species.*
[g] *Mortality rate based on systematic searches for grounded birds.*

source of food (i.e., bioluminescent prey). Procellariiform chicks are fed by regurgitation, but they do not receive parental care after fledging. Thus, they must learn to find food for themselves at sea. Some species grounded by lights consume bioluminescent prey, and inexperienced fledglings may confuse artificial lights for their natural bioluminescent prey (Imber 1975).

Second, for the first months of life, the only light cavity-nesting seabirds see is light streaming in from the burrow entrance. All a nestling's meals, brought by the parents, also arrive via that entrance; thus, food is associated with light and newly fledged birds might confuse artificial lights with a food source (D. Ainley, personal communication).

Third, artificial lights could override the ambient light of the moon, stars, or other stellar objects near the horizon. Thus, seabirds could lose the visual cues needed for finding the ocean, or even incorrectly use artificial lights as navigational cues (Telfer et al. 1987). In support of this hypothesis, generally seabirds do not crash directly into lights as they would do if they had confused them for prey. When they fly over lit areas or near bright lights, they seem blinded or disoriented and collide with structures such us walls, antennas, trees, or the ground. The fact that the number of grounded birds is lower when the moon is full, when artificial lights are less prominent relative to moonlight, also supports this hypothesis. The low contrast between artificial lights and the night sky during a full moon may make artificial lights less attractive to inexperienced seabirds looking for food, which also supports the food-source hypotheses. However, food-source hypotheses do not explain why birds older than fledglings also are affected.

Mitigation Measures

The impact of light pollution on seabirds can be reduced following a hierarchical mitigation plan organized (IUCN 2014) around the following actions: avoidance, minimization, rehabilitation, offsets, and supporting of conservation actions.

Avoidance

Avoidance entails measures taken to avoid creating impacts. In planning of new developments, avoidance includes identifying and not deploying light systems associated with bird groundings. For existing developments, unnecessary lights are removed or turned off when they are spatially and temporally unnecessary (Table 3). Obviously, the best way to mitigate light attraction is to remove all sources of artificial light. This is impractical in most areas, but virtually all external lights can be eliminated in some situations, such as small research stations on remote islands. For example, the number of birds affected on Marion and Gough Islands was greatly reduced once outside lights were removed and all windows were fitted with blackout blinds that are closed each evening before full dark (Cooper & Ryan 1994). Reducing the use of lights at night has also greatly reduced collisions with vessels fishing around seabird breeding islands (Glass & Ryan 2013).

Minimization

Minimization measures reduce the duration, intensity, or extent of the effects of artificial lights on seabirds. Removing all external lights in urban areas is difficult due to human safety concerns. Some progress has been made, nonetheless, in sparsely populated rural areas, such as Cilaos, Reunion, Indian Ocean, where streetlights are turned off during the fledging period of the Barau's Petrel (*Pterodroma baraui*) (M.L-C., personal observation). On Kauai, Hawaii, to avoid attracting Newell's Shearwaters (*Puffinus newelli*) to light, recreational events that previously occurred at night are being held during daylight hours (The Associated Press 2010) and legal action is underway to remove of unnecessary lights (Department of Justice 2010). Even though complete removal of external lighting is unpopular or impractical, reducing light emissions (i.e., turning off or shielding lights) can help limit the number of affected birds. Shielding and other light-source manipulations seek to achieve necessary illumination for humans while reducing light emissions visible to birds (e.g., reducing light projected toward the sky or onto reflective surfaces and automated features to turn off lights when they are not required) (KSHCP 2016). The number of grounded Newell's Shearwaters decreased by 40% when the main lights of a tourist resort at Kauai were shielded (Reed et al. 1985). On St Kilda Island, Scotland, reduced light emissions resulted in a decrease in the numbers of grounded Leach's Storm-Petrels (*Hydrobates leucorhous*) but not Manx Shearwaters (*Puffinus puffinus*) (Miles et al. 2010). Turning off streetlights along the 600-m-long bridge connecting Phillip Island to the Australian mainland reduced the number of grounded Short-tailed Shearwaters (*Ardenna tenuirostris*) (Rodríguez et al. 2014).

Identifying key temporal and spatial overlaps between seabirds and lighting is necessary to minimize risk. On a seasonal scale, it includes focusing measures on the time of year when fledgling occurs. On a nightly scale, minimizing light during the first few hours of darkness appears to reduce the attraction of fledglings of some species, although the timing of fledging is not well known for most seabird species (i.e. early or late at night). Most Cory's Shearwater (*Calonectris borealis*) fledglings GPS-tracked and grounded in lit areas initiate their flights toward the ocean during the first hours of darkness (Rodríguez et al. 2015*b*), coinciding with times of peak light pollution. Also on Kauai, the number of grounded Newell's

Shearwater fledglings reached a peak 2–3 hours after sunset (Reed et al. 1985). Thus, it seems that the benefits of partial night lighting (i.e., lights being switched off or dimmed when human activity is lower) could be limited for petrels, as for some bat species (Azam et al. 2015; Day et al. 2015).

Another way to minimize the number of grounded birds may be to change the spectral composition of lights, as it has been done for passerines (Poot et al. 2008; Doppler et al. 2015), although evidence for seabirds is scarce (Reed 1986, 1987). On Reunion Tropical Shearwaters (*Puffinus bailloni*) seem to be less attracted to red and yellow lights than to green and blue lights (Salamolard et al. 2007). On the Juan Fernández Islands, Chile, white streetlights around seabird colonies have been changed to red and recently to green lights, and grounding rates appear to have declined, although on a small spatial scale (P.H., personal observation).

Rehabilitation

Rehabilitation of individuals grounded by artificial light is a common feature of rescue campaigns. Rescue and rehabilitation reduce light-induced fatalities by reducing risk of death from predation, vehicle collision, or starvation and dehydration after grounding. Implementation and coordination of these programs vary among locations, but typically the general public takes grounded birds to designated rescue stations (e.g., fire or police station, town hall, or collaborating entities) or report them to qualified personnel. In small areas or nature parks, rescues can be conducted by qualified personnel directly (Miles et al. 2010; Rodríguez et al. 2014). After assessment of their condition, collected birds are released from seaside cliff tops in daylight or in a colony at night. To encourage participation and to raise awareness among lay people, dissemination and outreach activities are conducted that involve news stories; advertisements in local media, cinemas, social networks, and online; seminars and talks in primary and high schools; distribution of posters, stickers, and T-shirts; and publicity regarding releases of rescued birds.

The first rescue program was established in 1978 on Kauai (Telfer et al. 1987) and, since then, programs have been established in 16 locations for 34 species (Fig. 1 & Supporting Information). Thousands of seabirds have been collected and released by program participants (Table 2 & Supporting Information), and mortality rates for the populations involved have been reduced. The absence of these programs would increase mortality rates, and modeling studies suggest that not having these programs may affect populations negatively (Ainley et al. 2001; Fontaine et al. 2011; Griesemer & Holmes 2011). For the Tropical Shearwater, the rescue and release of 11,638 fledglings during the last 20 years is believed to have played an important role in maintaining a stable population (Gineste et al. 2016). These rescue programs alone are not an adequate response to the threat of fallout because not all birds subject to fallout are collected by these programs, not all birds collected survive, and postrelease survival of fallout birds remains largely untested.

Offsets

Offsets compensate for adverse impacts that cannot be avoided or minimized and for birds or areas that cannot be rehabilitated. Offsets should be implemented once avoidance, minimization, and rehabilitation measures have been exhausted (IUCN 2014). Examples of such compensatory actions include the control of predators at colonies (Holmes et al. 2016), shielding of coastal powerlines by planting trees (D. Ainley, personal communication), burying of powerlines near breeding areas (P.D., personal observation), provision of additional nesting habitat (e.g., artificial nests), and restoration of degraded breeding habitat to compensate for light-induced mortality by increasing breeding success and breeding habitat.

Supporting Conservation Actions

Actions that support conservation have positive effects but the level of effect is difficult to quantify. The qualitative outcomes of such measures do not fit easily into the mitigation hierarchy but may provide crucial support to the reduction of the effects of light pollution when they provide pertinent information on species' ecology or assess the effectiveness of management actions (The Biodiversity Consultancy 2016). On Kauai and Reunion, electricity companies have funded rescue programs and research to improve knowledge of the affected species and threats to these species (Ainley et al. 2001; Le Corre et al. 2002, 2003; Day et al. 2003). Ecotourism based on the seabirds affected by grounding may also lead to reductions of light-induced mortality. The added value of ecotourism to local economies could favor conservation-oriented lighting policies that otherwise would be opposed by local residents.

Estimating the Magnitude of the Problem

Quantifying the magnitude of fallout (i.e., the proportion of fledglings grounded by lights each year) and light-induced mortality is critical for the conservation and the management of susceptible species (Le Corre et al. 2002). The majority of existing data come from rescue programs, for which the goal is remedial action by the community not necessarily systematic monitoring. Obtaining accurate information is difficult and data are usually biased for several reasons.

Table 2. Number of grounded seabirds recorded by rescue workers by species and location.[a]

Species	IUCN category[b]	Total grounded birds	Location	Birds collected per year[c]	Maximum grounded[d]
Calonectris borealis	LC	64267	Tenerife, Canary Is.	948	1765
			São Jorge, Azores	923	1701
			Pico, Azores	884	1632
			São Miguel, Azores	668	1254
			Faial, Azores	653	1236
			Corvo, Azores	216	598
			Terceira, Azores	188	433
			Flores, Azores	163	342
			Graciosa, Azores	153	410
			Santa Maria, Azores	129	270
			La Palma, Canary Is.	64	104
			Madeira	57	67
			Porto Santo, Madeira	2	7
Puffinus newelli	EN	31575	Kauai, Hawaii	831[e]	2235
Puffinus bailloni	LC	12363	Reunion	642	1132
			Tahiti	7	28
Pterodroma baraui	EN	10557	Reunion	556	976
Ardenna tenuirostris	LC	9304	Phillip Island	547	1233
Pachyptila vittata	LC	7575	Gough Island	242	500
			Tristan da Cunha	2	10
Ardenna pacifica	LC	2870	New Caledonia	131	261
			Maui, Hawaii	56	93
			Kauai, Hawaii	41	78
			Réunion	15	37
Hydrobates hornbyi	DD	1660	Antofagasta	160	241
			Lima	77	200
Calonectris leucomelas	NT	1609	Awashima	402	1146
Fratercula arctica[f]	VU	1569	Newfoundland	314	825
Pseudobulweria rostrata	NT	1398	Tahiti	58	362
			New Caledonia	6	10
Pelecanoides urinatrix	LC	1265	Gough Island	40	150

Continued

Table 2. Continued

Species	*IUCN category*[b]	*Total grounded birds*	*Location*	*Birds collected per year*[c]	*Maximum grounded*[d]
Pelagodroma marina	LC	1037	Gough Island	32	100
			Tenerife, Canary Is.	4	7
Bulweria bulwerii	LC	901	Tenerife, Canary Is.	32	55
			Madeira	30	41
			La Palma, Canary Is.	3	5
			Porto Santo, Madeira	3	6
Pterodroma mollis	LC	825	Gough Island	26	50
			Marion Island	1	2
Pterodroma incerta	EN	800	Gough Island	26	50
Pachyptila salvini	LC	750	Marion Island	24	50
Puffinus huttoni	EN	691	Kaikoura, NZ	63	274
Pterodroma sandwichensis	VU	652	Maui, Hawaii	19	99
			Kauai, Hawaii	8	29
Puffinus lherminieri	LC	562	Tenerife, Canary Is.	18	45
			Madeira	3	4
			La Gomera, Canary Is.	2	5
			La Palma, Canary Is.	2	6
			Porto Santo	1	5
			Lanzarote, Canary Is.	1	2
			Gran Canaria, Canary Is.	1	3
			Fuerteventura, Canary Is.	1	3

[a]We compiled this list through interviews with groups working on seabird rescue and extracted some data from scientific literature and websites (sources are in Supporting Information). It includes only species listed on the International Union for Conservation of Nature's Red List (IUCN) (2014) for which over 500 birds were subject to grounding. For a more exhaustive list see Supporting Information.
[b]Abbreviations: EN, endangered; VU, vulnerable; NT, near threatened; LC, least concern; DD, Data deficient).
[c]Average number of birds collected (dead and alive) during the rescue campaign years (note that it is variable depending on the species and location; see Supporting Information for details).
[d]Maximum number of birds grounded in a single breeding season.
[e]Given the decline of P. newelli during the last decades, the current annual number of grounded birds is around 100–150 individuals.
[f]A non-petrel species.

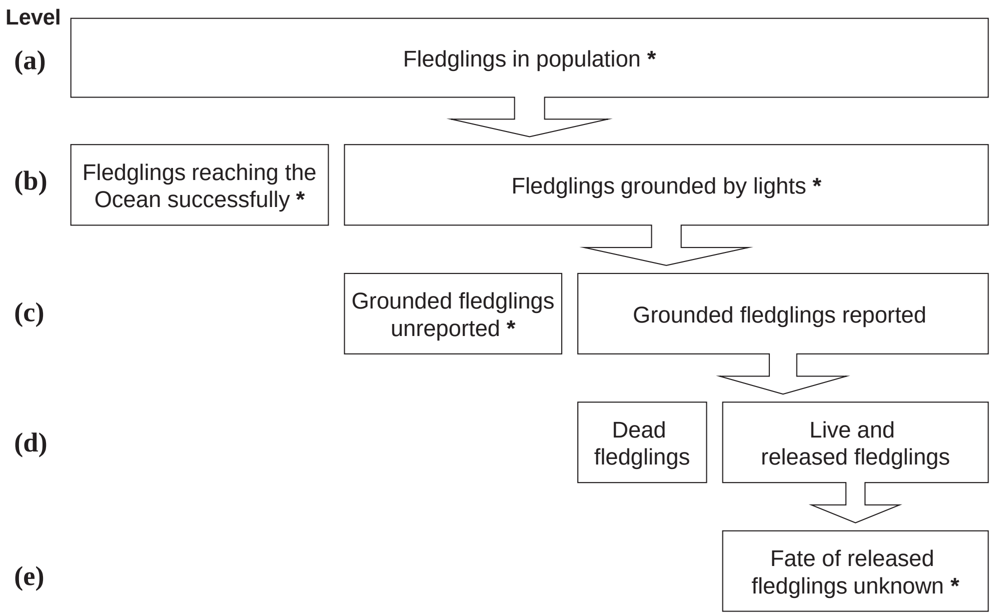

Figure 3. Hierarchical levels of sources of uncertainty in the estimation of the impact of light pollution on seabirds. Length of bar at A represents the total number of fledglings produced annually at the population. In subsequent levels, the boxes represent equal or lower numbers of fledglings than at level a (, steps where estimating the number with accuracy is difficult).*

The number of fledglings produced by a population is hard to estimate for many affected species (Fig. 3, level a). Colony locations are not always known and when they are known estimating breeding success without substantial disturbance of birds is hindered by the birds' nocturnal, cryptic, and burrow-nesting behavior. For some species, nest chambers are difficult to reach, multiple burrows may have a single narrow entrance, and colonies are often located in remote and inaccessible places (Brooke 2004).

The number of grounded fledglings is hard to record accurately and is consequently underreported (Fig. 3, level b). The real number of fledglings grounded by lights (Fig. 3, level b) must be at least equal to the number of grounded fledglings reported on the rescue campaigns (Fig. 3, level c). Accuracy of grounding numbers depends on the rescue effort. Determining the number of grounded fledglings requires an effective monitoring program that defines the area of impact, the search area, the probability of a carcass being found, and how quickly a bird may disappear due to predation, scavenging, or decay. Rescue campaigns are usually conducted by volunteers; thus, their success depends on public awareness. On Tenerife, Canary Islands, very few petrels of three species were reported during the first 2 years of implementation of a rescue program, likely due to a lack of awareness by the general public during that period (Rodríguez et al. 2012*c*). Such a pattern is not uncommon and has been reported in other long-term programs, such as those on Kauai and Reunion (Telfer et al. 1987; Le Corre et al. 2002). Grounded fledglings tend to spend daylight hours hiding in dense vegetation, holes, or crevices and are thereby easily overlooked by rescuers (Reed et al. 1985). Smaller seabird species (such as Storm-Petrels) may be harder to find and consequently may be substantially underrepresented in data sets.

Systematic searches for birds conducted by qualified personnel can increase the proportion of dead birds found during rescue campaigns (Fig. 3, levels c and d) because lay people may be less likely to report dead birds either because they are not aware of the importance of doing this or because corpses are less visible or unpleasant to handle (wet, bloody, decomposing, malodorous). On Kauai opportunistic surveys via the general public rescue program for Newell's Shearwaters identified 7.7% mortality of the collected birds, whereas systematic searches revealed 43% mortality (Podolsky et al. 1998; Ainley et al. 2001). On Phillip Island, Australia, systematic searches revealed a higher mortality (39%) of short-tailed Shearwater fledglings than in other opportunistic rescue programs (Table 1) (Rodríguez et al. 2014).

From an environmental management point of view, assessing the fate of rescued fledglings once they released into the wild is crucial, but studying this topic is challenging because of long-term recruitment and inaccessibility to colonies and nests. Thus, the fate of recovered fledglings is unknown (Fig. 3, level e) even though thousands of birds have been banded and released during rescue campaigns (Ainley et al. 2001). Some birds rescued and banded at rescue programs as fledglings have recruited as breeders (A.R., M.L-C., and A.F.R., personal observations), but these observations are too anecdotal to allow for recruitment estimates. However, they demonstrate that an unknown proportion of grounded birds survive after being released.

Despite these sources of uncertainty, rough estimates of the proportions of populations affected have been made based on the number of grounded fledglings reported and estimates of breeding population size and breeding success (the latter 2 normally taken from the literature). Some studies use correction factors to control for unreported birds, either dead or never found (Podolsky et al. 1998). Estimates of the percentage of fledglings affected vary from 0.1% to 60.5% of annual production, although these numbers are rarely estimated empirically (Table 1).

Petrels are long-lived species; consequently, the most important threats are those that affect adult survival (Brooke 2004). However, light-induced mortality of fledglings is a fatality source, which, in addition to other threats, could threaten the survival of some petrel populations (Simons 1984; Ainley et al. 2001; Fontaine et al. 2011; Griesemer & Holmes 2011). To quantify the impact of light pollution relative to other threats, population models have been used for the Hawaiian Petrel (Simons 1984), Newell's Shearwater (Ainley et al. 2001; Griesemer & Holmes 2011), and Cory's Shearwater (Fontaine et al. 2011). These models identified significant impacts to population growth rates when fallout threats were considered alone, primarily because of the number of birds expected to be subject to this threat as a proportion of the total population.

Temporal and Spatial Distribution of Fallout

Fallout predominantly coincides with the fledging season of the affected species. Numbers grounded usually show a normal distribution throughout the fledging season, corresponding with the population spread of fledging dates. The most important factor affecting this pattern is moon phase; fewer birds are grounded when the moon is full than when there is a new moon (Telfer et al. 1987; Le Corre et al. 2002; Rodríguez & Rodríguez 2009; Miles et al. 2010; Murillo et al. 2013; Rodríguez et al. 2014). As a result, the total number of grounded birds in a season is generally lower when the full moon coincides with the peak of fledging (Ainley et al. 2001; Rodríguez et al. 2012*c*).

Rescue campaigns also show where most grounded birds fall out (Ainley et al. 2001; Troy et al. 2011, 2013; Rodríguez et al. 2012*c*). In general, most grounded birds are found in well-lit coastal areas (Rodríguez & Rodríguez 2009; Rodrigues et al. 2012; Laguna et al. 2014; Rodríguez et al. 2015*a*), although some species are grounded at high elevations (e.g., Barau's Petrel and Mascarene Black Petrel [*Pseudobulweria aterrima*] at 1500 m asl on Reunion [Le Corre et al. 2002, 2003; Riethmuller et al. 2012]; Ringed Storm-Petrel [*Hydrobates hornbyi*] at 3052 m asl on Huaraz in the Andes [Y.M., personal observation]). Efforts to model the spatial fallout distribution generally show positive relationships with light pollution levels taken from satellite imagery (Rodrigues et al 2012; Troy et al. 2011, 2013). The spatial distribution of breeding colonies and their proximity to lit areas (directly adjacent or on transit routes out to sea) also plays a crucial role in determining the severity of the light-induced impact on seabirds. Fledglings from inland colonies typically are more likely to be grounded by lights than birds hatched in colonies located on seaward cliffs or slopes (Rodríguez et al. 2015*a*, 2015*b*). Some fledglings could reach the ocean and be attracted back to land by coastal lights (Baccetti et al. 2005; Rodríguez et al. 2014). In some cases, this type of attraction may be a large proportion of total fallout on the island (Troy et al. 2013). However, tracked flights of Cory's Shearwater fledglings from nests to grounding locations suggest birds were grounded on the night they fledge and very close to their natal burrows (Rodríguez et al. 2015*b*).

Making the Most of Rescue Programs

Rescue programs help mitigate light-induced mortality, but alone they cannot completely eliminate fatalities. Rescue programs also represent opportunities to advance conservation knowledge for poorly known or rare species. Such knowledge would otherwise be too expensive or intractable to acquire. For many years, the best evidence of reproduction for many rare petrel species came from birds grounded by artificial lights (e.g. Mascarene Black Petrel on Reunion [Le Corre et al. 2003; Riethmuller et al. 2012], Tahiti Petrel (*Pseudobulweria rostrata*) on Tahiti [Villard et al. 2006], and Manx Shearwater on Tenerife [Rodríguez et al. 2008]). The breeding grounds of the Ringed Storm-Petrel have never been found (Brooke 2004), but it is known from grounded fledglings delivered to rehabilitation programs in Peru and Chile that its fledging season is April–July (Murillo et al. 2013), which provides useful guidance on the appropriate time to search for its enigmatic breeding sites.

Because of the remoteness and inaccessibility of the colonies of some rare and secretive petrel species, ground-based population monitoring is limited. Records of the number of fledglings reported by rescue campaigns can be used as a population index because they reflect overall population size (number of fledglings produced cannot exceed the number of breeding pairs because petrels lay 1 egg/breeding attempt) and breeding success (a small number of fledglings could indicate a year of poor breeding success) (Day et al. 2003). Thus, declining trends in the number of grounded fledglings have been interpreted as indicative of declining populations. On Kauai, Newell's Shearwater numbers have decreased on some parts of the island, a trend probably related to a reduction in breeding pairs or extirpation of nearby colonies (Ainley et al. 2001; Day et al. 2003). On Tenerife, the number of Macaronesian Shearwaters (*Puffinus lherminieri baroli*) rescued has decreased since rescue campaigns started, suggesting its population is declining (Rodríguez et al. 2012*c*). However, an increase in the number of grounded birds is difficult to interpret because, usually, light-pollution levels and public awareness increase in parallel with reported numbers. Thus, the increases of Newell's Shearwaters recovered from the north shore of Kauai during the 1980s and Cory's Shearwaters on Tenerife from 1990 to 2010 were interpreted as a consequence of increasing urbanization and greater public awareness rather than an increase in breeding population or reproductive success (Ainley et al. 2001; Rodríguez et al. 2012*c*).

Despite light- emission reductions, enhancement of rescue campaigns, and other mitigation measures, artificial lights will inevitably cause fatalities. The fledglings that die constitute a homogeneous sample that can provide information on marine processes during the period they were raised because fledglings grounded during a given season belong to the same cohort. Thus, they could be used as indicators of marine environmental condition in long-term monitoring programs on epidemiology, pollution, marine productivity, or foraging ecology. Dead Cory's Shearwaters have been used to study plastic ingestion. Results of these studies show that parents transfer marine litter to fledglings and demonstrate plastic contamination in the food web of a human-exploited ecosystem (fishing), the Canary Current (Rodríguez et al. 2012*a*). Similarly, dead Newell's Shearwaters have provided insights into the diet and plastic ingestion of this endangered species (Ainley et al. 2014; Kain et al. 2016).

Future Research

As our findings emphasize, attraction of seabirds to artificial lights is poorly understood. Future research should focus on the following key areas: biology and ecology of susceptible species; effects of light intensity and spectra on grounding; improving rescue effort and rehabilitation and fate of rescued birds.

A lack of information on the biology and ecology of susceptible species is a primary problem. Without basic information on the location of colonies, breeding population sizes, and reproductive success, it is difficult to estimate the severity of light-induced mortality (Fig. 3). Intensive monitoring programs have shed some light on these topics for some species such as the Newell's Shearwater on Kauai and Barau's Petrel and Mascarene Black Petrel on Reunion.

In the absence of better information, light intensity has been mapped by nocturnal satellite imagery to better understand spatial fallout patterns (Rodrigues et al. 2012; Troy et al. 2011, 2013; Rodríguez et al. 2015*a*, 2015*b*). Although a higher impact, measured as the number of grounded fledglings, has been observed in areas with much light pollution (Rodrigues et al. 2012; Troy et al. 2011, 2013), the potential relationship between light intensity and the distance over which birds are attracted is poorly known because of the difficulty in tracking birds. For Cory's Shearwater fledglings on Tenerife, a positive correlation between light intensity and flight distance from nests to grounding location is reported (i.e., stronger lights attracted birds from farther away [Rodríguez et al. 2015*b*]). Understanding the relationship between light intensity and the distance over which birds are attracted has important implications for the management of the problem because it would allow quantification of the exposure of dark areas and colonies to light pollution.

Artificial lights are usually mapped in terms of light intensity with respect to human vision, but attention also needs to be paid to the spectra of lights responsible for seabird groundings. Given the differences in light sensitivity between seabirds and humans (Reed 1986), finding appropriate light spectra that minimize the stimulation of seabird photoreceptors may reduce the number of birds grounded by lights (studied in passerines [Poot et al. 2008; Doppler et al. 2015]). However, taxon-specific responses to light spectra and colors likely exist. Light characteristics that reduce the attraction for some avian groups (e.g. green lights for passerines [Poot et al. 2008]) may be more attractive to seabirds. Rigorous studies need to be designed to understand which light colors and spectra are most effective at reducing fallout, taking into account potential taxon-specific differences.

Rescue protocols vary on the basis of the number of rescued birds, species-specific needs, and amount of resources allocated to the campaign (personnel, facilities, and materials). From rescue to release, every step should be evaluated to maximize the survival of rescued birds. For instance, different materials used for rescue boxes (including wood, wire net, plastic, or cardboard) could have different effects on the waterproofing capacities of the plumage. For some species, food and liquids are provided if individuals are under a predetermined body-mass threshold (Rodríguez et al. 2017). Finally, time from rescue to release may be critical (Rodríguez et al. 2012*b*, 2015*a*, 2017), especially if veterinary care, liquids, or food are not provided. Thus, materials used in the boxes, body-mass thresholds, and release times should be based on scientific evidence.

After fledging, petrels spend several years at sea before returning to their breeding grounds. Because petrels generally breed underground, visit their colonies at night, and their colonies are generally difficult to access,

Table 3. Mitigation measures to reduce effect of artificial light in areas close to seabird colonies.

Measures to minimize artificial light effects	*Result*	*Level of effectiveness*	*Example*	*Reference*
Turning off lights during fledging period	prevents light attraction of fledglings	high	On Kauai, Hawaii, lights at all county sports facilities are turned off during peak fledging of *Puffinus newelli*. In Cilaos, Reunion Is., street lights are turned off during the fledging season of *Pterodroma baraui*. The street lights on the Phillip Is., Australia, bridge are turned off during fledging season of *Ardenna tenuirostris*	The Associated Press 2010; M. Le Corre, personal observation; Rodríguez et al. 2014
Banning external lights; blinds on windows with internal lights	prevents light attraction and window collision	high	Shielding windows on St Kilda Island reduced storm petrel strikes. Removing external lighting and requiring blinds to be closed at night virtually eliminated night strikes at South African research stations on Gough and Marion Islands. Similar measures on ships offshore (external lights limited to running lights only) also greatly reduced collisions with vessels	Cooper and Ryan 1994; Miles et al. 2010; P.G. Ryan, personal observation
Shielding the light sources	prevents light escaping upwards, minimizing light attraction	high	Reduction of 40% of *Puffinus newelli* groundings at a hotel.	Reed et al. 1985
Reducing traffic speed limits and displaying warning signals	reduction of road kills of seabirds grounded by lights	high	*Ardenna tenuirostris* road kills were reduced at sections of road under management regulations.	Rodríguez et al. 2014
Collaboration with rescue programs	rescue of grounded birds by rehabilitation and minimizing incidental threats	high	Thirty-four species benefit from rescue efforts worldwide (Table 1).	Telfer et al. 1987; Rodríguez & Rodríguez 2009; Rodríguez et al. 2014; Gineste et al. 2016
Modification of light characteristics	prevents collision and melatonin suppression with health and fitness consequences	not assessed	Several experiments report inconclusive results in seabirds, for example, for *Puffinus newelli*. Several studies show negative effect on other bird taxa.	Reed 1986; Poot et al. 2008; Doppler et al. 2015; Dominoni et al. 2016
Change of rotating beams of lighthouses by strobe or intermittent flashing signals	minimizes light attraction	not assessed	Light attraction of birds has decreased at flashing lights.	Montevecchi 2006
Keep light intensity as low as possible on outside areas	minimizes light attraction and potential blindness caused by too bright lights	not assessed	In general, seabirds are grounded in very brightly lit areas.	Rodrigues et al. 2012; Troy et al. 2013

unknown, or densely populated, following the fate of rescued birds is extraordinarily challenging. Ringing may help, especially in locations where monitoring programs are conducted on colonies. Satellite transmitters could be used to track and estimate survival of birds, at least during their first months at sea. Unfortunately, the high costs of satellite transmitters (>$3000 each) make large-sample projects prohibitively expensive.

Because most rescue campaigns are coordinated and carried out by people who are not scientists (e.g., local governments, environmental nongovernmental organizations, volunteers), analyses of their data are rarely published and scientific protocols are not followed rigorously. Combining rescue program information with rigorous scientific methods is crucial to better quantify the impact of light pollution on seabirds. Banding and tracking nestlings as they leave their natal colonies may improve understanding of maiden-flight characteristics (distances traveled, timing, or fatality areas [e.g., Rodríguez et al. 2015*b*]). Radar can also be used to monitor and quantify light attraction (e.g., Day et al. 2003, 2015). Remote sensing provides detailed information that has improved knowledge of the spatial distribution of light pollution (DMSP, VIIRS, EROS-B satellite imagery, or ISS photos [Kyba et al. 2014]), which is needed for a better assessment of light levels in the pathways to the ocean or colonies (Rodrigues et al. 2012; Troy et al. 2013; Rodríguez et al. 2015*a*). Despite the relatively large number of reports describing fallout patterns, further scientific studies should aim to unravel this problem, especially by focusing on rare species with limited biological information and on breeding grounds in different geographic locations (continental vs. insular, high vs. low altitude, coastal vs. inland, aggregated vs. sparse).

Conclusions

Artificial night lighting is a conservation problem for petrels; least 56 species are affected, including 24 classified as threatened on the IUCN Red List. However, light pollution affects other species, and determining the extent of the problem would be valuable. Without rescue programs, light pollution would have resulted in the death of at least 200,000 seabirds worldwide since rescue programs were established. Although light-related fatalities may be low relative to other human-induced mortality factors, such as bycatch and predation by introduced species, even a few light-related fatalities could have large negative effects on isolated seabird populations and endemic and endangered species (Gineste et al. 2016). Rescue programs are the most common mitigation measure used to reduce the risk of mortality once birds are grounded, but this action alone is insufficient to overcome the threat from artificial light. Avoidance and minimization measures are effective but are not commonly employed. Consideration of lighting impacts on seabirds should be included in the planning of new developments near petrel breeding areas (Table 3). Despite being a well-known problem for decades, understanding of why seabirds are attracted to lights and how best to mitigate light impacts is limited. More research is necessary to improve understanding of this human-wildlife conflict and to design appropriate and effective management and mitigation measures (Table 3). This is crucial given the critical conservation status of seabirds, particularly petrels (Croxall et al. 2012), and the ongoing global increase in light pollution (Falchi et al. 2016). Meanwhile, the general public and local governments should help reduce attraction to light and subsequent fatality through simple actions such as dimming, shading, or turning lights off at critical times of the year.

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Supporting Information

Information from rescue programs and anecdotal observations of species involved (Appendix S1), list of consulted organizations and researchers involved in rescue programs or studying seabird attraction to light (Appendix S2), IUCN list of Procellariiformes indicating whether they are burrow-nesting species and affected by artificial lights (Appendix S3), species assessments derived from our search of the IUCN Red List of Threatened Species website (Appendix S4), and a list of publications we identified on seabird mortality induced by marine- or land-based lights (Appendix S5). The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

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Appendix C

Avian Protection Plan for Activities Covered by the Kaua‘i Island Utility Cooperative’s Habitat Conservation Plan

DRAFT

AVIAN PROTECTION PLAN FOR ACTIVITIES COVERED BY THE KAUAʻI ISLAND UTILITY COOPERATIVE'S HABITAT CONSERVATION PLAN

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Contents

Page

Acronyms and Abbreviations

AMM	Avoidance and minimization measures
APP	Avian Protection Plan
CFR	Code of Federal Regulations
DLNR	Department of Land and Natural Resources
DOFAW	Division of Forestry and Wildlife
ESA	Endangered Species Act
FR	Federal Register
HCP	Habitat Conservation Plan
HPS	High pressure sodium vapor
HRS	Hawaiʻi Revised Statutes
ITL	State Incidental Take License
ITP	Federal Incidental Take Permit
Kauaʻi	Island of Kauaʻi
KIUC	Kauaʻi Island Utility Cooperative
LED	Light-emitting diode
MBTA	Migratory Bird Treaty Act
SOS	Save Our Shearwaters
State	State of Hawai'i
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service

1. Introduction

The Kauaʻi Island Utility Cooperative (KIUC) is a not-for-profit, tax-exempt cooperative association governed by a publicly elected nine-member Board of Directors.[1] As a public utility responsible for the production, purchase, transmission, distribution, and sale of electricity on the island of Kauaʻi (Kauaʻi), KIUC is regulated by the State of Hawaiʻi (state) Public Utility Commission, and is required by law to provide and ensure the availability of electrical service on the island of Kauaʻi. KIUC is entirely owned by its members, which total approximately 34,000 ratepayers. To ensure reliable electrical service to Kauaʻi, KIUC owns and operates a variety of electrical utility installations. These installations include fossil-fuel-fired, hydroelectric, and solar-generating facilities, 17 substations and switchyards, and approximately 1,487 circuit miles of transmission and distribution lines. KIUC also purchases power from several independent power producers and transmits power that it obtains from these sources through its electrical transmission system.

2. Purpose of the Avian Protection Plan

On April 20, 2023, the U.S. Fish and Wildlife Service (USFWS) issued a letter in response to the draft *Kauaʻi Island Utility Cooperative Habitat Conservation Plan* (HCP) with a request to prepare this Avian Protection Plan (APP) to evaluate potential effects on species listed under the Migratory Bird Treaty Act of 1918 (MBTA) that may be affected by implementation of the HCP on Kauaʻi. The draft HCP incorporates conservation measures to avoid, minimize, and mitigate potential impacts on covered species that are listed under the federal Endangered Species Act (ESA). Eight of the nine HCP covered species are birds and listed under the MBTA.[2] Many of the conservation measures in the HCP are also expected to benefit other MBTA species not covered by the HCP.

This document serves as a supplementary document for USFWS to consider when evaluating the potential effect of issuing an incidental take permit for ESA-covered species in the HCP. This APP evaluates the effects of KIUC's HCP on MBTA listed species, including the potential for take as defined by the MBTA. This APP also evaluates the benefits of the HCP conservation measures to MBTA species.

Avoidance and minimization measures (AMMs) in addition to the HCP conservation strategy are necessary to avoid or minimize potential take of MBTA species, particularly during some aspects of construction related to the HCP (i.e., construction of predator exclusion fences). These measures are detailed in this APP under *Avoidance and Minimization Measures*.

This APP is limited to KIUC's facilities and operations covered in the KIUC HCP to support the USFWS decision on whether to issue KIUC the incidental take permit. If needed, KIUC may amend this APP at a later date to address KIUC's other facilities and operations not covered by the HCP and, if necessary, seek authorization under the MBTA.

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[1] KIUC was formed as a cooperative pursuant to the provisions of Chapter 421C of the Hawaiʻi Revised Statutes.

[2] The ninth species covered in the HCP is green sea turtle (honu).

3. Regulatory Background

3.1 Federal Endangered Species Act

The federal ESA provides for the conservation of endangered or threatened species and the ecosystems on which they depend. Section 9 of the federal ESA prohibits the take of endangered or threatened wildlife species without a special exemption. Under the federal ESA, the term *take* means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect listed species or to attempt to engage in any such conduct (16 United States Code [U.S.C.] 1532; 50 Code of Federal Regulations [CFR] 17.3). *Harm* includes significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns including, but not limited to, breeding, feeding, or sheltering (50 CFR 17.3). *Harass* is defined as intentional or negligent acts or omissions that create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt essential behavioral patterns including, but not limited to, breeding, feeding, or sheltering (50 CFR 17.3).

3.2 Migratory Bird Treaty Act

The MBTA, as amended (16 U.S.C. 703-712), implements treaties and conventions between the United States and Canada, Japan, Mexico, and Russia for the protection of migratory birds. The MBTA prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of the Interior U.S. Fish and Wildlife Service.

The list of species protected by the MBTA is primarily based on bird families and species included in the four international treaties. The list of migratory bird species protected is in the Code of Federal Regulations, Title 50 Part 10.13. Most bird species native to Kauaʻi are considered migratory birds under the MBTA. All species protected by the MBTA that have been documented on Kauaʻi, including incidental and rare species, are listed in Appendix A, *Avian Species of Kauaʻi Protected under MBTA*.

The MBTA applies to native species and does not apply coverage to species introduced from outside the United States or nonnative bird species. In general, a nonnative or introduced species under the MTBA includes bird species that occur in the United States or its territories solely as a result of intentional or unintentional human-assisted introduction. On the Hawaiian Islands, including Kauaʻi, migratory bird species covered under the MBTA that were introduced are considered invasive. As defined in Executive Order 13112, introduced species or "introduction" is the intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity. "Invasive species" is defined as an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health (64 *Federal Register* [FR] 6183). To protect native species on the Hawaiian Islands, Control Order for Introduced Migratory Bird Species in Hawai'i (50 CFR 21.177) was established to control cattle egrets (*Bubulcus ibis*) and barn owls (*Tyto alba*), two invasive migratory bird species in Hawai'i. This control order allows authorized agencies to take these species without a permit using the methods listed in 50 CFR 21.177(c).

4. Kauaʻi Island Utility Cooperative Habitat Conservation Plan

KIUCʻs electrical transmission and distribution system is largely above ground and consists of wires supported by poles or towers that extend from 25 to more than 100 feet above ground. Three species of seabirds and five species of waterbirds listed under the federal ESA are known to collide with these powerlines. Such collisions often result in injury or mortality of the affected birds. In addition to powerline collisions, lights at KIUC facilities and KIUC streetlights are known to attract or disorient listed seabirds, particularly fledglings making their first flights to sea. Birds that become disoriented by these lights can exhaust themselves by flying around the lighted areas before eventually landing on the ground (commonly referred to as *fallout*). Due to their physiology, these birds have difficulty regaining flight, so without intervention, they either succumb to starvation or dehydration, or are killed by invasive predators or vehicles. While disoriented by light attraction, birds can also collide with other structures.

The take of species protected by the federal ESA and its state law equivalent, the Hawaiʻi Revised Statutes (HRS) Chapter 195D, incidental to otherwise lawful activities, is prohibited unless authorized by an incidental take permit issued by USFWS and an incidental take license (state ITL) issued by the State of Hawaiʻi Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) (hereafter DOFAW), respectively. These permits are referred to collectively as the *take authorizations*. Applications for a federal ITP and state ITL are supported by an HCP that describes, among other things, the anticipated effects of the proposed taking on listed species; how those effects on the affected species will be avoided, minimized, and mitigated; and how the HCP will be funded.

Eight avian species are covered in the HCP and include seabirds and waterbirds (Table 1). The covered species were selected based on their listing status and the potential for the covered activities to result in take of those species as defined by the federal ESA and HRS Chapter 195D.

Table 1. Covered Bird Species in the HCP

English Name	Hawaiian Name	Scientific Name	Status[a] (Federal/State)
Newell's shearwater	ʻaʻo	*Puffinus newelli*	T/T
Hawaiian petrel	ʻuaʻu	*Pterodroma sandwichensis*	E/E
Band-rumped storm-petrel[b]	ʻakēʻakē	*Hydrobates castro*	E/E
Hawaiian stilt	aeʻo	*Himantopus mexicanus knudseni*	E/E
Hawaiian duck	koloa maoli	*Anas wyvilliana*	E/E
Hawaiian coot	ʻalae keʻokeʻo	*Fulica alai*	E/E
Hawaiian common gallinule	ʻalae ʻula	*Gallinula galeata sandvicensis*	E/E
Hawaiian goose	nēnē	*Branta sandvicensis*	T/E

[a] Status:

E = Listed as endangered under the federal ESA or HRS Chapter 195D.

T = Listed as threatened under the federal ESA or HRS Chapter 195D.

[b] Hawaiʻi distinct population segment.

4.1 Covered Activities in the Habitat Conservation Plan

The covered activities section in HCP Chapter 2, *Covered Activities*, describes existing and future activities for which KIUC is seeking incidental take coverage under Section 10 of the ESA. These activities are collectively referred to as *covered activities*. The covered activities summarized below are intended to be as inclusive as possible of KIUC activities currently occurring or expected to occur in the Permit Area (Kauaʻi) and that are reasonably certain to cause incidental take of the covered species in the HCP.

4.1.2 Powerline Operation and Modifications

Powerline Operation

KIUC owns and operates overhead powerlines on Kauaʻi. The wire sizes and pole heights vary widely for each type of line depending on site-specific physical circumstances present along the powerline corridor (e.g., topography). Moreover, line configuration may switch from one type to another (and often back again) within distances of as little as a few hundred feet depending on site-specific conditions. This changeability makes it impossible to map the differences on a system-wide scale. All KIUC powerlines on Kauaʻi are considered operational when the wires are in place (i.e., when they are in the bird's flight path) whether or not they have been electrified.

Powerline Modifications: Increasing Wire Height

KIUC periodically modifies transmission lines or distribution lines in response to changes in electricity demand. In other cases, KIUC may modify powerline systems in response to changing land uses that might interfere with safe and reliable power delivery. In either instance, the following powerline modifications are covered activities if these modifications were to change wire height or expose wires, as described in HCP Chapter 2, *Covered Activities*.

- Increasing wire height
- Exposing wires through vegetation maintenance

Operation of New or Extended Powerlines

As described in HCP Chapter 2, *Covered Activities*, KIUC expects to add new or extend existing powerlines to accommodate growth and to integrate renewable resources across Kauaʻi. KIUC will also need to expand the system of distribution lines to service new homes and businesses that are developed outside of the existing network of distribution lines. These expansions are expected to require extending existing and/or installing new distribution and transmission lines.

KIUC estimates that 360 miles (579.4 kilometers) of new wires and support structures could be constructed over the 50-year permit term across KIUC's electric system. Construction of new powerlines is not a covered activity in the HCP, because construction activities are not expected to result in take of covered species (HCP Chapter 2, Section 2.4, *Activities Not Covered*). Once wires are in place (they do not need to be electrified), they are a covered activity under the HCP.

4.1.3 Lighting

Night Lighting for Restoration of Power

When equipment failure or powerline damage occurs, KIUC must restore power to its customers as quickly as possible.[3] In the case of power outages, KIUC would need to repair existing powerlines or construct new powerlines (in cases where the damage is too extensive to use the existing infrastructure), support structures and substations. If a power outage occurs at night, lighting may be necessary to illuminate the work area.

Lighting Operation

Operation of facility lights at the Port Allen Generating Station and the Kapaia Power Generating Station is a covered activity in the HCP. Both facilities maintain night lighting for operations, visibility of personnel, and safety.

The Port Allen Generating Station is located at Port Allen east of Hanapēpē. Facility lighting at the Port Allen Generating Station includes 29 KIUC-owned lights mounted on poles and placed throughout the facility and eight lights mounted on building walls. The Kapaia Power Generating Station is approximately 1 mile northwest of the town of Līhuʻe. Lighting consists of KIUC-owned streetlights and building lights placed throughout the facility in the parking lot and outdoor work areas.

Streetlights

Existing Streetlights

KIUC owns and operates approximately 4,100 streetlights under agreements with the state, County of Kauaʻi, and private entities, which include those located at KIUC facilities. KIUC owns all the lights it operates. Most of these lights are on poles that also carry electric lines, but some of the lights are standalone fixtures on their own stanchions. All lights are switched on and off at sunset and sunrise automatically by photosensitive switches installed in individual lights. All KIUC-operated streetlights have full-cutoff shielded fixtures.[4] As of 2017, all KIUC streetlights were converted from high pressure sodium vapor (HPS) to more energy-efficient 3,000-kilowatt light-emitting diode (LED) bulbs (Kauaʻi Island Utility Cooperative 2017), and of these approximately 75 percent are 41-watt bulbs and approximately 25 percent are 90-watt bulbs.

Operation of existing KIUC streetlights is a covered activity in the KIUC HCP because they contribute to the lightscape on Kauaʻi. For a streetlight to be considered operational under the HCP, the light must be energized and operational (i.e., streetlight construction, prior to the light being energized and operational, is not a covered activity). Despite efforts to minimize the amount of upward-directed light from KIUC streetlights, they may still result in incidental take through HCP-covered seabird fledgling fallout. Similarly, some MBTA species not covered by the HCP may be attracted to some streetlights operated by KIUC.

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[3] This does not include catastrophic events like Hurricane ʻIniki that threaten human life and property.

[4] Full cutoff shielded fixtures are designed to direct the light downward and outward, rather than upward toward the sky.

New Streetlights

KIUC expects to operate up to 1,754 new shielded streetlights along Kauaʻi's roadways over the 50-year permit term (an average of 35 new streetlights per year). Based on growth projections on Kauaʻi, the number of new streetlights is not expected to exceed 50 per year. As with all of the existing KIUC streetlights, any new streetlights will also be equipped with full-cutoff shields.

4.2 Implementation of the HCP Conservation Strategy

Certain activities related to implementation of the HCP conservation strategy at the conservation sites in the northwestern corner of Kauaʻi could result in the take of MBTA-covered species. The conservation measures implemented at the conservation sites include construction and maintenance of predator exclusion fences, predator control within and outside of the predator exclusion fences, social attraction to attract covered seabirds to new nesting colony sites within the fenced areas, and selective invasive plant species control. Details of the management actions at the conservation sites are described under Section 4.3.4, Conservation Measure 4, *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*, and in HCP Section 4.5, *Conservation Measures*. Potential impacts to MBTA species from the HCP Conservation Strategy is discussed in more detail in Section 5.3, *Effects of HCP Covered Activities on MBTA Species Not Covered by the HCP*.

4.3 Conservation Measures for Habitat Conservation Plan-Covered Birds

This section summarizes the conservation measures KIUC will implement or fund to meet the biological goals and objectives described in HCP Chapter 4, *Conservation Strategy*, for the covered birds. These conservation measures are designed to benefit the covered bird species; however, implementation of many of these measures are expected to also reduce impacts on other MBTA protected species, particularly non-covered seabird and waterbird species, that may occur in the Permit Area.

Other avian species protected under the MBTA, such as forest birds that occur at higher elevations, are not likely to be affected by most of the covered activities. However, bird species nesting or foraging at higher elevations could be incidentally affected by work at the conservation sites (Conservation Measure 4) where fence construction, fence maintenance, and predator-control activities could occur at any point during the year. These activities could pose a temporary risk to such forest birds if those species are present or nesting during work hours, particularly during breeding season. Potential impacts to MBTA birds from HCP covered activities and conservation measures are discussed in more detail in Section 5.3.

4.3.1 Conservation Measure 1. Implement Powerline Collision Minimization Projects

HCP Chapter 4, Section 4.4.1, describes the actions KIUC will take to meet the covered seabird and covered waterbird biological goals and objectives by minimizing powerline collisions. Powerline collision is one of the most, if not the most, important conservation issue for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) on Kauaʻi (Travers et al. 2012, 2013, 2014, 2015, 2016, 2017a, 2018, 2019, 2021a). Seabird collisions occur most often with the overhead static wire due to the wire's height and position and because the static wire has a smaller diameter than energized conductors; therefore, it is less visible.

The minimization actions under this conservation measure include reconfiguration of powerlines (i.e., changing the profile from vertical to horizontal, removing static wire and reducing the number of layers), static wire removal,[5] and installation of bird flight diverters on many powerlines (often combined with other minimization measures). Bird flight diverters make powerlines far more visible to covered seabirds at dusk and night, and far more visible to covered waterbirds in daylight. HCP Appendix 4B, *KIUC Minimization Projects*, identifies all reconfiguration projects, bird flight diverter installation, and static wire removal projects that were implemented by May 5, 2024, by span. Implementation of these measures individually or combined substantially reduce powerline collisions.

As described previously, KIUC will need to construct new transmission and distribution lines during the 50-year permit term to provide power to new development on Kaua'i. KIUC will avoid construction of new transmission and distribution lines in high-collision zones in the Permit Area, to the maximum extent practicable, as determined in coordination with a qualified avian biologist. During the planning process for each new covered transmission or distribution line, KIUC will review existing data and predictive models (Travers et al. 2017b) and consult with a qualified avian biologist to determine the potential strike rate (strikes per year) per span. Development is not expected to occur in the more remote areas of Kaua'i that currently have little to no development. Therefore, new powerlines are not likely to substantially change the current collision risk of the covered species.

4.3.2 Conservation Measure 2. Implement Measures to Minimize Light Attraction

HCP Chapter 4, Section 4.4.2, describes the actions KIUC will take to meet the covered seabird biological goals and objectives for light attraction minimization. Bright artificial lights attract and confuse seabird fledglings, causing them to become grounded (Imber 1975; Telfer et al. 1987). If the light-attracted individuals that become grounded are not rescued, they are at risk of succumbing to injury or mortality due to starvation, predation, collisions with cars, or a combination thereof. KIUC's streetlights and covered facility lights are one source of artificial light in the Plan Area that can result in these effects. Under this conservation measure, KIUC has already taken the following actions (as of 2023) to reduce and minimize this impact.

- **Streetlights**. The minimization actions under this conservation measure included installing full-cutoff shielded fixtures on approximately 4,150 existing streetlights in 2017. In 2019, KIUC replaced all green light bulbs in streetlights with white light bulbs to further reduce light attraction. All future streetlights will be installed by KIUC with these same light-minimization features.
- **Covered facility lights**. KIUC also operates night lighting at two facilities covered by the HCP, the Port Allen Generating Station and the Kapaia Generating Station, called the *covered facilities* (HCP Section 2.2.1.1, *Existing Facilities*). KIUC will continue to dim the exterior lighting at Port Allen Generating Station during the fledgling fallout season (September 15 to December 15) to minimize light attraction. At the beginning of the fallout season, all exterior facility lights are dimmed (controlled remotely through a website) to the lowest extent practicable (i.e., consistent with all applicable laws and regulations and allowing KIUC to conduct its work in a

[5] Powerline reconfiguration includes static wire removal, but static wire removal can also occur independent of reconfigurations.

safe manner). At the end of the fallout season, lights are returned to full brightness. KIUC began this practice in 2019 and saw significant reductions in fallout at this covered facility. In 2019, KIUC retrofitted all the exterior lights at the Port Allen Generating Station and at the Kapaia Generating Station. At the Port Allen Generating Station, KIUC replaced its existing freestanding exterior facility lights with full-cutoff white LED lights and shielded wall-mounted white LED box lighting. Any new lights installed at the two covered facilities by KIUC during the permit term will use these same minimization features. KIUC will consider dimming exterior lights outside of fallout season to the extent practicable, if KIUC finds an excessive amount of fallout outside of the typical fallout season of September 15 through December 15.

- **Night lighting for restoration of power**. KIUC may also need to use nighttime lighting during the seabird fallout season if power outages occur between September 15 and December 15. At work sites where nighttime lighting is required during these 3 months, KIUC will search for grounded birds after the work is completed according to the same protocol used at the covered facilities (HCP Section 4.4.2.2, *Covered Facility Lights*). Nighttime lighting would only be used to conduct the required power restoration work, and as necessary for the safety of workers.

4.3.3 Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program

The Save Our Shearwaters (SOS) program is an avian rescue and rehabilitation program that operates year-round on Kauaʻi. The initial focus of the program was on rescue and rehabilitation of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu). The program has since been expanded to include all native bird species including all covered seabirds and covered waterbirds, as well as other, non-covered birds. Under the SOS program, grounded seabirds, waterbirds, and other birds that are rescued by members of the public or businesses can be turned into SOS. Injured birds are assessed, rehabilitated if possible, and released back into the wild by trained staff and volunteers with the support of professional veterinary staff. All rehabilitation actions occur at an accredited animal rescue facility with extensive equipment and facilities for any necessary procedure to treat minor injuries or perform major surgery or treatment, including extended stays prior to release back into the wild.

Beginning in 2003, KIUC began funding and largely implementing the SOS Program with the Hawaiʻi Department of Fish and Wildlife oversight and assistance. KIUC has continued to provide the majority of the funding for the SOS Program annually. For this conservation measure, KIUC commits to fund the SOS program with $300,000 annually for the duration of the permit term. As described in HCP Chapter 7, *Plan Implementation*, KIUC funding will increase annually to keep pace with inflation. This funding is anticipated to adequately support the SOS program (or other adequate program) for the rescue, rehabilitation, and release of covered seabirds and covered waterbirds affected by KIUC's covered activities and that are found by the public and volunteers.

Conservation Measure 3 includes public outreach and education to inform and educate the public about the risks of powerline strikes and light attraction to threatened and endangered species on Kauaʻi.

4.3.4 Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites

This conservation measure describes the actions KIUC will apply to meet the biological goals and objectives for Newell's shearwater (ʻaʻo) Hawaiian petrel (ʻuaʻu), and band-rumped storm-petrel (ʻakēʻakē) for managing and enhancing seabird breeding habitat and colonies at conservation sites. The management and enhancement actions identified under this conservation measure will occur exclusively within designated conservation sites on Kauaʻi throughout the permit term. Conservation sites are specific, defined areas in the Plan Area where KIUC will continue to implement management actions (e.g., predator control, social attraction) to increase the reproductive success of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) breeding colonies, and to benefit band-rumped storm-petrel (ʻakēʻakē) occurring in the region.

Twelve conservation sites are proposed for the KIUC HCP (HCP Section 4.4.4.1, *Conservation Sites*). Many of the selected conservation sites are the same sites where KIUC has been funding predator control, seabird monitoring, and invasive plant species control annually since 2011 for KIUC's *Short-Term Seabird Habitat Conservation Plan* (Short-Term HCP) and in the interim period between the Short-Term HCP and commencement of this HCP. This history of managing conservation sites provided KIUC, USFWS, and DOFAW with a significant amount of data that was used to determine if the same type of management at these sites would continue to benefit the covered seabird species during HCP implementation. Other significant reasons to select the proposed conservation sites included presence of covered seabird species, proximity to known flyways, site accessibility and adjacency to existing sites, and the presence of existing predator exclusion fences.

Management Actions at Conservation Sites

The management actions at the conservation sites are the primary means of offsetting the impacts of the taking on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) and providing a net benefit for each species (see HCP Chapter 5, *Effects*, for modeling that quantifies this benefit). This conservation measure includes four management actions that KIUC will employ within the conservation sites, which are summarized below.

KIUC and its contractors will implement four management actions within protected conservation sites that contain breeding colonies of the seabird species in ways that minimize effects on seabirds. The majority of management actions are designed to protect seabirds at the sites and will be performed during seabird breeding seasons. Certain management actions that could disturb nesting seabirds (e.g., construction of predator exclusion fences) can be implemented from December to March, which is outside of the breeding season (April to mid-December) while the covered seabirds are at sea.

Preparation for these management actions began in the early 2000s and continued through 2010. These management actions occurred both during implementation of the Short-Term HCP (2011–2016) and since then as early implementation for this HCP (2017–2023).

Predator Control

Predation by introduced species is one of the major factors causing the decline of seabird populations on islands worldwide (Courchamp et al. 2003; Raine et al. 2020). Predator control is the primary management action to establish predator-free breeding habitat or substantially reduce predation, which is critical to successfully restore productive seabird colonies (Buxton et al. 2014;

Jones and Kress 2012; Young et al. 2018; Raine et al. 2020). Predators include cats (*Felis catus*), rats (*Rattus* spp.) and mice (rodents), pigs (*Sus scrofa*), feral bees (*Anthophila*), and barn owls. Deer and goats (*Capra hircus*) (ungulates) can damage habitat and seabird burrows. Terrestrial predator and ungulate control methods may include traps, bait stations, snares, hunting, and other control methods. Predator and ungulate control efforts may be timed based on seasonality, rainfall, and the phenology or vulnerability to toxicants of endemic species. Traps will also be deployed in other areas where there are high levels of human use such as weatherports, campsites, and other small facilities in the conservation sites. The HCP predator control program includes avoidance measures to protect the Hawaiian short-eared owl (pueo) and other nocturnal avian species during barn owl predator control efforts at the conservation sites (NTBG 2019).

Intensive predator control will be implemented at all sites without predator exclusion fencing. Intensive predator control creates a virtual fence through strategic placement of trapping and monitoring cameras along known routes, ingress points and around known seabird burrow locations. Based on colony monitoring data collected at KIUC managed sites since 2011, strategic trapping combined with rapid response when predators are detected on camera has proven to be very effective is suppressing depredation and increasing reproductive success rates.

Predator Exclusion Fencing

Predator exclusion fencing is defined in the HCP as constructed fences that are impenetrable to introduced terrestrial predators including feral cats, rats, pigs, deer, and goats. At four of the conservation sites, predator exclusion fences have been or will be constructed to exclude terrestrial predators (cats, rats, mice, pigs, goats) and social attraction will be implemented. Two small predator exclusion fences are existing structures (the Pōhākea PF and Honopū PF conservation sites). Predator eradication was completed at both sites and social attraction was initiated in 2022. KIUC took over management of both sites and the maintenance of these fences prior to the HCP term. KIUC will construct two additional predator exclusion fences at the Upper Limahuli Preserve by 2025 and at Upper Manoa by 2027 (Upper Limahuli PF and Upper Manoa PF). (See HCP Table 4-12 for management actions implemented at each conservation site and HCP Section 4.4.4.2, *Management Actions, Fencing Specifications* for additional manufacturing details).

Predator exclusion fencing supplements terrestrial predator control, which can be highly effective in and of itself, further reducing predation events. Depending on terrestrial predator abundance and the total size of the fenced area, complete terrestrial predator eradication can take anywhere from 3 to 12 months to achieve (Young in litt.); individuals must be removed at a rate faster than they can reproduce. In cases of a fence breach or damage, rapid response terrestrial predator control will occur within the fenced area to remove any predators that may have entered the breach and to maintain predator-free habitat.

Predator exclusion fences will not prevent entry of barn owls (and may even facilitate perching), so barn owl control at the fenced areas will still be necessary for the duration of the 50-year permit term. Control of barn owls will follow the provisions as outlined in 50 CFR 21.177. Barn owls are the only introduced owl in the state of Hawaiʻi and are known to be significant predators of Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and band-rumped storm-petrel (ʻakēʻakē) on Kauaʻi (Raine et al. 2017, 2019a). It is likely that barn owls also take MBTA protected species not covered by the HCP. Barn owls can have multiple clutches in a year and produce large broods (del Hoyo et al. 1999), far outpacing the number of fledglings produced by the covered seabird species annually. In addition, barn owls are difficult to control because they have large home ranges and the capacity to kill large numbers of seabirds in a short period of time (Raine et al. 2019a).

KIUC will be responsible for assessing the condition of each predator exclusion fence throughout the permit term and conducting maintenance and repairs as needed to avoid fence breaches. Acts of nature, accidents, and vandalism are likely to damage the fence over time. Therefore, it is essential to have an effective assessment, maintenance, and repair program to minimize and address fence damage as soon as practicable. If breaches occur, rapid response will be employed to address incursion of specific species and to repair the fence.

Social Attraction

More than 95 percent of seabirds are colonial (including the covered seabird species), which means they are attracted to breeding sites by the presence of individuals of the same species and other seabird species (Jones and Kress 2012). Social attraction is a technique that uses attractive social stimuli, generally the sight and sound of the same species, to promote nest initiation by colonial seabirds. Because of their nocturnal flight behavior, acoustical rather than visual techniques are considered to be the most successful means of attracting the covered seabirds as they fly over or near suitable habitat (Miskelly et al. 2009; Young et al. 2019; Raine et al. 2019b). If successful, the strategy can result in relatively high productivity within a small area (Young et al. 2019).

Social attraction will only be implemented within predator exclusion fencing (at four conservation sites) because the fencing will eliminate the threat of terrestrial predation and avoid the risk of actively attracting birds to a site with risk of terrestrial predation. For KIUC's HCP the primary purpose of the social attraction sites is to draw prospecting birds into the protected site that otherwise would have established burrows elsewhere. Social attraction techniques will be used to establish new colonies within the fenced conservation sites. The methods for social attraction include restoring targeted habitat, installing artificial burrows consisting of wooden boxes and plastic tunnels, and broadcasting calls of the target species.

Invasive Plant Species Management

Invasive plant species can degrade covered seabird breeding habitat across the state (Young et al. 2018). Invasive plant species displace and out-compete native vegetation, which alters vegetation composition and structure (Simberloff et al. 2013; VanZandt et al. 2014) and can make burrows inaccessible by the covered seabirds (Raine in litt.).

KIUC will fund regular invasive plant species management focused on the list of species in HCP Appendix 4C, *Invasive Plant Species Control Methods*, within the Upper Limahuli Preserve and the four social attraction sites (including a 30-foot perimeter around the outside of the predator exclusion fences). Invasive plant species control will occur in the other conservation sites on an as-needed basis, when observed and documented by colony monitoring and predator control field crews and determined to be spreading or otherwise problematic for seabird growth at the site (HCP Chapter 6, *Monitoring and Adaptive Management Program*).

5. Summary of Effects of HCP Covered Activities on all MBTA Species

This section evaluates the effects of HCP covered activities on all MBTA protected species. The evaluation begins with the HCP covered birds. This evaluation summarizes the extensive detail provided in the HCP on the benefits of the HCP conservation measures and the effects of HCP covered activities (for additional details on the adverse effects of the HCP covered activities, benefits of the conservation strategy, and net effects, see HCP Chapter 5, *Effects*).

Next, this section describes the potential effects of HCP covered activities on MBTA protected species not covered by the HCP. The section also describes the expected benefits of the HCP conservation measures on MBTA protected species not covered by the HCP.

5.1 Effects of HCP Covered Activities on HCP Covered Birds

5.1.2 Effects of Powerline Strikes

A range of powerline variables plays a role in the likelihood of MBTA species striking powerlines. These variables include, but are not limited to, the following list from Travers et al. (2021b).

- Location of powerlines
- Seasonality
- Topography
- Height of vegetation as it relates to the powerlines and level of shielding
- Height and configuration of wires, including wire thickness, number of wires, and vertical arrangement of wires
- Flight height and speed of birds and their ability to maneuver
- Number of birds in transit in a region
- Wind speed and direction
- Flight paths relative to wind
- Ambient light levels

In some areas of Kauaʻi, two or more of these variables contribute to increased risk of powerline collision. For example, the location of powerlines combined with flight height and speed may increase the risk of collision at certain spans for some species. Powerlines that cross a valley or drainage typically result in wires being positioned higher above the ground at mid-span compared to powerlines traversing flat terrain. Increased aboveground wire height places the wires into higher airspace, where a greater proportion of the local bird passages occur. Powerlines near or between wetlands and other water features present a relatively high risk to waterbirds because of their proximity to high-use habitat areas.

As described in HCP Chapter 5, Section 5.2.1.2, *Effect of Powerline Strikes on Covered Seabird Species*, in the HCP, powerlines are one of the most significant threats to Newell's shearwater (ʻaʻo) and Hawaiian petrels (ʻuaʻu) on Kauaʻi. Although there have been no documented powerline strikes associated with band-rumped storm-petrels (ʻakēʻakē) (*Oceanodroma castro*), observations of this species skimming over a section of powerlines in Waimea Canyon indicate that this species could occasionally strike powerlines (Travers et al. 2021b).

The life history of the covered waterbirds is substantially different than the covered seabirds, resulting in less vulnerability than the seabirds to population effects resulting from powerline collisions. That is, the covered waterbirds produce four or more offspring per year, mature much earlier in age than the covered seabirds (the covered waterbirds breed in their second year), and require much less parental care (i.e., young of the covered waterbirds leave the nest within days of hatching and become independent in several weeks); therefore, populations of the covered waterbirds are far less vulnerable to individual mortalities than the covered seabirds (see Appendix 3A, *Species Accounts,* in the HCP).

5.1.3 Effects of Light Attraction from Streetlights and Facility Lights

Artificial lighting often attracts birds, and after flying around the lights, birds can tire or inadvertently hit a structure and may become grounded, an event referred to as fallout (Imber 1975; Telfer et al. 1987). Factors influencing light attraction and fallout include brightness, wavelength, and direction of light, and location of lights relevant to critical life stages (e.g., seabird fledglings leaving nests).

Fallout of covered seabirds resulting from light attraction occurs seasonally during the autumn months in conjunction with the seabird fledging season (September 15 to December 15). Light attraction primarily affects fledgling seabirds on their first flight from their nesting colonies to the ocean (Reed et al. 1985; Telfer et al. 1987). However, adults may also be attracted to artificial lights when transiting to and from their nesting colony during the breeding period, particularly when lights are near the breeding colony (Raine et al. 2018; Center for Biological Diversity 2016).

When attracted to artificial lights, birds can become confused, disoriented, or blinded by the light. Light-attracted seabirds, in particular, may circle repeatedly and become grounded, which involves landing on the ground in locations where they usually do not land and from which they are unable to take off due to injury, exhaustion, and confusion (Reed et al. 1985). Due to their physiology, these birds have difficulty regaining flight, so without intervention, they either succumb to starvation or dehydration, or are killed by invasive predators or vehicles.

Birds that become disoriented by lighting may experience energetic costs in reorienting themselves or suffer mortality from predators such as cats, or impacts with automobiles. If either seabird parent dies due to fallout, the loss of its egg or mortality of its chick is assumed to occur because the egg/chick relies on both parents for incubation, provisioning, predator protection, and chick rearing (Ainley et al. 1997).

5.1.4 Effects of HCP Conservation Measures

The conservation strategy may also result in a minimal amount of take of covered seabirds as individual birds may be caught in leg hold or other traps placed for predator control. The number of birds anticipated to be taken as a result of conservation measures is described in HCP Section 5.3.3, *Species-Specific Seabird Effects.*

5.2 HCP Benefits to HCP Covered Birds

The conservation strategy of the HCP will result in multiple beneficial effects on HCP covered bird species. Powerline and light attraction minimization measures (Conservation Measures 1 and 2) will substantially reduce take and the impacts of taking of HCP covered species. Management and enhancement of seabird breeding colonies (Conservation Measure 4) will dramatically reduce the abundance and distribution of seabird predators in 12 conservation sites. Predator control and social attraction are expected to increase survival of adults and substantially increase the survival and number of fledglings produced annually. Funding the SOS program (Conservation Measure 3) will help to reduce HCP covered seabird and waterbird mortalities from various sources (KIUC and non-KIUC sources) through rescue and release of recovered injured covered birds.

5.2.1 Benefits to Newell's shearwater (ʻaʻo)

As described in HCP Chapter 4, *Conservation Strategy*, KIUC will offset the requested take of Newell's shearwater (ʻaʻo) primarily by managing and enhancing breeding colonies across 12 conservation sites[6] with suitable breeding habitat. A key management action will be to substantially reduce the abundance of seabird predators at these sites in northwestern Kauaʻi as described in Section 5.3.3.1, *Newell's Shearwater (ʻaʻo)*, subsection *Beneficial and Net Effects,* of the HCP. Other important management actions are installing and maintaining predator exclusion fencing and implementing social attraction as described in Section 4.3.4. Through these measures, KIUC will substantially increase the number of breeding pairs and fledglings produced annually to reverse the historic downward trend of this species' Kauaʻi metapopulation as determined by radar and acoustic call rates.

Management actions with demonstrated success at improving the reproductive success of Newell's shearwater (ʻaʻo) breeding colonies are ongoing and would continue and be expanded by the HCP for the duration of the permit term[7]. Expanding the scale and types of these conservation actions (e.g., installing predator-proof fencing at feasible sites) is expected to further reduce predation and increase the survivorship of fledglings produced each year. Social attraction within the fenced conservation sites is also expected to accelerate colony recruitment by drawing birds from unprotected colonies into the conservation sites where management is occurring and birds are protected from terrestrial predators. Predator control at the conservation sites is expected to maintain high reproductive success rates of Newell's shearwater (ʻaʻo) in these protected colonies. Predator control that either establishes predator-free breeding habitat or substantially reduced predation is required to successfully restore productive seabird colonies (Buxton et al. 2014; Jones and Kress 2012; Raine et al. 2020).

Substantial metapopulation increases and improved survival at the conservation sites, in combination with minimizing take island-wide, are expected to reverse the island-wide population decline based on the HCP worse-case model scenario[8]. HCP Chapter 4, Section 4.3.1, *Newell's Shearwater (ʻaʻo),* describes how USFWS and DOFAW estimates that 10,000 individuals (2,500 breeding pairs) represents a viable metapopulation of Newell's shearwater (ʻaʻo) on Kauaʻi. The

[6] Not all 12 conservation sites currently contain Newell's Shearwater (ʻaʻo). Based on Table 4-11 in HCP Chapter 4, seven of the conservation sites contained breeding pairs. This estimate was based on a 2021 combined auditory survey, burrow monitoring, and habitat suitability modeling effort.

[7] For a history of the conservation sites, see Chapter 4, Section 4.2.4, *Prior KIUC Conservation Measures*, in the HCP.

[8] As detailed in Appendix 5E, *Population Dynamics Models for Newell's Shearwater (ʻaʻo) on Kauaʻi.*

population dynamics model indicates that the KIUC HCP would meet Goal 1 for Newell's Shearwater (ʻaʼo), resulting in a viable Kauaʻi metapopulation of Newell's Shearwater (ʻaʼo), on Kauaʻi as described in HCP Section 5.3.2.3, *Newell's Shearwater (ʻaʼo).* This reversal in decline is predicted to establish a viable Kauaʻi metapopulation of Newell's shearwater (ʻaʻo) that is increasing over time. Because the HCP would fully offset the impacts of the HCP covered activities on Newell's shearwater (ʻaʻo) and provide a net benefit to the species, no additional avoidance and minimization or mitigation measures are needed for this species to address the MBTA.

5.2.2 Benefits to Hawaiian petrel (ʻuaʻu)

KIUC will offset the requested take of Hawaiian petrel (ʻuaʻu) primarily by managing and enhancing breeding colonies in 12 conservation sites with suitable breeding habitat. The conservation measure (see HCP Conservation Measure 4) is expected to mitigate Hawaiian petrel (ʻuaʻu) mortalities resulting from KIUC covered activities through management and enhancement of breeding colonies and substantial reduction of predators. The same predator control and social attraction techniques applied to Newell's shearwater (ʻaʻo) will also benefit Hawaiian petrel (ʻuaʻu), except for social attraction which will be targeted for Newell's shearwater.

Substantial metapopulation increases and improved survival at the conservation sites, in combination with minimizing take, are expected to eventually reverse the island-wide population decline and establish a stable, viable Kauaʻi metapopulation of Hawaiian petrel (ʻuaʻu) based on the HCP worse-case model scenario[9]. HCP Chapter 4, Section 4.3.1, *Newell's Shearwater (ʻaʻo)*, describes how *viable* is defined in the context of population dynamics modeling. The population dynamics model indicates that the KIUC HCP would meet Goal 2 for Hawaiian petrel (ʻuaʻu), resulting in a viable Kauaʻi metapopulation of Hawaiian petrel (ʻuaʻu) on Kauaʻi as described in HCP Section 5.3.3.3, *Hawaiian petrel (ʻuaʻu)*. Because the HCP would fully offset the impacts of the HCP covered activities on Hawaiian petrel (ʻuaʻu) and provide a net benefit to the species, no additional avoidance and minimization or mitigation measures are needed for this species to address the MBTA.

5.2.3 Benefits to Band-Rumped Storm-Petrel (ʻakēʻakē)

Funding for the SOS Program is expected to minimize and partially offset effects of powerline strikes for band-rumped storm-petrel (ʻakēʻakē) over the permit term (see HCP Chapter 4, Section 4.4.3, *Conservation Measure 3, Provide Funding for the Save Our Shearwaters Program*). In addition, the species is likely to benefit from predator control at the Honopū conservation site because of the site's proximity to the Nā Pali Coast where most band-rumped storm-petrel (ʻakēʻakē) are thought to occur on Kauaʻi. KIUC expects funding of the SOS Program, in addition to the conservation measures for the other two covered species and the extensive minimization measures across the island, to be sufficient to offset the impact of the taking of band-rumped storm-petrels (ʻakēʻakē). Considering the take associated with KIUC activities, the effects of SOS recoveries, social attraction at Honopū for band-rumped storm-petrel, and the intensive predator control near occupied habitat for the species, the KIUC HCP will have a net benefit on band-rumped storm-petrels (ʻakēʻakē) on Kauaʻi. Because the HCP would fully offset the impacts of the HCP covered activities on band-rumped storm-petrels (ʻakēʻakē) and provide a net benefit to the species, no additional avoidance and minimization or mitigation measures are needed for this species to address the MBTA.

[9] As detailed in Appendix 5F, *Population Dynamics Model for Hawaiian petrel (ʻuaʻu) on Kauaʻi*

5.2.4 Benefits to Covered Waterbirds: Hawaiian Coot (ʻalae keʻokeʻo), Hawaiian Gallinule (ʻalae ʻula), Hawaiian Stilt (aeʻo), Hawaiian Goose (nēnē), and Hawaiian Duck (koloa maoli)

The covered waterbirds are susceptible to powerline strikes but there is no evidence they are susceptible to light attraction on Kauaʻi, so the HCP analysis focuses only on estimating the effects of powerline strikes (see HCP Appendix 5B, *Rapid Waterbird Powerline Collision Assessment*). The HCP describes the ways in which powerline strikes can adversely affect the covered waterbirds[10]. Conservation Measure 1, *Implement Powerline Collision Minimization Projects*, will minimize powerline collisions of covered waterbirds by removing overhead static wire, reconfiguring powerlines, and installing bird flight diverters. Furthermore, in addition to measures on existing lines, the HCP commits to a 90% reduction of strike risk of waterbirds on new powerlines by incorporating minimization measures at the design phase. As described in HCP Chapter 4, *Conservation Strategy*, rescue and recovery efforts through the SOS Program will minimize the number of covered waterbird mortalities from powerline strikes. In addition, the SOS Program is expected to fully offset mortalities through the rescue, recovery, and release of waterbirds back into the wild that are affected by factors unrelated to KIUC's covered activities (e.g., botulism). Rescuing, treating, and releasing covered waterbirds in this situation contributes to the species recovery by increasing their survival and reproduction. HCP Section 5.4.3, *Species-Specific Waterbird Effects*, provides an analysis of the beneficial effects of the SOS Program on each covered waterbird species.

Because the HCP would fully offset the impacts of the HCP covered activities and provide a net benefit to the covered birds, no additional avoidance and minimization or mitigation measures are needed for the HCP covered bird species to address the MBTA.

5.3 Effects of HCP Covered Activities on MBTA Species Not Covered by the HCP

Appendix A, Table A1 provides a list of avian species listed under the MBTA that are endemic or known to occur on Kauaʻi. Appendix A, Table A2 lists avian species listed under the MBTA that have been documented on Kauaʻi but are not generally expected to occur near HCP covered activities because these species are accidental or rare occurrences. This section analyzes only the potential impacts on MBTA species in Appendix A, Table A1, because these species may nest and reside on Kauaʻi.

For the purposes of assessing potential effects of the HCP covered activities, endemic or known-to-occur MBTA species are grouped into the following functional categories (Appendix A, Table A1).

- Forest Passerines (8 species)
- Waterfowl (1 species, excluding 2 covered by the HCP)
- Raptors (1 species)
- Shorebirds (2 species, excluding 1 covered by the HCP)
- Seabirds (26 species, excluding 3 covered by the HCP)
- Rails and Coots (0, both species are covered by the HCP)

[10] See HCP Section 5.2.1.3, *Effect of Powerline Strikes on Covered Waterbird Species*.

- Herons, Egrets, Ibis (1 species)

5.3.1 Effects of Powerline Strikes

From 2012 to 2023, KIUC has conducted an extensive monitoring program of powerlines known or suspected to present a risk of bird collisions (Travers et al. 2023). The study involved systematic surveys (both acoustic and observation based), opportunistic observations, and the collection of grounded birds to assess the primary causes of grounding and mortality. Based on over 6,000 hours of observations, KIUC observed 162 powerline collisions across ten native and endemic birds on Kauaʻi. Of the 14 species observed colliding with powerlines, 13 were MBTA covered species of seabird or waterbird, and one raptor. All eight of the HCP covered birds were observed colliding with powerlines and most collisions observed during the standardized surveys (94%) were Newell's shearwaters or Hawaiian petrels. The remaining six MBTA species observed colliding with powerlines are listed below:

- Wedge-tailed shearwater (ʻuaʻu kani) (*Ardenna pacifica*),
- White-tailed tropicbird (koaʻe kea) (*Phaethon lepturus)*,
- Red-footed booby (ʻā) (*Sula sula*),
- Black-crowned night heron (ʻaukuʻu) (*Nycticorax nycticorax hoactli*),
- Pacific golden-plover (kōlea) (*Pluvialis fulva*),
- Hawaiian short-eared owl (pueo) (*Asio flammeus sandwichensis*).

The extent of powerline collision on these six MBTA species is largely unknown because they are not the focus of KIUC's powerline monitoring program and observations are often opportunistic or derived from grounded bird locations suggesting they are underestimates (Travers et al. 2023). The observations from 2012 – 2023 included 23 powerline collisions by Wedge-tailed shearwater (ʻuaʻu kani); 11 powerline collisions of Black-crowned night heron (ʻaukuʻu); 8 powerline collisions of White-tailed tropicbird (koaʻe kea); 7 power-line collisions of Red-footed booby (ʻā); 2 powerline collisions of Pacific golden-plover (kōlea); and 1 powerline collision of Hawaiian short-eared owl (pueo).

Wedge-tailed shearwater (ʻuaʻu kani), white-tailed tropicbird (koaʻe kea), and red-footed booby (ʻā) all nest on Kauaʻi in either ground burrows or in shrubs or trees along the coast (e.g., Kilauea Point National Wildlife Refuge, Lāʻie Point State Wayside Park, Makapuʻu Point Lighthouse Trail, and Lānaʻi Lookout), or in coastal areas (e.g., Waimea Valley). Cliff faces and coastal plateaus provide suitable breeding habitat. Wedge-tailed shearwater (ʻuaʻu kani) also nest on the coast in suitable soils near beaches and under coastal vegetation. Because these three seabirds forage at sea from coastal habitat, they are typically transiting only powerlines closest to the coast. (See HCP Figure 4-2, *KIUC Bird Flight Diverter Minimization Project Locations* and Figure 1 in Travers et al. (2023) for the locations of the minimization measures and the observed collisions and ground bird locations by functional category, respectively). Pacific golden-plover (kōlea) is a migratory shorebird visitor found typically in the winter months throughout the island in a wide range of habitats including lawns, golf courses, fields and even rooftops. Their breeding range is Siberia and western Alaska. Research on this species remains fragmentary, probably because the species is neither endemic nor endangered. The data from KIUC's powerline monitoring program for the years of 2012 – 2024 documents only rare instances of powerline collisions involving the Pacific golden-plover (kōlea) (less than three combined). Similarly, Hawaiian short-eared owl (pueo) powerline collisions and grounding were exceedingly rare during the Travers et al. (2023) observation period of 2012 - 2022.

Black-crowned night heron (ʻaukuʻu) may indeed strike powerlines frequently, as the 11 observed powerline strikes or powerline groundings in Travers et al. (2023) indicates, but this species is also believed to have a relatively high recovery rate following strikes, suggesting they often go undetected by ground surveys. Black-crowned night heron (ʻaukuʻu) is a species specializing on shallow wetland habitats on the island (ponds, streams, marshes, urban waterways, and shorelines) where it hunts for diverse prey. Wetland habitats are found throughout Kauaʻi and while most are in the lowlands, many can be found at higher elevations as well (including near the conservation sites).

In conclusion, it is therefore assumed that powerline strikes could lead to some adverse effects on four of the six MBTA protected species observed colliding with powerlines that are not covered by the HCP.

5.3.2 Effects of Light Attraction from Streetlights and Facility Lights

Some birds that become grounded on Kauaʻi are discovered by community members and businesses and turned into the SOS program as described above under Conservation Measure 3. The SOS program has recovered and released more than 32,500 seabirds since the program was created in 1979 (Raine et al. 2023). It is important to note that the recovery of birds by the SOS program does not indicate the cause of grounding, whether from light attraction, powerline strike, or other source of injury, fatigue, or disease. However, regardless of cause, recent SOS program data indicate there are many MBTA species that could benefit from the continued funding of the SOS program by KIUC over the 50-year permit term (Table 2).

Information is limited on the effect of artificial night lighting on other, non-seabird functional groups on Kauaʻi and other Hawaiian Islands. Most of what we currently understand is based on the recent synthesis of SOS program benefits and light effects on seabirds (Raine et al. 2023; Urmston et al. 2022), which has documented effects of light attraction on wedge-tailed shearwaters (ʻuaʻu kani). There is no clear evidence that streetlights can adversely affect birds on Kauaʻi other than seabirds. However, based on general bird biology there is some potential for effects on other bird species on Kauaʻi. It is therefore assumed that unshielded lights could attract seabirds and lead to disorientation of some members of the other functional groups in Table 2 that are not covered by the HCP.

For example, artificial light is known to attract migrating birds at night (Gauthreaux and Belser 2006) and to influence circadian rhythms and circannual cycles through their influence on functional photopigments within bird brains (Cassone 2014). As birds use the changes in day length as a cue to time seasonal behaviors, artificial night lighting may influence the perception of day length and may, thus, affect both circadian and circannual rhythms (Da Silva et Al. 2015). It is therefore assumed that unshielded lights could lead to some adverse effects on some other bird species on Kauaʻi.

5.3.3 HCP Conservation Measures

Activities related to implementation of the HCP conservation strategy at the conservation sites (i.e., Conservation Measure 4) may result in injury or mortality of some MBTA protected species not covered by the HCP that could be residing or nesting at the conservation sites or that become inadvertently trapped within predator traps or that collide with HCP infrastructure. The conservation measures implemented at the conservation sites include construction and maintenance of predator exclusion fences, predator control within and outside of the predator exclusion fences, social attraction to attract HCP covered seabirds to new nesting colony sites within the fenced areas, and selective invasive plant species control. These activities are further described in HCP Chapter 4, Section 4.5, *Conservation Measures*, in the HCP. There are also avoidance measures in place by contractor staff working in the conservation areas to protect species. For example, avoidance measures to protect the Hawaiian short-eared owl (pueo) are in place during barn owl predator control efforts at the conservation sites (NTBG 2019).

However, given the focus of Conservation Measure 4 on managing seabird breeding colonies, there is a potential for the inadvertent injury or mortality of some MBTA species not covered by the HCP. In particular, native forest birds and Hawaiian short-eared owl (pueo) are known to occupy habitats within or in the vicinity of the HCP conservation sites during their breeding seasons.

5.4 Benefits of HCP Conservation Measures to MBTA Species Not Covered by the HCP

HCP Chapter 4, *Conservation Strategy*, and the implementation of conservation measures will result in multiple beneficial impacts on MBTA covered species not covered by the HCP, as described below.

5.4.1 Minimizing Powerline Collision of Raptors, Shorebirds, Seabirds, and Waterfowl

The HCP minimization measures designed to reduce powerline strikes of the covered birds are likely to also reduce the risk of strikes of most of the other MBTA species of raptor, shorebirds, seabirds, waterfowl, rails and coots, and heron. The removal of static wires from almost all of KIUC's system will reduce opportunities for collision by many species. Similarly, the installation and maintenance of bird flight diverters (LED and reflective) on much of KIUC's powerline system will make those powerlines more visible to many bird species, further reducing the risk of collisions.

5.4.2 Minimizing Light Attraction and Disorientation

KIUC operates three types of lights that potentially attract birds—streetlights, external lights at its covered facilities, and night lighting for emergency repairs. KIUC has taken steps to reduce light attraction at its streetlights and covered facilities by shielding light fixtures using full-cutoff shields, turning lights off at night, and dimming covered facility lights during the seabird fledging season (see *Conservation Measure 2. Implement Measures to Minimize Light Attraction*). Although not all MBTA species are susceptible to disorientation or fallout, any measure that minimizes light visible to MBTA species flying overhead will help reduce disorientation or fallout.

5.4.3 Funding for Save Our Shearwater Program Benefits Many Species

KIUC has committed to providing funding for the SOS program (see HCP Conservation Measure 3). Over the last several years the program has expanded to include all native bird species. Under the SOS program, grounded seabirds, waterbirds, and other birds that are rescued by members of the public or businesses can be turned into SOS program staff. Injured birds are assessed, rehabilitated if possible, and released back into the wild by trained staff and volunteers with the support of professional veterinary staff. All rehabilitation actions occur at an accredited animal rescue facility with extensive equipment and facilities for any necessary procedure to treat minor injuries or perform major surgery or treatment, including extended stays prior to release back into the wild.

The SOS program has recovered and released more than 32,500 seabirds since the program was created in 1979 (Raine et al. 2023). Recent SOS program data indicate there are many MBTA species that could benefit from the continued funding of the SOS program by KIUC over the 50-year permit term (Table 2). The species listed in Table 2 excludes species covered by the HCP.

Table 2. Migratory Bird Treaty Act Species Recovered by the SOS Program (2007–2019), Excluding the HCP Covered Birds

Common Name	Scientific Name	Years Recovered by SOS
Passerines		
Brewer's sparrow	*Spizella breweri*	2007
Waterfowl		
Dabbling Ducks		
Northern pintail	*Anas acuta*	2012
American green-winged teal	*Anas crecca carolinensis*	2012
Laysan duck (koloa pōhaka)	*Anas laysanensis*	2013
Northern shoveler	*Spatula clypeata*	2012
Geese		
Snow goose	*Anser caerulescens*	2018
Black brant	*Branta bernicula nigricans*	2014
Grebes		
Eared grebe	*Podiceps nigricollis*	2012
Raptors		
Short-eared owl	*Asio flammeus*	2011, 2012, 2015–2019
Shorebirds		
Ruddy turnstone	*Arenaria interpres*	2012
Sanderling (hunakai)	*Calidris alba*	2011
Pacific golden-plover	*Pluvialis fulva*	2011–2013, 2015, 2016, 2019
Seabirds		
Laridae - Gulls, Terns, and Allies		
Black noddy	*Anous minutus*	2012
Brown noddy (noio kōhā)	*Anous stolidus*	2012
Sooty tern (ʻewaʻewa)	*Onychoprion fuscatus*	2007, 2011, 2019
Pelagic Seabirds		
Sooty shearwater	*Ardenna grisea*	2017
Wedge-tailed shearwater (ʻuaʻu kani)	*Ardenna pacifica*	2007, 2011–2019
Bulwer's petrel (ʻou)	*Bulweria bulwerii*	2007, 2011, 2012, 2018
Leach's storm-petrel	*Hydrobates leucorhous*	2011–2014, 2016–2019
Laysan albatross (mōlī)	*Phoebastria immutabilis*	2011, 2012, 2014–2019
Tahiti petrel	*Pseudobulweria rostrata*	2012

Common Name	Scientific Name	Years Recovered by SOS
Black-winged petrel	*Pterodroma nigripennis*	2011, 2018, 2019
Christmas shearwater ('ao'ū)	*Puffinus nativitatis*	2011
Suliformes - Gannets, Cormorants, and Allies		
Great frigatebird ('iwa)	*Fregata minor*	2018, 2019
Brown booby ('a)	*Sula leucogaster*	2007, 2011, 2015, 2019
Red-footed booby ('a)	*Sula sula*	2011–2015, 2018
Tropicbirds		
White-tailed tropicbird (koa'e kea)	*Phaethon lepturus*	2007, 2011–2019
Red-tailed tropicbird (koa'e 'ula)	*Phaethon rubricauda*	2011, 2012, 2015, 2017–2019
Herons, Egrets, Ibis		
Black-crowned night-heron ('auku'u)	*Nycticorax nycticorax*	2011–2019

Source: SOS Program Reports.

5.4.4 Predator Control at Conservation Sites

There are 13 MBTA bird species not covered by the HCP that are believed to be present at the conservation sites (Table 3) (Raine in. litt.). Many of these species are likely to benefit from the predator control and invasive plant control that will occur at the conservation sites. Expanding the scale and types of predator control (e.g., installing and/or maintaining predator exclusion fencing at conservation sites and predator eradication within predator exclusion fences) will further reduce predation risk and increase the survivorship of chicks produced each year for those nesting MBTA species within or adjacent to the conservation sites.

Despite the benefits of the conservation actions, some MBTA species, particularly the forest birds and raptor, have a risk of injury or mortality from certain activities at the conservation sites. Activities which may adversely affect MBTA species include the construction and maintenance of predator exclusion fences, predator control within and outside of the predator exclusion fences, and selective invasive plant species control.

To avoid and minimize potential take of MBTA covered species not covered by the HCP, KIUC has adopted:

- Avoidance and Minimization Measure 1, *Avoid Impacts to Forest Birds and Pueo from Fence Construction at Conservation Sites*, and
- Avoidance and Minimization Measure 2, *Avoid Impacts to MBTA Protected Bird Species from Predator Traps or Collisions with Facilities at Conservation Sites.*

Adoption of these MBTA-specific measures will avoid or minimize potential injury or mortality of MBTA protected species not covered by the HCP at the conservation sites. No additional measures are necessary to address MBTA species.

Table 3. Migratory Bird Treaty Act Species Not Covered by the HCP that May Be Present at the Conservation Sites on Kauaʻi

Common Name	Scientific Name	Current Status at Conservation Sites[a]	Breeding Season
Passerines (Perching Forest Birds)[b]			
Kauaʻi 'amakihi	*Chlorodrepanis stejnegeri*	Potential breeding	March 2 – October 31
Iʻiwi	*Drepanis coccinea*[c]	Not present, not likely breeding	March 2 – October 31
ʻApapane	*Himatione sanguinea*	Potential breeding	March 2 – October 31
ʻAkekeʻe	*Loxops caeruleirostris*[c]	Not present, not likely breeding	March 2 – October 31
Anianiau	*Magumma parva*	Not present, not likely breeding	March 2 – October 31
Puaiohi	*Myadestes palmeri*[c]	Not present, not likely breeding	March 2 – October 31
Akikiki	*Oreomystis bairdi*[c]	Not present, not likely breeding	March 2 – October 31
Raptors			
Hawaiian short-eared owl (pueo)	*Asio flammeus sandwichensis*	Potential breeding	November 1 – June 30
Seabirds			
Pelagic Seabirds			
Bulwer's petrel (ʻou)	*Bulweria bulwerii*	Not likely breeding, but could show up	April 1 – October 31 (Source: Whittow 1914)
Tropicbirds			
White-tailed tropicbird (koaʻe kea)	*Phaethon lepturus*	Breeding on cliffs below Honopu, Hanakapiai, Pohakea.	March 1 – January 31 (Raine et al 2020)
Herons, Egrets, Ibis			
Black-crowned night heron (ʻaukuʻu)	*Nycticorax nycticorax*	Not likely breeding but occasional presence in ULP only	December 1 – August 31 (Source: Pratt et al 1987)

[a] Source: Andre Raine, personal communication, November 2024.

[b] While Kauaʻi elepaio (*Monarcha sclateri*) is not an MBTA listed species, many of the conservation measures identified in the APP will benefit the species.

[c] Listed as threatened or endangered under the Endangered Species Act.

5.4.5 Avoidance and Minimization Measure 1. Avoid Impacts to Forest Passerines and Pueo from Fence Construction and Maintenance at Conservation Sites

As described previously, fence construction and maintenance at the HCP conservation sites has the potential to impact MBTA covered birds such as forest passerines and pueo if they are nesting in the conservation sites where these activities occur. Throughout the term of KIUC's management at the conservation sites (from 2011 to present), forest passerines and pueo have not been detected or documented nesting within the conservation sites with predator exclusion and ungulate fences that are maintained as part of KIUC's HCP. Therefore, the potential risk of impacting nesting forest birds and pueo is low based on historical and current conditions. Fence maintenance activities and other management actions are conducted on a regular basis at the conservation sites, which is expected to deter nesting of forest passerines and pueo at the fenced conservation sites. Vegetation maintenance at fenced conservation sites is conducted routinely to prevent vegetation from encroaching along the fenceline and compromising the integrity of the fence, which could result in predator incursions into the fenced site.

However, there is future potential for forest birds or pueo to be present and nest at the fenced conservation sites. Qualified avian biologists conduct HCP activities at the conservation sites on a regular basis. These biologists are trained to identify forest passerines and pueo. If forest birds or pueo are detected at the fenced conservation sites or within near proximity of fence maintenance or construction activities, KIUC will implement the following nest avoidance measures. With implementation of these nest avoidance measures at the conservation sites, no take of MBTA forest birds or pueo is expected to occur.

- **Step 1**: Determine whether vegetation management or construction can be postponed without compromising HCP biological goals and objectives at the sites where forest passerines or pueo are detected.
- **Step 2:** If vegetation management or construction cannot be postponed without compromising HCP biological goals and objectives, Step 2 would involve contacting USFWS to discuss alternative ways to address the current status. If, vegetation management or construction can be postponed without compromising HCP biological goals and objectives, then implement Step 3.
- **Step 3:** When forest passerines or pueo are present at fenced conservation sites, determine which species from Table 3 for which nest surveys are to be conducted prior to predator exclusion fencing construction and maintenance activities such as vegetation removal[11], use of powered equipment (e.g., chainsaws, line trimmers, mowers), or ground-disturbance activities are scheduled for purposes of fence construction or maintenance during the forest passerine and pueo breeding seasons, then implement Step 4.
- **Step 4**: A qualified biologist shall conduct preconstruction/pre-maintenance surveys for nests of forest passerines or pueo on any tree, vegetation, or structure within 500 feet of the project/activity footprint, where terrain allows, no more than 7 days before construction or vegetation management activities begin during the forest bird nesting season. If no active nests are found during focused surveys, no further action under this measure will be required. If a nest is found, proceed to Step 5.
- **Step 5**: If avoidance of the forest bird and pueo nesting season is not feasible and a nest is found of a forest passerine or pueo within the survey buffer, then construction and vegetation management shall be prohibited from within a buffer around the nest to avoid disturbance until

[11] Rapid response removal of trees and or shrubs that have fallen onto predator exclusion fences is acknowledged here as necessary to meet the HCP commitments to prevent predator intrusion within the fenced areas, and nests surveys will not be conducted prior to this type of maintenance.

the nest is no longer active (generally 50 to 100 feet for passerines and 250 to 500 feet for pueo, depending on the location and the professional judgment of the qualified biologist)[12].

No tree or vegetation shall be removed or trimmed within established buffers where an active bird nest is discovered. However, buffers may be reduced, expanded, or altered according to the discretion and professional judgment of the qualified biologist based on individual conditions such as the nesting species, surrounding terrain, and vegetation. The buffer shall be clearly marked and maintained until the young have fledged and are foraging independently.

Prior to construction or vegetation management activities, the qualified biologist shall conduct baseline monitoring of each nest to characterize normal bird behavior and establish a buffer distance, which allows the birds to exhibit normal behavior. The qualified biologist shall monitor the nesting birds during applicable activities and increase the buffer if birds show signs of unusual or distressed behavior (e.g., defensive flights and vocalizations, standing up from a brooding position, or flying away from the nest). If buffer establishment is not possible, the qualified biologist or construction foreman/vegetation management lead shall have the authority to cease all work in the area until the young have fledged, and the nest is no longer active.

5.4.6 Avoidance and Minimization Measure 2. Avoid Impacts to MBTA Protected Species from Predator Traps or Collisions with Facilities at Conservation Sites

There is a low risk that individual birds may be caught in predator control traps. During KIUC's management of the conservation sites, the data ranging from 2011 to 2024 indicates it is exceedingly rare for non-covered species to be caught in predator control traps. Two non-covered avian species have been detected in predator control traps since 2011. One Hawaiian goose (nēnē) was detected in a predator control trap in 2021. The bird was turned into SOS and subsequently released. One Hawaiian short-eared owl (pueo) was detected in a predator control trap in 2024; it was found to be in good health and was released onsite. Predator control traps are monitored by camera or by the predator control team while onsite and trapping incidents are detected and responded to quickly.

As a general practice, bird excluders are not used on predator control traps because they are known to reduce the effectiveness of predator control traps. KIUC may install bird excluders in very rare situations when predator control or colony monitoring teams identify the presence of non-covered seabirds in areas where traps are located and are at risk of interacting with those traps. These situations are determined on a case-by-case basis by the predator control team in coordination with qualified avian biologists. If KIUC detects an increase in non-covered birds becoming caught in predator control traps, KIUC will coordinate with USFWS Migratory Birds to seek advice on appropriate ways to reduce bird mortality risk.

A protocol has been developed by KIUC, seabird biologists, predator control teams and the SOS program to account for the infrequent situations where individual seabirds are caught in predator control traps or otherwise expected to have been impacted by collision with fences or weatherports

[12] If both forest passerines and pueo are detected nesting within proximity of fence maintenance and/or construction activities, construction may be significantly postponed if cessation of construction is deemed necessary until the nesting period is evacuated.

or any other HCP related action at the conservation sites that results in grounded/trapped birds. This protocol will be followed by KIUC's contractors that perform HCP measures at the conservation sites. In the rare event that non-covered species are detected in predator control traps, the seabird protocols can be adopted to address the issue. The full seabird protocol is provided as Appendix B and is briefly summarized below.

All colony monitoring and predator control staff not named on a banding permit and that implement HCP measures at the conservation sites will have in-person hands on training at SOS on an annual basis. In-person training will include proper methods for approaching a seabird found on the ground, proper handling and evaluation methods.

A bird box is located at each conservation site, either at the campsite or in a lock box, and is lined with clean material (e.g. sheet, towel, pillowcase). Crews must always carry a clean pillowcase (not reused) contained in a Ziplock bag or drybag. Pillowcases used to transport grounded birds must be replaced with clean pillowcases to prevent transference of avian diseases between individuals. After each use, used pillowcases must be appropriately cleaned offsite. Birds are always transported in a lined bird box except in emergency situations when obtaining a bird box from the weatherport will take too long to appropriately respond to the bird's condition. If a bird is transported in a clean pillowcase instead of a bird box, cover with body or rain gear to protect the bird from rain to the greatest degree possible.

With implementation of the following minimization measures at the conservation sites, no take of MBTA protected bird species is expected to occur.

- **Step 1: Initial Detection**. Upon detection of any MTBA species caught in a trap, always notify KIUC, the field supervisor or field partner immediately. Note the species, trap location, whether there is bait or a lure in the trap, and estimated time elapsed since bird was trapped. Take photo of bird without touching the bird.
- **Step 2: Observe the bird in situ.** Note the condition of the bird in the trap or in situ without touching the bird. If any signs of blood on the bird or its surroundings, if the bird's head is drooped or moving in an abnormal way (scanning, torticollis), if the bird is squinting its eyes or if eyes are occluded, and note if wings are splayed at their sides or in an unnatural position. Also note any signs of contamination from mud, feces, oil, etc., on feathers. If any of these are noted, proceed to **Step 3 through Step 5**. If none of these are noted, proceed to **Step 6**.
- **Step 3: Handling bird for evacuation.**
    - **3a. Removal from trap**:
        - Prior to removal, handler shall notify the office and field partner(s) that they are preparing to handle the bird. If possible, handler shall get a bird box from the weatherport and return with it to the trap. A clean pillowcase can be used in emergency situations or if a weatherport is too far away to remove the bird in a timely way. Handler to remove work gloves and handle birds with bare hands free from any residue (including hand sanitizer) that could transfer to the bird's plumage. Handler to lock trap door open and position their body to block the door and keep bird in the trap.
        - Reach into the trap and bring the bird's wings into the sides of its body to prevent it from hurting itself. Do not begin to pull the bird out until you are sure you have a secure hold of the wings to the body. As the bird is removed, watch that no toenails/wing

tips/etc. get hooked on trap parts. The bird may bite, but do not release the bird. The bird's safety comes first so let it bite you and keep holding it firmly but gently.

  - Place the bird inside the lined bird box or clean pillowcase (in emergencies). Immediately close the lid of the bird box or tie the end of the pillowcase to prevent the bird attempting to escape. In emergency situations when a bird box may not be accessible, use the clean pillowcase to contain the bird by gently inserting the bird inside and to the bottom of the pillowcase and knot the end. The bag should be tied off carefully so that no primaries or tail feathers are caught.

- **3b. Rescue from ground following collision with weatherport or other object**:

  - Ensure hands are free from any residue (including hand sanitizer) that could transfer to the bird's plumage. Approach the bird slowly and carefully, placing yourself between the bird and any potential avenue for escape. Reach down to grab the bird. Bring the wings to the sides of its body. Do not move the bird until you are sure you have control of the wings and body. Even if the bird is not struggling, always maintain a safe and secure hold.

  - Place the bird inside the lined bird box or clean pillow case (in emergencies) for immediate flyout. Immediately close the lid of the bird box or tie the end of the pillow case to prevent the bird attempting to escape.

- **Step 4: Flyout evacuation protocol.** Notify the supervisor and the bird will be flown out following the transport instructions.

  - Communicate with fellow crew or field supervisor to coordinate an immediate flight out.

  - If you will be transiting using webbing or in unstable terrain, communicate with your field partner to meet you along the trail to transit the bird together.

  - Transport the bird in a bird box back to the weatherport, except in emergency situations where a bird box can't be obtained within a reasonable period of time. In an emergency situation, use the clean pillowcase to transport the bird back to the weatherport. Keep the bag pressed securely to your middle, but not so firm as to suffocate the bird. Hike with the bird in an upright position and maintain hold on bird to prevent movement. The darkness of birdbox/pillowcase will help ensure the bird is calmer and more desensitized as you move. If it is raining, keep the bird sheltered as much as possible to prevent it from becoming wet.

  - Once back at the weatherport, or closest station with a bird box, gently pat the bird dry if wet and muddy. If transporting via pillowcase, place the bird in the bird box for helicopter transport. Line the box with a clean sheet, towel, or the pillowcase. Make sure the box is properly sealed, air holes are open/not blocked and place the box in a dark and cool location away from activity. Do not handle the bird, or attempt to provide food or water, while waiting on a helicopter.

  - In preparation for helicopter transport, place the bird in a quiet, dark, cool area away from activity to minimize stress until the helicopter arrives.

  - Once the helicopter arrives, hand the box to the pilot or whoever inside the helicopter that can safely position it for the flight out.

- Once helicopter arrives in Lihue, the lined bird box with bird inside will be immediately transported to SOS or handed off to SOS staff at a designated meeting place.

- **Step 5: Flyout weather delays.** If weather prevents helicopter access to fly bird out and deliver to SOS on the day the bird is placed in bird box for transport, field staff should contact KIUC, KIUC's avian biologist and SOS to get feedback/recommendations on whether or not it is best to release the bird at the site or continue waiting on extraction. If any signs of abnormality are present other than natural soiling, birds must always be extracted regardless of the time it takes for helicopter to access the site. It could become necessary to contact KIUC, KIUC's avian biologist and SOS to get additional feedback/recommendations on when it is appropriate to hike the bird out or to a different weatherport that is accessible by helicopter (for sites where hike out is an option).

- **Step 6: Removal and examination of the bird.** Before handling the bird for the examination detailed in Appendix B, find a location nearby as appropriate for the species in the vegetation or under something that can serve as a shelter for the bird until it returns to its occupied habitat. Make sure the location is not occupied and is dry, if possible. Record GPS points of the location and send it to your field supervisor or project manager. Follow remaining Step 6 steps detailed in Appendix B.

- **Step 7. Release.** If the bird is captured in a non-baited trap and is determined to be in good condition based on the examination, the bird can be released at the site.
  - Gently place the bird, head first about half way inside the previously identified covered location near where the bird was found. Allow the bird a few second to acclimate to its surroundings before releasing your hold.
  - If a bird is thought to have collided with a weatherport, is detected at night and is in good condition, release at weatherport unless it is raining. If it is raining, contain bird in bird box inside weatherport until rain abates or until the it can be released in a protected area with suitable habitat.
  - After handling bird, sanitize hands to the best of your ability while in the field and more thoroughly after returning to the weatherport. Take proper care of your health and safety. Any injuries should be appropriately attended. Do not touch mouth or eyes after handling bird.

- **Step 8. Reporting.** Field crew supervisors will report these incidents to KIUC's HCP Manager immediately upon detection, and will send a detailed report using the report form in Appendix B to KIUC's HCP Manager within four days of the detection. KIUC's HCP Manager will report seabird trap interactions to USFWS and DOFAW. Email notification of the incident will be made within 24 hours of detecting the incident followed by a detailed report within one week of detecting the incident. A copy of the detailed reporting form is provided on page 9 of Appendix B.

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Appendix A.
Avian Species of Kauaʻi Protected Under the Migratory Bird Treaty Act

Table A1. Avian Species Endemic or Known to Occur on Kauaʻi Protected Under the Migratory Bird Treaty Act[13]

Common Name	Scientific Name
Forest Passerines	
Kauaʻi ʻamakihi	*Chlorodrepanis stejnegeri*
ʻIʻiwi	*Drepanis coccinea*
ʻApapane	*Himatione sanguinea*
ʻAkekeʻe	*Loxops caeruleirostris*
ʻAnianiau	*Magumma parva*
Puaiohi	*Myadestes palmeri*
ʻAkikiki	*Oreomystis bairdi*
Waterfowl	
Dabbling Ducks	
Northern pintail	*Anas acuta*
Hawaiian duck (koloa maoli)*	*Anas wyvilliana*
Geese	
Hawaiian goose (nēnē) *	*Branta sandvicensis*
Raptors	
Hawaiian short-eared owl (pueo)	*Asio flammeus sandwichensis*
Shorebirds	
Hawaiian stilt (aeʻo)*	*Himantopus mexicanus knudseni*
Bristle-thighed curlew (kioea)	*Numenius tahitiensis*
Wandering tattler (ʻūlili)	*Tringa incana*
Seabirds	
Laridae - Gulls, Terns, and Allies	
Blue noddy (hinaokū)	*Anous ceruleus*
Hawaiian noddy (noio)	*Anous minutus melanogenys*
Brown noddy (noio kōhā)	*Anous stolidus*
White tern (manu o kū)	*Gygis alba*
Sooty tern (ʻewaʻewa)	*Onychoprion fuscatus*
Gray-backed tern (pākalakala)	*Onychoprion lunatus*
Pelagic Seabirds	
Buller's shearwater	*Ardenna bulleri*

[13] A current list of all MBTA species are available here: eCFR :: 50 CFR 10.13 -- List of Birds Protected by the Migratory Bird Treaty Act.

Common Name	Scientific Name
Sooty shearwater	*Ardenna grisea*
Wedge-tailed shearwater (ʻuaʻu kani)	*Ardenna pacifica*
Bulwer's petrel (ʻou)	*Bulweria bulwerii*
Band-rumped storm-petrel (ʻakēʻakē)*	*Hydrobates castro*
Tristram's storm-petrel (ʻakihikeʻehiʻale)	*Hydrobates tristrami*
Laysan albatross (mōlī)	*Phoebastria immutabilis*
Black-footed albatross (kaʻupu)	*Phoebastria nigripes*
Cook's petrel	*Pterodroma cookii*
Mottled petrel	*Pterodroma inexpectata*
Hawaiian petrel (ʻuaʻu)*	*Pterodroma sandwichensis*
Christmas shearwater (ʻaoʻū)	*Puffinus nativitatis*
Newell's shearwater (ʻaʻo)*	*Puffinus newelli*
Suliformes - Gannets, Cormorants, and Allies	
Great frigatebird (ʻiwa)	*Fregata minor*
Masked booby (ʻa)	*Sula dactylatra*
Brown booby (ʻa)	*Sula leucogaster*
Forster's booby	*Sula leucogaster plotus*
Red-footed booby (ʻa)	Sula sula
Tropicbirds	
White-tailed tropicbird (koaʻe kea)	*Phaethon lepturus*
Red-tailed tropicbird (koaʻe ʻula)	*Phaethon rubricauda*
Rails and Coots	
Hawaiian coot (ʻalae keʻokeʻo) *	*Fulica alai*
Hawaiian gallinule (ʻalae ʻula) *	*Gallinula galeata sandvicensis*
Herons, Egrets, Ibis	
Black-crowned night-heron (ʻaukuʻu)	*Nycticorax nycticorax*

* Species also covered by the KIUC HCP.

Table A2. Avian Species Migratory/Accidental/Rare on Kaua'i Protected Under the Migratory Bird Treaty Act

Common Name	Scientific Name
Waterfowl	
Dabbling Ducks	
Green-winged teal	*Anas crecca*
Baikal teal	*Anas formosa*
Laysan duck (koloa pōhaka)	*Anas laysanensis*
Mallard	*Anas platyrhynchos*
Ring-necked duck	*Aythya collaris*
Tufted duck	*Aythya fuligula*
American wigeon	*Mareca americana*
Eurasian wigeon	*Mareca penelope*
Gadwall	*Mareca strepera*
Northern shoveler	*Spatula clypeata*
Cinnamon teal	*Spatula cyanoptera*
Blue-winged teal	*Spatula discors*
Garganey	*Spatula querquedula*
Diving Ducks	
Lesser scaup	*Aythya affinis*
Redhead	*Aythya americana*
Greater scaup	*Aythya marila*
Canvasback	*Aythya valisineria*
Bufflehead	*Bucephala albeola*
Sea Ducks	
Hooded merganser	*Lophodytes cucullatus*
Surf scoter	*Melanitta perspicillata*
Common merganser	*Mergus merganser*
Red-breasted merganser	*Mergus serrator*
Whistling Ducks	
Fulvous whistling-duck	*Dendrocygna bicolor*
Geese	
Greater white-fronted goose	*Anser albifrons*
Snow goose	*Anser caerulescens*
Emperor goose	*Anser canagicus*
Brant	*Branta bernicla*
Canada goose	*Branta canadensis*
Cackling goose	*Branta hutchinsii*
Swans	
Tundra swan	*Cygnus columbianus*
Grebes	
Horned grebe	*Podiceps auritus*

Common Name	Scientific Name
Red-necked grebe	*Podiceps grisegena*
Eared grebe	*Podiceps nigricollis*
Pied-billed grebe	*Podilymbus podiceps*
Raptors	
Golden eagle	*Aquila chrysaetos*
Northern harrier	*Circus hudsonius*
Merlin	*Falco columbarius*
Peregrine falcon	*Falco peregrinus*
White-tailed eagle	*Haliaeetus albicilla*
Shorebirds	
Spotted sandpiper	*Actitis macularius*
Ruddy turnstone (ʻakekeke)	*Arenaria interpres*
Sharp-tailed sandpiper	*Calidris acuminata*
Sanderling (hunakai)	*Calidris alba*
Dunlin	*Calidris alpina*
Baird's sandpiper	*Calidris bairdii*
Curlew sandpiper	*Calidris ferruginea*
Stilt sandpiper	*Calidris himantopus*
Western sandpiper	*Calidris mauri*
Pectoral sandpiper	*Calidris melanotos*
Least sandpiper	*Calidris minutilla*
Ruff	*Calidris pugnax*
Semipalmated sandpiper	*Calidris pusilla*
Buff-breasted sandpiper	*Calidris subruficollis*
Common ringed plover	*Charadrius hiaticula*
Semipalmated plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferus*
Wilson's snipe	*Gallinago delicata*
Common snipe	*Gallinago gallinago*
Black-necked stilt	*Himantopus mexicanus*
Short-billed dowitcher	*Limnodromus griseus*
Long-billed dowitcher	*Limnodromus scolopaceus*
Marbled godwit	*Limosa fedoa*
Bar-tailed godwit	*Limosa lapponica*
Black-tailed godwit	*Limosa limosa*
Whimbrel	*Numenius phaeopus*
Red phalarope	*Phalaropus fulicarius*
Red-necked phalarope	*Phalaropus lobatus*
Wilson's phalarope	*Phalaropus tricolor*
Pacific golden-plover (kōlea)	*Pluvialis fulva*
Black-bellied plover	*Pluvialis squatarola*

Common Name	Scientific Name
Gray-tailed tattler	*Tringa brevipes*
Lesser yellowlegs	*Tringa flavipes*
Wood sandpiper	*Tringa glareola*
Greater yellowlegs	*Tringa melanoleuca*
Willet	*Tringa semipalmata*
Seabirds	
Laridae - Gulls, Terns, and Allies	
Blue-gray noddy	*Anous ceruleus*
Black noddy	*Anous minutus*
Black tern	*Chlidonias niger*
Bonaparte's gull	*Chroicocephalus philadelphia*
Caspian tern	*Hydroprogne caspia*
Herring gull	*Larus argentatus*
Common gull	*Larus canus*
Ring-billed gull	*Larus delawarensis*
Glaucous-winged gull	*Larus glaucescens*
Glaucous gull	*Larus hyperboreus*
Slaty-backed gull	*Larus schistisagus*
Laughing gull	*Leucophaeus atricilla*
Franklin's gull	*Leucophaeus pipixcan*
Bridled tern	*Onychoprion anaethetus*
Long-tailed jaeger	*Stercorarius longicaudus*
South polar skua	*Stercorarius maccormicki*
Pomarine jaeger	*Stercorarius pomarinus*
Common tern	*Sterna hirundo*
Arctic tern	*Sterna paradisaea*
Least tern	*Sternula antillarum*
Pelagic Seabirds	
Flesh-footed shearwater	*Ardenna carneipes*
Short-tailed shearwater	*Ardenna tenuirostris*
Streaked shearwater	*Calonectris leucomelas*
Northern fulmar	*Fulmarus glacialis*
Leach's storm-petrel	*Hydrobates leucorhous*
Tristram's storm-petrel	*Hydrobates tristrami*
Wilson's storm-petrel	*Oceanites oceanicus*
Short-tailed albatross	*Phoebastria albatrus*
Black-footed albatross	*Phoebastria nigripes*
Tahiti petrel	*Pseudobulweria rostrata*
White-necked petrel	*Pterodroma cervicalis*
Juan fernandez petrel	*Pterodroma externa*
Kermadec petrel	*Pterodroma neglecta*

Common Name	Scientific Name
Black-winged petrel	*Pterodroma nigripennis*
Murphy's petrel	*Pterodroma ultima*
Suliformes - Gannets, Cormorants, and Allies	
Lesser frigatebird	*Fregata ariel*
Blue-footed booby	*Sula nebouxii*
Rails and Coots	
Common gallinule	*Gallinula galeata*
Herons, Egrets, Ibis	
Great egret	*Ardea alba*
Great blue heron	*Ardea herodias*
Cattle egret	*Bubulcus ibis*
Green heron	*Butorides virescens*
White-faced ibis	*Plegadis chihi*
King Fishers	
Belted kingfisher	*Megaceryle alcyon*

Appendix B.
Protocols for Seabird Trap Interactions at Conservation Sites

PROTOCOLS FOR SEABIRD TRAP INTERACTIONS AT CONSERVATION SITES

Certain HCP measures conducted at KIUC managed conservation sites may result in occasional take of covered seabirds. Specifically, there is a risk that individual birds may be caught in predator control traps. The following protocols have been developed for situations where individual birds are caught in predator control traps or otherwise expected to have been impacted by any other HCP related action, and will be followed by KIUC's contractors that perform HCP measures at the conservation sites.

All colony monitoring and predator control staff not named on a banding permit and that implement HCP measures at the conservation sites, will have in-person hands on training at SOS on an annual basis. In-person training will include proper methods for approaching a bird found on the ground, proper handling and evaluation methods.

A bird box is located at each site, either at the campsite or in a lock box, and are lined with clean material (e.g. sheet, towel, pillowcase). Crews must always carry a clean pillowcase (not reused) contained in a Ziplock bag or drybag. Pillowcases used to transport grounded birds must be replaced with clean pillowcases to prevent transference of avian diseases between individuals. After each use, used pillowcases must be appropriately cleaned offsite. Always transport bird in a lined bird box except in emergency situations when obtaining a bird box from the weatherport is too far away or will take too long to appropriately respond to bird's condition. If a bird is transported in a clean pillow case instead of a bird box, cover with body or rain gear to protect the bird from rain to the degree possible.

SAVE OUR SHEARWATERS: The SOS Hotline is manned by a staff member 24/7. Call/text (808) 635-5117 as needed/able.

ARCHIPELAGO RESEARCH AND CONSERVATION: Andre Raine (808) 265-3723

1. INITIAL DETECTION

Upon detection of a seabird caught in a trap, always notify the field supervisor or field partner immediately. The field supervisor or project manager must always notify KIUC's HCP manager immediately. If detected on a camera and a crew is not onsite, the predator control crew that handles trapping at that site will get to the site as soon as possible to check on the status of the bird.

Note the following and report to field supervisor or project manager

a. Species
b. Trap location
c. Estimate of how long bird has been in trap or otherwise grounded

2. OBSERVE THE BIRD IN SITU

A. TRAP INTERACTIONS

◊ Take a photo of the bird in the trap or in situ, without touching the bird.

◊ Are there obvious signs of injury or illness?

Do you see blood on the bird ***or*** *the trap? Is the head drooped or moving in an abnormal way (scanning, torticollis)? Eyes squinting or obstructed? Wings splayed at sides or in an unnatural position?*

◊ Are there clear signs of contamination?

Is there noticeable mud, feces, oil, etc. on the feathers?

◊ Is bait or lure present in the trap?

IF YES TO ANY ⇨ PROCEED WITH STEP 3 AND 4.

IF NO TO ALL ⇨ CONTINUE TO STEP 5.

B. WEATHERPORT/ETC. COLLISIONS

◊ Take a photo of the bird in the trap or in situ, without touching the bird.

◊ As you approach the bird, take note of the bird's body posture and behavior.

Do you see any blood on the bird ***or*** *its surroundings? Is the head drooped or moving in an abnormal way (scanning, torticollis)? Eyes squinting or occluded? Wings splayed at sides or in an unnatural position?*

◊ Are there clear signs of contamination?

Is there noticeable mud, feces, oil, etc. on the feathers?

IF YES TO ANY ⇨ PROCEED WITH STEP 3 AND 4.

IF NO TO ALL ⇨ CONTINUE TO STEP 6.

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3. HANDLING BIRD FOR FLYOUT

A. REMOVAL FROM TRAP

◊ Prior to removal, notify the office and field partner that you are preparing to handle the bird. If weatherport is a relatively short hiking distance, get a bird box from the weatherport and return with it to the trap. A clean pillow case can be used in emergency situations or if weatherport is too far away to removal bird in a timely way.

◊ Prep yourself: Take off your bag and remove work gloves (handle birds with bare hands). Ensure your hands are free from any residue (including hand sanitizer) that could transfer to the bird's plumage.

◊ Prep your supplies: Have the bird box and/or clean pillow case ready and within reach.

◊ Lock open the trap door and block the door with your body to keep the bird in the trap.

◊ Reach into the trap and bring the bird's wings into the sides of its body to prevent it from hurting itself. Do not begin to pull the bird out until you are sure you have a secure hold of the wings and body. As you remove the bird from the trap, watch to make sure that no toenails/wing tips/etc get hooked on trap parts. The bird may bite, but do not release the bird. The bird's safety comes first so let it bite you and keep holding it firmly but gently.

◊ Place the bird inside the lined bird box or clean pillow case (in emergencies). Immediately close the lid of the bird box or tie the end of the pillow case to prevent the bird attempting to escape. In emergency situations when a bird box may not be accessible, use the clean pillowcase to contain the bird by gently inserting the bird inside and to the bottom of the pillow case and knot the end. The bag should tied off carefully so that no primaries or tail feathers are caught.

B. WEATHERPORT/ETC. COLLISIONS – PICKING UP BIRD

◊ Ensure that your hands are free from any residue (including hand sanitizer) that could transfer to the bird's plumage.

◊ Approach the bird slowly and carefully, placing yourself between the bird and any potential avenue for escape. Reach down to grab the bird. Bring the wings to the sides of its body. Do not move the bird until you are sure you have control of the wings and body. Even if the bird is not struggling, always maintain a safe and secure hold.

◊ Place the bird inside the lined bird box or clean pillow case (in emergencies) for immediate flyout. Immediately close the lid of the bird box or tie the end of the pillow case to prevent the bird attempting to escape.

4. FLYOUT PROTOCOL

◊ Notify your supervisor and the bird will be flown out following the transport instructions.

- ◊ Communicate with fellow crew or field supervisor to coordinate an immediate flight out.

- ◊ If you will be transiting using webbing or in unstable terrain, communicate with your field partner to meet you along the trail to transit the bird together.

- ◊ Transport the bird in a bird box back to the weatherport, except in emergency situations where bird box can't be obtained within a reasonable period of time. In emergency situation, use the clean pillowcase to transport bird back to the weatherport. Keep the bag pressed securely to your middle, but not so firm as to suffocate the bird. Hike with the bird in an upright position and maintain hold on bird to prevent movement. The darkness of birdbox/pillow case will help ensure the bird is calmer and more desensitized as you move. If it is raining, keep the bird sheltered as much as possible to prevent it from becoming wet.

- ◊ Once back at the weatherport, or closest station with a bird box, gently pat the bird dry if wet and muddy. If transporting via pillow case, place the bird in the bird box for helicopter transport. Line the box with a clean sheet, towel, or the pillowcase. Make sure the box is properly sealed, air holes are open/not blocked and place the box in a dark and cool location away from activity. Do not handle the bird, or attempt to provide food or water, while waiting on a helicopter.

- ◊ Once the helicopter arrives, hand the box to the pilot or whoever inside the helicopter that can safely position it for the flight out.

- ◊ Once helicopter arrives in Lihue, the lined bird box with bird inside will be immediately transported to SOS or handed off to SOS staff at a designated meeting place.

IN PREPARATION FOR TRANSPORT TO SOS, PLACE THE BIRD IN A QUIET, DARK, COOL AREA AWAY FROM ACTIVITY TO MINIMIZE STRESS UNTIL THE HELICOPTER ARRIVES.

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5. FLYOUT WEATHER DELAYS

- ◊ If weather prevents helicopter access to fly bird out and deliver to SOS on the day the bird is placed in bird box for transport and it is before mid-September for NESH and before mid-October for HAPE, field staff must contact Andre Raine and SOS to get feedback/recommendations on whether or not it is best to release birds at the site or continue waiting on extraction. If any signs of abnormality are present other than natural soiling, birds must always be extracted regardless of the time it takes for helicopter to access the site.

- ◊ If weather prevents helicopter access to fly bird out and deliver to SOS on the day the bird is placed in the bird box for transport and the bird has signs other than natural soiling, field staff must contact Andre Raine and SOS to get feedback/recommendations on when it's appropriate to hike the bird out or to a different weather port that is accessible by helicopter (for sites where hike out is an option).

6. REMOVAL AND EXAMINATION OF THE BIRD

- ◊ Before handling the bird for further examination, find a location nearby (hole or deep enclosed space that is no more than a few feet from trap) in the vegetation or under something other than a burrow that can serve as a shelter for the bird during the day. Make sure the location is not occupied and is dry, if possible. The hole or enclosed space where the bird is to be placed should be twice the length of the bird and protected from direct light. It will move back to its burrow at night, but will need cover during the day. Record GPS points of the location and send to it your field supervisor or project manager.

- ◊ Prior to removal from trap or retrieving the bird from ground, notify the office and field partner that you are preparing to handle and assess the bird. It is not necessary to wait for a response from the office or field partner.

- ◊ Prep yourself: Take off your bag and remove work gloves (handle birds with bare hands). Ensure your hands are free from any residue (including hand sanitizer) that could transfer to the bird's plumage.

- ◊ Prep your supplies: Pull out your clean pillowcase; have it ready and within reach. If possible, lay the pillowcase down to use as an examination surface. This will help avoid any additional contamination to the bird's plumage.

- ◊ Lock open the trap door and block the door with your body to keep the bird in the trap.

- ◊ Reach into the trap and bring the bird's wings into the sides of its body to prevent it from hurting itself. Do not begin to pull the bird out until you are sure you have a secure hold of the wings and body. As you remove the bird from the trap, watch to make sure that no toenails/wing tips/etc get hooked on trap parts. The bird may bite, but do not release the bird. The bird's safety comes first so let it bite you and keep holding it firmly but gently.

- ◊ Place the bird on the clean examination surface. Even if the bird is not struggling, always maintain a safe and secure hold.

- ◊ Check to see if the bird has a band. If band is present, document band number.

Note: Limit handling time to avoid unnecessary stress. Stress can exasperate existing issues and negatively impact the bird's health. Don't rely on the bird's behavior to show whether they are stressed or not, as wild animals commonly avoid showing any sign of weakness or vulnerability when faced with a threat. Assume a wild bird is experiencing stress even if it appears calm. Do your best to move efficiently through the exam while still being thorough. The bird should not be in hand for more than 5-10 minutes.

USE THE FOLLOWING PROMPTS TO GUIDE YOUR EXAM.
IF ANY ABNORMALITIES ARE FOUND, END EXAM AND PROCEED WITH IMMEDIATE FLY-OUT PROTOCOL.

Respiratory

◊ Breathing should not be audible or significantly labored. Respirations that sound wet are abnormal.

◊ The bird may or may not vocalize sporadically, both are normal. Mouth is typically kept closed, but the bird may begin open mouth breathing if stressed and/or hot.

Face/Mouth

◊ Assess the head/neck of the bird. Is it held upright (unless trying to hide)? Are eyes bright, open, and clear? Does the bird seem to react to its surroundings? Check the bill for chips or other abnormalities.

◊ To assess hydration, open the bill of the bird. Do this very carefully. Never pry open the mouth from the tip of the bill. The mucous membranes should be light pink/pink in color and moist. If saliva appears ropey or stringy, the bird is likely dehydrated.

Plumage

◊ Does the bird have any dirty or damaged feathers? Are the belly, chest, or vent feathers tinged with grime? Note that birds with small, seemingly insignificant amounts of dirt/etc. have required multiple poolings before they became fully waterproof.

Body Condition

◊ Use your fingers that are wrapped around either side of the bird's belly to examine the keel bone (breastbone). While this bone is easily felt, it should not be sharp to the touch. You should be able to feel muscle up either side of the keel.

Legs/Feet

◊ Examine the webbing and toes of both feet. Are there open sores, abrasions, or swelling?

◊ Do the legs show any physical injuries or signs of asymmetry? Do they lay flat when the bird sits? Does the bird avoid putting weight on its legs or feet?

Body posture/wings

◊ Loosen your hold on the bird to examine body posture. It should be centered and balanced.

◊ While your grip is loosened, take a moment to assess how the wings are sitting. Are they held into the body or are they splayed out to either side? Do they appear to be symmetrical? Are the flight feathers in good condition?

◊ If no abnormal findings have been observed, perform a flight test: Place your hands directly in front of the thighs along the belly of the bird with your thumbs wrapped around the back to maintain a secure hold of the body. Wings should be free of your grip. Raise the bird off the examination surface and tilt the body up ~80° so the chest faces forward. The bird should begin to flap in the air. Does the bird favor one wing during the flap test or have unequal wing beats?

IF NO ABNORMALITIES ARE OBSERVED, PROCEED TO STEP 7.
IF THE BIRD WILL BE TRANSPORTED TO SOS, PLACE THE BIRD BOX IN A QUIET, DARK, COOL AREA AWAY FROM ACTIVITY TO MINIMIZE STRESS UNTIL THE HELICOPTER ARRIVES.

---

7. RELEASE

◊ If the bird is captured in a non-baited trap and is determined to be in good condition based on the examination, the bird can be release at the site.

◊ Gently place the bird, head first about half way inside the previously identified covered location near where the bird was found. Allow the bird a few second to acclimate to the dark before releasing your hold. After the bird has run forward into the covered location, keep your hands over the entrance to dissuade the bird from running back out.

◊ Any trap that captures a bird during the breeding season must be locked open with zip ties or moved for the remainder of the seabird season.

◊ If bird is thought to have collided with weatherport, is detected at night and is in good condition, release at weatherport unless it is raining. If it's raining, contain bird in bird box inside weatherport until rain abates or until the next evening when it can be released in a burrow or protected area.

◊ After handling bird, sanitize hands to the best of your ability while in the field and more thoroughly after returning to the weatherport. Take proper care of your health and safety. Any injuries should be appropriately attended. Do not touch mouth or eyes after handling bird.

8. REPORTING

Field crew supervisors will report these incidences to KIUC's HCP Manager immediately upon detection, and will send a detailed report using the report form below to KIUC's HCP Manager within four days of the detection.

KIUC's HCP Manager will report seabird trap interactions to USFWS and DOFAW. Email notification of the incident will be made within 24 hours of detecting the incident followed by a detailed report within one week of detecting the incident.

A copy of the detailed reporting form is below.

KIUC Conservation Site Seabird Incident Report

Date	
Time	
Location (include GPS coordinates)	
Point of Contact (Name and Phone)	
Species of Bird/Age	
Summary of Event	
Status of Bird (healthy/ dead/injured etc.)	
Actions taken	
Additional information (optional)	

Map showing location of the incident, and photos of the site and affected bird insitu will accompany this report.

Appendix D

Cultural Impact Assessment

FINAL

Cultural Impact Assessment with Ka Paʻakai Analysis for the KIUC Habitat Conservation Plan, Island of Kauaʻi, TMK: (4) Multiple Zones, Sections, Plats and Parcels

Prepared for
U.S Fish and Wildlife Service (USFWS),
State of Hawaiʻi Department of Land and Natural Resources
Division of Forestry and Wildlife (DOFAW)
and
Kauaʻi Island Utility Cooperative (KIUC)

Prepared by
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(Job Code: KAUAI 5B)

February 2025

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Management Summary

Subject	Summary
Reference	Cultural Impact Assessment with Ka Paʻakai Analysis for the KIUC Habitat Conservation Plan Island of Kauaʻi, TMK: [4] Multiple Zones, Sections, Plats and Parcels (Kaapana et. al 2025)
Date	February 2025
Project Number(s)	Cultural Surveys Hawaiʻi, Inc. (CSH) Job Code: KAUAI 5B
Agencies	Environmental Review Program, U.S Fish and Wildlife Service (USFWS), State of Hawaii Department of Land and Natural Resources Division of Forestry and Wildlife (DOFAW), and Kauaʻi Island Utility Cooperative (KIUC)
Land Jurisdiction	Various Federal, State of Hawaiʻi, County of Kauaʻi, and private landowners
Study Description	A Habitat Conservation Plan (HCP) is being prepared in support of KIUCs application for a federal incidental take permit (ITP) issued by the USFWS and state incidental take license (ITL) issued by the DLNR. The HCP being developed is aimed at minimizing impacts of the covered activities, which includes the operation of KIUCs power lines, operation of KIUC facility lights and streetlights, power line retrofits, and night lighting for repair of KIUC power lines and facilities. The HCP covers nine species that are listed as endangered or threatened under the federal Endangered Species Act (ESA) and Hawaiʻi Revised Statutes (HRS) §195D including three species of seabird, four species of waterbird, the Hawaiian goose, and the green sea turtle. The covered species were selected based on their listing status and potential for the covered activities to result in injury or mortality to covered species due to light attraction (seabirds and green sea turtle) or collision with power lines (seabirds and waterbirds). KIUC is requesting authorization from USFWS and DOFAW for a 50-year permit term. KIUC's conservation strategy includes implementation of management actions within existing breeding colonies of covered seabird species or at sites with suitable habitat for establishing new breeding colonies of covered seabird species. These management actions include use of predator or ungulate exclusion fencing to fence conservation sites, active predator control (with or without fencing), and development of social attraction sites to promote seabird nesting. Predator exclusion and predator control activities are targeted to exclude or control rats (*Rattus* spp.), cats (*Felis catus*), and barn owls (*Tyto alba*) as well as ungulates. Social attraction sites for nesting seabirds will be developed within predator excluded areas and will utilize call playback and artificial burrows to attract covered seabirds to the site to breed.

Subject	Summary
	Conservation sites will be located in the steep and rugged terrain of remote areas of the Nā Pali Coast that support existing colonies of nesting seabirds or where suitable habitat has been identified. Access to conservation sites is limited and is primarily by helicopter. Conservation measures include the implementation of power line collision minimization projects, implementation measures to minimize light attraction, providing funding for the Save Our Shearwaters program, managing and enhancing seabird breeding habitat and colonies at conservation sites, implementing a green sea turtle nest detection and temporary shielding program, and identifying and installing practicable permanent light minimization techniques for green sea turtles. Activities not covered by the HCP include construction of KIUC infrastructure, routine wire retrofit and repair, routine support structure retrofit and replacement, operation and retrofit of other infrastructure within the Port Allen Generating Station and the Kapaia Power Generating Station, operation and retrofit of service wires, distribution wires at low heights or owned by others, operation and retrofit of existing solar facilities and hydroelectric facilities, operation and retrofit of existing substations and switchyards, and decommissioning infrastructure.
Study Area	The Study Area for the Cultural Impact Assessment (CIA) is defined as the Plan Area. The Plan Area is the area to which the ITP and ITL applies, and the approved HCP would be implemented, including where all covered activities, conservation measures, and associated impacts will occur. Because KIUC operates an island-wide system exclusively on Kauaʻi and is proposing conservation measures in remote areas of the island, the HCP Plan Area covers the full geographic extent of Kauaʻi. The Plan Area is depicted on a U.S. Geological Survey (USGS) topographic map of Kauaʻi.
Document Purpose	This CIA was prepared to comply with the State of Hawaiʻi's environmental review process under HRS §343, which requires consideration of the proposed project's potential effect on cultural beliefs, practices, and resources. The issuance of a federal incidental take permit constitutes a federal undertaking under Section 106 of the National Historical Preservation Act (NHPA). Therefore, USFWS may also use this document as an additional source in their review to determine if issuance of the permit has the potential to cause effects to historic properties. Through document research and cultural consultation efforts, this report provides information compiled to date pertinent to the assessment of the proposed project's potential impacts to cultural beliefs, practices, and resources (pursuant to the Environmental Review Program's (formerly the Office of Environmental Quality Control) *Guidelines for Assessing Cultural Impacts*) which may include traditional cultural properties (TCPs). These TCPs may be significant historic properties under State of Hawaiʻi Significance Criterion e, pursuant to Hawaiʻi Administrative

Subject	Summary
	Rules (HAR) §13-275-6 and §13-284-6. 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 Community Consultation	CSH made multiple attempts to contact Native Hawaiian organizations, agencies, and community members as well as cultural and lineal descendants to identify individuals with cultural expertise and/or knowledge of the plan area and vicinity. CSH reached out to a total of 73 individuals. Of the 73 individuals invited to participate in consultation, eight individuals responded either by phone or email. Attempts were made to engage in formal interviews, however, of the eight interested individuals, CSH was able to confirm and conduct only two separate interviews. Unfortunately, only one of the interviews have been reviewed and approved by the interviewee. Below is the name of the individual who shared her *manaʻo* (thoughts, opinions) and *ʻike* (knowledge) about the HCP, plan area, and respective *ahupuaʻa*: Makaʻala Kaʻaumoana, Executive Director, Hanalei Watershed Hui
Identification of Cultural Practices	Community consultation and background research conducted as part of this CIA has identified the following cultural, historical, and natural resources where past and ongoing cultural practices (including traditional and customary native Hawaiian rights) were/are being exercised: 1. Surfing 2. Farming, *kalo*, wetland and dryland 3. Deep-sea fishing 4. *Hula* 5. Salt Production 6. Subsistence farming (fishponds) 7. Burials and h*eiau*
Identification of Impacts to Cultural Practices	Consultation and background research has identified a number of concerns related to the environment and the broader community: 1. Makaʻala Kaʻaumoana is concerned for the safety of the *ʻaʻo* (Newell's shearwater) and the *ʻuaʻu* (Hawaiian petrel). She says KIUC power lines have become obstacles for these birds. 2. Makaʻala Kaʻaumoana also expressed the importance of predator control. In some cases, when birds come into contact with KIUC power lines, if they are not immediately killed, they are wounded and defenseless and are easily snatched up by feral cats.

Subject	Summary
	3. Makaʻala Kaʻaumoana mentioned the careless handling of albizia (*Falcataria moluccana*) trees that are trimmed out of way of power lines. Debris from recent trimming was dumped *mauka* of Hanalei River that can cause severe damage to stream life and can damage the reefs and nearshore marine resources. 4. Makaʻala Kaʻaumoana is concerned about the native plants in the remote area that KIUC accesses. She stressed the importance of preservation of these native plants while [KIUC] accesses these remote areas to install poles and power lines.
Mitigation Recommendations	CSH supports the following preliminary recommendations for future activities that may develop as a result of this HCP: 1. Personnel involved in related activities of the HCP 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 State Historic Preservation Division (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 related activities of the HCP, 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. The following actions are recommended to promote and preserve cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups: 1. Makaʻala Kaʻaumoana recommends predator control by KIUC or a hired agency to address the increased population of feral cats that snatch up wounded birds who come into contact with KIUC power lines. 2. Makaʻala Kaʻaumoana insists KIUC do their due diligence in assuring proper disposal of all trimmed albizia logs. 3. It is recommended that the preservation of native/endangered plants and animals be taken into consideration for continued propagation and reproduction. 4. It is recommended that, when feasible, allowing access to certain remote areas in the *wao akua* may assist cultural practitioners in

Subject	Summary
	fulfilling ceremonial and religious practices. Although KIUC does not control access to the HCP areas, future activities that may occur as a result of this HCP should not create any new encumbrances to access for traditional cultural practices in areas that are not currently restricted. 5. It is recommended that future activities that may develop as a result of this HCP should strive to minimize any interference with future, current or ongoing cultural rights and practices, as well as maintaining or considering view planes to sacred sites/markers and religious structures.
Ka Pa‘akai Analysis	In *Ka Pa‘akai vs Land Use Commission*, 94 Hawai‘i (2000) the Court held the following analysis must also be conducted: 1. The identity and scope of valued cultural, historical, or natural resources in the project area, including the extent to which traditional and customary native Hawaiian rights are exercised in the project area; 2. The extent to which those resources—including traditional and customary native Hawaiian rights—will be affected or impaired by the proposed action; and 3. The feasible action, if any, to be taken by the LUC to reasonably protect native Hawaiian rights if they are found to exist. Based on information gathered from the cultural and historical background, and community consultation for this project, there are a number of traditional cultural practices and resources to consider. The Ka Paakai Analysis is included in Section 9 of this report.

Table of Contents

List of Figures

List of Tables

Section 1 Introduction

At the request of ICF, and on behalf of the U.S. Fish and Wildlife Service (USFWS) and Hawaiʻi Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW), Cultural Surveys Hawaiʻi, Inc. (CSH) has prepared this cultural impact assessment (CIA) and Ka Paʻakai Analysis for the Kauaʻi Island Utility Cooperative (KIUC) Habitat Conservation Plan (HCP), Island of Kauai, Tax Map Key (TMK): (4) Multiple Zones, Section, Plats and Parcels.

1.1 **Project Background**

KIUC is applying for an incidental take permit (federal ITP) issued by USFWS and an incidental take license (state ITL) issued by DLNR. The federal ITP and state ITL would authorize taking species protected by the federal Endangered Species Act (ESA) and its state equivalent, Hawaiʻi Revised Statutes (HRS) §195D, that is incidental to otherwise lawful activities. Specifically, the federal ITP and state ITL would authorize take resulting from operation of KIUC's power lines, facility lights and streetlights, power line retrofits, and night lighting for repair of KIUC power lines and facilities (collectively referred to as "covered activities").

KIUC is developing a HCP in support of their application for a federal ITP and state ITL. The Plan Area is the area for which the ITP applies and the approved HCP would be implemented, including where all covered activities and conservation measures will occur. Because KIUC operates an island-wide system exclusively on Kauaʻi and is proposing conservation measures in remote areas of the island, the KIUC HCP plan area covers the full geographic extent of Kauaʻi. The plan area is depicted on a U.S. Geological Survey (USGS) topographic map of Kauaʻi (Figure 1) and an aerial photograph (Figure 2).

The HCP covers nine species listed as endangered or threatened under the ESA and HRS §195D including three species of seabird, four species of waterbird, the Hawaiian goose, and the green sea turtle (Table 1). The covered species were selected based on their listing status and potential for the covered activities to result in injury or mortality to covered species due to light attraction (seabirds and green sea turtle) or collision with power lines (seabirds, waterbirds, and Nēnē). KIUC is requesting take authorization from USFWS and DLNR for a 50-year permit term.

KIUC's conservation strategy includes implementation of management actions within existing breeding colonies of covered seabird species or at sites with suitable habitat for establishing new breeding colonies of covered seabird species. These management actions include use of predator or ungulate exclusion fencing to fence conservation sites, active predator control (with or without fencing), and development of social attraction sites to promote seabird nesting. Predator exclusion and predator control activities are targeted to exclude or control rats (*Rattus* spp.), cats (*Felis catus*), and barn owls (*Tyto alba*) as well as ungulates. Social attraction sites for nesting seabirds will be developed within predator-excluded areas and will utilize call playback and artificial burrows to attract covered seabirds to the site to breed. Conservation sites will be in the steep and rugged terrain of remote areas of the Nā Pali Coast that support existing colonies of nesting seabirds or where suitable habitat has been identified (see Figure 1).

Table 1. Covered species

Hawaiian Name	English Name	Scientific Name	Status[a]
Aeʻo	Hawaiian stilt	*Himantopus mexicanus knudseni*	E/E
ʻAkēʻakē	Band-rumped storm-petrel	*Oceanodroma castro*	E/E
ʻAlae keʻokeʻo	Hawaiian coot	*Fulica alai*	E/E
ʻAlae ʻula	Hawaiian common gallinule	*Gallinula galeata sandivicensis*	E/E
ʻAʻo	Newell's shearwater	*Puffinus auricularis newelli*	T/T
Honu	Green sea turtle	*Chelonia mydas*	T/T
Koloa maoli	Hawaiian duck	*Anas wyvilliana*	E/E
Nēnē	Hawaiian goose	*Branta sandvicensis*	T/E
ʻUaʻu	Hawaiian petrel	*Pterodroma sandwichensis*	E/E

[a]Status (Federal/State):
E = Listed as endangered under the federal ESA or HRS §195D.
T = Listed as threatened under the federal ESA or HRS §195D.

Conservation measures include the implementation of power line collision minimization projects, implementation measures to minimize light attraction, providing funding for the Save Our Shearwaters program, managing and enhancing seabird breeding habitat and colonies at conservation sites, implementing a green sea turtle nest detection and temporary shielding program, and identifying and installing practicable permanent light minimization techniques for green sea turtles.

Activities not covered by the HCP include construction of KIUC infrastructure, routine wire retrofit and repair, routine support structure retrofit and replacement, operation and retrofit of other infrastructure within the Port Allen Generating Station and the Kapaia Power Generating Station, operation and retrofit of service wires, distribution wires at low heights or owned by others, operation and retrofit of existing solar facilities and hydroelectric facilities, operation and retrofit of existing substations and switchyards, and decommissioning infrastructure.

Approval of the HCP and issuance of a federal ITP by USFWS and a state ITL by DLNR is subject to environmental review under the National Environmental Policy Act (NEPA) and the Hawaiʻi Environmental Policy Act (HEPA), respectively. To facilitate concurrent environmental reviews, a joint federal/state Environmental Impact Statement that evaluates the impact of issuing a federal ITP and state ITL is being prepared. Pursuant to HEPA, the environmental review will include consideration of the impacts of implementing the HCP and issuance of the state ITL on the cultural beliefs, practices, and resources of Native Hawaiians via a CIA.

1.2 Document Purpose

The purpose of this CIA is to comply with the State of Hawaiʻi's environmental review process under HRS §343, which requires consideration of the proposed project's potential effect on cultural beliefs, practices, and resources. The issuance of a federal incidental take permit constitutes a federal undertaking under Section 106 of the National Historical Preservation Act (NHPA). Therefore, USFWS may also use this document as an additional source in their review to determine if issuance of the permit has the potential to cause effects to historic properties.

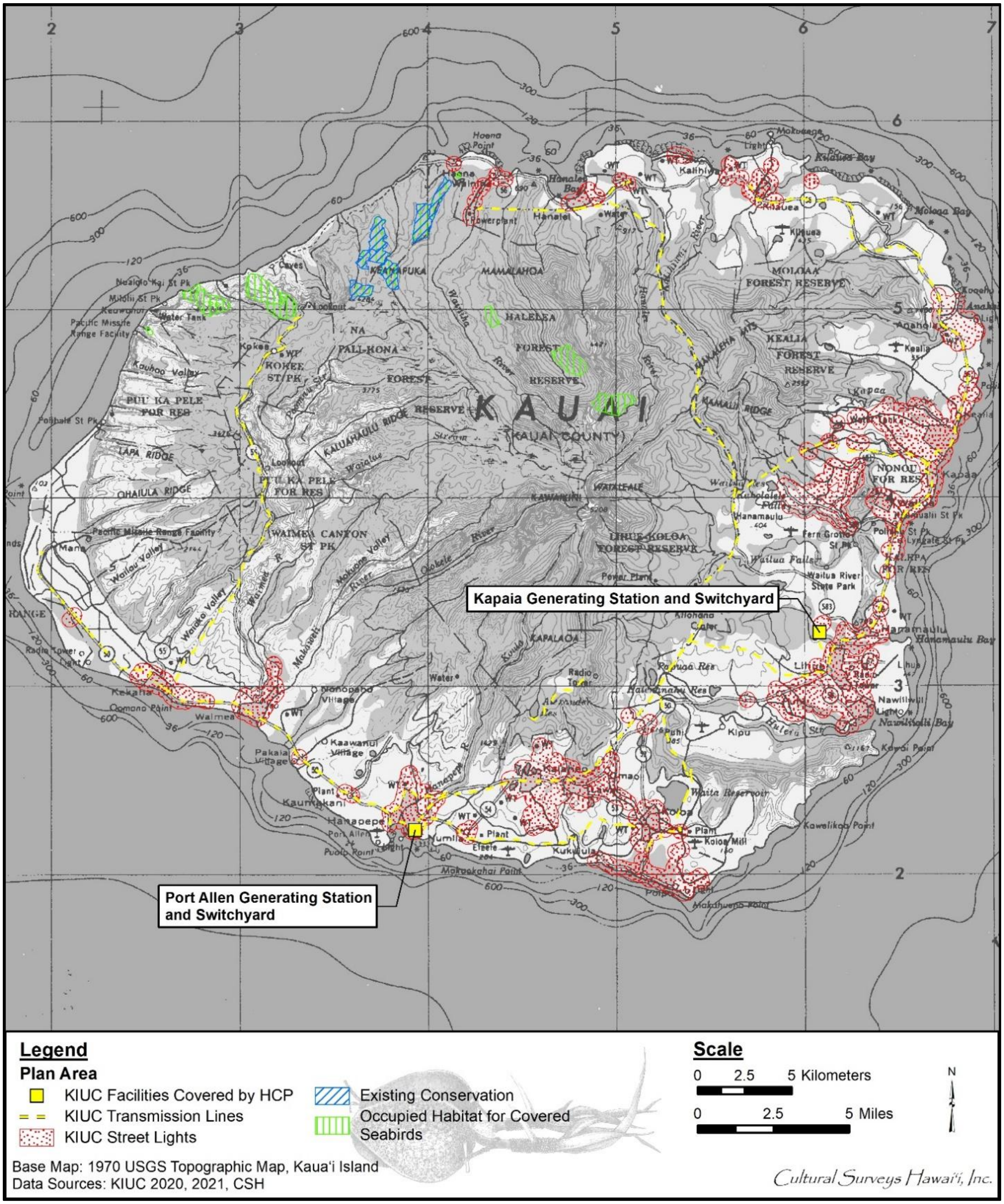


Figure 1. 1970 USGS topographic map of Kauaʻi showing KIUC transmission lines, street lights, two specific facilities, existing conservation sites, and occupied habitat for species covered by the Habitat Conservation Plan

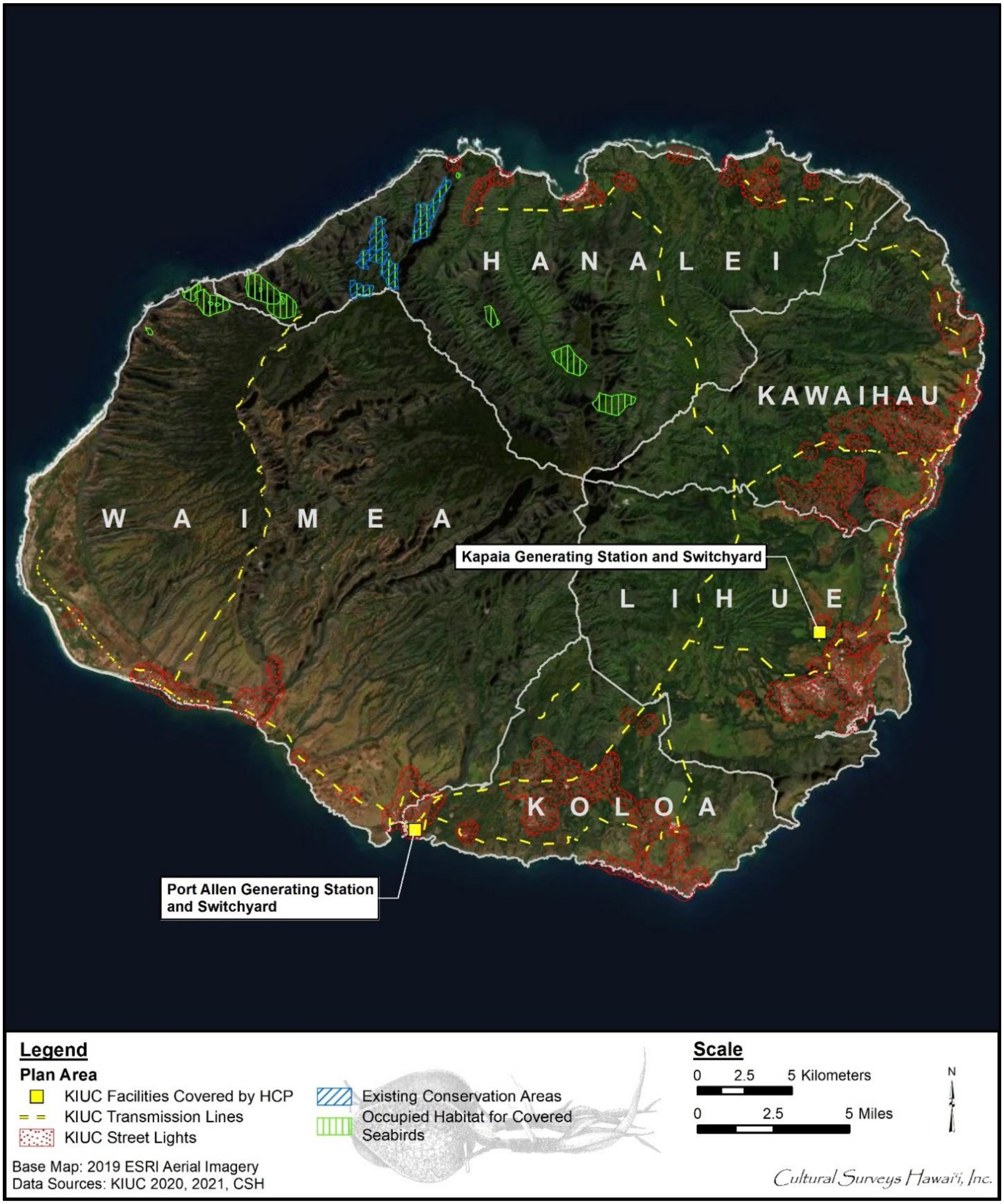


Figure 2. 2019 ESRI Aerial Imagery of Kaua‘i showing KIUC transmission lines, street lights, two specific facilities, existing conservation sites, and occupied habitat for species covered by the Habitat Conservation Plan

Through document research, this report provides information compiled to date pertinent to the assessment of the proposed project’s potential impacts to cultural beliefs, practices, and resources (pursuant to the Environmental Review Program’s (formerly the Office of Environmental Quality Control) *Guidelines for Assessing Cultural Impacts*) which may include traditional cultural properties (TCPs). These TCPs may be significant historic properties under State of Hawai‘i Significance Criterion e, pursuant to Hawai‘i Administrative Rules (HAR) §13-275-6 and §13-284-6. Significance Criterion e refers to historic properties that “have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group’s history and cultural identity” (HAR §13-275-6 and §13-284-6).

The purpose of the Ka Pa‘akai Analysis is to assist the client and responsible overseeing agencies to ensure the applicant has sufficiently assessed that the proposed project/action will not harm traditional and customary practices exercised by Native Hawaiians; and to provide sufficient documentation to support the overseeing agency’s assessment.

In *Ka Pa‘akai O Ka ‘Aina v. Land Use Commission*, the Hawai‘i Supreme Court

> [...] articulated an analytical framework to assist state agencies in balancing the State‘s obligation to protect traditional and customary practices against private property (as well as competing public) interests, by requiring specific findings and conclusions about:

1) the identity and scope of ‘valued cultural, historical, or natural resources’ in the relevant area, including the extent to which traditional and customary native Hawaiian rights are exercised in relevant area;
2) the extent to which those resources—including traditional and customary native Hawaiian rights—will be affected or impaired by the proposed action; and
3) the feasible action, if any, to be taken by the [agency] to reasonably protect native Hawaiian rights if they are found to exist. [*Ka Pa‘akai O Ka ‘Aina v. Land Use Comm’n*, 94 Hawai‘i 31, 35, 47 and 52–53, 7 P.3d 1068, 1072, 1084 and 1089–90 (2000)]

1.3 **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.

1.4 **Natural Environment**

1.4.1 ***Ka Lepo*** **(Soil)**

According to the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database (2001) and soil survey data gathered by Foote et al. (1972), the island of Kauaʻi consists of soils of the Jaucaus-Mokuleia, Hanalei-Kolokolo-Pakala, Kekaha-Nohili, Kapaa-Pooku-Halii-Makapili, Lihue-Puhi, Makaweli-Waiawa-Niu, Waikomo-Kalihi-Koloa, Rough broken land-Mahana-Kokee, Waialeale-Alakai, and Rough mountainous land-Rough broken land-Rock outcrop Associations (Figure 3).

Soils of the Jaucaus-Mokuleia Association are described as follows:

> This association consists of excessively drained and well-drained soils in dunes and on former beach areas on the island of Kauai. These soils are nearly level to moderately sloping. They developed in coral or basaltic sand. The association makes up about 1 percent of the island.
>
> The elevation ranges from near sea level to 150 feet. The annual rainfall is 20 to 100 inches. The mean annual soil temperature is 74° or 75° F. The natural vegetation is kiawe, klu, feather fingergrass, sandbur, koa haole, and bermudagrass.
>
> Jaucas soils make up about 60 percent of the association and Mokuleia soils 25 percent. Dune land and Jaucas soils, dark variant, make up the rest.
>
> Jaucas soils have a surface layer of pale-brown to grayish-brown, very friable loamy fine sand to sand. The substratum is light-colored loose sand. Mokuleia soils have a surface layer of very dark-brown, friable fine sandy loam. The substratum is dark-brown to dark grayish-brown, loose fine sand to sand.
>
> This association is used for irrigated sugarcane, irrigated alfalfa, pasture, and wildlife habitat. Mokuleia and Jaucas soils are used mainly for pasture. Irrigated areas of Jaucas soils are used for sugarcane and alfalfa. Jaucas soils are also used as a source of sand. Upland game birds are the principal kinds of wildlife. [Foote et al. 1972:3]

Traditional Hawaiian sites—such as cultural layers and human burials—are common in the Jaucas-Mokuleia Association soils.

Hanalei-Kolokolo-Pakala Association are described as follows:

> Deep, nearly level, poorly drained to well-drained soils that have dominantly moderately fine textured or medium-textured subsoil or underlying material; on bottom land

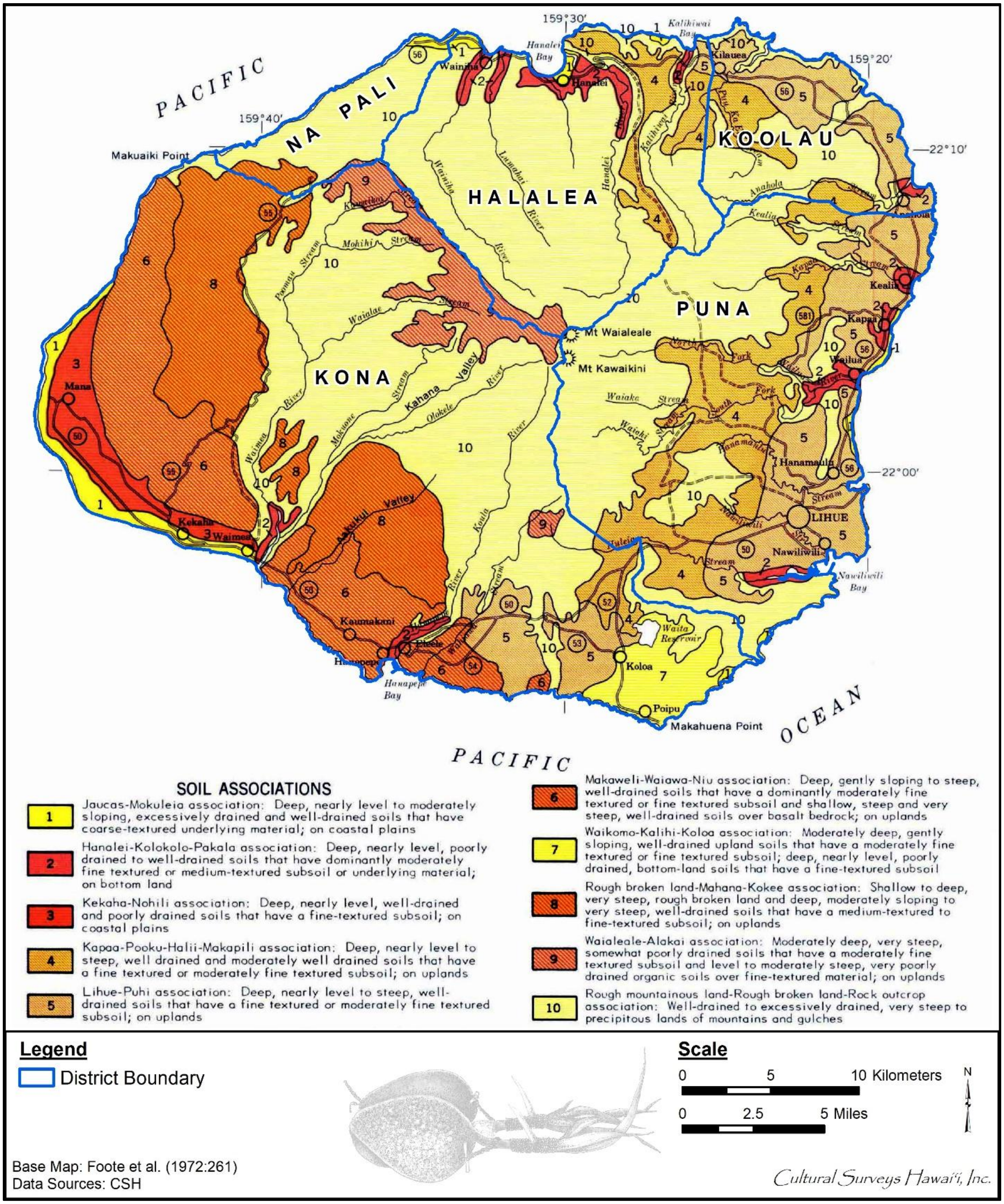


Figure 3. General soils map of Kauai Island, Hawai‘i from *Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii* (Foote et al. 1972:261)

> This association consists of poorly drained to well drained soils on bottom land on the island of Kauai. These soils are nearly level. They developed in alluvium. The association makes up about 2 percent of the island.
>
> The elevation ranges from near sea level to 500 feet. The annual rainfall is 25 to 150 inches. The mean annual soil temperature is about 74° F. The natural vegetation is koa haole, kiawe, bermudagrass, mango, California grass, sensitive plant, honohono, java plum, pangola grass, kikuyu grass, guava, pandanus, glenwood grass, rice grass, and hau.
>
> Hanalei soils make up about 45 percent of the association, Kolokolo soils 25 percent, and Pakala soils 20 percent. Mokuleia soils, poorly drained variant, make up the rest.
>
> Hanalei soils have a surface layer of mottled dark grayish-brown to mottled very dark gray, firm silty clay, silty clay loam, or peaty silty clay loam. Their subsoil is mottled, dark-gray to dark grayish-brown, firm silty clay or silty clay loam. The substratum is stratified alluvium. Kolokolo soils have a surface layer of very dark brown, friable silty clay loam, loam, or extremely stony clay loam. This layer is underlain by brown to very dark brown, friable loam to silty clay loam. The substratum is stratified alluvium. Pakala soils have a surface layer of dark reddish-brown, firm clay loam or extremely stony clay loam. Below this is very dusky red to dark reddish-brown, very friable very fine sandy loam to silt loam. The substratum is stratified alluvium.
>
> This association is used for irrigated sugarcane, irrigated taro, irrigated truck crops, pasture, and wildlife habitat. All of the soils are used for pasture. Irrigated areas of Hanalei and Pakala soils are used for sugarcane and truck crops. Hanalei soils are also used for taro. Upland game birds make up most of the wildlife population. [Foote et al. 1972:3–4]

Soils of the Kekaha-Nohili Association are described as follows:

> This association consists of well-drained and poorly drained, medium-textured to very fine textured soils on the Mana coastal plain on the island of Kauai. These soils are nearly level. They developed in alluvium. The association makes up about 2 percent of the island.
>
> The elevation ranges from near sea level to 80 feet. The annual rainfall is 20 to 23 inches. The mean annual soil temperature is about 75° F. The natural vegetation is koa haole, kiawe, klu, and fingergrass.
>
> Kekaha soils make up about 45 percent of the association and Nohili soils 15 percent. Fill land and Kaloko, Lualualei, and Mamala soils make up the rest.
>
> Kekaha soils have a surface layer of dark reddish brown, friable silty clay, clay, or extremely stony silty clay loam. The subsoil is dark reddish-brown, firm silty clay or clay. The substratum is stratified alluvium and marine clay. Nohili soils have a surface layer of dark reddish-brown, firm clav and a subsoil of dark-brown to very dark-gray, mottled, firm clay. The substratum is marly clay.

> This association is used for irrigated sugarcane, irrigated truck crops, and pasture. Sugarcane is the chief crop and is grown on all of the soils. Extremely stony phases of Kekaha soils are used for pasture. Nohili soils require drainage. [Foote et al. 1972:4]

Soils of the Kapaa-Pooku-Halii-Makapili Association are described as follows:

> This association consists of well drained and moderately well drained, fine-textured soils on the uplands of East Kauai. These soils are nearly level to steep. They developed in material weathered from basic igneous rock.
>
> The association makes up about 10 percent of the island. The elevation ranges from 100 to 1,000 feet. The annual rainfall is 70 to 200 inches. The mean annual soil temperature is between 72° and 74° F. The natural vegetation is melastoma, rhoclomyrtus, guava, rice grass, hilo grass, yellow foxtail, Christmas berry, false staghorn fern, pangola grass, kikuyu grass, kaimi clover, sensitive plant, java plum, and joee.
>
> Kapaa soils make up about 40 percent of the association, Pooku soils 25 percent, Halii soils 20 percent, and Makapili soils 5 percent. Rough broken land and other soils make up the rest.
>
> Kapaa soils have a surface layer of dark-brown to dark yellowish-brown, friable silty clay. The subsoil is yellowish-red to reddish-brown, friable silty clay and clay loam. The substratum is soft, weathered basic igneous rock. Pooku soils have a surface layer of dark-brown to dark yellowish-brown, friable silty clay. The subsoil is a dark-red to dark reddish-brown, friable silty clay loam to silty clay. The substratum is soft, weathered basic igneous rock. Halii soils have a surface layer of very dark grayish-brown, friable gravelly silty clay loam to gravelly silty clay and a subsoil of dark reddish-brown to dark-brown, friable clay loam to silty clay. The substratum is soft, weathered basic igneous rock. Makapili soils have a surface layer of dark-brown to very dark grayish-brown, friable silty clay and a subsoil of dark reddish-brown, firm clay loam to silty clay. The substratum is soft, weathered basic igneous rock.
>
> This association is used for sugarcane, pasture, pineapple, woodland, wildlife habitat, and water supply. Pooku and Makapili soils are used mainly for pasture, Kapaa soils for sugarcane, and Halii soils for water supply. Upland game birds and wild pigs are the principal kinds of wildlife. [Foote et al. 1972:4]

Soils of the Lihue-Puhi Association are described as follows:

> This association consists of well-drained, medium textured and fine-textured soils on the uplands of South and East Kauai. These soils are nearly level to steep. They developed in material weathered from basic igneous rock. The association makes up about 12 percent of the island.
>
> The elevation ranges from near sea level to 800 feet. The annual rainfall is 40 to 80 inches. The mean annual soil temperature is about 73° F. The natural vegetation

is guava, java plum, pangola grass, kikuyu grass, elephantopus, joee, yellow foxtail, rhodomyrtus, lantana, koa haole, molasses grass, guinea grass, and bermudagrass.

Lihue soils make up about 40 percent of the association and Puhi soils 35 percent. Ioleau, Koloa, and other soils, and areas of Rough broken land make up the rest.

Lihue soils have a surface layer of dusky-red to dark reddish-brown, firm to friable silty clay. The subsoil is dark-red to dark reddish-brown, firm silty clay. The substratum is soft, weathered basic igneous rock. Puhi soils have a surface layer of brown to very dark-brown, friable silty clay loam. The subsoil is reddish-brown to dark brown, friable silty clay loam and silty clay. The substratum is soft, weathered basic igneous rock.

This association is used for irrigated sugarcane, pineapple, pasture, woodland, and wildlife habitat. Sugarcane is the main crop. Upland game birds make up most of the wildlife population. [Foote et al. 1972:4]

Soils of the Makaweli-Waiawa-Niu Association are described as follows:

This association consists of well-drained, moderately fine textured and fine textured soils on the uplands of South and West Kauai. These soils are gently sloping to very steep. They developed in material weathered from basic igneous rock. The association makes up about 9 percent of the island.

The elevation ranges from near sea level to 2,000 feet. The annual rainfall is 20 to 40 inches. The mean annual soil temperature is between 69° and 74° F. The natural vegetation is kiawe, lantana, fingergrass, klu, koa haole, pili grass, aalii, guinea grass, indigo, and cactus.

Makaweli soils make up about 45 percent of the association, Waiawa soils 30 percent, and Niu soils 10 percent. Rough broken land and other soils make up the rest.

Makaweli soils have a surface layer of dusky-red to dark reddish-brown, friable silty clay loam or stony silty clay loam. The subsoil is dusky-red, friable silt loam and silty clay loam. The substratum is soft, weathered basic igneous rock that in places contains hard boulders. Waiawa soils have a surface layer of dark reddish-brown, very firm very rocky clay loam or very rocky clay. This layer is underlain by hard basic igneous rock. Niu soils have a surface layer of dusky-red to dark reddish-brown, friable silty clay loam to silty clay. The subsoil is dark-red, friable silty clay loam or silty clay. The substratum is soft, weathered basic igneous rock.

This association is used for irrigated sugarcane, pasture, woodland, and wildlife habitat. Makaweli and Kiu soils are used mainly for sugarcane. A small acreage of Makaweli soils is used for irrigated pasture. Waiawa soils are used only for pasture. Upland game birds, wild pigs, and wild goats are the principal kinds of wildlife. [Foote et al. 1972:4–5]

Soils of the Waikomo-Kalihi-Koloa Association are described as follows:

This association consists of well-drained, fine-textured soils that developed in material weathered from basic igneous rock and poorly drained, very fine-textured soils that developed in alluvium. These soils are gently sloping to nearly level and are on the uplands and bottom lands of Southeast Kauai. The association makes up about 2 percent of the island.

The elevation ranges from near sea level to 360 feet. The annual rainfall is 35 to 60 inches. The mean annual soil temperature is between 72° and 74° F. The natural vegetation is lantana, koa haole, java plum, cactus, swollen fingergrass, bermudagrass, and guinea grass.

Waikomo soils make up about 70 percent of the association, Kalihi soils 20 percent, and Koloa soils 10 percent. Waikomo soils have a surface layer of dark-brown to very dark grayish-brown, very firm stony silty clay. The subsoil is reddish-brown to dark yellowish-brown, firm heavy silty clay loam. The substratum is hard basic igneous rock. Kalihi soils have a surface layer of very dark-gray to mottled dark-brown, firm clay. The subsoil is dark-gray, mottled, firm clay. The substratum is grayish-brown and dark-gray, firm clay. Koloa soils have a surface layer of dark reddish-brown, firm stony silty clay. The subsoil is dusky-red to dark reddish-brown, firm siltv clay. The substratum is hard rock.

This association is used for irrigated sugarcane, pasture, and wildlife habitat. Sugarcane is the chief crop and is grown on all the soils. Pasture is grown only on Waikomo soils. Upland game birds are the principal kinds of wildlife. [Foote et al. 1972:5]

Soils of the Rough broken land-Mahana-Kokee Association are described as follows:

Shallow to deep, very steep, rough broken land and deep, moderately sloping to very steep, well-drained soils that have a medium-textured to fine-textured subsoil; on uplands

This association consists of well-drained, medium textured and fine-textured soils on the uplands of South and West Kauai. These soils are moderately sloping to very steep. They developed in material weathered from volcanic ash and basic igneous rock. The association makes up about 9 percent of the island.

The elevation ranges from 1,500 to 4,200 feet. The annual rainfall is 30 to 70 inches. The mean annual soil temperature is between 58° and 66° F. The natural vegetation is ohia lehua, pukiawe, blackberry, yellow foxfail, koa, plantain, uki uki, redwood, aalii, rice grass, molasses grass, silver oak, lantana, joee, Japanese tea, passion flower, Boston fern, and uki.

Rough broken land makes up about 35 percent of the association, Mahana soils 20 percent, and Kokee soils 20 percent. Oli, Paaiki, and Puu Opae soils make up the remaining 25 percent.

Rough broken land is very steep. The soil material ranges from very shallow to deep over hard, weathered basic igneous rock.

> Mahana soils have a surface layer of dusky-red to dark reddish-brown, friable loam to silty clay loam. The subsoil is dark-red to dusky-red, very friable very fine sandy loam to silty clay loam. The substratum is soft, weathered basic igneous rock. Kokee soils have a surface layer of dark-brown to very dark brown, friable silty clay loam. The subsoil is strong-brown to dark yellowish brown, friable silty clay loam to silty clay. The substratum is hard and soft, weathered basic igneous rock.
>
> This association is used for pasture, woodland, wildlife habitat, water supply, and irrigated sugarcane. Mahana soils are used chiefly for pasture. Small acreages are irrigated and are in sugarcane. Kokee soils are used chieflv for woodland. Upland game birds, wild pigs, wild goats, and deer are the principal kinds of wildlife. [Foote et al. 1972:5]

Soils of the Waialeale-Alakai Association are described as follows:

> This association consists of somewhat poorly drained to very poorly drained, organic soils on the uplands of Central Kauai. These soils are level to very steep. They developed in organic debris deposited on basic igneous rock. The association makes up about 3 percent of the island.
>
> The elevation ranges from 3,500 to 5,000 feet. The annual rainfall is 100 to 450 inches. The mean annual soil temperature is between 56° and 59° F. The natural vegetation is ohia lehua, Hawaiian lobelia, mokihana, pukiawe, treefern, lapalapa, bracken fern, and uki uki.
>
> Waialeale soils make up about 50 percent of the association and Alakai soils 35 percent. Rough broken land makes up the rest.
>
> Waialeale soils have a surface layer of dark reddish brown, friable mucky peat. The subsoil is dark-brown to strong-brown, friable gravelly silty clay loam. The substratum is hard, weathered basic igneous rock. Alakai soils have a surface layer of dark reddish-brown to very dusky-red, friable mucky peat. Below this is black, friable muck, and below the muck, gray to greenish-gray, firm clay.
>
> This association is used for water supply and wildlife habitat. Wild goats and wild pigs are the chief kinds of wildlife. [Foote et al. 1972:5–6]

Soils of the Rough mountainous land-Rough broken land-Rock outcrop Association are described as follows:

> This association consists of well-drained to excessively drained land types on uplands on the island of Kauai. The areas are very steep to precipitous. The association makes up about 50 percent of the island.
>
> The elevation ranges from near sea level to 5,170 feet. The annual rainfall amounts to as little as 22 inches in leeward lowlands and as much as 450 inches over windward slopes of Mt. Waialeale. The mean annual soil temperature is between 56° and 74° F. The natural vegetation is false staghorn fern, ohia lehua, java plum, kiawe, and koa haole.

> Rough mountainous land makes up about 45 percent of the association, Rough broken land 30 percent, and Rock outcrop 25 percent.
>
> Rough mountainous land is very steep. In most places elevations exceed 500 feet. The soil material is generally shallow over hard, weathered basic igneous rock. Rough broken land is very steep. The soil material is very shallow to deep over hard, weathered basic igneous rock. Rock outcrop is more than 90 percent bedrock. It occurs on very steep slopes or on precipitous cliffs.
>
> This association is used for water supply, pasture, woodland, and wildlife habitat. Rough mountainous land and Rock outcrop serve mainly as watershed. Upland game birds, wild goats, and wild pigs are the principal kinds of wildlife. [Foote et al. 1972:6]

1.4.2 *Ka 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:

> […] 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]

1.4.2.1 Halele‘a Moku (District)

The name of the winds of Kaua‘i are listed in a chant concerning a powerful gourd called *The Wind Gourd of La‘amaomao.* According to Handy and Handy (1972:220), the gourd is a *kino lau* (embodiment) of Lono, god of agriculture and fertility. Handy and Handy elaborate, “Lono is the gourd; the cosmic gourd is the heavens whence come winds, clouds, and rain” (Handy and Handy 1972:220). When the gourd was opened, a specific wind could be called to fill the sails of a canoe and take the person in the desired direction.

It is within this chant that Kūapāka‘a, the son of Pāka‘a and descendant of La‘amaomao, calls out the winds of the ancient Halele‘a District of Kaua‘i (Nakuina 1992:54):

He Maheu ko Kalihiwai,	Maheu is of Kalihiwai,
He Nau ko Kalihikai,	Nau is of Kalihikai,
He Luha ko Hanalei,	Luhau is of Hanalei,
He Waiamau ko Waioli	Waiamau is of Wai‘oli,
He K[P]uunahele ko Waipa,	Pu'unahele is of Waipa,
He Haukoloa ko Lumahai,	Haukoloa is of Lumaha‘i,
He Lupua ko Wainiha,	Lupua is of Wainiha,
He Pahelehala ko Naue,	Pahelehala is of Naue,
He Limahuli ko Haena,	Limahuli is of Ha‘ena.
[Home Rula Repubalika 1902]	[Nakuina 1992:54]

In the *The Epic Tale of Hiʻiakaikapoliopele* (Hoʻoulumāhiehie 2008a; 2008b), the goddess Pele traveled to Kauaʻi and recited the winds of Kauaʻi to her lover Lohiʻau and his people. Pele mentioned that the ʻUnumāhele and Haokoʻolau are the winds of Haleleʻa (Hoʻoulumāhiehie 2008b:19). She stated that "[t]he land here on Kauaʻi with the most winds, however, is Wainiha. There are three lands on Kauaʻi filled with winds, and they are Wainiha, Anahola, and Naue (Hoʻoulumāhiehie 2008b:18). Pele chanted the names of the 32 winds of Wainiha:

He Hoʻopulukēwai ka makani o Wainiha	The wind of Wainiha is a Hoʻopulukēwai
He Waianu ka makani o Wainiha	The wind of Wainiha is a Waianu
He Kuamauna ka makani o Wainiha	The wind of Wainiha is a Kuamauna
He Kaʻawakiki ka makani o Wainiha	The wind of Wainiha is a Kaʻawakiki
He Pāpalaʻā ka makani o Wainiha	The wind of Wainiha is a Pāpalaʻā
He Ākeakea ka makani o Wainiha	The wind of Wainiha is an Ākeakea
He Paio ka makani o Wainiha	The wind of Wainiha is a Paio
He Mālualani ka makani o Wainiha	The wind of Wainiha is a Mālualani
He Nihipali ka makani o Wainiha	The wind of Wainiha is a Nihipali
He Pāweo ka makani o Wainiha	The wind of Wainiha is a Pāweo
He Luluʻupali ka makani o Wainiha	The wind of Wainiha is a Luluʻupali
He Lehualāʻau ka makani o Wainiha	The wind of Wainiha is a Lehualāʻau
He Hanakaipo ka makani o Wainiha	The wind of Wainiha is a Hanakaipo
He Peʻa ka makani o Wainiha	The wind of Wainiha is a Peʻa
He Maunahina ka makani o Wainiha	The wind of Wainiha is a Maunahina
He Puna ka makani o Wainiha	The wind of Wainiha is a Puna
He Kalalea ka makani o Wainiha	The wind of Wainiha is a Kalalea
He Hukia ka makani o Wainiha	The wind of Wainiha is a Hukia
He Malama ka makani o Wainiha	The wind of Wainiha is a Malama
He Pueo ka makani o Wainiha	The wind of Wainiha is a Pueo
He ʻAlihiwai ka makani o Wainiha	The wind of Wainiha is an ʻAlihiwai
Lele ka makani o Wainiha	The wind of Wainiha is a flying Lele wind
He Kapaia ka makani o Wainiha	The wind of Wainiha is a Kapaia
He Amoa ka makani o Wainiha	The wind of Wainiha is an Amoa
He Hīhīmanu ka makani o Wainiha	The wind of Wainiha is a Hīhīmanu
He Likenōalike ka makani o Wainiha	The wind of Wainiha is a Likenōalike
He Limunui ka makani o Wainiha	The wind of Wainiha is a Limunui.
He ʻUa ka makani o Wainiha	The wind of Wainiha is an ʻUa
He Lūpua ka makani o Wainiha	The wind of Wainiha is a Lūpua
He Koʻolau ka makani o Wainiha ma waho	The wind outside of Wainiha is a Koʻolau
He Pōhīkai ka makani o Wainiha	The wind of Wainiha is a Pōhīkai
He Āpaʻakona ka makani o Wainiha.	The wind of Wainiha is an ʻĀpaʻakona.

[Hoʻoulumāhiehie 2008a:21–22; 2008b:21–22]

Pele also chanted the “nineteen swirling winds” of Naue:

He Lūpua ka makani o Naue	The wind of Naue is a Lūpua
He Pahelehala ltt hinano, aia i laila	The Pahelehala wind that tosses the hinano is there
He Pāʻūkīlepalepa ua makani, aia i laila	The wind, a Pāʻūkīlepalepa, is there
He Kalolo, aia no i laila	A Kalolo wind is there
Pa ana ka makani Waikahe i Naue	The Waikahe wind blows at Naue
He Lele ka makani o Naue	The wind of Naue is a Lele
Ulupue ka makani, aia i laila	Ulupue, the wind, is there
He Mene ka makani o Naue	The wind of Naue is a Mene
He Kalahale ka makani o Naue	The wind of Naue is a Kalahale
He Kamalama ka makani o Naue	The wind of Naue is a Kamalama
He ʻAuikekai ka makani o Naue	The wind of Naue is an ʻAuikekai
He Hala'ala ka makani o Naue	The wind of Naue is a Hala'ala
He Pūʻauki ka makani o Naue	The wind of Naue is a Pūʻauki
He Hanaimaʻa ka makani o Naue	The wind of Naue is a Hanaimaʻa
He Puaokeneki ka makani o Naue	The wind of Naue is a Puaokeneki
He Apoanu ka makani o Naue	The wind of Naue is an Apoanu
He Puaʻaʻala ka makani o Naue	The wind of Naue is a Puaʻaʻala
He Hīnano ka makani o Naue	The wind of Naue is a Hīnano
He Huikoʻolau ka makani o Naue	The wind of Naue is a Huikoʻolau

[Hoʻoulumāhiehie 2008a:22; 2008b:22]

Pele referred to Hāʻena Ahupuaʻa as “a land of winds.” She mentioned that “two bad winds,” Kilioe and Nuʻuikalanahaʻakoi, are “found where the moʻo cling to the cliffs” (Hoʻoulumāhiehie 2008b:24). Pele recited the winds of Hāʻena:

He Kalahale ka makani o Hāʻena	The wind of Hāʻena is a Kalahale
He Limahuli ka makani o Hāʻena	The wind of Hāʻena is a Limahuli
He Kolokini ka makani heʻe nalu o Kahuanui a Lohiʻauipo i Hāʻena	The surfing wind of Kahuanui and Lohiʻauipo in Hāʻena is a Kolokini
He Unukupua ka makani lawe leo o Lohiʻauipo i Hāʻena	The wind carrying the voice of Lohiʻau at Hāʻena is an Unukupua
He Kānaenae ka makani lawe ʻala a Lohiʻau i Hāʻena	The wind carrying the scent of Lohiʻau in Hāʻena is a Kānaenae
He Kīlauea ka makani kāʻili aloha a Lohiʻau i Hāʻena	The wind that snatches the love of Lohiʻau in Hāʻena is a Kīlauea
He Leoʻikua ka makani lawe aloha a Lohiʻau i Hāʻena	The wind carrying the love of Lohiʻau at Hāʻena is a Leoʻikuā
He Iponoenoelauaʻe ka makani ki'i wahine a Lohiʻauipo i Hāʻena	The wind that fetches the wife of Lohiʻauipo at Hāʻena is an Iponoenoelauaʻe

[Hoʻoulumāhiehie 2008a:24; 2008b:24]

Pele also recited the numerous winds between Wainiha and Anahola Ahupuaʻa which include several *ahupuaʻa* (traditional land division) within the Haleleʻa District (Hoʻoulumāhiehie 2008b:19–21). She recounted that Kalihikai is associated with the Nau wind; Kalihiwai is associated with the Maheu wind; Hanalei Iki is associated with the Haukaʻeʻe wind; Hanalei Uka is associated with the Lūhau wind; Waiʻoli is associated with the Huiwaiamau wind; Waikoko is associated with the Māpuholo wind; Waipā is associated with the ʻŌmaʻokaulehua wind; and Lumahaʻi is associated with the Haukōloa wind (Hoʻoulumāhiehie 2008b:19–21).

1.4.2.2 Koʻolau Moku

Kūapākaʻa's chant also mentions the winds of the Koʻolau Moku (Nakuina 1992:54):

He Amu ko Anahola,	Amu is of Anahola,
He Kololio ko Moloaa,	Kololio is of Moloaʻa,
He Kiuinuwai ko Kooolau	Kiukainui is of Koʻolau,
[Home Rula Repubalika 1902]	[Nakuina 1992:53–54]

In Pele's chant, she recited names of the 14 winds of Anahola (Hoʻoulumāhiehie 2008a:18). She chanted,

He Anu ka makani o Anahola	An Anu is the wind of Anahola
He Kiuwailehua no, aia i laila	A Kiuwailehua is also found there
Hokualele ka makani o Anahola	Hokualele is the wind of Anahola
He Aopoʻonui ka makani o Anahola	An Aopoʻonui is the wind of Anahola
5. He Laupeʻekoa ka makani o Anahola	5. A Laupeʻekoa is the wind of Anahola
He Laulā ka makani o Anahola	A Laulā is the wind of Anahola
He Laekuaehu ka makani o Anahola	A Laekuaehu is the wind of Anahola
He Ākeakea ka makani o Anahola	An Ākeakea is the wind of Anahola
He Laekāhala ka makani o Anahola	A Laekāhala is the wind of Anahola
10. He Ulumano ka makani o Anahola	10. An Ulumano is the wind of Anahola
He ʻAoʻaoa ka makani o Anahola	An ʻAoʻaoa is the wind of Anahola
Holoikalapa, makani pe'e mii lualua o Anahola	The Holoikalapa is the ravine-hiding wind of Anahola
Holoʻāhiukaimaloʻo ka makani o Anahola	A Holoʻāhiukaimaloʻo is the wind of Anahola
He Mālua ka makani kai nui o Anahola.	A Mālua is the wind of high tides of Anahola.
[Hoʻoulumāhiehie 2008a:19; 2008b:19]	

Within Pele's recital of the winds between Anahola and Wainiha, she mentions that the "flying wind of Koʻolau is a Haliokaunuunu" (Hoʻoulumāhiehie 2008b:19). She also reveals the winds of several other *ahupuaʻa* of the Koʻolau District. She states that Aomuku and Kaipiha are the winds of ʻAliomanu; Puea is the wind of Pāpaʻa; Hoʻokololilo is the wind of Moloaʻa; Huikai is the wind of Lepeuli; Kāmoe is the wind of Pīlaʻa; Āhea is the wind of Waiakalua; Uhao is the wind of Kāhili; and Waimio is the wind of Kīlauea (Hoʻoulumāhiehie 2008b:19).

1.4.2.3 Puna Moku

The winds of the Puna District are also mentioned within Kūapākaʻa's chant (Nakuina 1992:53):

He Puapua ko Kipu,	Paupua is of Kipu,
He Alaoli ko Hulaia,	Alaʻoli is of Huleʻia [Haiku Ahupuaʻa],
He Waikai ko Kalapaki,	Waikai is of Kalapaki,
He Kaao ko Hanamaulu,	Kaʻao is of Hanamaʻulu,
He Waikua-aala ka Makanikulai Hale no Konolea	Waipuaʻaʻala is the wind that knocks down hale of Konolea,
He Waiopua ko Wailau [Wailua],	Waiʻopua is of Wailua,
He Waiolohia ko Nahanahanai	Waiolohia is of Nahanahanai,
He Inuwai ko Waipouli,	Inuwai is of Waipouli,
He Hooluamakani ko Makaiwa	Hoʻolua is the wind of Makaiwa [Kamakaiwa in Kamalomaloʻo Ahupuaʻa],
He Kehau ko Ka-Paa,	Kehau is of Kapaʻa,
He Malamalamaiki ko Kealia	Malamalamamaikai is of Kealia,
He Makanihulilua ko Hanaikawao [*Homaikawaa*]	Hulilua is of Homaikawaʻa,
[Home Rula Repubalika 1902]	[Nakuina 1992:53]

Pele's chant also reveals the winds for several *ahupuaʻa* in the Puna District. She notes Keālia has a wind named Mālamalama; Kapaʻa has a wind named Pepeʻekiukena; Waipouli has a wind named Inuwai; Wailua has a wind named Mālua; Nāwiliwili has a wind named Huʻeone; Kalapakī has a wind named Wamua; Hanamāʻulu has a wind named Hoʻoluakoʻinehe; Niumalu has a wind named Kāhilipiʻi; Kīpū Kai has a wind named Puapuaʻapanoʻo; and Kīpū Uka has a wind named Puapuaʻa (Hoʻoulumāhiehie 2008b:15–18).

1.4.2.4 Kona Moku

Numerous winds of the Kona District are also mentioned in Kūapākaʻa's chant (Nakuina 1992:53):

He Aikoko ko Nualolo,	ʻAikoko is of Nuʻalolo,
He Makani Kaehukai ko Milolii,	Kuehu-kai is the wind of Miloliʻi,
He Puukapele ko Mana,	Puʻukapele is of Mana,
Ke Moeahu ko Kekaha,	Moeahua is of Kekaha,
He Waipao ko Waimea,	Waipao is of Waimea,
He Kapaahoa ko Kahana,	Kapaahoa is of Kahana,
He Maka'upili ko Peapea,	Makaupili is of Peʻapeʻa,
He Aoao ko Hanapepe,	Aoao is of Hanapepe,
He Unulau ko Waihawa,	Unulau is of Wahiawa,
He Kiu Anu ko Kalaheo,	Kiuanu is of Kalaheo,
He Ae hoi ko Lawai,	Aʻe is of Lawaʻi,
He Malanai ko Koloa,	Malanai is of Koloa,
He Kuiamanini ko Weliweli,	Kuʻiamanini is of Weliweli,

He Makahuena ko Kapaa	Makahuena is of Paʻa,
He Onehali ko Manenene,	Onehali is of Manenene,
He Koomakani ko Mahaulepu,	Koʻomakani is of Mahaʻulepu,
[Home Rula Repubalika 1902]	[Nakuina 1992:53]

The names of the winds for several *ahupuaʻa* in the Kona District are also revealed in Pele's chant. She mentions that Mānā is associated with the wind named Puʻukapele; Waimea with the wind named Hoʻokomowaipao; Makaweli with the wind named Punohuʻula; Hanapēpē and Lāwaʻi with the wind named ʻAoa; Wahiawa with the wind named Unulau; Kālaheo with the wind named Kiuanu; Kōloa with the wind named Holomālani; Weliweli with the wind named Kuimanihi; Pāʻā with the wind named Makahūʻena; and Māhāʻulepu with the wind named Pūʻōkū (Hoʻoulumāhiehie 2008b:15–18).

1.4.2.5 Nāpali Moku

Kūapākaʻa's chant also mentions the winds of the Nāpali District (Nakuina 1992:53):

He Lawakua ko na Pali	Lawakua is of Napali
He Lanikuuwa ko Kalalau,	Lani-kuʻu-waʻa is of Kalalau,
He Lauae ko Honopu,	Lauae is of Honopu,
[Home Rula Repubalika 1902]	[Nakuina 1992:53]

Pele also recites the winds of the Nāpali District in her chant of winds of Hāʻena (Hoʻoulumāhiehie 2008b:24). She mentions the Peke wind is associated with Hanakāpīʻai, the Kaiʻopihi wind is associated with Hanakoa, the Lanikuʻua wind is associated with Kalalau, and the Uluhinahina wind is associated with Hanapū (Honopū) (Hoʻoulumāhiehie 2008b:24).

1.4.3 *Ka 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, *hoʻoilo* (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 Kauaʻi had a Hawaiian name for its own rain. According to Akana and Gonzalez:

> 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]

It was a customary and necessary tradition to grant a name for each type of rain. Rains were named to show their action toward plants or the supposed effects on people or their possessions

(Pukui and Elbert 1986:361). The following section presents these rains as they were mentioned in historical texts compiled by Akana and Gonzalez (2015).

1.4.3.1 Haleleʻa Moku

There are several rains within the Haleleʻa Moku. These rains include the Makakoʻi, Makaʻupili, and the Uli rain. Other rains associated with Haleleʻa include the Hāʻao, Hehipuahala, Hōʻehaʻili, Hoʻokamumuhala, Hoʻopuluhīnano, Kanikaukū, Kanilehua, Kehau, Koʻapuaiʻa, Lena, Loku, Lokuhala, Lūlaukō, Paliloa, Panehewa, and Paʻūpili rains.

According to Akana and Gonzalez (2015:170), the name Makakoʻi "refers to the edge of an adze." The Makakoʻi rain is described in a *ʻōlelo noʻeau* (proverb) as "*Ka ua Makakoʻi o Haleleʻa*. The adze-edged [Makakoʻi] rain of Haleleʻa" (Pukui 1983:172). Mary Kawena Pukui describes the Makakoʻi rain as "so cold that it feels like the sharp edge of an adze on the skin." Makaʻūpili translates to "eyes shut tight." It is also the name of a wind (Akana and Gonzalez 2015:172). The name Uli translates to "dark" (Akana and Gonzalez 2015:269). In a *makena* (lament) composed for ʻEmalani Kaleleonālani, Haleleʻa is described as having a "dark [Uli] rain."

The *ahupuaʻa* of Hanalei is associated with several rains. These include the Hehipuahala, Hōʻehaʻili, Hoʻokamumuhala, Kanilehua, Lena, Loku, Lokuhala, Makakoʻi, and Paʻūpili rains.

Hehipuahala translates as "to tread upon hala fruit" (Akana and Gonzalez 2015:36). The Hehipuahala rain is described as the "rain that treads on the pandanus flowers of Poʻokū, Hanalei, Kauaʻi."

Hōʻeha ʻili translates as "to hurt the skin" (Akana and Gonzalez 2015:37). The Hōʻeha ʻili rain is mentioned in the *mele* (song), *Maikaʻi Kauaʻi*, where Hanalei is described as "simply magnificent[,] In the heavy rain that hurts the skin."

> 3. Hanohano wale ʻo Hanalei
> I ka ua nui hōʻeha ʻili
> I ka wai ʻuʻinakolo
> I ka polio Nāmolokama
>
> *Hanalei is simply magnificent*
> *In the heavy rain that hurts the skin*
> *And the roaring water*
> *In the bosom of Nāmolokama*
>
> From the song ʻMaikaʻi Kauaʻi.ʼ Hawaiian source: Wilcox et al. 160. English trans. by author.
>
> [Akana and Gonzalez 2015:37]

The Hoʻokamumuhala rain is described as a "roaring rain" (Akana and Gonzalez 2015:40). The name Hoʻokamumuhala "refers to the crunching sound of hala." In a *mele* in the legend of Lāʻieikawai, the Hoʻokamumuhala rain is described as the "*rain that roars in the hala trees*[,] *Roaring in the hala trees of Hanalei ē*."

> 1. E nānā mai i ou mau pōkiʻi
> I nā hoa ukali o ke ala
> O ke ala nui, ala iki

O ka ua hāʻawe kua
Me he keikiʻokamumuhala
Hoʻokamumuhala o Hanalei ē

Look upon your little sisters
Friends who have followed you on your journey
Over the wide way, the narrow way
In the rain, heavy on the back
Like a child
In the [*Hoʻokamumuhala*] *rain that roars in the hala trees*
Roaring in the hala trees of Hanalei ē

From a mele in the legend of Lāʻieikawai, recited by Mailekaluhea to her brother ʻAiwohikupua as he was leaving on a canoe after forsaking her and her sisters. Hawaiian source: Haleole, *Ke Kaao* 70. English trans.: Haleole, *Lāʻieikawai* 29.

[Akana and Gonzalez 2015:40]

The Kanilehua rain is mentioned in a *mele inoa* (name chant) composed for Keliihelemauna.

49. Mauna puʻu mamau a ka ua Kanilehua
I ka hoʻowali kīʻililī ʻia eke Pahelehala
Kiʻi papani hone i ke kula o Hanalei
I pauma wai ʻia komo i Lumahaʻi

The rough, hilly mountainside of the Kanilehua rain
Lazily mixed by the Pahelehala wind
Playfully attempting to block the plains of Hanalei
Water is pumped to enter Lumahaʻi

From a mele inoa, or name chant, for Keliihelemauna. Hawaiian source: Holaniku. English trans. by author. Additional source: "Pā ka leo" 11.

[Akana and Gonzalez 2015:63]

The name Kanilehua refers to "the chattering of birds on ʻōhiʻa lehua trees, the rustling of lehua flowers, or the drinking of the rain by lehua flowers" (Akana and Gonzalez 2015:50).

Lena translates to "yellow" (Akana and Gonzalez 2015:151). Pukui and Elbert (1986:334) define Ua-Lena as a "yellow-tinted rain famous at Hanalei, Kauaʻi."

Akana and Gonzalez (2015:164) describe the Loku rain as a "downpour." It is mentioned in an *ʻōlelo noeau* as "*Ka ua loku o Hanalei.* The pouring rain of Hanalei" (Pukui 1983:170). The Loku rain of Hanalei is also mentioned in the following excerpts:

2. ʻIke wale aku nō ʻoe
I ka ua Loku o Hanalei
Lipolipo wale maila
Kanahele o Hoʻohie

So apparent to you
Is the Loku rain of Hanalei
Darkening

The forest of Ho‘ohie

From the chant "Ula noweo." Hawaiian source: Barrere, Pukui, Kelly 87. English trans. by author. Additional source: "Ula no weo [*sic*]." *Note: Barrere, Pukui, Kelly say, 'This Kaua‘i [chant] was used when the people were learning the letters on that island. Later, it was revised and made into a mele inoa or name song for Kapi‘olani, the granddaughter of Kaumuali‘i, the hereditary chief of Kaua‘i. Kapi‘olani was dearly loved, but more so by those of the island of her illustrious ancestors.'*

3. Kau aku ka mana‘o no Hanalei
E ‘ike i ka nani o ka ua Loku

My thoughts are on Hanalei
To see the beauty of the Loku rain

From the hula 'Aloha Niihau' by Kalekahee. Hawaiian source: Tava and Keale 20. English trans. by author.

4. Kaulana wale e ka ua o Hanalei
E nihi a‘e nei i nā pali
E ho‘opili ‘ia me ka laua‘e
Me he ipo ho‘oheno nei i ka poli
Ka hoene mai nō a ke kai
Me he ala e ‘i mai ana
E ho‘i mai nō kaua lā e pili
Kaua Loku kaulana a‘o Hanalei

Famous indeed is the rain of Hanalei
Sweeping along the cliffs
To be joined with the laua‘e fern
Like a sweetheart cuddling in embrace
The sea murmurs softly
As though it were saying
You and I should be together again
Like the famous pouring [Loku] rains of Hanalei

From the song 'Ka ua Loku' by Alfred ‘Alohikea. Source: Wilcox et al. 94. Additional source: Elbert and Mahoe 62.

5. E ka ua Loku o Hanalei
Kui ‘ia mai nā mokihana
Na ka Lūpua e lawe mai
I wehi, i ‘ohu no Kalani
O Loku rain of Hanalei

The mokihana fruits are to be strung
The Lupua wind will bring them
A decoration, an adornment for the chief

From the song ʻPela kapu o Kakae.ʼ Hawaiian source: Holstein 33. English trans. by author.

[Akana and Gonzalez 2015:164–166]

Lokuhala translates as "to drench hala trees" (Akana and Gonzalez 2015:166). In Daniel Kahaʻulelio's narrative discussing a visit to Kauaʻi, he describes Hanelei as the "land of the heavy [Lokuhala] rains that fall through the hala trees."

2. I ka hiki ʻana aku hoʻi i ua ua Lokuhala nei o Hanalei, ʻaʻole ua mau hoaloha nei, ʻo ka hala ʻana aku no ia, hala ke aloha, naue me ka ʻanoʻai.

When I reached Hanalei, land of the heavy [Lokuhala] rains that fall through the hala trees, these friends of mine were not at home, they had just left; gone was love and with it went affection.

From a narrative by Daniel Kahaʻulelio about his visit to Kauaʻi. Source: Kahaʻulelio 264-65.

[Akana and Gonzalez 2015:166]

Paʻūpili translates as "to soak pili grass" (Akana and Gonzalez 2015:221). The Paʻūpili rain is described as circling above Hanalei in a *kanikau* (lament) composed in honor of Esetera Wahahee.

18. Aūe! Ka mea aloha ʻo ka wahine i naue aku nei
Kuʻu wahine mai ka ua Paʻūpili o Hanalei
Ke pōhai maila i luna o Hihimanu

Alas! The beloved one, the woman who has moved on
My dear wife from the Paʻūpili rain of Hanalei
That circles above Hīhīmanu

From a kanikau, or lament, for Esetera Wahahee. Hawaiian source: Kalionui. English trans. by author.

[Akana and Gonzalez 2015:225]

Other rains associated with Hanalei include the Hāʻao; Kanikaukū, and Lūlaukō rains.

The *ahupuaʻa* of Hāʻena is associated with the Koʻapuaiʻa and Paliloa rain. The Koʻapuaiʻa rain is mentioned in a *mele* for Albert Ka Haku O Hawaiʻi by Keoni Ana, or John Young.

1. He wai makaʻikai na ko laila kupa
Ke nānā lā i ke Koʻapuaiʻa
ʻIke aku i ke Kiuwailehua
ʻAʻala ka ihu o Hāʻena ua makani
Kuʻu mea aloha e, ma ʻaneʻi mai ā

Waters visited by the people of that area
Observing the Koʻapuaiʻa
Seeing the Kiuwailehua wind
The nose of Hāʻena is scented with fragrance; it is windy
My beloved, come here

From a mele for Albert Ka Haku O Hawai'i by Keoni Ana, or John Young. Hawaiian source: Ana. English trans. by author.

[Akana and Gonzalez 2015:106–107]

In the legend of 'A'ahoaka, the Paliloa rain is described as seeming "inactive," as "it creeps slowly at the back of Hā'ena" (Akana and Gonzalez 2015:221).

10. 'A'ohe hana a ka ua Paliloa
Ke nihi a'ela make kua o Hā'ena

The Paliloa rain seems inactive
It creeps slowly at the back of Hā'ena

From the legend of 'A'ahoaka. Hawaiian source: 'He moolelo no Aahoaka' 2/24/1877-English trans. by author.

[Akana and Gonzalez 2015:221]

1.4.3.2 Ko'olau Moku

Ko'olau Moku is associated with the Kukupa'u and Nāulu rains. Akana and Gonzalez (2015:131) describe the Kukupa'u rain: "Kukupa'u. Or Kukupa'ū or Kukupau. Rain associated with Hawai'i and Kaua'i. 'Kukupa'u' means 'to do with zest.' 'Kuku pa'ū' means 'to beat overlaid kapa.' 'Kuku pau' means 'to beat completely,' as kapa" (Akana and Gonzalez 2015:131).

The Kukupa'u rain is mentioned in a *makena* (lament) composed for 'Emalani Kaleleonālani. In the *makena*, the "*Kukupau rains atop the hala leaves*" (Akana and Gonzalez 2015:131). The *makena* also mentions groves of *hala* trees at Hālaulani, a *pu'u* (peak) above Waiakalua Ahupua'a (Akana and Gonzalez 2015:131).

2. I kumu wai ho'i Neki na ka wai
Ua i Pueo, ke kumu o ka ua
Hohola ihola i luna o Hā[l]aulani
Ka [pane'e kū] aka ua i ka la'au
Ka ua Kukupau i luna o ka lau hala
Ka ua Kanikaukū, me he kanaka lā
Ka ua hahi i ke kai o Manolau

The headwaters at Neki are fed by the water
Raining at Pueo, the origin of the rain
Spreading out above Hālaulani
The rain forces its way through the trees
The Kukupau rain atop the hala leaves
The Kanikaukū rain, seemingly a person
The rain that walks on the sea of Manolau

From the makena, or lament, 'He kumu lewa no Kaleleonalani' for 'Emalani Kaleleonālani. Hawaiian source: Nogelmeier 353. English trans. by author. *Note: According to Soehren, 'Neki' is the name of a peak at the Wai'oli-Waipā-Lumaha'i border in Halele'a, Kaua'i, and 'Manolau' is an area along the seaward border of Hanalei and Wai'oli. Keaweamahi says that 'Hālaulani' is the name of a peak*

> *above the ahupuaʻa of Waiakalua, which has groves of hala trees. It is also the name of an area on the seaward side of Anahola.*
>
> [Akana and Gonzalez 2015:131]

Nāulu means "sudden shower" and is a rain that can be found on all islands except for Kahoʻolawe (Akana and Gonzalez 2015:187). Nāulu is also "the name of a shower cloud and a wind." The Nāulu rain is mentioned in a *mele*, "Maikaʻi Kauaʻi," which was composed by Kapaʻakea.

> 43. ʻAʻohe pahuna hala ʻole a ka Māluakele
> Tū nō, mino 'olu ka ʻeli o ka āʻau
> Ka ʻōʻō ʻia i ka ua a wali ka nahele
> Puʻupuʻua i luna ke ʻawa aka Naulu
> Huahuaʻi nā huawai aka ua i ka Jani
> Piha pono nā kiʻo wai o Kūlanihākoʻi
> ʻAʻohe pakī wai a ke Tēhau
>
> *The Māluakele wind never misses in its thrusting*
> *Stabbed indeed, the digging of the stick creates a pleasant indentation*
> *Pierced in the rain, mashed and made supple is the forest*
> *Swollen above is the cold rain of the Nāulu*
> *The water gourds with rain from the heavens gush forth*
> *The pools of Kūlanihākoʻi are full to the brim*
> *Not a sprinkling of the Tēhau rain*
>
> From a mele about Kauaʻi, said to be composed by Kapaʻakea. The chant is a mele inoa, or name chant, a mele ʻāina, or chant for the land, and a mele hula, or hula chant. Hawaiian source: ʻMaikai Kauai.ʼ English trans. by author.
>
> [Akana and Gonzalez 2015:198]

The Nāulu rain is also mentioned in a *mele mākaʻikaʻi* (travel chant) composed for ʻEmalani Kaleleonālani.

> 48. Nani Kilohana i ka wai o Kemamo
> He liko lehua ia no Puʻukapele
> He wai no ka ua Nāulu
> I hoʻāu iho i ke Koʻolau
>
> *Beautiful is Kilohana in the water of Kemamo*
> *It is like a new leaf of the lehua from Puʻukapele*
> *Waters of the sudden Nāulu rains*
> *That wash down over the Koʻolau district*
>
> From a mele mākaʻikaʻi, or travel chant, for ʻEmalani Kaleleonālani. Source: Nogelmeier 73.
>
> [Akana and Gonzalez 2015:200]

1.4.3.3 Puna Moku

There are many rains associated with the *moku* of Puna. These rains include Kea and Makanoe. Other rains associated with Puna include ‘Ala, Kenikeni, Līhau, Mokihana, Naulu, Pa‘ūpili, Paupua, and Waiolohia rains.

Kea translates to “white” and is described as a “misty rain” (Akana and Gonzalez 2015:70). The Kea rain is mentioned in the following verse taken from a *makena*, or lament, for ‘Emalani Kaleleonālani, wife of Kamehameha IV, Alexander Liholiho.

10. He ua Kea ko Puna
Ke ua māile i Kuaahiahi
He ua ho‘omalie kai no Makaīwa
E ana ana i ka laulā o Kapa‘a

Puna has a white [*Kea*] *rain*
Raining now at Kuaahiahi
A rain that quiets the sea of Makaīwa
Measuring the expanse of Kapa‘a

From a makena, or lament, for ‘Emalani Kaleleonālani. Source: Nogelmeier 355.

[Akana and Gonzalez 2015:72–73]

Makanoe translates to “misty face” (Akana and Gonzalez 2015:171). The Makanoe rain is mentioned in a *kanikau* for David Kahalepouli Pi‘ikoi, a descendant of kings from Kaua‘i.

1. Noho i Puna ka ua Makanoe
He ua Makanoe anu ia no uka
He haili hoaka na ke Ko‘olau
He welelau makani ia no ka Maluakele

‘Launa aku māua me ku‘u wahine
I ka ua Makanoe i Haua‘iliki ē’

Dwelling in Puna is the Makanoe rain
This is a cold Makanoe rain from the uplands
A memory cast by the Ko‘olau wind
This is the tip of the wind from the Miiluakele

‘My darling wife and I come together
In the Makanoe rain at Haua‘iliki’

From a kanikau, or lament, for David Kahalepouli Piikoi. Hawaiian source: Paukaikena. English trans. by author.

[Akana and Gonzalez 2015:171–172]

Kenikeni is a rain associated with Līhu‘e, Kaua‘i. The two pieces below were published in *Ka Nupepa Kuokoa* to be included in the obituary for Eda Kawaikauomaunahina Kalua, a resident of Kaua‘i.

1. E ka ua Kenikeni o Līhu‘e, ua pau kou ho‘opulu pē ‘ana i ka ‘ili o ku‘u aloha.

O Kenikeni rain of Līhuʻe, your drenching of my love's skin has ended.

From an obituary for Eda Kawaikauomaunahina Kalua. Hawaiian source: Kalua. English trans. by author.

[Akana and Gonzalez 2015:77]

The obituary included a *kanikau* which again mentioned the Kenikeni rain:

2. Me ka ua Kenikeni o Līhuʻe
E ue helu mai ʻo Kaapuwai

With the Kenikeni rain of Līhuʻe
Kaapuwai wails, recounting your deeds

From a kanikau, or lament, for Eda Kawaikauomaunahina Kalua. Hawaiian source: Kaapuwai. English trans. by author.

[Akana and Gonzalez 2015:77]

In a textbook on Hawaiian language, *E Kamaʻilio Hawaiʻi Kakou: Let's Speak Hawaiian*, Kahananui and Anthony describe the Paʻūpili rain as "pili [grass] soaking." They noted that "*Līhuʻe, Kauaʻi, has a Paʻūpili rain.*"

20. He ua Paʻūpili (pili soaking) ko Līhuʻe, Kaua'i. Līhuʻe, Kauaʻi, has a Paʻūpili rain.

From a textbook on the Hawaiian language. Hawaiian source: Kahananui and Anthony 108. English trans. by author.

[Akana and Gonzalez 2015:226]

The Paʻūpili rain is also mentioned in the *mele* "Wailua alo lahilahi," also known as "Nani wale Līhuʻe." The *mele*, which is "credited by Liliʻuokalani and Kapoli and by others to Leleiohoku and Mrs. Kamakua," describes Līhuʻe as "*calm* […] *In the mist of the Paʻūpili rain*."

21. Nani wale Līhuʻe i ka laʻi
I ka noe a ka ua Paʻūpili

So beautiful is Līhuʻe in the calm
In the mist of the Paʻūpili rain

From the song 'Wailua alo lahilahi,' also known as 'Nani wale Līhuʻe,' credited by some to Liliʻuokalani and Kapoli and by others to Leleiohoku and Mrs. Kamakau. Source: Liliʻuokalani 275. Additional sources: Holstein 22; Wilcox et al. 201. *Note: Wilcox et al. say, 'In this mele ... winds and weather suggest a range of experiences enjoyed by these lovers, from the soft Paʻūpili rain that moistens the pili grass to the Malualua, a gusty north wind.'*

[Akana and Gonzalez 2015:226]

In the *mele* "Maikaʻi Kauaʻi," the Paʻūpili rain is described as "drenching rain that clings to the house."

22. Ua nani wale ʻo Līhuʻe

I ka ua Paʻūpili hale
I ka wai huʻihuʻi anu
Kahi wai aʻo Kemamo

So very beautiful is Līhuʻe
In the drenching [Paʻūpili] rain that clings to the house
With the cold, refreshing waters
From the springs of Kemamo

From the song ʻMaikaʻi Kauaʻi.ʼ Source: Wilcox et al. i6o.

[Akana and Gonzalez 2015:226]

Although rainfall on the windward side of Kauaʻi Island is generally plentiful, only the Nāulu rain is known to be associated with Keālia Ahupuaʻa. The Nāulu rain is mentioned in a chant originally composed for Lunalilo and inherited by Kalākaua (Akana and Gonzalez 2015:199). The *mele*, composed by Nāmāhana, speaks of the Nāulu rain that "fills the spring of Keālia."

The rain associated with Wailua is known as Mokihana, also the name of a native tree on Kauaʻi and its fruits. The passage below describes the Mokihana rain:

1. I Wailua koʻu hoa luhi ē ue nei i Halehuki ē
Pulu ka ʻuhane i ka ua Mokihana
Ke wehe lā i ke oho o ke kāwelu ē

At Wailua my weary companion cries, at Halehuki
The spirit is drenched in the Mokihana rain
Opening up the leaves of the kawelu grass

From a kanikau, or lament, for M. E. Manu. Hawaiian source: Hoapili. English trans. by author.

[Akana and Gonzalez 2015:177]

1.4.3.4 Kona Moku

There are several rains within the *moku* of Kona. These rains include the Kēwai and the Nāulu rains. Other rains associated with Kona include Hōliʻo, Kapaʻahoa, Kapakapaʻahoa, Keʻehilehua, Kehaupua, Kiʻowao, Kiu, Koʻapuaiʻa, Līhau, Makakoʻi, Makaʻupili, Nahae, Noe, Nounouʻili, Paʻūpili, Puananaiea, ʻŪkiukiu, and ʻUlalena rains.

Akana and Gonzalez (2015:7) describe the Kēwai rain as a "misty rain" and translate the name Kēwai as "watery, misty, dew-laden." The Kēwai rain is mentioned in the following excerpt:

3. Hanohano Kauaʻi i ka malie
Malino i ke kai o Kona i ka laʻi
Hoʻoipoipo a ka ipo ahi
I ka ua kēwai lawe malie
Pulu ʻelo ke oho a loke lau liʻi
Ka palai moe anu o Maialoa

Kauaʻi is glorious in the calm
Calm in the serenity of the sea of Kona

The lovemaking of the fiery sweetheart
In the soft, gentle kēwai rain
The foliage of the small-leafed rose is drenched
The palai fern that rests in the cold of Maialoa

From a mele inoa, or name chant, for Keahi Luahine's great-grandmother. Hawaiian source: Barrere, Pukui, Kelly 88. English trans. by author.

[Akana and Gonzalez 2015:78]

The Nāulu rain is mentioned in a *mele* composed by Nāmāhana for Lunalilo which was inherited by Kalākaua,

47. Hana ua wai Nāulu ʻo Kona
Hana ua wai Nāulu ʻo Mānā
I hoʻonani ʻia e piha Keālia wai
Wai Kahelu, ua piha Kalanamaihiki
Na ka wai ua Kaunalewa
Maikaʻi iho i ka wai Lolomauna

Kona produces the Nāulu rainwater
Mānā produces the Nāulu rainwater
That enhances and fills the spring of Keālia
The waters of Kahelu, Kalanamaihiki is filled
By the rainwater of Kaunalewa
Beautified by the water of Lolomauna

From a chant originally composed for Lunalilo and inherited by Kalākaua. This portion of the mele was composed by Nāmāhana. Hawaiian source: *Na Mele Aimoku* 151. English trans. by author. Additional sources: Namahana; Kanahele 19- 20.

[Akana and Gonzalez 2015:199]

The *ahupuaʻa* of Mānā, Kauaʻi is associated with the Kiu, Koʻapuaiʻa, and Nāulu rains. The Kiu rain is mentioned in a *mele* composed for Haili, the daughter of Kaumualiʻi:

4. E Kū, e Lono, e Kāne, Kanaloa
ʻAkahi ʻoe a ʻike i ka mole wai
I nā mole wai pūhae a ka makani
I nā lile wai ʻono kau i ka pali
I nā muliwai loloa a ka ua Kiu
ʻOlolī ka wai ʻolokeʻa i Mānā
Uhalu ʻole ke kaha ʻōkolo i ka helu

Kū, Lono, Kāne, Kanaloa
You are just now seeing the source of water
The water sources torn by the wind
The sparkling, delicious water placed on the cliffs
The long streams created by the Kiu rain
Narrow are the waters crisscrossing at Mānā

> *Innumerable are the places across which they crawl*
>
> From a mele for Haili, the daughter of Kaumualiʻi. Hawaiian source: Pukui, *Nā Mele Welo* 38. English trans. by author.
>
> [Akana and Gonzalez 2015:106]

The Koʻapuaiʻa rain is mentioned in the following excerpt of *mele* describing Hiʻiakaikapoliopele and her companions.

> 2. Makemake au i ke inu wai o lalo
> I ka hoʻonani mai a ke Koʻapuaiʻa
> Pāpāʻana kōʻeleʻele Mānā
> ʻEleu no i ke kaha o Nohomalu ē, i laila
>
> *I wish to sip of the waters below*
> *Enhanced by the Koʻapuaiʻa showers*
> *Mānā shudders and clamors in haste*
> *Rushing to the sheltered strands of Nohomalu, yes, there*
>
> From a mele recalled by Hoʻoulumāhiehie as he described the fine physiques of Hiʻiakaikapoliopele and her companions. Hawaiian source: Hoʻoulumāhiehie, *Ka Moʻolelo* in English trans.: Hoʻoulumāhiehie, *Epic* 70. Additional source: *Na Mele Aimoku* 169.
>
> [Akana and Gonzalez 2015:107]

The Nāulu rain is mentioned in a *mele* chanted by Hiʻiakaikapoliopele when she arrived at Hāʻena, Kauaʻi.

> 49. A ua wai Nāulu ka uka o Mānā
> Ke hahai lā i ka li ʻulā o Kaunalewa
>
> *The waters of the sudden Nāulu showers cover Mana*
> *Following the mirage of Kaunalewa*
>
> From a mele by Hiʻiakaikapoliopele upon her arrival at Hāʻena, Kauaʻi. Hawaiian source: Hoʻoulumāhiehie, *Ka Moʻolelo* 180. English trans.: Hoʻoulumāhiehie, *Epic* 168.
>
> [Akana and Gonzalez 2015:200]

The Kapaʻahoa and Nounouʻili rains are known to be associated with the *ahupuaʻa* of Waimea. The Kapaʻahoa rain is mentioned in the following excerpts:

> 5. ʻO Luʻanuʻu a Laka, ʻo Luʻanuʻu ke keiki a Laka, ʻo Hīkāwaelena ka makuahine, he aliʻi wahine ʻo ia no ka ua Kapaʻahoa no Waimea i Kauaʻi.
>
> *Luʻanuʻu of Laka, Luʻanuʻu is the son of Laka; Hīkāwaelena is his mother; she is a chiefess of the Kapaʻahoa rain of Waimea in Kauaʻi.*
>
> From the legend of Luʻanuʻu. Hawaiian source: Kamakau, ʻKa moolelo Hawaiiʼ 10/28/1869. English trans. by author. Additional source: Kamakau, *Tales* 147.
>
> 6. Kuʻu kāne, e kuʻu kāne hoʻi

Kuʻu kāne mai ka wai ʻula ʻiliahi o Waimea
Wai nono ʻula aka ua Kapa'ahoa

My beloved husband, oh, my dear husband indeed
My dear husband of the red sandalwood waters of Waimea
Red-glowing water of the Kapaʻahoa rain

From a kanikau, or lament, for Kamehameha IV by his wife, ʻEmalani Kaleleonālani. Source: Nogelmeier 339. *Note: Fukui, ʻOlelo 179, says that ʻka wai ʻula ʻiliahi o Waimeaʼ refers to Waimea Stream, which runs red following a storm. ʻWhere it meets Makaweli Stream to form Waimea River, the water is sometimes red on one side and clear on the other. The red side is called ʻwai ʻu la ʻiliahi.ʼ*

7- Kau ke Kiuwaiʻahulu o Waimea
Wai nono ʻula aka ua Kapaʻahoa
I hoʻoluʻu a kohu i ka pili
A ʻula mai heʻa ka uka o Kahana

The Kiuwaiʻahulu wind of Waimea settles
Blushing water of the Kapaʻahoa rain
Dyed and stained by the closeness
Becoming red, stained red are the uplands of Kahana

From a chant originally composed for Lunalilo and inherited by Kalākaua. This portion of the mele was composed by Kaʻahumanu. Hawaiian source: *Na Mele Aimoku* 147-48. English trans. by author.

[Akana and Gonzalez 2015:65–67]

Nounouʻili means "to pelt the skin" (Akana and Gonzalez 2015:212). Nounouʻili rain is mentioned in an *ʻōlelo noeau*, "*Ka ua Nounouʻili o Waimea*. The skin-pelting [Nounouʻili] rain of Waimea" (Pukui 1983:172).

Several other rains are associated with Waimea including the Hōliʻo, Keʻehilehua, Kehaupua, Kiʻowao, Līhau, Makakoʻi, Nahae, Nāulu, Noe, Puananaiea, and ʻUlalena rains.

The Kiu rain is mentioned as being related to the Makaweli Ahupuaʻa. Within the name chant for Wahinaloha, the line is chanted "*Anu māʻeʻele i ka noe a ke Kiu,*" "numb with cold in the mist of the Kiu." This line describes the Kiu rain as a mist.

3. ʻAʻala ka ʻiliahi o Makaweli
ʻAʻala ke kiele me ke kupukupu
E aʻoaʻo ana ke ʻala
Me ka lehua maka noe i ke anu
Anu māʻeʻele i ka noe a ke Kiu
ʻAʻala ka hala o Māpuana i ke kai

The ʻiliahi tree of Makaweli is fragrant
The kiele plant and ferns are fragrant
The fragrance confers
With the lehua maka noe shrub in the cold

> *Numb with cold in the mist of the Kiu*
> *The hala trees of Māpuana by the sea are fragrant*
>
> From a mele inoa, or name chant, for Wahinealoha. Hawaiian source: Savia. English trans. by author.
>
> [Akana and Gonzalez 2015:105–106]

Other named rains within the Makaweli Ahupua‘a include the Kapa‘ahoa, Kapakapa‘ahoa, Maka‘upili, Pa‘ūpili, and the ‘Ūkiukiu.

In an obituary written for Eda Kawaikauomaunahina Kalua, the Noe rain is mentioned in association with Kōloa Ahupua‘a

> Rain of Kōloa, Kaua‘i
>
> 10. E ka ua Noe o Kōloa, ua pau kou ho‘opulu ‘ana i ka nui kino o ku‘u aloha.
>
> *O Noe rain of Kōloa, your drenching of my love's entire body has ended.*
>
> From an obituary for Eda Kawaikauomaunahina Kalua. Hawaiian source: Kalua. English trans. by author.
>
> [Akana and Gonzalez 2015:210]

1.4.3.5 Nāpali Moku

Nāpali Moku is associated with the Leikoko‘ula or Leikōkō‘ula rain. Akana and Gonzalez (2015:148) describe the Leikoko‘ula rain:

> Leikoko‘ula. Or Leikōkō‘ula. Probably related to Koko and koko ‘ula. Rain associated with Waimea, Hawai‘i, and found in other areas. ‘Lei koko ‘ula' and ‘lei kōkō ‘ula' can refer to a lei of red color or a rainbow-hued lei. [Akana and Gonzalez 2015:148]

1.4.4 *Nā Kahawai* (Streams)

There have been 376 perennial (year-round flowing) streams identified throughout the Hawaiian Islands, providing a steady resource and access to fresh water for cultural, subsistence, and spiritual use. The perennial streams receive their consistent supply from rainfall that gathers in the mountain ranges and wet forests.

> Rainfall feeds streams in many ways. One way is direct surface runoff, in which rainfall flows over the surface into nearby streams. Rainfall also feeds streams by flowing through shallow layers of soil or bog, or by percolating down to sources of groundwater. [CWRM and RTCAP 1993:7]

The water source for many of the streams of Kaua‘i is Wai‘ale‘ale, which is known as the wettest place and earth, receiving "more rainfall than any other gage in the world" (Giambelluca et al. 1986:17). Other peaks providing a water source for several streams on Kaua‘i include Kawaikini, Kilohana, and Makaleha.

Streams play a vital role in sustaining wetland wildlife and Native Hawaiian agriculture. Streams provide freshwater to *lo‘i kalo* (taro patches), wetland marshes, and *loko i‘a* (fishponds). These areas are habitats for various species including *‘o‘opu* (goby fish, families include

Eleotridae, Gobiidae, and *Blennidae*), *hīhīwai* (Endemic grainy snail, *Neritinu graposa*), *ʻōpae, ʻalae keʻokeʻo, ʻalae ʻula, aeʻo,* and others (CWRM and RTCAP 1993).

The following subsections include a list of streams throughout the island of Kauaʻi, separated by *moku*.

1.4.4.1 Haleleʻa Moku

Haleleʻa Moku is fed by several water sources ʻAnini Stream, Hanalei River, Kalihiwai River, Lumahaʻi River, Limahuli Stream, Mānoa Stream, Puʻukumu Stream, Waikoko Stream, Waileia Stream, Wainiha River, Waipā Stream, Waiʻoli Stream and an unnamed stream. Perennial streams and their tributaries in Haleleʻa depicted in Figure 4 and are listed in Table 2.

1.4.4.2 Koʻolau Moku

There are several perennial streams in the *moku* of Koʻolau. These streams include ʻAliomanu, Anahola, East Waiakalua, East and West Waipake, Kīlauea, Kulihaili, Moloaʻa, Papaʻa, and Pīlaʻa. Perennial streams and their tributaries of Koʻolau are listed in Table 3 and depicted in Figure 5.

1.4.4.3 Puna Moku

Puna Moku also has several perennial streams including Hanamāʻulu Stream, Hulēʻia Stream, Kapaʻa Stream, Kawailoa Stream, Kīpū Kai Stream, Kumukumu Stream, Moikeha Canal, Nāliwiliwili Stream, Pūʻali Stream, Waikaea Canal, and Wailua Stream. Perennial streams and their tributaries in Puna are listed in Table 4 and depicted in Figure 6.

1.4.4.4 Kona Moku

There are numerous streams in Kona Moku including Aʻakukui Stream, Hāʻeleʻele Stream, Hanapēpē Stream, Kaʻawaloa Stream, Kauhao Stream, Kaʻulaʻula Stream, Kinekine Ditch, Lāwaʻi Stream, Mahinauli Stream, Miloliʻi Stream, Nahomalu Stream, Nuʻalolo Stream, Wahiawa Stream, Waikomo Stream, Waimea Stream, and Waipao Stream. Perennial streams and their tributaries in Kona are listed in Table 5 and depicted in Figure 7.

1.4.4.5 Nā Pali Moku

Perennial streams of Nā Pali Moku include Awaʻawapuhi, Hanakāpīʻai, Hanakoa Stream, Honopū, Hoʻolulu, Kalalau, Maunapuluo, Nakeikionaiwi, Pōhakuʻao, Waiahuakua, and Waiolaa. Perennial streams and their tributaries in Nā Pali are listed in Table 6 and depicted in Figure 8.

1.4.5 *Ka Lihikai a me Ka Moana* (Seashore, Ocean)

Traditionally, the seashore and ocean areas were vitally important for resource extraction in the early days of settlement. Fishermen along the coast maintained a respected status within traditional Hawaiian society; Kanahele asserts that "early Hawaiians regarded fishing as the oldest, and hence the most prestigious of professions (Kanahele 1995:17). For those engaged in this profession, knowledge of the seas, particularly fishing grounds, was especially important. This knowledge was passed down from one generation to another. As D. Kanewanui notes, "our fishing grounds were sought by the ancestors with great patience, and those spots were revealed to their children, which is how that knowledge was passed down" (Kahāʻulelio 2006:xv).

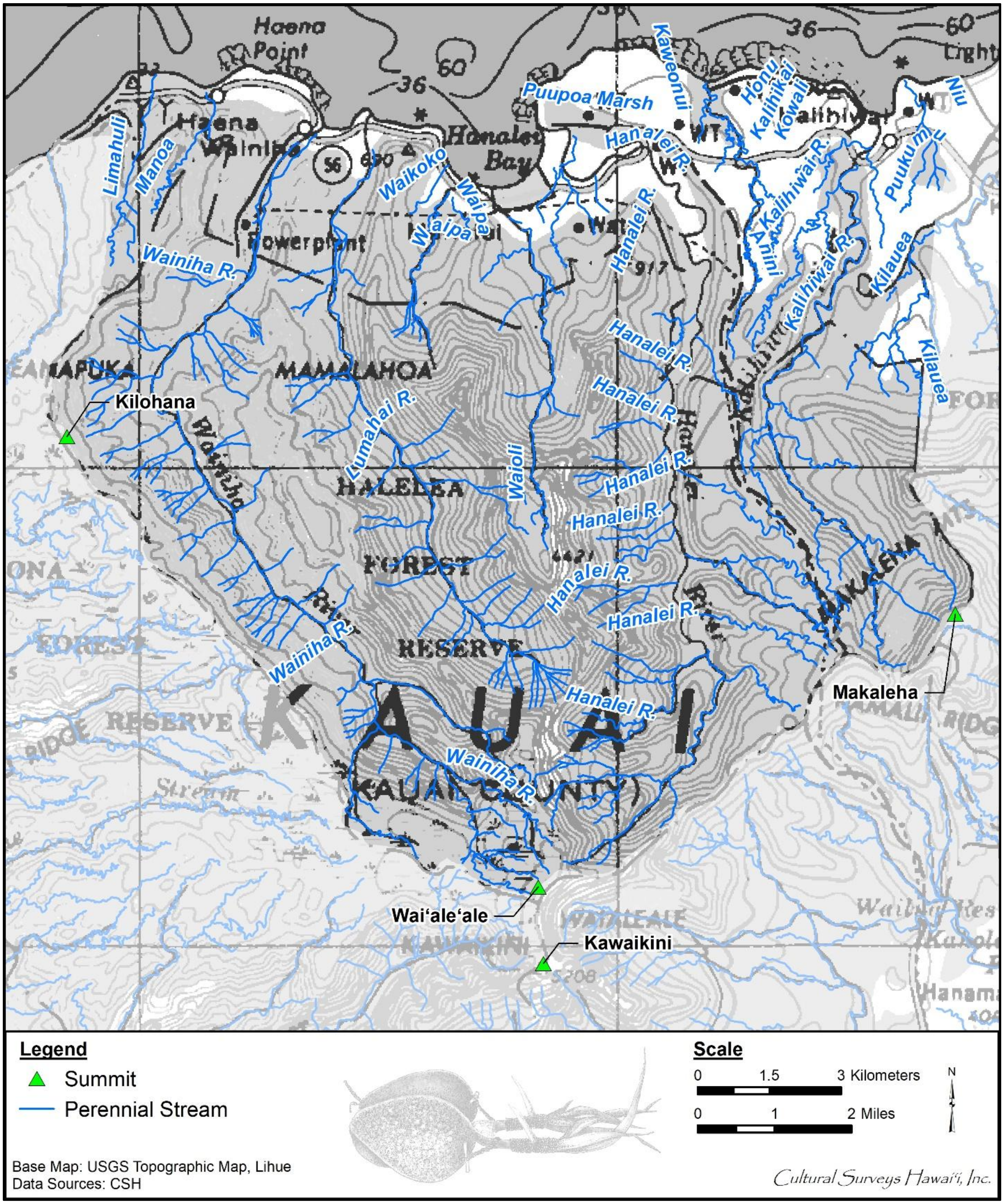


Figure 4. Perennial streams of Haleleʻa Moku

Table 2. Perennial streams and tributaries in Halele‘a Moku (CWRM 1990:21, 26–27)

Stream	Tributaries	*Ahupua‘a*
Anini		Hanalei, Kalihikai
Hanalei River	Kaapoko, Waipunaea	Hanalei
Kalihiwai River	Kaumoku, Pouli	Kalihiwai
Lumahai River		Lumaha‘i
Limahuli		Hā‘ena
Manoa		Hā‘ena
Puukumu		Kalihiwai
Unnamed		Hanalei
Waikoko		Waikoko
Waileia		Hanalei
Wainiha River	Hiaupe, Makawea, Maunahina	Wainiha
Waipa		Waipā
Waioli		Wai‘oli

Table 3. Perennial streams and tributaries in Ko‘olau Moku (CWRM 1990:21, 26–27)

Stream	Tributaries	*Ahupua‘a*
Aliomanu		‘Aliomanu
Anahola	Kaalua, Kaupaku, Keaoopu	Anahola
E. Waiakalua		Waiakalua
E. Waipake		Waipake
Kilauea	Halaulani, Kahiliholo, Kalaumakua, Pohakuhonu, Puu Ka Ele, Wailapa	Kīlauea
Kulihaili		West Waikalua
Moloaa		Moloa‘a
Papaa		Papa‘a
Pilaa		Pīla‘a
W. Waipake		Waipake

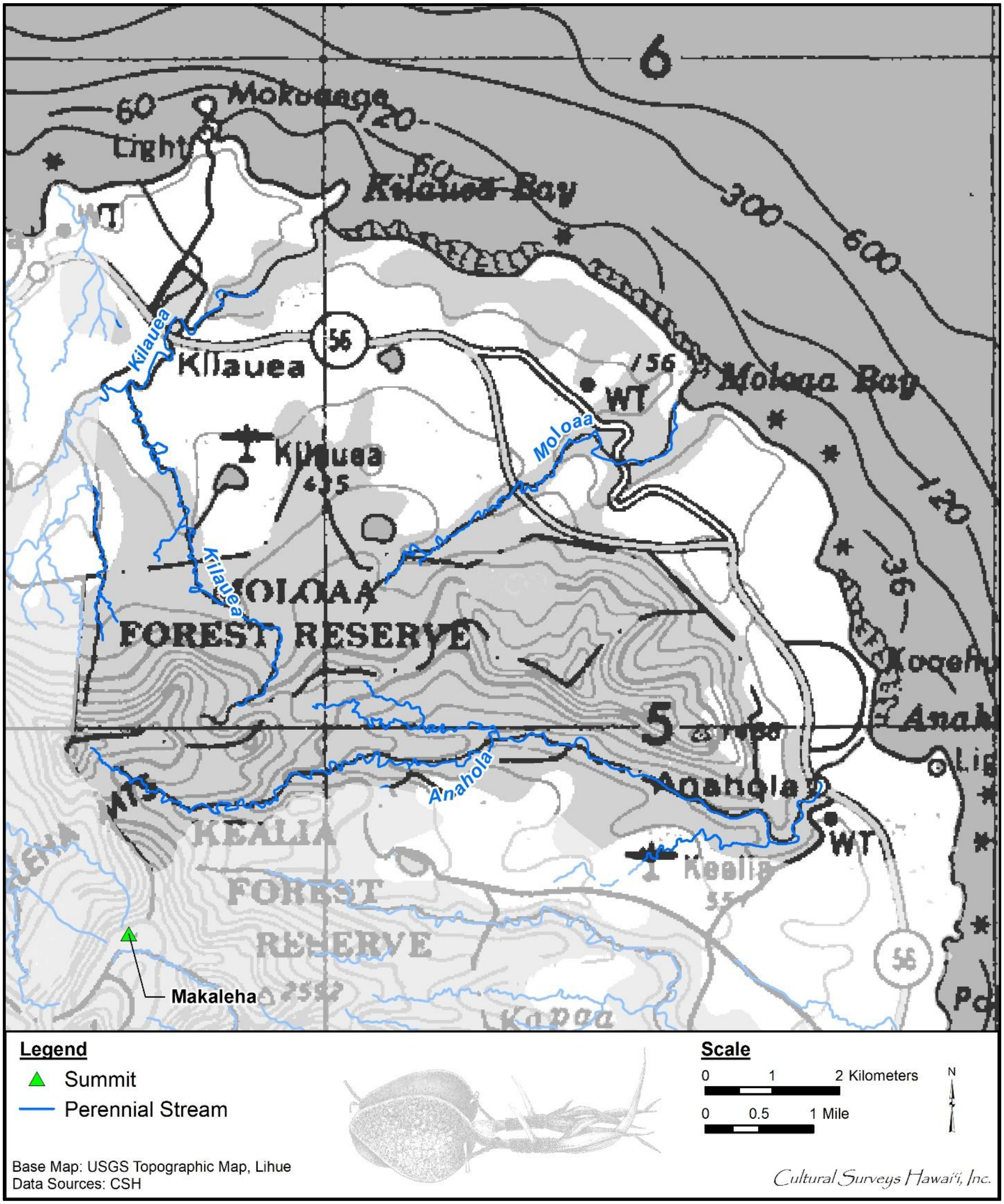


Figure 5. Perennial streams of Ko‘olau Moku

Table 4. Perennial streams and tributaries in Puna Moku (CWRM 1990:21, 26–27)

Stream	**Tributaries**	***Ahupuaʻa***
Hanamaulu		Hanamāʻulu
Huleia	Halenanahu, Hoinakaunalehua, Kamooloa, Kuia, Paohia, Papakolea, Papuaa, Puhi, Weoweopilau	Haʻiku, Kīpū
Kapaa	Kapahi, Kealia, Maiakii, Makaleha, Mimino, Moalepe	Kapaʻa
Kawailoa		Hanamāʻulu
Kipu Kai		Kīpū Kai
Kumukumu		Keālia
Moikeha Canal		Kapaʻa
Naliwiliwili		Nāwiliwili
Puali		Niumalu
Waikaea Canal	Konohiki	Waipouli, North Olohena, South Olohena
Wailua S.	Halii, Iliiliula, Iole, Kalama, Kaulu, Kaiwi, Keahua, Maheo, North Fork Wailua, Opaekaa, Palikea, South Fork Wailua, Uhau Iole, Waiahi, Waiaka, Waikoko, Waianuenue, Wailua River	Wailua, Hanamāʻulu

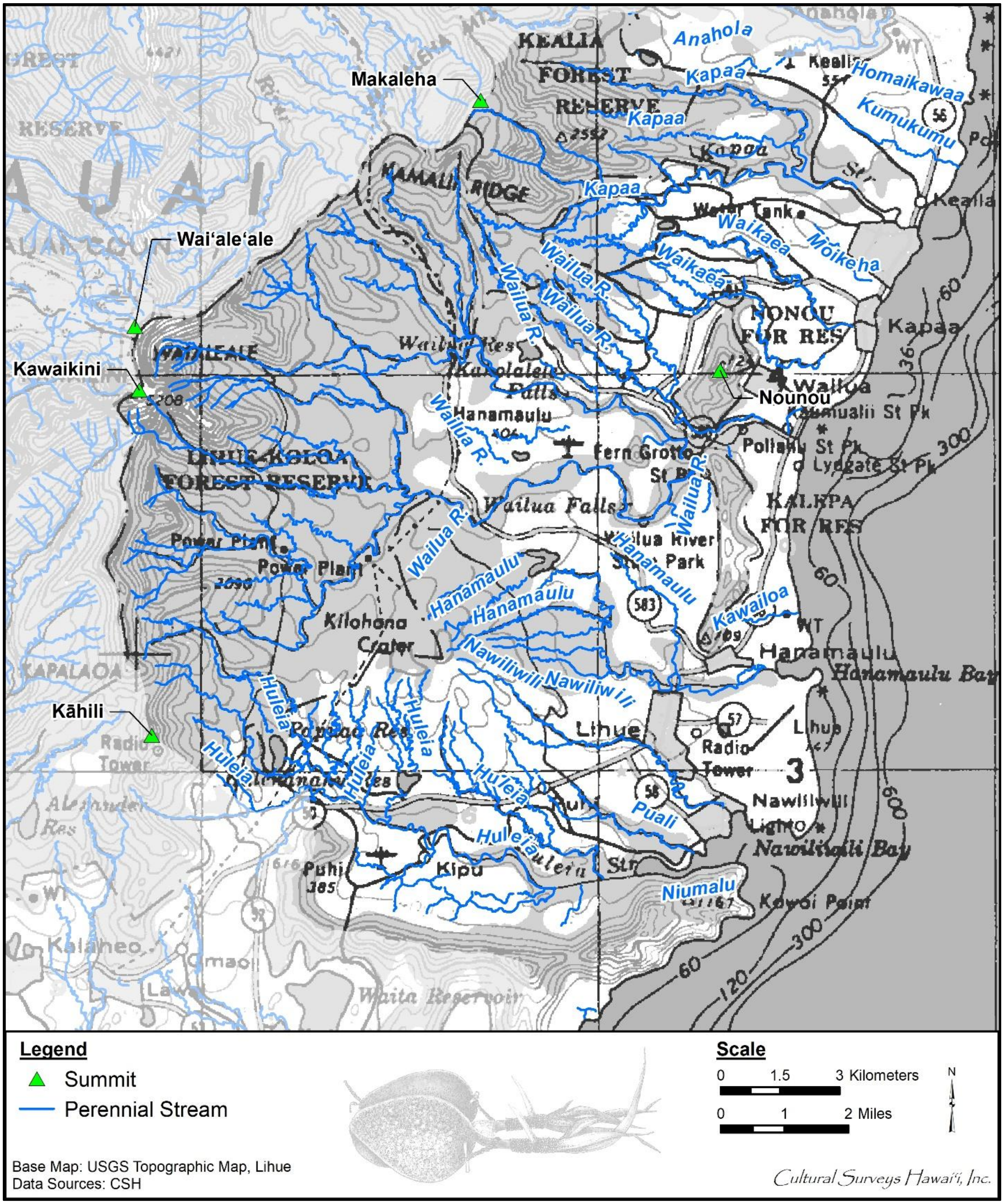


Figure 6. Perennial streams of Puna Moku

Table 5. Perennial streams and tributaries in Kona Moku (CWRM 1990:21, 26–27)

Stream	**Tributaries**	***Ahupuaʻa***
Aakukui		Makaweli
Haeleele		Waimea
Hanapepe	Hauhili, Kalai, Kapohakukilomanu, Kawaipuua, Koula, Wainonoia	Hanapēpē
Kaawaloa		Waimea
Kauhao		Waimea
Kaulaula		Waimea
Kinekine Ditch		Waimea
Lawai		Lāwaʻi, Kalāheo
Mahinauli		Makaweli
Milolii		Waimea
Nahomalu		Waimea
Nualolo		Waimea
Wahiawa		Wahiawa
Waikomo	Omao, Poeleele, Waihohunu	Kōloa
Waimea S.	Awini, Elekeninui, Halehaha, Halekua, Halemanu, Halepaakai, Kauaikinana, Koaie, Koholoina, Kokee, Loli, Makaweli, Malaupopoki, Mohihi, Mokihana, Mokuone, Nawaimaka, Noe, Olokele, Poomau, Waiahulu, Waiakoali, Waiale, Waiau, Waimea River	Waimea, Makaweli
Waipao		Makaweli

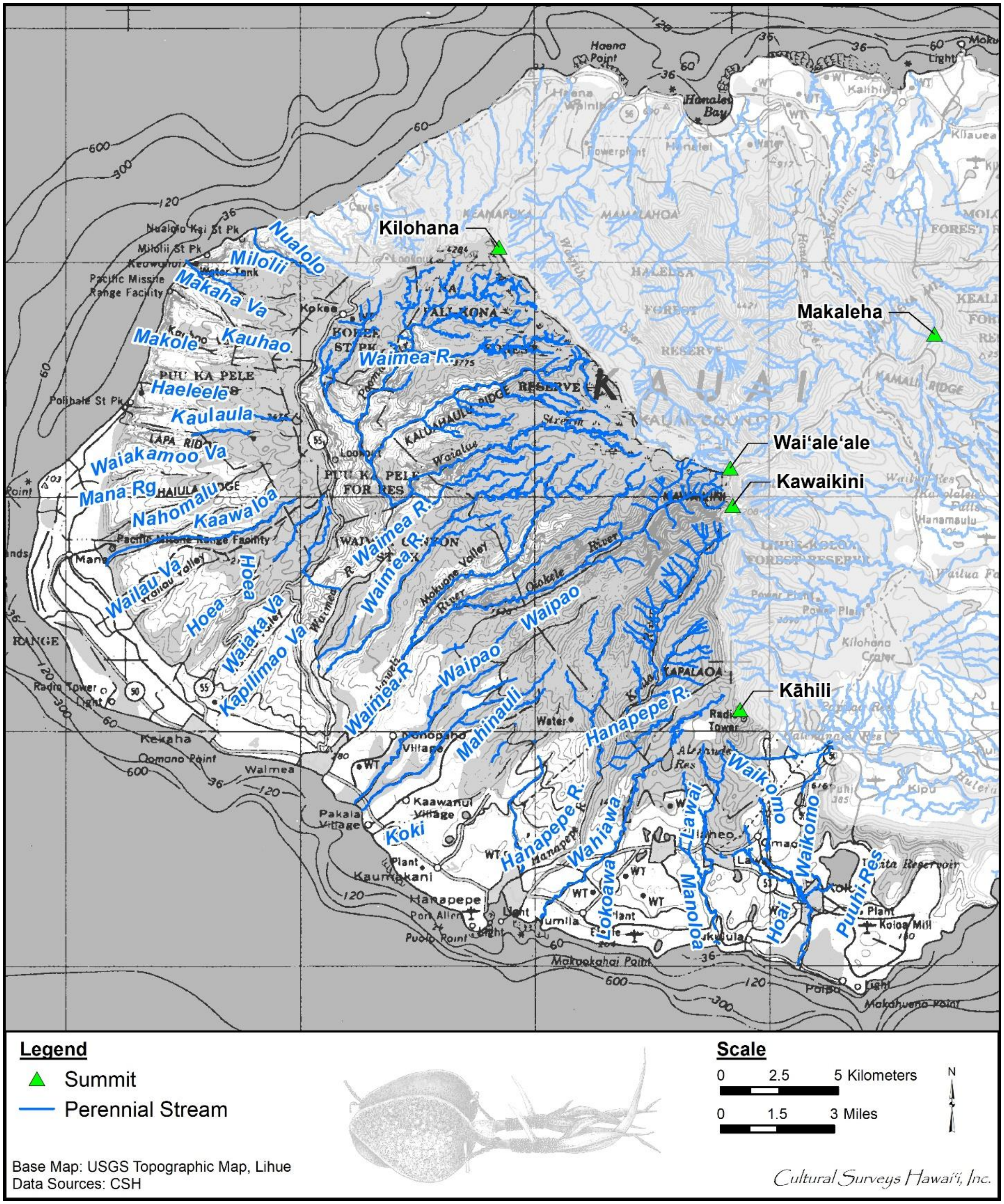


Figure 7. Perennial streams of Kona Moku

Table 6. Perennial streams and tributaries in Nā Pali Moku (CWRM 1990:21, 26–27)

Stream	**Tributaries**	***Ahupua‘a***
Awaawapuhi	--	Honopū
Hanakapiai	--	Hanakāpī‘ai
Hanakoa	--	Hanakoa
Honopu	--	Honopū
Hoolulu	--	Hanakāpī‘ai
Kalalau	--	Kalalau
Maunapuluo	--	Hanakāpī‘ai
Nakeikionaiwi	--	Honopū
Pohakuao	--	Pōhaku‘ao
Waiahuakua	--	Hanakoa
Waiolaa	--	Pōhaku‘ao

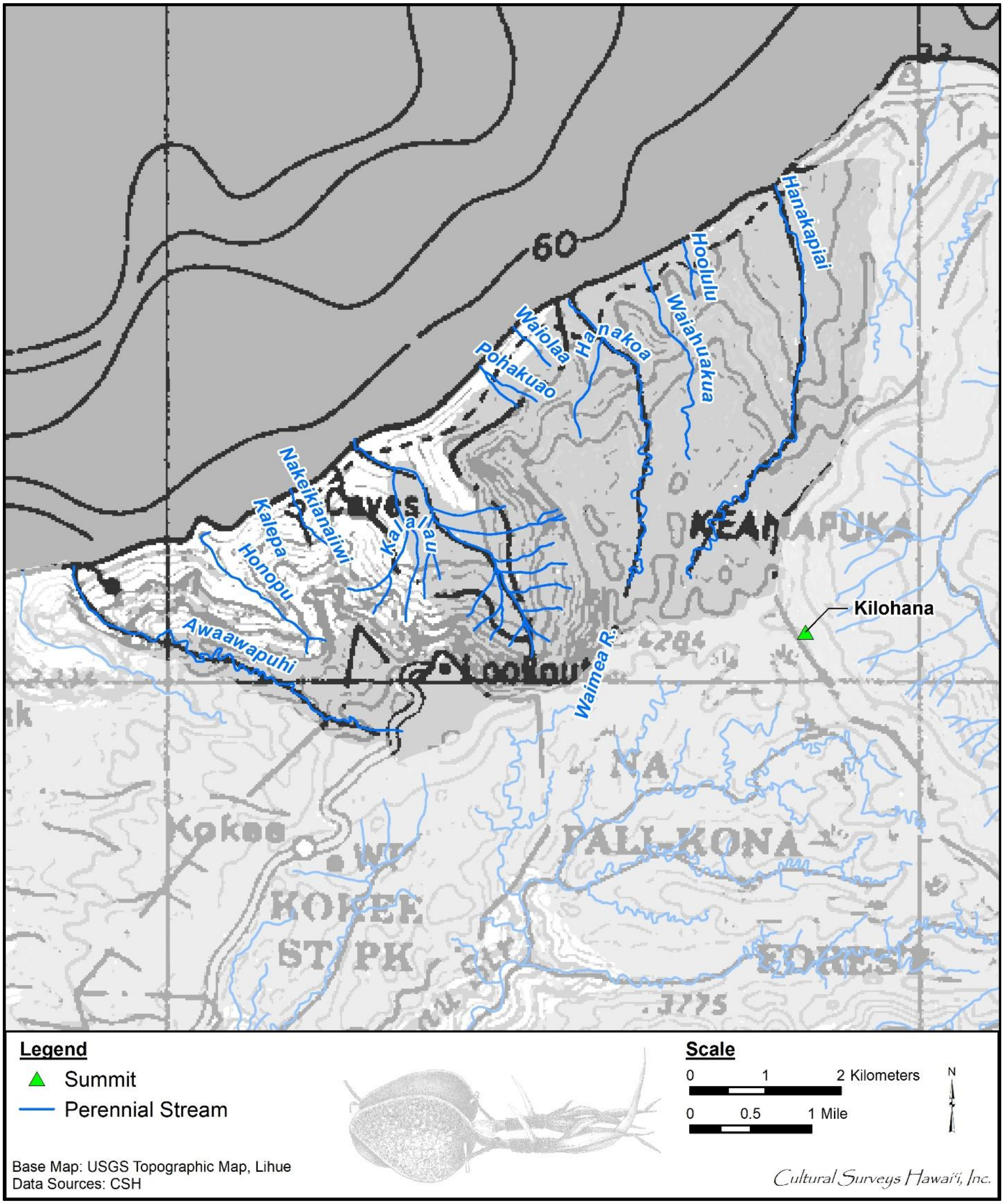


Figure 8. Perennial streams of Nā Pali Moku

There are several regulated fishing areas on the island of Kauaʻi (DLNR 2021). The Hāʻena Community-Based Subsistence Fishing Area is in Hāʻena Ahupuaʻa in Haleleʻa Moku. Puna Moku has Hanamāʻulu Bay and Ahukini Recreational Pier in Hanamāʻulu Ahupuaʻa, Kapaʻa and Waikaʻea Canals in Kapaʻa Ahupuaʻa, and Nāwiliwili Harbor in Nāwiliwili Ahupuaʻa. Also in Puna Moku is the Wailua Reservoir Public Fishing Area located "approximately five miles mauka [inland] of Kūhiʻō Hwy, above the city of Wailua." Kona Moku has Port Allen and Waimea Bay and Waimea Recreational Pier. Also in Kona is the Kōkeʻe Public Fishing Area which includes "certain streams, reservoirs and ditches in the Kōkeʻe State Park."

The seashore and ocean also maintained spiritual significance for the people of Kauaʻi.

> The Ocean *(ka moana nui a Kane)* surrounded the earth. It was made salt by Kane so that its waters should not stink, and to keep it thus in a healthy and uninfested state is the special occupation of Kane. In imitation of Kane, the priests prepare waters of purification, prayer and sanctification (holy water) ʻ*wai hui kala*,ʼ ʻ*wai lupalupa*,ʼ and ʻ*Ke Kai olena*,ʼ wherewith to drive away demons and diseases; it was called ʻ*Ka wai kapu a Kane*.ʼ Women purified themselves after child-birth by bathing naked in the sea and sprinkling their *paʻu,* or skirt, with sea water. If they were too far from the sea, they took a calabash of salted water, and at high noon offered a prayer of blessing and poured it over their bodies. Doses of medicine (taken by fives) were followed by a sea bath. In the Pele legend, Lohiau, after being brought back to life from the dead, is bathed five times in the sea for purification. [Fornander in Green and Beckwith 1926:176]

Both seashore and ocean provided physical and spiritual sustenance (NOAA 2017) for the people of Kauaʻi. According to Malo, the ocean was divided into smaller divisions, stretching from *ʻae kai* (water's edge) to *moana* (pelagic zone) (Malo 1951:25–26). Outside the coastal areas was the belt known as *kua au*, where the shoal water ended (Malo 1951:26). Further out was the *kai au*, deeper waters designated for surfing, swimming, or spearing squid (Malo 1951:26).

Numerous Kauaʻi seashores have been utilized for the sport of *heʻe nalu* or surfing. Mary Kawena Pukui of the Bishop Museum made a list of surfing spots mentioned in Hawaiian oral traditions (Finney and Houston 1996:31). For Hanelei in Haleleʻa Moku, she recorded Hawaiʻiloa ("long (or distant) Hawaiʻi"), Hoʻopeʻa ("to cross"), Kūakahiunu ("standing like a fishing shrine"), Makawa, and Puʻulena ("yellow hill"). For Waiʻoli, also in Haleleʻa, she recorded Manalau ("many branches"). For Anahola in Koʻolau Moku, she recorded Kanahāwale (meaning "easily broken"). For Kapaʻa in Puna Moku, she recorded Kamakaiwa ("the mother-of-pearl eyes"), Poʻo, ("head"), and Koʻa-lua ("two coral heads"). For Wailua, also in Puna Moku, she recorded Makaiwa ("mother-of-pearl eyes") and Kaʻōhala ("the thrust passing"). In Kona Moku, she recorded Hanapēpē ("crushed bay"). For Waimea, also in Kona Moku, she recorded the names of *Kaua* ("war"), *Kualua* ("twice"), and *Poʻo* ("head").

John Papa ʻIʻī, the early Hawaiian historian, had a similar list of Kauaʻi surfing spots:

> The surf of Kamakaiwa is in Kapaa, Kauai, and so is the surf of Kaohala and one that runs to the sand of Wailua. Others are the surfs of Poo, Koalua, and the one that runs to the mouth of the sand-bottomed stream of Waimea, and the surf of Manalau is in Waioli. [ʻĪʻī 1959:135]

1.4.6 Built Environment

The plan area generally covers the full expanse of Kauaʻi Island where areas of potential effect may occur due to KIUC transmission lines and street lights. Existing conservation sites are *makai* of Hanalei. Occupied habitats for covered seabirds are both *mauka* and *makai* of Hanalei and *makai* Waimea. KIUC streetlights wrap around the island from about Hāʻena around to Kekaha. The built environment consists of residential communities commercial and industrial businesses, and resorts located primarily on the coastal areas of the island.

Section 2 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*, 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, 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 2014), 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 2021), 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).

2.2 **Community Consultation**

2.2.1 Scoping for Participants

We begin our consultation efforts by utilizing our contact lists from previous outreach efforts to facilitate the interview process. We then review an in-house database of *kupuna* (elders), *kama‘āina* (native born), cultural practitioners, lineal and cultural descendants, Native Hawaiian Organizations (NHOs; includes Hawaiian Civic Clubs and those listed on the Department of Interior’s NHO list), and community groups. We also contact agencies such as SHPD, OHA, and the appropriate Island Burial Council where the proposed project is located for their response to the project and to identify lineal and cultural descendants, individuals and/or NHO with cultural expertise and/or knowledge of the study area. CSH is also open to referrals and new contacts.

2.2.2 “Talk Story” Sessions

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.

“Talk Story” sessions range from the formal (e.g., sit down and *kūkākūkā* [consultation, discussion] in the participant’s choice of place 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 interviewee's 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) providing missing details for *moʻolelo*.

Prior to the interview, CSH cultural researchers explain the role of a CIA, how the consent process works, the project purpose, the intent of the study, and how their *ʻike* (insight) and *manaʻo* (opinion) will be used in the report. The interviewee is given an Authorization and Release Form to read and sign.

In order to ensure the safety of participants and comply with state and county COVID-19 mandates, no in-person interviews were conducted as part of this CIA. While it is always a preference to meet with participants in person, CSH cultural researchers were able to effectively communicate with participants via telephone, email, and video conference call interviews.

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 to make any necessary edits. Once the interviewee has made those edits, we incorporate their *ʻike* and *manaʻo* 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 to CSH cultural researchers to 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 *ʻohana* (family). CSH researchers feel this is an important component to building relationships and being part of an *ʻohana* and community.

"*I ulu no ka lālā i ke kumu*—the branches grow because of the trunk," an *ʻōlelo noʻeau* (#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 *ʻohana* 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 Traditional Accounts

3.1 *Nā Ka‘ao a me Nā 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, 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 as a "legend, tale […], romance, [and/or], fiction" (Pukui and Elbert 1986:108). *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 define *mo‘olelo* as a "story, tale, myth, history, [and/or] tradition" (Pukui and Elbert 1986:254). The *mo‘olelo* are generally traditional stories about the gods, historic figures or stories that 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. However, it is also necessary to note there are exceptions, and not all *ka‘ao* discuss gods of an ancient past. *Mo‘olelo* on the other hand, reference a host of characters from *ali‘i* (chief), to *akua* and *kupua* (supernatural beings), to finally *maka‘āinana* (commoner), 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 remain 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 presents traditional accounts within the districts of Kaua‘i. Many relate to an age of mythical characters whose epic adventures inadvertently lead to the Hawaiian race of *ali‘i* and *maka‘āinana*. The *ka‘ao* and *mo‘olelo* presented below should not be considered as a complete collection as there are many more *ka‘ao* and *mo‘olelo* that still need to be discovered and recorded.

In the days of old, certain species of birds and some turtles, were considered a delicacy and was sought after by *ali‘i.* Kepelino briefly mentions how a *ho'okupu* (gift) was prepared for the *ali‘i*:

> When the commoners were ready with their gifts, the announcer or *Kalaku* called out with a loud voice at the hour of half after six in the evening as follows: "O high

> chiefs, landlords, chiefs of the *ahupua‘a* and the *okana, O konohiki,* O rulers over the *mo’oaina,* the *kihapai,* the *lapa,* the *kuewa,* and you landless. Tomorrow fetch wood, ti leaves, banana leaves, and all other necessary things when you return to cook the food. The next day bake pig, dog, turkey, chicken. Let the mountain chiefs bring petrels, geese, birds from the holes [Kepelino 1932:148]

Bringing the *ho‘okupu* happened as follows:

> […] When the overseer came he said to his landlord, “Here is the gift of our land, twenty calabashes of poi, ten pigs, twenty dogs, two men loaded with chickens cooked in ti leaves, ten bundles of turkeys, six bundles of young petrels, forty large bundles of pounded potato, […] [Kepelino 1932:150]

Kepelino also briefly notes that *uwa’u* were cooked by the process of *hakui*. Fish, chicken, petrel, turkey, and other fowl were cooked this way. The process is explained below:

> Put some smooth pebbles into the fire and let them get red hot. To cook a fresh fish or any such food, put it into a calabash and put hot stones over it, then lay another fish ion top of the stones and close the calabash tight to keep in the steam. After a time, take off the lid, sprinkle on a little salt, pour on a little water and cover again. After a time open and eat. That is the way to cook with hot stones. [Kepelino 1932:160]

Malo also shares that the *‘ua‘u i*s an excellent bird to eat and mentions they are caught by using nets and by simply grabbing them (Malo 164). In addition, Malo add that turtle were made separate for only *ali‘i*, not women (Malo 1987:158). Malo goes on to say that the shell of the turtle was best used to scrape the fiber of the *olonā* (*Touchardia latifolia*) and it can be sharpened enough to cut hair. The shell of the *‘Ea* (Hawksbill turtle) was used for fishhooks but that particular turtle was not good to eat (Malo 1987:169). The following sections present *mo‘olelo* from their respective Moku.

3.1.1 Halele‘a Moku

The following are mo‘olelo from Halele‘a Moku.

3.1.1.1 Pele travels to Kaua‘i

The tradition begins with Pele going into a deep sleep in Puna, Hawai‘i and her spirit-form being attracted by the sound of drums and voices of Lohi‘au, a highborn chief of Kaua‘i, and his *‘aikāne* (friend) Kauakahiapaoa (Ho‘oulumāhiehie 2006b:4). When Pele hears the sound of drums and voices, her spirit is enchanted. Her spirit begins to make the journey falling the sound of the drums. The drums take her throughout Hawai‘i Island, then to Mau; moving up the Hawaiian Island chain towards Kaua‘i. At O‘ahu, Pele travels to Makapu‘u, Kualoa, and Ka‘ena Point. She finally crosses Ka‘ie‘iewaho Channel and hears the pounding of the *pahu* (drum) at Hā‘ena, Kaua‘i (Ho‘oulumāhiehie 2008b:5).

Pele takes on her most attractive form adorning herself with the lovely scents of the *kūpaoa* (night cestrum*; Cestrum nocturnum*), *kupali‘i* (forest herbs), *hala* (pandanus, *Pandanus odoratissiumus*), *lehua* (*Metrosideros polymorpha*), *‘ōlapa* (*Cheirodendron*), *maile* (native twining shrub, *Alyxia olivaeformis*), *hīnano* (*Pandanus tectorius*), and *‘awapuhi* (wild ginger, *Zingiber zerumbet*). Pele walks toward the drums and voices where a mass of people were gathered. The scent of her garlands carries onto the Hā‘ena breeze and spreads amongst the *ali‘i* and *maka‘āinana*. Lohi‘au and Kauakahiapaoa are in a *hālau* (long house) with higher ranked *ali‘i* and their attendants. The crowd parts as they see Pele and Lohi‘au and Kauakahiapaoa call out to her, “Come, come inside. Welcome!” (Ho‘oulumāhiehie 2008b:8).

Lohi‘au asks Pele where she traveled from. Pele replies that she comes from Kaua‘i. Lohi‘au states that he is familiar with all of Kaua‘i and is sure he has never seen her before. The two have several exchanges back and forth—Pele insisting she is from the island of Kaua‘i while Lohi‘au insists she is not a resident. Pele finally admits she is from Puna. Lohi‘au continues,

> ‘Ah yes, now I see,’ said Lohi‘auipo. ‘I got what I wanted in questioning you. So it turns out you are from Puna, from the land where ‘awa grows wild, as though planted by the birds, the land perfumed with hīnano blossoms. Beloved is that land where sweetness dwells.
>
> These must be the fragrances of Puna whose redolence comes to us now, for these are exotic perfumes here in Hā‘ena. We are smelling kūpaoa, kupali‘i, ‘ōlapa, maile, ‘awapuhi, and all the other aromatic greenery of the forest. The hala and hīnano, though, are familiar scents here.’
>
> After these enthusiastic words of response from Lohi‘auipo, he ordered the stewards of his court to prepare food for their guest. [Ho‘oulumāhiehie 2008b:8–9]

After the food is ready, Lohi‘au calls to the stranger to eat. Pele declines to eat, however, Lohi‘au insists she must be hungry after her long travel. After declining numerous times to dine on delicacies, Lohi‘au orders his court to eat. After Lohi‘au and his court have completed their meal he invites Pele to his home, Hālauaola. Pele accepts his offer and together they begin their union as husband and wife for three nights and three days (Ho‘oulumāhiehie 2008b:10). Lohi‘au is famished after consummating his marriage with Pele and requests a feast. When the feast is prepared, again Pele declines to eat but announces that two visitors will be arriving, Kilioeikapua and Kalanamainu‘u, two *mo‘o* (lizard, reptile of any kind) women who are said to be the guardians of the cliffs of Hā‘ena (Ho‘oulumāhiehie 2008b:12). Aware that Lohi‘au would be enthralled by the *mo‘o* women, she tells Lohi‘au:

> ‘Listen,’ said Pele in response to the man, ‘you are reserved for me. And you must remember to acknowledge us as companions, lest love be wasted on a dog. A dog would be but a dog, whereas I am a human. Therefore, I place upon you my decree, called Kai‘okia, a protective sanction.’ [Ho‘oulumāhiehie 2008b:12]

Lohi‘au parts with Pele to dine and entertain his guests. The two *mo‘o* women are as beautiful as Pele except they are much more pale. The *mo‘o* pair flirts and dines with Lohi‘au and Kauakahiapaoa. Because Pele instilled the Kai‘okia (set apart) law on Lohi‘au, he is restrained from Kilioeikapua and Kalanamainu‘u’s enticements. Because of Pele’s powers, she can see the two *mo‘o* women pursuing Lohi‘au.

When Lohi‘au and his followers finish eating, they move to the *hālau hula*. Pele uses her powers to look even more beautiful than when she first met Lohi‘au. When the assembly is settled, Lohi‘au and Kauakahiapaoa begin to beat the *pahu*. Lohi‘au asks Pele to present a *hula* but instead she responds with the following: “The voice is not withheld when requested, and here is a response.

However mine is not a chant or an actual dance, but I shall call on the wind guardians of your island, moving from Nihoa to here on Kaua‘i" (Ho‘oulumāhiehie 2008b:13).

Pele begins to recite the winds of Nihoa, Ka‘ula, and Ni‘ihau. Once she is finished, the audience outside the *hālau* sees the ocean has become white with swells and clouds began to form, scaring the people and causing them to question what is happening (Ho‘oulumāhiehie 2008b:14). Pele says to the audience, "This is fair Kaua‘i, perfection in the calm, yet this is no calm day, for the farthest reaches of all the winds shall unite, and the vortex of wind will spin this land of Kaua‘i. This is a day of storm" (Ho‘oulumāhiehie 2008b:14–15).

Kalanamainu‘u states the day is fine and that "the only storm is the Kalakala‘ihikalaoa wind" and Pele was exaggerating the extent of the storm (Ho‘oulumāhiehie 2008b:15). Angered by Kalanamainu‘u's words, Pele begins to chant the winds of Lehua, Ni‘ihau, and Kaua‘i. Pele rests in between and states to the assembly: "Say, you people! This land of Hā‘ena is a land of winds. There are, however, two bad winds here, a Kilioe and the haughty Nu‘uikalanaha‘akoi. These winds are found where the mo‘o cling to the cliffs" (Ho‘oulumāhiehie 2008b:23).

Kilioeikapua and Kalanamainu‘u were furious with Pele. Kilioeikapua snapped,

> ‘You are such an insulting woman! Who are you belittling as mo‘o? You rudely imply that Kilioeikapua and Kalanamainu‘u are like bad winds for this place, Hā‘ena, and you dare to call Kalanamainu‘u haughty!
>
> You are the haughty one, you interloper, coming here and thinking that here in Hā‘ena your hunger will be sated. There is no husband for you here. You will have no man at all. The love-snatching wind here in Hā‘ena is called a Kīlauea, just so you know.' [Ho‘oulumāhiehie 2008b:23]

The assembly was upset. But Pele retorts,

> ‘If, indeed, the two of you know yourselves to be mo‘o, who "cling to rocks, cling to trees, and cling to the dirt," then your rude interruption is warranted, but if that is not the case, then the two of you are very wrong to attack like that without provocation. Kilioeikapua and Kalanamainu‘u, whom I mentioned, are children of Mo‘omilinanea. Listen all of you, to the chant—' [Ho‘oulumāhiehie 2008b:23]

3.1.1.2 Hi‘iakaikapoliopele and Malaeha‘akoa

Upon Pele's return to Hawai‘i Island from her time in Kaua‘i, she commands her youngest sister, Hi‘iakaikapoliopele (also referred to as Hi‘iaka), to fetch Lohi‘au and return him to Pele. As Hi‘iaka journeys to Kaua‘i, she encounters many people, many creatures, and many battles.

Arriving in Hā‘ena, Kaua‘i, Hi‘iakaikapoliopele seeks out the house of Malaeha‘akoa, who has the reputation of being a seer. Being unable to walk, his wife, Wailuanuiahō‘ano, took him down to the seashore so he could fish. Later, Wailuanuiahō‘ano returned home to continue her work of *kapa* (tapa, as made from *wauke* [paper mulberry, *Broussonetia papyrifera*] or *māmaki* [small native trees, *Pipturus* spp.] bark) making. While she is at home, Hi‘iaka and her companion Wahine‘ōma‘o arrive at the house. Hi‘iaka chants,

> *Kunihi ka mauna i ka la‘i, e,*
> *O Wai-aleale, la, i Wai-lua;*

Huki iluna ka popo ua o Ka-wai-kini;
Alai ia ae la e Nounou,
Nalo ka Ipu-haʻa,
Ka laula ma uka o Ka-paʻa, e,
I paʻa i ka leo, he ole e hea mai.
E mai ka leo, e!

Translation
The mountain turns the cold shoulder,
Facing away from Wai-lua,
Albeit in time of fair weather.
Wai-kini flaunts, toplofty, its rain-cap;
And the view is cut off by Nounou,
Thus Humility Hill is not seen,
Nor Ka-paʻa's broad upland plain
You seal your lips and are voiceless
Best to open your mouth and speak;
[Emerson 1915:109]

Wailuaahōʻano did not reply to this request, therefore, Hiʻiaka with her companion, Wahineʻōmaʻo, turn and continue on their journey. As they travel, a song reaches Hiʻiaka's ear. It is Malaehaʻakoa chanting a song as he fished.

> He had cast the comminuted [broken up] fragments of the shrimps whose bodies baited his hooks and, as he waited for a bite he chanted a song (to the god of good luck) that reached Hiiaka's ear:

Pa mai ka makani o ka lele waʻa, e:
Makani kai ehu lalo o ka pali o Ki-pu.
I malenalena i Wai-niha i kaʻu makau:
He iʻa, he iʻa na ka lawaia, na Malae-haʻa-koa, e!

Translation
A wind-squall drives the canoes in flight,
Dashing the spray against the cliff of Kipu.
Peace, waves, for my hook at Wai-niha:
Come, fish, to the hook of the fisher.
The hook of Malae-haʻa-koa.

Hiiaka's answer to this was a song:

Malae-haʻa-koa, lawaia o ka pali,
Keiki lawaia oe a Wai-niha,
Mo'opuna oe a Ka-nea-lani,
Lawaia ku pali o Haena;
Au umauma o ke ala haki;

> *He iʻa na ka lawaia,*
> *Na Malae-haʻa-koa, e.*
>
> Translation
> I hail thee, Malae-haʻa-koa,
> Thou fisherman of the cliffs.
> As a youth you fished at Wai-niha;
> Grandson thou to Ka-noa-lani,
> Fishing now ʻneath the bluffs of Haena,
> Sometime breasting the steep mountain ladder.
> Send fish, O Heaven, to this fisherman;
> Send fish to Malae-haʻa-koa.
>
> As if obedient to the charm of Hiiaka's incantation, the breeze sank to a whisper and the ruffled surface of the ocean took on a calm that brought fish to the fisherman's hooks. [Emerson 1915:110–111]

After a night of feast and celebration, Hiʻiaka and Wahineʻōmaʻo are set to continue their journey to fetch Lohiʻau. Upon explaining this to Malaehaʻakoa, he informs Hiʻiaka that "Lohiau has been dead for many days" (Emerson 1915:131). However, Hiʻiaka replies, "Let that be as it may […] I will go and see for myself" (Emerson 1915:131).

3.1.1.3 The Menehune of Haleleʻa

Described as "energetic, broad-shouldered, and muscular people […]," the Menehune were known throughout Kauaʻi and the other Hawaiian islands as hard workers who could complete many tasks, like building *heiau* (pre-Christian place of worship, shrine) or fishponds overnight. Wichman stated that:

> They were organized in divisions based upon their skills and duties, and they were completely obedient to their leaders. There were twenty divisions of men and eight of women. They worked as a team, and if a project was interrupted for any reason, they abandoned it and never returned to finish it. [Wichman 1998:10–11]

It was said that the Menehune preferred to live on the ridge between the *ahupuaʻa* of Wainiha and Lumahaʻi.

3.1.1.4 Naupaka Uka and Naupaka Kai

At Hāʻena in Wainiha Ahupuaʻa there was a man and a woman who were both in the same *hālau hula* (hula troupe) and were in love. It was *kapu* (taboo) for men and women in the same *hālau hula* to be in intimate relationships. Before their graduation, they ran off, asking Laka, the goddess of *hula*, for forgiveness. Kilioe, the chiefess of the school, followed them. When she caught the woman in a cave, she killed her. Kilioe then chased the man up toward the mountain, caught, and killed him.

Laka, being a kind goddess, turned both the man and woman into half flowers. *Naupaka kuahiwi* (mountain naupaka, *Scaevola gaudichardii*) is the man, while *Naupaka kahakai* (beach naupaka, *Scaevola taccada*) is the woman. "Each shrub bears only half a flower, and like the lovers they are incomplete when separated. But when they are brough together, the blossoms can be made to form a single perfect flower” (Wichman 1998:117).

3.1.1.5 Lonoikamakahiki

Kamakau and Fornander tell of Lono-i-ka-makahiki, a son of Keawe-nui-a-ʻUmi, who goes crazy and wanders for a long time on Kauaʻi. When he regains sanity, his faithful attendant sings a song reminding him of the places they wandered, especially on Kauaʻi, and one of the lines recalls, “Ka ua hoʻopala ʻohiʻa o Waiʻoli—The rain that ripened the mountain apples of Waiʻoli” (Kamakau 1961:52; Fornander 1919:4[2]:358–359).

Ka-iki-lani-kohe-panaiʻo wanders through the wilderness of Kauaʻi with his companion, Kapa-ʻihi-a-hilina, out of his mind with grief for having killed his wife (Dye 2004:7). Ka-iki-lani-kohe-panaiʻo composes a chant of affection for the chief, recounting their wanderings in the wilderness of Kauaʻi mostly on the North Shore:

[. . .] *He kaʻupu e Lono e,*	A friend [was I] O Lono,
He kanaka au no ka ua iki,	A server was I in the light rain,
Ina hoʻi ha he hoa au no ka ua iki la paʻia,	I was your companion in the light rain of the forest,
He hoa i ka nahele lauhala loloa,	A companion in the long-leafed pandanus groves,
Mai Kilauea a Kahili la,	[That extend] from Kilauea to Kalihi,
O ka hala i ʻaina kepa ʻia e ka manu	The pandanus [whose fruit] is pecked by the birds,
O Poʻoku i Hanalei la.	[The pandanus] of Poʻoku in Hanalei.
Hala ia mao a ka ua e ka hoa e, falling,	There we were till the rain ceased
He hoa i ka makani lauwili Poʻaihele,	O my companion, My companion in the hurrying whirlwind,
Mauka o Hanalei iki a Hanalei nui,	In the uplands of lesser Hanalei, of greater Hanalei,
Mauka mai hoʻi kekahi ua,	[In] the rain that came from the uplands,
Makai mai hoʻi kekahi ua,	Rain that came from the lowlands,
Ma naʻe mai hoʻi kekahi ua,	Rain that came from the east,
Malalo mai hoʻi kekahi ua,	Rain that came from the south,
Maluna iho hoʻi kekahi ua,	Rain that came from the above,
Malalo aʻe hoʻi kekahi ua,	Rain that came from below,
Ma ka lae hala o Puʻupaoa,	Along the cape of Puʻupaoa, over-grown with pandanus,
Ilaila ka ua kike hala,	There was the rain that pelted the pandanus fruit,
Hoʻowalea ike one ʻai a ke kinaʻu,	Drenching the sand where the sand eels fed,
He kiaʻu ʻai hala o Mahamoku,	The eels that ate the pandanus of Mahamoku,

Ka ua hoʻopala ʻohiʻa o Waiʻoli […]	The rain that ripened the mountain apples of Waiʻoli […]

[Kamakau 1992:48–51]

3.1.1.6 Damming the Waters of Waipā

Kalākānehina was the ruling chief of Waimea. He heard there were bird catchers in Waipā that were catching *kapu* birds. Hearing this, Kalākānehina sent his warriors to kill these two bird catchers. However, his son, Lauhaka, instead killed these warriors one by one, eventually damming the waters with the bodies. Wichman (1998) recounts this story:

> This, according to legend, was caused by a chief named Lauhaka. His mother left her husband, Kalākānehina, the ruling chief of Waimea, during the time of the kona kingdom because of his cruelty. Lauhaka was raised in the mountains by his uncle, a bird catcher. Learning that two bird catchers were catching the forbidden *ʻuaʻu*, the dark-rumped petrel, Kalākānehina sent some warriors to kill them. Lauhaka stationed himself on the steep path where only one man at a time could come toward him. As Lauhaka killed the soldiers the bodies fell into the stream and dammed up the river. [Wichman 1998:114]

3.1.1.7 The Robbers of Waikoko and Lumahaʻi

Waikoko Ahupuaʻa and Lumahaʻi Ahupuaʻa held a reputation as dangerous places for travelers. This was due to the *ʻōlohe* (a type of robber who removed all the hair from their body, including the head and would keep their skin oiled) who frequented these areas.

> One of his friends watched from the ridge. If several travelers came together, the lookout called out, 'High tide!' and they were not attacked. However, if a single traveler, well laden with goods, came along, the lookout called, 'Low tide!' and the traveler was attacked, killed, and his body placed in a hole in the tongue of lava at the foot of Makahoa Ridge. [Wicham 1998:115]

A *konohiki* (head of an *ahupuaʻa* land division under the chief) from Wainiha Ahupuaʻa heard about the *ʻōlohe* and the travelers and sent an *ʻelele* (messenger) to investigate. When the suspicions of the *konohiki* were verified, he sent warrior to kill the *ʻōlohe*.

3.1.2 Koʻolau Moku

The following are moʻolelo from Koʻolau Moku

3.1.2.1 Lahemanu

Lahemanu was the daughter of an Anahola chief. There is a *pōhaku* (stone) along the slopes of Hōkūʻalele which is said to have once been a man who was punished for spying on Lahemanu while she was bathing.

Lahemanu bathed in a clear pool beneath a cliff in the waters of Anahola. She was so beautiful that her father requested that a maid watch over and protect her from the eyes of others. One day the maid sensed that a man was watching Lahemanu so the next time she went to bathe, Lahemanu brought her *kahuna* (priest) to look out for her. When the man realized he had been caught watching Lahemanu, he ran up onto the mountain ridge above the clear pool. He stopped to rest halfway up the ridge and the *kahuna* cast a spell turning the man into stone, where he still sits to this day (Armitage and Judd 1944).

3.1.3 Puna Moku

The following are mo‘olelo from Puna Moku.

3.1.3.1 Hi‘iaka and Lohi‘au Reunited at Waipouli

Waipouli is the place where Hi‘iaka and Lohi‘au were reunited. Hi‘iaka had returned Lohi‘au to Pele on Hawai‘i Island, only to discover that Pele had not protected Hi‘iaka's grove of *‘ōhi‘a lehua* trees as she had promised. Hi‘iaka was heartbroken. However, during her travels, Hi‘iaka had fallen in love with Lohi‘au and in defiance of Pele, kissed him. Pele, easily angered and realizing what had occurred between Hi‘iaka and Lohi‘au, killed Lohi‘au by covering him in lava. Due to Pele's action against Lohi‘au, Hi‘iaka vowed to never speak to her sister Pele, left Hawai‘i Island, and returned to Kaua‘i. Wichman (1998) further explains:

> Two of Pele's brothers took pity on Lohi‘au and brought him back to life. When he arrived at Hanamā‘ulu, he found two old men preparing sheets of kapa to take to Waipouli as gifts to honor the marriage of Hi‘iaka and Paoa. Paoa had sworn to avenge his friend Lohi‘au but became Pele's lover instead. Lohi‘au asked the old men to help him get to Waipouli without being seen. They folded their kapa sheets over a carrying pole, and when the pole stretched from one man's shoulder to the other, Lohi‘au hid beneath the fold. When they reached Waipouli, the old men joined in the game of *kilu*, a favorite pastime. Hi‘iaka tossed her *kilu*, a coconut marker, and hit the marker of one of the old men. Sadly she chanted a song that she and Lohi‘au had created on their travels together. A voice joined her somehow knowing the correct words. Hi‘iaka looked around but saw no one and thinking she was perhaps imagining things, she continued the game, this time hitting the marker of the other old man. Once again she chanted and the unknown voice joined in. Hi‘iaka knew that this chant had been created on the volcano's edge as the lava approached them and she knew no one else would know the words. She rushed to the kapa and brushed it aside to find Lohi‘au. Hi‘iaka and Lohi‘au were married and lived the rest of their lives together at Hā‘ena. [Wichman 1998:83]

3.1.3.2 Makaīwa

Makaīwa (mother-of-pearl eyes, as in an image, especially of the god Lono), sometimes written as Maka‘iwa, is known as a surfing spot that had the best of waves. Wichman (1998) wrote a short *ka‘ao* entitled *Ka He‘e Nalu ‘ana ma Wailua* (Surfing at Wailua). In this *ka‘ao*, Kapo‘ulakina‘u with her eight companions are in Kaua‘i. Kapo‘ulakina‘u was searching for a husband for each of her companions. Arriving to Wailua, Kapo‘ulakina‘u describes the land and sea of the area:

> […] she [Kapo‘ulakīna‘u] was staring down the broad expanse of the Wailua river. There were no canoes on it, no fish jumped to break the water surface, that great mirror reflecting only the few clouds over head.
>
> But Kapo‘ulakina‘u was looking beyond the river mouth, beyond a beach of dazzling white sand, the beach of Alio where the gods had created the first man and woman. Beyond Alio was the sea, a sea that did not rise and fall without breaking.

> There were crests to these waves, the long-back billows that followed one after another. The spray broke in masses in the sea. This was a large surf, the surf that brings combers to carry the daring rider on an exhilarating ride, swooping and sliding down the face, into and through tunnels formed by the breakers, with unimagined speed and always danger waited for the rider's skill to falter.
>
> […] This was the surf of Makaʻiwa where hundreds of years before Hiana-a-ulu-ā surfed and married Moʻikeha, the traveler from Raiʻātea far, far to the south. This is where their granddaughter Ka-ʻili-lau-o-ke-koa surfed with her friends. [Wichman 2001:70–71]

Kapoʻulakinaʻu saw a man on the beach named Kaumakaamano. Kapoʻulakinaʻu with her eight companions went up to Kaumakaamano and mentioned the great surfing waves of Makaīwa. Kaumakaamano offered his surfboard, made of the finest *koa*, to Kapoʻulakinaʻu. Kapoʻulakinaʻu took the surf board and paddled out to sea, meeting the eight friends of Kaumakaakamano. At sea, Kapoʻulakinaʻu convinced these eight men to go back to shore and meet her eight companions. Kapoʻulakinaʻu paired each of her companions with one of Kaumakaamano's friends, except Kahalaiʻa. Because Kapoʻulakinaʻu was with Kaumakaamano, Kapoʻulakinaʻu gave her companion, Kahalaiʻa, to Kaumakaamanao. All of them went out to continue surfing while Kapoʻulakinaʻu stayed on the sand (Wichman 2001).

As Kapoʻulakinaʻu watched her companions with their new friends (soon to be husbands), she saw that something was not right. Each of her companions except Kahalaiʻa came back to shore, while their male counterparts continued to surf. When Kapoʻulakinaʻu asked one of her companions why she was not with her man friend, her companion answered that he was a son a farmer and was unable to take her home. Kapoʻulakinaʻu went to talk to each of her companions and they each told a similar story. This started to infuriate Kapoʻulakinaʻu. Soon after, Kahalaiʻa and her male companion, Kaumakaamano, came to shore. Kahalaiʻa saw Kapoʻulakinaʻu and asked if she was okay. Kapoʻulakinaʻu explained to Kahalaiʻa what had happened to each of their companions and then turned to Kaumakaakamano and asked to borrow his surfboard again (Wichman 2001).

Kapoʻulakinaʻu paddled out to sea and met the group of men again, waiting for a good wave to catch. Unbeknownst to the group of men, Kapoʻulakinaʻu possessed some magical powers, one of which allowed her to control the waves of the ocean. When Kapoʻulakinaʻu reached the group of men, she challenged them to a surfing contest: to ride the biggest wave safely to shore, with the wager being their bones. The men could not resist the bet. Kapoʻulakinaʻu called forth a big wave and they all rode that wave together. To Kapoʻulakinaʻu's surprise, each of the eight men rode the wave safely. They all paddled out again to continue the bet. Kapoʻulakinaʻu called forth an even bigger wave than the last. This time, two of the men fell. Kaumakaakamano said to Kapoʻulakinaʻu that she had won her bet. Kapoʻulakinaʻu replied, "Not yet." The remaining men with Kapoʻulakinaʻu paddled out again. Kapoʻulakinaʻu called forth a mountain-sized wave (Wichman 2001):

> Rise up, rise up, great waves from Kahiki
> Powerful curling waves,
> Rise up, the pōhuehue calls you
> Arise, long raging surf!

[Wichman 2001:74]

The men caught the wave and were dragged underneath the water. Each of the men struggled, churning against the strength of the wave that Kapoʻulakinaʻu called forth. The men were being tossed back and forth against the rocks on the bottom of the ocean floor until eventually each of the men turned into rocks themselves. It is said that "the rocks washed along the ocean bottom and clung onto the rock wall called Hikina-a-ka-lā heiau" (Wichman 2001:75).

3.1.3.3 Kaililauokekoa

Kaililauokekoa was a chiefess who lived in Kapaʻa, Kauaʻi. She was the daughter of Laʻamaikahiki, the granddaughter of Moʻikeha and Hoʻoipoikamalanai. Thomas Thrum (1906) explains that:

> [Kaililauokekoa's] greatest desire was to play *konane*, a game somewhat resembling checkers, and to ride the curving surf of Makaīwa (keʻekeʻe nalu o Makaīwa), a surf which breaks directly outside of Waipouli, Kapaʻa. She passed the larger part of her time in this manner every day, and because of the continual kissing of her cheeks by the fine spray of the sea of Makaīwa, the bloom of her youth became attractive 'as a torch on high,' so unsurpassed was her personal charm [Thrum 1906:83–84]

Similarly, Beckwith (1970) shares Dickey's version of this *moʻolelo*:

> Ka-ili-lau-o-ke-koa is the granddaughter of Moikeha and Hoʻoipo-i-ka-malanai, high chiefs of Kauai, and daughter of Laʻa. At her home by the sea at Kapaʻa she rides the curving sea of Makaiwa and develops skill in the game of konane. […] She is betrothed by her father to Keliʻikoa from Kona district. [Beckwith 1970:538]

The *moʻolelo* continues on into Wailua, Kauaʻi, where Kauakahialiʻi lives. Beckwith explains:

> Far up the Wailua river at Pihana-ka-lani in a house woven of flowering lehua branches and bird feathers, with birds as companions, lives Kauakahi-aliʻi, the adopted son of the sorceress Waha, with his sister Ka-hale-lehua (House of lehua). He invents the nose-flute (ohe), the sound of whose magic notes attracts the attention of the chiefess by the sea. Stealing out of the house at night with her attendant and little white dog, she climbs the ridge called Kua-moʻo-loa-a-Kane (Long lizard-back of Kane), is beaten back by rain and mist sent by his sister, and presents herself at the home of her wooer. Here she finds a garden of plenty and a well-stocked fishpond, is hospitably received, and becomes his wife. [Beckwith 1970:538]

It is said that this couple, Kaʻililauokekoa and Kauakahialiʻi, ruled over the Puna district of Kauaʻi (Beckwith 1970:539).

3.1.3.4 Moʻikeha

Moʻikeha is the grandchild of Māweke, one of the principal genealogical lines from which Native Hawaiians today trace their ancestry (Beckwith 1970:352). However, like many *moʻolelo*, there are several variations of the story of Moʻikeha.

In one version of the *moʻolelo* of Moʻikeha, Kamakau (1991) tells his readers of the journey that Moʻikeha took from Kahiki to Hawaiʻi. While Moʻikeha was living in Kahiki, he committed some wrongdoings: "[…] the food-offering calabash (*ipu ʻaumakua*) of his older brother ʻOlopana and had been caught with his [ʻOlopana] wife Luʻukia undoing her 'chastity belt', the *ʻaha* binding called Luʻu-a-nā-koʻa-i-ka-moana" (Kamakau 1991:105).

Because of his actions, Moʻikeha left Kahiki by way of canoe with several other companions. His companions included Moaʻula, Pāhaʻa, Laʻamaomao, Mōʻeke, Kaunaewa, and others. Arriving in Kaʻū, Hawaiʻi, Moʻikeha and his companions sailed from island to island, each of them finding a home to dwell in. For example and as mentioned earlier, Laʻamaomao, the goddess of winds, made her home on Molokaʻi (Kamakau 1991:106). As for Moʻikeha, Kamakau explains:

> As Moʻikeha sailed on, the backs of Hāʻupu and Kalalea on Kauaʻi were seen, then Kalalea rising from the sea as though carried in the arms of Nounou, then the face of Puna and its harbor, Wailua. He landed in Puna at Wai-mahana-lua in Kapaʻa. He left the things he had used on the sands of Kapaʻa among the kalukalu sedges of Kēwā.
>
> The chiefs of Kauaʻi who lived at Kapaʻa while Moʻikeha was living there were Puna-nui-kai-anaina, Puna-kai-ʻōlohe, and Puna-ʻai-koaʻe. A beautiful daughter of the Puna chiefs, Hoʻoipo-i-ka-malani—also called Hina-ʻau-luaa—lived at Waimahanalua because of the excellence of the surf of Makaīwa there. Moʻikeha took her to wife, and they were united in a lasting union (hoʻao paʻa). [Kamakau 1991:106]

Moʻikeha and Hoʻoipoikamalanai ended up having three sons, each of them having names dedicated to ʻOlopana, Moʻikeha's brother.

> When their oldest son was born, Moʻikeha gave him the name Hoʻokamaliʻi for the skin of ʻOlopana. Their second son he named Haulani-nui-ai-ākea for the eyes of ʻOlopana, and their third son he named Kila for Luʻukia, the wife of ʻOlopana. [Kamakau 1991:106]

In another version of the *moʻolelo* of Moʻikeha, Moʻikeha was born in Waipiʻo, Hawaiʻi. As Moʻikeha begins his voyage, he leaves Waipiʻo and sails to Kahiki (Tahiti) along with a retinue of attendants, his brother Olopana, and sister-in-law Luʻukia. Once Moʻikeha and his attendants arrive in Kahiki, both Moʻikeha and his brother, Olopana, become chiefs. Moʻikeha adopts a son whom he names Laʻamaikahiki (referred to as Laʻa), but he is forced to leave his son behind after a family argument. Together with his navigator, Kamahualele, Moʻikeha voyages back to the Hawaiian Islands, this time landing in Wailua, Kauaʻi, which is ruled by the high chief Puna at that time (Beckwith 1970).

Here is an excerpt from Thrum's *More Hawaiian Folk Tales*:

> [...] arrived at Wailua, Kauai, where a large company of people were gathered for surf-riding. Recognizing the canoe with its kapu insignia as that of a high chief, they lifted it bodily and bore it to the shore. Among the gathering of surf-riders were the two daughters of the king of Kauai, Hooipo and Hinauu, who immediately fell in love with Moikeha as he and his companions joined in the sport, for he was a godly man to look upon, with a tall commanding figure. He in turn was struck

> with the beauty and grace of the two sisters and decided that one of them should be his wife. The sisters informed their father of what they had seen, and their desire to take the young chief as a husband. The king therefore sent for Moikeha, and on being brought into the family presence, and mutual love being expressed, the two sisters took him to be their husband, and in course of events he became king of Kauai. [Thrum 1923:21]

Eventually, Haulani-nui-ai-ākea, the second son of Moʻikeha, became a chiefly ancestor of chiefs and commoners of Kauaʻi, with many of the chiefly lines connecting to a chief born in Holoholokū, in Wailua, Kauaʻi (Kamakau 1991:108).

3.1.3.5 Kila

Moʻikeha ended up having many children, however, the youngest, Kila, was his favorite child. "Kila's favorite sport was to sail in a small canoe in the Waimahanalua River and, as he grew older, to surf with a canoe on the waves of Makaʻiwa and Ka ʻŌhala" (Kamakau 1991:105). Moʻikeha chose Kila to return to Kahiki to bring back his adopted son, Laʻa. Kila set off on this voyage to Kahiki to retrieve Laʻa accompanied by ten companions. Following Moʻikeha's instructions, Kila stopped on Oʻahu and other places in order to greet his relatives. On each island, they asked Kila how his father Moʻikeha was doing, and each time, Kila replied with some variation the following chant:

> Dwelling at ease on Kauaʻi where the sun rises and sets; where the surf of Makaīwa curves and bends; by the changing blossoms of the *kukui* of Puna; by the broad waters of Wailua, he will live on Kauaʻi and die on Kauaʻi. [Beckwith 1970:355–356]

In another legend, Kila is credited for bringing fish to Hawaiʻi. In the *Ka Nūpepa Kuʻokoʻa* published at the turn of the century, Akina (1913:6) tells the story of how Moʻikeha's son, Kila, stocks the Hawaiian Islands with the *akule* (big-eyed or goggle-eyed scad fish, *Trachurops crumenophthalmus*), *kawakawa* (bonito, little tunny, *Euthynnus yaito*), and *ʻōpelu* (mackerel scad, *Decapterus pinnulatus* and *D. maruadsi*) fish. When Kila travels to Kahiki, he seeks out his grandfather Maweke and explains that he is the child of Mōʻīkeha. When Maweke asks Kila if Moʻikeha is enjoying himself, Kila answers with the following chant of Puna, Kauaʻi:

I walea no kuʻu makuakā i ke ao	My father enjoys the billowing
Hoʻokanunu iluna o Pōhakupili	clouds over Pōhakupili
I ka poi uouo ono ae no-a	The sticky and delicious poi
Me ka iʻa i na mai o ka Puna	With the fish brought from Puna
Ka opae hoainahanaha o Kapalua	The broad-blacked shrimp of Kapalua
Na opae kua hauli o Pohakuhapai	The dark-backed shrimp of Pohakuhapai
Na puawa ona mai no o Maiakii	The potent awa root of Maiakii
Me ka ulu moelehu mai no o Makialo	The breadfruit laid in the embers at Makialo
Me na kalo pehi hua o Keahapana	The large heavy taros of Keahapana
A i kekee nalu ae no hoi o Makaiwa	The crooked surf of Makaiwa too
A i ke kahuli aku kahuli mai o ka pua uku me ka pua neki	The bending hither and tither of the reed and rush blossoms

A i ka nuʻa ae no o ke kalukalu o Puna	The swaying of the kalukalu grasses of Puna
A i na mea nui nepunepu no a kuʻu mau Makuahine	The large, plump, private parts of my mothers
O Hoʻoipoikamalanai me Hinau-u	Of Hoʻoipoikamalanai and Hinau-u
A i ka la hiki ae no a napoo aku	The sun that rises and sets,
Walea ai no ka nohona ia Kauaʻi	He enjoys himself on Kauaʻi
Ua puni a puna Kauai ia Moʻikeha	All of Kauaʻi is Moʻikeha's
[Akina 1913a]	

Maweke is delighted and when the boy is questioned as to his purpose, Kila tells his grandfather he is seeking fish for his family. Maweke tells Kila to lead the fish back to his homeland. This is how Kila led the *akule, kawakawa,* and *ʻōpelu* to Hawaiʻi (Akina 1913a).

3.1.3.6 Laʻa and the First Introduction of Drum and Ideas

Kila was successful in his journey to bring Moʻikeha's adopted son, Laʻa, back to Wailua.

> When Laʻa's canoe slid onto the sands of ʻAliʻō beach at Wailua, father and son greeted each other warmly. Laʻa had announced his arrival with the beating of a huge drum made of a hollowed out coconut trunk covered on its open end by shark skin, the first of its kind seen in Hawaiʻi. It had a deep voice and from then on was beaten to announce the births of chiefs on the birthing stones at Holoholokū *heiau*, where the drum was kept until the ancient religion was destroyed in 1819. [Wichman 2003:32]

What is also significant about Laʻa's visit is that he brought two concepts that altered Hawaiian society (Wichman 2003:32). One was the introduction of a new god, Lono, the god of medicine and agriculture. The other idea he introduced is the first *kumukānāwai*, "an edict or law" (Wichman 2003:33).

3.1.4 Kona Moku

The following are moʻolelo from Kona Moku.

3.1.4.1 The Work of the Menehune

The Menehune are accredited with being a very skillful race able to complete tasks at extraordinary speed, intelligent and organized, and able to survive on their own without the need to borrow or take from others.

> On the cliffs of Kauai are still seen many paths and roads which were built by them and which are still called Ke-ala-pii-a-ka-Menehune, the Trails-of-the-Menehunes. These trails are still to be seen above Hanapepe, Makaweli, Mana, Napali, Milolii, Nualolo, and Hanapu. In the little hollows on the cliffs, they planted wild taro, yams, ferns, and bananas. No cliff was too steep for them to climb. [Rice 1977:40–42]

However, one curious fact about the Menehune is that they did not work in the daylight as to avoid being seen by people. Many of the tasks they undertook were completed in one single night.

> They also built many *heiaus,* including those of Elekuna, Poli-hale, and Kapa-ula, near Mana, Malae at Wailua, on the Lihue side of the river, just above the road, and Poli-ahu on the high land, between the branching of the Wailua River and the Opai-kaa stream. All the stones for these *heiaus* were brought from Makaweli. The Menehunes formed two lines, and passed the stones from man to man They also built the *heiau* at Kiha-wahine on Niʻihau.
>
> After their return, the Menehunes built the wall of Alakoko fishpond at Niumalu. Standing in two rows they passed the stones from hand to hand all the way from Makaweli to Niumalu Daylight came before they had finished the work, and two gaps were left in the wall. These were filled in by Chinamen in later years, and the pond is still in use. [Rice 1977:40–42]

3.1.4.2 The Menehune and Half-built Fishpond

One night, a boy named Manu made plans to go fishing with his friends the next day, however, those plans changed when his father wanted him to take the next few days to build a wall by the stream. Luckily the chief of the Menehune overheard their conversation. Mrs. Betty Snowden, who's family genealogy traces to Lāwaʻi for over 200 years recounted this story in the *Honolulu Advertiser* (1997).

> One night, as he sat on the hill watching the people in the valley, the chief of the Menehune overheard Manu and his father discussing the need to build a wall in the stream. Manu's father wanted him to spend the next few days helping with the project.
>
> But Manu and his friends had planned a fishing trip to Niʻihau and he wasn't happy about the thought of being left behind. Yet, he certainly couldn't ignore his father's request to help. Maybe if he began right away, starting a rock pile […]
>
> Manu threw himself into the task. He was so busy he didn't see the Chief of the Menehune until the Chief came right behind him and tugged at his clothing. The Chief made an offer that would benefit them both.
>
> For two puʻolo, or bundles of shrimp the size of two large coconuts, the Menehune would build a wall for Manu and his family.
>
> Manu agreed. For the next two days he surfed, fished and swam with his friends. On the second day he watched the sun setting in the west before he realized that he needed to catch opae [shrimp]. He rushed over to the stream and tried to catch as many shrimp as he could before it got too dark to see but he only collected one bundle full.
>
> That's OK, he thought. It's a large bundle and so that should be enough. He placed the shrimp at the promised location.
>
> That night, the moon rose full and the Menehune crept down the valley. They worked most of the night to build the stone wall in the stream.

> When Manu and his family awoke the next morning, they found half a wall standing. The Menehune had built only half a stone wall because they had received only half the promised o*pae*. [Snowden 1997:B1]

Snowden concludes that one can still see the neat, perfectly made half-wall built by the Menehune of Lāwai‘i Kai at the edge of the stream in Lāwa‘i Valley.

3.1.4.3 The Stealing of Fruit at Māhā‘ūlepu

The Menehune were very righteous and proudful people, especially known for their work ethic and respect for one another. Damon (1931) recalls a story when one Menehune, overcome with a powerful desire for watermelon, stole from another’s patch.

> Sometimes a Menehune, overcome with thirst, would be almost too human and, yielding to the irresistible longing for watermelon, would purloin a luscious fruit at a patch not his own. But thieving was held in the contempt of a capital crime by this sturdy folk, and when one of them did once steal watermelons at Mahaulepu, a valley southwest of Kipū-kai toward Koloa, he was forthwith turned to stone by the verdict of his tribesmen. [Damon 1931:395–396]

3.1.4.4 Ke Kōloa o Kaipū

Kaipū was a *mo‘o* guardian of Kōloa, guarding the shoreline of Kōloa, keeping everyone away from the swimming places and from the food on the reefs and in the sea. She would eat fishermen and swimmers near the shore. Soon no one living in Kōloa would come to the ocean to fish, gather the golden brown *līpoa* (bladelike, branched, brown seaweeds, *Dictyopteris plagiogramma and D. australis*) seaweed used to flavor their food, or work at the natural rock pans where salt was made. The *mo‘olelo* of *Ke Kōloa o Kaipū* begins with Liko. Liko and his grandmother lived on the hill above Kukui‘ula bay.

One day, Liko’s grandmother expressed that she longed for the taste of *i‘a ho‘omelu*, the relish made of raw *hīnālea* (brightly colored wrasses, family *Labridae*) fish mixed with red salt, roasted *kukui* (candlenut tree, *Aleurites moluccana*) nuts, and brown *līpoa* seaweed. Liko decided his grandmother must have the fish and brought his *kauila* (a native tree in the buckthorn family, *Alphitonia ponderosa*) wood spear and his *hīnālea* trap woven from *‘inalua* (*Cardiospermum halicacabum)* vine. Liko dove into the water and battled Kaikapū. He defeated her by swimming into the lava tube opening that led to a rocky platform above and trapping her in the narrowing tube. From then on, the seashore was free for everyone to use. Even today when the column of water shoots high into the sky, an angry roar echoes from the tube, *ke kōloa o Kaikapū* (Wichman 1991:88–91).

3.1.4.5 Chief Keakianoho and His Favorite Food

Pā‘ā was famous for its *he‘e* (octopus), which was especially large and delicious. Keakianoho, the Pā‘ā *konohiki* who loved *he‘e,* was disturbed when the *he‘e* were being eaten by a giant crab. This is the tale about the chief Keakianoho:

> [*He‘e*] was the favorite food of Ke-akia-noho, the *konohiki* who had become the local chief after Kaluaopālena, with the help of his son Palila, had conquered Nāmakaokalani of Kona, and he looked forward happily to a lifetime supply of his favorite food. Within weeks, however, the *he‘e* of Pā‘ā disappeared. Keakianiho

> sent for his kahuna Kāne-a-ka-lua to discover the reason for this lack. The priest hid on the ridge above and soon saw a giant crab with eleven dark red spots on its back emerge from a hole in the ground and enter the ocean. After a time it returned, bearing *heʻe* in its claws, and disappeared into the hole.
>
> When the *konohiki* and his soldiers found the hole, they saw that it led underground into a network of large caves where they found a handful of defeated Kona warriors and a fierce battle took place. At the end, none of the enemy survived. The caves were searched for the large crab, but it was never seen again. Shortly thereafter, however, the reef for Pāʻā became filled with little *ʻalamuku* crabs, each bearing eleven red spots on its back. [Wichman 1998:46]

3.1.4.6 ʻAikanaka Defeating Kawelo

ʻAikanaka, once a ruling chief of Kauaʻi, had been defeated in battle by his younger brother, Kawelo. Following the conquest, Kawelo divided the lands to his choosing, leaving ʻAikanaka to live in poverty with no lands and no home. ʻAikanaka settled in upland Hanapēpē, where he was later visited by Kaeleha, the son of Kawelo. Kaeleha was shown great kindness and hospitality by ʻAikanaka, and therefore felt indebted to him.

Taking pity on ʻAikanaka for the way he was forced to live, Kaeleha instructed him on how to defeat his father, Kawelo, in battle. Kaeleha explained to ʻAikanaka that Kawelo had never been taught on how to dodge stones in battle. Kawelo soon learned about the possible uprising from ʻAikanaka and his son, Kaeleha. With great anger, Kawelo immediately traveled to Wahiawa:

> When he [Kawelo] arrived at, he saw several war canoes belonging to Kaeleha and Aikanaka, just back of the great mounds of stones. On the sides of the mounds of stones, he saw women and children with stones in their stands, and all were apparently ready for the conflict. All Kawelo had in his hands were his war club, Kuikaa, and his wife's pikoi, two weapons to defend himself with.
>
> […] In the fight, Kawelo was not able to dodge the stones that were hurled at him, for a great many of them were thrown at the same time, therefore he stood in one place while the stones were hitting him from all sides. In the course of time, Kawelo was completely covered by the stones, the stones rising until his height was reached […] After a while the mound of stones over Kawelo grew higher and higher, when at last nothing else could be seen but a great mount of stones which was like a grave for Kawelo. [Fornander 1918:5(1):64–66]

After the battle, Kawelo's body was removed from the mound of stones. The people beat his lifeless body with clubs to ensure he was dead. They body was then carried from Wahiawa to ʻAikanaka's temple at Maulili in Kōloa. Arriving at Maulili near dark, Kawelo's body was left within the temple enclosure overnight, with a plan of offering the body to the gods the following morning. However, Kawelo miraculously awakened and recovered from his injuries. The following morning, at the arrival of ʻAikānaka, Kaeleha, chiefs, warriors, men, women, and children, Kawelo surprised the gathering with a chant. "Kawelo then ceased chanting and began the slaughter, killing everyone; none escaped. Kauaʻi therefore once more came under the rule of Kawelo, and he again assumed the reins of power" (Fornander 1918:5[1]:70).

3.1.5 Nāpali Moku

The following is a moʻolelo from Nāpali Moku.

The Menehune had made their home in Kauaʻi, adding their language to place names, their skills into the building of fishponds, and various stone features throughout the island. However, the queen of the Menehune people, Mōhihi, noticed the Menehune men were marrying Hawaiian women; she knew it was time for her people to leave. All the Menehune gathered in the mountains of the Nāpali District and marched along the ridge over to Hāʻena, where they boarded their canoes and sailed off (Wichman 2003:13).

3.2 ***Nā Inoa ʻĀina a me Nā Wahi Pana*** **(Place Names and Storied Places)**

Wahi pana are legendary or storied places of an area. These legendary or storied places may include a variety of natural or human-made structures. Oftentimes dating to the pre-Contact period, most *wahi pana* are in some way connected to a particular *moʻolelo*, however, a *wahi pana* may exist without a connection to any particular story. Davianna McGregor outlines the types of natural and human-made structures that may constitute *wahi pana*:

> Natural places have mana, and are sacred because of the presence of the gods, the akua, and the ancestral guardian spirits, the ʻaumakua. Human-made structures for the Hawaiian religion and family religious practices are also sacred. These structures and places include temples, and shrines, or heiau, for war, peace, agriculture, fishing, healing, and the like; puʻuhonua, places of refuge and sanctuaries for healing and rebirth; agricultural sites and sites of food production such as the loʻi pond fields and terraces slopes, ʻauwai irrigation ditches, and the fishponds; and special function sites such as trails, salt pans, holua slides, quarries, petroglyphs, gaming sites, and canoe landings. [McGregor 1996:22]

As McGregor makes clear, *wahi pana* can refer to natural geographic locations such as streams, peaks, rock formations, ridges, offshore islands and reefs, or they can refer to Hawaiian land divisions such as *ahupuaʻa* or *ʻili* (land section, usually a subdivision of an *ahupuaʻa*), and man-made structures such as fishponds. In this way, the *wahi pana* tangibly link the *kamaʻāina* to their past. It is common for places and landscape features to have multiple names, some of which may only be known to certain *ʻohana* or even certain individuals within an *ʻohana*, and many have been lost, forgotten, or kept secret through time. Place names also convey *kaona* and *huna* (secret) information that may even have political or subversive undertones. Before the introduction of writing to the Hawaiian Islands, cultural information was exclusively preserved and perpetuated orally. Hawaiians gave names to literally everything in their environment, including individual garden plots and *ʻauwai* (waterway or ditch), house sites, intangible phenomena such as meteorological and atmospheric effects, *pōhaku*, *pūnāwai* (freshwater springs), and many others. According to Landgraf (1994), Hawaiian *wahi pana* "physically and poetically describes an area while revealing its historical or legendary significance" (Landgraf 1994:v).

The following sections provide a general overview of place names and *wahi pana* for each *ahupuaʻa* in each district. This is not a comprehensive listing of all place names and *wahi pana* for Kauaʻi. Definitions of place names (if available) were either provided by Wichman (1998) or Soehren (2019) who referenced resources such as *Place Names of Hawaiʻi* (Pukui et. al 1974) and the *Hawaiian Dictionary* (Pukui and Elbert 1986). If a definition of a place name was unavailable, no Hawaiian diacritics were used in writing of its name.

3.2.1 Haleleʻa Moku

The following are *wahi pana* within Haleleʻa Moku.

3.2.1.1 Hāʻena Ahupuaʻa

Hāʻena (red hot) Ahupuaʻa is bordered by Hanakāpiʻai Ahupuaʻa of the Nāpali District on the west and Wainiha Ahupuaʻa of the Haleleʻa District. Hāʻena Ahupuaʻa consists of the cliffs, Limahuli (turning hand) and Mānoa (thick) valleys, *kula* (plain, field, open country, pasture) lands, and stretches of beach, where on one side lies Makua (ancestor) Bay (Wichman 1998:125).

There were ten *ʻili ʻāina* identified in mid-nineteenth century land documents for Hāʻena Ahupuaʻa: Kalolo, Kanulau, Kēʻē (avoidance), Koia, Kupapaulau, Mahau, Mānoa (vast), Moolalaole, Puukoka, and Waikapu.

3.2.1.1.1 Caves of Hāʻena

Hāʻena Ahupuaʻa was home to a few caves. Maniniholo (traveling reef surgeonfish) was a cave by Kaiwikuʻi Ridge. Maniniholo was a fisherman who would gather food along the reefs and bay of Hāʻena with some of his workers. They caught such a big catch that they could not bring all their food to the cave, so they left some behind. At night, the *ʻeʻepa* (imps) stole the food. Maniniholo and his workers caught the *ʻeʻepa* and killed them (Wichman 1998:127).

Waiokanaloa (water of Kanaloa) was said to be dug and created by Kanaloa himself, while other accounts suggest Pele dug this cave when she was searching for a home in Kauaʻi (Wichman 1998:129). Waiokapalaʻe (water of the lace fern) or also known as Waiakapalae (water of terror) or Waiakapalaʻe (water of shiny tapa) is a cave said to be the home of a *moʻo* guardian. The *moʻo* guardian fell in love with a chief and they both disappeared for a few months. When she returned, she possessed a baby, however, the chief was nowhere to be found. When the chief's companions asked her where the chief was, she made a motion across her throat suggesting he was dead. The chief's companions then killed this *moʻo* guardian (Wichman 1998:129).

3.2.1.1.2 ʻOʻoʻaʻa, Pōhakuloa, and Pōhakuokāne Stones

ʻOʻoʻaʻa, Pōhakuloa, and Pōhakuokāne are stones scattered throughout Hāʻena Ahupuaʻa. According to *moʻolelo*, a sister and her two brothers who were all stones came from distant lands and arrived at Hāʻena, Kauaʻi. The sister wanted to stay by the sea reef, while both brothers wanted to continue traveling up toward the mountain.

> When they reached the reef off Haena the sister wanted to stay there, but one of the brothers urged her to go on, saying 'If you stay here the limu will cover you, the opihi will cling to you, and the people coming to fish will climb over you.'
>
> To this the sister replied, 'If you go into the mountains the birds will light on you and the lizards will crawl over you.' [Rice 1977:35]

The sister ended up remaining at the sea and was named ʻOʻoʻaʻa, the Fast Rooted, while the two brothers continued on inland. One of the brothers began to get tired and decided to take a rest. This spot eventually became his home "lying among the pūhala trees, covered with moss" (Rice 1977:36). This *pōhaku* is known as Pōhakuloa or Long Stone.

The last brother continued on his journey and began to climb up the steep mountains of Hāʻena. However, he was struggling to reach the ridge. "The great god, Kane, say him and, taking pity on him, threw him up on the top of the ridge where he is today, known as the Stone of Kane, Pohaku-o-Kane" (Rice 1977:35).

3.2.1.2 Wainiha Ahupuaʻa

Wainiha (hostile waters) is the longest valley of Kauaʻi and known to have *loʻi kalo* and other plants such as *ʻuala* (sweet potato, *Ipomoea batatas*), *waukē*, *olonā* (native shrub, *Touchardia latifolia*), *noni* (Indian mulberry, *Morinda citrifolia*), *ʻawa* (kava, *Piper methysticum*), and others. *Maiʻa* (general term for banana) was also in abundance, even growing in the wild.

There are 20 *ʻili ʻāina* identified in mid-nineteenth century land documents for the Wainiha Ahupuaʻa: Kaʻākau (the right, the north), Kaʻeleʻele, Kaloopa, Kaluanui (the big pit), Kaluapoʻo, Kaluhea (fragrant), Kapāʻele (the dark, black, also a variety of sweet potato), Kapaia (the walls or bowers), Kapāloa (the long fence), Kapōhaku (the stone), Kaumaiʻa, Kawaihae (the water of wrath), Kīlua (to do with determination), Kīluaiki (small Kīlua), Maunaloa (long mountain), Ōwī, Poapuaʻa, Puaʻaloiloi, ʻUmi (strangle), and Ulukea.

3.2.1.2.1 Hinanalele and Kamakakiloiʻa

Hinanalele (leaping young goby fish) and Kamakakiloiʻa (eyes of the fishermen) are two peaks in Wainiha. Hinanalele is a peak where the Mū (legendary people of Kauaʻi) people settled when they arrived at Kauaiʻi from Kānehūnāmoku (a floating island of the Mū people). The Mū people were known to eat the *ʻoʻopu* as their main staple for protein (Wichman 1998:122). Kamakailoiʻa is a cliff and peak near Waiʻaleʻale and is also the name of the leader of the Mū people. The responsibility of the leader of the Mū people was to navigate the course, secure canoes, and help guide the Mū people back to their home to Kānehūnāmoku (Wichman 1998:122).

3.2.1.2.2 Kaʻaluheʻe

Wichman (1998) retells an account associated with the place known as Kaʻaluheʻe ("sagging one;" known also as Kalauheʻe, "slippery leaf"), a tributary stream on the east side of the Wainiha River:

> On its banks, a lonely young woman beat her *kapa*. She was disfigured with birthmarks and people teased her by saying she was really a *loli* (sea slug). One day, as she beat her *kapa*, a *heʻe mākoko* (deep ocean octopus) swam up the stream and settled on a rock near her. She was so lonely that she began to talk to the octopus. After many days the *heʻe* revealed that he was a demi-god who could assume the form of a man. He assumed his human form and his face too, was marked as hers. Loli fell in love. She left her *tapa* soaking too long in the stream while they dallied. Her scandalized parents tried to separate the lovers, but Loli jumped off the nearby cliff. She was changed into a *heʻe mākoko* to be united forever with her lover. [Wichman 1998:123]

3.2.1.2.3 Naue

Naue (tremble) is sandy flatland that stretches from Kaʻumaka to Hāʻena and was covered with groves of *hala* (pandanus or screw pine, *Pandanus odoratissimus*) tree. Temporary structures were built along Naue, probably to help provide shade while mats were being woven from the *hala* leaves. These structures were temporary as winter storms would sweep over the area. Occasionally, tsunamis would occur and demolish the area (Wichman 1998:124).

3.2.1.2.4 Nā Heiau

Apaukalea Heiau resided close to Laumaki Heiau, however, due to the increase of occupation within the area "make the distinction of this heiau difficult" (Bennett 1931:135). Kaunupepeiao Heiau was a 12-foot (ft) *heiau* that was simply used to make offerings (Bennett 1931:135), however, to exactly what deity or purpose is unknown. Similar to Kaunupepeiao Heiau, little is known about Laumaki Heiau except that it was "a small, open platform, paved heiau, 2 feet high, of husbandry class" (Bennett 1931:135).

3.2.1.3 Lumahaʻi Ahupuaʻa

Lumahaʻi and its meaning is connected to a certain formation of twisting the fingers when playing *hei* (string figure, cat's cradle) (Pukui and Elbert 1986).

Only two *ʻili ʻāina* has been indicated within mid-nineteenth century land documents: Kawaihī (the trickling water) and Kokoaha.

3.2.1.3.1 Kaʻalele

Kaʻalele or messenger is a group of *pōhaku* near the mouth of the river. These *pōhaku* are known for their reddish hue. It is said that the reddish hue came from the blood of a Menehune fisherman from when he struggled with an *ulua* (jack fish) (Wichman 1998:117).

3.2.1.3.2 KaʻālelooPilikua Pōhaku

Kaʻālelooilikua or the "tongue of Pilikua" is a flat tongue-shaped rock platform that juts from the river mouth. This area is named after the giant, Pilikua. Pilikua would recount the beauty of Kauaʻi as travelers came through Lumahaʻi. The residents of Lumahaʻi, however, grew tired of hearing the same stories over and over, so they killed Pilikua and threw his body into the sea. The fish and birds began to consume Pilikua, leaving only the tongue as it had grown too tough to eat. The tongue of Pilikua still remains (Wichman 1998:117–118).

3.2.1.3.3 Maʻinakēhau Pōhaku

Meaning "sickness of the dew," Maʻinakēhau is a large *pōhaku* in the shape of a man. It is said that one day, a Menehune was tired of his job as a stone carver. He asked the chief if he could change to another task, however, the chief declined his request. Frustrated, the Menehune decided to leave and traveled toward the mountains. When the chief heard of this, he sent his warriors to fetch this man and turned him into stone (Wichman 1998:119).

3.2.1.3.4 Pānaʻanaʻa Pōhaku

Pānaʻanaʻa meaning "protruding dish" is a flat *pōhaku* that rests below a waterfall. Originally located at Wainiha, Pānaʻanaʻa Pōhaku was moved by the Menehune. This *pōhaku* resembles the shape of a *poi* board, with half the *pōhaku* being gray and the other half being black. *Wī* (freshwater shellfish) also known as *hīhīwai* (*Neritinu graposa*) would frequent this *pōhaku*. However, there were restrictions and protocol on how to gather the *wī* which was dependent on if you were a man or a woman. Women were required to adorn themselves with a *lei lāʻī* (ti leaf *lei*) that is shredded or possess two *ʻōhiʻa lehua* branches, one thrown *mauka* of the *pōhaku*, while the other was thrown *makai* (seaward). Then they must chant to the *kupua*.

> ʻEia he mohai a he alana naʻu (e ha ii ka inoa), ia ʻoe e ka hoʻoluʻe a hoʻolaupaʻi wi o uka nei la, e noa hoʻi iaʻu ka mana nui, mana iki o ke kahawai nei, a hoʻi au me ka hoʻopilikia ole ia, me ka nui hoʻi kaʻu wi ke hoʻi, i ole hoʻi au e hilahila i ka ʻōlelo ia mai he lawaʻa paoa e.ʼ ʻHere is an offering from (she must give her name) to bring forth an abundance of wī, from the small mana and the large mana of this stream, grant that I do not get into difficulty and that the wī will not be shy.ʼ [Wichman 1998:119]

Similar to the women's protocol, the men must gather two *pōhaku* and throw one *mauka* and the other *makai* of the stone. He must also collect two *ʻōhiʻa lehua* branches and chant a prayer.

> ʻE noa iaʻu ke kahawai nei e nā Menehune, Kini, Lau a lau ka ʻoukou kokua iaʻu, i nui kaʻu wī e hoʻi ai i hauʻoli ko kauhale, a paʻa no hoʻi ka waha o ka poʻe wahaʻa a leoleoʻa hoʻomahuakala iaʻu.ʼ ʻFree me this stream, O Menehune, bring happiness to my house and confound those sharp tongued, loud people who do not believe me.ʼ [Wichman 1998:119–120]

3.2.1.3.5 The Groves of Lumahaʻi

Three groves of various plants were known throughout Lumahaʻi. Kahalaomāpuana "the pandanus of Māpuana," is a grove a *hala* trees along the beach. One of these *hala* trees bears red *hala* fruit instead of the usual yellow-orange. It is said that this *hala* tree is Māpuana. Māpuana was the youngest sister of ʻAiwohikupua and the Maile sisters. Kahauomāʻihi, or "the hibiscus trees of Māʻihi," were planted along the Māʻihilaukoa Heiau. Nāʻuluoweli, or the "breadfruits of Weli," was planted by the first Menehune *konohiki* of Lumahaʻi named Weli (Wichman 1998:120–121).

3.2.1.3.6 Kailiopaia Heiau

Kailiopaia Heiau was located east of the Lumahaʻi stream, however, it has been destroyed and nothing remains (Bennett 1931:135).

3.2.1.4 Waikoko

The naming of Waikoko (bloody water) takes place in Waipā. Wichman (1998) refers to a tradition behind the periodic damming of the waters of Waipā by a sand bar at the coast. Below is a snippet of Wichman's account, however, a complete account of the story can be found at Section 3.1.2.1.1.

> When Lauhaka was damming up the neighboring stream, the blood from the soldiers flowed into this stream and colored it red. In Ancient times, however, an aquatic plant grew in this stream that dyed the water red, but these plants disappeared when rice began to be grown here. [Wichman 1998:115]

Only one *ʻili ʻāina* was found in Waikoko Ahupuaʻa. It is Kaikapa.

3.2.1.5 Waipā Ahupuaʻa

Waipā has various meanings, depending on how the name is pronounced or written. If it is Waipā, it could mean "to request to the gods in prayer" or "touched water." If it is Waipaʻa, then it could mean "dammed-up water" (Wichman 1998:114). See Section 3.1.2.1.1 "Damming the Water of Waipā" to learn the *moʻolelo* about Waipā and its meaning.

Within the Waipā Ahupuaʻa, eight *ʻili ʻāina* have been recorded in mid-nineteenth century land documents: Haʻaheo (pride), Haako, Halaloa (tall pandanus), Kahihiilu, Kapuhai, Kīwaʻa (a mythical bird), Kuwahine, and Mokuna (division, boundary, border, as of land).

3.2.1.5.1 Halulu and Kīwaʻa

Halulu and Kīwaʻa are two areas in Waipā Ahupuaʻa named after mythical birds. Halulu was a man-eating bird and it was said that his feathers were like "particles of water from the dazzling orb of the sun" (Wichman 1998:114) while his sister Kīwaʻa was "a pilot bird that leads a navigator through the surf […]" (Wichman 1998:115).

Legend has it that Halulu kidnapped a man named ʻAukele, who was known as a hero across Hawaiʻi. Halulu took ʻAukele to his cave where other captives were held. When he was hungry, Halulu would reach down with one of his wings to grab a captive as his meal. One day, Halulu reached down and ʻAukele chopped off his wing. When Halulu reached his other wing into his cave, Halulu and the other captives helped chop off his other wing. Finally, Halulu stuck his head into the cave and ʻAukele chopped it off. To help ʻAukele escape, Kīwaʻa guided ʻAukele by creating a *poʻomuku* (a headless rainbow) and so it was called because the rainbow only consisted of three colors; *ʻula* (red), *lena* (yellow), and *ʻōmaʻomaʻo* (green) (Wichman 1998:114–115).

3.2.1.5.2 Halaloa Heiau

Halaloa Heiau was said to be built for Kāne, one of the four main Hawaiian gods. This *heiau* was destroyed to make room for a mill (Bennett 1931:135).

3.2.1.6 Waiʻoli Ahupuaʻa

Waiʻoli, meaning "joyous water," is famous for Māmalahoa Ridge as well as Nāmolokama Ridge. Māmalahoa (law of the splintered paddle) was named after the wife of Kāne (Wichman 1998:113). During and after heavy rains, multiple waterfalls flow down. Nāmolokama (interweaving bound fast) Ridge is named after the waterfalls that form after heavy rainfall. The waterfalls look like they all interweave between one another (Wichman 1998:113).

In Waiʻoli Ahupuaʻa, 18 *ʻili ʻāina* were recorded in mid-nineteenth century land documents: Aikahala, Kaaihoonuu, Kalena (the lazy one), Kaʻohe (the bamboo), Kapanaa, Kapanoa, Kapuoni, Kaukiuki, Kaumaikahiki, Kaumoi, Kaupana, Keahakea (Bobea trees and shrubs), Kuaiwa, Kumulehua (*lehua* tree), Namakaokaoha, Oniki, Opailele, and Waiau (swirling water).

3.2.1.6.1 Makaihuwaʻa Ridge

Makaihuwaʻa, meaning "eyes of the canoe prow," is a ridge above Waiʻoli Ahupuaʻa. It is said that on this ridge the Menehune had built a platform with some torches as the Menehune fishermen were having difficulty returning home after night fishing. This is said to be one of the first lighthouses built in Hawaiʻi (Wichman 1998:113).

3.2.1.7 Hanalei Ahupuaʻa

Hanalei carries multiple meanings, such as "crescent bay," "wreath making," or "lei valley" (Wichman 1998:108). However, it is suggested that "lei valley" or "wreath making" may be the closer interpretation as it refers to "the rainbows that appear in the upper valley from the constant rain showers" (Wichman 1998:108). Hanalei is also the name of the river. Hanalei River is fed from the lake at Waiʻaleʻale.

There are 23 *ʻili ʻāina* found in mid-nineteenth century land documents: ʻAnini (dwarfish, stunted), Hakanawaliwali, Haluaalo, Hanaleiiki (small Hanalei), Kahe (flow), Kaʻina (the sea urchin), Kaluaalo, Kama (child), Kānoa (bowl, as for kava), Kānoaiki (little Kānoa), Kapukawai (the water outlet), Kaunuopua, Kiloa (long ti plant), Kukui (candlenut lamp, light of any kind), Kūloa (long Kū), Kumuʻōhiʻa (ʻōhiʻa tree), Limunui, Mahaaua, Nahuluhuluia, Nounou (throwing), Nukuhuluii, Opukahi, Puapuahoi, and Wainini (old name of ʻAnini).

3.2.1.7.1 Kaʻawakō Heiau

Kaʻawakō Heiau was used by the Mū people. The *kilo iʻa* or fisher watcher would go to Kaʻawakō Heiau after placing his *ʻoʻopu* fish trap. The *kilo iʻa* would make his offering of *ʻawa* (kava, *Piper methysticum*), *maiʻa* (bananas), and *kumu kalo* (the *kumu* variety of taro). He then would brew a cup of *olonā* (a native shrub, *Touchardia latifolia*) leaves and perform chants. After the ritual was completed, he would run down to his fish trap to see all the *ʻoʻopu* that he caught (Wichman 1998:109).

3.2.1.7.2 Hīhīmanu Peak

Hīhīmanu, or "manta ray," Peak is one of three massifs that overlook Hanalei Ahupuaʻa. Hīhīmanu Peak is rightfully named as it comprised of two twin peaks resembling the fin tips of a *hīhīmanu* (manta ray) as it glides through the water. Hīhīmanu were numerous along the Nāpali coast (Wichman 1998:110).

3.2.1.8 Kalihikai Ahupuaʻa

Kalihikai (ocean edge) is a relatively small *ahupuaʻa* that consists of smaller streamlets. These streamlets predominately flow into its neighboring *ahupuaʻa* of Kalihiwai and Hanalei (Wichman 1998:107).

There were five *ʻili ʻāina* identified within Kalihikai Ahupuaʻa in mid-nineteenth century land documents: Kahilei, Kaluhapa, Kapāpala (the *Charpentiera* shrub), Niula (or Nuila), and Papaʻula (red flats).

3.2.1.8.1 Maheu Heiau

A rather small *heiau*, only 18 by 21 ft, Maheu Heiau was located on the top of Puʻu Maheu (Bennett 1931:134).

3.2.1.9 Kalihiwai Ahupuaʻa

Kalihiwai, meaning "water's edge," is the name of the *ahupuaʻa* as well as a stream. There were 18 *ʻili ʻāina* identified in mid-nineteenth century land documents for Kalihwai Ahupuaʻa: ʻAuwailalo (lower ditch), ʻAuwailuna (upper ditch), Hālawaiʻa (sinker), Hali (to carry, fetch, bear), Hanapai, Kaʻauwailalo (the lower ditch, possibly the same as ʻAuwailalo), Kaʻauwailuna (the upper ditch, possibly the same as ʻAuwailuna), Kawehu, Kaholo (the running), Kaihalulu (roaring sea), Mohio (also written as Kamohio), Mokuula, Molaipua, Oniki, Paʻa, Pānui (large enclosure or wall), Pipio, and Waʻakau (fishman's canoe),

3.2.1.9.1 Hanapai Bay

Hanapai (lifting bay) Bay was used as a canoe landing area. It is presumed that this bay received its name in reference to the canoes being lifted out of the water to be taken to the *hālau waʻa* (canoe house) (Wichman 1998:107).

3.2.1.9.2 Kīhei Heiau

Kīhei (shawl, cape, cloak) Heiau was built by Chief Kīhei. After two attempts to invade Kaua‘i, Kamehameha decided that a diplomatic approach to obtaining Kaua‘i might be best. Kamehameha sent one of his chiefs, Chief Kīhei, to Kaua‘i to meet with then ruler, Kaumuali‘i. Kaumuali‘i showered Chief Kīhei with many gifts, which led Chief Kīhei to the decision to make Kaua‘i his new home. Kaumuali‘i promoted Chief Kīhei to *konohiki* of Kalihiwai.

Chief Kīhei built this *heiau* in honor of the good fortune that had fallen on him from Kaumuali‘i and the people of Kaua‘i. When he passed away, the floor of the *heiau* was dug up and Chief Kīhei was laid to rest in that spot (Wichman 1998:107).

3.2.2 Ko‘olau Moku

The following are *wahi pana* within Ko‘olau Moku.

3.2.2.1 Kīlauea Ahupua‘a

Kīlauea (spewing of many vapors) Ahupua‘a runs from Mahaleha Mountains to the ocean. Due to the nature of Kīlauea Ahupua‘a, it was not suitable for wetland farming, however, there are remains of irrigation ditches. It is said that these ditches are claw marks from a *mo‘o* who was under the direction of Manokalanipō, the *ali‘i nui* of Kaua‘i, who ordered the lizard to open up Kīlauea Ahupua‘a for agriculture (Wichman 1998:102).

Only two *‘ili ‘āina* were recorded in mid-nineteenth century land documents. These are Hulā‘ia (pushed through) and Maluawai.

3.2.2.1.1 Three Pōhaku

When Pele traveled the Hawaiian Islands to find a home, she would dig into the earth to form a crater. However, her sister, Nāmakaokaha‘i would extinguish her lava and drown her crater with sea water. While Pele attempted to make her home on Kaua‘i, Nāmakaokaha‘i drowned her pit. Unbeknownst to Pele, three strangers were watching and began to laugh at Pele. Enraged, Pele asked these strangers for their names. One replied “I am Kalama, this is Pua, and this is Lāhela” (Wichman 1998:103). Pele repeated their names as she touched Pā‘oa, her digging staff, and each of them turned into a *pōhaku*. These *pōhaku* are a reminder to everyone not to mock Pele. These stone have been moved during the sugar plantation era (Wichman 1998:103).

3.2.2.1.2 Pailio Heiau

Pailio Heiau is described as a round *heiau* with a diameter of 100 ft. However, this *heiau* was destroyed when the area was used as a cane field (Bennett 1931:133).

3.2.2.2 Kāhili Ahupua‘a

Kāhili (feather standard) Ahupua‘a was named after the chiefess of the same name. She, along with her husband catered a memorable feast at Hā‘ulaolono Heiau in the *kukui* groves of Kaukahe. As a gift, the chief gave an *ahupua‘a* to his wife, Kāhili.

> Meanwhile, his wife was also busy. She brought anise-scented berries of *mokihana* from the cliffs of Ka-hili-kolo, ‘creeping tangle,’ and dark-backed shrimp from the stream of Ka-lua-o-ka-lani, ‘pit of heaven.’
>
> The high chief was delighted with his entertainment and before he left, he named the nearby grassy hill after the *konohiki* chief, Ka-moku. He gave the wife an

> *ahupuaʻa* of her own, making sure that the bottomlands of the Kīlauea River from waterfall to mouth were included. This was given the name: Kāhili, ʻfeather standard.ʼ [Wichman 1998:100]

Six *ʻili ʻāina* were identified in mid-nineteenth century land documents: Hoʻōpala (to litter), Kanaele (the bog), Kaukahinu, Kupe, Makahuwaʻa (phosphorescent light seen in water at night), and Ulehulehu.

3.2.2.2.1 Waiaʻula Pond

Waiaʻula (water becoming red) Pond is the home of Kihawahine, a *moʻo* man-killing goddess. When the water was red, it was a sign that Kihawahine was home in the pond. It was said that the red color water was the body of Kihawahine (Wichman 1998:102).

3.2.2.3 Waiakalua Ahupuaʻa

Waiakalua (water of the pit) Ahupuaʻa consisted of streams fed by springs. This *ahupuaʻa* was divided into two areas: Waiakaluaiki (Small Waiakalua) and Waiakaluanui (Big Waiakalua). There were *loʻi* noted in the valleys and houses along the *kula* plains (Wichman 1998:100). However, no *ʻili ʻāina* were identified within government land documents.

3.2.2.4 Pīlaʻa Ahupuaʻa

Pīlaʻa Ahupuaʻa is roughly 1,250 acres large, however, the meaning of Pīlaʻa is unknown. The *ahupuaʻa* consisted of a sandy beach area stretching from Kepuhi in Waipakē Ahupuaʻa to Pōhakumalumalu (sheltering stone) which is located toward the neighboring *ahupuaʻa*, Waiakalua. Moving *mauka*, there is a narrow stretch of land where the Pīlaʻa Stream flows.

There were 22 *ʻili ʻāina* recorded in mid-nineteenth century land documents: Halekou (*kou* [*Cordia subcordata*] wood house), Kahoʻiwai, Kalama (the torch of the *lama* [*Diospyros, synonym Maba*] tree), Kaluanūnū (the trumpetfish hole), Kaluaunui, Koamoaʻahuʻula (the chicken feather cape), Kaʻōhiʻa (the *ʻōhiʻa* tree), Kaʻōhule (the bald person), Kauhakeke, Kēōkea (the white sand), Lolaulu, Makiloia, Makuakapala, Manawa, Nāpaʻakō (the dry lowland plains), Okikalanui, Paaiki, Pahupoko, Pakiiholo, Puaʻa (pig), Ulukanu, and Waihī (trickling water).

3.2.2.4.1 Kamoaʻahuʻula Plain

The Pīlaʻa Ahupuaʻa was unique in nature in that it did not stretch to the mountain ranges. This may have posed a problem as it was common practice during the *makahiki* season (an ancient festival) to pay taxes with feathers from birds who predominately lived in the mountains.

Because Pīlaʻa Ahupuaʻa did not stretch to the mountains, it is possible the people of this area paid their taxes with chicken feathers as indicated by the place name Kamoaʻahuʻula (feather cloak made of chicken feathers) (Wichman 1998:99).

3.2.2.4.2 Kānoa and Kaukahe

Kānoa Valley was named after a large *pōhaku* shaped like a *kānoa* (bowl). Kaukahe is located at the top of Kānoa Valley and is the home the oldest *kukui* trees in Kauaʻi (Wichman 1998:99–100).

3.2.2.4.3 Hāʻulaolono Heiau

Located amongst the *kukui* groves of Kaukahe, Hāʻulaolono (red stem of Lono) Heiau is built from water-smoothed pebbles with offerings and sacrifices being made to Lono.

3.2.2.5 Waipakē Ahupuaʻa

Waipakē (brittle water) Ahupuaʻa is roughly 706 acres in size and consisted of an excellent reef and upland area. Even though there are no consistent flowing streams in Waipakē Ahupuaʻa, farming was still practiced within this area. Many farmers relied on freshwater springs to help irrigate their farmlands.

It is said this *ahupuaʻa* received its name because of two women who were pounding *poi*. As one of the women was pounding her *poi*, it made a popping sound (*pakē*). The second woman would laugh and tease the first woman on her *poi* and *poi* making skills. When it came time for the second woman to begin pounding her *poi*, hers too would make that *pakē* sound. Since then, this *ahupuaʻa* was named Waipakē (Wichman 1998:97).

There were 13 *ʻili ʻāina* identified in mid-nineteenth century land documents for Waikapē Ahupuaʻa: Auwele, Kaa, Kaiaau, Kaluahole, Kaluaopoki, Kamoana, Kamoomola, Kapopa, Kapuna (the spring), Kawau, Keʻaki (the top, tip), Kulikoa, and Pokalua,

3.2.2.5.1 Kepuhi Blowhole

Kepuhi, literally meaning "blowhole," is a blowhole in Waipakē Ahupuaʻa close to Pīlaʻa Ahupuaʻa.

3.2.2.6 Lepeuli Ahupuaʻa

According to Wichman (1998), Lepeuli is a relatively small *ahupuaʻa* and knowledge about the area and lifestyle is sparse. "Lepe-uli, ʻdark cockscomb,ʼ is very small and does not reach the mountains. There are no surviving legends attached to this *ahupuaʻa*. and only two of its place names offer clues to ancient life" (Wichman 1998:96).

Four *ʻili ʻāina* have been identified in mid-nineteenth century land documents: Kalamaʻula (red *lama* tree), Kanele (the bog), Kanualiʻi, Kaʻumekaʻiwa (allure of the man-of-war bird), and Puaʻa (pig).

3.2.2.6.1 Kaʻumekaʻiwa

Named after the *ʻiwa* (*Fregata minor*), Kaʻumekaʻiwa (allure of the man-of-war bird) is a house lot in Lepeuli near the beach. This house lot also consisted of six *loʻi* (Wichman 1998:96).

3.2.2.6.2 Kalamaʻula

Kalamaʻula (red *lama* tree) is a small pasture area within Lepeuli Ahupuaʻa. *Lama* (all endemic kinds of ebony, *Diospyros*, synonym Maba) was a type of wood associated with the practice of medicine and *hula* (dance) as another meaning for *lama* is "torch, light" (Wichman 1998:96–97).

3.2.2.7 Kaʻakaʻaniu Ahupuaʻa

Kaʻakaʻaniu (rolling of the coconut) is a very small *ahupuaʻa* that lies west of Moloaʻa Ahupuaʻa. Kaʻakaʻaniu Ahupuaʻa was famous for its *limu* (seaweed). The quality of *limu* that could be gathered at Kaʻakaʻaniu was considered "the finest on the island" (Wichman 1998:95).

Kumuʻōhiʻa *(ʻōhiʻa* tree) is the only *ʻili ʻāina* recovered from mid-nineteenth century land documents for Kaʻakaʻaniu Ahupuaʻa.

3.2.2.8 Moloa‘a Ahupua‘a

Described as “a classic valley *ahupua‘a*” (Wichman 1998:95), Moloa‘a Ahupua‘a includes gentle slopping mountains leading to *kula* lands that gently widens near the ocean. Meaning “twisted roots,” Moloa‘a Ahupua‘a was said to have an abundance of *wauke* (paper mulberry) that was so overgrown, its roots ended up twisting with one another (Wichman 1998:94).

Three *‘ili ‘āina* were referenced in mid-nineteenth century land documents: Inaipoo, Ka‘apuna (wipe pumice, as in cleaning gourd containers), and Kiala,

3.2.2.8.1 Kawaiamaliu Spring

Kawaiamaliu (spring of Maliu) Spring is named after a Menehune named Maliu. One day, Maliu decided to venture off on his own. He fell in love with a Hawaiian woman and they had a child. Months passed before the chief of the Menehune noticed Maliu was missing. He sent the other Menehune to find and return him. Maliu heard that the Menehune were after him so he escaped toward the sea and began digging a hole in the sand. Finally, the chief and the other Menehune saw Maliu. The chief inquired of Maliu as to what he was doing. “ ‘Digging for fresh water,’ Maliu said. ‘If there is fresh water, you will live,’ said the chief. ‘If not, you will die.’ Maliu kept digging and soon a gush of fresh, sweet water flowed up. Maliu was saved” (Wichman 1998:96).

3.2.2.9 Pāpa‘a Ahupua‘a

Pāpa‘a (secure enclosure) Ahupua‘a is similar to ‘Aliomanu Ahupua‘a as it is a relatively small *ahupua‘a* with a reef, bay, and some *kula* land area which leads to a mountain ridge named Kihe (a small fern, *Xiphopteris saffordii*).

Only three *‘ili ‘āina* were recorded in mid-nineteenth century land documents for the Pāpa‘a Ahupua‘a: Kahoiwai, Kamoana, Ki‘owai (water hole).

3.2.2.9.1 Pūweuweu Hill

Pūweuweu (clump of greenery) honors the goddess Laka, the goddess of hula. The term *pūweuweu* or *pūpū weuweu* is the name of a prayer chant “designed to free the *kapu* from a *hula* student at the end of a period of training” (Wichman 1998:94).

3.2.2.9.2 Pāpa‘a Heiau

Named after the *ahupua‘a*, Pāpa‘a Heiau was dedicated to the god Kahōali‘i, known to be the god of the underworld, and was used for human sacrifice (Wichman 1998:94–95).

3.2.2.10 ‘Aliomanu Ahupua‘a

‘Aliomanu (scar made by birds) is a relatively small *ahupua‘a* that includes a reef, sand beach, and land stretching to the foot of the mountain. From here, the land makes an abrupt turn up and climbs to the peak of Kalalea (prominent). Often used as a metaphor to describe some as haughty or conceited, Kalalea is named after a warrior who behaved snobbishly to a woman (Wichman 1998:92).

Seven *‘ili ‘āina* were recorded in mid-nineteenth century land documents: ‘Akole (a large endemic fern, *Dryopteris unidentate*), Kalūhau (the shaking down of dew or rain drops from tree boughs by a breeze), Kapā‘ele (the dark, black, a variety of sweet potato), Kapahupoko (the short stake), Kapoho (the depression), Kealohimanienie, and Puhulu.

3.2.2.10.1 Kealaokaʻiole Trail and Puʻuanakōua

Kealaokaʻiole (trail made by a rat) is named after a rat *kupua*. Chief Anahola was known to grow his *ʻawa* in ʻAliomanu. At night, this rat *kupua* would make a trail to Chief Anahola *ʻawa* patch and eat the *ʻawa* along with other farmers' crops. The chief offered his daughter's hand in marriage to anyone who could kill the rat. Prince Kawelo of Oʻahu took on the challenge. One day, Prince Kawelo heard the rat and threw his spear, which pierced the mountain, knocking out a huge rock that fell and smashed the rat (Wichman 1998:92).

This area became known as Puʻuanakōua (hill of the cave towed in the rain), also known as Hole in the Mountain. There is another story linked to this area that involved a Menehune and cliff jumping (see Section 3.2.3.1.2).

3.2.2.11 Anahola Ahupuaʻa

The meaning of Anahola is unknown, however, it is said that Anahola Ahupuaʻa is named after a *moʻo* guardian, "a male lizard *kupua* that appeared on land as a man and in the sea as a merman" (Wichamn 1998:90). Anahola Ahupuaʻa is the largest *ahupuaʻa* within the Koʻolau district, extending 6,327 acres. The shoreline stretches from Papaloa (long reef) on the east to Kuaehu (lonely) on the west.

There were 72 *ʻili ʻāina* identified in mid-nineteenth century land documents: Hahalina, Hakaea, Halalua (two or double pandanus), Hīkiʻi (to bind), Hioka, Hoolakaupa, Hoʻōpala (to litter), Hope, Kaʻākaulua (the double north or double right) or Kaʻakaulua (rolling died-by-side), Kahalepua, Kaheʻewale (the miscarriage), Kahunalu, Kalaiula, Kalalea (prominent), Kalama (the torch or the *lama* tree), Kaluanui (the big pit), Kaluaʻōhiki (the sand crab hole), Kaluaʻoʻopu (the *ʻoʻopu* [goby] fish hole), Kamalupa, Kamano, Kamoku (the district or the cut-off portion), Kamokuapi, Kamuliwai (the river mouth, estuary), Kanahawele, Kanamoa, Kanapaa, Kanuana, Kaopupu, Kapoho (the depression), Kapuakea (the white blossom), Kapuapala, Kapukalio, Kapunahuoi, Kapuoni, Kapuoninui, Kauakahi, Kauapa, Kauhake, Kaupapa, Kawaikapu (the sacred or forbidden water), Keʻalohi (the sparkle, brilliance), Keawaawaehu (the dusty valley), Kekau, Kiaiki (small post), Koʻolaukai (seaward Koʻolau), Koʻolaukani (sounding [of the] Koʻolau [wind]), Kuaimanu, Kuha (to spittle, to spit), Kukuluʻaukai, Kulou (to bow or beckon with the head), Lanakini, Makoikoi, Mamania, Manaiki, Olelokana, Olokauha, Paeaea, Paeia, Palawai (bottom lands) or Pālāwai (pond scums), Palikoa, Papaikiopoaka, Papakōlea (plover flats), Papaukai, Piwaha, Poanoho, Pohakumano, Poukou or Pouku, Puapala, Pukoenieni, Puoio, Puoko, and Puumano.

3.2.2.11.1 Alaweo Pond

Alaweo Pond, possibly named after the *alaweo* plant (a native shrub) that grew along the pond, had a *moʻo* guardian named Pehuiki who guarded the pond with his three daughters. Right above Alaweo Pond is a cave called Hāhālina (to grope through the stickiness).

3.2.3 Puna Moku

The following are *wahi pana* within Puna Moku.

3.2.3.1 Kamalomaloʻo Ahupuaʻa

Kamalomaloʻo means "dry loin cloth," the typical clothing items for males. This *ahupuaʻa* is credited with receiving its name from a practice that took place when an *aliʻi* returned home, whether it was from a voyage or surfing. Before the *ali‘i* landed, “his bodyguards threw their spears at him. It was a mark of chiefly strength that he could dodge or catch every spear” (Wichman 1998:87). Afterwards, the *ali‘i* was ceremoniously given a *malo malo‘o*.

No *‘ili ‘āina* were recorded in mid-nineteenth century land documents for this *ahupua‘a*.

3.2.3.2 Māhunāpu‘uone

Māhunāpu‘uone, meaning “vapor that rises from the sand dunes,” is a *heiau* that was used for human sacrifices and was built by Kawelomahamahai‘a to celebrate the birth of his twin grandsons. Being of a certain status, everyone who came in the presence of the twins was required to lie flat on the ground; failure to do so resulted in death (Wichman 1998:88).

3.2.3.2.1 Hōmaikawa‘a and ‘A‘aka

Hōmaikawa‘a (bring me the canoe) is a valley that rests next to ‘A‘aka (grumbling). Right in front of ‘A‘aka is ‘Āhihi Point. The *mo‘olelo* of these places originated with the Menehune.

‘A‘aka was a Menehune who loved to jump off cliffs. He would play a game where he would throw a stone toward the ocean and jump off the cliff to go after it. One day at ‘Āhihi, a cliff in Kamalomalo‘o, ‘A‘aka played his game. He threw his stone off ‘Āhihi and jumped after it, only to land almost in the mouth of a waiting shark down below. ‘A‘aka was able to avoid the shark but was furious at the shark for interfering with his game. ‘A‘aka, even though he was not of chiefly status, commanded other Menehune to help him prepare a net made of the *‘āhihi* (low spreading bush, *Metrosideros* sp.) vine. When the net was finished, ‘A‘aka yelled, *hō mai ka wa‘a* or bring the canoe! ‘A‘aka and his companions were able to catch the shark (Wichman 1998:87).

3.2.3.3 Keālia Ahupua‘a

Keālia has various meanings but all meanings have a common element, *pa‘akai* (salt). This place name can mean “salt encrustation,” “salt land,” or “salt pan” (Wichman 1998:85). Salt was a staple and was necessary for preparing food and ceremonial purposes.

Eighteen *‘ili ‘āina* have been identified in mid-nineteenth century land documents: Aikiana, Awikiwiki, Hanaipehu, Haulei, Kaeleele, Kahue, Kapuna (the spring), Kapunakai (the seaward spring), Kauaha, Kaunakakai (beach landing), Kealohapaa, Kuahaki, Kulehale, Lōpānui (big peasant), Mahuaku, Makapono, Pauahi (destroyed by fire), and Waipuna‘ula (red spring water).

3.2.3.3.1 Waipāhe‘e Waterfall

Waipahe‘e means “slippery water” and is known to be a place for leisure fun. Waipahe‘e is a slanted waterfall with a moss-covered channel right above. A person could sit at the top, blocking the water like a dam. Once there was enough water, the person would push themselves, sliding down the moss channel, off the waterfall, and into the pool of water below (Wichman 1998:86).

3.2.3.4 Kapa‘a Ahupua‘a

Kapa‘a (solid) Ahupua‘a is famous for a particular type of grass known as *kalukalu* (a kind of rush or grass like *kaluhā* sedges, famous on Kaua‘i).

> The kalukalu was woven into mats that were stronger and more durable than pandanus mats. A kalukalu mat was laid on the ground under a tree, covered with a thick pile of grass, and a second mat was thrown over that for a comfortable outdoor bed. There were no mosquitoes in the ancient days. Lovers enjoyed whiling

> away the time in the kalukalu grass, for it was soft enough to be comfortable and tall enough for secrecy. [Wichman 1998:84]

Seven *‘ili ‘āina* have been recorded in mid-nineteenth century land documents: ‘Apōpō (tomorrow), Awāwaloa (long valley, gulch, ravine), Hahanui, Kahana (cutting), Kupanihi, Māeleele (numb), and Moalepe (chicken with comb).

3.2.3.4.1 Kolokolo Pond

Kolokolo is a type of soap plant for which Kolokolo Pond received its name. This plant was used like soap by Native Hawaiians. The leaves of the *kolokolo* plant when mixed with water would lather like soap (Wichman 1998:84).

3.2.3.4.2 Keahiahi

Keahiahi means “the night” and is a point at the north end of Kapa‘a. This place is where Pāka‘a was brought up with his mother, La‘a‘maomao (the one who possessed the wind gourd), and his uncle Mailou, a bird catcher (Wichman 1998).

3.2.3.5 Waipouli Ahupua‘a

Waipouli literally means the “dark water.” According to one theory, peoplehere may have seen the water appear darker during a solar eclipse, hence the name (Wichman 1998:82). Waipouli refers to the *ahupua‘a*, the village, and the beach.

Ten *‘ili ‘āina* were recorded in mid-nineteenth century land documents: Hape (incorrect, faulty, inaccurate), Kahaloko (bank of a pond), Keku (to repulse), Kūkaeuli (dark excrement), Mokuapi, Nā‘ohe (the bamboos), Pau, Pini, Pōhaku (stone), and Pua.

3.2.3.5.1 Mākahaokūpānihi

Mākahaokūpānihi, meaning “fierceness of Kūpānihi,” is pool that was used for bathing by *ali‘i* only. Mākaha is an star located by Makali‘i (Pleiades). Kūpānihi was a god worshipped by canoe carvers (Wichman 1998:83).

3.2.3.6 Olohena Ahupua‘a

Unfortunately, there are no translations available for Olohena Ahupua‘a. According to Wichman, “the use of its name has all but disappeared as it calls to mind two hills whose shape resembles a pair of buttocks” (Wichman 1998:81).

There were four *‘ili ‘āina* recorded in mid-nineteenth century land documents: Holau, Kaoki, Puakea (white blossom), and Puakei,

3.2.3.6.1 Kaikihāunakā Heiau

Kaikihāunakā (little striking blow) Heiau was built by Kawelo after he defeated ‘Aikanaka. This *heiau* was used as a place of offering. Kawelo would place the first enemy warrior slain in battle at Kaikihāunakā as an offering to his war god (Wichman 1998:81).

3.2.3.6.2 Kukui Heiau

Kukui (candlenut tree, light, enlightenment) Heiau is a rather large *heiau* built by the giant Nunui. The stones of this *heiau* were estimated to weigh several tons. The giant Nunui, after he finished building Kukui Heiau, was tired and stretched out by a nearby hilltop where he still sleeps today (Wichman 1998:81).

3.2.3.6.3 Halepāiwi

Halepāiwi, meaning "house enclosed with bones," is a house dedicated to the art of *hoʻopāpā*, the art of riddling. The bones of those who lost the game made up the fence of the house (Wichman 1998:82).

3.2.3.7 Wailua Ahupuaʻa

Wailua, like other place names, possesses multiple meanings. Several meanings of the name "Wailua" have been given, with the most popular meaning "two waters," supposedly referring to the two main forks (north and south) that flow together to form the Wailua River. However, as Lyle Dickey writes, "this explanation never seems to occur to a native Hawaiian" (Dickey 1917:15). Another meaning is "water pit," referring to the pools at the bottom of several waterfalls along the river's course (Damon 1931:360). According to Pukui and Elbert (1986:379), the term "wailua" means "spirit, ghost; remains of the dead," and also refers to "an ancient variety of sweet potato presumably introduced from Wailua, Kauaʻi." But the name of Wailua Ahupuaʻa was most likely derived from the fourteenth century high chief Wailuanuiahoʻāno as described by Kamakau:

> Wailuanui-a-Hoʻano was born in ʻEwa, Oahu, and his descendants went to Kauai and to Maui, and wherever they settled they called the land after the name of their ancestor. Wailua was a song of Laʻakona, ancestor of the ʻEwa family by Ka-hoʻano-o-Kalani. His name, Wailuanui-a-Hoʻano, came from adding the name of his mother. [Kamakau 1976:7]

There were 45 *ʻili ʻāina* recorded in mid-nineteenth century land documents within Wailua Ahupuaʻa: Ahalike, Halepuolo (bundle house), Haleʻula (red house), Halilauhau, Hapuupuu, Hio, Inaiokama, Kahakoa, Kahihei, Kahoolealii, Kamalau (the canoe bait carrier), Kamaluokukui (the shade of a *kukui* trees), Kamani, Kanaele (the bog), Kapalai (a native fern), Kapuaiomolohua, Kapuhai, Kaulupalau, Kawaiiki (small Kawai), Kealakaʻiole (the path of the rat), Kihapiilani, Kuʻemanu, Kulaakapua, Kulahuhu, Kupapaupapa, Lanipaʻa (firmament), Mahunapuʻuone, Māʻili (pebbly), Malaehakoa, Malaihanono, Maulili, Noliha, Okeoke, Opalakawai, Paki, Pakoli, Pālauhulu (to take all of a fish catch for a chief instead of dividing it), Papaalai, Papalinaulu, Pāpōhaku (stone fence), Pelehuna, Pohoula, Puhauula, Waioo, and Waiʻōpua (water of cloud banks, name of a pleasant breeze at Wailua).

3.2.3.7.1 Holoholokū Heiau

Holoholokū, possibly meaning "to run and stop," is a special *heiau* that gave blessings to those born within the *heiau*.

> *Hānau kea liʻi i loko o Holoholokū, he aliʻi nui;*
>
> *Hānau ke kanaka i loko o Holoholokū, he aliʻi nō;*
>
> *Hānau ke aliʻi mawaho aʻe o Hoooholokū, ʻaʻohe aliʻi , he kanaka ia.*
>
> ʻThe child of a chief born in Holoholokū is a high chief.
>
> The child of a commoner born in Holoholokū is a chief.
>
> The child of a chief born outside of Holoholokū is a commoner.ʼ [Wichman 1998:66]

At Holoholokū Heiau, there are two *pōhaku* referred to as Pōhaku Hānau. One *pōhaku* is where the expectant mother would sit while the second *pōhaku* is flat where she could rest her back (Wichman 1998:66).

3.2.3.7.2 Nā Heiau ‘ē a‘e

Wailua Ahupua‘a is home to various *heiau*. Another *heiau* known as Kaleiomanu (wreath of Manu) was located by Holoholokū Heiau. Kaleiomanu Heiau was used for sacrificial purposes. Pigs, chicken, dogs, and fish were sacrificed to the gods. Occasionally, humans were also used as a sacrifice to the gods. The bones of those sacrificed were taken to Pu‘ukī and buried there (Wichman 1998:72).

Malae Heiau was built by the Menehune along the banks of the Wailua River. Malae Heiau was used as a place where people could gather and witness ceremony. The Malae Heiau was also referred to as Maka‘ukiu Heiau, possibly after the wind of the area (Wichman 1998:68**).**

Poli‘ahu Heiau rested along the top of Kuamo‘o Ridge, close to the Wailua River. Wichman shares that Poli‘ahu Heiau was a

> […] paved and walled enclosure approximately 242 feet in length and 165 feet in width, making it one of the largest heiau on Kaua‘i […] It was covered with white tapa and kapu to all but the ali‘i nui (ruling chief) and the kahuna nui (head priest). The kahuna nui sat alone on the top floor and, with proper prayer and ritual, waited for the advice of the gods. [Wichman 1998:69]

Poli‘ahu Heiau and Malae Heiau were clearly visible to each other.

3.2.3.7.3 Hikinaakalā

Hikinaakalā, meaning "rising of the sun," was classified as a *pu‘uhonua* or a "place of refuge" for warriors defeated in battle. This *pu‘uhonua* was treated like a *heiau*. Warriors seeking refuge could enter this *pu‘uhonua* knowing no harmful action will befallen them. These refugees would then make an offering to the gods and be granted a stay within the safety of the *pu‘uhonua* for several days. Once some time passed, the warrior was free to leave and return to his normal life. *Pu‘uhonua* were not only for warriors, but for others in need of safe refuge such as those who break *kapu* or taboo, or those avoiding prosecution (Wichman 1998:70).

3.2.3.7.4 Makaīwa

Makaīwa (mother of pearl eyes) is known as a famous surfing spot enjoyed by both commoners and royalty. Along the shores of Makaīwa is Paeki‘imāhūowailua (row of homosexual images at Wailua). These eight *pōhaku* were the potential male partners of Kapo‘ulakīna‘u companions (see Section 3.1.2.2).

3.2.3.7.5 Nounou

Nounou (to pelt) is known as the Sleeping Giant "stretched out on his back, his feet at the north end, a big stomach in the middle, and his face on the south" (Wichman 1998:74). The story of Nounou has many origins and claims that the giant sleeping is either Puni or Nunui.

Puni was a giant who was simply taking a nap when a fleet of war canoes from O‘ahu came in to attack. Puni's friends, the Menehune, tried to wake him up to no avail. The Menehune then hurled stones at Puni's stomach which bounced and landed toward the canoes at sea until the fleet retreated back to O‘ahu. The next day, the Menehune tried to wake Puni up again, but they came to realize Puni was dead. During the battle, some of the rocks had bounced from Puni's stomach into his mouth and as he snored, he choked to death (Wichman 1998:75–76).

Nunui, like Puni, was a giant. After a hard day of work building Kukui Heiau (see Section 3.2.2.5.2), Nunui lay down to rest and never woke up. He is considered to be sleeping to this day.

3.2.3.8 Hanamāʻulu Ahupuaʻa

Hanamāʻulu, meaning "tired bay," reflects the location of the *ahupuaʻa*. It is said that this place received the name "Hanamāulu" as people who traveled here had to walk extra miles and would often arrive hungry, tired, and with sore feet (Wichman 1998:60–61).

There were 14 *ʻili ʻāina* recorded in mid-nineteenth century land documents: Hanamāʻulu, Kaʻaukai (the sailor), Kapaia (the walls of bowers), Kapūhala (the pandanus tree), Kuha (spittle, to spit), Limawela, Makahi, Maulili, Noni (Indian mulberry, *Morinda citrifolia*), Opai, Palaha, Peʻaiki (small Peʻa), Waiʻaoʻao, and Waieo.

3.2.3.8.1 Waiahi and Waiaka Stream

Waiahi (fiery water) and Waiaka (reflecting stream) were known to be *kupua* or the body of supernatural beings. Waiahi receives its water from the famous mountain, Waiʻaleʻale. The waters of Waiahi then flow into the Waiaka Stream.

3.2.3.8.2 Ahukini

Ahukini, meaning "shrine for many blessings," refers to a landing point overlooking Hanamāʻulu Bay as well as a *heiau*. According to Wichman:

> Chief Ahukini lived circa 1250 A.D. and was one of the three sons of Laʻa-mai-kahiki who had come from Raiʻātea in the Society Islands to visit with his foster father Moʻikeha. Ahukini became *aliʻi nui* of Puna after Ka-ʻili-lau-o-ke-koa, granddaughter of Moʻikeha, died without children of her own. On the bluff was a *heiau* of the same name. It was a medium-sized temple, but by the turn of the century only the foundations remained. [Wichman 1998:61]

3.2.3.8.3 Kalepa

Kalepa, meaning "to flutter, to wave, flag," is a ridge above Hanamāʻulu. It may refer to the use of the *lepa* or flag. A *lepa* was flown by anyone who had items to barter such as fish, *poi*, or other articles for sale.

3.2.3.8.4 Kalauokamanu Heiau

Kalauokamanu Heiau was dedicated for human sacrifice. The stench from the many bodies sacrificed was so bad that people would hurry pass the *heiau*. The *heiau* was destroyed around 1855 and the foundation used for the Hanamāʻulu sugar mill.

3.2.3.9 Kalapakī Ahupuaʻa

Kalapakī according to Wichman means "double-yolked egg" (Wichman 1998:59), however, a definition from Pukui et al. (1974) was unavailable. Wichman believes there may be a *moʻolelo* connected to an egg at this place (Wichman 1998:59).

There were ten *ʻili ʻāina* identified in mid-nineteenth century land documents: Kaahakea, Keāhua (the mound), Kena (quenched, satisfied of thirst; weary, as from heavy toil), Kiʻolepo (swamp, mire, mud puddle, dirty pool), Koenaawaiki, Koenaawanui, Nuuhai, Palauohi, Pau, and Puhauluau.

3.2.3.9.1 Ninini

Ninini means "to pour" and is the name of various locations. Ninini is a beach as well as a cliff. One of the famous pastimes of Mehehune was to throw a stone off a cliff, jump after it, and land in the water. The Menehune would bring small *pōhaku* from their homes to the cliffs in order to engage in this fun game (Wichman 1998:60).

3.2.3.9.2 Kapapaokamehehune Stone

On the way to Ninini to enjoy their cliff-jumping game, the Menehune brought a large *pōhaku* to build a better platform to jump off. On the way to Ninini, the large *pōhaku* broke in half. One half of the *pōhaku* rolled down to Hulēʻia River and became known as Kapapaokamenehune (causeway of the Menehune), which acts like a bridge to this day. The other half of the *pōhaku* was taken to Ninini as the Menehune planned (Wichman 1998:60).

3.2.3.10 Nāwiliwili Ahupuaʻa

Nāwililiwili Ahupuaʻa received its name from the *wiliwili* (Hawaiian leguminous tree, *Erythrina sanwicensis*) trees. Nāwiliwili was known for groves of *wiliwili* trees. Nāwiliwili is a conjunction of a much longer name, Nāwiliilipakaʻāwililauʻililua or "wiliwili trees upon which raindrops fall, twisting the leaves so the rain touches both sides" (Wichamn 1998:58–59).

There were 21 *ʻili ʻāina* that were recorded in mid-nineteenth century land documents: Kaakauloko, Kahala, Kaholo (the running), Kalamanui (big Kalama [the torch or the *lama* tree]), Kaleihao, Kauluolono (the inspiration of Lono), Kawailoa (the long water), Keana (the cave), Kuainiho, Kuapepe, Kukuikahea, Mālamalama (enlightened), Maulua (difficult, hard), Moaʻula (red chicken), Nāluahine (the old women), Niu (coconut), Pakalana (the Chinese violet, *Telosma cordata*), Pāpālina (cheek), Papālinahoa, Pualii, and Wailāʻau (sap of plants, liquid medicine).

3.2.3.10.1 Līhuʻe

Līhuʻe (goose flesh) is a town within Nāwiliwili Ahupuaʻa. Its older name is Kalaʻiamea (calm reddish brown place) (Wichman 1998:59). As years progressed, Līhuʻe became a center point for the Puna District and in turn, the name Līhuʻe also represented the Puna District. And insert from the Hawaiian language newspaper *Ka Nupepa Kuokoa* illustrates such accounts.

> *O Lihue, oia ka inoa nui o keia Apana holookoa i keia wa, he inoa hou nae o Lihue, a o ka inoa mua o Puna no ia. He Apana keia e huli pono ana i ka hikina, o kekahi moku aina keia o ka mokupuni o Kauai nei. A maloko o keia moku-aina, ua mahele ia i mau Ahupuaa, i mau ili, a pela aku. A eia na Ahupuaa i kapaia he mau mahele aina iloko o ka Apana o Lihue*
>
> […]
>
> *Lihue. - Aole keia he mahele aina kuokoa mamua, aka, i keia wa, ua kuokoa oia ma kona helu ana. O ka inoa mua o keia wahi, o Kalaialamea, a i ka wa i noho ai o Kaikioewa ma Kauai nei, a hele mai oia a noho ma keia wahi, Kalaialamea. A no ka maikai o keia wahi, oluolu ka noho ana, no ka uliuli maikai o ka nahelehele, ua hoohalike o Kaikioewa i ka noho ana o keia wahi me ka noho ana ma Lihue i Oahu.*

> *No ia mea, ua kapa keia keia wahi o Lihue, mai ia wa mai ka paa ana o keia inoa o Lihue a hiki i keia la* […] [*Ka Nupepa Kuokoa* 4 September 1875]

> Lihue, it is the overall name for the entire district right now, Lihue had another name, however, Puna was its original name. This is a district on the eastern side of the larger district of the island of Kauai. Inside this district, it has been divided into land divisions, smaller land divisions, and others. Here are the land divisions that are called land sections that make up the district of Lihue.
>
> […]
>
> Lihue. – This was not an independent land section in the past, however, today, it counts as its own independent area. The previous name of this place was Kalaialamea, during the time Kaikioewa lived on Kauai, he went and resided in Kalaialamea. Because of the comfort of this place, residing here is pleasant, the forest is lush and dark, Kaikioewa compared living at this place to that of Lihue on Oahu. Because of this, this place was named Lihue, and from this time and on, Lihue has been its name even in today's time […] [Translation provided by CSH]

3.2.3.10.2 Kuhiau Heiau

Kuhiau (I gesture) is a *heiau* possibly used for ceremonial purposes as Wichman shared that "even today, it is said that one can hear the drums beating at night and see the *akua lele* (flying gods) in the form of flashing lights" (Wichman 1998:59).

3.2.3.11 Niumalu Ahupuaʻa

Niumalu, meaning "shaded coconut tree," possibly received its name for when Kūpunohu, in a contest with Kemamo, threw his spear and as it flew, it shaded the coconut trees below.

There were 22 *ʻili ʻāina* identified in mid-nineteenth century land documents: Aione, Hakala, Hawaii, Holilea, Kaaipo, Kakulua, Kaluahanu, Kaʻōhiʻa (the *ʻōhiʻa* tree), Kapaeli, Kapaihema, Kapalau, Kawaloa, Keone (the sand), Kumulii, Lauakea, Pahunui, Paiaʻa, Pākauila (fence of the *kauila* [native tree of the buckhorn family, *Alphitonia ponderosa*] wood), Palipaliahi, Pāpala (named for a tree belonging to the amaranth family, *Charpentiera*), Pauma, and Pūʻali (groove).

3.2.3.11.1 ʻAlekoko Fishpond

ʻAlekoko (rippling blood) fishpond was built by the Menehune at the request of Chief ʻAlekoko and his sister, Chiefess Kalālālehua. The Menehune had agreed upon the request with one condition: the two of them were not allowed to watch the Menehune work and must remain in their house until it was finished. The two of them agreed to the conditions and stayed in their house for most of the day and into the night. However, Chief ʻAlekoko's curiosity became too much for him to bear and he took a peek outside. Immediately, the Menehune chief knew and ordered everyone to stop working. The Menehune left the pond unfinished as reminder to Chief ʻAlekoko of breaking his promise (Wichman 1998:58)

3.2.3.12 Haʻikū Ahupuaʻa

Haʻikū has many meanings and its exact origin may have been lost. Haʻikū means "to speak abruptly," "haughty," "conceited," or "sharp break" (Wichman 1998:51).

There are 21 *ʻili ʻāina* recorded in mid-nineteenth century land documents: ʻĀlapa, Hoa, Kahakea (high, inaccessible, as a cliff), Kalaniuli, Kamoa, Kapenu, Kiwi, Kuaa, Kūʻia (obstructed), Lahaoolo, Makaokole, Makaopuna, Nakioi, Pahani, Pahunui, Peakoa, Pōhaku (stone), Puʻu Loa (long hill), Waiʻāpuka (water coming out), Wailua (two waters), and Waipapa.

3.2.3.12.1 Kalanipuʻu

Kalanipuʻu, meaning "royal or heavenly hill," is a cliff in Haʻikū Ahupuaʻa. Kalanipuʻu is referred to as a *puʻu kāhea* (calling hill) where the head fishermen of a group would call out his instructions to the fishermen below (Wichman 1998:51).

3.2.3.13 Kīpū Ahupuaʻa

Kīpū, meaning "to remain, as mist or rain," describes the weather this area commonly experiences. The Hāʻupu Ridge in Kīpū is frequently capped with a "cloud that floats like a great white bird. This cloud was called Ke-ao-lewa, ʻclouds of the atmosphereʼ" (Wichman 1998:52). When the ridge was covered with puffy, white clouds referred to as "pig clouds—one of the forms of Kamapuaʻa" (Wichman 1998:52), it was a *hōʻailona* (sign) that rain would be coming.

These 19 *ʻili ʻāina* found in mid-nineteenth century land documents refence locations within Kīpū Ahupuaʻa: Hananewa, Hooneenee, Kahuakahee, Kaiahonu, Kalumau, Kaʻōhiʻa (the *ʻōhiʻa* tree), Kapauela/Kapauwela, Kapuahi (fireplace), Keakaule, Kuhonu, Kumuʻulu (breadfruit tree), Kūpeʻe, Mahuka (flee), Paenoni (group of *noni* trees), Peekoa, Pepeawa, Puaku, Puapuaku, and Upa.

However, nine *ʻili ʻāina* were specifically identified as belonging to Kīpū Kai: Alaiki, Haleohai, Kamooloa, Keawaau, Maneiki, Pakakua, Pīhoihoi (disturbed, excited, worried, agitated), Pokeokeo, and Puhua.

3.2.3.13.1 Kīpū Uka and Kīpū Kai

The Hāʻupu Ridge cuts through Kīpū Ahupuaʻa, splitting it into two: Kīpū Uka "upland Kīpū" and Kīpū Kai (Kīpū at the sea). Kīpū Uka is a lush, wet land area, while the land of Kīpū Kai is more dry.

Kīpū Kai provided many opportunities for its people. The residents of Kīpū Kai were known to grow *ʻuala*, *ipu* (bottle gourd, *Lagenaria siceraria* or *L. vulgaris*), and *uhi* (yams). More *makai*, the people worked the salt pans and fishpond.

3.2.3.13.2 Hananena Bay

Hananena Bay references the *nena* (seaside heliotrope, *Heliotropium curassavicum*) plant. It is a prostrate herb with white or purple flowers that is indigenous to Hawaiʻi. When dried, the *nena* was used as a tea (Pukui and Elbert 1986). This plant is also referred to as *kīpūkai* as it would grow within Kīpū Kai.

3.2.3.13.3 Waiʻauʻauohiʻiaka Spring

Waiʻauʻauohiʻiaka, meaning "bathing water of Hiʻiaka," was created by Pele when she first arrived to Kauaʻi. She created this spring for her youngest sister, Hiʻiakaikapoliopele, so she would have a place to bathe (Wichman 1998:55).

3.2.3.13.4 Hinaiuka

Hinaiuka, or "Hina of the uplands," is an area on the side of Hāʻupu Ridge in the shape of a woman holding her finger to her lips. A chiefess of Oʻahu, Peleʻula heard that the women of Kauaʻi were the most beautiful. She voyaged to Kauaʻi and met with Chiefess Hina. The two ended up having a contest which involved adorning themselves and showcasing a hula. Peleʻula adorned herself with *ʻilima* (a native shrub, *Sida* or *S. fallax)*, a flower that represents Oʻahu, while Hina adorned herself with *maile* (a native twining shrub, *Alyxia olivaeformis*) and *mokihana* (a native tree, *Pelea anisata*). In the end, Hina won the contest and Peleʻula declared that the women of Kauaʻi were the most beautiful and exclaimed, "you must warn future visitors" (Wichman 1998:56). Hina's profile of her face, holding her finger to her mouth, is a warning to those coming to Kauaʻi, that Kauaʻi's beauty is unmatchable.

3.2.4 Kona Moku

The following are *wahi pana* within Kona Moku.

3.2.4.1 Māhāʻulepū Ahupuaʻa

Māhāʻulepū means "falling together," a possible reference to the battle when the past ruling chief, Kūkona, lured the invading army of the Hawaiian chief, Kalaunuiohua, into the inland area of Wahiawa, where all the Hawaiian warriors "fell together" (Wichman 1998:47). Also noted is a variant of this name, Mahaʻulepu:

> No people who love puns as much as the Polynesians could resist playing with the name Mā-hā‘ule-pū. A subtle change creates Mahaʻule-pu, ʻinactive foreskin,ʼ said as a complaint by the wives of the men who spent all their time throwing fishing nets off the reefs until their hands, feet, and other appendages become too waterlogged and shriveled to be used. [Wichman 1998:48]

There were 23 *ʻili ʻāina* named in mid-nineteenth century land documents: Halulu (to roar, thunder, or a legendary man-eating bird), Hāʻula (reddish, perhaps a reference to *limu hāʻula* [type of edible seaweed]), Kaeaea, Kahoukahe, Kalāiki, Kalānui, Kalua (the pit), Kapakalehu, Kapalehehu, Kapapalehu, Kaualehu, Kaukii, Kawailoa (the long water), Kekaualehu, Kioea (name for bristle-thighed curlew), Koholāiki (little whale), Lānui, Paeole, Papakea, Punakea (barely visible rainbow or white coral), Wailua (two waters), Waipao (scooped water), and Waipau.

3.2.4.1.1 Kāmala

Kāmala, meaning "hut" or "garden," is a place in Māhāʻulepū known for its many burials. Traditions explain that this area is where the slain warriors of Kamehameha's army were buried. Other accounts suggest this *wahi pana* was a burial place for commoners (Bennett 1931:120).

3.2.4.1.2 Keōlewa Heiau

Bennett (1931) listed this *heiau* as being destroyed before the 1930s, and suggested the meaning of this *heiau* is "shifting sand" (Bennett 1931:121).

3.2.4.2 Pāʻā Ahupuaʻa

Pāʻā literally means "dry, or rocky." Wichman defines it as "fence of lava rock" (Wichman 1998:45). Pāʻā Ahupuaʻa was famous for its *heʻe* (octopus), which were known to be large and very delicious (Wichman 1998:46).

Only five *ʻili ʻāina* are mentioned in mid-nineteenth century land documents: Hihinui (much entanglement), Kaloko (the pond), Kaluaʻōhiki (the sand crab hole), Keoneloa (the long sand), and Pula.

3.2.4.2.1 Keoneloa Beach

Keoneloa or Long Sand Beach is known for its *kuakua paʻakai* (salt ponds) (Wichman 1998:45).

3.2.4.2.2 Kāneʻaukai Heiau

Kāneʻaukai Heiau is dedicated to the god Kāneʻaukai. His sisters were turned into fishing grounds, each dedicated to a specific species of fish. Kāneʻaukai, however, turned into *wauke*.

Kāneʻaukai in his human form came across some fishermen who were praying for fish, however, they did not include the name of a particular fishing god. Kāneʻaukai, intrigued by this, asked the men why they did not include the god's name. The fishermen replied that they knew there was a god but they did not know his name. Kāneʻaukai replied, "His name is Kāne-ʻaukai, and when you let down your nets again call out, ʻEia ka ʻai a me ka iʻa, e Kāneʻaukai,' 'Here is the food and fish, Kane-aukai,' and he will help you" (Wichman 1998:46).

Every time these men went to lay their nets out, they chanted this prayer. When it was time to bring in their nets, their nets were filled with an abundance of fish. Soon, other people began to hear of these fishermen's success and started to pray to Kāneʻaukai.

3.2.4.3 Weliweli Ahupuaʻa

Weliweli means "fearful" and this area was possibly given its name due to a gruff-voiced man named Weliweli. According to Wichman (1998), when the island was being explored by the Menehune, who had been brought to Kauaʻi by Kūʻalunuipaukūmokumoku, one adventuresome group was led by Weliweli. He was very strict and everyone jumped to fulfill his orders. The area was named after him (Wichman 1998:43–44).

Only one *ʻili ʻāina* is mentioned in Māhele documents, probably reflecting the fact that only one *kuleana* Land Commission Award (LCA) was claimed for this small *ahupuaʻa*. The *ʻili* was Kahoanalua (the double whetstone).

3.2.4.3.1 Weliweli Heiau

Bennett (1931) records a *heiau* located on the shore in Weliweli Ahupuaʻa. As described by Thrum and re-recorded by Bennett, Weliweli Heiau is "a paved heiau of large size, pookanaka class […]" (Bennett 1931:120).

3.2.4.4 Kōloa Ahupuaʻa

Kōloa means "large sugar cane" and may also reference the large, soft, Hawaiian sugarcane (*Saccharum officinarum*), however, there are a few versions of how Kōloa Ahupuaʻa may have received its name. The name Kōloa may reference a prominent and steep rock called Paliokōloa, which is on the banks of Waikomo Stream. This bank area by the Waikomo Stream was also referred to as Kōloa, and possibly had a species of Native Hawaiian duck (*Anas wyvilliana*) (Kikuchi 1963:46; Pukui et al. 1974:116).

There are 66 *ʻili ʻāina* listed in mid-nineteenth century land documents, emphasizing the importance of this well-watered *ahupuaʻa* and the dense population it could support. The *ʻili* are Aea, ʻAwikiwiki, Hālāliʻi, Halehinahina, Kaakaupuawa, Kaʻauwailalo (the lower ditch), Kaauwailuna (the upper ditch), Kahoai, Kahoana (the whetstone), Kahoiwai, Kaʻiliʻili (the pebble), Kalehuaokaʻele, Kaluaʻalamihi, Kamaemae, Kamaloula (the red loincloth), Kamanomano, Kaʻōhiʻa (the *ʻōhiʻa* tree), Kāpalaʻalaea (daub of ocher), Kapalakea (a variety of taro), Kapalau, Kapo‘o, Kapuna (the spring), Kaukahōkū (the star appears), Kaulia (hung, suspended), Kauluolona, Kaunuolono (the altar of Lono), Kawailehua, Keaku, Keanakaha‘ia, Kekui, Kihinui, Kīkīaola (container acquired by Ola), Kioea (bristle-thighed curlew), Kiona (Zion, or dung heap, privy), Kōloa Hikina (east Kōloa), Kōloa Komohana (west Kōloa), Kualu, Kuunameheala, Lapapōhaku (stone ridge), Lauuluhaa, Lepoakua, Makapala (sore beginning to heal), Mākea (fallow land, or a variety of *kalo* or *awa*), Malaula, Maneneha‘aha‘a (low plantain), Manini, Ma‘uliuli, Mauna Pōhaku, Milohai, ‘Ōma‘o (green), Opuohaku, Palaulalo, Paoa, Pipipi‘eu‘eu (lively mollusk, *Theodoxus neglectus*), Poahonu, Pō‘ele‘ele (black night), Pōhakuomakali‘i (stone of Makali‘i), Puahehu, Puhaku, Punahelu, Puokahaku, Pu‘u Holo, Pu‘u o Haku (Haku hill), Waikomo (entering water), Wailā‘au (sap of plants, or a liquid medicine), and Waiohai.

3.2.4.4.1 Maulili Pool

Maulili Pool, meaning “constant jealousy,” in Waikomo Stream, was a sacred place once located in the present Kōloa Town, in the middle of the *ahupua‘a*.

One tale is of the gods Kāne and Kanaloa who slept on the eastern bank of Maulili Pool and left the impressions of their forms on the *‘āpapa* (coral flat).

> The apapa in this vicinity is called an ‘Unu.’ and a ‘Heiau,’ but was never walled in, it is said. On the nights of Kāne the drums are heard to beat there, also at the sacred rocks, or *unu’s*, of Opuokahaku and Kānemilohae, near the beach of Po‘ipū [...]. [Farley 1906:93]

Just below the resting places of Kāne and Kanaloa is the “Pali o Kōloa” or “Cliff of Kōloa.”

3.2.4.4.2 Waihānau

Waihānau, meaning “birth pool,” is a *pōhaku* located on the eastern bank of Maulili Pool. In an *oli* Waihānau is mentioned as

> *‘Aloha wale ka Pali o Kōloa,*
> *Ke Ala huli i Waihānau e, hānau.’* [Farley 1906:93]

3.2.4.4.3 Ka‘ōleloohawai‘i

Ka‘ōleloohawai‘i, meaning, “the language of Hawai‘i,” is a tongue-shaped *pōhaku* located below Waihānau *pōhaku*. It is said that Ka‘ōleloohawai‘i was brought to Kaua‘i by Kaweloleimakua from Hawai‘i Island (Wichman 1998:40).

3.2.4.4.4 Maulili Heiau

Built by Kapueomakawalu, Maulili Heiau was a *heiau* dedicated to human sacrifice. When Kapueomakawalu passed, this *heiau* was no longer used and was lost (Wichman 1998:41) until the time of ‘Aikanaka.

> When ‘Aikanaka had overcome his cousin Kawelo in the battle of stones on the plains of Wahiawa, ‘Aikanaka wanted a place to sacrifice the body. He asked that the location of Maulili [Heiau] be found, but no one knew anything about it. At last, a deaf mute was asked and he knew. He led ‘Aikana to the place, pointed out the remains of the stone walls, and the *heiau* was built. [Wichman 1998:41]

3.2.4.4.5 Louma Heiau

Louma Heiau was also built by Kapueomakawalu. This *heiau* was dedicated to Lonoikaoualiʻi in which pigs, red fishes, and other sacrifices were offered. Louma Heiau is located by a small pond just *mauka* of Maulili, along the mountain side of Hoʻoleinakapuaʻa (Wichman 1998:41).

3.2.4.5 Lāwaʻi Ahupuaʻa

Lāwaʻi, like many other Hawaiian place names, has different meanings and interpretations. According to Kikuchi (1963:39), the name *"lāwaʻi"* means "the day to end the fishing tapu." Others believe the name Lāwaʻi comes from "lawa aʻi [ʻai]" which means "plenty to eat" or "valley of plenty" (Allerton 1972:9). Pukui et al. (1974) do not give a meaning for the name.

Mid-nineteenth century land documents mention ten *ʻili ʻāina:* Haia, Hapaiehu, Kaʻohe (the bamboo), Keʻekeʻe (zigzag, angular), Kihakii, Kukuimōkoi, Kuliloli, Moʻoʻawalu (*moʻo* number eight), Papakea, and Peʻapeʻakuakui.

3.2.4.5.1 Nā Heiau

There are three *heiau* mentioned by Bennett (1931). Niukapukpau Heiau (Bennett 1931:116), which is located at the top of the hill with the same name, Niukapukapu; Kalohiokapua Heiau (Bennett 1931:116) that was used as a place for circumcision; and Mamalu Heiau (Bennett 1931:116), located near the center of Lāwaʻi Valley.

3.2.4.6 Kalāheo Ahupuaʻa

Kalāheo, meaning "the proud day," is known for its saltwater pond, Nōmilu, and a prominent cinder cone, Kukuiolono.

There are 16 *ʻili ʻāina* are mentioned in mid-nineteenth century land documents: Halekamahine (house of, for a girl), Haleopai (shrimp house), Kaawa, Kalaaukiele, Kapaili, Koali (morning glory), Koʻolau (windward), Lonohale, Mahuolo, Makaʻalaea, Pāʻele (dark, black; also a variety of sweet potato), Poipuupuu, Punipoi, Puʻu Halulu, ʻUmiʻumihale, and Waiʻāpuka (water coming out).

3.2.4.6.1 Nōmilu

Nōmilu, meaning "seepage whirls," refers to how the water seeps away in the form of whirlpools as the level of the pond rises and falls with the tide. Nōmilu is a natural salt water pond where a series of salt pans "produced the finest and most desired salt of Kauai" (Wichman 1998:34–35).

The cape fronting Nōmilu is known as Nāmakaokahaʻi or Makaokahaʻi. Nāmakaokahaʻi is the sister of Pele. As Pele traveled through the Hawaiian Islands from Niʻihau to Hawaiʻi, she would attempt to make herself a home. However, each time Pele dug her *ʻōʻō* (digging stick) into the earth to make her lava pit, Nāmakokaʻi would send a mighty wave and drown Pele's pit with seawater.

> Then Pele caused the hill she and her sister were fighting on to erupt, which covered the plains of Wahiawa with stones the size of coconuts. Nāmakaokahaʻi flooded the new crater, forming the pond. Pele fled to Oʻahu, followed by Nāmakaokahaʻi. The cape at Nōmilu is named Nā-makao-ka-haʻi, in memory of she who put out the volcano. [Wichamn 1998:36]

3.2.4.6.2 Puhiʻula and Puhipakapaka Stones

After the battle between Pele and Nāmakaokahaʻi, Pele fled to Oʻahu. As she departed, she turned two supernatural eels into stone to always guard and protect this place that was once meant to her home. These stones are called Puhiʻula (Red eel) and Puhipakapaka (Scaly eel).

3.2.4.6.3 Kakalua Spring

Kakalua, meaning "sinkhole," is a spring located on the side of Nōmilu pond. Kakalua Spring was famous for *ʻōpae* or shrimp. According to Wichman, "these shrimp were a light pink and had a white spot in front of the head and sometimes a white tail. The Menehune were especially fond of these shrimp […]" (Wichman 1998:35).

3.2.4.6.4 Kukuiolono

Kukuiolono, meaning "the light of Lono," is visible throughout the Kona District. A bonfire was lit on top of Kukuiolono as a beacon for fishermen (Wichman 1998:33–34).

3.2.4.6.5 Nā Heiau

On top of Kukuiolono was Kukuiolono Heiau, one of the largest *heiau* on the island (Wichman 1998:34). Kahalekiʻi Heiau, located nearby Kukuiolono Heiau, is a *heiau* dedicated to Lono, one of the four major gods, who represented the clouds, winds, sea, fertility, and agriculture. Sacrifices of animals were made at Kahalekiʻi, however, the animals were brough already t dead, as to not pollute the *heiau* with blood. The place where the sacrifices were killed was known as Nāpōhakuakiʻi (Wichman 1998:34). Nearby Kahalekiʻi Heiau was Ipuolono Heiau. This was a small *heiau* that perpetuated the spiritual values of daily prayer. According to Wichman:

> Each family owned an *ipuolono,* a food gourd covered with wickerwork and hung with strings from a notched stick. Vegetable food, fish, meat, and kava were kept in the gourd. Twice a day, the family head took the gourd down and laid it at the door of the house. Facing the sun, he prayed for his chief, his extended family, and for his own immediate family. Then he ate some of the food and sucked on the kava root. Afterward, the *ipuolono* was washed, the food was replaced, and the gourd stored away again. [Wichman 1998:34]

3.2.4.7 Wahiawa Ahupuaʻa

Wahiawa (Wahi-awa), or "milkfish place," was said to have been named after the *awa* (milkfish), which were plentiful and easy to harvest. The *awa* were "grown in taro fields, needing no other sustenance than the algae that grew among the taro corms" (Wichman 1998:32). The *awa*, specifically the belly, was soaked in salted water and mist with *limu manaua*, a reddish seaweed, or *limu ʻoʻolu*, another variation of a red seaweed (Wichman 1998:32).

3.2.4.7.1 Pōhakuawa

The Pōhakuawa is a large boulder with a bowl carved into its surface. The stone was used in traditional Hawaiian times by fisherman transporting *awa* from the brackish Nōmilu Fishpond to a large pool in the Wahiawa Stream. "The fisherman stopped the night at Pohakuawa and kept his catch alive in cool fresh water in the bowl of the rock that was draped over with vines to keep the stone cool and keep the fish from jumping out" (Sandison 1956). The *awa* fish (*Chanos chanos*) has close associations with *loko iʻa* and was a common fishpond species throughout the islands.

3.2.4.7.2 Kāhili Peak

Halfway up the ridge leading to Kawaikini and Wai‘ale‘ale is Kāhili, meaning “feather standard.” Here at Kāhili, various *ahupua‘a* boundaries meet. These *ahupua‘a* included Kōloa, Hā‘iku (in Puna District), Wahiawa, and Kalāheo. According to Wichman (1998), places like Kāhili were valuable in maintaining law and order. These areas were known for their *manu* (bird) and many bird-catchers would gather within this vicinity.

> Such a common border needed to be something recognizable, especially as this was bird catching country. Like the laws that regulated the use of water, the laws concerning the *kia manu* (bird-catchers) were very strict. Each *ahupua‘a* had to pay as tax a certain amount of feathers taken from the bright honeycreepers—the yellow of the *‘anianiau*, the green of the *‘ō‘ū*, the red of the *olokele*. The *kia manu* always made sure that birds were left for breeding purposes. Some, like the black *‘ō‘ō ‘ā‘ā* that had only a few yellow feathers under its wings, were plucked and released to grow new ones. [Wichman 1998:31]

3.2.4.7.3 Pōhakuloa

Pōhakuloa meaning “long rock,” was an erect stone and was one of three that stood in a line.

> Pōhakuloa on the plain, one on the seacoast that is now gone, and one out in the sea where the deep-sea fishing grounds were. These stones together were a *ko‘a* (fishing shrine) where a fisherman prayed for success on his way to fish and where he left an offering of the first catch of the day on his way home. [Wichman 1998:32–33]

3.2.4.7.4 Kaua‘iiki Stone

While clearing their *lo‘i kalo* of stones, this Hawaiian family came across a *pōhaku* that resembled Kaua‘i. Because of this, this family left the stone in its place and gave it the name Kauai‘iiki or Small Kaua‘i (Sandison 1956). An additional account by Keahi Luahine makes reference to the large stone shaped like the island of Kaua‘i:

> At Wahiawa on Kauai was a stone called Kauai-iki which stood in a taro patch also called Kauai-iki. The taro that grew there was the finest and the largest on the island, said to be made so by the stone. When the paved road was built Alexander McBride [*sic*] removed the Kauai-iki stone so that it should not be blasted and ground up by the road workers. He took it to Maialoa and later to Kukui-o-Lono Park where it is to this day.
>
> In ancient times people used to say that even though you had seen the entire island of Kauai and had not seen Kauai-iki, then you had not seen all of Kauai. This small taro patch and stone were much visited in the old days. [Pukui in Handy 1940:65]

3.2.4.7.5 Ke‘ukihōlua

Ke‘ukihōlua is a land area in Wahiawa Ahupua‘a. Meaning “sedge for a sled racecourse,” the *‘uki* (sedge grass) was known to grow in the area and was used to cover the *hōlua* racecourse as its slippery texture helped create the ideal environment for the best *hōlua* sledding (Wichman 1931:33).

3.2.4.8 Hanapēpē Ahupua‘a

Hanapēpē (crushed bay) has two main origin stories for its name. One says this name was given because of its land attributes and its appearance when a person is gazing at Hanapēpē while out on the ocean. From the ocean, it looks like the cliffs are crushing the bay. Another origin of Hanpēpē is linked to a species of a bird that was prominent in the area. Wichman (1998) stated that:

> Some say that the appearance of the cliffs from the sea is the source of the name Hana-pēpē, ‘crushed bay.’ In addition, hanapēpē was the name given to a honeycreeper that is called nukupu‘u on the other islands. It was notable for having one mandible much longer than the other. The name hanapēpē recalls the lost species of colorful birds whose feathers provided the raw materials of the finest form of Polynesian art—the feathered capes, helmets, standards, and wreaths. [Wichman 1998:30]

There were 25 *‘ili ‘āina* in mid-nineteenth century land documents: Akia, Hanapēpē Luna (Upper Hanapēpē), Hikiula, Ka‘auwaikahi (the first *‘auwai*), Kaawaiki, Kaawanui, Kahaoa, Kahunaone (the speck of sand), Kamōhio (the draft, gust of wind), Kamoku (the district of the cut-off portion), Kamoonui, Kapalawai (the bottom lands), Kapouhana (kingpost), Kapuaahola, Kuhumu, Kuhumulalo, Kuhumuluna, Kūmimi (named for an anthid crab), Opulala, Ukuula, Waiaka (reflection water) or Wai‘aka (laughing water), Waikanono, Waikanonoluna, Waikoko (blood water), and Waiulili.

3.2.4.8.1 Manauahi

Manuahi, meaning “fire bird,” was a well-inhabited valley due to the land and streams. The term “fire bird” is taken from the *mo‘olelo* of Māui, a demigod who gained the knowledge of fire through the *‘alae‘ula* (red *gallinule*).

> […] ‘the ‘alae, the endemic gallinule, which had the secret of fire. The demigod Māui got the secret of fire from the bird and burned the top of the ‘alae’s head in revenge for its many lies. Since then the dark gray bird always has a fiery red streak on the top of its head.’ [Wichman 1998:27–28]

3.2.4.8.2 Kō‘ula Stream

Kō‘ula, meaning “red sugarcane,” is an *‘ili ‘āina* and a *kahawai* within the Hanapēpē Ahupua‘a. The Kō‘ula Stream helped feed the various farmlands and toward the lower end, fed the Manawaiopuna Waterfall (Wichman 1998:27).

3.2.4.8.3 Manawaiopuna Waterfall

Manawaiopuna, which translates as “Stream branch of Puna,” is a famous stream and waterfall of Kō‘ula and is considered that most beautiful waterfall (Wichman 1998): “[…] two streams flow over the top of the cliff and join together about halfway down and drop the last hundred feet in a wide flow. The mists keeps the lichens and ferns green and moist” (Wichman 1998:27).

3.2.4.8.4 Pōhākani Stone

Pōhākani, meaning “sounding stone,” was located in Manuahi and was a *pōhaku* with a hole in the middle. However, this stone was partially destroyed after the rebellion of 1824. According to Wichman (1998):

> […] it was struck with the stalk of *kī* (ti plant), it sounded like a drum and was used as a signal from one *heiau* to another. After the rebellion of 1824, Ka‘ahumanu queen regent of all the islands, sent Huleia, a former priest now converted to Christianity, to destroy every vestige of the old religion on Kaua‘i. Pōhākani was on the list and Huleia broke off a part of the inside of the hole. Now, instead of shouting a resounding drumming sound, Pōhākani only whispers. [Wichman 1998:27–28]

3.2.4.8.5 Pāpōhakuhuna‘ahu‘ula

There is a large stone at the river crossing called “Pāpōhakuhuna‘ahu‘ula” which translates as “stone wall in which a feather cape is hidden” where ‘Aikanaka hid his *‘ahu‘ula* in order to conceal his rank (Wichman 1998:27).

3.2.4.8.6 Kaleinaaka‘uhane

Kaleinaaka‘uhane, meaning “leaping place of the soul,” is a cliff located across from Holoiwi. Here is where the souls of the dead would gather and leap over the cliff and transition to their journey into *pō* (night). “The souls of the dead gathered at this place and leaped over the cliff to the valley floor, where they embarked on canoes that took them to Pō, the land of the dead that lies deep in the ocean off the west end of the island” (Wichman 1998:29–30).

3.2.4.9 Makaweli Ahupua‘a

Makaweli has several meanings associated with its name. Wichman (1998) explained that there are variations on the meaning of Makaweli, which seem to correlate to *heiau* and human sacrifice.

> Maka-weli has several interconnected meanings: ‘glaring, threatening eyes,’ a reference, some say, to the shining mother-of-pearl eyes of the fierce wooden idols that surrounded any *heiau* where human sacrifices were offered; ‘fearful eyes,’ of the victims themselves; and ‘terrifying eyes,’ of the idols hungry for blood. [Wichman 1998:22]

However, a more ancient name for Makaweli is Ho‘ānuanu which means “to cause cold” (Pukui 1983:47). This older name is no longer used to refer to Makaweli Ahupua‘a as a whole; however, it is a name still used to refer to Ho‘ānuanu Bay along the ocean.

There were 36 *‘ili ‘āina* mentioned in mid-nineteenth century land documents: Hakioa, Hoolamau, Huahā‘ule (fallen fruit or seed), Kaala, Kahana (cutting), Kahoomano, Kakalae, Kalemokaaina, Kaloulu, Kamakaheleikou, Kaneli, Kanoheka, Kapapa (the flat surface), Kapuemana, Keāhua (the mound), Kekupua (the demigod), Koleakalo, Kuanuu, Kuanuuiki, Kukinihohoi, Māha‘iha‘i (brittle), Mahinauli (dark moon), Māka‘ika‘i (to visit, stroll), Manini (many things), Mokuone (sand island), Moole, Nonopahu, Papaloa (long flat), Piliamo‘o (cling, as a lizard), Poliwai, Puulima, Uhilau, Waikai, Waikolu (three waters), Wailele (waterfall), Wiliwilike‘e (crooked *wiliwili* [Hawaiian leguminous tree, *Erythrina sandwicensis*, formerly called E. Monosperma] tree).

3.2.4.9.1 Pakala

Pakala, like other Hawaiian place names can be interpreted in many ways dependent on the spelling and pronunciation. Some of these variations include Pākala (unicorn fish enclosure), Pākalā (shining sun), or Pākālā (money field). Clark (2002) included a *mo‘olelo* shared by Carlos Andrade in his conversation with a *kama‘āina* of Ni‘ihau.

> […] He told me that there were several perspectives on the name without fully committing to singling out one as being ‘right.’ Pākala with only one *kahako* on the first a could be translated as an enclosure for the unicorn fish known as kala. Pākalā, with *kahako* over the first and last a’s, has to do with the shining (*pā*) of the sun (*ka lā*). Pākalā is in the lee of Kaumakani, where the clouds and wind stop and rest, and till this day the onshore wind that is common on Pākalā on especially clear mornings has to do with the shining of the sun at this place, heating the land and causing convective winds to come in off the sea even on days when the trades are strong on the east side of Kaua‘i. Apela also told me that if the name were pronounced with all three a’s covered by the *kahako* [Pākālā], it could mean ‘money field.’ The sugarcane plantation of the Robinsons is legendary for its production of sugar in pounds per acre. A combination of lots of sunshine and abundant water from the Waimea, Hanapēpē, and Olokele valleys makes this possible. It is one of the last surviving sugar plantations because of these phenomena. Close to what is the little village of Pākalā today are the most productive of the fields, according to Apela, of the entire plantation. Hence the possibility of ‘money field,’ the fields that produced the most profit […]. [Clark 2002:279–280]

3.2.4.9.2 Kukui‘ula Spring

Kukui‘ula or “red candlenut” is a spring within the Wai‘awa‘awa valley.

> A red kukui tree was planted here by Kahapula, the mother of Ola, after she was banished to Mokuone by her husband, Kū‘alunuipaukūmokumoku. When they parted, he gave her a loincloth, a feather cape, a helmet, and a spear as gifts for their unborn son and a *kukui* nut that she was told to plant as soon as she arrived. [Wichman 1998:23]

3.2.4.9.3 Kahōluamanu Canyon

Kahōluamanu means “sled of Manu”; it is located in Olokele. This canyon was named after Manu, a boy who was mistreated and overworked by his parents, who did not have time to learn the sport of *hōlua* (sled).

One day, Manu watched as a Menehune slid down the hill on a *hōlua*. This Menehune unfortunately fell and his sled broke. Manu, being a kind child, repaired the Menehune’s sled in between all his chores. As a thank you, the Menehune gifted Manu a special *hōlua* sled (Wichman 1998:24).

3.2.4.9.4 Nā Heiau

‘A‘akukui Heiau rests by the Kekupua Valley and has been described as “a paved and walled heiau in good preservation” by Thrum (Bennett 1931:111). Kapakaniau Heiau was unable to be located by Bennett (1931), however, it has been recorded by Thrum that Kapakaniau Heiau was “a paved, open platform heiau; in good condition” (Bennett 1931:152). Located at the ridge near Hikilei and Kunalele valleys, Kaunumelemele Heiau is said to be as Thrum describes, “an open platform heiau in good condition” (Bennett 1931:111). Kūwiliwili Heiau rested in the cane fields, by Makaweli Camp 3. Thrum has described the *heiau* as “a large, high walled enclosure of pookanaka class now destroyed” (Bennett 1931:112). Unfortunately not much is known about Mahaihai Heiau except that it was destroyed. It was previously noted on an old map by Frances

Gay (Bennett 1931:111). The location of Peeamoa Heiau is unknown, however, it has been described by Thrum as "an unwalled heiau" (Bennett 1931:152).

3.2.4.10 Waimea Ahupuaʻa

Waimea, meaning "red water," is the name of the *ahupuaʻa*, river, and canyon. Kuʻalunuikiniāke is credited as one of the first known settlers of Kauaʻi, who chose Waimea as his home possibly for the water and climate. Waimea is known for its shallow seas between Kauaʻi and Niʻihau which bring in a bountiful of fish, access to fresh water, and a warm climate which was ideal for growing crops (Wichman 1998:6).

There were 38 *ʻili ʻāina* in mid-nineteenth century land documents: ʻEleao (aphid), Hakila, Halepua, Hopeʻō (wasp, yellow jacket), Kahuamoa (chicken egg), Kekauakaloha, Kalooloa, Kamuliwai (the river mouth, estuary), Kanaʻana (Canaan), Kapalawai (the bottom lands), Kapele, Kaulu (ledge, grove) or Kaʻulu (breadfruit), Kekaha (the place), Koaiʻe (acacia koaia tree), Koaiki, Koolaiki, Koolanui, Kukui (candlenut lamp, light of any kind), Laumahi, Miloliʻi (find twist as sennit cord), Mokihana (*Pelea anisata*), Nāmāhana (the twins), Nania, Nuʻalolo, ʻŌpelu (variety of taro), Paliuli (green cliff), Pauiwa, Peekauai, Pepekanaka, Pōkiʻi (youngest brother or sister), Puehulunui (big feathers on the back of a bird), Waiahulu, Waiʻalae (mudhen water), Waiawa (milkfish water), Waiʻawaʻawa (bitter water), Waikolu (three waters), Waimea (reddish water, as from erosiion of red soil), and Waiōhole (mature *āhole* [*Kuhlia sandvicensis*] water).

3.2.4.10.1 Waikea and Kawaiʻulaʻiliahi

Waikea (white water) and Kawaiʻulaʻiliahi (water that turns the skin red as fire). These two streams did not mix. If they were to cross paths, the clear water was Waikea and the reddish water was Kawaiʻulaʻiliahi (Wichman 1998:7).

3.2.4.10.2 Kīkīaola

Kīkīaola means "container acquired by Ola" and refers to the *ʻauwai* that Ola asked the Menehune to help construct. Farmlands were then established around this *ʻauwai* (Wichman 1998:9).

3.2.4.11 Mānā Ahupuaʻa

Mānā means "arid," and the lifestyle of those from Mānā is quite different from the rest of those on Kauaʻi. A *moʻolelo* shared that a chief and his wife were banished in exile and sent to live in Mānā.

> This land of sand, march, and heat, intermingled fresh and salt water, a land of decorated gourds and of fishermen, the home of supernatural white and black dogs, a land where confused spirits of the newly dead wandered, was not at first a desirable place to live. But a chief named ʻUweʻuwelekēhau and his wife made it so. [Wichman 1998:158–159]

There were no *ʻili ʻāina* identified within Mānā Ahupuaʻa, however, it is possible that some *ʻili ʻāina* accredited to Waimea Ahupuaʻa are within the vicinity of Mānā Ahupuaʻa. It was noted by Soehren (2019) that Mānā was "one of 9 Crown lands, formerly an ahupuaa in the ʻokana of Waimea. Not named in Mahele Book" (Soehren 2019).

3.2.4.11.1 Kamoenahoholaomānā

Kamoenahoholaomānā, meaning "unfolding mat of Mānā," is a beach named by a traveler from Kahiki who came to Mānā. This traveler built his house on the sand dunes so he could enjoy and partake of the view of the beach unfolding before his eyes like a mat (Wichman 1998:159).

3.2.4.11.2 Kapuʻai

Kapuʻai means "taboo on eating" and is a beach in Mānā. It is named to warn people to not eat the fish in these waters as the fish are poisonous. According to Wichman: "*Weke* fish caught here have fed on a seaweed that contains a poison that accumulates in the fish's head. This poison at best cause psychedelic dream but can also prove fatal. This still holds true today" (Wichman 1998:160).

3.2.4.11.3 Keonekanionohili

Keonekanionohili, also known as "barking sands of Nohili," was named after Nohili, a fisherman, and his dogs. Unlike most Native Hawaiians who only raised dogs as livestock or for sacrificial purposes, Nohili kept his dogs like pets and would not eat nor kill his dogs (Wichman 1991:24).

> […] Nohili had collected the nine colors of native dogs. The largest of these was an *ʻīlio moʻo*, a dog brindled like a lizard's skin. There was an *ʻīlio apowai*, a gray-brown dog whose eyes and nose were the same color. The *ʻīlio peʻelua* was striped like a caterpillar and the *ʻīlio makue* was a solid brown. There was an *ʻīlio ʻōlohe*, a hairless dog noted for its fierceness and cunning. The four small dogs were the *ʻīlio iʻi ʻāʻula,* reddish brown like the seaweed; the *ʻīlio iʻi keʻokeʻo* that was like the whiteness of breaking waves; the *ʻīlio iʻi hinahina*, the dog that was the gray of the low spreading beach plant; and the *ʻīlio iʻi ʻea ʻula*, the dog colored like a turtle shell. [Wichman 1991:24]

Nohili would tie up his nine dogs to three different pegs (three dogs per peg) as he went fishing. On one of his fishing trips, he was caught in a storm that pushed him out to the island of Nihoa. Nohili's dogs would run around, bark, and dig into the sand to help guide Nohili home. When Nohili finally made it ashore to Kauaʻi, his dogs were gone. The only trace of them were the circles and markings they have left running around and barking. As he continued on his way, he could hear his dogs barking as if it was coming from below. It is believed that in the dogs' attempt to guide Nohili back home, they buried themselves into the sand (Wichman 1998:160–161).

3.2.4.11.4 Kolo

Kolo means to "creep, crawl, or pull." Located at the foot of one of the ridges of Puʻukāpele, there were five taro patches. What made these taro patches unique was the way the taro was farmed. During the season of heavy rains, wooden frames were made and taken to the ponds. Here the farmers would tie the frames together and fill the frames with dirt until the frames were buried. *Kalo* was then planted in the new mounds which ended up looking like "one large floating field of taro" (Wichman 1998:161). The only other place this occurred is in Hāʻena, Kauaʻi.

3.2.4.11.5 Polihale Heiau

Deemed as one of the oldest and most sacred *heiau* on Kauaʻi, Polihale (House Blossom) Heiau is dedicated to Kāne and Kanaloa as this was their first home in Hawaiʻi. According to Wichman:

> Chief Polihale had a daughter, Nā-pihe-nui, who attracted the attention of Kū, the first of the four great Polynesian gods to come to Kauaʻi. In the form of a white dog, he [Kū] would play with her [Nā-pihe-nui] and her maidens as they swam and bathed in the nearby pond. He asked Polihale for his daughter, but he was refused. Kū said he would kill all the inhabitants one by one until Polihale would agree to the marriage. Kū did so in his form as a large black dog. Polihale prayed to Kāne and Kanaloa, two more of the great gods, to help him in this uneven battle. The gods came in their seagoing bird forms and defeated Kū. In thanks, Polihale built this *heiau* that bears his name as the first home in Hawaiʻi of Kāne and Kanaloa. [Wichman 1998:162]

It is also believed that the spirits of the dead would gather at Polihale, by Kāʻana (divide). Here the spirits would follow Hikimoe (to arrive prostrated) Stream to Polihale Heiau. The spirits would rest here before continuing their journey up the cliff and leaping into the ocean into Pō (Wichman 1998:162).

3.2.5 Nāpali Moku

The following are *wahi pana* within Nāpali Moku.

3.2.5.1 Awaawapuhi Ahupuaʻa

Awaawapuhi (eel valley) Ahupuaʻa is said to be named after an eel made its home in the valley. While searching for a new home, the eel slithered through the area, carving out the ridges of the valley (Wichman 1998:152–153).

3.2.5.2 Honopū Ahupuaʻa

Honopū (conch bay), like its neighboring *ahupuaʻa*, was home to various house lots and consisted of an extensive irrigation system. Honopū Ahupuaʻa possibly received its name from the *pū* (triton shell) where the tip was cut off so the shell could make a trumpet-like sound (Wichman 1998:148–149).

3.2.5.2.1 Kainamanu Peak

Kainamanu (sound of birds in the distance) is a peak overlooking Kalawao valley and stream. This peak possibly received its name because this area is frequented by *kia manu* or bird catchers who would catch birds to collect their feathers (Wichman 1998:150). These feathers were used to make *ahuʻula*, *lei*, and other prized items.

3.2.5.3 Kalalau Ahupuaʻa

Kalalau Ahupuaʻa was heavily populated and the largest *ahupuaʻa* in the Nāpali District. Being a self-sufficient *ahupuaʻa*, many varieties of produce were grown such as *kalo*, *maiʻa*, *ʻuala*, *kō* (sugarcane), and others. There is a variety of *kalo* called Kalalau, possibly in reference to this *ahupuaʻa*. Fish were also easy to access when the seas were calm (Wichman 1998:148).

There are two ways in which the name of this *ahupuaʻa* can be pronounced and written. One way is "Kalalau" which is in reference to a *moʻolelo* about a giant named Puni and the Menehune. Puni, being a giant, arrived at this area long before his Menehune companions. To pass the time, he shaped the cliffs of Kalalau to resemble curtains. Another pronunciation would be Kalālau (to seize) which is related the actions of Kukuaokalalau, a man who would steal fish nets, taro fields, or basically anything he wanted (Wichman 1998:142–143).

3.2.5.3.1 Trails of Kalalau

Kalou (the hook) is one of the most used trails in Kalalau Ahupua‘a, beginning at Kilohana and ending toward Kaunuohua. This trail leads to the Nāwaialole (Lole’s water) Valley where there is a small spring. Keala(a)ka‘īlio (dog’s trail) is a trail along the cliff, while Kapea (scrotum) trail leads down the steep cliffs of Kalalau Ahupua‘a. Kapea possibly got its name as a reference “to the fact that the scrotum of a frightened man has a tendency to tighten” (Wichman 1998:144).

More toward the eastern side of Kalalau Ahupua‘a is Kanau (chewed) trail which ran along the narrow Kaloa ridge. Ke‘ala (pathway) trail ran from the valley below up *mauka* to Ke‘ala Peak. The trail continued on the Āle‘ale‘alau Peak and into Hanakoa Ahupua‘a (Wichman 1998:146–147).

3.2.5.3.2 Nākeikionā‘iwi Peak

Nākeikionā‘iwi (the children of Nā‘iwi) is one of the peaks of Kalalau Ahupua‘a, close to Nianiau peak. Nākeikionā‘iwi is marked with two large *pōhaku*, representing Nā‘iwi’s children who were turned to stone by the sun. Nā‘iwi’s two children could not be touched by the sun, which left them bored as they only played with each other and not with the other kids in the valley below. Usually, the children in the valley would return home after the sun went down. However, one day the children played through the sunset and into the night. Nā‘iwi’s children grasped at the opportunity and ran down to valley to play. Excited with newfound friends, all the children played throughout the night and into the early morning. Nā‘iwi’s children noticed that the sky was beginning to brighten and sprinted back home. However, as they approached the peak, they were touched by the sun and both were turned into stone (Wichman 1998:146).

3.2.5.3.3 Waihonu Pool

Waihonu (turtle water) is a pool that provided a place for residents of Kalalau Ahupua‘a to swim safely. This area, as its name suggests, was also a place of refuge for turtles where they could safely lay their eggs in the sand (Wichman 1998:148).

3.2.5.3.4 Kahuanui Heiau

Kahuanui (big foundation) Heiau is named after Lohi‘auipo’s sister, Kahuanui. Kahuanui, along with being *kumu* of a *hālau hula* in Hā‘ena, was famously known for her *kapa* making skills. It is said that when Pele first came to Kaua‘i, Kahuanui gifted Pele a *kapa* she had beaten from *laua‘e* ferns, which provided the *kapa* with a most pleasant scent (Wichman 1998:148).

3.2.5.4 Pōhaku‘au Ahupua‘a

Pōhaku‘au (swimming rock) Ahupua‘a is a small *ahupua‘a* that stretched from the cliff-lined shoreline to the ‘Āle‘ale‘alau, the highest peak in the Nāpali district. Pōhaku‘au Ahupua‘a is bordered by Kalalau on the west and Hanakoa on the east.

3.2.5.4.1 Pōhakukūmanō Stone

Pōhakukūmanō (rock resembling a shark) is a stone in the shape of a shark which lives in the Keaomau cave. Roughly 60 to 70 feet (ft) long, the head of the *pōhaku manō* (shark stone) is in Pōhaku‘au Ahupua‘a while the tail is in Hanakoa Ahupua‘a. Residents would offer banana leaves to this shark for protection (Wichman 1998:140).

One *moʻolelo* suggests this area was a favorite place for Koʻamanō, a shark guardian who watched over the seacoast. Koʻamanō would take Laukahiʻu, the grandson of *aliʻi nui* Kūhaimoana, to the cave to bask in the waterfall and to partake in the freshwater (Wichman 1998:141).

Another *moʻolelo* shared that this was a shark killed by Makanikau, chief of the winds. Makanikau was a *kupua* who could take the form of wind or man. While traveling to Kauaʻi from Oʻahu in his wind form, Makanikau noticed that several men were being troubled by a shark. Makanikau quickly changed into his human form, dove into the water and landed on the shark. Grabbing the shark by its fins, he led the shark to the cave, tied him up, and turned him into stone (Wichman 1998:141).

3.2.5.4.2 Kawaikūʻauhoeakalawaiʻa Cliff

Kawaikūʻahoeakalawaiʻa (water of the paddle handle of the fisherman) is a cliff along the shore where freshwater would cascade down the face of the cliff. When fishermen were out at sea and became thirsty, they would stick their paddles against the cliff and let the freshwater trickle down their paddle so they could quinch their thirst (Wichman 1998:141).

3.2.5.4.3 The Resting Places of Pōhakuʻau

Due to the features of this *ahupuaʻa*, most trails went up to the ridges as there was no other way in or out of this *ahupuaʻa*. Because of this, there were several resting spots created for those making the journey out of Pōhakuʻau. Kauakoʻū (moist rain), Pueoinu (drinking owl), and Keahupōhaku (heap of rocks) are a few of those resting places (Wichman 1998:142).

3.2.5.5 Hanakoa Ahupuaʻa

Hanakoa (bay of warriors or bay of *koa* trees) Ahupuaʻa is nestled between Pōhakuʻau and Kalalau Ahupuaʻa toward the west and Hanakāpiʻai Ahupuaʻa on the east. This *ahupuaʻa* was presumed to be well-populated as there is an extensive area of house sites and wetland taro patches.

Another name variation for this *ahupuaʻa* is Hanakeao. Hanakeao was the name of a Menehune chiefess. As the Menehune were leaving Kauaʻi, they approached the cliffs. Unfortunately, Hanakeao slipped on a stone and plunged off the cliff. This *ahupuaʻa* was named in her memory (Wichman 1998:139).

3.2.5.5.1 Waiahuakua and Wailaʻa

Waiahuakua (waters of the altar of the gods) is a valley along the border of Hanakāpiʻai whose waters flowed from the mountains to the ocean. Wailaʻa (sacred water) is an *ʻili* within the valley which consisted of house lots and *loʻi kalo* nestled along the stream (Wichman 1998:140).

3.2.5.6 Hanakāpiʻai Ahupuaʻa

Hanakāpiʻai Ahupuaʻa was a well populated valley. Its meaning, however, is often mistranslated or listed as unknown. Hanakāpiʻai Ahupuaʻa was named after a chiefess who died in childbirth by the Menehune. This *ahupuaʻa* is often written as Hana-ka-pī-ʻai which translates to "bay sprinkling food," however, this name and translation has no relation to the origin of its name. Wichman (1998) provided an additional written variation of the *ahupuaʻa*, its translation, and possible origin.

> A play on words transposes the name into Hana-ka-pī-ʻei, 'constant looking out to protect a love affair.' A certain chiefess named Hanakoa liked to 'make trouble'

> with a handsome chief named Wai-ehu. They met in a cave, thinking themselves secure from prying eyes, but brought attention to themselves by constantly peeking out to see if they are being observed. [Wichman 1998:138]

Hanakāpiʻai Ahupuaʻa was famed for its *nōpili* or *ʻoʻopu peke* (dwarf goby fish). This *ʻoʻopu* is a variation of the *ʻoʻopu ʻai lehua* (lehua-eating *ʻoʻopu*) which had the ability to climb vertical rock walls. *Nōpili* could be found in the streams and river in Makaweli, Hanalei, and Wainiha, but the ones in Hanakāpiʻai were known as *ʻoʻopu peke* because it was much shorter and thicker than those found elsewhere (Wichman 1998:138).

3.3 *Nā ʻŌlelo Noʻeau* (Proverbs)

Hawaiian knowledge was shared by way of oral histories. Indeed, one's *leo* (voice) is oftentimes presented as *hoʻokupu* ("to cause growth," a gift given to convey appreciation, to strengthen bonds); the high valuation of the spoken word underscores the importance of the oral tradition (in this case, Hawaiian sayings or expressions), and its ability to impart traditional Hawaiian "aesthetic, historic, and educational values" (Pukui 1983:vii). Thus, in many ways these expressions may be understood as inspiring growth within reader or between speaker and listener:

> They reveal with each new reading ever deeper layers of meaning, giving understanding not only of Hawaiʻi and its people but of all humanity. Since the sayings carry the immediacy of the spoken word, considered to be the highest form of cultural expression in old Hawaiʻi, they bring us closer to the everyday thoughts and lives of the Hawaiians who created them. Taken together, the sayings offer a basis for an understanding of the essence and origins of traditional Hawaiian values. The sayings may be categorized, in Western terms, as proverbs, aphorisms, didactic adages, jokes, riddles, epithets, lines from chants, etc., and they present a variety of literary techniques such as metaphor, analogy, allegory, personification, irony, pun, and repetition. It is worth noting, however, that the sayings were spoken, and that their meanings and purposes should not be assessed by the Western concepts of literary types and techniques. [Pukui 1983:vii]

Simply, *ʻōlelo noʻeau* may be understood as proverbs. The Webster dictionary notes a proverb 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 these Hawaiian expressions or proverbs contain references to places. This section draws from the collection of author and historian Mary Kawena Pukui and her knowledge of Hawaiian proverbs describing *ʻāina* (land), chiefs, plants, and places. The following proverbs concerning the *ahupuaʻa* in Kauaʻi come from Mary Kawena Pukui's *ʻŌlelo Noʻeau* (Pukui 1983). Unfortunately, not all *ahupuaʻa* possessed an *ʻōlelo noʻeau*. However, it may be possible that there may be *ʻōlelo noʻeau* that have yet to be discovered in Hawaiian newspapers, chants, and/or songs.

3.3.1 Haleleʻa Moku

The following are *ʻōlelo noʻeau* within Haleleʻa Moku.

3.3.1.1 Hāʻena Ahupuaʻa

Several *ʻōlelo noʻeau* include reference to Hāʻena Ahupuaʻa.

3.3.1.1.1 Ka ʻŌlelo Noʻeau #1799

The following proverb is in reference to the *moʻo wahine,* Kilioe, the one Pele faced when she chanted the winds of Kauaʻi, Niʻihau, and Nihoa.

> *Kilioe, wahine i uka*
>
> Kilioe, woman of the upland.
>
> Kilioe, was a wahine moʻo (lizard woman) famed in chants and songs of the aliʻi. She belonged to Kauaʻi and it was she who tried to prevent Hiʻiaka from taking the body of Lohiʻau from a cave at Hāʻena. [Pukui 1983:193]

3.3.1.1.2 Ka ʻŌlelo Noʻeau #2392

The following proverb describes an event where firebrands were hurled from the cliffs of Hāʻena.

> *ʻŌʻili pulelo ke ahi o Kāmaile*.
>
> The fire of Kāmaile rises in triumph.
>
> Said of one who is victorious over obstacles, this is the first line of a chant composed for Kamehameha II. In olden days, firebrands hurled from the cliffs at Hāʻena, Kauaʻi, made a spectacular sight. [Pukui 1983:261]

3.3.1.2 Wainiha Ahupuaʻa

No proverbs were found, however, some may exist in the form of songs or lines within chants.

3.3.1.3 Lumahaʻi Ahupuaʻa

One *ʻōlelo noʻeau* includes reference to Lumahaʻi Ahupuaʻa.

3.3.1.3.1 Ka ʻŌlelo Noʻeau #1778

The following proverb describes shells native to Kauaʻi island used for the craft of hat bands:

> *Ke one lei pūpū o Waimea.*
>
> The sand of Waimea, where shells for lei are found.
>
> Waimea, Oʻahu, and Lumahaʻi, Kauaʻi, were the two places where the shells that were made into hat bands were found. Those on Oʻahu were predominantly white and those on Kauaʻi, brown. Not now seen. [Pukui 1983:191]

3.3.1.4 Waipā Ahupuaʻa

One *ʻōlelo noʻeau* includes reference to Waipā Ahupuaʻa.

3.3.1.4.1 Ka ʻŌlelo Noʻeau #1107

The following proverb describes the wind of the area:

> *Hoopāpā i Waipā ka Lūpua.*
>
> The Lūpua wind touches at Waipā.
>
> Said of one who cannot refrain from touching or pawing. Waipā is the name of a wind and location on Kauaʻi. [Pukui 1983:118]

3.3.1.5 Waiʻoli Ahupuaʻa

One *ʻōlelo noʻeau* includes reference to Waiʻoli Ahupuaʻa.

3.3.1.5.1 Ka ʻŌlelo Noʻeau #2860

When Kamehameha dreamed of his conquest of Kauaʻi, he mentioned the southernmost boundary of Waiʻoli, Namolokama, as one of the places he wished to enjoy:

> *E holo a inu i ka wai o Wailua, a hume i ka wai o Nāmolokama, aʻai i ka ʻanae ʻau of Kawaimakua i Hāʻena, a lei hoʻi i ka pahapaha o Polihale, a laila, hoʻi mai a Oʻahu, ʻoia ka ʻāina e noho ai*
>
> Let [us] go and drink the water of Wailua, wear a loincloth in the water of Nāmolokama, eat the mullet that swim in Kawaimakua at Hāʻena, wreathe [ourselves] with the seaweed of Polihale, then return to Oʻahu, the land to dwell upon. [Pukui and Elbert 1986:271]

Another saying is "*ʻUʻina ka wai o Nāmolokama*," (The water of Nāmolokama falls with a rumble) because Nāmolokama Falls, Kauaʻi is famous in chants and songs (Pukui 1983:313).

3.3.1.6 Hanalei Ahupuaʻa

Several *ʻōlelo noʻeau* includes reference to Hanalei Ahupuaʻa.

3.3.1.6.1 Ka ʻŌlelo Noʻeau #404

The following *ʻōlelo noeau* discusses a *moʻolelo* concerning the *aliʻi* of Hanalei and his land:

> *Haehae ka manu, ke ʻale nei ka wai*.
>
> Tear up the birds, the water is surging.
>
> Let us hurry, as there is no time for niceties. Kaneʻaloha and his son lived near the lake of Halulu at Waiʻaleʻale, Kauaʻi. They were catchers of *ʻuwaʻu* birds. Someone falsely accused them of poaching on land belonging to the chief of Hanalei, who sent a large company of warriors to destroy them. The son noticed agitation in the water of Halulu and cried out a warning to his father, who tore the birds to hasten cooking. [Pukui 1983:50]

3.3.1.6.2 Ka ʻŌlelo Noʻeau #1442

This *ʻōlelo noʻeau* discusses the *limu* of Hanalei:

> *Ka limu kā kanaka o Manuʻakepa.*
>
> The man-throwing algae of Manuʻakepa.
>
> Hanalei, Kauaʻi, was known for its pouring rain. A slippery algae grows among the grasses on the beach, and when carelessly stepped on, it can cause one to slip and fall. This algae is famed in songs and chants of that locality. [Pukui 1983:156]

3.3.1.6.3 Ka ʻŌlelo Noʻeau #1584

The following describes the rain of the *ahupuaʻa*:

> *Ka ua loku o Hanalei.*
>
> The pouring rain of Hanalei. [Pukui 1983:170]

3.3.1.6.4 Ka ʻŌlelo Noʻeau #1787

This proverb describes the demeanor of a person as well as a *wahi* in Hanalei Valley:

> *Kiʻekieʻe Kaupoku-o-Hanalei*.
>
> High up is Kaupoko-o-Hanalei.
>
> Said of the haughty, conceited, or willful. Kaupoku-o-Hanalei is a ridge behind Hanalei Valley, Kauaʻi. [Pukui 1983:192]

3.3.1.6.5 Ka ʻŌlelo Noʻeau #2034

The proverb below describes an expression related to the rain of Hanalei:

> *Luʻuluʻu Hanalei i kaua nui; kaumaha i ka noe o Alakaʻi.*
>
> Heavily weighted is Hanalei in the pouring rain; laden down by the mist of Alakaʻi.
>
> And expression used in dirges and chants of woe to express the burden of sadness, the heaviness of grief, and tears pouring freely like rain. Rains and fogs of other localities may also be used. [Pukui 1983:219]

3.3.1.6.6 Ka ʻŌlelo Noʻeau #2151

The following *ʻōlelo noʻeau* is an expression related to Hanalei Ahupuaʻa:

> *Meʻe uʻi o Hanalei*.
>
> The handsome hero of Hanalei.
>
> Said of one who is attractive. [Pukui 1983:234]

3.3.1.7 Kalihikai Ahupuaʻa

No proverbs were found, however, some may exist in the form of songs or lines within chants.

3.3.1.8 Kalihiwai Ahupuaʻa

No proverbs were found, however, some may exist in the form of songs or lines within chants.

3.3.2 Koʻolau Moku

Research could not locate any *ʻōlelo noʻeau* in Koʻolau Moku.

3.3.3 Puna Moku

The following are *ʻōlelo noʻeau* within Puna Moku.

3.3.3.1 Kamalomaloʻo Ahupuaʻa

No proverbs were found, however, some may exist in the form of songs or lines within chants.

3.3.3.2 Kealia Ahupuaʻa

One *ʻōlelo noʻeau* includes reference to Kealia Ahupuaʻa.

3.3.3.2.1 Ka ʻŌlelo Noʻeau #744

This *ʻōlelo noʻeau* is playing on the place name Kealia and the term, "*alia*" (to wait).

> *Hele ka hoʻi a hiki i Kealia, ua napoʻo ka lā.*
>
> When one reaches Kealia at last, the sun is set.

Said of one who procrastinates. A play on alia (to wait). [Pukui 1983:82]

3.3.3.3 Kapaʻa Ahupuaʻa

One *ʻōlelo noʻeau* includes reference to Kapaʻa Ahupuaʻa.

3.3.3.3.1 Ka ʻŌlelo Noʻeau #1450

This *ʻōlelo noʻeau* recalls Kapaʻa, Kauaʻi as a place of peace for Mōʻīkeha chief of Kauaʻi, who later made Kapaʻa his home.

Ka lulu o Moikeha i ka laulā o Kapaʻa.

The calm of Moikeha in the breadth of Kapaʻa

The chief Moikeha [Mōʻīkeha] enjoyed the peace of Kapaʻa, Kauaʻi, the place he chose as his permanent home. [Pukui 1983:157]

3.3.3.4 Waipouli Ahuapuaʻa

No proverbs were found for Waipouli, Puna, Kauaʻi, however, some may exist in the form of songs or lines within chants.

Within Pukui (1983), there is an *ʻōlelo noʻeau* that includes the place name of Waipouli. However, due to the other place name reference, Honomāʻele, it is believed that this Waipouli is of Maui Island and not Kauaʻi. This *ʻōlelo noʻeau* is included for reference purposes only.

Na keiki o Waipouli me Honomaʻele.

Children of Waipouli and Honomaʻele.

A humorous reference to very dark people. A play on *pouli* (dark) in Waipouli and *ʻele* (black) in Honomaʻele. [Pukui 1983:245]

3.3.3.5 Olohena Ahupuaʻa

No proverbs were found for Olohena, Puna, Kauaʻi, however, some may exist in the form of songs or lines within chants.

3.3.3.6 Wailua Ahupuaʻa

Several *ʻōlelo noʻeau* includes reference to Wailua Ahupuaʻa.

3.3.3.6.1 Ka ʻŌlelo Noʻeau #467

This *ʻōlelo noʻeau* references the place Holoholokū, located in Wailua, Kauaʻi, as a sacred birthplace of chiefs.

Hānau ke aliʻi i loko o	*The child of a chief born in*
Holoholokū, he aliʻi nui;	*Holoholokū is a high chief;*
hānau ke kanaka i loko o	*the child of a commoner born*
Holoholokū, he aliʻi no;	*in Holoholokū is a chief;*
hānau ke aliʻi mawaho aʻe o	*the child of a chief born outside*
Holoholokū, ʻaʻohe aliʻi,	*of the borders of Holoholokū*
he kanaka ia.	*is a commoner.*

Holoholokū, sacred birthplace of the chiefs, is in Wailua, Kauaʻi. [Pukui 1983:56]

3.3.3.6.2 Ka ʻŌlelo Noʻeau #1648

This *ʻōlelo noʻeau* refers to Wailua as a land with large streams.

Ka wai hālau o Wailua.

The expansive waters of Wailua.

Wailua, Kauaʻi, is the land of large streams. [Pukui 1983:178]

3.3.3.6.3 Ka ʻŌlelo Noʻeau #1724

This *ʻōlelo noʻeau* references a famous surfing spot in Wailua, Kauaʻi that was enjoyed by royalty.

Ke kai kaha nalu o Makaiwa.

The surfing of Makaiwa

Famous is the surf of Makaiwa at Wailua, Kauaʻi, enjoyed by the native chiefs and royal quests from the other islands. [Pukui 1983:185]

3.3.3.7 Hanamāʻulu Ahupuaʻa

One *ʻōlelo noʻeau* includes reference to Hanamāʻulu Ahupuaʻa.

3.3.3.7.1 Ka ʻŌlelo Noʻeau #2320

This *ʻōlelo noʻeau* is used to reference a person who is stingy. The people of Hanamāʻulu would hide their food containers from their guests; apologizing for not having anything to offer.

No Hanamāʻulu ka ipu puehu.

The quickly emptied container belongs to Hanamāʻulu.

Said of the stingy people of Hanamāʻulu, Kauaʻi – no hospitality there. At one time, food containers would be hidden away and the people of Hanamāʻulu would apologize for having so little to offer their guests. [Pukui 1983:252]

3.3.3.8 Kalapaki Ahupuaʻa

No proverbs were found for Kalapaki, Puna, Kauaʻi, however, some may exist in the form of songs or lines within chants.

3.3.3.9 Nāwiliwili Ahupuaʻa

No proverbs were found for Nāwiliwili, Puna, Kauaʻi, however, some may exist in the form of songs or lines within chants.

3.3.3.10 Haʻikū Ahupuaʻa

No proverbs were found for Haʻikū, Puna, Kauaʻi, however, some may exist in the form of songs or lines within chants.

3.3.3.11 Kīpū Ahupuaʻa

Several *ʻōlelo noʻeau* includes reference to Kīpū Ahupuaʻa.

3.3.3.11.1 Ka ‘Ōlelo No‘eau #1395

Ka‘i ka pua‘a i luna o Hā‘upu e ua ana.

When the pigs move around the summit of Hā‘upu, it is going to rain**.**

When puffy ‘pig’ clouds encircle the top of Hā‘upu above Kīpū on Kaua‘i, it is a sign of rain. [Pukui 1983:151]

3.3.3.11.2 Ka ‘Ōlelo No‘eau #1408

This *‘ōlelo no‘eau* is said when someone speaks about a difficult and trying task, however, when the task is completed, it was easier than expected.

Kai no paha he pali nui o Kīpū e ‘ōlelo ia nei, eia kā he pali iki no.

By the way it is talked about, one would think that Kīpū is a large cliff, but instead it is only a small one.

By the way people talked the task sounded difficult, but it was easy after all. Kīpū is on Kaua‘i. [Pukui 1983:153]

3.3.4 Kona Moku

The following are *‘ōlelo no‘eau* within Kona Moku.

3.3.4.1 Māhā‘ulepū Ahupua‘a

No proverbs were found for Māhā‘ulepū, Kona, Kaua‘i, however, some may exist in the form of songs or lines within chants.

3.3.4.2 Pā‘ā Ahupua‘a

No proverbs were found for Pā‘ā, Kona, Kaua‘i, however, some may exist in the form of songs or lines within chants.

3.3.4.3 Weliweli Ahupua‘a

No proverbs were found for Weliweli, Kona, Kaua‘i, however, some may exist in the form of songs or lines within chants.

3.3.4.4 Kōloa Ahupua‘a

One *‘ōlelo no‘eau* includes reference to Kōloa Ahupua‘a.

3.3.4.4.1 Ka ‘Ōlelo No‘eau #47

This *‘ōlelo no‘eau* is used to describe someone who is intoxicated.

Aia i Kōloa.

Is at Kōloa

A play on kō (drawn) and loa (long)—drawn a long way under. Drunk. [Pukui 1983:8]

3.3.4.5 Lāwa‘i Ahupua‘a

No proverbs were found for Lāwa‘i, Kona, Kaua‘i, however, some may exist in the form of songs or lines within chants.

3.3.4.6 Kalāheo Ahupuaʻa

No proverbs were found for Kalāheo, Kona, Kauaʻi, however, some may exist in the form of songs or lines within chants.

3.3.4.7 Wahiawa Ahupuaʻa

One *ʻōlelo noʻeau* includes reference to Wahiawa Ahupuaʻa.

3.3.4.7.1 Ka ʻŌlelo Noʻeau #1173

This *ʻōlelo noʻeau* is in reference to a small *pōhaku* in Wahiawa, Kauaʻi that was planned to be destroyed in order to build a road. The *pōhaku* was eventually moved to avoid desecration.

> *I ʻike ʻoe ia Kauaʻi a puni a ʻike ʻole ia Kauaʻi-iki, ʻaʻole no ʻoe i ʻike ia Kauaʻi.*
>
> If you have seen all of the places on the island of Kauaʻi and have not seen Little Kauaʻi, you have not seen the whole of Kauaʻi.
>
> Kauaʻi-iki (Little Kauaʻi) is a stone that stood in a taro patch at Wahiawa, Kauaʻi. When it was threatened by destruction by the building of a road, it was rescued by Walter McBryde and taken to Maiʻaloa and later to Kukuiolono Park, where it stands today. [Pukui 1983:128]

3.3.4.8 Hanapēpē Ahupuaʻa

No proverbs were found for Hanapēpē, Kona, Kauaʻi, however, some may exist in the form of songs or lines within chants.

3.3.4.9 Makaweli Ahupuaʻa

One *ʻōlelo noʻeau* includes reference to Makaweli Ahupuaʻa.

3.3.4.9.1 Ka ʻŌlelo Noʻeau #1097

This *ʻōlelo noʻeau* refers to the meaning of Makaweli and speaks of a time when a god is sent to destroy.

> *Hoʻolele ka uila o Makaweli.*
>
> Sending the lightning of Makaweli flying.
>
> A play on *maka-weli* (terrifying eyes), this saying refers to the sending of a god on an errand of destruction. [Pukui 1983:117]

3.3.4.10 Waimea Ahupuaʻa

Several *ʻōlelo noʻeau* includes reference to Waimea Ahupuaʻa.

3.3.4.10.1 Ka ʻŌlelo Noʻeau #1028

This *ʻōlelo noʻeau* references salt returning to Waimea.

> *Hoʻi hou ka paʻakai i Waimea.*
>
> The salt has gone back to Waimea.
>
> Said when someone starts out on a journey and then comes back again. The salt of Waimea, Kauaʻi, is known for its reddish brown color. [Pukui 1893:110]

3.3.4.10.2 Ka ʻŌlelo Noʻeau #1339

This *ʻōlelo noʻeau* is in reference to the fishing season of *hinana*, the spawn stage of an *ʻoʻopu*. During this season, there was such a vast amount that one could not go into the water without being touched by the fish.

> *Ka iʻa hoʻopā ʻili kanaka o Waimea*.
>
> The fish of Waimea that touch the skins of people.
>
> When it was the season for *hinana*, the spawn of *ʻoʻopu*, at Waimea, Kauaʻi, they were so numerous that one couldn't go into the water without rubbing against them. [Pukui 1983:146]

3.3.4.10.3 Ka ʻŌlelo Noʻeau #1591

This *ʻōlelo noʻeau* refers to the rain of Waimea, Kauaʻi, and how this rain pelts the skin.

> *Ka ua nounou ʻili o Waimea*
>
> The skin-pelting rain of Waimea.
>
> Refers to Waimea, Kauaʻi. [Pukui 1983:172]

3.3.4.10.4 Ka ʻŌlelo Noʻeau #1662

This *ʻōlelo noʻeau* was found in chants about Waimea, referencing the moments when Waimea River would run red.

> *Ka wai ʻula ʻiliahi o Waimea.*
>
> The red sandalwood water of Waimea.
>
> This expression is sometimes used in old chants of Waimea, Kauaʻi. After a storm Waimea Streak is said to run red. Where it meets Makaweli Stream to form Waimea River, the water is sometimes red on one side and clear on the other. The rede side is called *wai ʻula ʻiliahi*. [Pukui 1983:179]

3.3.4.10.5 Ka ʻŌlelo Noʻeau #1775

This *ʻōlelo noʻeau* references a *puʻuhonua* or a place a refuge for the people of Waimea, Mānā, and those who reside on the Kona side of Kauaʻi.

> *Ke one kapu o Kahamaluʻihi*
>
> The sacred sand of Kahamaluʻihi.
>
> A city of refuge for those of Waimea, Mānā, and the Kona side of Kauaʻi. [Pukui 1983:190]

3.3.4.11 Mānā Ahupuaʻa

Several *ʻōlelo noʻeau* includes reference to Mānā Ahupuaʻa.

3.3.4.11.1 Ka ʻŌlelo Noʻeau #18

Used to describe someone who is delusional, this *ʻōlelo noʻeau* speaks of a time where mirages were common in Mānā, Kauaʻi.

> *Ahu kupanaha ka lā i Mānā.*
>
> Peculiar is the action of the sun in Mānā.

Said of a delusion. Mānā, Kauaʻi, is a place where mirages were once seen. [Pukui 1983:5]

3.3.4.11.2 Ka ʻŌlelo Noʻeau #1018

This *ʻōlelo noʻeau* uses a play on words to describe the movements of a dance.

Hōʻaleʻale Mānā i ke kaha o Kaunalewa.

Mānā ripples over the land of Kaunalewa

Said of the movements of a dance. A play on ʻaleʻale (to ripple like water), referring to the gestures of the hands, and lewa (to sway), referring to the movement of the hips. [Pukui 1983:109]

3.3.4.11.3 Ka ʻŌlelo Noʻeau #1203

This *ʻōlelo noʻeau* refers to the mirages of Mānā to describe a person attempts to fool another.

ʻIke mai la o Mānā, ua hāi ka wa liʻulā.

Mānā notices the waters of the mirage.

The attempt to fool is very obvious. [Pukui 1983:131]

3.3.4.11.4 Ka ʻŌlelo Noʻeau #1657

This *ʻōlelo noʻeau* describes the mirages of Mānā. According to Pukui (1983), the mirages of Mānā could be seen on the nights of Kū and Kāne.

Ka wai liʻulā o Mānā.

Mirage of Mānā

Mirages were seen at Mānā on the nights of Kū and Kāne. [Pukui 1983:179]

3.3.4.11.5 Ka ʻŌlelo Noʻeau #1680

This *ʻōlelo noʻeau* compares the mirages of Mānā to some who is overly dressed.

Ke ʻanapa nei ka wailiʻulā o Mānā.

The water in the mirage of Mānā sparkles.

Said of one who is overdressed. [Pukui 1983:181]

3.3.4.11.6 Ka ʻŌlelo Noʻeau #1908

This *ʻōlelo noʻeau* uses the mirages of Mānā as a reference to someone who is extremely boastful.

Kūkulu kalaʻihi ka lā i Mānā.

The sun sets up mirages at Mānā.

Said of a boastful person who exaggerates. [Pukui 1983:205]

3.3.4.11.7 Ka ʻŌlelo Noʻeau #1909

This *ʻōlelo noʻeau* shows us who the god of mirages is and how this god would build villages during the night.

Kūkulu kauhale a Limaloa.

Limaloa builds his house.

Limaloa was the god of mirages who at certain times of the year would build a village in the moonlight at Mānā, Kauaʻi. The village would vanish as quickly as it had appeared. [Pukui 1983:205]

3.3.4.11.8 Ka ʻŌlelo Noʻeau #2135

This *ʻōlelo noʻeau* refers to a taro farming practice, *puʻe kalo*, or planting taro in mounds.

Mānā, i ka puʻekalo hoʻoneʻeneʻe a ka wai.

Mānā, where the mounded taro moves in the water.

Refers to Mānā, Kauaʻi. In ancient days there were five patches at Kolo, Mānā, in which deep water mound-planting was done for taro. As the plants grew, the rootlets were allowed to spread undisturbed because they helped to hold the soil together. When the rainy season came, the whole area was flooded as far as Kalamaihiki, and it took weeks for the water to subside.

The farmers built rafts of sticks and rushes, then dived into the water. They worked the bases of the taro mounds free and lifted them carefully, so as not to disturb the soil, to the rafts where they were secured. The weight of the mounds submerged the rafts but permitted the taro stalks to grow above water just as they did before the flood came. The rafts were tied together to form a large, floating field of taro. [Pukui 1983:232–233]

3.3.4.11.9 Ka ʻŌlelo Noʻeau #2136

This *ʻōlelo noʻeau* refers to Mānā, Kauaʻi being situated on the west where the sun sets.

Mānā kaha kua welawela.

Mānā where the back feels the heat [of the sun].

Refers to Mānā, Kauaʻi. [Pukui 1983:233]

3.3.4.11.10 Ka ʻŌlelo Noʻeau #2874

This *ʻōlelo noʻeau* illustrates that Mānā, Kauaʻi, tends to get flooded during the rainy seasons.

ʻUmeke piha wai o Mānā.

A calabash full of water is Mānā.

Refers to Mānā, Kauaʻi, which is flooded during the rainy seasons. [Pukui 1983:314]

3.3.4.11.11 Ka ʻŌlelo Noʻeau #2910

This *ʻōlelo noʻeau* is in reference to when people from the surrounding *ahupuaʻa* would travel to Mānā to exchange land products like *poi* for fish.

Waikāhi o Mānā.

The single water of Mānā.

When schools of ʻōpelu and kawakawa appeared at Mānā, Kauaʻi, news soon reached other places like Makaweli, Waimea, Kekahi, and Pokiʻi. The uplanders

> hurried to the canoe landing at Keanapuka with loads of poi and other upland products to exchange for fish. After the trading was finished, the fishermen placed their unmixed poi in a large container and poured in enough water to mix a whole batch at once. It didn't matter if the mass was somewhat lumpy, for the delicious taste of fresh fish and the hunger of the men made the poi vanish. This single pouring of water for the mixing of poi led to the expression, ‘Waikāhi o Mānā.’ [Pukui 1983:318–319]

3.3.5 Nāpali Moku

The following are *‘ōlelo no‘eau* within Nāpali Moku.

3.3.5.1 Awawapuhi Ahupua‘a

No proverbs were found for Awawapuhi Ahupua‘a, Nāpali District, Kaua‘i, however, some may exist in the form of songs or lines within chants.

3.3.5.2 Honopū Ahupua‘a

One *‘ōlelo no‘eau* includes reference to Honopū Ahupua‘a.

3.3.5.2.1 Ka ‘Ōlelo No‘eau #2833

This *‘ōlelo no‘eau* is in reference to the exceptional *‘olonā* that grew in Honopū.

> *Ua nīki‘i ‘ia i ke olonā o Honopū.*
>
> Tied fast with the olonā of Honopū.
>
> Said of a situation that is made fast. Honopū, Kaua‘i, was said to produce excellent olonā in ancient days. [Pukui 1983:310]

3.3.5.3 Kalalau Ahupua‘a

No proverbs were found for Kalalau Ahupua‘a, Nāpali District, Kaua‘i, however, some may exist in the form of songs or lines within chants.

3.3.5.3.1 Ka ‘Ōlelo No‘eau #419

This *‘ōlelo no‘eau* plays on the meaning of *lalau* (to go astray) to describe someone who may not be mentally focused.

> *Hala i Kaua‘i i Kalalau.*
>
> Gone to Kalalau, on Kaua‘i.
>
> Said of one who is off-course mentally or is off gadding somewhere; a blunderer. A play on lalau (to go astray). [Pukui 1983:52]

3.3.5.3.2 Ka ‘Ōlelo No‘eau #490

This *‘ōlelo no‘eau* mentions the place names of Hā‘ulelau, Kalalau, Lūali‘i, and Kauli‘ili‘i.

> *Hā‘ulelau o Kalalau, o Lūali‘i la i Kauli‘ili‘i.*
>
> Hā‘ulelau is at Kalalau, and Lūali‘i is at Kauli‘ili‘i.
>
> Such a scattering all over the place, like fallen leaves, with bits and pieces all strewn about. A play on hā‘ule-lau (fallen leaves), Kalalau (wander around), lū-ali‘i (scatted in pieces), and kau-li‘ili‘i (a little here and a little there). [Pukui 1983:59]

3.3.5.3.3 Ka ʻŌlelo Noʻeau #1433

This *ʻōlelo noʻeau* refers to the *lauaʻe* fern. Kalalau and Makana were known as places where *lauaʻe* flourish.

> *Ka lauaʻe ʻala o Kalalau.*
>
> Fragrant laua‘e ferns of Kalalau.
>
> Makana and Kalalau, on Kaua‘i were noted for the growth and fragrance of *lauaʻe* ferns. [Pukui 1983:155]

3.3.5.3.4 Ka ʻŌlelo Noʻeau #2190

This *ʻōlelo noʻeau* describes someone who tends to wander off subject.

> *Molale loa no kumupali o Kalalau.*
>
> Clearly seen is the base of Kalalau cliff.
>
> It is obvious that one is way off the subject. A play on *lalau* (to wander, err). [Pukui 1983:2190]

3.3.5.3.5 Ka ʻŌlelo Noʻeau #2287

This *ʻōlelo noʻeau* refers to the cliffs of Kalalau and is said to describe someone who is worn out.

> *Nāpelepele na pali o Kalalau i ka wili a ka makani.*
>
> Weakened are the cliffs of Kalalau in being buffeted by the wind.
>
> Said of one who is worn out. [Pukui 1983:249]

3.3.5.4 Pōhaku‘au Ahupua‘a

No proverbs were found for Pōhaku‘au Ahupua‘a, Nāpali District, Kaua‘i, however, some may exist in the form of songs or lines within chants.

3.3.5.5 Hanakoa Ahupua‘a

No proverbs were found for Hanakoa Ahupua‘a, Nāpali District, Kaua‘i, however, some may exist in the form of songs or lines within chants.

3.3.5.6 Hanakāpi‘ai Ahupua‘a

One *ʻōlelo noʻeau* includes reference to Hanakāpi‘ai Ahupua‘a.

3.3.5.6.1 Ka ʻŌlelo Noʻeau #1399

This *ʻōlelo noʻeau* is a boast about the people of Hanakāpi‘ai.

> *Ka iki koaiʻe a Hanakāpīʻai.*
>
> The small koai‘e tree of Hanakāpī‘ai.
>
> A boast of that locality on Kaua‘i. One may be small in stature but he is as tough and sturdy as the *koaiʻe* tree.

3.3.5.6.2 Ka ʻŌlelo Noʻeau #1517

This *ʻōlelo noʻeau* refers to the *ʻoʻopu* of Hanakāpī‘ai.

Ka ʻoʻopu peke o Hanakāpīʻai.

The short ʻoʻopu of Hanakāpīʻai.

The *ʻoʻopu* at Hanakāpīʻai on Kauaʻi were said to be shorter and plumper than those anywhere else. Mentioned in chants. [Pukui 1983:164]

3.3.5.6.3 Ka ʻŌlelo Noʻeau #2529

Similar to *ʻōlelo noʻeau* #1517, this *ʻōlelo noʻeau* refers to the *ʻoʻopu* of Hanakāpīʻai.

ʻOʻopu peke o Hanakāpīʻai.

The stunted ʻoʻopu fish of Hanakāpīʻai.

Famed in the legends of Kauaʻi are the *ʻoʻopu* of Hanakāpīʻai, which are said to be plump and shorter in length than those elsewhere. Sometimes applied humorously to a short, plump person. [Pukui 1983:276]

3.4 ***Nā Mele*** **(Songs)**

The following section draws from the Hawaiian art of *mele*, poetic song intended to create two styles of meaning.

> Words and word combinations were studied to see whether they were auspicious or not. There were always two things to consider, the literal meaning and the *kaona*, or ʻinner meaning.ʼ The inner meaning was sometimes so veiled that only the people to whom the chant belonged understood it, and sometimes so obvious that anyone who knew the figurative speech of old Hawaiʻi could see it very plainly. There are but two meanings: the literal and the *kaona*, or inner meaning. The literal is like the body and the inner meaning is like the spirit of the poem.
>
> The Hawaiians were lovers of poetry and keen observers of nature. Every phase of nature was noted and expressions of this love and observation woven into poems of praise, of satire, of resentment, of love and of celebration for any occasion that might arise. The ancient poets carefully selected men worthy of carrying on their art. These young men were taught the old *meles* and the technique of fashioning new ones. [Pukui 1949:247]

Mele or songs, like *oli*, can take on various styles, various meanings, and be interconnected all the while being pleasant to the ear. Some styles of *mele* include *mele aloha* (a love song), *mele hoʻohanohano* (an honorific chant), *mele wahi pana* (song honoring storied places), and etc. The beauty and style of *mele Hawaiʻi* or Hawaiian songs is the ability to have layers of multiple facets. For example, many *mele aloha* can include the aspects of *wahi pana*. Therefore, these *mele* can be classified as a *mele aloha* and a *mele wahi pana*.

> Through mele and kaona [hidden meanings], kupa o ka ʻāina [natives of the land] described the beauty of the mountains, the sound of the ocean, and the flow of the sunset […] Inspired by their intimate knowledge of the landscape, haku mele (musical composers) masterfully enumerated the ʻōlelo noʻeau, winds, rains, and place names associate with the places glorified in their compositions. [Oliveria 2014:67]

3.4.1 Halele‘a Moku

The following are *mele* within Halele‘a Moku.

3.4.1.1 Hālau Hanalei

Like many *mele* and *oli*, “Hālau Hanalei” includes references to the land, rain, and water source of Hanalei. According to Emerson (1909), the composer of this *mele* used the term “*hālau*” to illustrate the pattern in which the rains of Hanalei fall. The rains pour down in columns and as it draws together, it forms walls around the valley like a *hālau*. Wai‘oli is a place name within part of a valley in Hanalei as well as the name of a river (Emerson 1909:155).

Hālau Hanalei i ka nini a ka ua	Hanalei is a hall for the dance in the pouring rain
Kūmano ke po‘o-wai a ka liko	The stream-head is turned from its bed of fresh green
Nahā ka opi-wai a Wai-aloha	Broken the dam that pent the water of love –
O ke kahi koe a hiki i Wai-oli	Naught now to hinder its rush in the vale of delight
Ua ‘ikea	You’ve seen it.
[Emerson 1909:155]	

3.4.1.2 Hanohano Hanalei

Composed by Alfred Unauna Aloikea, this *mele* features various aspects that one may see and feel in Hanalei, such as “*ka ua nui*” (heavy rains), “*wai nā Molokama*” (the majestic streams of Molokama), and “*ka nani Māmalahoa*” (the beauty of Māmalahoa) (huapala.org n.d).

Hanohano Hanalei i ka ua nui	The glory of Hanalei is its heavy rain
E pakika i kahi limu o Manu‘akepa	Slippery seaweed of Manu‘akepa
I laila ho‘i au i ‘ike iho ai	There I felt
I ka hana hu‘i konikoni i ka ‘ili	Tingling cool sensation of the skin
Aloha kahi one o pua rose	Greetings o sand and rose flowers
I ka ho‘opē ‘ia e ka hunakai	Drenched by sea spray
‘Akahi ho‘i au a ‘ike i ka nani	Never have I seen such splendor
Hanohano Hanalei i ka ua nui	The glory of Hanalei is its heavy rain
Kilakila kahi wai nā Molokama	Majestic streams of Molokama
I ke kau ‘ia mai ho‘i e ka ‘ohu	Mist covered
He ‘ohu ho‘i ‘oe no ka ‘āina	You are the mist of the land
A Hanalei a e ha‘aheo nei	That Hanalei cherishes
Kilohi i ka nani Māmalahoa	Behold the beauty of Māmalahoa
I ka ho‘opē ‘ia e ke kēhau	Drenched by the dew
‘Elua wale iho nō māua	She and I are two
‘Ekolu i ka hone a ka ‘ehu kai	Three with the rustle of the sea spray
[huapala.org n.d.]	

3.4.1.3 Ka Ua Loku

Composed by Alfred U. Alohikea, this *mele* speaks to the relationship between the rains of Hanalei, the ferns, and ocean in which it clings (huapala.org n.d.).

Kaulana e ka ua o Hanalei	Famous indeed is the rain of Hanalei
E nihi aʻe nei i nā pali	Sweeping along the cliffs
E hoʻopili ʻia me ka lauaʻe	To be joined with the lauaʻe fern
Me he ipo hoʻoheno nei i ka poli	Like a sweetheart cuddling in embrace
Ka hoene mai nō a ke kai	The sea murmurs softly
Me he ala e ʻī mai ana	As though it were saying
E hoʻi mai nō kāua lā e pili	You and I should be together again
Ka ua loku kaulana aʻo Hanalei	Like the famous pouring rain of Hanalei

[huapala.org n.d.]

3.4.1.4 Lumahaʻi

Situated close by one another, Lumahaʻi Ahupuaʻa and Hanalei Ahupuaʻa are both mentioned this *mele*, referring to famous features of these lands: Hanalei, being known for the Manuʻakepa seaweed and Lumahaʻi for the misty rain of Luluʻupali.

Hanohano Hanalei i ka ua nui	Famous is Hanalei for much rain
He pakika i ka limu o Manuʻakepa	Slippery the seaweed of Manuʻakepa
ʻAuʻau i ka wai ʻo Lumahaʻi	Bathed in the water of Lumahaʻi
Ka lehua maka noe o Luluʻupali	is the misty-faced lehua of Luluʻupali
Eʻena Hāʻena i ka ʻehu kai	Hāʻena is fearful, because of the sea spray
A he aha la o ka hana Lohiau ipo	And what is Lohiau ipo's work
Haʻina ʻia mai ana ka puana	The story is told
He pakika i ka limu o Manuʻakepa	Slippery the seaweed of Manuʻakepa

[huapala.org n.d.]

3.4.2 Koʻolau Moku

The following are *mele* within Koʻolau Moku.

3.4.2.1 Anahola

Composed by Jerimiah Kaialoa, Sr., "Anahola" shares a famous *moʻolelo* that has taken place in Anahola Ahupuaʻa. Known as for its homestead land, inland of Anahola is a hill named Kalalea. It has been said that a spear was once hurled at the hill which left a hole. This hole was named Konanae. This *mele* also mentions the name Amu, which is a place name and wind name of Anahola.

Hanohano Kalalea kau mai i luna	Majestic Kalalea raises above
ʻO ka pali kaulana aʻo Anahola	The famous cliff of Anahola

ʻAlawa iho ʻoe iā Konanae	You glance at Konanae
ʻO ka hoapili like o kuʻu milimili	The beloved close companion
I laila hoʻi au ʻike ihola	I was there and I saw
Nā kaula likini mōliolio	The rigging lines pulled tautly
Huli aku nānā iā Amu	Turn and look at Amu
I ka makani ʻalo ʻehu hele ulūlu	The wind that blows fiercely
Haʻina ʻia mai ana ka puana	The story be told
ʻO ka pali kaulana aʻo Anahola	Of the famous cliff of Anahola
[huapala.org n.d.]	

3.4.2.2 Kalalea

Composed by Kealiʻikuaʻāina Kahanu and Kaleialoha Williams, this *mele* speaks about Kalalea, a famous peak in Anahola and the rustling sea of Hālaulani, where a gentle breeze flows.

Kiʻekiʻe Kalalea i ka makani	Kalalea stands majestically in the wind
ʻO ka pali kaulana o Ahahola	Fames cliff of Anahola
Noho iho e ka ʻohu noe i nā pali	The mist rests upon the cliffs
A he nani maoli nō mai ʻo a ʻō	Simply exquisite from end to end
Ake aku la e ʻike	I yearn to see
I ke kai nehe aʻo Hālaulani	The rustling sea at Hālaulani
ʻO ka pā kolonahe a ka makani	The gentle breeze
I laila māua me kuʻu aloha	That's where I am with my sweetheart
[huapala.org n.d.]	

3.4.3 Puna Moku

The following are *mele* within Puna Moku.

3.4.3.1 Hanohano Pihanakalani

According to Nona Beamer (2004), Hanohano Pihanakalani is

> [...] a time-honored Kauaʻi chant, made famous by the people of that northern island. They proudly tell of the glorious uplands, the 'singing' mountain shells, and romance amid the birds and the native *mokihana* trees found only on Kauaʻi. [Beamer 2004:46]

It is said this is a *mele inoa* or name song that honors Hāliʻalaulani, who was the goddess of Pihanakalani (Huapala.org 1997), which is the mountain region above Wailua and was "the home of aliʻi, the ruling class of the island of Kauaʻi" (Beamer 2004:46).

Hanohano e ka uka i Pihanakalani	Glorious is the upland of Pihanakalani
I ka leo o ka ʻohe kani e ka wī	And the voice of the mountain shell
Nāna hoʻoipoipo ke aloha	He wooed with love
A loaʻa ʻo Kaʻililauokekoa	And won Princess Kaʻililauokekoa

Ke kuini i ka home o nā manu	She is the queen of the home of the birds
Ke ʻala anuhea pua mokihana	Amid the cool fragrance of the *mokihana*
Haʻina ʻia mai ana ka puana	Tell the refrain
ʻO Hāliʻalaulani kou inoa	Hāliʻalaulani is your name
ʻHE INOA NO HĀLIALAULANIʼ	ʻIn the name of Hāliʻalaulaniʼ
[Beamer 2004:46]	

3.4.3.2 Hula o Makee

Using the ships Makee and Malulani as a metaphor, this *mele* recollects a time when the steamship *Makee* was stuck on the reef in Kapaʻa and the *Malulani* came to aid. According to Elbert and Mahoe, "Makee here represents a girl who has deserted her lover, Malulani, who is looking for her" (Elbert and Māhoe 1970:55). The ʻIeʻie Channel is mentioned in this *mele* and is located *makai* of Kapaʻa. This channel connects Kauaʻi to Oʻahu.

ʻAuhea iho nei la Makee	Where is the Makee?
A ka Malulani la e huli hele nei	The Malulani looks everywhere
Aia aku nei kahi i Kapaʻa	There she is at Kapaʻa
Ka waiho kapakahi i ka ʻāpapa	Keeled over on the reef
ʻO ke kani honehone a ke oeoe	Softly sounds the whistle
A e haʻi mai ana la i ka lono	Telling the news
ʻO ka hola ʻumi ia o ke aumoe	Ten o'clock at night at night
Kāʻalo Malulani mawaho pono	The Malulani passes by.
Kū mai Hailama paʻa i ka hoe	Hiram stands and grasps the paddle
I mua a i hope ke kulana nei	Careening bow to stern
Ākea ka moana nou e Makee	Broad us your ocean, O Makee,
Ma ke kai holuholu o ka ʻIeʻIe	and the swaying seas of ʻIeʻie.
Haʻina ʻia mai ana ka puana	Tell the refrain
ʻAuhea iho nei la ʻo Makee	Where is the Makee?
[Elbert and Mahoe 1970:55]	

3.4.3.3 Kaʻililauokekoa

Written by Henry Waiau, this *mele*, "Kaʻililauokekoa," is based on the *moʻolelo* of a *wahine* (woman) with the same name on the Island of Kauaʻi. As she sleeps, Kaʻililauokekoa hears the sound of a nose flute. This sight entices her to travel up Wailua River to Pihanaokalani.

Maʻemaʻe wale ke kino o ka palai	Beautiful is the hedge of fern
Pulupē i ka ua liʻiliʻi kilikilihune	Sprinkled by the tiny raindrops
A he wehi ia nō ka uka o ka nahele	Decorating the mountainous region
E moani ke ʻala i lawe ʻia mai	Bringing forth

Hu‘ihu‘i konikoni e	A cooling breathing scent
Hui:	Chorus:
Kani e ka wī ‘uhe‘uhe‘uhene	Sing o you shell ‘uhe‘uhe‘uhene
E Ka‘ililauokekoa	The bark of the leaf of the koa tree
‘Auhea ‘oe?	Where are you?
Eia nō ‘o au lā	Here I am
O Pihanaokalani	The fulfillment of the heaven
E Ka‘ililauokekoa	The bark of the leaf of the koa tree
Ua moe paha ‘oe?	Are you asleep?
‘A‘ole lā	I am not
Me wai lā ‘oe ho‘ohenoheno nei?	With whom are you flirting.

[Huapala.org n.d.]

3.4.3.4 Ka Ulu Niu O Waipouli

Composed by S. Maka Herrod, this *mele* speaks about a coconut grove nestled in Waipouli.

Eia au e i Waipouli	Here I am in Waipouli
Kaulana no ka ulu niu	Famous for the coconut grove
E kilohi au i ka nani	I glance at the beauty
I ka holulnape o ka niu	of the swaying of the coconut trees
O ka niu ku kilakila	The coconut stands tall (majestically)
I ke onaona mau la	With its forever lasting fragrance
Eia au ma ka hikina	Here I am in the east
A he pua nani no Kapa‘a	the pretty flower for Kapa‘a
Ha‘aheo kou inoa i lohe ia	Proudly is your name to be heard
I ka ulu niu o Waipouli	Of the coconut grove of Waipouli

[Transcribed and translated by CSH]

3.4.3.5 Kipu Kai

Composed by Mary Kawena Pukui and Mandy K. Lam, "Kipu Kai" praises the *ahupua‘a* of Kipu Kai in the Puna District and also honors the Jack Waterhouse estate (huapala.org n.d.).

No Kipu Kai ke aloha	For Kipu Kai is my affection
Home i ka pili kahakai	Where there is a home by the sea
I laila au i ‘ike ai	It was there that I found
I ka nui loko maika‘i	Such unbounded hospitality.
Nanea i ka ho‘olohe	I enjoy listening
I ka hālulu mai o ke kai	to the roar of the sea
Ka nalu nui e holu ana	As the large waves come rolling in
I ka lae a o Kua-honu	to Kua-honu pond
Pau‘ole ko‘u ho‘ohihi	Endless is my admiration
I ka nani a‘o Hā‘upu	For the beauty of Hā‘upu

Mauna kiʻekiʻe i luna	A hill so high
Hanohano ke ʻike aku	Majestic to my sight
Makemake wale ka ʻikena	It is a delight to see
I nā manu pikake nani	The pretty peacocks
E kakaʻi e haʻaheo ana	Strutting by together
I ka malu a o ke kiawe	In the shade of the kiawe
Puana ia me ke aloha	Thus ends my song with affection
No ka nani a o Hāʻupu	For the beauty of Hāʻupu
Me keaka loko maikaʻi	And for Jack, the kind-hearted
Ka haku a o Kipu Kai	The owner of Kipu Kai.

[huapala.org n.d.]

3.4.3.6 Līhuʻe

Composed in honor of Līhuʻe, Kauaʻi, various features of this place are woven into the *mele*. The Paupili rain is mentioned, alongside various *wahi pana* such as Niumalu, Hauola, and Hāʻupu.

Aloha ʻia no aʻo Līhuʻe	Beloved is Līhuʻe
I ka neʻe mai a ka ua Paupili	In the moving of the Paupili rain
Ua pili nō au me kuʻu aloha	I am close with my love
Me ke kai nehe mai aʻo Niumalu	By the murmuring sea at Niumalu
Ua malu ko kino naʻu hoʻokahi	Your body is reserved for me alone
Na ka nani pua rose aʻo Hauola	By the beautiful rose blossom of Hauola
Ua ola nō au me kuʻu aloha	My very life is my love
A kau i ka pua o ka lanakila	Worn as the flower of victory
Kilakila Hāʻupu aʻe kū nei	Majestic is Hāʻupu standing there
Kahiko i ka maka aʻo ka opua	Adorned in the mist of the clouds
A he pua lei momi na kuʻu aloha	A lei of peals from my love
Ua sila paʻa ia i ka puʻuwai	Was sealed in my heart
A he waiwai nui naʻu ko aloha	Great riches is your love to me
Kaulana nō ka ʻāina malihini	Famous indeed the new land
Hea aku no wa o mai ʻoe	I call, you answer
Na ka pua lei momi poinaʻole	For the unforgettable person, precious as a rare shell lei.

[huapala.org n.d.]

3.4.3.7 Nāwiliwili

Nāwiliwili is an *ahupua‘a* as well as a harbor within the Puna District. Also mentioned in this *mele* is Ninini, which is a possible reference to the lighthouse in Nāwiliwili.

Kaulana mai nei a‘o Nāwiliwili	Famous is Nāwiliwili
He nani no ‘oe iā Ninini	You are lovely, because of Ninini
He beauty maoli nō	Very beautiful, indeed
Kuahiwi nani ‘oe a‘o Ha‘upu	You are a beautiful mountain, Ha‘upu
Ka pua mokihana, ‘eā	With the mokihana berry
Ka pua nani o Kaua‘i	The lovely flower of Kaua‘i
Ho‘ohihi ka mana‘o a‘o Kaua‘i	I cherish my thoughts of Kaua‘i
E ō mai ko leo aloha	Your beloved voice answers
Ke kani a‘o Pi‘ilani	The call of Pi‘ilani
Ha‘ina ‘ia mai ana ka puana	Tell the refrain
Kaulana mai nei Nāwiliwili	Famous is Nāwiliwili
He nani maoli nō.	Very beautiful, indeed.

[huapala.org n.d.]

3.4.3.8 Waipahe‘e

Waipahe‘e literally translates as slippery water, referring to the waterfall with the same name, Waipahe‘e. This *mele*, composed by James Von Ekekela, also mentions Keali‘a, a land and stream in the Puna District.

Ho‘ohihi kahi mana‘o	One’s mind is fascinated
I ka u‘i nohea o Keali‘a	By the lovely freshness of Keali‘a
Ia u‘i e walea ana	Loveliness to enjoy
I ka nani a‘o Waipahe‘e	In the beauty of Waipahe‘e
Hui:	Chorus:
E he he he he he	A ha ha ha ha ha
E pakika, e pahe‘e	Slip, slide
Kahi wai kili‘opu	That waterfall for diving feet first
Kahi wai kili‘opu	That waterfall for diving feet first
A‘o Waipahe‘e	Waipahe‘e
Nā ‘ōpae kua hāuli	The black freshwater shrimp
‘O‘o pōhaku no Hapai	Stone digging tools from Hapai
Me na uhi mālelehu	With the twilight mist
‘Ihi‘ihi a‘o Makiala	Reverenced is Makiala

[huapala.org, n.d.]

3.4.4 Kona Moku

The following are *mele* within Kona Moku.

3.4.4.1 Kōkeʻe

As composer, Dennis Kamakahi said in this *mele*, "*mele au no ka beauty, i ka uka ʻiuʻiu, I Kōkeʻe ua ʻike au I ka noe poʻai ai*. I sing for the beauty In the lofty uplands at Kōkeʻe I saw the encircling mist." (huapala.org n.d.)

Upu aʻe he manaʻo	A thought recurs
I ka wēkiu o Kōkeʻe	To the summit of Kōkeʻe
I ka nani, o ka ʻāina	In the beauty of the land
O ka noe pōʻai ai	Of the encircling rain
Hui:	Chorus:
ʻO Kalalau, he ʻāina laʻa	Kalalau is a sacred land
I ka ua liʻiliʻi	In the drizzling rain
ʻO Waimea kuʻu lei aloha	Waimea is my beloved wreath
Never more to say goodbye	Never more to say goodbye
Hoʻi mai ana i ka hikina	Returning to the east
I ka lā welawela	In the doubly hot sun
I ke kai hāwanawana	To the whispering sea
I Pōʻipu ma Kōloa	At Pōʻipu in Kōloa
Mele au no ka beauty	I sing for the beauty
I ka uka ʻiuʻiu	In the lofty uplands
I Kōkeʻe ua ʻike au	At Kōkeʻe I saw
I ka noe pōʻai ai	The encircling mist
[huapala.org n.d.]	

3.4.4.2 Kōloa

Father of the Songbird of Hawaiʻi, Lena Machado, Robert Waialeale composed this *mele* in honor of Kōloa, with the inclusion of a famous *wahi pana*, Kemamo. Kemamo is a spring reserved for royalty.

Nani Hāʻupu kū kila i ka laʻi	Beautiful Hāʻupu, rising in the calm
Hanohano kilohana i ka nahele	Magnificent is the view of the forest
Aia i laila ka maka e ka ʻōpua	There the cloudbanks
Kihene i ka wai o Kemamo	Gather over the waters of Kemamo
Hui:	Chorus:
He ani maoli no ka ua noe o Kōloa	Beautiful indeed, the misty rain of Kōloa
He makalapua i ka wao kele	Bringing forth the blossoms in the uplands
Nā hiʻona o kuʻu ipo ua like me ka ʻanoʻi	The appearance of my sweetheart awakens my desire
Nā dews kēhau o ke aumoe	Like the dews at midnight
[huapala.org n.d.]	

3.4.4.3 Kōʻula/Manawaiopona

Composed by Alvin K. Isaacs, this *mele* has a dual name, Kōʻula and Manawaiopuna. Kōʻula is a traditional place name for a valley and stream in Hanapēpē. At the lower end of Kōʻula valley is where one can come upon Manawaiopuna, a 200-ft waterfall (huapala.org n.d.).

Nani wale e ka ua aʻo Kōʻula *Kilihune nei i ka ua liʻiliʻi*	How beautiful is the rain of Kōʻula The misty rain, little drops
ʻO ka piʻo ana mai o ke ānuenue *Hoʻoheno ana i ka wele lāʻau*	Way up high is the beautiful rainbow Proudly behold its beauty over the trees
Kaulana Manawaiopuna *Ke kumu o ka wai aʻo Manuahi*	Famous this spring Manawaiopuna The source of the water, flowing freely [Manuahi]
Kūmaka ka ʻikea ia wailewa *Koʻiaweawe I ka wele lau pali*	I see this beautiful waterfall The tumbling waterfall, gliding, sliding down the pali
E ola ka ʻōpua kū kilakila *Ma ke kihi o ke aʻo mālama*	Picture clouds gather and rise tall At the beginning of day, at first light
Puana ka inoa poinaʻole	My song comes to an end, never to forget
Kaulana nā Manawaiopuna	Famous is the beauty of Manawaiopuna, source of the stream

[huapala.org n.d.]

3.4.4.4 Nohili Ē

"Nohili E" was written for Nohili , where the sand makes noise (hence the nickname "barking sands"). Here at Nohili, at Polihale, one would come across the *limu pahapaha* and the spraying of the sea mist as mentioned by the composer, Muriel Amalu.

Noenoe mai ana ia'u *I ke aloha o ka mokihana* *A he hana maʻa ʻole iaʻu* *I ke aloha e hana nei*	A misty, foggy, feeling comes to me For the love of the mokihana (This feeling) is unfamiliar to me This love that is happening
Hui: *Nohili e* *E ke one kani* *E ʻuhene nei* *I ka poli*	Chorus: Nohili the barking sands A merry tune For the heart
Wehiwehi Polihale	How festive is Polihale

I ka lau o ka pahapaha	With the lushness of pahapaha (seaweed)
I ka lele o ka ʻehukai	Where the sea spray seems to leap
Pōhina lua i nā pali	Like two mists that creep upon the cliffs
Nani wale ka ʻikena	Always beautiful
I ka wai koni i ka ʻili	Water that makes my skin tingle
I ka wai kaulana	The famous water
Neia uka uluwehiwehi	That comes from the lush mountains.
[huapala.org n.d.]	

3.4.5 Nāpali Moku

Research could not locate any *mele* for the Nāpali District. This certainly does not mean that none exist, but that we were unable to locate the source where it could be found.

Section 4 Historical Accounts

4.1 Moku ‘o Halele‘a

4.1.1 Pre-Contact to Early Post-Contact Period

The Island of Kaua‘i, affectionately described as “*Kaua‘i nui moku lehua pane‘e lua i ke kai*” (Great Kaua‘i of the lehua groves which seem to move two-by-two to the shore), is the oldest of the larger main Hawaiian Islands (Maly and Maly 2003:5). Historically, it was divided into several districts and political units which in ancient times were subject to various chiefs—sometimes independently, and at other times, in unity with the other districts; these early *moku o loko* or districts included Halele‘a, Kona, Ko‘olau, Nāpali, and Puna (Maly and Maly 2003:5). The lands of the Halele‘a-Nāpali districts were highly valued by the *maka‘āinana* because of the streams and fresh water resources that could be diverted into extensive *lo‘i kalo*. The wealth of these lands was further enhanced by the sheltered bays and rich fisheries fronting them (Maly and Maly 2003:6).

During Kamehameha’s conquest of the Hawaiian Islands from the 1780s to the 1790s, Kaua‘i was never under Kamehameha’s direct rule. Kamehameha made an agreement with Kaua‘i chief Kaumuali‘i that Kaua‘i would revert to Kamehameha upon Kaumuali‘i’s death (Silva 1995:2). Kaumuali‘i in the meantime would retain a life-interest in rulership of Kaua‘i; however, he was subject to commands from O‘ahu and taxes were to be paid to the Kamehameha line.

Kamehameha preceded Kaumuali‘i in death by five years. During that time, residents of Kaua‘i never dealt with any upheavals of land distribution or war. Lands were maintained by *maka‘āinana* while *konohiki* acted as overseers. Kaumuali‘i died in 1824, leaving instructions that honored his agreement with Kamehameha. Refusing to follow the traditional reassignment of lands to local chiefs upon his death, Kaumuali‘i was displaying his loyalty to the Kamehameha line. Even during his last visit to O‘ahu, Kaumuali‘i was hesitant to choose a successor. With the help of Kauikeaouli’s (Kamehameha III) advisors, Kaumuali‘i’s nephew Kahalaia was installed as successor.

Chief of Hawai‘i Island, Kalanimoku, traveled to Kaua‘i to execute Kaumuali‘i’s last wishes and announce the successor. Kamakau relates the story of Kalanimoku’s announcement:

> ‘Those of the chiefs who hold land, they are well off; the commoner who holds property is fortunate; the chief or commoner who has no portion is unfortunate. The lands shall continue as they now stand. Our son, Kahalaia, shall be ruler over you.’ [Kamakau 1992:267]

The news did not sit well with Kiaimakani, a blind chief from Waipouli. Instead, Kiaimakani felt the land should be redivided because there was a new ruler. Kalanimoku did not consent to this and a rebellion ensued. Armies from O‘ahu and Maui traveled to Kaua‘i. Because the Kaua‘i forces had lived peacefully under Kaumuali‘i’s rule, they were not prepared for a battle resulting in a bloody defeat.

After the bloody battle, all chiefs came together and Kalanimoku redistributed the lands of Kaua‘i (Silva 1995:3). People were upset that Kaumuali‘i’s wishes were not being executed. In the end, it was decided that Kahalaia would not be ruler. Kaua‘i and Ni‘ihau were ruled by Kauikeaouli and Kaikioewa was appointed governor (Kamakau 1992:268–269). Kahalaia was bitter against Kauikeaouli's step-mother and *kuhina nui* (powerful officer) Kaʻahumanu for dethroning him, but he was later consoled and made Kauikeaouli's guardian.

4.1.1.1 Subsistence and Settlement

The abundance of fresh water attracted settlers to the *moku* of Haleleʻa. Native grasses and trees including *hala*, *milo* (*Thespesia populnea*) and *kou* (*Cordia subcordata*) trees covered the plains. Earle (1978:163) relates that "only the prime areas of alluvial soils were farmed intensively aboriginally." No evidence of pre-Contact villages have been found in Haleleʻa; rather, homes were scattered around the *moku* (Wilcox 1981:141).

During the centuries before Euro-American Contact, the land and waters of Hanalei had long afforded possibilities for intensive agricultural and cultural development by *kanaka maoli*. The large alluvial flat on both sides of Hanalei River had been farmed extensively for taro for centuries. E.S. Craighill and Elizabeth Handy present the *ahupuaʻa* resources that pre-Contact Hawaiians utilized and amplified:

> Hanalei is unique on Kauai in having a broad river flowing into a magnificent level seaward area [...] The flats in which rice was planted by the Chinese had been the taro *loʻi* of the Hawaiians, amply irrigated by ditches from the Hanalei River. Sugar cane and ranching at different times have taken over most of the land where taro was originally grown. And yet in recent years some taro was still grown there and there was a *poi* mill […]
>
> Because of an abundance of foods of all sorts, Hanalei was, and still is, one of the most attractive dwelling places in the islands. In addition to its rich lands and water resources, and its beautiful beach, it was close enough to the rich deep-sea fishing grounds off the Nāpali coast to supply its people with plenty of fish. [Handy and Handy 1972:420–421]

Elsie H. Wilcox, a descendant of missionaries to Kauaʻi, writing in 1917, further characterizes Hawaiian settlement in Hanalei into the early decades of the nineteenth century:

> The settlement then extended along the beach, where the climate was drier and where fishing was available, and the grass-thatched houses were set in the midst of gardens of fruit-trees, vegetables and flowers. Bananas, breadfruit, coffee, sugar-cane, cocoanuts, sweet-potatoes, yams, squashes, pia and taro were cultivated, and chickens and pigs raised. On account of the sandy soil and lack of water 'makai', most of the taro-patches were further up the valley, the farmer going up daily to 'mahiai' and returning at night to his home on the beach. The banks of both rivers were lined with taro-patches which, following the watercourses, extended far up into the valleys. Terraced remains of these patches are still to be seen far above present habitations, their extent indicating a goodly population at that time. The stretch of land between the two rivers, now used as rice-land (i.e. 1917), was then an undrained swamp, not available for cultivation. [Wilcox 1991:5]

Prior to Western Contact, the hill areas of the *ahupuaʻa* of Hanalei, Kalihiwai and Kalihikai may well have been used for gathering as part of the land open to all *ahupuaʻa* members. Economically viable plants have been identified in association with archaeological remains on the lower slopes (25 to 125-ft elevation) of the valley ridge; these have been associated with dry land or *kula* lands to supplement the crops growing in the adjoining terraces (Cleghorn 1979; Schilt 1980). The pandanus groves of the upper slopes of the valley wall would have been another resource for residents of Hanalei Ahupua‘a who would not have to travel so far *mauka* to find the *hala* needed for their mats, etc. The *ahupua‘a* all had irrigation systems in place in the 1850s to distribute stream and rain water to the extensive *lo‘i* fields.

Handy (1940:171) assumed yams were cultivated throughout inland Halele‘a. Coconuts were grown in select coastal areas of Kaua‘i, including Hanalei (Handy 1940:193). Hanalei was a planting area for *wauke* for *kapa* (Handy 1940:198). *Wauke* is also known as paper mulberry and is an important canoe plant transported to Hawai‘i, as are sweet potatoes, which Handy noted were planted in the “narrow coastal strip between the hillsides and the sea at Kalihi-kai and Anini” since they are “ideal for this type of planting (Handy 1940:153).

The topography and post-Contact land use patterns of the eastern portion of Hanalei Ahupua‘a are more similar to those of Kalihikai and Kalihiwai *ahupua‘a* than to the rest of Hanalei. Māhele records indicate the presence of traditional agriculture and house lots along the coast and lowlands near ‘Anini Stream and the three smaller streams in Kalihikai Ahupua‘a.

Kalihikai is a small *ahupua‘a* that “had quite extensive *lo‘i* areas near the sea. There were *lo‘i* back along main streams and side streams,” although the valley is shallow (Handy and Handy 1972:421). The lands are described as “a rolling plain that has been gouged by small streamlets which, for the most part, drain away into the neighboring *ahupua‘a* of Kalihiwai and Hanalei. The plain drops over low hills broken by four little gulches onto a flat strip of land. It was here that the lo‘i, irrigated field ponds, were dug and taro grown, and the people lived” (Wichman 1995a:1).

The majority of the Kalihikai coastal areas were developed entirely in agricultural terraces when observed by Handy in the 1930s (Handy 1940:71). E.S. Craighill and Elizabeth Handy present the *ahupua‘a* resources that pre-Contact Hawaiians utilized and amplified:

> East of Hanalei are two small *ahupua‘a*, Kalihi-kai and Kalihi-wai, both of which had quite extensive *lo‘i* areas near the sea. There were *lo‘i* back along main streams and side streams, but both valleys are shallow. Actually the stream flow from both valleys is diverted eastward to Kilauea, the adjacent *ahupua‘a* in the *moku* of Ko‘olau. [Handy and Handy 1972:420–421]

Kalihiwai also had *lo‘i* areas near the sea in the “shallow valley” that opened to the ocean. In 1848, *noni* (*Morinda citrifolia*) and orange trees were known to have been cultivated, although by 1850, cattle and hogs had begun trampling the groves (Wichman 1995b:1).

Kalihiwai Valley, especially in the fairly broad lower flood plain, was traditionally *lo‘i* land. These *lo‘i* also extended into the narrow side valleys farther upstream (Handy and Handy 1972:421). E.S. Craighill Handy provides a more detailed description of Kalihiwai:

> Kalihiwai has an extensive terrace area on the flatlands through which Kalihiwai River meanders to the bay. This whole area is now planted in rice. Where the valley becomes narrower, a mile inland there were small terraces. Two miles inland, and again 2.75 miles inland, in sharp bends of the river, there are small flatlands where wet taro was formerly grown. Just east of Kalihiwai Bay, Puukumu Stream flows in a shallow valley. A quarter of a mile below the road there is a small area of old terraces. [Handy 1940:71]

Numerous accounts attest to extensive *hala* groves in the uplands of Hanalei, Kalihikai and Kalihiwai in the early nineteenth century (Alexander 1991; Bird 1890; King 1991; Lydgate, H.E. 1991). William DeWitt Alexander (1991:124) describes these groves during a trip around the island in 1849, "Five more miles of riding through woods of *hala*, brought us to the tip of the hill that overlooks Hanalei Valley [...]" William T. Brigham visited Kauaʻi in 1865 and also commented on the extensive pandanus, "Vast numbers of pandanus cover the hillsides and grow so luxuriantly as to furnish an admirable shelter from the rain" (Lydgate, H.E. 1991:139).

Handy (1940:72) mentioned that Waiʻoli Ahupuaʻa was "planted in rice up to the base of the hills." He also noted that, "Smaller terraces up the valley are now unused."

Waikoko Ahupuaʻa is the smallest *ahupuaʻa* in Haleleʻa District. Earle (1978) provides the following summation of Waikoko:

> The *ahupuaʻa* boundaries include the catchment area of a small permanent stream and an area of alluvial plain. The eastern boundary arbitrarily divides a large alluvial flat between Waikoko and Waipā. Along the coast (1.4 km long), Waikoko has access to a section of Hanalei Bay and to a coral reef. [Earle 1978:33]

Handy (1940:72) also described Waipā Ahupuaʻa. Handy noted that "a sizable flatland on the southwest side of Hanalei Bay" is planted in rice. This area was irrigated by Waipā Stream which is formed by three small streams originating upstream from the shore. Earle (1978:33) mentions Waipā had "several good areas for irrigated agriculture," noting that "in 1850, four [irrigation systems] were present in the coastal plain." Earle also mentioned "reports of the archaeological remains for several irrigation systems in the valley interior."

Handy (1940:72–73) mentions that Lumahaʻi Ahupuaʻa had numerous small terraces along the upper course of Lumahaʻi River. Handy noted, "the upper part of this broad valley bottom is covered with *hau* (*Hibiscus tiliaceus*) and guava jungle, with old mango trees marking former home sites." He also observed rice was being "grown west of the stream on the broad terrace lands," while ranch lands "planted in elephant grass" were located on "the broad flats at the lower end of the valley" east of the stream. Handy and Handy (1972:420) states, "Lumahaʻi must have had many *loʻi* areas in old Hawaiian days, but in 1935 most of it was used for ranch lands, which obliterates the evidences of Hawaiian farming. It could not have supported a population as large as Wainiha or Hanalei."

Wainiha is the second largest *ahupuaʻa* in Haleleʻa District, after Hanalei. Wainiha Valley, though relatively narrow, is approximately 13 miles (20.92 km) long, extending from the ocean well into the interior of the island where its steep walls reach over 4,000 ft (1,219.2 m) high (Handy and Handy 1972:419). Handy and Handy (1972:420) state,

> There were, of course, house sites all through the valley on ground not suitable for irrigation. On such land sweet potatoes were planted. Bananas flourished: in 1931 *maiʻa Poloapola* (*Borabora banana*, *musa pehi*) was found in gulches. This Tahitian banana, which bears its fruit on an upright stalk, is said by local Hawaiians to be indigenous to Wainiha. *ʻAwa* of several varieties was growing there also, and undoubtedly the economic staples *wauke* and *olona* were planted. Specimens of yams were collected in 1931. [Handy and Handy 1972:420]

The well-formed off-shore reef undoubtedly provided valley residents with a wealth of resources. However, portions of coastal Wainiha are vulnerable to inundation by tsunamis originating in the north Pacific Ocean and flooding due to heavy rainfall is a frequent occurrence in Wainiha. The flooding of Wainiha is even mentioned in folklore (Pukui 1951:67). Perhaps it is this natural characteristic of the valley that explains the origin of the name "unfriendly water."

The *ahupuaʻa* of Hāʻena was permanently inhabited and intensively utilized in pre-Contact times, based on archaeological, historical, and oral history documentation (e.g., Andrade 2008; Handy 1940; Handy and Handy 1972; Silva 1995). Andrade describes Hāʻena as "well endowed with natural resources. Extending from uplands to coastal plain, it descended from cloud-shrouded peaks broadening out to include a fishery encompassing several large reefs and bays fronting the ahupuaʻa" (Andrade 2008:30).

Hāʻena is a narrow coastal strip that lies between high cliffs and mountain sides (Handy and Handy 1972:419). Hāʻena consisted of several extensive areas of *loʻi kalo* including the lower portions of Limahuli Valley and the east and west sides of the valley as well. Areas between the *makai* and *mauka* areas of Hāʻena were also filled with *loʻi kalo*. The small valley of Mānoa was also filled with irrigated terraces. East of Limahuli Stream was a swampy area where taro was grown in a unique style similar to that of Mānā and Waiʻeli located in west Kauaʻi (Handy and Handy 1972:419). Swamp mud was piled onto rafts that were partially submerged. *Kalo* was cultivated in the swamp mud on these partially submerged rafts. Sweet potatoes were grown in the sandy areas along the coast of Hāʻena. Bananas were formerly planted in Limahuli and Mānoa valleys as well as sugarcane and *ʻawa*.

4.1.2 Early Historic Period

The nineteenth century would see the Hawaiian-evolved landscaped transformed by the interventions of newly arrived Euro-American missionaries, entrepreneurs, settlers and adventurers.

4.1.2.1 Historic Accounts

4.1.2.1.1 The Russian Enterprise at Hanalei

Early in the nineteenth century, a short-lived scheme to establish the Russian Empire in the Hawaiian Islands unfolded on Kauaʻi. During a gale in the early morning hours of 31 January 1815, the *Behring*—a 210-ton three-master owned by the Russian-American Company—was beached at Waimea Bay on the south coast of Kauaʻi. The *Behring* was loaded with seal skins destined for the company's headquarters at Sitka, the capital of Russian America. Kaumualiʻi, the king of Kauaʻi, took possession of the vessel and its cargo, maintaining that anything brought to land upon Kauaʻi became the king's property.

Alexander Andreievich Baranov, the Russian-American Company's manager at Sitka, chose Georg Anton Schäffer, a German adventurer, to lead a mission to recover the cargo. Schäffer arrived on the island of Hawaiʻi in November 1815, but it was not until May 1816 that he sailed for Kauaʻi aboard the company's 300-ton vessel, the *Otkrytie*, supported by an armed crew. Arms, however, were not needed; Schäffer found Kaumualiʻi willing to return the *Behring*'s cargo and eager for an alliance with the Russian Empire.

Over the next few months, a busy Schäffer established the Russian presence on Kauaʻi, intending to make the island a launching point for control of the entire Hawaiian chain. In

September 1816, Schäffer began construction at Waimea Bay of a lava-rock walled fort to be named after the Russian Empress Elizabeth. He then gave orders for the creation of two earthenwork forts at Hanalei: one named after the Russian General Barclay de Tolly, the other—constructed on a plateau overlooking Hanalei Bay (on the grounds of the present Princeville Hotel)—named after the Emperor Alexander. At the same time, Kaumuali‘i deeded Hanalei to Schäffer who renamed the *ahupua‘a* “Schäfferthal.”

By the spring of 1817 Kaumuali‘i had lost confidence in Schäffer. Hearing a false report that Russia and the United States were at war, Kaumuali‘i became anxious that he had allied himself with the weaker of the two powers in the Pacific. On the morning of 8 May 1817, Kaumuali‘i, accompanied by “a thousand men” (according to Schäffer) at Waimea, ordered the Russian emissary and his compatriots off the island immediately. Aboard two company ships, they fled to Hanalei where Schäffer intended to make a stand; he wrote in his journal:

> I took possession of the island of Kauai in the name of His Majesty, the Great Emperor of Russia Alexander Pavlovich, ordered the Russian flag raised on Fort Alexander, fired three canon shots, and declared myself chief of Hanalei Valley. [Pierce 1965:202–203]

But Schäffer and the others soon realized their predicament was hopeless. In June 1817 they sailed away from Hanalei Bay and concluded the Russian venture on Kaua‘i.

Little is known of the “lost” Russian Fort Barclay and other Russian infrastructure constructed at the coast. On 15 November 1816 Schäffer records that “until now I have worked energetically on Forts Alexander and Barclay. Platov [Ka‘umuali‘i’s deputy, a Kaua‘i chief also known as Obana Tupigea that Schäffer named after a Russian hero] […] works daily with his Indians on constructions of the fortifications” (quoted in Pierce 1965:186). On 25 November 1816 Schäffer wrote to Alexander Baranov that “I now have almost ready here one fortress of stone [Fort Elizabeth in Waimea] and two fortifications of earth, with palisades [in reference to forts Alexander and Barclay at Hanalei]” (Pierce 1965:82). On 1 April 1817 Schäffer reported “I visited the fortifications and found Forts Alexander and Barclay both nearly finished” (Pierce 1965:198). Pierce provides the following:

> Sheffer accepted the province of Hanalei and started to build two fortresses there, one [Fort Barclay] on the right side of the river Hanalei at the mouth of the harbor and another [Fort Elizabeth] on the same side of the river but much higher, at the harbor itself. Both fortresses were built of earth; however both remained unfinished. The work was being done by promyshlenniks [hunter/trappers working for the Russian American Company], with the aid of the inhabitants of the province, without any aid from the king. [Pierce 1965:128]

Mills (2002:26) comments that “These two forts [Fort Alexander and Fort Barclay], built primarily with Russian-American company labor, had low earthen work walls, possibly with palisades.”

Samuel Whitney (1838:50) referred to one or both of them as a “slight breastwork” where a few cannon were mounted.

In addition to Fort Barclay it appears there was other Russian infrastructure at the coast as referred to in a letter from George Young (and four other Russians) to Schäffer dated 29 December

1816 reporting the murder of an Aleut working as a watchman for the Russians and the arson of a “winery” at Hanalei excerpted below:

> The boat with your messenger Fedor Leshchinskii was ready, as was the boat loaded with chalk and clay. Mr. George Young was then on the beach about to send off a letter to you. The natives left their houses and went somewhere near our buildings, which include a winery, by the lake, with [___] and masses of calabashes. They took two butts of wine and a large quantity of roots used in making alcohol. We, Mr. Young, myself, and Bologov, decided that we needed a watchman so no one, whether an Aleut, a Russian, or a kanaka, would dare to steal or rob [us of] anything. We thought we could avoid trouble that way, but just as we handed the sealed envelope to Leshchinskii, suddenly we heard a gunshot from the guard posted in the kanaka [___]. We—Captain Young, myself, Bologov, and Leshchinskii—rushed from the room. We found two men from Mr. Young’s boat whom we sent to inquire as to the cause of the shooting. We followed them ourselves and started to run along the shore; before we had covered half of the distance we met the returning men, who told us that the watchman was dead. As soon as we heard that, we saw the building burning on all sides, although there was not one Sandwich Islander to be seen. In ten minutes this unusual fire was over. The grass was burned out and we could see the dead body. Using water brought from the lake in calabashes, Mr. Young, I and the others put out the rest of the fire. We examined the body of the dead man in the presence of a large crowd. We found the cause of death—a large wound in the chest and two more in [__]. We brought the body to the house[…] [Pierce 1965:83–84]

The geography referred to is less than certain, but it appears there was a company house quite close to the mouth of Hanalei Stream and that a different structure, the “winery, by the lake” (evidently a thatched structure), was to the north near the present marsh. The assertion that the fire was put out “using water brought from the lake” suggests the “winery” was closer to the lake than to either the coast or the Hanalei River. Notably there is no reference to Fort Barclay in the account.

4.1.2.2 Hanalei Bay

Into the early 1820s, the Russian episode in Hanalei was apparently past remembrance. Rev. Hiram Bingham, describing a visit to Hanalei in 1821 with Kaumuali‘i and King Liholiho, makes no mention of the former Russian presence but gives details of the ongoing Hawaiian culture:

> The people in their original state treated us with such as they had. One ascended a coca-nut tree and threw down a nut. Another tore off with his teeth, the thick, fibrous husk, then cracked the shell with a stone, to give us a drink. The head man gave us a course dinner. A pig, baked with heated stones covered in the ground, was set before us on a large, shallow, wooden tray. Kalo, baked in the same manner, and beaten, was laid on large green leaves instead of plates, on the ground [...] Water was given us in a tumbler consisting of the neck of a gourd-shell, and bananas, ripe, rich, and yellow, were put into our hands singly. [Bingham 1847:143]

Three years later—1824—Bingham witnessed at Hanalei an example of the concerted human effort that could still be evoked by the *ali‘i*. The brig *Pride of Hawaii*, owned by Liholiho, ran aground in Hanalei Bay. Bingham proclaimed the effort by a great crowd of Hawaiians to salvage the disabled yacht "one of the best specimens of the physical force of the people, which I ever had opportunity to observe for more than twenty years among them—indeed the most striking which I ever saw made by unaided human muscles" (Bingham 1847:221).

> The chief Kiaimakani of Waipouli passed up and down through the different ranks, and from place to place, repeatedly sung out with prolonged notes, and trumpet tongue [...] 'be quiet—shut up the voice.' To which the people responded [...] 'say nothing,' as a continuance of the prohibition to which they were ready to assent when they should come to the tug. Between the trumpet notes, the old chieftain, with the natural tones and inflections, instructed them to grasp the ropes firmly, rise together at the signal, and leaning inland, to look and draw straight forward, without looking backwards toward the vessel. They being thus marshaled and instructed, remained quiet for some minutes, upon their hams. [Bingham 1847:221]

The salvage efforts ultimately failed and the brig was lost. The grounding of the *Pride of Hawaii* at Hanalei Bay in 1824 would suggest the perils of navigation by western ships within the bay and the rest of the northern Kaua'i coast where wind and sea conditions made impossible any secure anchorage. During subsequent decades of the nineteenth century, as increasing numbers of traders, ranchers, and settlers moved into Hanalei, the bay could serve only as one "among the many outposts (in the Hawaiian Islands) supplying provisions to the whaling fleet" (Thomas 1983:23). "Hanalei was visited by an occasional whaler and by inter-island ships, since there was some cargo to be carried out, but it was a dangerous harbor, especially when winter winds and rain blew down from the north" (Joesting 1984:141).

4.1.2.3 Missionaries

During the 1830s, the Protestant American Board of Commissioners for Foreign Missions (ABCFM) established a mission station at Hanalei Bay in the neighboring *ahupua'a* of Wai'oli. "The Waioli valley seemed the best place on the north shore of Kauai to build a church, school and the necessary domestic buildings which together made up a mission station. Hawaiians there were enthusiastic" (Riznik 1987:5).

The first missionary assigned to the station was William Patterson Alexander who, along with his wife and son, arrived at Hanalei Bay in 1834. The Alexanders would remain at Wai'oli until 1843.

The first Roman Catholic Church in Hanalei was not established until 1864. The Catholic Chapel was built on the western bank of the Hanalei River near the river mouth (Damon 1931:340). Behind the Chapel was Hanalei's first trading store, called Hubertson's Store, run by an Englishman named Hubertson who arrived in the 1840s with a shipload of goods. The Catholic Chapel was built on land purchased on 10 October 1849 by Frenchman John Brosseau, who secured a grant for the land from King Kamehameha III (Kauikeaouli).

Brosseau died at Moloa'a on 21 January 1850, and the land was bought by Henry Rhodes, who then willed it to his brother, sea captain Godfrey Rhodes. Godfrey and his wife Anna Louisa then deeded the Hanalei land to Father Maudet in 1860 for the Catholic chapel (Damon 1931:341).

Hanalei's first Catholic Chapel was blessed on the site near the Hanalei River on 3 October 1864. The chapel was dedicated to Saint Maxime, the Patron Saint of a friend of the Rhodes family, M. Desnoyers, who was the French consul at Honolulu and also a friend of the Rhodes'. The

Chapel and a Rectory, a small house for the priest, were built by Brother Arsene Bernat and blessed by Father Maudet (Damon 1931:340–341) (Figure 9).

4.1.3 Middle to Late Nineteenth Century

4.1.3.1 The Māhele

The Organic Acts of 1845 and 1846 initiated the process of the Māhele—the division of Hawaiian lands—that introduced private property into Hawaiian society. In 1848, the Crown and the *aliʻi* received their land titles. *Kuleana* awards to commoners for individual parcels within the *ahupuaʻa* were subsequently granted in 1850. Crown Lands were considered the private lands of the monarch, and many lands were sold or mortgaged during the reigns of Kamehameha III and IV to settle debts to foreigners. To end this practice, the Crown lands were made inalienable in 1865, and their dispensation was regulated by the Board of Commissioners of Crown Lands, which effectively put them under the administrative control of foreign-born residents (Kameʻeleihiwa 1992:310; Chinen 1958:27).

In 1850, the Privy Council passed resolutions that affirmed the rights of the commoners or native tenants. To apply for fee-simple title to their lands, native tenants were required to file their claim with the Land Commission within the specified time period of February 1846 to 14 February 1848. The Kuleana Act of 1850 confirmed and protected the rights of native tenants. Under this act, the claimant was required to have two witnesses who could testify they knew the claimant and the boundaries of the land, knew that the claimant had lived on the land for a minimum of two years, and knew that no one had challenged the claim. The land also had to be surveyed. Not everyone who was eligible to apply for *kuleana* lands did so and, not all claims were awarded.

Some claimants failed to follow through and come before the Land Commission, some did not produce two witnesses, and some did not get their land surveyed. Out of the potential 2,500,000 acres of Crown and Government lands, less than 30,000 acres of land were awarded to the Native Hawaiian tenants (Chinen 1958:31).

Figure 10 shows Kauaʻi's population in 1853. Haleleʻa's population was concentrated within the coastal plain due to the prevalence of alluvial soils and proximity to ocean resources.

As a result of the Māhele, Land Commission Awards (LCA) were claimed in five distinct clusters within Hanalei Ahupuaʻa: the shoreline, the Mahaʻana (taro fields adjacent to Waioli Ahupuaʻa), Puapuahoi-Limanui (the bottom lands of the Hanalei River), ʻAnini (on the coast northeast of Hanalei Bay), and Kīloa (inland and adjacent to Limanui).

Seventy claims were filed for Hanalei (some filed the same property under two numbers) and 49 were awarded. These claims, both awarded and not awarded, detail land usage referred to here as land use components. These components (204) comprise more than 124 taro patches or *moʻo* (one or more taro patches in a *moʻo*) (61.1%), 44 house lots (21.7%), 18 *kula* (8.9%), more than eight orange and more than one lemon trees (4.9%), five *loko* (2.5%) a *noni* and banana patch, 400 head of cattle and 160 acres of coffee, and a wharf (misc. 1%).

In Kalihikai Ahupuaʻa, the majority of LCA claims were for agricultural *loʻi* for *kalo*. Also claimed were a few house lots. These claims are almost all on the narrow coastal plain along the central and easternmost of the three streams of Kalihikai Ahupuaʻa. It appears the narrow stream valleys lacked suitable natural alluvial terraces and may have been too prone to flooding to attract

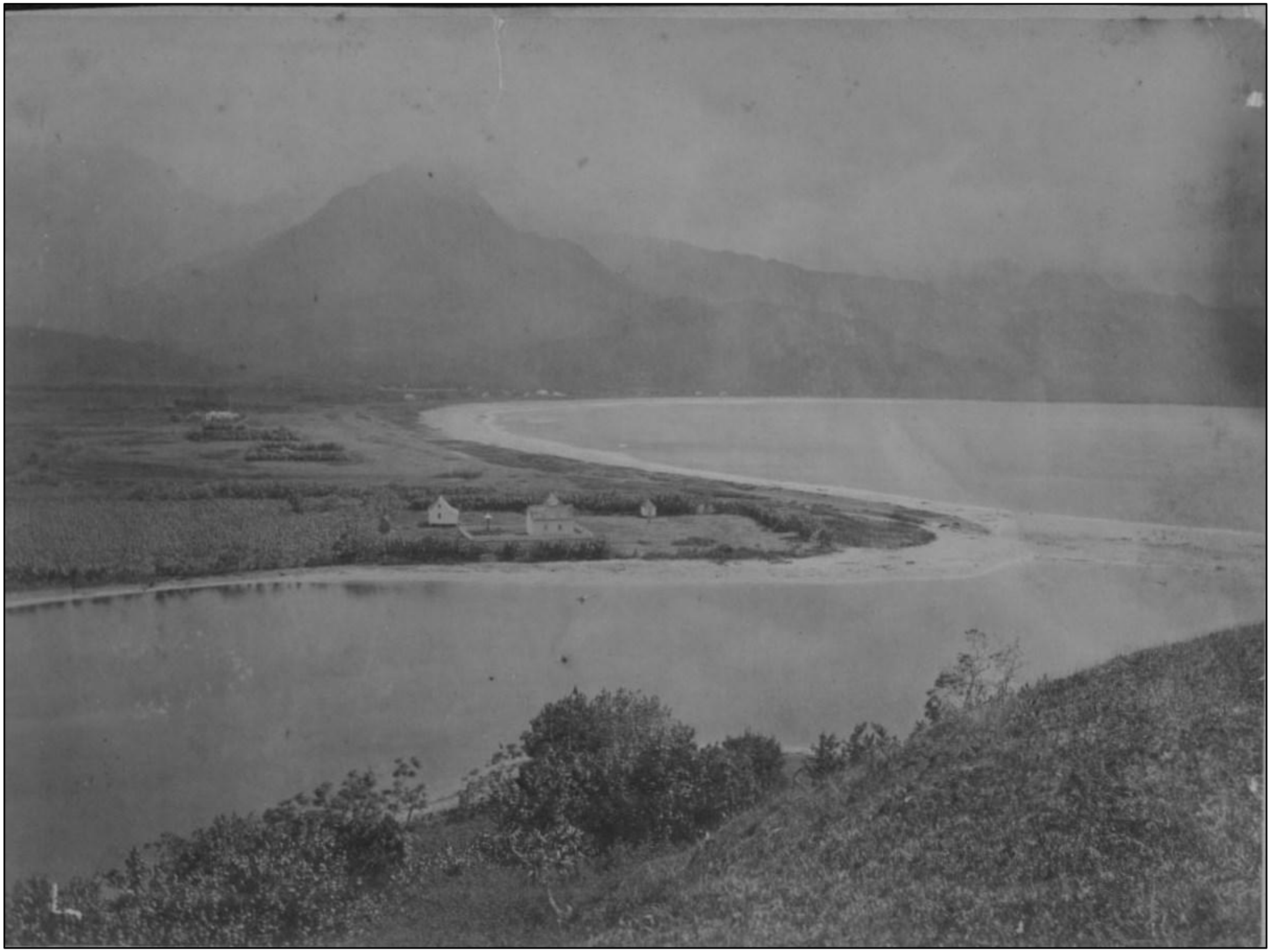


Figure 9. Photo (date unknown) of the Roman Catholic Church within Halele‘a (courtesy of the Hawai‘i State Archives Digital Collections)

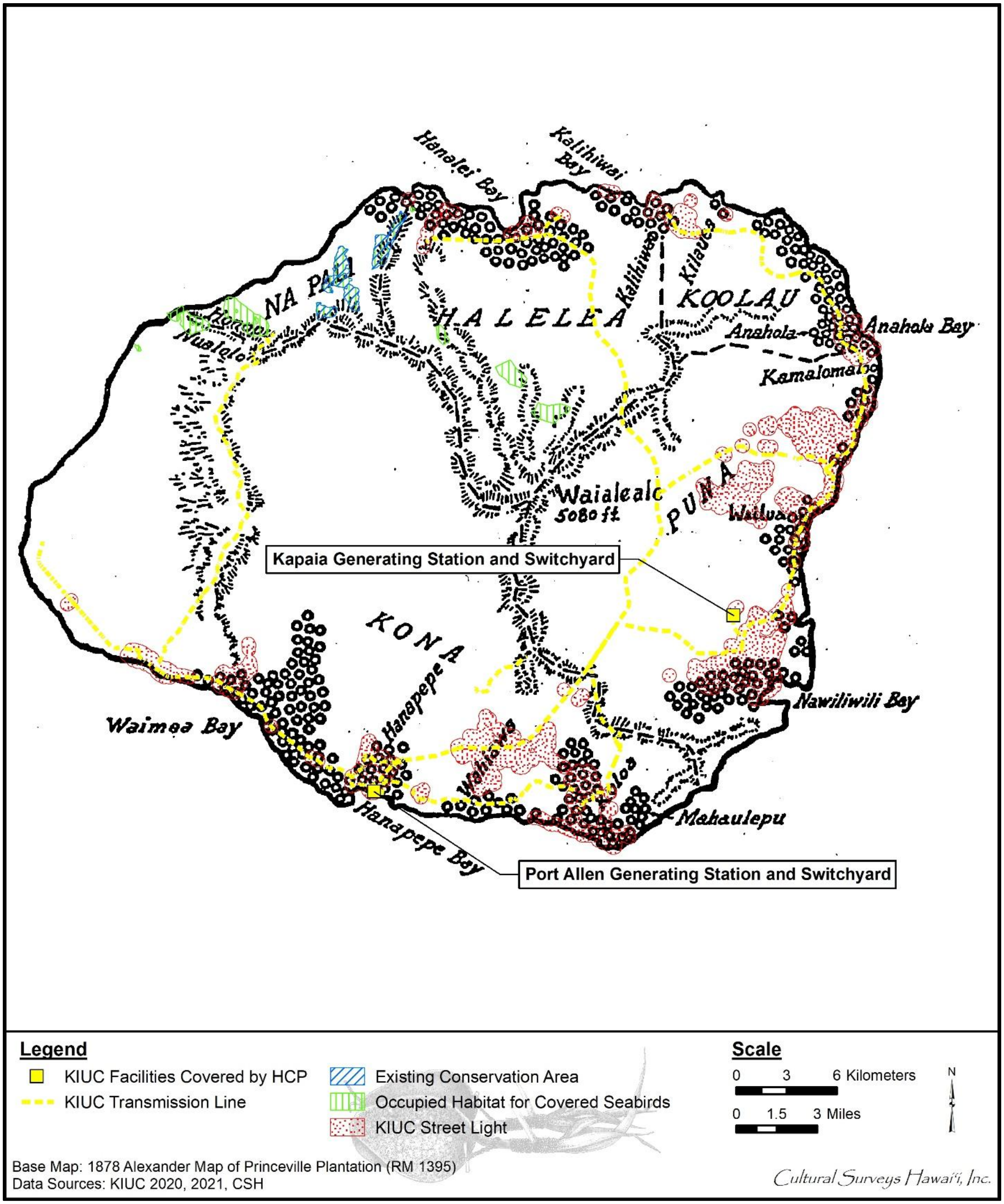


Figure 10. 1853 (Coulter 1931) population density estimates; each symbol represents 50 people; overlayed with KIUC transmission lines, street lights, two specific facilities, existing conservation sites, and occupied habitat for species covered by the Habitat Conservation Plan

permanent settlement or intensive agricultural development. The clumping of settlement near where the central and easternmost of the streams debouch on the coastal plain may well have related to the ease of irrigation at these locations.

Kalihiwai Ahupuaʻa was granted to William Lunalilo in the Māhele (LCA 8559-B). There were 24 smaller *kuleana* awards in the *ahupuaʻa*, mostly concentrated in the lower portions of the valley. Their small size, location, and shape indicate clearly that these are *loʻi* lands.

From the LCA testimony, it seems that by 1850 the people in the district had a tradition of shared resources and functioned as part of the larger district entity rather than maintaining a separate *ahupuaʻa* status. Even though neighboring *ahupuaʻa* would have had their own resources, LCAs show some persons had agricultural land in Waiʻoli but lived elsewhere, and some people living in Waiʻoli had agricultural land elsewhere. During early historic times Waiʻoli served as a nucleus of not only the new western culture and religion, but also as a resource garden for imported cultigens in the vicinity of the Waiʻoli Mission.

The Land Commission Awards describe at least 154 taro *loʻi* along the Waiʻoli Stream, the *ʻauwai* systems, and Waikonono Stream, another small stream leading eventually down to the floodplain on the Nāpali side of Waiʻoli Stream. There are 26 claims for house lots in Waiʻoli with 12 persons claiming they live in Hanalei (LCAs 4109, 9139, 9261, 9274, 9275, 9276, 9278, 9280, 10593, 10594, 10915, and 11059) but have their *loʻi* in Waiʻoli. Another claimant has a house lot in Waiʻoli but the rest of his land is in Hāʻena (LCA 7949). Various other claimants mention they live in Waiʻoli but do not claim a house lot. There are claims for 27 *kula* in Waiʻoli. There are no specified crops listed for any of the *kula*, but based on traditional *kula* lands, there would be sweet potatoes, yams, bananas, and sugarcane. One claimant mentions a *muliwai* (or brackish water pond behind the sand dunes used for fishing; LCA 3781), and two mention a fishpond (LCAs 4109, 10309). The Land Commission Awards also include one for the Waiʻoli Mission, where a claim is for a framed schoolhouse, pasture land, and cultivated grounds, a 4-acre taro patch, a Native Church on 1/2 acre, and pasture land on the narrow strip on the western side of the Waiʻoli River.

Waiʻoli, with 3,350 acres, has 154 claims for *loʻi*, which works out to .046 *loʻi* per acre for the entire *ahupuaʻa* or probably 1.5 per acre on the 100 acres of floodplain. *Loʻi* represent 74% of possessions claimed, *kula* 13%, house lots 12.6%, and other less than 1%. A scant 14% of the awardees claimed to have held the land prior to 1824. A quarter of the claimants received their land during the time of Davida Papohaku, *konohiki* of Waiʻoli from 1834–1837. Davida Papohaku or David Stonewall was one of the five members who came to help organize the Waiʻoli Mission and it was his duty to correct and help Mr. Alexander translate his sermons into Hawaiian. He came with 75 of his own retainers and they formed the little village of thatched huts known as Kalema or Bethlehem (Damon 1931:325). Perhaps these claimants' families came with Papohaku to the Hanalei area and were part of his train. Another fifth of the claimants received their land from Daniela Oleloa, a *konohiki* in the 1840s. Oleloa did not have a very high genealogy but he held four lands prior to the Māhele (Kamēʻeleihiwa 1992:280). There are 88 names mentioned in the LCAs as neighboring land cultivators or house lot holders and some of these persons received grants to the land, such as Emelia but have no LCA listed for them. Others like Lewi and Kalili are shown in the LCA index as having received land, but no maps show them as having title to the land (at least by 1912). We might assume they died, perhaps intestate, or perhaps they passed the land to someone else. In any case someone else was occupying the land they claimed.

Waipā Ahupuaʻa was awarded to Ruta (Ruth) Keʻelikōlani, great-granddaughter of Kamehameha I, during the Māhele: LCA 7716:1, TMK: [4] 5-6-004, which became part of the Bishop Estate. It was one of 12 lands she retained, the majority of which were located on Hawaiʻi Island and Maui (Dye 2004:8). Eleven individuals were awarded lands in Waipā Ahupuaʻa.

There were two names mentioned in Waikoko Ahupuaʻa but only one was awarded. LCA 11216 was given to M. Kekauʻōnohi, daughter of Kahoano Kū Kinauʻu who was the son of Kamehameha I. Her mother was a close relative of Kekaulike, Chief of Maui. Most importantly she was the wife of Kamehameha II (Liholiho). After her husband's death she moved to Kauaʻi, married Keliʻiahonui (son of the deceased Kaumualiʻi), and became governor of Kauaʻi in 1842. No land use or landscape features were given.

Basic *kuleana* documentation specifies that the entire *ahupuaʻa* of Lumahaʻi was awarded to L. Konia Wahine. No individual *kuleana* are indicated by the Māhele data to date. In addition to the irrigated fields of *kalo,* it can be assumed that all the common Hawaiian agricultural crops were raised in Wainiha.

Wainiha is part of a larger LCA (11216.5) of M. Kekauʻōnohi. A study of all the claims and their supporting testimony for Wainiha shows a well-developed land system in place. The overall settlement pattern, dating to the mid-1800s, exhibited habitation near the coast and agricultural undertakings in the well-watered interior areas. During his island-wide survey of Kauaʻi in 1928-1929, Bennett (1931:136) observed the remains of many terraced house sites and irrigated fields at Maunahina Ridge (Site 153), about 7.2 km (4.5 miles) from the sea. Maunahina is said to be the location of the ancient trail (Wichman 1985:114) that leads out of Wainiha, up to Kilohana at the north edge of the Alakaʻi Swamp, through Kōkeʻe and down to Waimea on the southwest side of the island, used to take advantage of the resources of the Alakaʻi and as an overland alternative route to Waimea. Earle's (1978:58–67, 126) analysis of the Land Commission Awards of 1850 shows that by that time, far inland sites were already abandoned and active use of the valley extended only about 2.4 km inland from the sea. At Wainiha, Earle's field survey identified six separate irrigation systems.

The Foreign Testimony (1850) presented before the Land Commission indicates Hawaiians were also raising more recently introduced crops such as oranges and coffee. The cultivation of rice came to Wainiha like to many other *kalo*-growing areas in Hawaiʻi, during the late 1800s. Immigrant Chinese rice growers took over former *loʻi* devoted to *kalo* and founded a major cash crop industry catering to Hawaiʻi's growing Asian population (Coulter and Chun 1937:21).

During the Māhele, the bulk of Hāʻena Ahupuaʻa was awarded to Abner Pākī (father of Bernice Pauahi). Waihona ʻAina lists 34 LCAs in Hāʻena, although five are numbered incorrectly and seven were not awarded, so 22 land commission awards were granted to Native Hawaiians.

One *kuleana* award, LCA 7942 awarded to Kuapiko, had ten *loʻi*, although the Foreign and Native testimony both state the property contained five *loʻi* and "3 very small" ones. LCA 10965 awarded to Wahieloa was "held […] from the days of Kaumualii" who died in 1824. LCA 9179, awarded to Kaukapawa had also been held from the same period. These awards both contained *loʻi* and a house lot. Other land grants, including LCA7943:2, LCA 7945, and LCA 10965, also contained *loʻi* (LCA 7943:2 and 10965), and a house lot (LCA 7945 and 10965).

Upon the death of Pākī in 1855 and his wife Laura Konia in 1857, their Hāʻena lands passed to Bernice Pauahi. These Hāʻena lands were sold to William H. Pease, a surveyor in 1858, and following his death were conveyed to William Kinney in 1872. In 1875, Kinney transferred approximately 2,500 acres to Kenoi Kaukaha and 37 other individuals as tenants in common. Hui Kūʻai ʻĀina, as the group was known, worked and held the lands until 1967. Hāʻena continued to be primarily under taro cultivation in the 1880s. Mahuiki and Company, "taro planters," owned 900 acres of land and maintained 400 of those acres in taro cultivation (Silva 1995:39) E. Kekela, the *konohiki* for Hāʻena, held LCA 7949:3. She was Pākī's mother's sister, and was one of the only female *konohiki* (Andrade 2001:118–119). The land contained "*loko kalo*" (taro pond field) and was called "Kanaele."

4.1.3.2 Commercial Agriculture and Ranching

The first recorded use of the uplands of Hanalei and Kalihikai by a non-Hawaiian was in 1831, when the British Consul of the Sandwich Islands, Richard Charlton, was awarded the use of land to feed his livestock at "Hanalei," Kauaʻi by the Governor of Kauaʻi, Kaikioʻewa (Wilcox 1991).

> In 1831 (Charlton) leased from Kaikioewa (Governor of Kauaʻi) a stretch of land at Hanalei to be used as a cattle ranch. Its extent was not defined by any boundaries, it being generally termed Hanalei, and the cattle were allowed to range without absolute limit, except that they were not to encroach on the cultivated lands adjacent [...] The lease was for some twenty years from August 27, 1831. [Wilcox 1991:6–7]

Wilcox (1991:7) describes the cattle ranging over the slopes and plateau land between Hanalei and Kalihiwai. The topography is fairly uniform, descending gradually *mauka-makai* with the uplands generally removed from the cultivated lands in gulches and alluvial lands associated with more abundant water resources at lower elevations. Besides failing to fulfill his contract with Kaikioʻewa, Charlton also allowed the livestock to encroach on cultivated lands. Earle (1978:149) reports on the mid-nineteenth century "decline of kula farming due to the destruction of gardens by newly introduced cattle" in the region.

According to Wilcox, in 1834, the same Governor Kaikioʻewa granted Hanalei land to Joel Deadman for sugarcane cultivation. Deadman later testified in 1844 at the time of the Māhele, revealing the instability of the early land ventures at Hanalei and the informality of the land transactions. Kaikioʻewa "[…] agreed to cause [the Hanalei land] to be cultivated & planted with sugar cane and [to] find the materials for a mill &c and labor." In exchange, Kaikioʻewa was to be paid "one half of the sugar & Molasses produced." "Deadman […] remained there 6 months at considerable loss & expense and had even work made for the mill" but the plantation never materialized. Deadman further testified that Kaikioʻewa

> was taken sick & soon after went to Oahu [but] on his last visit to Hanalei before he left Kauai he told me that if he did not look after [the land] himself the natives would not do anything properly, so he gave it up, but he told me then and repeatedly afterwards both at Kauai & Oahu to keep the land, that it was my own. [Wilcox 1991:7]

In 1842, Deadman sold the land to Dr. T.C.B. Rooke, father of the future Queen Emma (Wilcox 1991:7).

In 1845, a French consul of the Sandwich Islands, Captain Jules Dudoit, purchased the lease of the Hanalei uplands from Charlton (Damon 1931) and continued the cattle operation upon the same Hanalei-Kalihikai-Kalihiwai uplands. The sale of cattle and salt beef in Honolulu and to whale ships was supplemented with the production of milk. A visitor in 1850 commented on the "1800 head of fine cattle" on Mr. Dudoit's estate (Damon, 1931:335). This was a tremendous growth over the 100 head of cattle estimated in 1840 and is a logical explanation for the destruction of *kula* lands reported above, and native landscape in general.

At the termination of the lease in 1851, the Dudoit's moved to the Koʻolau District and it is uncertain whether cattle ranching continued in the uplands of Hanalei, Kalihikai and Kalihiwai. There is some mention of sheep in Hanalei although their grazing lands are not identified (Damon 1931). In 1853, the Scotsman who served for many years as Minister of Foreign Affairs, Wyllie, began acquiring lands in the Hanalei Valley. He began in 1853 by purchasing the same portion of Hanalei that Charlton had leased. By the time he had acquired the *ahupuaʻa* of Kalihikai and Kalihiwai in 1862 and consolidated his lands into the Princeville Plantation, sugarcane cultivation had become his primary agricultural pursuit.

Other enterprising attempts included silk making and coffee plantations. Charles Titcomb, an American sailor, developed a silk plantation in Hanalei during the 1830s. By the early 1840s, his plantation comprised four varieties of mulberry trees that were reported to produce excellent silk (Wilcox 1991:7). Titcomb had also established a plantation at Kōloa. Charles Titcomb's silk plantation at Kōloa was devastated in 1840 by a "drought […] bringing in its train insect pests, aphids and spiders" and by heavy winds, "trade and kona, whipping off the mulberry leaves" (Kuykendall 1938:183). The Hanalei plantation escaped this disaster but "finally encountered financial and other troubles" and the silk-making enterprise was abandoned in 1844; Titcomb is reported to have lost $15,000 in the venture on Kauaʻi (Kuykendall 1938:183).

According to Kuykendall (1938), despite his losses, Titcomb was able to replant his Hanalei fields in coffee with seed procured from Kona. Coffee cultivation was first introduced to Hanalei in 1842 when John Bernard and Godfrey Rhodes began the Hanalei Coffee Plantation on two parcels of land leased from the Government—"one on the east side of the Hanalei River containing ninety acres and one on the west side containing sixty acres" (Wilcox 1991:8)—with "plants and seeds […] secured from Governor Boki's land in Manoa Valley [on Oʻahu]" (Wilcox 1991:9). Although Oʻahu and Hawaiʻi islands had cultivated coffee, Hanalei's new fields represented the "first extensive coffee plantations" in the Hawaiian islands (Kuykendall 1938:316), and in 1844 the two Hanalei plantations comprised "upward of 100,000 trees" (Wilcox 1991:9).

Near mid-century, coffee dominated the Hanalei landscape: "a great part of the whole valley, at least to the extent of 1,000 acres, was under cultivation in coffee at this time" (Wilcox 1991:10). William DeWitt Alexander, son of the former Waioli missionary William P. Alexander, described his visit to Hanalei in 1849, after a six-year absence. His first view of the valley is of the "majestic Hanalei River winding its way through coffee plantations, & the graceful curve of the bay, bordered with houses, & groves" (Alexander 1991:125). He later visited the two coffee plantations:

> Capt. Rhodes has a fine coffee plantation. It contains upwards of 100 acres. It is in very fine cultivation. He had also banana, & orange trees, & a very fine grove of bamboo. I was much interested in observing the operation of the coffee mill. As in a sugar mill, a mule turns a perpendicular post. To the top of this is fitted a large

> horizontal cog wheel. This sets in motion a fly wheel which is connected to the rest of the machinery by bands. There are 3 or 4 mills which perform different stages of the operations. The noise which they made was most deafening. [Alexander 1991:127–128]

The Titcomb coffee plantation is characterized as "flourishing" though "not as large as Mr. Rhodes', nor is the coffee as luxuriant" (Alexander 1991:128). After John Bernard, Godfrey Rhodes' partner, died at sea off Hanalei Bay in 1845, Rhodes and other investors continued the coffee operation. The company was renamed Rhodes & Co. Coffee Plantation, and comprised 750 of the 1,000 acres of Hanalei land under coffee cultivation in 1846 (Wilcox 1991:9–10).

According to records of the Royal Hawaiian Agricultural Society—organized in 1850—in Honolulu, "for the twelve months from July, 1850, to June, 1851 [...] Hanalei exported (to Honolulu) 21,298 pounds of coffee, 39 barrels of Irish potatoes, and 20 head of cattle, at a total value of $2,744.08" (Damon 1931:334). Coffee cultivation continued to dominate Hanalei, apparently established firmly within the landscape. However, the plantation owners were apprehensive; they foresaw an eventual lack of manpower in their fields as production increased and Hawaiian workers increasingly expressed their discontent with plantation life: "Mr. Rhodes stated (in an 1851 report) that laborers were demanding one dollar a day [...] and that some had refused to work even at four dollars a day" (Damon 1931:351). The California gold mines lured many Hawaiian laborers away from the island. The Agricultural Society's plan to import "Chinese coolie laborers under contracts based on the indentures used in employing seamen" was welcomed by Hanalei planters (Damon 1931:351). In 1852 the first Chinese laborers arrived at Hanalei to work on the coffee plantations. By the following year the Chinese were fully integrated in the labor system; Rhodes' 1853 report to the Agricultural Society on Hanalei noted:

> Mr. Titcomb's Coffee Plantation is in fine order, and he expects a large crop, of perhaps 80 to 100 M. lbs. He has lately cleared more land for planting: his plantation is compact, and well managed. I believe he is satisfied with his coolies. He has a number of natives engaged, but has difficulty in making them fulfill their agreements. Our own plantation is thriving, although a number of years must elapse before it re-attains the prosperous state it was in 1849 and 1850, when our natives all left us, smitten with the California fever. I am very well satisfied with the coolies, and much prefer them as laborers. [Damon 1931:352–353]

According to Damon (1931), although the labor force was secure, natural forces wreaked havoc on the plantations. In 1847, a torrential rain flooded the valley, severely damaging the coffee trees. In 1851 and 1852 the Hawaiian Islands suffered a severe drought and the subsequent blight ravaged coffee trees at Hanalei and on all the islands. The plantations were able to continue producing for a few more years but, by the end of the 1850s, the Hanalei plantations were devastated; a visitor in 1860 contrasted the current situation with the flourishing scene of three years earlier:

> The coffee blight has entirely covered the two Hanalei plantations which in the spring of 1857 we saw in full and successful culture, yielding 200,000 pounds of excellent coffee. It was sad to witness the contrast. Then scores of women and children were busy picking the ripe berries, and depositing their gatherings at night at the overseer's office, but now all was silent. Not a gatherer was abroad, and we

> saw laborers bringing in coffee trees upon their shoulders, to heat the fires under the sugar boilers of Mr. Titcomb. [Damon 1931:351]

The "sugar boilers of Mr. Titcomb" the visitor noted were evidence of an unflagging resilience; for Titcomb, who had earlier converted his fields from silk to coffee, turned his energies to sugar growing during the latter 1850s.

Godfrey Rhodes, the other Hanalei coffee grower, sold his coffee plantation on 13 September 1855. The Crown Lands leased by Rhodes Coffee Plantation were purchased for $1,300 in 1853 and 1855 Rhodes sold out his interest in the plantation for $8,000 (Wilcox 1991:13). The man who purchased the land and plantation was Robert Crichton Wyllie, the Hawaiian Kingdom's Minister of Foreign Affairs. Wyllie, a Scotsman who made his fortune as a merchant in South America, arrived in the Hawaiian Islands in 1844. Though Wyllie had not intended to settle in Hawaiʻi, in 1845 he accepted an appointment by King Kamehameha III as Minister of Foreign Affairs and served in that office until his death 20 years later.

As Foreign Minister, Wyllie's great ambition was the recognition of the Hawaiian Kingdom as a sovereign nation by the world's powers, which had been secured in 1843. But a more personal aspiration also captivated Wyllie: to build a manor for himself at Hanalei quite as magnificent as any he had known in Scotland. So in 1853 he began acquiring tracts of Hanalei land—beginning with the Rhodes Coffee Plantation—that within a few years would comprise an estate and plantation. Wyllie attempted to save the coffee plantation: "For ten years (Wyllie) doggedly fought against [the] blight which gradually withered the trees. Finally facing reality, he pulled out the dead trees and planted a new crop, sugar" (Hackler 1982:66).

By 1862 Wyllie had "constructed an extensive sugar factory and other buildings at the eastern end of the Valley, along the river, importing much of the machinery from Scotland" (1000 Friends...1987:32) and in 1863 he bought Titcomb's lands, only one piece among the extensive land purchases Wyllie made during the early 1860s:

> On Feb. 5, 1863, Mr. Titcomb sold out to Mr. Wyllie [...] In all, four pieces of land passed to Wyllie, 750 acres at Emmasville, 1 acre at the landing, Kanoa Pond, 10 A., and Kukia on the opposite side of the river. Wyllie had before this, on April 17, 1862, bought the Ahupuaa of Kalihikai, this being the property of A. Keliiahonui, grandfather of Levi Halelea, given to Keliiahonui by an old alii. On Oct. 5, 1862, Wyllie bought at public auction from J.W. Austin and Chas. Kanaina (Guardians of W.C. Lunalilo) the Ahupuaa of Kalihiwai. [Wilcox 1991:14]

According to Wilcox (1991), Wyllie's land purchases and substantial investment in the development of his sugar operation reflected the brilliant future he envisioned for his estate. He intended to name as heir to his lands the young "Prince of Hawaii" (*Ka Haku o Hawaiʻi*), Albert Edward Kauikeaouli Leiopapa a Kamehameha, who had been born in 1858, the son of King Kamehameha IV and Queen Emma. It was after a visit by the royal family to Hanalei in 1860 that Wyllie named the estate "Princeville." He resolved to petition the king to proclaim the estate the "Barony of Princeville"—making it a fit legacy for the prince—but his plans were undone in 1862 when Albert died at the age of four. Wyllie himself died three years later. The estate and plantation were deeply in debt and in 1867 Wyllie's lands were auctioned off in 1867, sold for $40,051.50 to Elisha Hunt Allen who, like Wyllie, was an official of the Hawaiian government.

The Princeville Plantation continued in operation—in 1872 “the average crop was 400 tons, capacity of the mill, 1,000 tons” (Wilcox 1991:18)—under changing ownership until the 1890s (Figure 11). By the last decade of the nineteenth century, the difficulties of growing sugarcane at Hanalei were insurmountable:

> [...] the cane had never done well in that cool, wet climate. Much of it rotted in the lower fields; the upper fields were, it is said, not plowed deeply enough and at times there was not water enough to flume the cane down to the mill. [Wilcox 1991:18–19]

The company failed; the last crop was harvested in 1893. By 1899, Albert S. Wilcox had secured control of the entire plantation, “The lower lands were rented out to Chinese rice-planters, and the upper lands between Hanalei and Kalihiwai were planted to imported grasses and turned into a cattle-ranch” (Wilcox 1991:19). Wilcox would later, in 1916, sell the land to Lihue Plantation Company and W.F. Sanborn (Wilcox 1991:19).

William Alexander had viewed the Hanalei valley dominated by coffee plantations; a visitor in the 1890s would come upon an entirely transformed landscape.

Eric A. Knudsen, recounting a trip around Kauaʻi in 1895, presents the view of Hanalei as his party approached from Kalihiwai Ahupuaʻa:

> We [...] were glad when we reached the great valley of Hanalei. The road in those early days almost dived straight down to the bridge. It was steep and in wet weather very slippery [...]
>
> About half way down, the valley began to open up. Rice fields and taro patches covered the flat bottom lands as far as the eye could see [...] the view to our right, the winding river with a barge loaded with rice slowly drifting down on its placid surface, and beyond the great sweep of sandy beach, were a truly inspiring sight. [Knudsen 1991a:153]

Knudsen’s account reveals significant features of the Hanalei landscape during the last years of the nineteenth century. The bridge that now spanned the Hanalei River from the government road was a recent development. Until the 1880s, as noted in a tourist guide of that decade, there was no bridge over the river but there was a “ferry opposite the Princeville Plantation, where passengers, cattle, teams, etc., can pass the river free of charge, the ferry being supported by the Government and the Princeville Plantation, jointly” (1000 Friends...1987:58–59; Figure 12).

By the 1860s, taro production was being replaced by rice cultivation in all the valleys of the district except Hāʻena (Figure 13), frequently reworking the irrigation systems previously used for taro pond fields (Hoffman 1980:4). This shift from taro to rice production included the importation of Asian laborers for the plantation as well as the introduction of Asian technology developed for irrigation and cultivation of rice. Rice production flourished from 1890 to 1930 in the Haleleʻa District, at which point prices dropped due to increased rice production in California and most Hawaiian rice fields were abandoned (Earle 1973:183). The growth of rice cultivation is documented by a population shift suggested by tax records and by a lease between the Bishop Estate and Chulan and Company in 1882 which rented parts of Lumahaʻi Valley’s alluvial plain for rice production (Hoffman 1980:4). The 1865 tax records documented 25 Hawaiians and one Chinese paying taxes. By the time Chulan and Company had been growing rice for three years,

Figure 11. 1878 W.D. Alexander map showing the Princeville Plantation with overlay of KIUC Transmission Lines and Streetlights

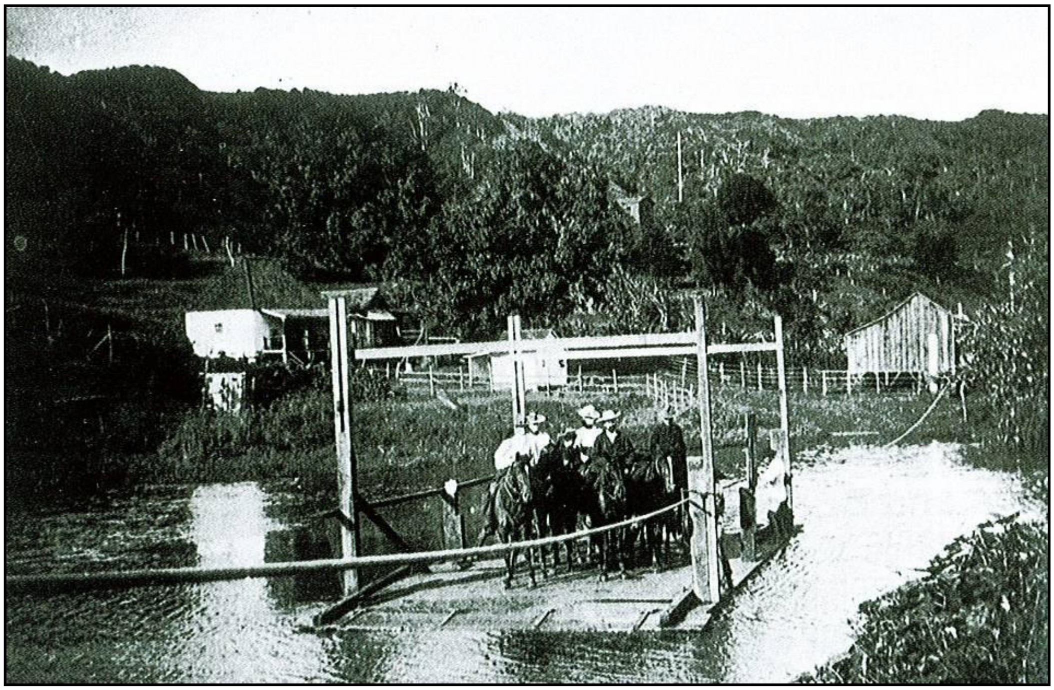


Figure 12. Photograph of the hand-pulled ferry used, ca. mid-1800s, before the Hanalei Bridge was built (Harrington 2008:86, Kaua‘i Museum Archives)

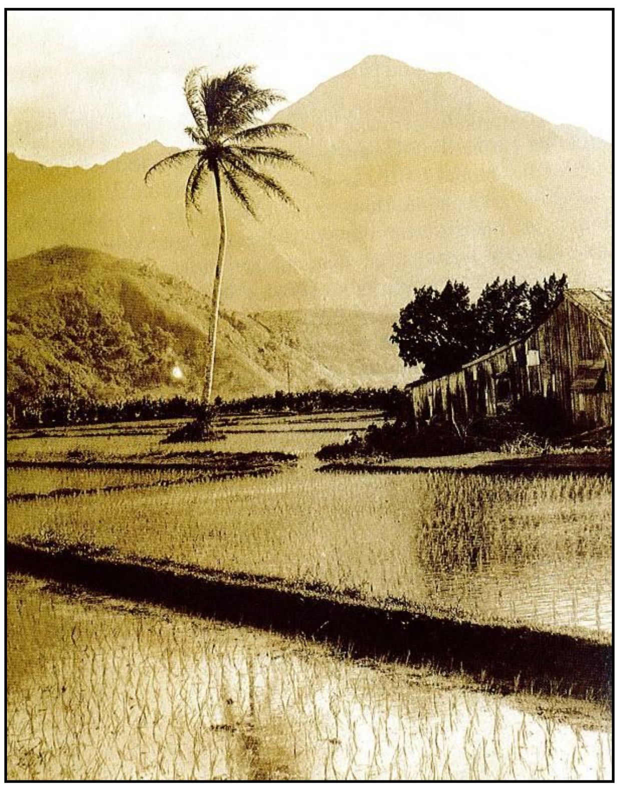


Figure 13. Photograph of the Hanalei rice fields on Charles Titcomb’s former silk plantation ca. 1840 (Harrington 2008:50, Kaua‘i Museum Archives)

the 1890 tax records documented only one Hawaiian and 34 Chinese. The Sing Tai Wai Company also rented lands for rice growing in the Lumahaʻi Valley (Kelly et al. 1978).

George Bowser, editor of *The Hawaiian Kingdom Statistical and Commercial Directory and Tourists Guide* (1880) wrote about various statistics and places of interest around the Hawaiian Islands (Maly and Maly 2003). In the following excerpts from "An Itinerary of the Hawaiian Islands […]" Bowser's narratives offer descriptions of the communities and various attractions of the Haleleʻa region:

> The next place, about two miles further on, is Lumahai. The valley here is about twenty miles long, and is on the average about a mile and a half wide. It is nearly all under cultivation. Messrs. Chulan & Co. have about 100 acres of it under cultivation for a rice crop. The supply of water is abundant at all seasons of the year. The scenery here is extremely grand, the mountain tops being cut into every imaginable shape of crag and peak, and their sides clothed with evergreen trees. In the gulches and ravines the wild banana grows to perfection, and the *awa* is found in profusion. This part of the island will grow any description of vegetable. When there I tasted at the table of my host, Mr. Robinson, some most delicious green peas, the seeds of which had only been sown six weeks before. The weather was delightful when I was there, and, although the rains are sometimes very heavy, the climate as a whole is exceedingly fine and enjoyable. Whilst here I climbed to the top of the dividing range between the Wainiha and Lumahai valleys. The views thus obtained are exceedingly grand. The massive mountain peaks running up to 3,000 feet high, are covered almost to their summits with forests, with occasional intervals of splendid grass. In the distance was the sea with scarcely a ripple on its surface, and the fine beach of brown sand. In the valleys the winding streams pursuing their course to the sea, hidden sometimes by the overhanging trees, with the rice fields in various stages of growth, some covered with water, others beautifully green and laid out in the most perfect order. Add to this a lovely Italian sky and a pleasant temperature of about 70º, a gentle breeze to make riding no exertion, and you have the scene as I saw it, as charming as any I have seen in the islands […] [Maly and Maly 2003:36]

The exact date these companies discontinued rice cultivation in Lumahaʻi is unknown but oral reports indicate they were gone by 1925 when six Japanese families moved into Lumahaʻi Valley to grow rice (Hoffman 1980). One family "lived on the eastern side of the stream, about a mile *mauka* [inland] of the highway; the other families lived on the western (Wainiha) side, and their houses still stand today" (Kelly et al. 1978). Four families left the valley as rice prices dropped, while two others converted to taro cultivation (Hoffman 1980). The lease was taken over by Lester Robinson for cattle grazing in Lumahaʻi Valley. Robinson offered the two remaining Japanese families land in neighboring Wainiha Valley and all cultivation in the valley ceased (Hoffman 1980).

Handy and Handy (1972:420) briefly discuss taro production in Waipā: "Below Hanalei and a little to the west of it on the bay is a compact area of terraces watered by Waipā stream." However, they reprint a reminiscence of an early resident (Lydgate 1913) concerning the terraces of Wainiha Ahupuaʻa, in the same district.

> All along the river, wherever the encroaching *palis* on either side leave the least available space, the land has been terraced and walled up to make ʻ*lois*.ʼ And so the whole valley is a slowly ascending stairway of steps, broad in the tread and low in the rise, all the way to Laau. [Lydgate 1913:125–127]

Like Lumahaʻi, Waipā was a taro-growing area, and using LCAs records, Earle (1973 and 1978) has been able to pinpoint four irrigation systems along Waipā Stream in 1850 which were used for taro cultivation (Hoffman 1980:15). Waipā Valley followed similar patterns to that of Lumahaʻi, shifting from taro to rice:

> By the 1860s Chinese and later Japanese laborers imported en masse for plantation bottom lands, large areas of old taro pond fields were converted to rice. From 1880 to 1930 rice became an extremely important export industry for Halelea, and taro was virtually abandoned except in Haena, the most isolated *ahupuaʻa*. Technologically, water buffalos with associated harrowing and leveling implements were introduced to prepare planting surfaces. The increased effectiveness of the individual farmer coupled with a growing market in the western United States resulted in a rapid expansion of the area in production. This was possible only with extensive use of flumes, wood and cement dams, and perhaps more intricate drainage channels. The cleaning of these expanded ditch systems was in turn greatly facilitated by the use of sickles, pitchforks, and shovels. It is highly likely, therefore, that irrigation systems in operation after 1880 were both altered and expanded for rice production. [Earle 1973:183–184 in Dye 2004:14]

The 1938 Territory tax records indicate several dwellings and other buildings in the vicinity of the rice mill in Waipā held by Hiramoto (Dye 2004:15). These Territory tax records list the family names of Takabayashi, Hiramoto, Okazaki, Koga, Morimoto, and Azeka. Hoffman (1980:15) reported that the lands owned by the Bishop Estate were entirely used for cow pasture, although the more marshy sections were not well suited for this use. According to Kinichi Shikawa, a Waikoko farmer, the land had been overgrown for a long period of time and some years previously Bishop Estate demanded the lessee, the Robinson family, to make improvements that resulted in massive clearing operations; large areas were chained and bulldozing eliminated sections of irrigation systems east of Waipā Stream (Hoffman 1980:15). In 1986, Bishop Estate leased the land to the Hawaiian Farmers of Hanalei, Inc., a community-based, for-profit corporation that manages the *ahupuaʻa* of Waipā (Dye 2004:15).

> Waipā Ahupuaʻa is currently managed by the Waipā Foundation, a community-based 501c3 nonprofit that evolved from an original community initiative in the 1980s. The Waipā Foundation serves as a Native Hawaiian learning center and community center where all who visit can renew ties to the *ʻaina* (land and resources), and learn about traditional values and lifestyle through *laulima* (many hands working together). As stewards of the *ahupuaʻa*, we are intently focused on our *kuleana* (responsibility) to establish and perpetuate a thriving *ahupuaʻa* as an example of healthy interdependent relationships between people and earth's natural resources. We strive to be a leader in demonstrating a Hawaiian approach to watershed-scale natural resource management. [Waipā Foundation 2012]

By the early 1900s, Wainiha had its own Chinese community which included not only the rice farmers, but also merchants and other business people (Coulter and Chun 1937). The rice industry eventually went into decline due to disease, pests, and competition from outside Hawaiʻi, and rice lands reverted to *kalo*. Rice cultivation probably served the unintended purpose of keeping the ancient irrigation systems and *loʻi* operational throughout this period. In the 1930s Handy (1940:73) reported both crops being cultivated simultaneously in Wainiha with actually more land seemingly devoted to *kalo* than rice. The valley even had its own commercial *poi* factory at the time. The cultivation of *kalo* is ongoing today and is the most active agricultural undertaking in the still rural Wainiha Valley.

4.1.4 Twentieth Century to the Present

4.1.4.1 Commercial Agriculture

During the first decade of the twentieth century, rice farming by the Chinese continued to be the focus of large-scale economic activity in Hanalei.

Two significant structures, which still exist, were constructed at Hanalei in 1912: the pier at the mouth of Hanalei River and the bridge spanning the river (Figure 14 and Figure 15). The pier is described, in an application for placement on the National Register of Historic Places, as a "wooden deck [...] built during a period of economic prosperity in the area, primarily the result of a thriving rice industry" which "replaced an earlier shorter pier and primarily was employed for the shipment of rice."

While the new pier reflected the current flourishing rice-based economy of the valley, the construction of the bridge—replacing the wood bridge Eric Knudsen had crossed in 1895—would provide an impetus to further change within Hanalei. The bridge is described, in an application for placement on the National Register of Historic Places, as a "106-foot, single span, steel through-truss (Pratt Truss) bridge built on reinforced concrete abutments, with a 17-foot roadway deck made of timber planks." The application also notes that the construction of such substantial steel structures, replacing older, flimsier timber bridges "helped stimulate the economic and social growth of the then relatively isolated North Shore" of Kauaʻi. The facilitated access in and out of the valley may have accelerated the development of vacation houses along the Hanalei beach to take advantage of the pleasant breezes and spectacular water views.

A 1916 article in the *Garden Island* characterized Hanalei's attractions by the second decade of the twentieth century:

> Hanalei has been a popular and populous community of late, a sort of suburb of Lihue since there were many Lihue people summering there, the various beach houses being full to overflowing. Morning, noon, and night the wharf has been alive with enthusiastic but 'green' fishermen, mostly of a tender age, and the sands dappled with figures in proper costume and the waters flecked with tumbling swimmers who mostly couldn't swim. [1000 Friends...1987:63]

Clearly foreshadowed is the future development of Hanalei and Princeville as a resort destination. Figure 16 shows Hanalei Bay prior to modern development. Rice farming declined sharply throughout the Hawaiian Islands after the first decades of the twentieth century as lower-priced rice grown in California inundated the market. Total acreage in the Islands dropped from a high of 9,425 acres in 1909 to 1,130 acres in 1935. By the end of the 1930s, the rice industry had

Figure 14. Aerial photo ca. 1924 of Hanalei Bay and Hanalei River showing the pier (Hawai‘i State Archives Digital Collections)

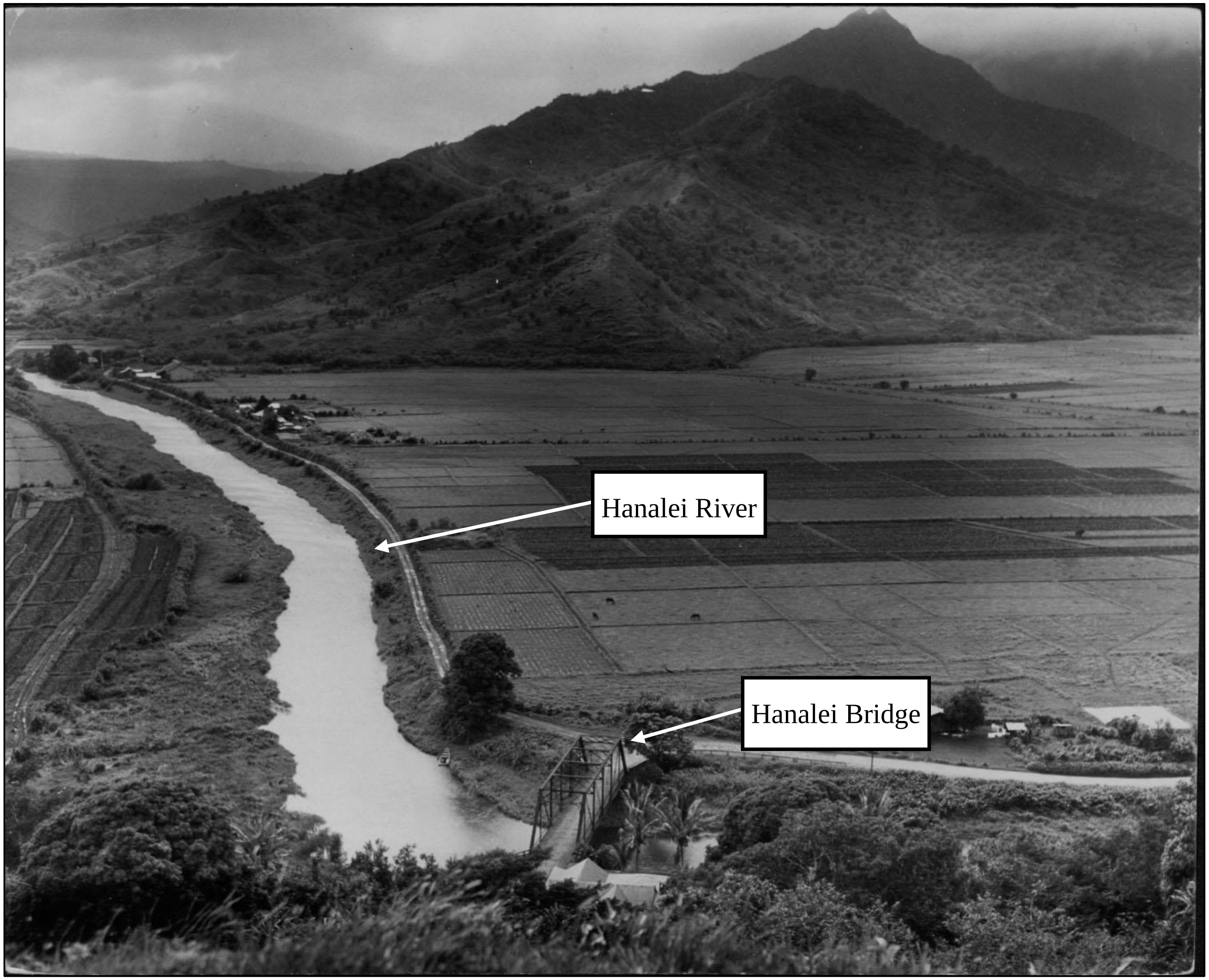


Figure 15. Photo (date unknown) of Hanalei Bridge crossing over the Hanalei River (Hawai‘i State Archives Digital Collections)

Figure 16. 1924 aerial photograph of Hanalei Bay and coastline (Glick 1980:59)

ceased entirely on the islands of Hawaiʻi, Maui, and Molokaʻi (Coulter and Chun 1937:62). The rice farming that survived at Hanalei was of a different character. Already in the preceding decades, Chinese rice planters at Hanalei and elsewhere had begun selling their fields to immigrant Japanese rice growers:

> In 1916, 16% of the rice lands in the then Territory of Hawaiʻi were controlled by Japanese growers. By 1932, a survey indicated that 62 percent of the Hawaii-grown rice was being cultivated by Japanese. At first the Japanese sold their paddy to Chinese owned rice mills; then, gradually, they took over the mills too. [Coulter and Chun 1937:62]

As increasing numbers of Japanese moved into Hanalei to reside and work the rice fields, the original Chinese rice growers moved to other commercial pursuits. For example, the Haraguchi family began leasing rice land at Hanalei from the Man Sing family and subsequently purchased the Man Sing mill in 1924. The family cultivated 75 acres in the valley. When the original Man Sing mill was destroyed by fire in 1930, the Haraguchi family built the still extant mill that is presently listed on the National Register of Historic Places (Figure 17). The documentation for the mill's placement on the Register notes that the Japanese rice growers replaced the Chinese variety of rice with shorter grain rice that the Japanese preferred.

In the 1930s, the Agricultural Extension Service of the University of Hawaiʻi began a program to increase rice production at Hanalei, resulting in a brief "resurgence in rice cultivation"; acreage in Hanalei increased from "759 in 1933 to 1058 in 1934," and by 1936 Hanalei "produced over two-thirds of all rice in Hawaii, almost all of it for consumption within the Territory" (1000 Friends...1987:117–118). It is this rice-dominated Hanalei landscape that E.S. Craighill Handy, in his 1940 study of planting areas throughout the Hawaiian Islands, describes as it appeared in the 1930s. Handy's account is especially valuable, and merits citation at length, as he notes both present usages, based on his field observations, and former usages, based on information from native informants:

> The swampy land below the hills at the west end of Hanalei next to Waioli is unused. The land between the highway and the bay on the west side of the river, much of which used to be terraces, is now given over to pasture and home sites. The land named Paele in the great bend of the river east of the bay, which used to be in rice or taro, is now used for pasture. The broad area inland from the river, named Kahanawai, is now planted with rice, except for the flats adjoining the base of the hill. According to Sheriff Lota, this area was only partly developed in terraces in ancient times. In the 1880's, the land just above the highway was planted in sugar cane, which gradually extended far up Hanalei Valley. Subsequently much of this land, which had not previously been in terraces, was cut up by the Chinese into paddy fields. It was only in the flats of Hanalei Valley proper that terraces were continuous in the old days. At present, rice paddies are continuous for 1.3 miles from the highway bridge where the Hanalei River turns east; another sizable rice patch lies four tenths of a mile beyond, the land between being neglected. Beyond this farthest rice plantation the Hawaiian homesteads commence. A few Hawaiians and other homesteaders plant a little taro for home consumption. It is said that there are numerous areas of abandoned small terraces farther in the interior. In lower

Figure 17. Photo of Haraguchi Rice Mill (Library of Congress n.d.)

> eastern Hanalei, Mr. Sanborn is successfully growing taro in flats that have been used for rice for over 30 years. [Handy 1940:72]

Handy’s description suggests that by 1930s, Hanalei Valley comprised a patchwork of mutating idle and active agricultural fields and pastures which reflected the vagaries of decades of shifting economic pressures.

While Handy asserts that taro farming survived in the 1930s only as a subsistence crop for a “few Hawaiians and other homesteaders” other sources suggest the taro-growing area at Hanalei was somewhat more expansive. A U.S. Department of Commerce agriculture census of 1939 recorded 108 acres in taro at Hanalei, comprising fully one-fifth of the total 529 acres in taro throughout Hawai‘i (1000 Friends...1987:118).

According to National Register of Historic Places documentation on the Haraguchi rice mill, by the “early 1950s there were about 50 growers cultivating 170 acres of rice on Kauai” with Hanalei holding 90 of those acres, a precipitous drop from the 1,058 acres recorded in 1934. Clearly, rice farming at Hanalei was no longer viable, once again frustrated by inexpensive rice imported into the Territory. The last rice mill, run by the Haraguchi family, ceased operating by the early 1960s.

As the Japanese farmers phased out rice production in the 1950s and ‘60s, they converted their fields to taro *lo‘i*. By the late 1980s, taro growing, that once dominated the traditional Hawaiian landscape, was firmly re-established within Hanalei, and farmed in two areas of the valley (Figure 18):

> [...] 195 active taro *lo‘i* cover 140 acres within the Hanalei National Wildlife Refuge. These terraces range in size from 40 feet by 70 feet, to 220 feet by 400 feet, although taro *lo‘i* are characteristically not regular in shape. The smallest taro patch recorded within the refuge was one-twentieth of an acre, while the largest was over two acres in size [...]
>
> Currently (in 1987), there are 201 active taro patches covering 93 acres mauka of Kuhio Highway, across from Hanalei town [...] These range in size from 30 by 90 feet, to 160 by 130 feet. The smallest taro patch within this area is one-fifteenth of an acre, while the largest is one-half an acre in size. [1000 Friends...1987:27–28]

As taro farming secured its place in Hanalei during the second half of the twentieth century, contemporary developments, entrepreneurial and governmental, within the *ahupua‘a* would further re-define the character of Hanalei.

4.1.4.2 Land Ownership

4.1.4.2.1 The Wainiha Hui

Sometime after the Māhele, Kekau‘ōnohi, a chief, held the *konohiki* lands of Wainiha, those being all of the remaining lands in the valley not awarded to the tenant farmers as *kuleana*. Seeking a quick profit on a sandalwood deal, Kekau‘ōnohi convinced Aldrich & Company of Honolulu to back the venture to the amount of $10,000. Kekau‘ōnohi purchased a schooner, the *Manuokawai*, hired a captain and crew, filled the ship with sandalwood and sent it off to the Far East. Whether the ship was wrecked at sea or as Lydgate implies, was stolen by the captain who had less than a pristine reputation, she was never seen in Hawai‘i again. Able to raise $1,000, Kekau‘ōnohi still

Figure 18. Photo of Hanalei Valley with *loʻi* (Library of Congress n.d.)

needed $9,000 to pay off Aldrich & Company. The plan was to sell the land to the Wainiha *kuleana* owners. The residents agreed to the plan although most of them were still basically subsistence farmers and did not have the cash to close the deal. Kekau‘ōnohi gave them one year to raise the capital. By the time the year ended, 71 Wainiha residents had convinced Princeville Plantation of Hanalei to underwrite their venture at $100 each with the residents signing notes for the future delivery of agricultural goods, services, and labor to the plantation. This only amounted to $7,100 but Kekau‘onohi persuaded his creditor to let the residents assume the rest of the debt with interest (Lydgate 1913). Thus, in 1877 the Hui Kū‘ai ‘Āina O Wainiha, the “group to purchase the land of Wainiha,” was officially formed. The Wainiha Hui, as it was commonly called, now owned approximately 15,000 acres of the valley (*Garden Island* 1947). A plan was instituted to give each shareholder 10 acres of arable land—5 acres *mauka* and 5 acres *makai*. The land was never formally surveyed nor legally partitioned and disputes were settled by an executive committee. In the coming years the *hui* (organization) members, in debt and paying property taxes, found that being large landowners was not at all like what Kekau‘ōnohi had promised, as shares in the *hui* had essentially become a liability (Lydgate 1913).

Around the turn of the century, McBryde Sugar Company was looking for a source of electrical power to run its irrigation pumps and mill operations at ‘Ele‘ele on the southwest side of the island. They proposed to build a hydro-electric power plant at Wainiha and to pay the *hui* $1,500 a year for the water rights (Thrum 1924:95–112). The Kauai Electric Company was formed to construct and operate the power plant, which was completed in 1908. They built a landing and warehouse on Wainiha Bay with a light rail system to carry materials up the valley, along with roads, trails, and laborers’ camps, as well as the plant itself and the transmission line that traversed the island (Gartley 1908:141–146). While there were other similar groups formed on Kaua‘i, most notably at Hā‘ena and Moloa‘a, the Hui Kū‘ai ‘Āina O Wainiha remained a singular success story. The lands of Wainiha were finally partitioned and the *hui* dissolved in 1947 after legal action was initiated by McBryde Sugar Company. Each of the original 71 shares was then worth about $5,000. Through the years McBryde had bought up most of the shares and owned 48. The Robinson brothers, Aylmer and Sinclair, held 10 and 6⅓ shares respectively. Only the remaining few shares were still in the hands of the heirs of the original *hui* members (Circuit Court of the Fifth Judicial Circuit 1947).

4.1.4.2.2 Hui Kū‘ai ‘Āina O Hā‘ena

Hui Kū‘ai ‘Āina O Hā‘ena was formed by residents to purchase land after the serious repercussions that the Māhele and the Kuleana Act brought (Andrade 2008:103). The *hui* (club, association) organized because *maka‘āinana* recognized that lands provided for them from the Māhele and Kuleana Act were inadequate to sustain themselves. *Maka‘āinana* organized themselves and obeyed all bylaws, eventually drafting a plan outlining their activities and goals. *Maka‘āinana* in the *hui* began to raise money, which eventually led to purchase or lease of portions of *ahupua‘a* that were not awarded to them. Attempting to uphold a traditional lifestyle was difficult due to a shifting legal system that was moving toward western ideas and methodologies (Stauffer 1989:2–3, 125).

William Kinney owned Hā‘ena Ahupua‘a. In January 1875, Mr. Kinney moved from Kaua‘i to Onomea, Hawai‘i and sold his land holdings to 38 original shareholders of the Hui Kū‘ai ‘Āina O Hā‘ena (Andrade 2008:105). All the original members of the *hui* were Native Hawaiian. Some of these shares passed down through family generations; other times shares were divided amongst family members.

In 1898, an influx of foreigners began to take up residency in the Hawaiian Islands. The Islands eventually became a territory of the United States and lawsuits were asking for *hui* to divide lands. Hāʻena Ahupuaʻa stayed intact longer than other *hui* lands. A suit to divide the lands in Hāʻena didn't occur until 1955 (Andrade 2008:104–106). In addressing the partitioning, shareholders of the *hui* needed to be identified and then a percentage of each person's share needed to be determined (Watson 1932:14–15). There were three main categories for determining land: Hui Kūʻai ʻĀina O Hāʻena (or lands originally awarded during the Māhele and later purchased from Mr. Kinney by the *hui* members); *kuleana* lands (LCAs that were awarded); and land grants (land granted to individuals by the government). However, *kuleana* and granted lands were excluded from the partitioning. Hāʻena Ahupuaʻa is approximately 1,800 acres. The sum of *kuleana* and granted lands totaled 41 acres. The original deed from Mr. Kinney to the *hui* totaled 2,500 acres (Andrade 2008:106).

Because it was a huge undertaking to sort out and address the issues of partitioning the land, three commissioners were appointed by the court: Henry C. Wedemeyer, Yeiso Yamaura, and Nicholas Akana (Andrade 2008:108). The three commissioners were acting under the court to prepare a plan and execute the partition. Duties included planning the division of lands; providing roads and rights of way; mapping; surveying; appraisements of property values; investigation of whether the lands have been occupied by the shareholders; devising drainage, irrigation, and easements (Watson 1932:18–20). As stated earlier, the undertaking was huge—people had relocated, shares of land changed over the years, families grew and changed beneficiaries and shares, and the *hui* didn't have very many records or written documentation.

Eventually western law and justice dominated and the partition was based on cash value rather than land area (Andrade 2008:114). A share in Hui Kūʻai ʻĀina O Hāʻena totaled $11,612.77. Family members could combine their shares to secure a larger parcel. The County of Kauaʻi was awarded several lots for a well site and other water services for the community. Only four lots were not awarded and were auctioned off. The sales of these four lots offset court costs, the commissioners' time, and guardians appointed by the court. With the partitioning of land, Hāʻena Ahupuaʻa became entirely privatized.

As a result of Hui Kūʻai ʻĀina O Hāʻena disbanding, the actress Elizabeth Taylor's brother, Howard Taylor, bought a parcel of land near the coast. However, when Mr. Taylor attempted to acquire building permits to construct a home on his property, he was denied (Pacific Worlds & Associates 2001). The state denied Mr. Taylor because they were planning to condemn the land to create Hāʻena State Park but he still had to pay taxes for the land. Disgusted and upset with the state, Mr. Taylor offered his property to a colony of transient hippies who had previously been evicted from Hanamāʻulu Beach Park (Clark 1990:38–39).

The hippie movement of the late 1960s and 1970s was comprised of suburbanites who rejected contemporary political, social, and economical values and were experimenting and attempting to reconnect to a simple, subsistent, alternative lifestyle. Hippies began to relocate to Hawaiʻi where they could live off the land in a tropical setting.

Taylor Camp, at its maximum size, was home to more than 80 permanent residents and 50 transient residents. Residences included tree houses, tents, and shacks along the banks of Limahuli

Stream. Amenties included a communal shower, a toilet, a church, and a co-op store. The camp wasn't completely self-sufficient and residents still needed to purchase goods. Finances for these trips to the store were raised via drug money or through welfare funds (Clark 1990:39).

In 1972, the state began to condemn lands for Hāʻena State Park. Mr. Taylor and camp residents protested. The court ruled in favor of the state and the campers were evicted. The state finally took over the Taylor Camp parcels in 1977 (Taylor Camp n.d.)

4.1.4.3 Kūhiō Highway

By the end of the nineteenth century, each of the major Hawaiian Islands dreamed of building a "belt" road system. The idea for belt roads dated to the early Hawaiians, who built and maintained networks of traditional trails on all the islands. Belt roads that circumnavigated the islands played an important role in Hawaʻi's transportation history, connecting isolated communities to their island's economic, political, and social centers.

> In 1911, the territorial legislature established a 'loan fund,' which provided the bonding needed for each island to build its belt roads and bridges. A Loan Fund Commission (LFC) was appointed for each island […] By 1917, Kauaʻi considered its belt road complete, a feat that was accomplished earlier than any other island. [Fung Associates, Inc. 2013:14–15]

The Kūhiō Highway, Route 560, was completed in 1917 and listed as site 03001048 on the National Register of Historic Places in Hawaiʻi.

> Route 560 is a 10-mile rural road that was part of the first completed belt road in the Hawaiian Islands (constructed in early 1900s), and has retained a significant portion of its original characteristics and features. In recognition of Route 560's historic stature, a Rural-Historic Road Corridor Plan was drafted to provide design guidelines for the DOT-HWY that reflect a community consensus for future work on the highway. [Hawaiʻi Department of Transportation 2011:12–13]

As mentioned previously, in 1895, traveler Eric Knudsen described the route from Hanalei to Hāʻena as a trail, the wagon road ending at Hanalei. "West of Waikoko Stream, Knudsen related that the trail climbed over the bluff and then descended straight down to the ocean before turning back and running along the beach again" (Fung Associates, Inc. 2013:12).

> According to historian Ralph Kuykendall, nineteenth century Hawaiʻi roads, 'or what were called roads,' came into existence by a familiar historical process, 'the trail became a road.' Many roads, especially in the rural districts like Kauaʻi's North Shore, were little more than cleared rights-of-way. [Fung Associates, Inc. 2013:12]

The highway westward of Waiʻoli Bridge in Hanalei is identified as a scenic roadway and historic district corridor:

> The historic district begins at Mile Marker 0 on Route 560 and continues to its termination at Mile Marker 10 at Haʻena State Park […] The Kauaʻi Belt Road between Princeville and Haʻena traverses ten miles along the island's north shore and is coterminous with its historic right-of-way. This portion of Kauaʻi's 'belt road' was part of Kauaʻi's original belt-road system, which extended from Haʻena on the north shore to Mana on Kauaʻi's west shore. Although belt-road systems in

> the Hawaiian Islands were intended to circumvent [*sic*] each island, Kaua‘i’s road, like the Hawai‘i Belt Road, never completely encircled the island due to the rugged topography of Na Pali Coast. The north shore section of the Kaua‘i Belt Road begins at State Route 560’s Mile Marker 0 at Princeville and passes through the communities of Hanalei, Wainiha and Ha‘ena, ending at Mile Marker 10 at Ha‘ena State Park. The […] historic district includes the road, the Hanalei Valley Scenic Overlook, and thirteen historic bridges and culverts. The period of significance for the north shore section of the Kaua‘i Belt Road is from 1900 when the Territory of Hawai‘i Superintendent of Public Works began roadway improvements until 1957 when the Wainiha Bridges were rebuilt after a tidal wave. The Kaua‘i Belt Road between Princeville and Ha’ena retains historic significance and character in its location, alignment, design, setting, and association. The Kaua‘i Belt Road between Princeville and Wainiha was built during the 1910s, and from Wainiha to Ha‘ena circa 1928. Most of the roadway alignment is unaltered and predates the road’s construction. The road passes through rural areas along Kaua‘i’s North Shore, connecting communities much as it did in the early twentieth century when it was built. In many areas, the road was built over a trail used by Hawaiians and nineteenth-century travelers. There is no shoulder along most of the roadway, except near Princeville. The road has been widened since its construction, but is still narrow in many locations. The roadbed varies between 18’ and 20’ wide, being narrower as it hugs the sea cliffs and wider as it passes through valleys and residential communities. Near Princeville and Hanalei, the road is 22’ wide. For most of the road’s length, there are no guardrails, which contributes to the road’s historic feeling. Lava-rock guardwalls, some dating to the 1920s, remain along the road in many locations, although many have been undermined by soil erosion. In a few locations, timber guardrails remain along the road. Only a few steel w-beam guardrails have been installed along the road in recent years. [Fung Associates, Inc. 2013:6]

Maintaining the aesthetics of this scenic and historic highway, the stream bridges along the Kūhiō Highway, Route 560, of Kauai‘i’s north shore are all one-lane bridges listed on the National Register of Historic Places as a Historic Bridge District on the Kaua‘i Belt Road (North Shore Section) (Fung Associates, Inc. 2013). The one-lane bridges require a local courtesy of taking turns, five to seven cars crossing at a time (Figure 19).

> Most of the bridges and culverts on the Kaua‘i Belt Road are one-lane wide and date to the early 1900s. The bridges represent two popular types of construction in early twentieth century Hawai‘i: steel truss and reinforced-concrete flat slab. The reinforced concrete bridges feature solid concrete parapets. In addition, there are also several pipe culverts with masonry rock headwalls that were probably constructed in the first half of the twentieth century. [Fung Associates, Inc. 2013:10]

Improvements to Kūhiō Highway and specifically to Kauai‘i’s north shore bridges became a high priority in the early twentieth century:

> Kaua‘i’s bridge-building program was extensive in 1912. During a special meeting in May, the LFC decided to build ‘a number of bridges’ near Hanalei, including

Figure 19. Photo of Wainiha Stream Bridge, n.d. (CSH)

> Waikoko, Waipa, and Wai‘oli. The LFC instructed Moragne to prepare plans and specifications for concrete structures, and he designed three flat-slab bridges with solid concrete parapets. Within months of Moragne’s assignment, contracts were authorized for George Mahikoa to build the Wai‘oli and Waikoko bridges; and George Ewart to build Waipa Bridge. Work on the new bridges began almost immediately and was none too soon. In August 1912, three of the timber bridges that were to be replaced collapsed under the strain of wagons delivering crushed rock for the new concrete bridges. [Fung Associates, Inc. 2013:16]

4.1.4.4 Tsunamis

The northern shore of Kaua‘i is vulnerable to inundation by tsunamis originating in the North Pacific Ocean. The tsunami of 1 April 1946 greatly impacted Wainiha and Hā‘ena. Shepard et al. (1950:415) detail the following disturbing account of the damage at the coast:

> Half a mile east of Haena Bay the water swept inland 1,600 feet, knocking over trees, and a little further east it smashed through a dense grove of pandanus, laying the trees over in parallel rows […] Fishes were carried inland, as at many other places; and 11 days after the wave, small fish were found still alive in a pool 1,000 feet inland […] At the head of Wainiha Bay the water rose 24 to 27 feet above normal sea level […] several houses were wrecked and some loss of life occurred. [Shepard et al. 1950:415]

This destruction included stripping the sediment from the beach areas, which was washed varying distances inland and deposited. Coral blocks, up to 12 ft in diameter, were picked up and carried as much as 500 ft inland (Shepard et. al. 1950:414–415). Another account reports, “The 1946 tsunami hit with two powerful waves, with a maximum run-up of forty-five feet in elevation. All the bridges at Wainiha were washed out, and the tiny village of Wainiha itself was flattened” (Pacific Worlds & Associates 2001).

When the 1946 tsunami devastated Hā‘ena, the area was described as “a small year round population of Hawaiians, numbering about 60.” Ten people were killed and the tsunami caused extensive damage. In the vicinity of Hā‘ena the water rose to heights generally between 6 and 9 m. At the head of Hā‘ena Bay it crossed a shore platform about 1 m above sea level and 160 m wide, and rose on the cliff at the landward side of the platform to a height of 13.5 m (Shepard et al. 1950:413).

The 1957 tsunami destroyed 25 of the 29 homes in Hā‘ena (*Honolulu Advertiser* 1957) and caused a 38-ft rise in sea level at Wainiha and low-lying areas as far as 4,000 ft inland were inundated (DLNR 1975). Based on the damage caused by the tsunami, it is not surprising that the 1965 USGS map (Figure 20) shows little development for the entire northeast shoreline.

Flooding due to heavy rainfall is also a frequent occurrence in Wainiha and results from stream-channel overflow. The valley has recorded rainfall as high as 24 inches in 24 hours. Since 1956 there have been at least eight damaging floods in Wainiha, one of which caused loss of life (DLNR 1975).

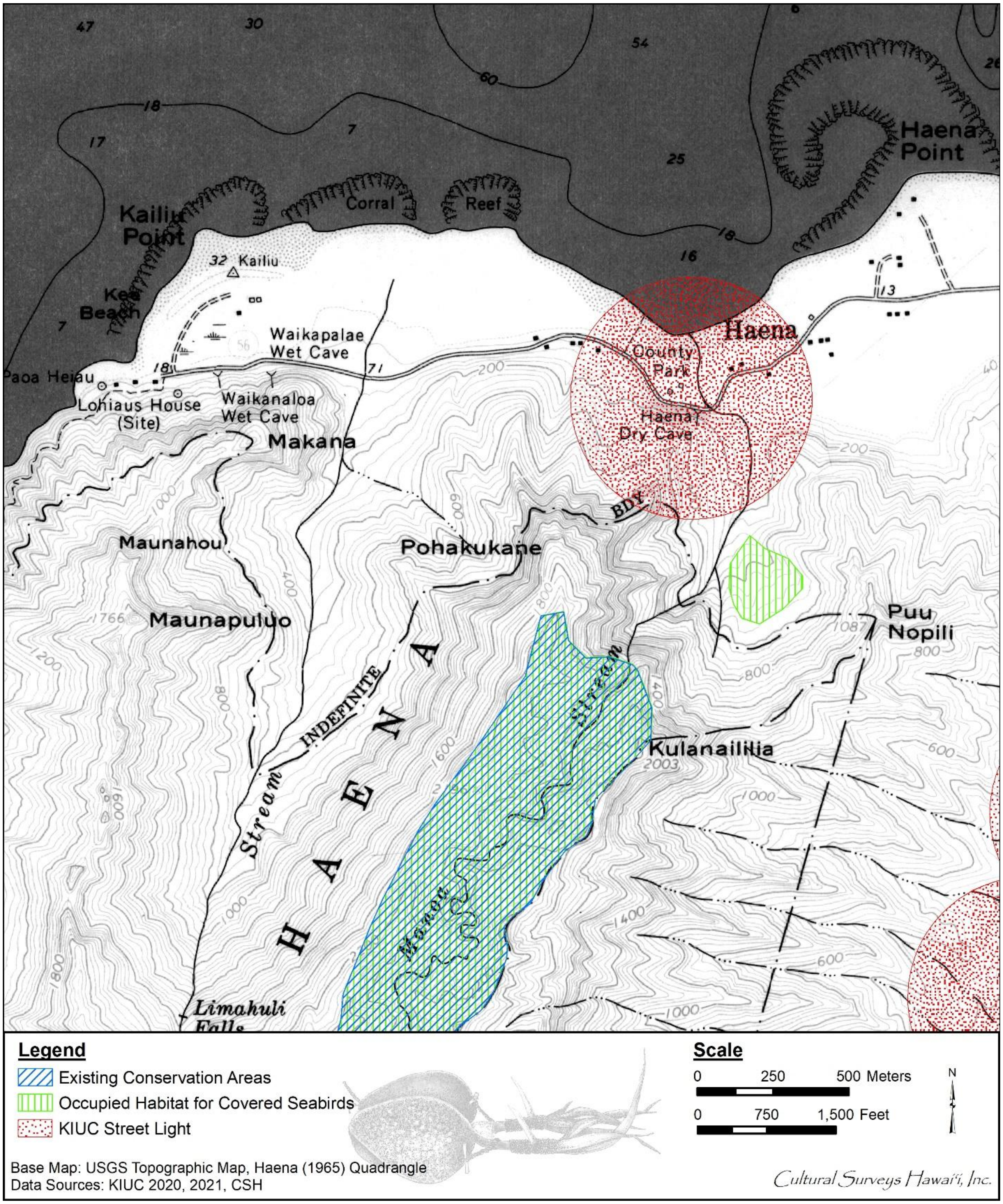


Figure 20. 1965 Haena USGS topographic quadrangle depicting tsunami damage to coast; several structures are shown along the highway as well as a county park and Haena Dry Cave within the area of KIUC Streetlights

4.1.4.5 Modern Land Use

Beginning in the 1960s, the Princeville area began its evolution—which continues at present—as a major resort and condominium complex. At the same time:

> [...] the Federal government became a partner in shaping land use in the Hanalei Valley [...] by working with the Princeville Development Corporation to acquire land for the U.S. Fish and Wildlife waterbird refuge. The refuge has a supportive policy of continued taro production and the maintenance of the irrigation system and existing houses and farm outbuildings. [1000 Friends...1987:10]

The Hanalei National Wildlife Refuge was established in 1972 to provide feeding and nesting areas for endangered Hawaiian water birds, including the coot, stilt, gallinule, and duck. It encompasses 917 acres of Hanalei Valley, including 70 acres of ponds, 600 acres of forest, and mountain areas, and in 1993, 125 acres of commercial taro fields (U.S. Fish and Wildlife Service 2009).

More recently, severe hurricanes—Iwa in 1982 and ʻIniki in 1992—have demonstrated the precariousness of human development within the Haleleʻa environment, just as natural disasters thwarted the efforts of the newly arrived nineteenth century entrepreneurs. However, the endurance of taro through the changes documented above—and its flourishing today—may preserve the memory of the pre-Contact Hanalei with its *heiau*, *hula* house, and starting places for races to the beach.

Modern development and land uses in the *moku* of Haleleʻa are depicted on 1970s USGS orthophotoquad aerial photographs (Figure 21).

4.2 **Moku ʻo Koʻolau**

4.2.1 Pre-Contact to Early Post-Contact Period

4.2.1.1 Subsistence and Settlement Patterns

Anahola Ahupuaʻa, comprised of 6,327 acres, is the largest of the *ahupuaʻa* located in the Koʻolau District. Anahola contains the largest river in the district and numerous agricultural terraces taking advantage of this river have been identified in this *ahupuaʻa*. Handy and Handy (1972:423) describe the area:

> There are old abandoned terraces along its banks far upstream, there are old *loi* from two to four miles inland along Anahola River and its tributary Kaʻalaua Stream and below their point of juncture there are many *loi* on the flats along the river banks as it meanders through its wide gulch. The delta is three-fourths mile wide, and this was all terraced. [Handy and Handy 1972:423]

Coastal Zones were utilized for marine resources, habitation, burials, and ceremonial structures often associated with fishing (Bennett 1930). Anahola included two reefs. The reef on the east extended to Kahala Point. On the north side of Anahola Bay, a reef extends all the way to Papaʻa Bay. It is said regarding the island of Kauaʻi that the northeast shores are closed by sand bars and afford a plentiful harvest to the fishermen (Damon 1931). Two large boulders located on the *mauka* side of ʻAliomanu Road, containing several circular and linear worn depressions on the stones' surface, suggest pre-Contact marine subsistence focus along the Anahola shoreline (Dixon et al.

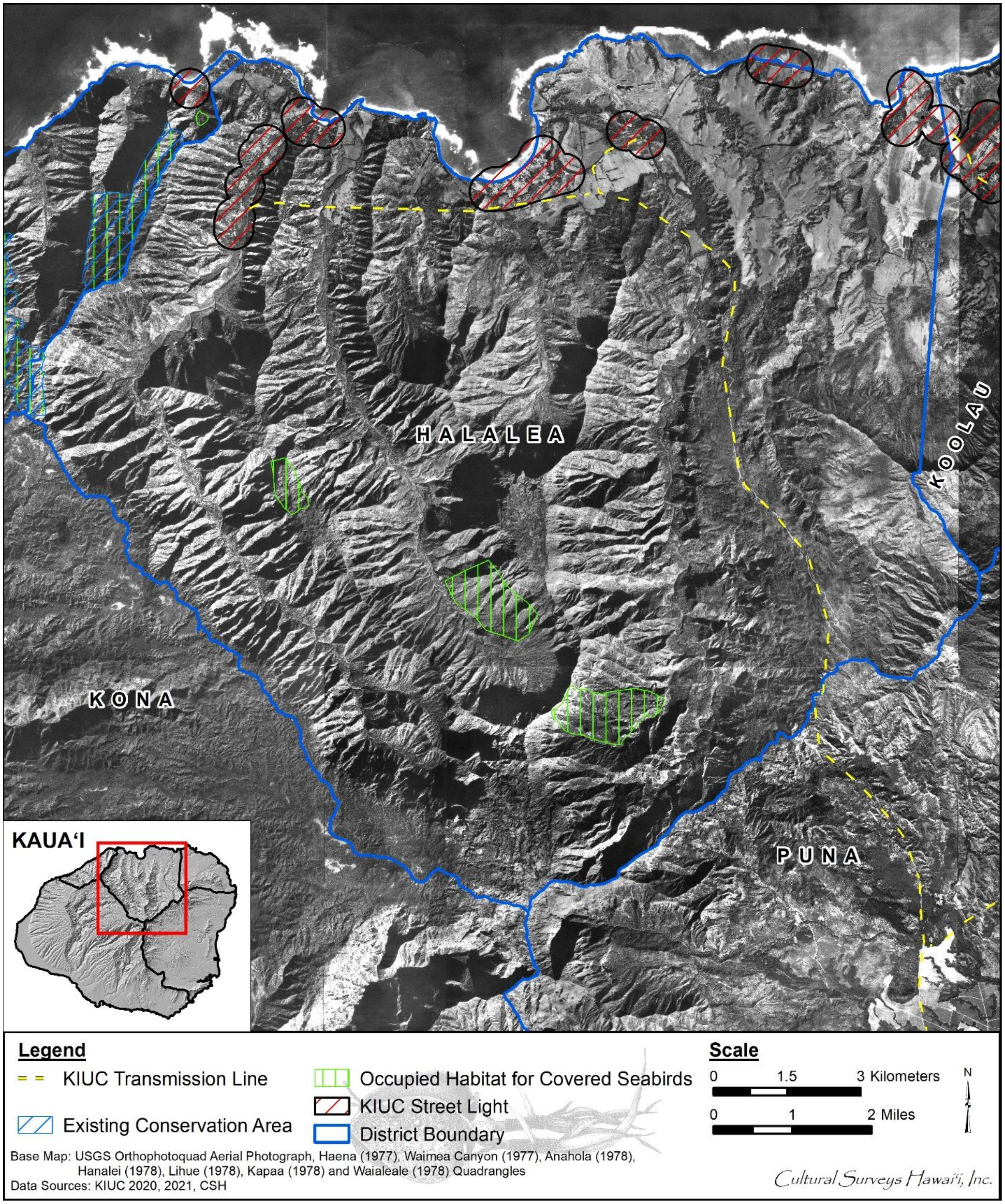


Figure 21. Portions of 1977 Haena, 1977 Waimea Canyon, 1978 Anahola, 1978 Hanalei, 1978 Lihue, and 1978 Kapaa and 1978 Waialeale USGS Orthophotoquad aerial photographs depicting modern development and land use in Halele‘a Moku

1997). The depressions on the rock face are described by Kirch as bait cups (Kirch 1985:273). “The practice of chumming the water with pounded fish remains, poison, and perhaps *kukui* nut oil in order to spear fish rising to feed on the bait—a practice often conducted at night by torch light” (Dixon et al. 1997).

Handy (1940:69) describes Aliomanu Ahupua‘a as a small *ahupua‘a* that was “watered by Aliomanu Stream” and had a “few small terraces” which were not being used.

Pāpa‘a Ahupua‘a had “old, small terraces” which extended “several miles inland” along Pāpa‘a Stream. The *ahupua‘a* received its name from Pāpa‘a Stream which Handy described as, “a sizable, meandering watercourse through *kula* land, fed by a number of small streamlets arising on the northern slopes below Puuehu.” Bennett also “observed terraces grouped around a heiau (4, site 122)” along “one of the northern branches” of Pāpa‘a Stream.

Moloa‘a Ahupua‘a’s resources, which would have been utilized by the pre-Contact Hawaiian population, were still in evidence well into the twentieth century; according to Handy and Handy (1972):

> Moloa‘a had a good stream which watered many terraces along its three-mile course toward the sea. A half mile of relatively flat land, inland from its bay was all terraced beautifully. Near the shore the soil consists of sand mixed with humus, which made it ideal for sweet potatoes. There were still a few old breadfruit trees there in 1935. Upstream, where there used to be *lo‘i*, all is now dry, owing to the stripping of timber from the land and to grazing cattle. [Handy and Handy 1972:422]

Handy and Handy also note that Moloa‘a’s name apparently derives from the abundant cloth fiber material once available to the Hawaiians there; they cite the following by the Hawaiian scholar Mary Kawena Pukui:

> Keahi (a native of Kauai) and I went over to Kauai and when she was asked [the meaning of Moloa‘a] she didn’t know [...] In passing Moloa‘a, Keahi pointed to some low hills *mauka* and makai of the highway and said ‘When I was a small girl, I used to come here with my *tutu-wahine* for *wauke*. These hills, now barren, were once so thickly overgrown that the *a‘a* (roots) of the *wauke* were *molo* (matted) together, weaving into each other like the meshes of a mat...This was once a great wauke growing place...Molo-a‘a, Matted-roots.’ [Handy and Handy 1972:422]

Other translations of Moloa‘a attest to the importance of the crawling root of the *wauke* used as dye for *kapa* staining (Mark Boiser, 31 May 2003 personal communication in Mann et al. 2003). It is said that in both historic and prehistoric times Moloa‘a was saturated with *wauke*.

Moloa‘a was not only characterized by its terrestrial resources. It was also noted for one of its seaweeds. According to Frederick B. Wichman:

> Moloa‘a is still famous for the quality of its edible *limu* (seaweed). The *limu kohu* was brought here from South Kohala, on the island of Hawai‘i by a chief of that place. The *limu* was placed under *kapu* and strictly reserved for the use of the *ali‘inui*. A beach and land section on the plains to the west of the valley is

> Kaʻakaʻaniu, ʻrolling of the coconut,ʼ where the quality of seaweed was considered the finest on the island. [Wichman 1998:95]

Handy (1940:70) describes Lepeuli Ahupuaʻa as "a narrow *ahupuaʻa* with several small streams arising from springs" which the "larger of these streams watered a number of small terrace plantations near the sea which are now planted in rice."

Waipake Ahupuaʻa was named after Waipake Stream which Handy (1940:70) noted is "quite sizable" and had "numerous terraces along the lower mile and a half of its course." At the time, Handy noted that a "compact group of terraces just below the highway bridge" were currently being used as part of a rice plantation. Handy also pointed out that on one of the unused *kuleana* lands were a "number of old breadfruit trees."

Pīlaʻa is a small *ahupuaʻa* that probably never had a very large population. In a survey of taro-growing features made by E.S. Craighill in the 1940s, Handy noted the following:

> This *ahupuaʻa*, famous for its great *kukui* forest, was watered by Pilaa Stream, which had several small terraces along its lower course. There were other small streams east of the main stream, arising from springs and watering a few small terraces. [Handy 1940:70]

> Next is Pilaʻa, with several small terraced areas watered by its main stream and by small streams originating in springs. This small *ahupuaʻa* was famous for its great old *kukui* grove. There is a small remnant of it still there. Its name was Kaukake [Kaukahe]. It was a place where the *aliʻi* of Kauai met in council. There was a *heiau* in the grove. Since the *kukui* was a form of Kamapuaʻa, we infer that the *heiau* and grove were sacred to Lono. [Handy and Handy 1972:421]

The inhabitants probably supplemented their diet with dryland crops such as sweet potatoes and resources from the ocean. A wide reef fronting Pīlaʻa beach extends from Kepuhi Point to Kāhili Beach. Pīlaʻa Beach is bisected by a rocky point once used by Hawaiian fishermen as a fish-spotting site. The fishermen would place a net in the water and when a school of fish was seen on the incoming tide by the spotter, he would signal the fishermen to move behind the fish and kick (*kāpeku*) with their feet, driving the fish into the nets (Clark 1990:19). The coast was also a favorite spot up to the present day for gathering *limu kohu* (*Asparagopsis taxiformis*). One long-time resident remembered the following:

> Our *limu* expeditions took us from Moloaʻa to Pīlaʻa and back. Kaʻakaʻaniu is the reef that's good for *limu kohu* on the west side of the bay [Moloaʻa Bay]. The *kohu* here is very red, but has more *ʻopala* [*ʻōpala*, trash] to clean than the *kohu* at Pīlaʻa, which is lighter but had less *ʻopala*. [Bill Huddy 1986 in Clark 2002:251]

Kahili is a relatively small (1,396+ acres) but unusual *ahupuaʻa* in the *moku* of Koʻolau. The major fresh waterway in the area, Kīlauea Stream, is not entirely included within an *ahupuaʻa*, but rather forms a portion of the boundary between Kahili and its neighboring *ahupuaʻa*, Kīlauea to the west. To the east lie Waiakalua and Papaʻa. Along the shoreline lie Kīlauea Bay and Makalea Point with a narrow but continuous coral reef. The *ahupuaʻa* extends *mauka* across undulating terrain of ridges and short, irregular valleys, to the ridge separating the modern judicial districts of Hanalei and Kawaihau at an elevation of around 2,000 ft above sea level. The mid-section of the *ahupuaʻa* contains fairly level land which would have been suitable for *kula* agriculture, with limited strips of flood plain along the two small streams, Kaluamakua and Wailapa. These two streams, tributaries of Kīlauea Stream, appear to be crucial features controlling the configuration of the *ahupuaʻa* boundaries. The *ahupuaʻa*, although it has a typical “pie-slice” shape, encompasses a width of land from stream to ridge, rather than the more common pattern of ridge to ridge. The water sources, and the associated watered lands of the two tributary streams were probably more important as traditional subsistence resources than Kīlauea Stream itself. This is certainly borne out in the location of the LCAs that cluster along the lower reaches of these tributaries.

Handy and Handy (1972) believed the area had a wealth of good *kula* land for sweet potato growing, but was a comparatively small producer of *kalo*. In the uplands, the tributaries of Kīlauea Stream travel in very steep, narrow gorges, making dispersal of these waters for irrigation purposes difficult. Because of this, *kalo* growing areas on the Kīlauea Stream existed only in the last mile of its course to the seashore where the waterway and its floodplain broadens. Even then, irrigation water was not taken from Kīlauea Stream itself, but rather from its tributaries, most of the old pond fields existing in the areas where these tributaries entered the main stream. In Kahili, the main tributary was Wailapa Stream with Kaluamakua Stream likely playing a secondary role.

Handy and Handy (1972:421) note, “There are two very small *ahupuaʻa* east of Kahili, Waiakalua-iki and Waiakalua-nui, where terrace areas were watered from several streams that originate in springs.”

Handy (1940:70) described Waiakalua-iki (West Waiakalua) as a “very small *ahupuaʻa* watered by Puuoa Stream,” and Waiakalua-nui (East Waiakalua) as “another small but distinct *ahupuaʻa* watered by the Waiakalua streams, which arise half a mile inland from springs and which used to irrigate small terraces near the sea.” Handy pointed out that these terraces were being used as pasture. Bennett also observed that the old terraces in both eastern and western valleys of Waiakalua were “well preserved and taro still grew along the edges of the streams; near the beach the terraces were no longer used (4, site 130)” (Handy 1940:70).

The settlement pattern or Hawaiian use of the lower part of Kilauea Ahupuaʻa that seems most likely would include temporary camp and processing sites related to the hunting of seabirds for their flesh and feathers. This activity would probably have occurred very near the coastal cliffs on which the birds have long nested and are today protected. Both Kikuchi (1987) and Fredericksen and Fredericksen (1989) surveyed areas of the Kīlauea coast for remains of that activity.

Other activity may have included some sweet potato growing and harvesting on the high level ground *mauka* or south of Crater Hill back toward the town of Kīlauea. Any evidence of what must have been dispersed and discontinuous farming in this area would have been lost to the development of sugar in the late nineteenth century. The most probable area of concentrated population and industry would have been along Kīlauea Stream near its issue into Kīlauea Bay where the stream could more readily be accessed for irrigation. The absence of LCAs in that area of Kīlauea Ahupuaʻa suggests those terraces were less suitable in later years or that no one of an associated lineage was living along or working that part of the river at the time of the Māhele.

Namahana Ahupuaʻa is a small, atypical *ahupuaʻa* in that it is not laid out to stretch from the reef to the mountains. It includes only the shoreline of Kauapea Beach and a small intermittent stream valley. The *ahupuaʻa* extends only 6,000 ft inland and is not more than 3,500 ft wide.

Tracing the traditional pattern of land use one would expect a fishpond or extensive *loʻi* along the shoreline but it appears that neither were present. The bulk of the *ahupuaʻa* would have been *kula* lands. Handy and Handy (1972:421) indicate that similar *kula* land in the adjacent Kīlauea Ahupuaʻa also may have been productive land for cultivating sweet potatoes. In both *ahupuaʻa,* the relatively dry landscape was undoubtedly non-productive for taro *loʻi*.

Because Namahana Ahupuaʻa does not extend upland and it appears to be situated within what may have been the original northwest corner of Kīlauea Ahupuaʻa, Namahana may have been an *ʻili* that was subsequently subdivided from Kīlauea Ahupuaʻa. Namahana is briefly mentioned in Commission of Boundaries (1873) documents of Kalihiwai Ahupuaʻa as being a mountain peak along the east boundary of Kalihiwai. However, no mention of the adjacent *ahupuaʻa* of Namahana or Kīlauea are given in these documents.

4.2.2 Early Historic Period

4.2.2.1 Historic Accounts

Early reports relate that Anahola was a small village surrounded by fertile fields.

George Vancouver (1798:221–223) examined the east coast of the island from his ship in 1793 and stated that it was the "most fertile and pleasant district of the island […]" However, he did not anchor or go ashore due to inhospitable ocean conditions.

In 1840, Peale and Rich, with Charles Wilkes' United States Exploring Expedition (1844), traversed the coastline on horseback heading north from Wailua:

> The country on the way is of the same character as that already seen. They passed the small villages of Kuapau [Kapaʻa], Keālia, Anehola [Anahola], Mowaa, and Kauharaki, situated at the mouths of the mountain streams, which were closed with similar sand-bars to those already described. These bars afforded places to cross at, though requiring great precaution when on horseback. The streams above the bars were in most cases, deep, wide, and navigable a few miles for canoes. Besides the sugarcane, taro, etc., some good fields of rice were seen. The country may be called open; it is covered with grass forming excellent pasture-grounds, and abounds in plover and turnstones, scattered in small flocks. [Wilkes 1845:69]

In 1849 William Patterson Alexander toured the island of Kauaʻi and described Anahola as:

> [...] chequered with kalo patches, and studded with houses [...] a delightful view from the south side. The Anahola river, one of the finest on the island, flows through the valley, and spreading near its mouth into a broad sheet of water, surrounds a little islet which has a romantic appearance. [Alexander 1991:123]

In 1849, William DeWitt Alexander wrote the following passing account crossing the Kilauea/Kahili River:

> […] A little farther on we entered groves of *hala*, through which we continued to ride for the rest of our journey. We turned from the road to see the falls of the Kahili River. Though not large they are beautiful. Here the river falls in a jet of foam over a precipice of about 40 feet into a broad clear basin below […] [Alexander 1991:124]

4.2.2.2 Protestant Missionaries

The first missionaries from the American Board of Commissioners for Foreign Missions came to the Hawaiian Islands in 1820. In this year, the first company established missions at Honolulu, Oʻahu and Kailua, Hawaiʻi. The Board sent new missionaries to support and sometimes replace the first company. Rev. William Patterson Alexander and his wife Mary Ann McKinney Alexander arrived in 1832 with the fifth company. Alexander was stationed at the Waioli Mission in Hanalei from 1834 to 1843 (Day 1984:19). Besides preaching at his own church, he toured the entire Koʻolau area, preaching wherever a large crowd of Hawaiians could be gathered. William wrote a letter to his brother James Alexander in Tennessee:

> I have just returned from an excursion to Kauhakake in Koolau where I preach every Thursday under the shade of a large kukui grove to an attentive audience of 400. It is about 10 miles distant up hill and down. I preach 5 or 6 times a week to an audience of about 1000 here at the station [Waioli], give out medicine to many 'impotent folk'—spend as much of the forenoon in my study as the sick will allow, and afternoons converse with those who come in crowds to enquire about the way to heaven. We have cheering evidence that the Holy Spirit is moving on the minds of many […] The little church here now consists of 38 members. [Alexander 1934a:12–13]

In 1841, the ships of the U.S. Exploring Expedition under Lieutenant Charles Wilkes stopped in the Hawaiian Islands. While on Oʻahu, he sent several naturalists to Kauaʻi to explore that island and they met with Rev. Alexander.

> On their way they passed through a beautiful grove of tutui-nut [*kukui*] trees, in which the Rev. Mr. Alexander is in the habit of preaching to the natives. These trees are large, and form a delightful shade. There are few places in the open air so well calculated to hold divine service in, and it is well fitted to create feelings of religion. The view, by Mr. Agate, will give a good idea of it. [Wilkes 1845:4:69]

As noted above, Mr. Alred T. Agate sketched a scene of the missionary preaching below the *kukui* tree grove called Kauhake, possibly in the glade within the grove known as Kaukahekekeʻe. His son, James M. Alexander, who wrote a memoir of his father, placed this grove in Pīlaʻa.

> Mr. Alexander made tours through the adjoining districts, and soon held regular meetings at two out-stations, at one of which, Pilaa, in Koolau, eight miles distant, he was accustomed to preach under the shade of a noble kukui grove, to a congregation seated on the ground, so romantic a place for religion meeting that Commodore Wilkes afterwards had a picture of it drawn, representing Mr. Alexander with a tree for a pulpit. [Alexander 1888:93]

On a visit to the Islands in 1849, another son, William DeWitt Alexander, rode a horse over the same lands that his father used to ride:

> The country through which we were now riding, was undulating, clothed with luxuriant pasturage, & diversified with groves. Here and there were little glens which seem like little fairy spots, But the beauty of the country was the abundance of water. Every valley, large or small had its stream. […]

> A ride of five miles from this valley [Moloa‘a] over hill, and dale, brought us to a grove of venerable kukui trees. Their spreading branches, interwoven, and interlaced with each other, form a fine natural canopy overhead, & the grass carpet under our feet, making this a pleasant place for holding meetings. Mr. Johnson pointed out the place where my father used to stand when preaching. The natives called the place Kauhakuku. Here we stopped to rest our horses, & had a fine bath in the adjoining valley beneath a cascade which answered the purpose of a shower bath. There are several orange trees in this valley. An old man living near by, made us a present of a water melon which was very refreshing. [Alexander 1991:124]

This grove seems to have been present until at least 1915, as it was noted in a Hawaiian tour guide:

> The Marine Drive from Lihue to the mouth of the Wailua River, a distance of six miles, is most beautiful, the road running along the tumultuous sea on one hand and along coconut and other groves on the other. This drive may be extended to Hanalei, 34 miles by crossing the Wailua River steel bridge. Then come in succession, in the words of J.J. Lydgate: The Kapaa flats, backed by rice, sugar, and pineapples; Kealia with its big sugar factory and its artificial landing, formed by a stone breakwater thrown out from one wing of the bay; Anahola, a picturesque rice-growing valley, dominated by ragged, precipitous peaks back of it; the Pilaa kukui groves, magnificent trees of great age and beauty, famous in Hawaiian history, beneath whose ample and grateful shade the early missionary fathers were wont to address large audiences of primitive worshippers; five groves of breadfruit trees, in secluded and sheltered hollows laden with fruit; Kilauea plantation, with roadside bits here and there, of dell and stream, and pool and waterfall […] [Schnack 1915:198]

4.2.2.3 Catholic Missions

In the post-Contact period, the *ahupua‘a* of Moloa‘a enters the historical record in the 1840s when Father Robert Walsh arrived at Kōloa to establish the first Catholic Church on Kaua‘i. Traveling along the east side of the island early in 1842, Walsh spent the night in Moloa‘a “at the house of Luapele, the *konohiki* of the place.” Walsh “took down the names of thirty-four natives who declared themselves desirous of studying the Catholic Faith” (Yzendoorn 1927:175). In April 1842 Walsh and his assistant, Father Barnabe Castan, baptized 112 adults and 14 children at Moloa‘a. Father Barnabe set up a station at Moloa‘a:

> Moloaa became a center of Catholicism during these early days. In the school built there, the girls worked at spinning and recited their lessons at the same time.
>
> At Moloaa the Catholics had their first substantial success [on Kaua‘i] [Joesting 1984:146]

By the mid-nineteenth century, the Catholics were firmly established at Moloa‘a. In his journal, William DeWitt Alexander described a trip around Kaua‘i in 1849. Riding on horseback around northeast Kaua‘i, Alexander noted:

> About five miles from Anahola we crossed Molowa [Moloaa] valley a most beautiful spot. There is a village here, in which a Catholic priest resides, the

> inhabitants of which are mostly Catholics. The country near this place has been lately burnt over, but the vegetation is springing up anew. [Kauai Historical Society 1991:124]

The Catholic presence in Moloa‘a was further solidified with the construction of St. Stephen’s, in 1854. St. Stephen’s Catholic Church consisted of a frame schoolhouse, a frame rectory, and a stone church (Schoofs 1978: 225). Reports sent from Moloa‘a record the Catholics’ success in the second half of the nineteenth century. A typical report, from 1864, noted:

> At Moloaa, the habitual residence of Father Denis, the Faith has made consoling progress this year. Services are well attended; slothful Christians have come back to their duties, and Protestants have been converted [in Damon 1931: 340]

St. Stephens became the second largest Catholic missions on the island of Kaua‘i by the mid 1800s, after St. Raphael’s in Kōloa. However, tragedy struck in 1869 when a tidal wave destroyed St. Stephen’s church resulting in the dispersal of the Moloa‘a Catholic community (Schoofs 1978: 228). Subsequent industrial developments caused the closure of several of the original Catholic churches on Kaua‘i (including Moloa‘a). The majority of the original missions were relocated or abandoned, with larger chapels built in other Hawaiian villages that were more heavily populated.

4.2.3 Mid- to Late Nineteenth Century

4.2.3.1 The Māhele

In Anahola Ahupua‘a, 64 out of 86 individual *kuleana* LCA claims were granted. Most of the awards are in the delta area or Anahola River. In general, claims included multiple *‘āpana* (parcels) for different types of land use such as *lo‘i*, *kula*, and house lots. House lots were for mostly coastal, with *lo‘i* parcels on either side of Anahola River where it spreads out and becomes a wide floodplain.

Anahola LCAs were claimed for *lo‘i kalo*, *wauke*, and *noni*. Additional parcels were used for house lots, ponds, and some *mala* (garden, cultivated field) of *noni* and *wauke*. The claims for *lo‘i* and *kula* suggest that people were producing a wide range of crops such as yams, sweet potatoes, and squashes. These crops were likely being sold or traded at the landing.

Of the six land claims made in ‘Aliomanu Ahupua‘a, five were awarded (Waihona ‘Aina 2021). Claims included numerous *lo‘i*, *kula*, and *mala* which were planted with *noni*, *wauke*, breadfruit, coffee, and an orange tree. Each award also contained house sites.

A total of 11 land claims were awarded within the Pāpa‘a Ahupua‘a. All of the land claims were located in the lower portion of the valley and all were included in the Pāpa‘a Bay area. Of the 11 LCAs occurring in various portions of the Pāpa‘a Bay area, most were related to *lo‘i* cultivation (Powell and Spear 1999:8). LCA 4641 contained *lo‘i* fields (Powell and Spear 1999:8). Several house lots were also present near the Pāpa‘a Bay coastline.

Nineteen LCAs for individual parcels (including one to the Roman Catholic Church) were recorded in Moloa‘a Ahupua‘a. The LCAs were focused along the course of the Moloa‘a Stream. Given their locations, it is likely these award parcels were taro *lo‘i* and associated house sites. The disposition of these awards may reflect a continuation into the post-Contact era of the traditional Hawaiian settlement of Moloa‘a.

In Lepeuli Ahupuaʻa, six land claims were made, five of which were awarded (Waihona ʻAina 2021). These claims included numerous *loko*, *loʻi*, and *kuakua* (embankment between taro patches that was kept under cultivation). Each claim also had *kula* land which was planted with *wauke* and *noni*. Some claims also mention house lots in Lepeuli, however, one claims a house site in the adjacent *ahupuaʻa* of Kaʻakaʻanui.

The entire *ahupuaʻa* of Pīlaʻa was awarded as a Konohiki Award (LCA 1559B) to William C. Lunalilo, a half-brother of a grandson of Kamehameha I; Lunalilo became the king of Hawaiʻi after the death of Kamehameha V in 1873. Unlike the *makaʻāinana,* the *konohiki* did not have to provide any information on the land use of their awards, only a list of lands as shown in the LCA award to Lunalilo.

A total of 27 *kuleana* LCAs were claimed in Pīlaʻa. A twenty-eighth claim, LCA 8527 to Hanai, was made for land in Waipakē, but a corner of this lot now overlaps the modern boundary of Pīlaʻa. Six claims were not awarded, most because evidence showed the claimant had moved away or recently died. For the *kuleana* awards, the claimant had to list the use of the land, whether as a house site, as agricultural or pasture land, or for other resource use.

The Māhele *kuleana* testimony indicates each of the claimants lived in the *ahupuaʻa*. Usually the *loʻi* were located next to the house lot and often there were also *māla* for native plants such as *noni* and *wauke* and introduced plants such as bitter melons (gourds), oranges, corn, and tobacco. The *ʻāpana* are rather widely scattered, which is probably why there seems to be only one *ʻili* name for each house lot award. However, eight people claimed an *ʻāpana* in one *ʻili*, Kahoiwai. In each case the land use for this *ʻili* was for *kula* or for some orange trees. This was probably a communal area used to pasture livestock, such as horses and perhaps cattle. There is no mention of any land claimed in the uplands to gather forest resources and there is no mention of fishing rights. However, information from the historic period indicates marine resource gathering was important, such as fishing the rich wide reef off Pīlaʻa Bay and gathering *limu kohu* from near the shore.

During the Māhele, quiet title to Waipakē Ahupuaʻa was given to Naeole, the *konohiki* for this area. Upon his death in 1860, he willed all his lands to his wife, Kini (Jean/Jane), "kuʻu wahine mare i aloha nui ia." The will was disputed by Kalaikoa, but proved and certified by the First Circuit Court on 2 January 1861 (Waihona ʻAina 2021). Testimony from LCA documents indicates most of the parcels had been occupied since before 1839, when they were first given to the claimants by the *konohiki*. The LCA documents indicated *loʻi* and *kula*, growing *kalo, noni, ipu,* and *kou* trees were among agricultural endeavors in Waipakē.

The *ahupuaʻa* of Waiakaluanui (also known as Waiakalua 1, East Waiakalua, Waiakalua Hikina or Big Waiakalua) was retained by the Kingdom of Hawaiʻi as Government lands. Regrettably there is virtually no data regarding the *ahupuaʻa* in supporting documents. Only one individual *kuleana* claim to lands within Waiakaluanui was recorded (LCA 3404). Adamu claimed two parcels (*āpana*) at Papaʻa at which he claimed a house lot, five *loʻi*, seven orange trees, breadfruit trees, one coconut tree, and *kula*. It appears that one of these parcels was located along a small stream in Waiakaluanui although this may have been another parcel Adamu claimed which was not awarded.

The *ahupuaʻa* of Waiakaluaiki (also known as Waiakalua 2, Waiakalua Komohana, West Waiakalua, or Small Waiakalua) was one of several *ahupuaʻa* composing LCA 11216 awarded to

M. Kekau‘onohi. Regrettably there is virtually no data regarding the *ahupua‘a* in supporting documents. No individual *kuleana* claims to lands within Waiakaluaiki were recorded.

Ka‘aka‘aniu and Namahana Ahupua‘a were also awarded to M. Kekau‘ōnohi (LCA 11216) who also received extensive lands elsewhere on Kaua‘i, Maui, Hawai‘i, and Moloka‘i. Unfortunately little is known of these small *ahupua‘a*. There are no *kuleana* awards listed within this land. Namahana Ahupua‘a was incorporated into Kilauea Plantation Company in the late nineteenth century.

In Kahili Ahupua‘a, nine claims were made for parcels but the Land Commission awarded only eight. William Lunalilo, grandnephew of Kamehameha I and future king of Hawai‘i, was awarded the entire *ahupua‘a* excepting those lands claimed by the seven other awardees. Of the remaining seven LCAs, six (9067, 10013, 10013B, 10015, 10082, 10083) are located on the eastern flood plain of the Kīlauea Stream in the vicinity where Wailapa Stream empties into it. In this area, according to the records, there were more than 20 individual *lo‘i* for raising *kalo*. Almost all of the claimants also had *kula* land and house sites there. Crops mentioned in the records besides *kalo* include *noni*, *wauke*, and oranges, and there was also pastureland and ponds, possibly *loko wai* or fresh water fishponds.

The one remaining LCA (10333) exists farther *mauka* on the Kīlauea Stream floodplain, and contained a number of small *lo‘i* and *kula* lands. This parcel was probably watered by what was known then as “Kilauea Brook,” a small tributary of the main stream that is unnamed on current USGS maps. It is interesting to note here that what is called Kīlauea Stream or River today, was known as Kahili River back in the mid-1800s, possibly denoting a placement of higher contemporary importance of Kahili over Kīlauea as an agricultural and settlement area. Kīlauea would gain more importance only near the turn of the century with the development of a sugar plantation there.

In the Māhele, Kīlauea Ahupua‘a was retained as Government Lands. In the records for LCA, there are no entries for commoner land claims associated with Kīlauea Ahupua‘a. It is unknown why there were no commoner *kuleana* land holdings within Kīlauea Ahupua‘a at the time of the Māhele (1848) and the following Kuleana Act. There was, however, a pattern at the time of the division of lands in which the land overseers (*konohiki*) often tried to present their overlord *ali‘i* with undivided tracts of land believing that to be in the best interests of their masters. Thus it could be that there was a systematic pattern to discourage commoner land claims in Kīlauea Ahupua‘a. It certainly seems odd that there was not a single claim in what should have been a well-populated *ahupua‘a*.

4.2.3.2 ‘Āina Hui O Moloa‘a

During the 1860s, Moloa‘a was the focus of major land transactions involving the Hawaiian government, a new educational institution, and private individuals. Early in the decade, 2,600 acres of land at Moloa‘a and Pāpa‘a Ahupua‘a were deeded to Punahou School by the government to augment the school’s endowment. The land was sold almost immediately to Herman A. Widemann: “In 1861 Mr. Widemann of Lihue bought practically the entire Kauai land grant of 2,262 acres for $1833.33 from the trustees of Punahou, perhaps with the intention of using it as a cattle and sheep ranch” (Damon 1931:590).

Widemann's plans were unsuccessful and "in order to divide up the land among small holders, Mr. Widemann organized the Moloaʻa Hui, or Company, among the Hawaiians of that region, with shares at $100 apiece, and sold the land to that Hui" (Damon 1931:590).

J.H.K. Kaiwi, secretary of the ʻĀina Hui O Moloaʻa, in 1916 gave a brief description of its landholding (Lai 1985:149):

Ahupuaa Moloaa (school land)	460 acres
Ahupuaa Papaa B (school land)	1,046 acres
Ahupuaa Aliomanu (school land)	647 acres
Ahupuaa Kaapuna (Smith land) L.C.A.	535 537 acres
E. Rowell Land—Grant 549	33 acres
Uka—RP or Grant 4044, LCA 6645 3 roods, 29 perches	

Thirty-four individuals owned shares in the *hui* including A.S. Wilcox, five shares; Hee Fat, four; Enoka Lovell, two; Robert Puuki, one-fourth share; Aloiau, three; and the heirs of Charles Miller, one share (Lai 1985:149).

4.2.3.3 Commercial Agriculture

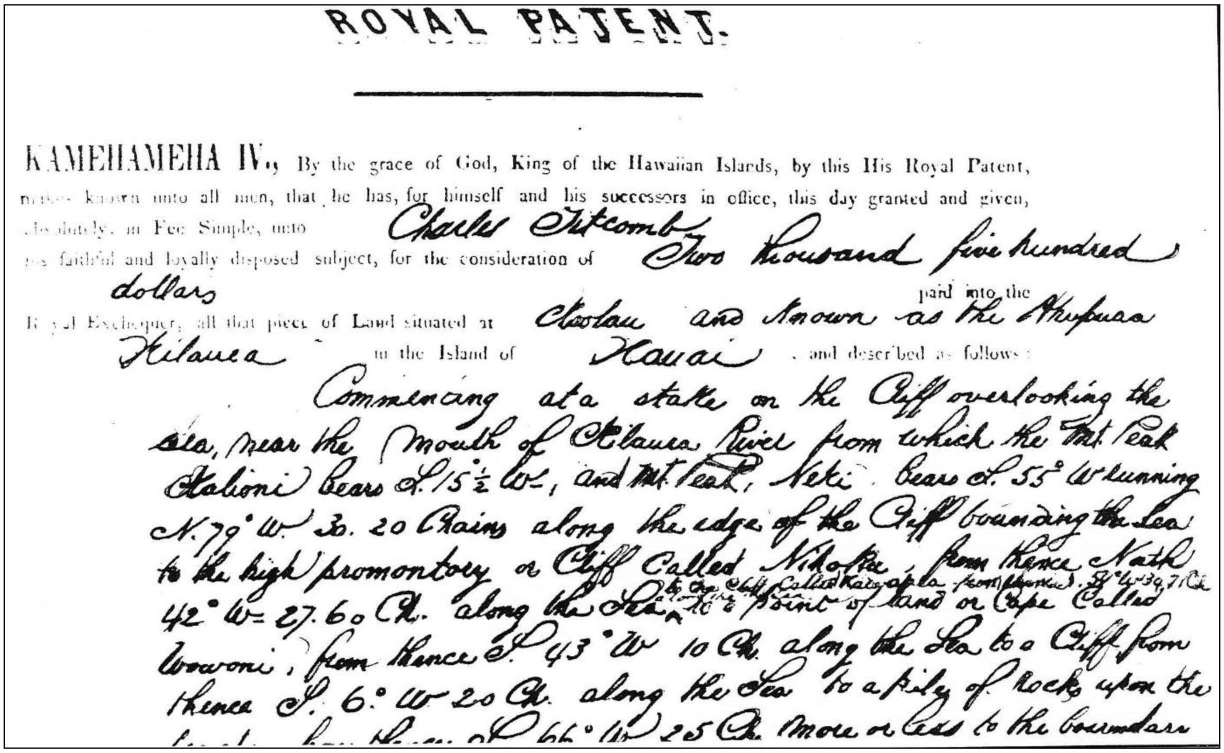
4.2.3.3.1 Sugar

Following the Māhele, private land ownership began to change land usage. Sugar plantations quickly developed and by 1877, eight sugar plantations had been established on Kauaʻi. The same year, Makee Sugar Company began cultivating sugar in Anahola. The sugar fields were located on the southern side of Anahola Stream and in the delta areas.

In January 1863, a former American whaler named Charles Titcomb purchased the entire *ahupuaʻa* of Kīlauea amounting to approximately 3,016 acres (1,221 ha) from Kamehameha IV for $2,500, Grant 2896 (Figure 22 and Figure 23). By this time, Charles Titcomb was already a veteran of several enterprises at Kōloa, Hanalei, and Kīlauea, Kauaʻi, including efforts to cultivate silkworms, coffee, tobacco, sugarcane, and cattle. He expanded his holdings to the west through further purchases within the next couple of years. The Kilauea Plantation, begun in 1863 by Mr. Titcomb, became a sugar estate in 1877 when Captain John Ross and E.P. Adams, in partnership with Titcomb, purchased much of the land and leased another substantial tract (Aikin 1988:19). Adams and Ross bought 6,000 head of cattle to run on the land and began to plant more acreage in sugar. They incorporated as the Kilauea Sugar Plantation Company in 1879 and as the Kilauea Sugar Company in 1880. Titcomb and his family continued to be involved in the plantation. He, his Hawaiian wife, and two of his eight children are buried in a family plot near his former home behind the Kīlauea Elementary School.

The Kilauea Plantation "was one of the smallest plantations in the Hawaiian Islands operating its own sugar mill" (Condé and Best 1974:150, Figure 24). In 1881, a railway was begun and Princess Lydia Kamakaeha (Liliʻuokalani) drove in the first spikes for the railroad bed. The plantation infrastructure grew over the next 20 years:

> Transportation system consists of 12 and a half miles of permanent track, five miles of portable track, 200 cane cars, six sugar cars and four locomotives. Kilauea is situated three miles from the landing at Kahili, with which it is connected by the



ROYAL PATENT.

KAMEHAMEHA IV., By the grace of God, King of the Hawaiian Islands, by this His Royal Patent, makes known unto all men, that he has, for himself and his successors in office, this day granted and given, absolutely, in Fee Simple, unto Charles Titcomb his faithful and loyally disposed subject, for the consideration of Two thousand five hundred dollars paid into the Royal Exchequer, all that piece of Land situated at Koolau and known as the Ahupuaa Kilauea in the Island of Kauai, and described as follows:

Commencing at a stake on the Cliff overlooking the sea, near the Mouth of Kilauea River from which the Mt. Peak Kaliono Bears S. 15½ W., and Mt. Peak, Neki Bears S. 55° W. running N. 79° W. 30.20 Chains along the edge of the Cliff bounding the Sea to the high promontory or Cliff Called Nihoku, from thence North 42° W. 27.60 Ch. along the Sea to the Cliff Called Kaiaakea from thence S. 84° 43' W 39.71 Ch. to a Point of land or Cape Called Waiwoni, from thence S. 43° W. 10 Ch. along the Sea to a Cliff from thence S. 6° W. 20 Ch. along the Sea to a pile of Rocks upon the ... thence N 66° W. 25 Ch. more or less to the boundary

Figure 22. Portion of Royal Patent Granting "the Ahupua'a Kilauea" to Charles Titcomb (from Aikin 1988:17)

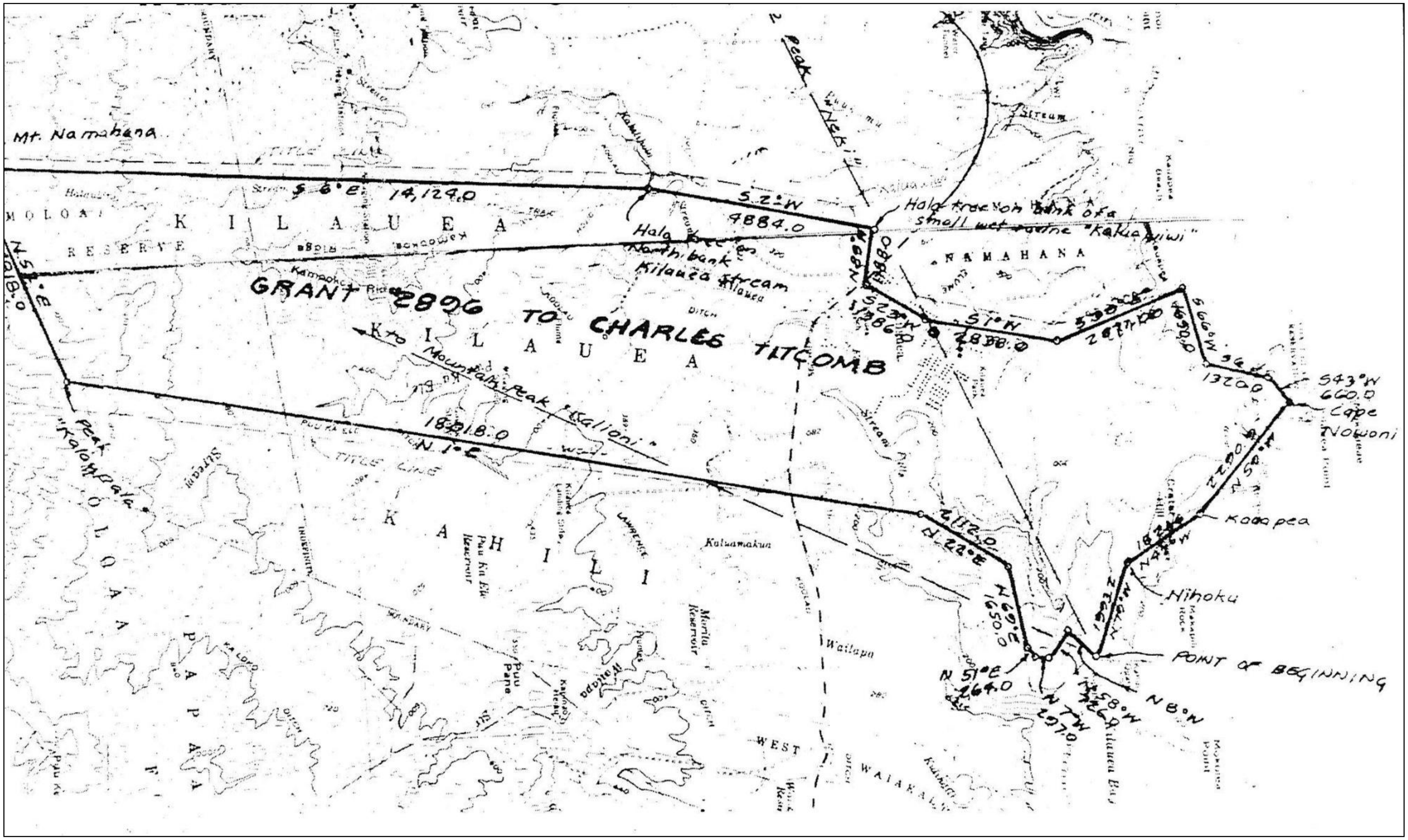


Figure 23. Map of Grant 2896 (Kīlauea Ahupuaʻa) sold to Charles Titcomb (from Aikin 1988:18)

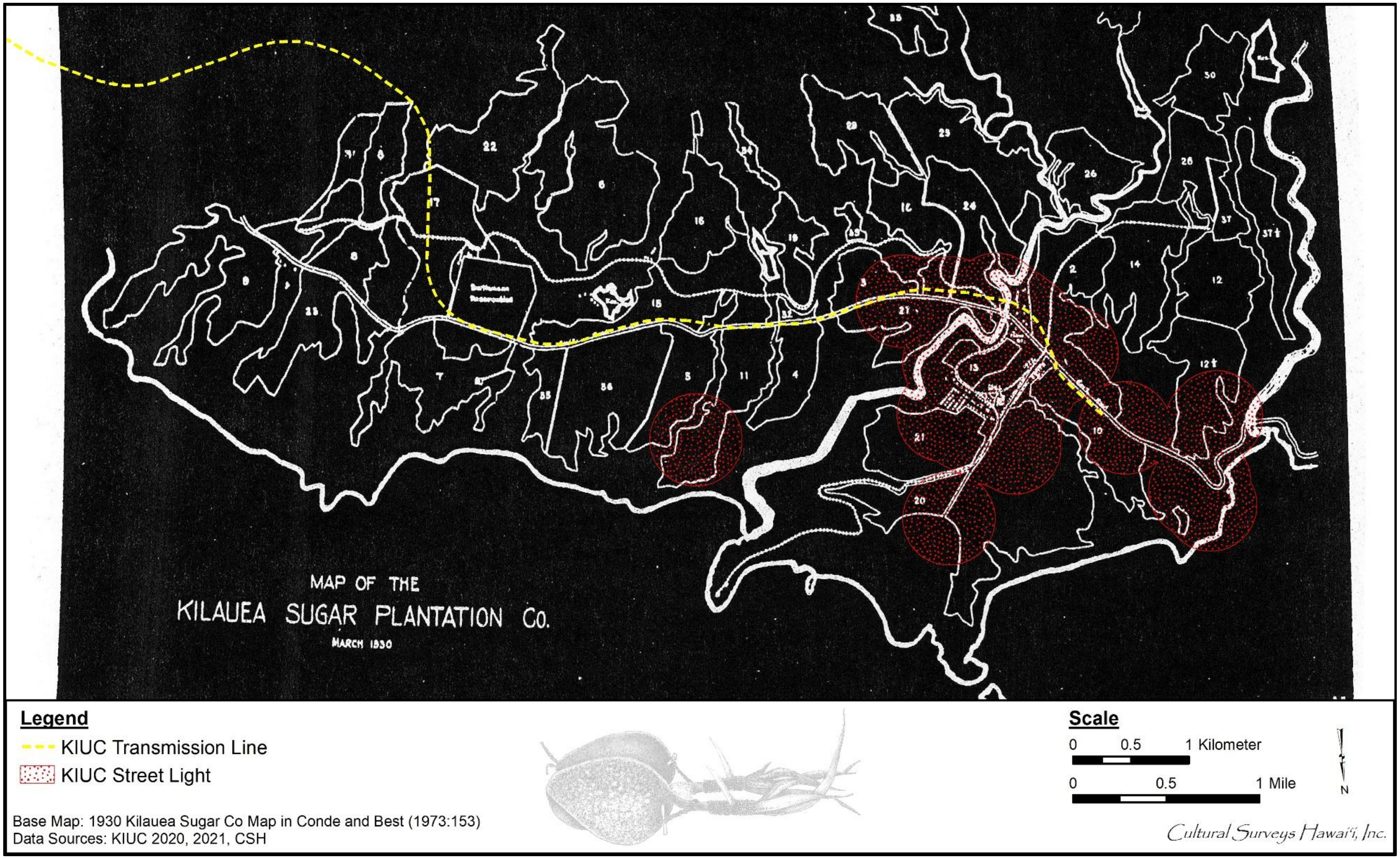


Figure 24. 1930 map of the Kilauea Sugar Company (Condé and Best 1974)

> railway system. Sugar is delivered to the steamers by means of a cable device at the rate of from 600 to 800 bags an hour. Mr. J. R. Meyers was the plantation manager. [*San Francisco Chronicle*, 18 July 1910, in Condé and Best 1973:152]

Part of this Kilauea Plantation Company rail system passed by Kahili Quarry on the way to an off-loading station at Mokolea Point, where raw sugar was cabled down to transport ships (State Inventory of Historic Places [SIHP] # 50-30-04-1811). Kahili Quarry was located on Kīlauea Bay at the mouth of Kīlauea Stream. Rock from the quarry was hauled by rail car and later by truck through the plantation fields where it was used to reinforce the field roads (Fredericksen and Fredericksen 1989:8).

The plantation employed Chinese and Portuguese workers. In the 1880s, Kilauea Sugar Company began major modification of water resources in the uplands with dams, reservoirs, ditches, and flumes (Joesting 1984). This may have had a major damaging effect on *loʻi kalo* downstream and possibly signaled the end of large-scale native agricultural practices in Kīlauea and vicinity.

In 1892, Sanford B. Dole referred to Kīlauea's agricultural resources by saying, "great engineering enterprises were undertaken, such as irrigation systems of Wahiawa, Kapaa, and Kilauea on the island of Kauaʻi" and continued "[…] the antiquity of some of these is so great that even tradition fails to account for their origin, as in the case of the parallel irrigation ditches at Kilauea, the digging of which is attributed by the Hawaiians to the fables [*sic*] moo, or dragon" (Dole 1892 in McGerty and Spear 1997:8).

The Kilauea Plantation Company started to be managed by C. Brewer and Company in 1910 and C. Brewer took over the controlling interest in 1948. In 1938, trucks were employed to transport harvested cane, and by 1942, the rail system was abandoned entirely (Condè and Best 1973). The Kilauea Plantation Company continued to operate until 1971.

Kilauea Plantation expanded past its first location in Kīlauea Ahupuaʻa. By 1930, it had fields planted from Nāmāhana to Kaʻakaʻaniu. Three *ahupuaʻa*—Kāhili (1,789 acres), West Waiakalua (332 acres), and Pīlaʻa (1,520 acres)—had originally been awarded to William Lunalilo in the Māhele. He sold these lands to a German resident, Christian Henry Bertelmann, between 1878 and 1883. Bertelmann also owned the *ahupuaʻa* of Lepeuli (102 acres), obtained in a deed from William Worner in 1883, and five shares of land owned by the Moloaʻa Hui in the *ahupuaʻa* of Moloaʻa. He ran a sheep and cattle ranch on the property and lived in a large 100-acre homestead *mauka* of the highway with his wife, Susan Titcomb Bertelmann, his three sons, and six daughters (U.S. Circuit Court of Appeals 1916, 1929).

Christian Bertelmann was one of the few Caucasian settlers who contracted leprosy. After he contracted the disease sometime after 1888, to avoid being sent to the leper quarantine colony at Kalaupapa on Molokaʻi, his family built a secret room in their house where their father could live and be kept hidden. At night he would ride out to a hill within earshot of his neighbors playing music and play along with his flute. He died on one of these nights. He was found by the family and quietly buried near his home (Joesting 1984:238).

In 1890, Bertelmann had leased almost all his land, except for the 100-acre homestead in Pīlaʻa, to the Kilauea Sugar Company for 25 years. The homestead was divided into lots and willed to his wife, three sons, and six daughters, one lot each. The sugarcane leased lands were willed to all of the children with the instruction that the three sons could acquire title to the sugarcane lands at the end of the lease in 1915 by paying each of the daughters $5,000. If one or more sons did not wish to acquire all of the land, the land was to be sold and the money divided equally among the children (U.S. Circuit Court of Appeals 1916).

In 1902, Frank Charles, son of Christian Charles, mortgaged his one-ninth right to the title of the land in payment of $9,845 dollars from Mary Lucas. Between 1903 and 1907, the two other sons and five of the six daughters sold their rights, titles, and interest in the leased lands and to each of their homestead lots to Mary Lucas for $5,000 dollars apiece. Thus at this point, Mary Lucas owned seven-ninths of the interest in the land, Frank Charles owned one-ninth (mortgaged to Mary Lucas) and the children of the third sister, Mrs. Stone, owned the last ninth. Disputes arose when Mary Lucas bought the interest to the land through a foreclosure of the mortgage, which was disputed by Frank. Many lawsuits resulted, brought by Frank and the children of Mrs. Stone. Litigation continued until 1938 but in the end, Mary Lucas gained most of the land. She renewed the lease to the Kilauea Sugar Company which continued to plant sugarcane in the *ahupua‘a* until its closing in 1971. The Lucas family trust used a 400-acre area near Ka Loko Reservoir as a cattle pasture (Finnegan 2006; U.S. Circuit Court of Appeals 1916, 1929).

The Mary N. Lucas Trust managed the Pīla‘a lands up to the present.

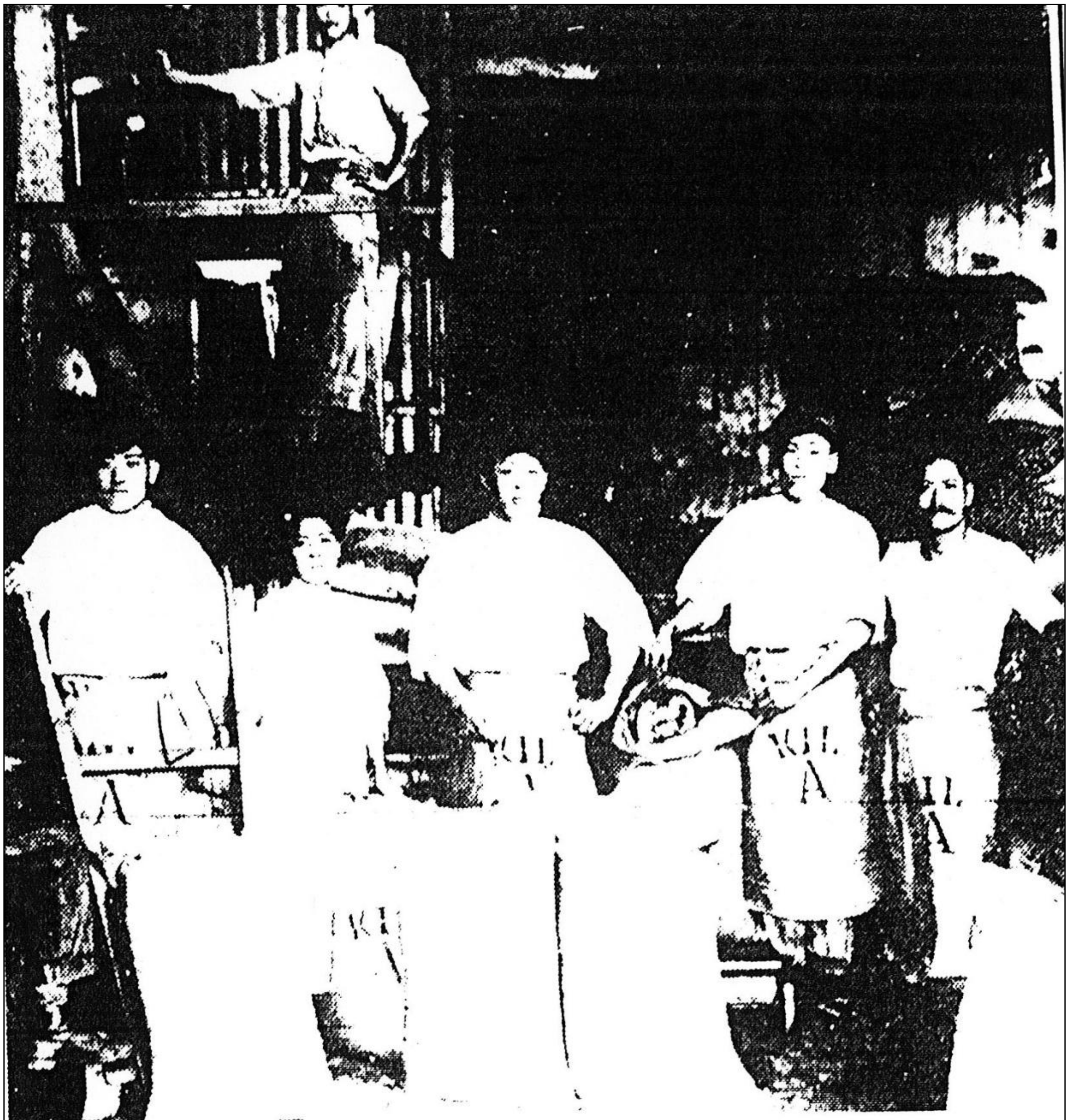
> In addition to its use as a retreat by family members, portions of the property have been variously operated as a cattle ranch, a papaya farm, an alfalfa farm, and a prawn farm. In recent years the property has been managed by co-trustee and Honolulu businessman James Pflueger, one of Mary Lucas' grandsons. [Clark 1990:18]

4.2.3.3.2 Rice

Like most well-watered areas in Hawai‘i, rice crops began replacing former *lo‘i kalo* in the second half of the nineteenth century. Chinese settlers purchased lands and converted *lo‘i* terraces adjacent to the Anahola River into rice fields. By 1892, Anahola was a rice farming district controlled by Mana and Hee Fatt from Kapa‘a. Travelers passing through Anahola described "rice fields as far as one can see" (Damon 1931:358). Traveling north beyond the village of Anahola, "rugged, inaccessible bluffs meet the beating of waves and the strong sweep of trade winds at the northeastern corner of the Island" (Castle 1917:155).

There were 55 acres (22 ha) of land in rice production in the Kīlauea-Kāhili area in 1892 and eventually a rice mill on Kīlauea Stream (Char and Char 1979). While it is understood that this rice mill was begun by Chinese, it clearly went into Japanese management. A photograph of the interior of the Kilauea Rice Mill (Figure 25) suggests it was not a mom and pop affair but rather a good-sized enterprise (*Garden Island* 31 March 1978). The mill is known to have been on the stream terrace east of Kīlauea Stream. Rice and vegetable cultivation is also indicated along the banks of Kīlauea Stream ca. 1925.

At Moloa‘a Ahupua‘a, as in other locales, groups of Chinese began leasing former taro lands for conversion to rice farming. Sadly, the taro lands' availability throughout the Islands in the later nineteenth century reflected the declining demand for taro as the Native Hawaiian population diminished. Rice production co-existed with the nearby sugar plantations until the 1930s when rising costs of production and competition from California caused a decline in rice production (Char and Char 1979:13–14).



Gone are the days . . .

THE ONCE BUSY KILAUEA RICE MILL . . . has now become a part of Kauai's history but a photo lent by the Kauai Museum brings back memories of the days when the fields from Hanalei to Wailua were planted with rice . . . and identifies the young workers as . . . (l to r) Imada, Kagawa, Okimoto, Okasaka, and Miyashiro.

Figure 25. Historical photo of the interior of the Kilauea Rice Mill showing that it was a relatively large rice mill for Kaua‘i and also that it was run by Japanese (*Garden Island* 1979)

4.2.3.3.3 Firewood

Describing a visit to Kauaʻi in 1865, William T. Brigham, who would later become the first director of the Bishop Museum, recorded,

> Moloaa was the next place we came to and it is the chief wood station at present on this part of Kauai. Here several vessels have been wrecked, and only the week before a schooner ran on the rocks through the carelessness of the master. [Kauai Historical Society 1991:142]

What "wood station" means is unclear. However, it suggests Moloaʻa Ahupuaʻa may have been a major site for the exporting of firewood to Honolulu.

4.2.4 Twentieth Century to Present

Before the turn of the century, land use was changing rapidly in Kauaʻi:

> By 1890 there were villages and hotels where once there had been no inhabitants at all, a reflection of how the centers of population were shifting. The places that had offered the most to Hawaiians—the sea to fish in, a stream to provide water for taro—these things became less important as the new commercial world took increasing control. Although some Hawaiian preferred the old life-style, many moved close to the plantation mill with the nearby company store, and their generally thinning numbers reduced old villages to fragments of what they had once been. [Joesting 1984]

4.2.4.1 Ahukini Terminal & Railway Company

The Ahukini Terminal & Railway Company was formed in 1920 to establish a railroad to connect Anahola, Keālia, and Kapaʻa to Ahukini Landing and "provide relatively cheap freight rates for the carriage of plantation sugar to a terminal outlet" (Condé and Best 1973:185). The rail system in Anahola traveled along the coast to a landing that had been built in Anahola Bay in the early nineteenth century. In 1934, the Lihue Plantation Company absorbed the Ahukini Terminal & Railway Company and Makee Sugar Company (Condé and Best 1973:167, Figure 26). The railway and rolling stock formerly owned by Makee Sugar Company became the Makee Division of the Lihue Plantation. At the same time, in addition to hauling sugarcane, the railroad was also used to haul plantation freight including "fertilizer, etc [...] canned pineapple from Hawaiian Canneries to Ahukini and Nāwiliwili, pineapple refuse from Hawaiian Canneries to a dump near Anahola and fuel oil from Ahukini to Hawaiian Canneries Co., Ltd." (Hawaiian Territorial Planning Board 1940:11). Shortly after the Lihue Plantation gained ownership of the railroad, passenger cars ran on the tracks. The last railroad tracks were removed in 1959 (Hilton 1990:378).

4.2.4.2 Pineapple

Sugarcane was not the only extensive crop planted in or around the Koʻolau District during the early decades of the twentieth century. Writing in the early 1930s, Ethel Damon noted, "Today as one travels along the uplands of Kilauea, Moloaʻa, and Anahola, neatly ridged pineapple fields stretch away for miles toward the sea and up into the foothills" (Damon 1931:357). Lihue Plantation had, earlier in the nineteenth century, purchased much of the former Moloaʻa Hui lands with the intention of future expansion into north Kauaʻi. These were lands, planted in pineapple, that Damon observed (Damon 1931:919).

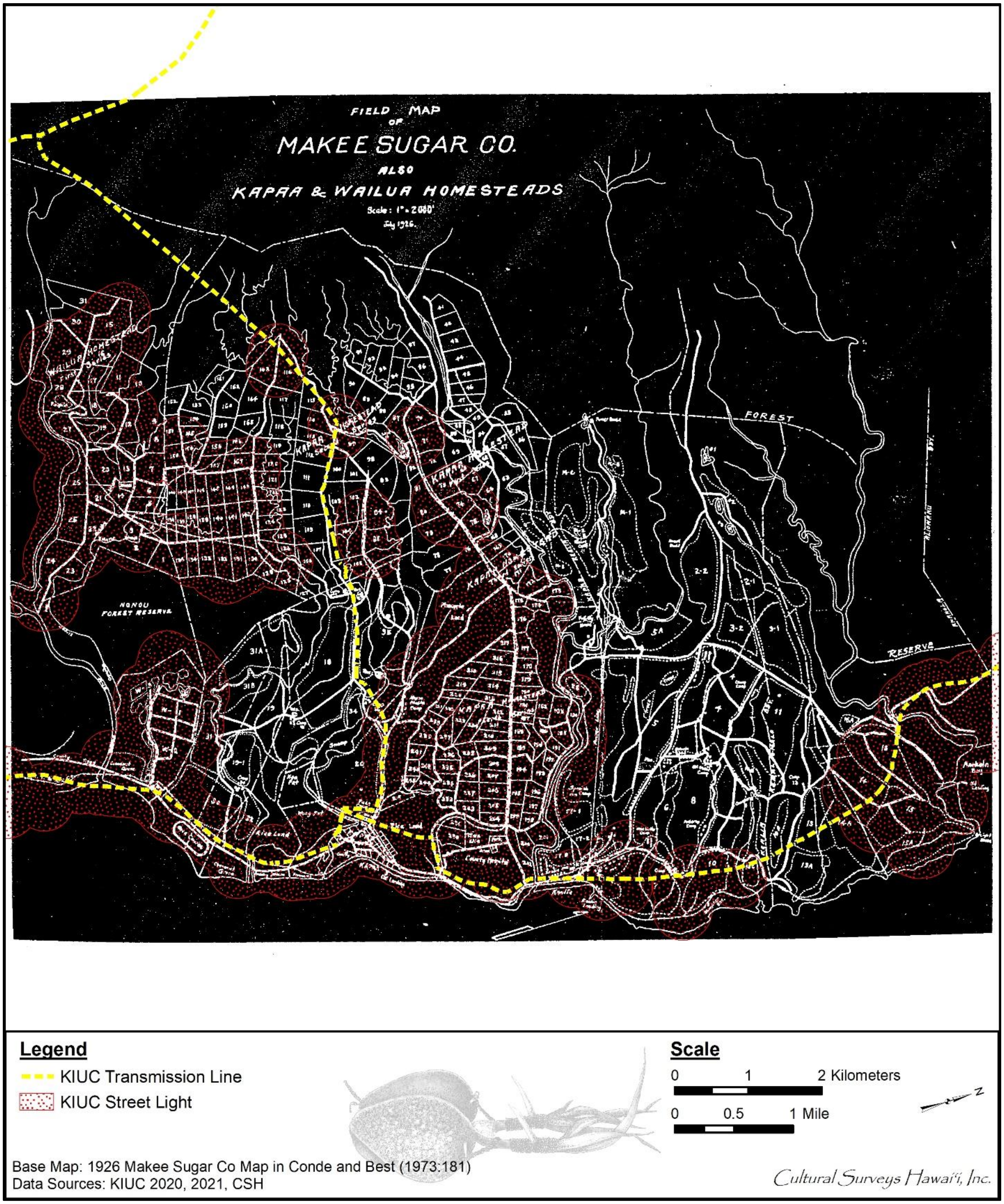


Figure 26. 1926 Makee Sugar Company field map (Condé and Best 1973:181)

4.2.4.3 Modern Land Use

Kilauea Sugar Plantation closed in 1971, forcing the area's population to search for new agricultural work. "Besides cattle, which had long been an industry in this area, papaya, guava, prawn ventures, and agricultural subdivisions were established [...]" (Wilcox 1996:85). By this time, the majority of the local families in Moloaʻa relocated to Anahola and Kīluaea, where job opportunities were more stable. However, many of the local *kuleana* families retained their *kuelana* lands, returning regularly to continue family traditions and cultures, which included gathering marine resources at Moloaʻa Bay.

In 1973, Hawaiian Fruit Packers went out of business, although its fields in the Pāpaʻa area may have been abandoned earlier. Lihue Plantation Company began planting sugarcane in the area for a few years but phased it out in the mid-to-late 1970s when the plantation was able to access and secure cane land from Grove Farm, which brought sugarcane cultivation closer to Lihue Plantation Company milling activities in Līhuʻe.

In 1974, the beach and other areas in Pīlaʻa were used as the backdrop for the movie "The Castaway Cowboy" starring James Garner and Vera Miles. The movie concerned a cowboy stranded on the island in the 1880s who helps a widow start a cattle ranch in the area; therefore, the movie somewhat mirrored the actual history of the area as a cattle ranch. The second movie filmed in part at Pīlaʻa was "None But the Brave," a World War II movie directed by Frank Sinatra in 1964. In this case, Pīlaʻa was used to represent an island in the Solomon Islands archipelago where several Japanese and American sailors were stranded (Cook 1996:52–53).

Lihue Plantation closed in November 2000 (Ruehl 2001). Towns dependent on sugar cultivation and production suffered after the closing of the plantations, however, the growing tourist industry had begun to ease the economic effects. Plantation fields in Anahola that were formerly Crown Lands reverted to the Department of Hawaiian Home Lands.

Meadow Gold had their main dairy operation in Waimea and in 1991 moved it to Pāpaʻa (Hammatt and Ida 1992:22–23). Ranching operations which has always been ongoing in the area to various degrees continued throughout this century. With the construction of the Pāpaʻa Bay Ranch in the 1980s and 1990s, Pāpaʻa was bought privately and changed owners a few times throughout the years in the late twentieth century. In 1998, 171 acres in Pāpaʻa was purchased by Hollywood movie executive Peter Guber and his wife (nicknamed "Tara") through a commercial entity, Mandalay Properties Hawaii LLC. Peter Guber called the property "Tara Plantation" for his wife's nickname. The Gubers constructed more buildings throughout their vast estate (The Real Estalker 2007). In 2009, the estate was sold to a non-celebrity professional couple (*Garden Island* 2009:1).

The 203-acre Kīlauea National Wildlife Refuge is located along the Kīlauea shoreline and was created largely as a preserve for various seabird species. A popular guidebook notes,

> Along the backshore, the lower reaches of Kīlauea Stream form one of the most pristine estuaries in the state. In former times it supported an important mullet fishery. Mullet and other fish are still found there, but are not fished commercially. [Clark 1990:22]

Modern development and land uses in the *moku* of Koʻolau are depicted on 1970s USGS orthophotoquad aerial photographs (Figure 27).

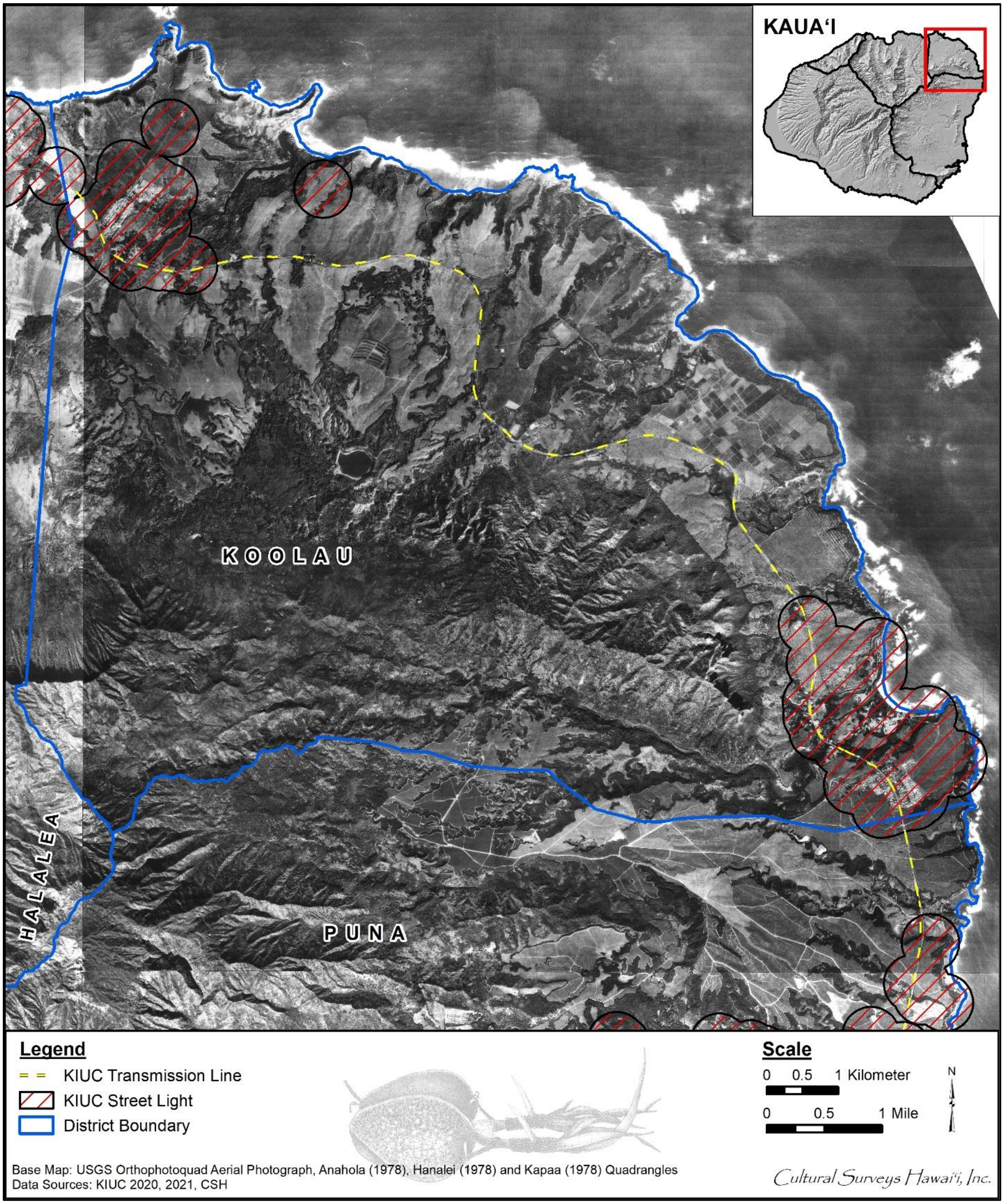


Figure 27. Portions of 1978 Anahola, 1978 Hanalei, and 1978 Kapaa USGS Orthophotoquad aerial photographs depicting modern development and land use in Ko'olau Moku

4.3 **Moku ʻo Puna**

4.3.1 Pre-Contact to Early Post-Contact Period

During the eleventh and twelfth centuries, Kapaʻa Ahupuaʻa was a destination for voyaging chiefs and their intra-Polynesian journeying and voyaging. Kapaʻa also was a more secular center during those early times (Liborio et al. 2016:30).

The Tahitian chief Māweke and his sons arrived in the Hawaiian Archipelago during the tenth or eleventh centuries, initially occupying Oʻahu before moving on to conquer Kauaʻi, Maui, and Molokaʻi (Fornander 1996:3). The bloodline of Māweke is considered among the highest of Hawaiian *aliʻi*; it produced Mōʻīkeha, the future *aliʻi nui*, of Kauaʻi. Hōkū Akana (2006) notes,

> As a northern Oʻahu chief, Māweke was a lineal descendent of the Nanaulu line, which Fornander considers to be the more reliable genealogy being least affected by interpretation compared with the Ulu lineage. Although both the Nanaulu and Ulu lines are descended from Wākea and Papa, the Nanaulu lineage is most often referred to by the Kauaʻi and Oʻahu chiefs but less so by Maui chiefs and hardly ever with Hawaiʻi chiefs.
>
> According to Fornander, the son of high chief Kekuapahikala and Maihikea, Māweke is 29 generations after the time of the gods, Wākea and Papa, and the first recorded chief of Oʻahu. In these stories we see Māweke as the ruler of Oʻahu during an era when Polynesian people are constantly travelling between various island groups across the Pacific and beyond.
>
> According to newspapers and other sources, Prince Māweke was from Tahiti and a contemporary of ʻAikanaka, the father of Hema. Māweke married the two sisters of Nuʻuhiwa, the grandson of Paumakua. Māweke had 3 sons with Naiolaukea. These were Mulieleali‘i, Keaunui, and Kalehenui who resided in Koʻolau, Oʻahu. The stories of Moʻikeha, Māweke's celebrated grandson have been recorded by Fornander, Kamakau, and Kalākaua. [Akana 2006]

In oral history, Kapaʻa is famous as the home of the great *aliʻi* Mōʻīkeha who lived there in his later years. This high chief was born in Waipiʻo, Hawaiʻi, but went to Kahiki following a disastrous flood in the valley. When he returned to Hawaiʻi he lived at Kapaʻa, but after his death his bones were taken to Kahiki. Near the shore in Kapaʻa is a place called Lulu-o-Moikeha (the Sheltered-place-of-Moikeha). Before Mōʻīkeha's death, his son Kila (brother to the son who is reputed to have brought the breadfruit from Kahiki to Oʻahu) went to Kahiki seeking his grandfather, and identified himself by a chant describing the charms of Kapaʻa:

> My father enjoys the billowing clouds over Pohaku-pili
> The sticky and delicious poi,
> With the fish brought from Puna,
> The broad-backed shrimp of Kapalua,
> The dark-backed shrimp of Pohaku-hapai,
> The potent ʻawa root of Maiʻakiʻi
> The breadfruit laid in the embers at Makialo,
> The large heavy taros of Keahapana. […]

He enjoys himself on Kauai,
All of Kauai is Moikeha's.
[Akina 1913:6b]

The tale of Kila returning to the Hawaiian Islands was recorded by a journalist in Kapaʻa in 1913: "[…] he brought back with him these kinds of fishes: the akale [akule], kawakawa, and ʻopelu. Before his time Kahiki had these, not Hawaii. Now they are found everywhere in our island waters" (Handy and Handy 1972:423–424).

After Mōʻīkeha were the following *aliʻi ʻai moku* (chief who rules a *moku*) of Kauaʻi (in chronological order): Haulanuiaiakea, (son of Mōʻīkeha, born on Kauaʻi), Laʻamaikahiki (ca. 951–1011, son of Mōʻīkeha, born in Tahiti and returns to Tahiti), Ahukinialaa (son of Laʻamaikahiki, born on Kauaʻi), and Kamahano (son of Ahukinialaa, born on Kauaʻi).

Some stories say the district of Puna was settled by the chief Punanuikaianaina, who came to Hawaiʻi from the Marquesas between AD 1000 and 1100 (Fornander 1996:45–46). The early settlers of the Hawaiian archipelago would have been especially attracted to the windward side of Kauaʻi, which boasted large river valleys supporting a vast inland region of irrigated pond-fields for *kalo* cultivation that became the agricultural core of Kauaʻi. The greatest of these river valleys were around Wailua and Hanamāʻulu streams. Excavation data near the mouth of Hanamāʻulu Stream indicates early occupation of the area between AD 1170 and 1400 (SIHP # 50-30-11-1839, Walker et al. 1991). This area was richly endowed with agricultural wealth and was a major residential and religious center for the nobility (Kirch 2010:171). A number of prominent *heiau* and a sacred birthing site were located in the central Wailua area (Bennett 1931:125–128). In approximately AD 1450 (a time estimate based on an average length of generational intervals in chiefly genealogies), the Kauaʻi *aliʻi* Manokalanipō is credited "for the energy and wisdom with which he encouraged agriculture and industry, executed long and difficult works of irrigation, and thus brought fields of wilderness under cultivation" (Fornander 1996:93).

On the island of Oʻahu in approximately AD 1490, the *ʻaha aliʻi* (council of chiefs) chose Māʻilikūkahi, an *aliʻi kapu* (sacred chief) who was born at the sacred site of Kūkaniloko in the uplands of Waialua to be the new *aliʻi nui* of Oʻahu. After his paramountship was installed at the *heiau* of Kapukapuākea in central Waialua, Māʻilikūkahi instituted an explicit land division and administration structure (Kirch 2010:84–90). Although Kauaʻi remained politically independent during this time period, a hierarchical land system was also imposed on that island.

Much of the Puna District is a flat plain nestled between the Hāʻupu mountain range to the south and the Makaleha mountain range to the north. The Puna District is fed by four main water sources, the Hulēʻia River, the Hanamāʻulu River, Keālia River, and the Wailua River. The attractiveness of this region to the early Kauaʻi residents is preserved in the following *ʻōlelo noʻeau*:

He nani wale no o Puna mai ʻo a ʻo.

There is only beauty from one end of Puna to the other.
There is nothing to complain about—refers to Puna, Kauaʻi. [Pukui 1983:91]

4.3.1.1 Settlement and Subsistence Patterns

Handy and Handy (1972) describe the land in Puna Moku:

> The *moku* of Puna included ten *ahupua‘a* along the southeast coast of Kauai. The topography is very much like that of southern Ko‘olau: a broad *kula*, intersected by streams flowing from the eastern slopes of the ridge on the east side of Hanalei Valley, until we come to Wailua River which cuts far back to Mt. Wai‘ale‘ale, and also drains the northern slopes of Kilohana crater (1,134 feet high). This was an area of diversified farming: taro, sweet potatoes, breadfruit, coconuts […] South of Kealia was an interesting irrigation ditch, which is described by Wm. C. Bennett:
>
> > ‘A large, simple dirt ditch, about 6 feet in width of varying depths which is traditionally referred to as a Hawaiian ditch. The interesting part is a deep cut about 100 feet long made through a low ridge along-side of which the ditch ran. The lands to be irrigated were on the other side of this ridge and so the cut was made to a depth of 10 or 15 feet through loose rock and subsoil’
>
> [Handy and Handy 1972:423]

Wendell Bennett of the Bishop Museum conducted a comprehensive archaeological survey of Kaua‘i in the 1930s. During his survey, Bennett visited Kapa‘a and provided a description of the area: “In the foothills of the mountains [back of the Hawaiian homestead area] are many little valleys which contain taro terraces. Single rows of stone mark the divisions with some 2-foot terraces” (Bennett 1931:128).

A *kama‘āina* of Kapa‘a wrote in the newspaper *Ku‘oko‘a* on 9 May 1913:

> As I looked up toward the mountains, O how beautiful it was! The waterfall of Makaleha fell on the distant height of Kapahi, the inland forest where I lived for many years and knew so well. As my eyes traveled on the left of the waterfall of Makaleha, I saw a billowing cloud on Pohaku-pili but could not see Palila’s banana grove, the grove spoken of in olden days,
>
> A banana grove at Kaea,
>
> [where] the bananas were fully ripe.
>
> They did not ripen in ten days
>
> But were fetched from the pit
>
> [where they were buried for ripening].
>
> Your writer had himself gone to the top of the mountain and saw the stalk and fruit of this banana grove of Kaea, had tasted and eaten and this is what it was like: The stalk could hardly be surrounded by two men, and was about 35 feet high from the soil to the lowest petiole. The length of the cluster from stem to lowest end of the bunch of bananas was about one and three-quarters fathoms long. There were only two bananas on each, about 1/2 inches around the middle ... The diameter of the end of the fruit stem of this banana seemed to be about 10 feet. This kind of banana plant and its fruit seemed to be almost supernatural ... [as does the retrospective imagination of the raconteur!] [Handy and Handy 1972:423–424]

While traditional sources record little about Keālia Ahupuaʻa during the years preceding Western Contact in the late eighteenth century, the presence of *loʻi* and terraces on wide flats suggest it could have supported a stable population (Perzinski et al. 2000:100). Documented land use in Keālia included prehistoric burial interment. Physical evidence of prehistoric utilization of Keālia *makai* are the human burials located at the south end of Donkey Beach (SIHP # 50-30-08-1899-1, 2, 3, and 4) (Perzinski et al. 2000:100).

Handy (1940:69) also discussed Kamalomaloʻo Ahupuaʻa. He defines Kamalomaloʻo as, "dry (maloo) Kamalo," which he states, "indicates that it was generally dry, as it is now." He noted that Kamalomaloʻo Ahupuaʻa is named for "a small stream which meanders seaward through a shallow gulch in *kula* land." He added that the stream "had constant flow and probably there were small terraces in the flats up the gulch."

Handy (1940:153) noted Wailua was one of the places in Kauaʻi with a broad, sandy shore where sweet potatoes grew well. There were still some sweet potato gardens in the area when Handy made his survey of agricultural terrace remains in the late 1930s. The main taro cultivation areas were along ʻŌpaekaʻa Stream and the south fork of the Wailua River, with smaller areas along the north fork of the Wailua River and along the numerous small tributary streams. Handy (1940:153–154) also noted that many of the former taro terrace areas had been converted to rice cultivation.

Waipouli, according to Handy (1940), is described as "watered by Konohiki Stream, in the bed of which are sizable flats where wet taro undoubtedly used to be planted. The level, swampy land of this *ahupuaʻa*, south of Kapaʻa by the sea, shows evidences of old terraces" (Handy 1940:68).

Waipouli Ahupuaʻa as well as the surrounding *ahupuaʻa* consisted of similar vegetation and forest life. Forest species like *koa* (*Acacia koa*), *hau*, and *kukui* were vastly used by Native Hawaiians for multiple purposes. Handy (1940) also showcased a map of the island of Kauaʻi, indicating its *ahupuaʻa* wind flow direction and planting localities. Handy explains that taro terraces were located within the Puna district (commonly referred to as Kawaihau). The taro grown was specifically wet taro and not dry land taro; however, that does not mean dry land taro was not grown and harvested. Banana terraces could also be found within the area but these depended on the strength and direction of the wind, as bananas require a "not so windy" type of environment. Along the banks of these terraces, *pia* or arrowroot could be found growing. Eventually, these areas were turned into sugar and/or rice plantations (Handy 1940:59).

Other food plants such as sweet potato were found through the coastal areas. *Wauke* was dominant throughout the Puna district as well as coconut groves. And *olonā* also flourished in the forest regions (Handy 1940:59).

Handy explains that "Kapaa, Waipouli, Olohena (North and South), and Wailua are ahupuaʻa with broad coastal plains bordering the sea, any part of which would be suitable for sweet potato plantings; presumably a great many used to be grown in this section. There are a few flourishing plantations in Wailua at the present time" (Handy 1940:153).

In Hanamāʻulu, people grew taro in the gulches and planted sweet potatoes on the cliffs above, near where they built their houses (Handy 1940:154). Handy described the area as:

> Hanamāʻulu River, rising below Kilohana Crater, winds its zigzag way to the sea through a relatively broad gulch, which had many small terraces commencing at a

> pint about 2.5 miles up from the sea continuing down to the delta of the river which begins about a mile inland. […] The delta region is a continuous area of flatland now mostly under sugar cane and house sites. Formerly this must all have been planted in taro. [Handy 1940:154]

Ha‘ikū Ahupua‘a contained the broad delta plain of the Hulē‘ia River (Handy 1940:66). According to Māhele records, the Hulē‘ia Valley, shared by Ha‘ikū on the north and Kīpū on the south, was a major locus for irrigated taro cultivation. In his survey of agricultural remains in the late 1930s, Handy (1940:66) noted numerous terraces along Hulē‘ia Stream, and mango, breadfruit, and wild plum trees on the banks above, indicating the area of former house sites. By the 1850s, many of these former taro lands had been converted to rice paddies; the tax records of the 1880s list at least 60 Chinese living and working in the area. The Hulē‘ia Valley was not only noted for food production, but its lush pastures were used for roaming cattle, often to the depredation of native farms. There was a herd of 265 cattle owned by the government in Hulē‘ia by 1847. In the 1850s, the government sold their cattle and horses to Paulo Kanoa. By 1900, there were over 200 head of cattle in Kīpū and Ha‘ikū on both sides of the Hulē‘ia River (Neller and Palama 1973:19).

The *ahupua‘a* of Kalapakī was permanently inhabited and intensively used in pre-Contact and early historic times. At the coastal areas were concentrations of permanent house sites and temporary shelters, *heiau*, *ko‘a*, and *kū‘ula* (both types of relatively small shrines dedicated to fishing gods), and numerous trails. The *kula* of the *ahupua‘a* contained native forests and were cultivated with crops of *wauke*, *‘uala*, and *ipu*. Legends and historic documentation (especially Land Commission records) elaborate on many of these important natural resources.

Traditional fishing villages were once located near the seashore at Kalapakī, east and north (around and up the coast) of Kalapakī Beach. *Loko* and small drainages were inland of these settlement areas. Land Commission documents indicate a land use pattern that may be unique to this part of the island, or to Kaua‘i in general, in which *lo‘i* and *kula* lands are described in the same *‘āpana*, with house lots in a separate portion. In most places, *kula* lands are defined as drier landscapes, and they do not typically occur next to, and among, wetter *lo‘i* lands. Also, according to Hammatt and Creed (1993:23), “there are several [LCA] references to other *lo‘i* next to the beach which indicate wetland cultivation extending right to the shoreline.” This is another type of land use that seems to be fairly unique to Kaua‘i.

Nāwiliwili Stream has formed extensive natural (alluvial) terraces along its length. Two smaller streams (Koena‘awa nui and Koena‘awa iki) are identified in Land Commission documents as draining into Kalapakī Bay.

The *ahupua‘a* of Nāwiliwili was permanently inhabited and intensively used in pre-Contact and early historic times, based on a large amount of archaeological, historical, and oral history documentation. The archaeological record of early Hawaiian occupation in this area indicates a date range of ca. AD 1100 to 1650 (Walker et al. 1991). A radiocarbon date of AD 1170-1400 was obtained from excavated sediments near the mouth of Hanamā‘ulu Stream.

Handy (1940) describes Nāwiliwili Valley in his chapter on the main *kalo* growing locations in Puna, Kaua‘i:

> For 3 mi inland from the sea the Nāwiliwili River twists (*wiliwili*) through a flat valley bottom which was formerly all in terraces. Inland, just above the bay, three Hawaiian taro planters cultivate wet taro in a few small terraces. Most of the land is [now] in pasture. [Handy 1940:67]

Due to the concentration of *lo‘i* within the vicinity of the coast, as well as the availability of aquatic resources, the coastal area contained a majority of the population of the *ahupua‘a* of Nāwiliwili.

The *kula* of these *ahupua‘a* contained native forests and were cultivated with crops of *wauke*, *‘uala*, and *ipu*. Legends and historic documentation (especially Land Commission records) elaborate on many of these important natural resources.

The meandering stream of Nāwiliwili has formed extensive natural (alluvial) terraces along its length; these abundant terraces consist of small level areas formed along major meanders that could be planted with relatively little preparation of the landscape. Higher terraces were irrigated by diverting some of the stream flow, which was carefully managed by *konohiki*. It is likely that there were once other smaller drainages between the Nāwiliwili and Hanamā‘ulu streams to the north and that Native Hawaiian planters used and modified these as *‘auwai*. Most of these smaller drainages have been changed beyond recognition by historic and modern land use and development.

Traditional fishing villages were once located near the seashore at the north side of the Nāwiliwili Stream mouth. *Loko* and small drainages were inland of these settlement areas. Ching et al. (1973:Appendix 6) list some *kapu* resources for the *ahupua‘a* at and near Nāwiliwili Harbor. These were gleaned from Land Commission documents describing these areas. *Akule* were *kapu* in both Nāwiliwili and Kalapakī Ahupua‘a, while *koa* was *kapu* in Nāwiliwili.

Handy (1940:62) has noted that the major occupation for the Hawaiian occupants of Niumalu was fishing in the rich offshore waters and at the inland fishponds. One of the most noted features of Niumalu is ‘Alekoko Fishpond, which provided mullet to the *ali‘i* of the area. It was awarded to Victoria Kamāmalu in the Māhele, but by the 1890s it was generally unused and neglected. It was repaired in 1900 and operated by a Chinese company (Neller and Palama 1973:21). Handy (140:62) noted a few taro terraces were found along Puali and Halehaka streams. Ching et al. (1973:5) has summarized the settlement pattern as:

> In ancient times, Niumalu was an important horticulture, aquaculture, and fishing area. Although quiet and isolated today, it was still a focal point of activity through the nineteenth century. The surrounding land was utilized intensively by the Hawaiians. There were large wet taro patches (*lo‘i*) with a well developed irrigation canal (*auwai*) system, all associated with several fish ponds. [Ching et al. 1973:5]

Although Kīpū itself is watered by Puakukui Stream (Handy 1940:66), the major agricultural area of Kīpū was along the Hulē‘ia River, where irrigated taro was grown.

Kīpū Kai was watered by only one small stream, but there were some springs that could be used to irrigate small patches of taro and sweet potatoes (Handy 1940:66). Kīpū Kai was also known as a salt-making area (Clark 2002:194).

4.3.2 Early Historic Period

4.3.2.1 Historic Accounts

Western historical accounts of Kauaʻi were authored by foreigners and settlers, travelers, missionaries, and surveying expeditions. Missionary accounts of the first half of the nineteenth century provide the majority of the early written records for this portion of Kauaʻi, and in some ways, they confirm and expand upon what can be gathered from oral tradition.

Few westerners visited Wailua in the years just after Cook's arrival and detailed descriptions of the area are scarce. Most of the voyagers during the late eighteenth and early nineteenth centuries landed at Waimea, on the southwestern side of the island, a location that would eventually overshadow Wailua in its royal importance because of the opportunities there to associate and trade with these foreigners (Lydgate 1920).

However, in March 1793, Wailua was still the "capitol" of Kauaʻi and Captain George Vancouver, who had already visited the island several times, both under Captain James Cook and later as captain of his own expedition, knew this fact well and tried to land there. Although conditions prevented him from anchoring, Vancouver observed the area from offshore and gave this description:

> This part seemed to be very well watered, as three other rapid small streams were observed to flow into the sea within the limits above mentioned. This portion of Attouai, the most fertile and pleasant district of the island, is the principal residence of the King, or, in his absence, of the superior chief, who generally takes up his abode in an extensive village, about a league to the southward of the north-east point of the island. Here Enemo the regent, with the young prince Tamooerrie, were now living. [Vancouver 1798:221–222]

Within decades of Western Contact, the area lost its ancient importance, and likely its population also. The *aliʻi* largely who benefited from their contact with westerners, spent more time in Waimea—the preferred anchorage for visiting ships. Also the complex of *heiau* at Wailua lost their great significance after the abolishment of the *kapu* system in 1819.

Missionary Hiram Bingham passed through Wailua twice in 1824 and visited the birthplace of King Kaumualiʻi (the Pōhaku Hoʻohānau site), a *hōlua* slide, and the lower falls on the south fork of the river, but left no clues as to the size or extent of the settlement there (Bingham 1847:220, 231).

In October 1840, members of the U.S. Exploring Expedition came to Wailua and recorded the following:

> The country on this route was uninteresting, until they reached Wailua, the residence of Deborah, a chief woman of the islands, readily known as such from her enormous size, and the cast of her countenance. She has a person living with her called Oliva Chapin, who speaks English, and has learned how to extort money. Deborah has about forty men in her district; but they were absent, being employed in the mountains cutting timber to pay the tax to the king.
>
> Near Deborah's residence are extensive fishponds belonging to her, which have been made with great labour: they are of different degrees of saltiness. The fish are

> taken from the sea when young and put into the saltiest pond; as they grow larger, they are removed into one less salt, and are finally fattened in fresh water. While our gentlemen were there, Deborah received young fish in payment of the poll-tax, which were immediately transferred to her ponds.
>
> Wailua, (two waters,) was formerly a place of some importance. It is situated on a small stream of the same name, in a barren, sandy spot.
>
> Deborah furnished them with a double canoe, to carry them up the river to visit the falls. Taking the western branch, they ascended it for two and a half miles.
>
> There are many good taro-patches and sugar plantations on its banks. They landed in what appeared to have been an old crater, in front of a basin, with high perpendicular bank. The low grounds along the river are extremely fertile, producing bread-fruit, sugar-cane, oranges, etc. The latter, however, are suffering from the blight, and some of the trees were covered with a black smut, produced by a species of aphis.
>
> In ascending, an insulated black rock is passed, known as the ‘Muu,’ which has been detached from a high rocky bluff, that is remarkable for the dikes visible in it.
>
> They afterwards ascended the bank, two hundred feet high, and crossed about half a mile to the falls, over a plain covered with grass and wild sugar-cane. The stream was very small, running sluggishly, and passed over a precipice of barren rocks, one hundred and sixty feet in height. Although there is neither tree nor shrub along the stream above the fall, the valley beneath is filled with them; the most conspicuous was the pandanus. The whole scene is picturesque. Below, the falls present a very curious appearance, the wind continually breaking and dispersing the water in heavy showers over a great variety of ferns, which are growing in the crevices of the rocks. The volume of water does not exceed ten hogsheads a minute. In the basin beneath were found many fine specimens of *Neritina granulata*, and two other species were found further down the stream, about four feet below the surface; these were procured by diving. Mr. Rich obtained specimens of the plants.
>
> Mr. Peale found but few birds; ducks were abundant on the river’s banks, some of which were killed. Rushes were growing along the banks from eight to ten feet in length, four or five feet under the water; besides these, the banks were covered with hibiscus and ricinus (castor-oil trees), growing wild. [Wilkes 1845:4:68–69]

Of note in the above U.S. Expedition account is that only “about forty men” are said to live in the district. This is seemingly a major reduction in settlement from Vancouver’s 1793 observation of an “extensive village.” The apparent decrease in population may be attributed to the decimation of Native Hawaiians by western-introduced diseases and possibly by a movement of people to the Waimea area, which by 1840 had become the center of trade and politics on Kaua‘i.

The U.S. Exploring Expedition then traversed the coastline on horseback heading north from Wailua:

> The country on the way is of the same character as that already seen. They passed the small villages of Kuapau [Kapa‘a], Keālia, Anehola, Mowaa, and Kauharaki,

> situated at the mouths of the mountain streams, which were closed with similar sand-bars to those already described. These bars afforded places to cross at, though requiring great precaution when on horseback. The streams above the bars were in most cases, deep, wide, and navigable a few miles for canoes. Besides the sugarcane, taro, etc., some good fields of rice were seen. The country may be called open; it is covered with grass forming excellent pasture-grounds, and abounds in plover and turnstones, scattered in small flocks. [Wilkes 1845:4:69]

William DeWitt Alexander, son of Waioli missionary William P. Alexander, traveling from Kōloa to the north shore of Kaua‘i in 1849 records some descriptive notes of Hanamā‘ulu Ahupua‘a:

> A few miles further on we crossed the picturesque valley of Hanamā‘ulu. This valley is prettily bordered by groves of *Kukui*, *koa*, & *hala* trees, and is well cultivated with taro. A fine stream flows through the midst of it, which makes a remarkable bend at this place like a horse shoe. We then traveled along the seashore at the foot of a range of hills through groves of *hau*, & among hills of sand. It was now after dark, but the moon shone brightly, and there was no difficulty in finding our way. About eight o-clock we arrived at the banks of the Wailua river. [Alexander 1991:121]

Alexander also mentions the area from Wailua to Kapa‘a. The following are excerpts from Alexander’s trip on 4–5 May 1849:

> May 4 […] About eight o-clock [P.M.] we arrived on the banks of the Wailua river. After calling for some time, a canoe came from the other shore, and took us over. A native led our horses over the sand bar. We were then welcomed by Deborah, the chiefess of the place, to her hospitable mansion. When she was informed that I was Alakanakela’s son, what alohas, shaking of hands, & wailing! Before we retired to rest, I engaged a horse from Deborah to go the remainder of the journey to Waioli.
>
> May 5. This morning we rose early. While the natives were getting the horse, I walked along the banks of the Wailua river. This noble stream, deep enough within the bar to float a vessel of considerable size, and it was broader than any stream that I had seen on the other islands. We did not remain here long, but got under way as soon as possible. A few miles from Wailua, near Kapa‘a we passed the wreck of a schooner on the beach, which once belonged to Capt. Bernard. It was driven in a gale over the reef, and up on the beach, where it now lies. A few miles further we arrived at Keālia. We had some difficulty crossing the river at this place, owing to the restiveness of our horses. The country here near the shore was rather uninviting, except the valley which always contained streams of water. [Alexander 1991:123]

In later years, the notorious Kapa‘a reef was to become the location of many shipwrecks, particularly once a landing was built there in the 1880s (Liborio et al. 2016).

Accounts of excursions by missionaries and naturalist-travelers along the east coast of Kaua‘i during the first half of the nineteenth century make no specific reference to Waipouli. These accounts may reflect a general destituteness within the area, the result of shifts in population that had taken place on Kaua‘i in response to the stresses—including disease and commerce—of post-

Contact life. J.W. Coulter, in his study based on the missionary censuses, comments that by the mid-nineteenth century "on the east coast of Kauai nearly all the people lived in Koʻolau Wailua and in the vicinity of Nāwiliwili Bay" (Coulter 1931:15). A map of Kauaʻi in Coulter's study, showing population distribution in 1853, indicates no single area from Olohena to Kapaʻa contained a population much greater than 50. This may reflect an ongoing migration of people from more remote, formerly well-populated areas to the population centers of the mid-nineteenth century.

One of the last vestiges of the pre-cash crop landscape is depicted in the diary entry for the Rice family's arrival on Kauaʻi in 1854. During the second half of the nineteenth century, western settlers and entrepreneurs set their sights on southeast Kauaʻi. Ethel Damon, in *Koamalu*, her history of the Rice family of Kauaʻi, describes the Puna landscape at the time of the family's arrival at Nāwiliwili Bay:

> From the deck of their river craft in 1854 Mrs. Rice and the children could plainly see above the rocky shore and ruins of Kuhiau, the old *heiau*, or temple, and nearby on the bluff the flaming blossoms of a great *wili-wili* [*Erythrina sandwicensis*] tree among *koa* trees which ten grew almost down to the water's edge [Damon 1931:17–18].

These early accounts speak of hills of native forest and taro cultivation. They do not mention intensive inland agriculture as oral tradition suggests, but some are from cursory visits. Land claim records during the Māhele do document such land use. There is indirect reference to the sandalwood trade in the Hanamāʻulu area. Ethel Damon records that early settler Richard Isenberg had been told by Chief Forester C.S. Judd that Mount Kālepa had formerly been covered with sandalwood (Damon 1931:913).

During the 1830s, the Rev. Peter Gulick was stationed on Kauaʻi, first in Waimea Ahupuaʻa and then in Kōloa. Gulick's journal provides the following information about the kind of provisions one could find in Hanamāʻulu in the 1830s:

> [...] The governor [Kaikioewa] reached Hanamāʻulu in his canoe just as we entered on horse back.[...]
>
> This is the governor's custom, when he travels. A man is sent before to give notice that provision may be made, at the different stopping places, for him and his train: which frequently amounts to two hundred. ...I with a few natives had a comfortable house at Hanamāʻulu. The inhabitants brought us fish fresh from the ocean, fowls, taro, potatoes, and a pig, all except the fish roasted or baked in the ground. [...] A youth who went with me for the purpose prepared my food. My bed, which was made with mats, was covered with ten tapas; these were the bed clothes which according to custom were presented to the guest for whom they were spread. [Damon 1931:360]

Another early Kauaʻi resident of missionary descent, Mary Rice, noted the large Hawaiian settlements in the Puna District, including in Halehaka Valley, Niumalu, Nāwiliwili, and Hanamāʻulu. Mrs. Rice also remarked about the *heiau* once located at the base of Kālepa: 'Another large Heiau, one of the most interesting, was located just above the Hanamāʻulu mill, its stones being many of them used in the foundation of the mill. This was said to have been the Heiau for human sacrifices” (Rice 1977:47–48).

4.3.2.2 Kaua‘i Rebellion of 1824

Debora Kapule was a member of Kaua‘i’s royalty. Kapule, the former wife of Kaua‘i sovereign Kaumuali‘i, took up residence in Wailua in 1835, shortly after the rebellion of 1824 in which Kaumuali‘i’s son George Humehume led a revolt put down by forces loyal to Kamehameha II. Debora, who remained loyal to Kamehameha II, was granted lands at Wailua by Ka‘ahumanu, *kuhina nui* or regent of the islands (Stauffer 1994:15). The fishponds mentioned above as belonging to Debora Kapule were located on the property of the former Coco Palms Resort.

After Kaumuali‘i’s death in May 1824, the people of Kaua‘i were in turmoil regarding land tenure distribution since Kaumuali‘i’s reign was subservient to Kamehameha II (Liholiho) (Stauffer 1994:52–54). However, Liholiho pronounced he would not take Kaumuali‘i’s land. Traditionally, upon the death of a sovereign the land titles of the *ali‘i* would be rearranged. However, the *maka‘āinana* lands were reasonably fixed. This rearrangement was referred to as the *kālai‘āina*. On Kaumuali‘i’s death bed, he said he wanted the lands to remain “as is” for the *ali‘i* and *maka‘āinana*—those who had lands would continue to hold them and those who did not have lands would not have any (Stauffer 1994:52–54). Kaumuali‘i chose to not follow the *kālai‘āina*. This was untraditional; however, the last time it had been done was upon Kamehameha I’s death for the other Hawaiian Islands (Stauffer 1994:53).

Kaumuali‘i’s son, George Humehume, led a revolt in 1824 because he felt he should be appointed as Kaua‘i’s governor and successor to his father (Stauffer 1994:55). The difference between George Humehume and Debora Kapule was land: Debora had lands, George Humehume had none. Debora ultimately benefited from not having a *kālai‘āina*; George Humehume would benefit if a *kālai‘āina* was held. George Humehume and his troops attacked the fort in Waimea in August 1824 but began to withdraw after the arrival of Kalanimōkū, a Big Island *ali‘i* who was also Ka‘ahumanu’s major partner in government. When the news of the attack on the fort reached O‘ahu, several boats with troops sailed to Kaua‘i as reinforcement (Stauffer 1994:59). A brutal battle broke out leaving men, women, and children dead from Kōloa to Līhu‘e (Stauffer 1994:61). Kalanimōkū returned to O‘ahu, convening a council of Big Island *ali‘i* who decided the island should be given to the new king, Kamehameha III (Kauikeaouli), since Liholiho perished on his trip to Great Britain (Stauffer 1994:62–63). Because Kauikeaouli was underage, Kahalai‘a (nephew to Kalanimōkū) was appointed as his guardian as a consolation and Kalanimōkū was appointed as governor of Kaua‘i (Stauffer 1994:63).

Over 20 years later, a final *kālai‘āina* was established: the Māhele. Because of the change in powers from the revolt, no land shares existed for claims prior to 1824. All land claims began from 1824 when Kalanimōkū became governor of Kaua‘i (Stauffer 1994:67). Thus Debora’s lands, such as the *ahupua‘a* of Wailua, that were given to her by Ka‘ahumanu stating that she was the *haku‘āina* (landowner, landlord) held no lasting status. Debora’s claim was of no avail. The thousands of acres that were once hers became Crown Lands controlled by the king. Debora was awarded a handful of acres including the fishponds mentioned above which are located on the property of the current Coco Palms. Debora stayed in Wailua until 1835, eventually moving to Waimea to be closer to the mission. Debora Kapule died in 1853.

Debora Kapule left the area in the early 1850s when she chose to move back to Waimea. Upon her death in 1853, her lands in Wailua, as well as those of her son, Kaumuali‘i, were willed to her adopted daughter Kaluaipihana. By 1867, a Mr. LaPaz indicated that nothing remained of Kapule’s complex (Kikuchi et al. 1976:7). This was echoed by Gerald Fowke in the early 1820s: “Near the mouth of the Wailua River […] is the former abode of the royal family. The place is so overgrown, except in the few cultivated spots, that no examination of it can be made. No traces of the residences are apparent although the stone boundary walls of the grounds are still standing” (Fowke 1922 in Kikuchi et al. 1976:11).

Ernst Lindeman leased Kapule’s *kuleana* and planted a 2,000-tree coconut grove in the mid-1890s. The site was planted with nuts from Samoa for the purpose of harvesting copra. Mr. A.D. Hill later purchased the Kapule estate in 1913; it was later known as the famous Coco Palms Resort.

4.3.2.3 Līhu‘e Town

Western homesteading and commerce moved into the lands above Nāwiliwili Bay that would evolve into Līhu‘e Town within a few years after the establishment of the missionary and business activities at Kōloa in the mid-1830s. Two years after he had arrived at the mission station at Kōloa, Dr. Thomas Lafon moved east to open a branch of the Kōloa Church:

> In 1839 [...] Lafon made his home in what became known as the Līhu‘e district. The church he was in charge of there had been built by order of Kaikio‘ewa [governor of Kaua‘i]. There must have been considerable activity in the Līhu‘e area to cause Lafon to move there from Koloa. James Jarves, who passed through the area in 1840, reported that in addition to the church there was a ‘straw palace,’ built for Keaweamahi, the wife of Kaikio‘ewa. [Joesting 1984:153]

At that time, the area was still heavily wooded, as noted by a long-term resident, Mary Rice, who in 1914 described the area as it was around 1850:

> Upon ascending to the top of the hill [from Nāwiliwili Harbor] we come upon beautiful open country with no fences or stone walls to obstruct travel in any direction. Though the roads ran somewhat differently from now they are very much the same with the exception that our present grades are vastly improved. The mauka land consisting of the ridges running to the crater of Kilohana, were nearly all densely wooded with the indigenous koa, sandalwood, hao and ahakea. Some of these groves were of such dense growth that they were almost impossible to ride through. Upon the lower lands were groves of the beautiful Kukui and Hau. [Rice 1914:47]

Kaikio‘ewa, who died in 1839, had apparently intended to create a “city” at Līhu‘e. Kaikio‘ewa’s activities at Līhu‘e drew a small community of westerners, including Dr. Lafon and his family, to the area, which impelled the creation of a horse trail between Kōloa and the Līhu‘e area.

The route of the present Kaumuali‘i Highway runs through the “Gap,” likely following the alignment of the traditional trail system that joined east and west Kaua‘i. The Gap itself was the subject of traditional Kaua‘i legends and premonitory tales, “for the clump of *hau* trees formerly near the bend of the mountains at the Gap was said to have been the hiding place of robbers, and *ʻakuas* lurked in its hidden depths" (Rice 1977:53).

Further evidence that the Gap marked a well-known and well-traveled area of Kauaʻi in pre-Contact times was presented in testimonies by Native Hawaiians during Commission of Boundaries sessions in the 1870s. These testimonies of the *kamaʻaina* recorded in the proceedings of the commission throughout the Hawaiian Islands provided otherwise anonymous Hawaiians an unprecedented opportunity to display not only a comprehensive understanding, passed down through generations, of the contours of the *ahupuaʻa* but, at the same time, allowed them to reveal local traditions, place names, no-longer-existing sites including *heiau* and settlements, areas where traditional activities were practiced, and historic events which they had witnessed or participated in. Testifying on the boundaries of Kōloa Ahupuaʻa in 1874, Hupai stated, "The boundary of Kona and Puna [districts] was at Hoaea [i.e., Kahoaea on the Haʻikū/ Kōloa border above the Gap], that was where the battle flags were hung, that was when the battles were fought" (Boundary Commission, Kauai, Vol. 1, 1874).

Traditional accounts give few clues as to the exact routes of the trail system east of the Haʻikū/ Kōloa Gap, but it seems probable that it roughly corresponded to the present highway alignment.

Accounts of nineteenth century travelers on the trail between Kōloa and Līhuʻe present the first western accounts of the lands surrounding Līhuʻe which includes Niumalu Ahupuaʻa. William DeWitt Alexander, son of the former Waioli missionary William P. Alexander, described a return visit to Kauaʻi in 1849, six years after his family had left the island. Traveling on horseback from Kōloa to Wailua, Alexander noted in his diary:

> We then rode through a gap in the hills, leading out from Kōloa. The scenery was very fine, and worthy of Kauaʻi. Mauna Kāhili was close on the left, & on the right a beautiful range of hills extending towards the northeast, and terminating in an abrupt peak which goes by the name of 'Hoary Head' [Hāʻupu]. We rode on over a beautiful undulating table land, dotted with groves of lauhala and kukui. After riding about five miles, we crossed a stream fitly called Stoney Brook. We afterwards crossed many other streams on our way. Five miles further we passed Dr. Lafon's former residence. Here we began to descend towards the sea. [Alexander 1991:122]

Apparently, Alexander observed no conspicuous Hawaiian settlements between the Gap and Dr. Lafon's residence in the Līhuʻe area. It may be, however, that substantial settlement down in the Hulēʻia Stream Valley was largely obscured from his view.

Ethel Damon, in *Koamalu*, cites the scenic description of Līhuʻe given by Reverend Hiram Bingham in his book, *A Residence of Twenty-One Years in the Sandwich Islands*, published in 1847:

> In 1824, when walking around the island from Waimea to counsel the people after the wreck of The Cleopatra's Barge, Rev. Hiram Bingham crossed from Hanapepe, as has been seen, over the old upland trail back of Kilohana, and wrote of it as "a country of good land, mostly open, unoccupied and covered with grass, sprinkled with trees, and watered with lively streams that descend from the forest-covered

> mountains and wind their way along ravines to the sea, –a much finer country than the western part of the island. [Damon 1931:401]

In the *Narrative of the United States Exploring Expedition* (1845), Lt. Commander G.E.G. Wilkes describes the “Lihui” District:

> At noon they reached Lihui, a settlement lately undertaken by the Rev. Mr. Lafon, for the purpose of inducing the natives to remove from the sea-coast, thus abandoning their poor lands to cultivate the rich plains above. Mr. Lafon has the charge of the mission district lying between those of Koloa and Waioli. This district was a short time ago formed out of the other two
>
> [...] The temperature of Lihui has much the same range as that of Koloa, and the climate is pleasant: the trade-winds sweep over it uninterruptedly, and sufficient rain falls to keep the vegetation green throughout the year.
>
> As yet there is little appearance of increase in industry, or improvement in the dwellings of the natives. There are no more than about seventy pupils in this district, who are taught by natives. There are two houses of worship, and about forty communicants. No decrease is apparent in the population within a few years.
>
> On the fertile places, although the pasture was good, yet no cattle were to be seen.
>
> From Lihui, they pursued their way to Hanawale, which is a small fishing village at the mouth of a little stream. The country on this route was uninteresting, until they reached Wailua [...] [Wilkes 1845:4:67–68]

According to Hammatt and Creed (1993), the name Līhu‘e was not consistently used until the establishment of commercial sugarcane agriculture in the mid-nineteenth century. From the 1830s to the Māhele, the names Nāwiliwili and Līhu‘e were used interchangeably to some extent to refer to a settlement along Nāwiliwili Bay. Some sources attribute the decision to call this area Līhu‘e (literally translated as “cold chill”) to the ruling chief Kaikio‘ewa, who apparently named it after his nearby upcountry home.

4.3.3 Mid- to Late Nineteenth Century

4.3.3.1 Commerce and Trade

In early accounts of life on Kaua‘i by westerners, a lack of industry is noted, referring specifically to production of goods beyond the needs of those producing them. Pigs, sweet potatoes, and salt, among other items, were traded to the earliest sailing vessels arriving in Hawai‘i (post-1794) and it is likely that in Puna District, as elsewhere, the production of these items increased beyond the needs of the immediate family and their expected contributions to their chiefs during this period of early visiting voyagers.

The sandalwood trade or industry was soon replaced by the whaling trade. Between the 1840s and 1860s, trade with whaling vessels anchoring in the Hawaiian Islands became a major source of revenue. Whaling ships would come to Hawai‘i to spend the winter, repair their ships, recruit sailors, leave sick sailors behind, and stock up supplies for the next season. Early historical accounts relate that Kōloa, on the south side of Kaua‘i, was a major port or roadstead for the victualing trade for whalers, fur traders, and merchant ships plying their trades between Asia and the west and back and forth to the Arctic. Although there is no specific evidence that crops raised in the Līhu‘e area were for trade in Kōloa, the roadstead would have provided residents of Līhu‘e with a market for their produce (Burke and Hammatt 2013).

One of the first people to succeed in business in the Keālia area was a German by the name of Ernest Krull. In 1854, a government survey was prepared for Kumukumu, Kaua‘i (Hawai‘i State Survey, Registered Map [RM] 141). In handwritten notes of the map, Mr. Krull indicated his desire to buy government interest to the land for $200.00. Apparently, Mr. Krull was successful in obtaining Kumukumu because by the early 1860s, he was running a thriving business supplying whaling ships with beef and dairy products (Joesting 1984:171). Mr. Krull’s ranch and dairy were located in the Waipahe‘e area of Kumukumu in a place called Kalualihilihi (Kapa‘a School 1983:4). His residence also served as a rest stop for travelers during the 1860s (Lydgate, H.E. 1991:142). Mr. Krull continued to lease a portion of the tablelands above Keālia until 1876 when he sold his ranch to Colonel Z.S. Spalding and Captain James Makee (Hawai‘i State Archives 1879; Kapa‘a School 1983:4).

4.3.3.2 Commercial Agriculture and Ranching

By 1830, the sandalwood trade had waned and the whaling industry was just beginning. At the same time, commercial agriculture was being established on Kaua‘i. When the first crop of sugarcane was harvested at Kōloa, the king himself commanded that portions of his private land be planted in cane. In 1839, Governor Kaikio‘ewa began farming the slopes of Nāwiliwili Bay where there was more rain than at Kōloa (Dorrance and Morgan 2000). He also built a house and church in Nāwiliwili Ahupua‘a.

Donohugh (2001:94) describes Kaikio‘ewa’s attempt to establish the first commercial sugar mill and plantation in Līhu‘e in 1839:

> During the early decades of Kōloa Plantation, other sugar plantations had started up on the island. One was to result in the ascendancy of Līhu‘e to the principal town and seat of government on Kaua‘i, replacing Wailua. When Kaikio‘ewa was appointed governor, he located his home in what is now the Līhu‘e District. He planned to grow sugar cane but died in 1839 before his plans could be realized. Kaikio‘ewa was responsible for the name [Līhu‘e], which means ‘cold chill,’ the name of his previous home at a higher and chillier altitude on O‘ahu. [Donohugh 2001:94]

Following Kaikio‘ewa’s death in 1839, shortly after the establishment of the sugar plantation, the plantation closed down in 1840 (Dorrance and Morgan 2000).

During this time period, there were indications that the Kapa‘a/Waipouli area was being considered for new sugarcane experiments, similar to those occurring in Kōloa. In a historic move, Ladd & Company received a 50-year lease on land in Kōloa from Kamehameha III and Kaua‘i Governor Kaikio‘ewa. The terms of the lease allowed the new sugar company “the right of someone other than a chief to control land” and had profound effects on “traditional notions of land tenure dominated by the chiefly hierarchy” (Donohugh 2001:88). In 1837, a very similar lease with equivalent terms was granted to Wilama Ferani, a merchant and U.S. citizen based in Honolulu (Hawai‘i State Archives 1837). The lease was granted by Kauikeaouli (Kamehameha III) for the lands of Keālia, Kapa‘a, and Waipouli for 20 years for the following purpose:

> For the cultivation of sugar cane and anything else that may grow on said land, with all of the right for some place to graze animals, and the forest land above to the top of the mountains and the people who are living on said lands, it is to them whether they stay or not, and if they stay, it shall be as follows: They may cultivate the land according to the instructions of Wilama Ferani and his heirs and those he may designate under him […] [Hawaiʻi State Archives 1837]

Unlike Ladd & Company, which eventually became the Kōloa Sugar Company, there is no further reference to Wilama Ferani and his lease for lands in Kapaʻa, Keālia, and Waipouli. In a brief search for information on the Honolulu merchant Wilama Ferani, nothing was found. It is thought that perhaps Wilama Ferani may be another name for William French, a well-known Honolulu merchant who is documented as having experimented with grinding sugarcane in Waimea, Kauaʻi at about the same time the 1837 lease for lands in Kapaʻa, Keālia, and Waipouli was signed (Joesting 1984:152).

Around this time, perhaps as late as 1842, the first missionaries settled in the Līhuʻe area led by Dr. and Mrs. Thomas Lafon, and assisted by Rev. and Mrs. Peter Gulick from Kōloa. Schools were established, and some missionaries attempted to grow cotton as the first intensive cash crop, but were unsuccessful (Damon 1931).

William Harrison Rice came to Hawaiʻi as a missionary is 1841. His son William Hyde Rice was born in Honolulu when his father was a teacher at Punahou School. The family moved to Līhuʻe, Kauai in 1854, when the father became manager of the Lihue Sugar Plantation. In 1872, William Hyde Rice purchased 6,000 acres in the *ahupuaʻa* of Kīpū (including Kīpū Kai) from Princess Ruth Keʻelikōlani, who had inherited the land from Victoria Kamāmalu, the awardee during the Māhele. The land was bought with the understanding that the land would stay in the family and would not be developed. He also bought the cattle and horses on the land and formed Lihue Ranch. On some of the land, his son planted cane at Kīpū Plantation in 1907; the cane was hauled to Lihue Mill to be processed (Nellist 1925:57, 940).

The Kīpū Kai lands of Kīpū Ranch were generally used as cattle pasture. An 1895 ostrich farm in the area was unsuccessful (Damon 1931:847). William Hyde Rice sold 2,000 acres of Kīpū Ranch to his son-in-law Jack Waterhouse. The last owner, John T. Waterhouse, who died in 1984, deeded the entire ranch to the State of Hawaiʻi, with the stipulation that the land would be administered by a trust while his nieces and nephews remained alive. He hoped that the state would preserve the land as a wildlife preserve, especially to provide protection for the native Hawaiian goose, the *nene*, that he had reintroduced to the ranch (Clark 1990:76–77). The scenery of this area and the story itself were used as the backdrop to a motion picture with George Clooney called "The Descendants."

Chinese rice farmers had begun to cultivate the lowlands of Kapaʻa with increasing success about this same time. Several Native Hawaiian owners leased or sold outright their parcels *mauka* of the swampland to rice cultivators. Concurrently, the economic activity as a result of the rice and sugar cultivation sparked interest in the *kuleana* house lot on the *makai* side of the marsh for increasing commercial and residential development (Lai 1985:148–161). This land was drained and used for cane in the early twentieth century before more recent urbanization of the area.

Sometime after 1886, but before the turn of the century, the marshy former taro lands in the *makai* portion of Waipouli were planted in rice; these rice fields extended into Kapaʻa, where a rice mill was located.

Like most well-watered areas in Hawaiʻi, rice crops began taking over former *loʻi kalo* in the second half of the 1800s. This sharing of the land by the Chinese rice farmers and native *kalo* growers continued throughout the century. Knudsen (1991) visited Wailua in 1895 and wrote the following:

> We rode through the Lihue Plantation cane fields, passed through Hanamaulu and came to the Wailua River. What a sight! The great river lay clear and placid—winding away up toward the mountains with rice fields and taro patches filling all the low lands. [Knudsen 1991a:152]

By 1935, Handy (1940:67) found no *kalo* being cultivated. The terraces had been taken up by rice, sugarcane, sweet potato, and pasture. Handy explains that

> Waipouli, Olohena (North and South), and Wailua are *ahupuaʻa* with broad coastal plains bordering the sea, any part of which would be suitable for sweet potato plantings; presumably a great many used to be grown in this section. There are a few flourishing plantations in Wailua at the present time. [Handy 1940:153]

4.3.3.3 The Māhele

During the Māhele, Kapaʻa Ahupuaʻa was designated as Crown Lands (Commissioner of Public Lands 1929). The *ʻili* of Paikahawai and Ulakiu in Kapaʻa Ahupuaʻa were retained as Government Lands. The land claims during this period show 11 claims, three by Keo, one of which is a wrong number, one is rejected, and one is awarded. Nine claimants, including Lunalilo, are awarded land. Interestingly, the residential "village" of Kapaʻa did not exist as a single entity, but was a series of probably small settlements or compounds, perhaps even individual house lots that stretched along the shoreline of the *ahupuaʻa* and included (south to north) Kupanihi (Makahaikupanihi), Kalolo (Kaulolo), Puhi, and Ulukiu.

Keālia Ahupuaʻa was granted to the *aliʻi wahine* Miriam Keʻahikuni Kekauʻōnohi (Land Commission Award 11216; Royal Patent 6071). Kekauʻōnohi was a granddaughter of Kamehameha I, as well as being one of Liholiho's wives. She served as Kauaʻi governor from 1842 to 1844. Nineteen land claims were made in Keālia by 17 individuals; one was wrongly numbered and 15 were awarded including Kekauʻōnohi.

Sixty-seven cultivated *loʻi* were claimed in the *kuleana,* with reference to numerous uncultivated *loʻi* and boundaries of other cultivated *loʻi* that were not claimed. In the Māhele documents, there are ten instances in which the individual *loʻi* are referred to with their personal names. Two ditches or *ʻauwai* are recorded, Kaauwaelalo (LCA 01980) and Kahaukua (LCA 10148). Keālia River and Keahapuna (Keahapana) River were also named as boundaries, although they may refer to the same river. This information suggests taro farming continued to be central to Keālia. In addition, four *kōʻele* (land cultivated by a tenant for a local chief) are named in the Keālia Māhele documents. This suggests the *konohiki* of Keālia maintained a fair amount of power and played an active role in land and water distribution even as population was declining and foreign powers were beginning to trickle in.

Another noteworthy resource in Keālia was ponds or *loko wai*. Four ponds were mentioned, though no reference to location is given for two of them. Akiana Pond (LCA 8060) is thought to be located in the *ʻili* of Akiana and Loko Waipunaula (LCA 8833) is thought to be in Waipunaula ʻIli. In addition to the fishponds providing fresh fish, the Keālia records indicate freshwater fish were also caught in the rivers and streams. Although many Hawaiians did not submit or follow through on claims for their lands, the distribution and written testimonies of LCAs can provide insight into patterns of residence and agriculture. There were several disputes over orange trees (LCAs 3413-B, 2381, and 10473). In one case, the *konohiki* affirmed that he himself had taken away two orange trees belonging to a claimant. Oranges were a prize item for trade with ships as they prevented scurvy.

Kamalomaloʻo Ahupuaʻa, along with Hōmaikawaʻa in neighboring Keālia Ahupuaʻa, was claimed by Holoaumoku, who was the *konohiki* of the area. However, the claim was not awarded as Holoaumoku, her son Alapai, and their servants left Hōmaikawaʻa and moved to Anahola and a new *konohiki* was appointed.

At the time of the Māhele, William C. Lunalilo (the future king) was awarded the entire *ahupuaʻa* of Waipouli (Grant 8859B:42) along with Kāhili, Kalihiwai, Pīlaʻa, Manuahi, Kamalomaloʻo, and Kumukumu. LCA records (Waihona ʻAina 2021) reveal an additional 11 individual *kuleana* awards (many of which are divided into two detached plots, or *lele*) within the *makai* portion of Waipouli. Seven of the awards included separate *ʻāpana* for taro *loʻi* and *pāhale*. *Kula* and *loʻi* associated with these awards were located within and adjacent to the extensive swamp in the *makai* region of Waipouli. This swamp, perhaps the site of a former fishpond, appears to be the most pervasive natural feature of the seaward end of Waipouli. Peter H. Buck (1964:1:10) describes how the marsh areas would have been utilized: “Wet taro planting took place along the banks of streams and in swamps where the mud was heaped up into mounds.”

North Olohena was acquired by Kiaimoku (Grant 3662) and South Olohena was acquired by Rufus P. Spalding (Grant 5264). Only one *kuleana* parcel was awarded within the *makai* portion of these *ahupuaʻa*, and it is located in North Olohena.

Historic maps show North Olohena made up mostly of Kiaimoku’s grant, with a small *kuleana* award to Pahuwai, and South Olohena made up of Grant 5264 to Rufus P. Spalding for Lihue Plantation. The one *kuleana* award is inland on Konohiki Stream (LCA 3813). Pahuwai, the single claimant in both Olohena, had two parcels, one in Olohena ʻIli and one in Kuanea ʻIli (not shone on maps), and he lived and worked his *loʻi* there. He was awarded one parcel, but all that he claimed was included in the award. Pahuwai’s award is near the Waipouli boundary at the edge of marshland called “Waialiali,” and Pahuwai was not far from his nearest neighbors, the most inland Waipouli claims.

The *ahupuaʻa* of Wailua was awarded to Victoria Kamāmalu (sister of Kamehameha IV and V) as a Konohiki Award, but she returned the land, which then was designated as Crown Land. Only 51 parcels, totaling approximately 75 acres, were awarded to 27 individual claimants in Wailua as *kuleana* awards. These parcels comprise 122+ *loʻi*, five *moʻo*, 24 house lots, and eight *kula*. All of the parcels are within approximately a mile of the shore. Of the parcels on which *kalo* was cultivated on the north side of the Wailua River, most were watered by *ʻauwai* sourced in ʻŌpaekaʻa (or Wailuaiki) Stream.

All of the *kuleana* awardees originally received their land from Debora Kapule “in the days of Kaikio‘ewa” or “in the days of Ka‘ahumanu” indicating a rather short tenancy since around 1825 or later. It is generally understood that following the suppression of the Kaua‘i Rebellion of 1824 by the forces loyal to Kamehameha II, there was a massive redistribution of Kaua‘i lands. Apparently when Debora Kapule received the Wailua lands from Ka‘ahumanu, she served as *konohiki* for the *ahupua‘a* or in her own words, the *haku‘āina*.

It appears likely that the commoner lands of Wailua were far more extensive than what was documented in the Māhele. On the other hand, the general pattern seems likely to have been much the same with Hawaiian activity focused on the river flood plains.

Paulo Kanoa, Governor of Kaua‘i at the time of the Māhele, claimed both the *ahupua‘a* of Hanamā‘ulu and Kalapakī, but was awarded neither. Victoria Kamāmalu was awarded both *ahupua‘a* under LCA 7713:2, comprising of 2,004 acres of land.

The locations of *kuleana* or commoner land claims of the Māhele (1848–1853) in Hanamā‘ulu are from the shore back into and along the floodplains of the valley land. In Hanamā‘ulu there were 18 claims, of which 15 were awarded. The primary activity claimed within the parcel was the cultivation of taro, the major staple. There were also small *kula* parcels claimed, where presumably sweet potatoes and other produce were grown. House lots were situated both inland and along the coast.

No LCAs were awarded in the upper *mauka* lands of Hanamā‘ulu. The claims for LCAs throughout Hanamā‘ulu reveal that Hawaiian *hale*, *lo‘i*, and *kula* lands were located along both sides of Hanamā‘ulu River, extending from the shore up to the village of Kapaia. The *lo‘i* and *kula* lands were often included together in one *‘āpana*, with house sites belonging to separate *‘āpana* slightly removed from the floodplain. In addition, several *kuleana* parcels contained *kō‘ele*/*pō‘alima* (small land units farmed by a tenant for the chief). Overall, the LCA documentation indicates a wide range of indigenous Hawaiian subsistence activities being practiced in and around Hanamā‘ulu Stream, including *kalo*, *wauke*, *noni*, and *‘ulu* (Waihona ‘Aina 2021).

The locations of *kuleana* land claims from the Māhele (1848–1853) in Kalapakī Ahupua‘a are from the shore back into and along the flood plains of the valley land. There were 13 claims in Kalapakī, of which 12 were awarded. LCA documents record the cultivation of *kalo*, the major staple, along the river flood plains. All the house lots in Kalapakī were at the shore. There were small *kula* listed for the *ahupua‘a* where presumably sweet potatoes and other produce were grown. The only crop other than *kalo* mentioned specifically is *wauke*. Additionally, more than one claim in Kalapakī mentions the fishponds of Koenaawa. Two streams—Koenaawa nui and Koenaawa iki—are identified in the claims but neither is named on current maps.

The Kalapakī claimants described traditional taro *lo‘i* cultivation along the river with houses at the shore in a village. The Kalapakī *lo‘i* claims were on the north side of Nāwiliwili River (the *wauke* land in Claim 3907 on the south side of the river being the sole exception) and along the smaller brooks of Kalapakī and Koenaawa where there were springs. The claims on the south side of the Nāwiliwili River are in the *ahupua‘a* of Nāwiliwili. Most Kalapakī claimants lived, however, at the shore in the “*kulana kauhale*” or village of Kalapakī, located on Nāwiliwili Bay. Several of the claimants described their village house lots in relation to the fishponds of Koenaawa

(Koenaawainui and Koenaawaiki). There is also a description of the *muliwai* or estuary of Koenaawanui.

Cattle, introduced by Vancouver, were at first put under a royal *kapu* and were allowed to roam freely and reproduce. Within a few decades, cattle had begun to wreak havoc on village gardens and taro lands and homes. Residents either abandoned the land destroyed by roaming cattle or else started building walls to keep the cattle out of their homes and gardens. Hulē‘ia, an *ahupua‘a* to the south of Kalapakī was claimed by Victoria Kamāmalu during the Māhele, as a preserve for cattle (Māhele information). Apparently, as the report by Wilkes suggests, the people of Līhu‘e had so far been safe from such depredation (ca. 1840s).

Following the death of Victoria Kamāmalu in 1866, her lands were inherited by Princess Ruth Ke‘elikōlani. In 1870, Ke‘elikōlani sold large portions of her Kalapakī and Līhu‘e lands to William Hyde Rice of Lihue Plantation. William Hyde Rice made subsequent land purchases from Princess Ruth in 1879:

> William Hyde Rice, who already had his own home on the hill east of the mill, bought a large *makai* section of the *ahupua‘a* of Kalapakī from Princess Ruth in 1879 and there conducted the Lihue Ranch. In later years he sold most of this land to the plantation [Damon 1931:747].

Ha‘ikū Ahupua‘a was also awarded to Victoria Kamāmalu as part of LCA 7713, and she retained this land. Victoria Kamāmalu’s holdings at Ha‘ikū were estimated to contain 9,585 acres. Documents associated with this award gave no indication of specific land uses or activities other than for pasturage. The Native Register account relates “Hule‘ia, a district of Kaua‘i, however, the Government cattle shall graze there.” It appears that Victoria Kamāmalu almost immediately leased the Ha‘ikū lands to Judge Widemann, probably in 1850 for the span of 25 years. When Victoria Kamāmalu died in 1866, Princess Ruth Ke‘elikolani inherited her lands.

Kuleana awards for individual parcels within the *ahupua‘a* were subsequently granted in 1850. Thirty-eight claims were made in Ha‘ikū Ahupua‘a, of which 35 were awarded. Mentioned are 264 *lo‘i,* 26 houses, 31 *kula*, three *wauke kula*, one pig enclosure, and two mentions of bulrushes. The average number of *lo‘i* per claimant (seven) is higher than in most other *ahupua‘a* on Kaua‘i, even Hanapēpē (where the average is 6.6 per claimant). One claim (No. 3634) mentions a dam, and three claims mention houses in other *ahupua‘a,* either Kīpū or Kōloa. Thirty-one of these claims are located on the lower portion of Hulē‘ia River.

Victoria Kamāmalu was also awarded over 2,180 acres in Nāwiliwili Ahupua‘a as a part of LCA 7713. In addition to Kamāmalu’s large award at Nāwiliwili, there were many smaller *kuleana* awards. According to Hammatt and Creed (1993):

> Within the valley floor and adjacent to the alluvial plain [in Nāwiliwili] […] are 14 Land Commission Awards for which there are testimonies available in the Land Commission records […] The awards vary in size between one to two acres and are generally around one acre. The majority of land recorded is for *lo‘i* (wetland agriculture) but *kula* (dryland plots) are present as are a few houselots.
>
> In all there are 54 *lo‘i* recorded. Each award is generally two to three *lo‘i* plots. The largest award comprised eight *lo‘i*; a single award consisted of one *lo‘i.* All awards contained *lo‘i* and nine of the fifteen total awards had *kula* lots. Without exception,

> the nine awards containing *kula* mention only one *kula* per award. This is of interest because it shows that the alluvial plain was not entirely dedicated to wetland planting and that a small *kula* lot was essential for subsistence agriculture. [Hammatt and Creed 1993:20]

Some awards at Nāwiliwili mention house lots along the shoreline.

According to Kikuchi (1973), Nāwiliwili was home to at least five other fishponds in addition to ʻAlekoko (Menehune) Loko. The names of two of these were unknown, but the others are Kalalalehua (near a *moʻo* of the same name), Lokoponu, and Papalinahoa (near a *moʻo* of the same name). Land Commission documents identify the *konohiki* for Nāwiliwili at the time of the Māhele as Daniela Oleloa; in testimony and register documents, claimants and their witnesses trace the right to live and work the lands from the *konohiki.*

Māhele records indicate that taro continued to be cultivated in Nāwiliwili Valley through the mid-nineteenth century. However, later in that century, much of the taro lands in Nāwiliwili, as in other wetland regions of the Hawaiian Islands, were converted to rice cultivation. This shift was dictated by changes in the ethnic make-up of the islands' population and economic demands. Little is known of the rice industry in Nāwiliwili.

The *ahupuaʻa* of Niumalu, comprising 1,760 acres, was also awarded to Victoria Kamāmalu as a part of LCA 7713. Following her death in 1866, her father, Mataio Kekūanaoa inherited her lands. Stauder (1973:26) relates that following Victoria Kamāmalu's father's death, Niumalu Ahupuaʻa was inherited by Kamehameha V and then by her stepsister Ruth, who sold Niumalu to Paul P. Kanoa in 1883. Paul P. Kanoa resided in Niumalu, and was Governor of Kauaʻi. He also served as *konohiki* of Kamāmalu's lands (Stauder 1973:31–34).

Catherine Stauder (in Ching et al. 1973) summarized the following information from Land Commission documents. Niumalu had at least 24 Land Commission Awards with at least 80 separate *loʻi*. Dozens of separate *ʻili* are named, and claimants describe *loko* or Kiowai, translated by Stauder as "pond" (cf. LCA 3634 at Haʻikū). Pukui and Elbert (1986:153) define *kiʻo wai* as a "water hole." Niumalu had seven other ponds in the vicinity of the well-known ʻAlekoko (Menehune) Loko. Survey notes (Ching et al. 1973:105) for Niumalu Ahupuaʻa state "[t]he fishing priviledge [*sic*] of Huleia River belongs to the Ahupuaʻa of Niumalu from its mouth to the Road crossing it to Kīpū Kai." The data also shows that *loʻi* and *kula* lands are described as being in the same *ʻāpana,* a pattern that appears common to Puna Moku, Kauaʻi, but is not common elsewhere in Hawaiʻi. Perhaps *makaʻāinana* were creating *kula* lands by piling up soil adjacent to wet lands. Throughout most of the Hawaiian Islands, *kula* lands refer specifically to dry sloping lands between the mountains and the sea. At Puna Moku, in contrast, *makaʻāinana* were referring to lands in valley bottoms as *kula.* Some claimants also describe their lands as being trampled by cattle.

Kīpū Ahupuaʻa was also awarded to Victoria Kamāmalu as part of LCA 7713. In addition to this land, 19 LCA lots were awarded to commoners, one in each of the 19 *ʻili* that make up Kīpū. The testimony of these awards mention *loʻi* and *kalo* land. Tax maps indicate that most, if not all, of these lands were adjacent to the south side of Hulēʻia Stream near the northern boundary of the *ahupuaʻa.*

Also awarded to Victoria Kamāmalu was Kīpū Kai Ahupua‘a as part of LCA 7713. Ten LCA lots were awarded to commoners, one per *‘ili*. Three of the claimants had land in both Kīpū and Kīpū Kai. The land use mentioned most often in these documents was for *kula*, potato patches, and house lots. The one stream in this area was too small for irrigated taro. The *kula* was probably used to cultivate dryland crops, such as potatoes, and for cattle pasture. The Hawaiians that claimed land in both Kīpū and Kīpū Kai probably had taro land in Kīpū, with house lots near the shore, adjacent to small gardens of dryland crops.

4.3.4 Twentieth Century to the Present

4.3.4.1 Sugar Plantations

4.3.4.1.1 Grove Farm

Grove Farm, started by Warren Goodale in 1850, was sold the same year to James F.B. Marshall for $3,000, and sold again in 1856 to Mr. Widemann for $8,000. At the end of 1863, Judge Widemann asked George Wilcox to undertake the supervision of the cutting of a water lead or irrigation ditch for the Grove Farm Plantation using Hawaiian labor. The ditch (“1st Ditch”) was completed in July 1863, but failed to bring water to the fields. Wilcox leased Grove Farm Plantation from H.A. Widemann at the end of 1864 and rapidly developed the irrigation infrastructure further.

Western commerce between Kōloa and Līhu‘e took off during the second half of the nineteenth century. A visitor to Kaua‘i in 1865, William T. Brigham, described the route between Līhu‘e and Kōloa:

> From Līhu‘e the road led over the plain with the mountains on the left. A ditch crossed and recrossed the road as it wound along the hills from the fountains to the canefields below. Owls (*pueo*) were very abundant. The Pass over the mountains was very good and not at all steep, and all the way which was some twelve miles, the road was very good, in fact a carriage road. Two hours riding brought me to Dr. Smith’s [in Kōloa] at eight. [Lydgate, H.E. 1991:143]

The “ditch” Brigham described probably included “1st Ditch” excavated in 1864 and “2nd Ditch,” which was completed in 1865. “3rd Ditch,” which traverses the Kokolau Tunnels area, was developed in 1866–1867. The Kokolau Tunnel actually was excavated under portions of the 3rd Ditch. The ditches were excavated by Hawaiian labor at 25 cents per man per day, but Chinese labor was used to excavate short tunnel sections. Almost all of the ditch construction was by shovel with one man capable of digging 5 linear ft in one day. Black powder blasting was used on occasional hard rock outcrops. 3rd Ditch is annotated on a map of Grove Farm as starting at the “Halenanaho” (properly “Halenanahu”) Reservoir, *mauka* of the highway, then heading south, crossing the highway alignment, and then running roughly parallel with the Hule‘ia River toward the core Grove Farm fields.

In 1870, Wilcox bought Grove Farm from Widemann for $12,000, three-quarters of which was borrowed. Four years later he had 200 acres under cultivation. The cane was milled at the Līhu‘e Mill and exported from Nāwiliwili. In 1874, Wilcox renewed a lease for 25 years for a 10,000-acre tract of Ha‘ikū Ahupua‘a from Princess Ruth Ke‘elikolani (Krauss and Alexander 1984:179). On 1 April 1881, George Wilcox bought 10,500 acres of Ha‘ikū Ahupua‘a from Princess Ruth, increasing the acreage of Grove Farm nearly ten-fold (Krauss and Alexander 1984:206). The sale was part of a package deal in which Willie Rice also received Kīpū and Kīpū Kai for a total price of $27,500—money which Princess Ruth used to build her palace which rivaled Kalākaua's palace which was completed the following year.

In the 1920s, Grove Farm began a building program at Puhi, along the route of the present Kaumuali‘i Highway:

> About 1920 George [Wilcox] began construction of a completely modern camp at Puhi in the heart of the expanding plantation. Instead of building houses haphazardly as new families moved in, a complete village was laid out with streets, a playground, room for gardens, and lawns. The houses had proper kitchens equipped with running water and enough bedrooms for each family depending upon the number of children. [Krauss and Alexander 1984:310]

Puhi Camp consisted of some 600 homes occupied by up to 1,200 workers and their families. Puhi Camp also contained a movie hall, three stores, a Chinese laundry, a slaughterhouse, and an area for social events (Chang 2007).

At the same time that the Belt Road construction program was underway, during the mid-1930s, Grove Farm was further expanding into Puhi. Grove Farm moved its headquarters there, constructing a new office building, shop, and stables:

> The new plantation headquarters was a snug, concrete building with grey-white walls and a Hawaiian style roof of grey cement shingles. Broadbent [the plantation manager] and Alexander [the assistant manager] shared a room almost as big as the entire old office. Time keepers had the main room, the bookkeeper a space for himself. The engineering department worked in another small room and supervisors had desks for filling out reports. Nearby, across the compound, young Bill Moragne was busy erecting an all electric-powered plantation repair shop. By the end of 1935, Grove Farm would be the most modern, best equipped plantation in the Territory of Hawai‘i. [Krauss and Alexander 1965:336]

Most of the Puhi Camp housing was removed in the 1970s prior to the construction of KCC. In the 1980s, the last homes in Puhi Camp were dismantled (Chang 2007).

The Grove Farm website (2010) relates that during World War II, "large acreages […] previously used for sugar [were dedicated] to grow food for the local population and the military."

In 1948 Grove Farm purchased Kōloa Plantation. This doubled the size of Grove Farm (Figure 28), gave Grove Farm its own sugar mill for the first time, and eliminated duplication in manpower, equipment, and administrative costs. In 1948-1949 a cane haul truck tunnel (the Wilcox Tunnel) was excavated under the Hoary Head Range connecting the sugarcane fields of Ha‘ikū to the Kōloa Mill (Krauss and Alexander 1984:366–368).

In the mid-1960s Sam Wilcox of Grove Farm donated 200 acres of former sugar land to the State for Kaua‘i Community College (Kamins and Potter 1998:275). Grove Farm ended its sugar business in 1974, setting aside lands for development and also for the continuation of sugar cultivation by leasing its Līhu‘e lands to Lihue Plantation, and its Kōloa lands to McBryde Sugar (Wilcox 1996:76).

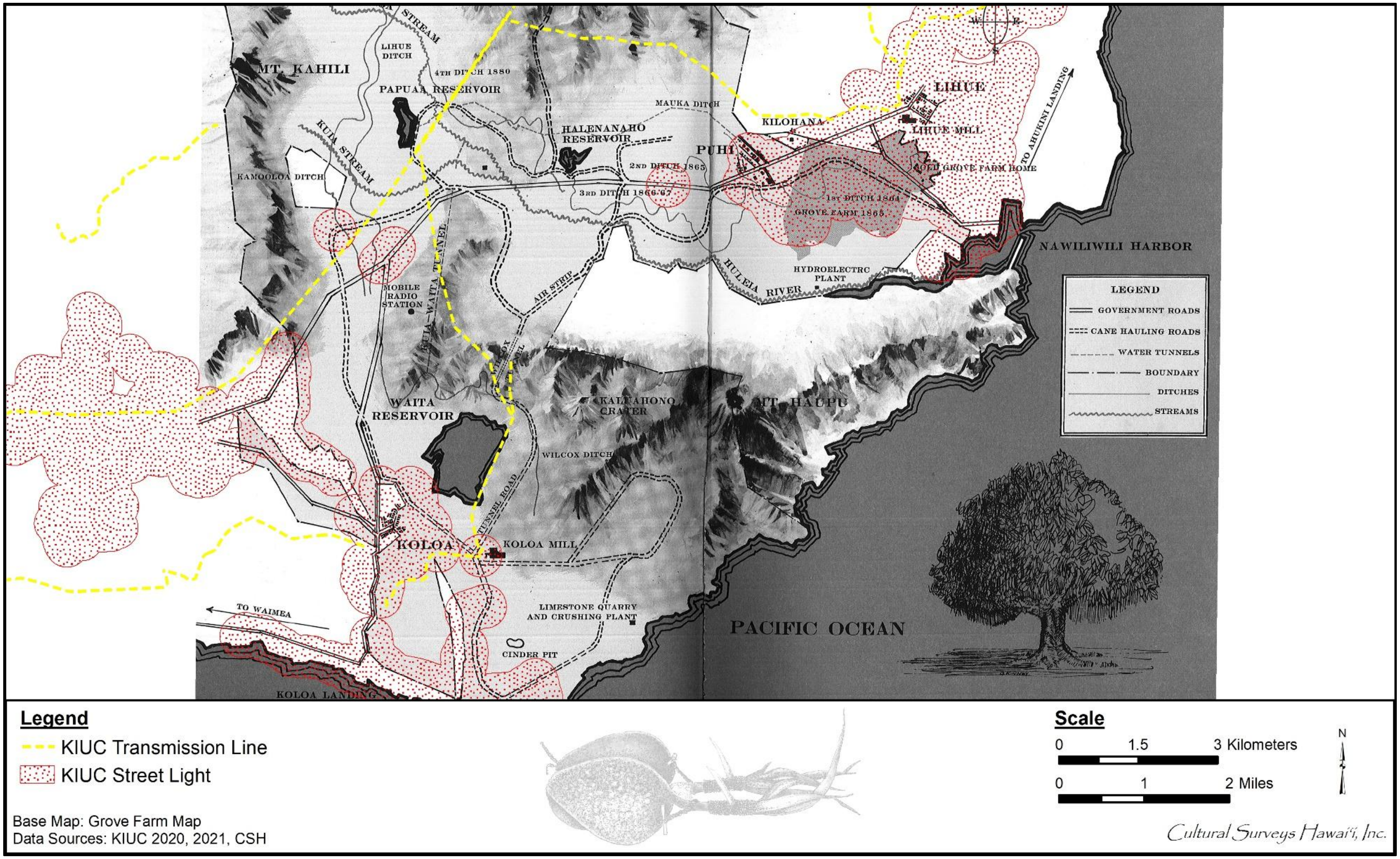


Figure 28. Map of Grove Farm lands in Līhu‘e and Kōloa districts (Krauss and Alexander 1984:book endpiece)

4.3.4.1.2 Līhu‘e Plantation

Līhu‘e Plantation started in 1849 and really began in 1851 as a partnership of Henry Augustus Pierce, Judge William Little Lee, and Charles R. Bishop. The company obtained up to 3,000 acres of land, and by 1851 a water-driven sugar mill was constructed (on the site of the present Līhu‘e Sugar Mill). Hawaiians made up the labor force. They built their homes on the land surrounding the mill. Planting was begun in 1850 and the first crop, amounting to a little over 100 tons of sugarcane, was ground in 1853 (Joesting 1984:173). Under the management of a former ABCFM teacher, William Harrison Rice, from 1854 to 1862, the plantation invested heavily in irrigation ditch infrastructure known initially as “Rice’s Folly” (Krauss and Alexander 1984:67).

As early as 1857, sugarcane was grown in Hanamā‘ulu, although the cane was hauled to Līhu‘e Mill for grinding. Other agricultural ventures included the cultivation and milling of cotton in 1860; however, this venture was not a success. Līhu‘e Plantation began to lease lands for sugarcane cultivation in 1863 (Damon 1931:476, 586). In 1870, Paul Isenberg, manager of the sugarcane company Lihue Plantation, purchased 17,000 acres in the *ahupua‘a* of Hanamā‘ulu (Dorrance and Morgan 2000:29). This land was called the Hanamā‘ulu Plantation, but it was operated in concert with the Lihue Plantation. A mill was built in 1877. In 1898, the two plantations were completely merged (Damon 1931:746).

Later, Mr. August Dreier was engineer in the mill. He had come out about 1869 for Hoffschlaeger and Stapenhorst to install a cotton mill in upper Hanamā‘ulu land. The combination of a cool temperature with rain and red dust proved too much for successful cotton growing, but many wild bushes of it are still found in Kapaia Valley (Damon 1931:586).

The first 3,000 acres were purchased in Nāwiliwili and an additional 300 acres were purchased in Ahukini in 1866. The Lihue Plantation became the most modern plantation at that time in all of Hawai‘i. It featured a steam-powered mill built in 1853, the first use of steam power on a Hawaiian sugar plantation, and the 10 mile-long Hanamā‘ulu Ditch built in 1856 by plantation manager William H. Rice. The ditch was the first large-scale irrigation project utilized by the sugar plantations (Moffatt and Fitzpatrick 1995:103). Dorrance and Morgan (2000:28) provide a slightly different list of achievements for Līhu‘e Plantation: “The first irrigation ditch in Hawai‘i was dug in 1857 [at Līhu‘e], and in 1859 the first steam engine in a Hawai‘i mill was installed at Lihue Plantation.”

Lihue Plantation’s technological innovations include the 1912 installation of two 240-kilowatt generators above the cane fields on the slopes of Kilohana Crater. The plantation became one of the first hydroelectric power producers (along with Kekaha, Kaua‘i) in the Hawaiian Islands with the generator installation (Dorrance and Morgan 2000). In 1919, Lihue Plantation began the development of an extensive irrigation water system that eventually “spanned and connected several watersheds from Hanalei to Koloa” (Wilcox 1996:70).

Lihue Plantation’s irrigation ditches rivaled those of the East Kauai Irrigation Company, which was established in 1924. The two entities oversaw 51 miles of ditches. Wilcox (1996:68) relates that “Lihue Plantation had more ditches than ditch records, so only a rough chronology of its water development can be pieced together.” The first irrigation ditch, originally constructed in 1856 by William Hyde Rice, eventually “metamorphosed into the Lower Lihue Ditch” (Wilcox 1996:70).

The establishment of the Līhu‘e Plantation transformed Hanamā‘ulu Ahupua‘a, as sugarcane cultivation transformed the traditional landscape of Kalapakī in the first decades of the twentieth century. By 1931, Lihue Plantation had 6,712 acres in cane. The expansion of the plantation's fields would accelerate throughout Kalapakī and finally incorporate the entire coastal area. In addition to the cane fields, the present Līhuʻe Town expanded around the mill and plantation laborer camps (Figure 29).

In the early twentieth century, Hanamāʻulu workers at the Lihue Plantation lived in Hanamāʻulu Town and at some dispersed work camps in company housing. From 1961–1963, houses began to be built in residential divisions, with the first bids offered to current employees of the plantation. Hanamāʻulu Town continued to grow in the 1970s and by 1990, Hanamāʻulu had a population of 3,600 people and 901 separate houses. Commercial sugarcane cultivation continued in Līhuʻe until 2000, when the last remaining 400 workers in Hamamāʻulu were laid off at the closing of the Lihue Plantation (Lo 2006).

The first stretch of the Lihue Plantation Company railroad was laid and the first sugar moved by rail on 7 January 1892. By 1921, the Lihue Plantation Company was reputed to have the most modern and extensive railroad system in the islands. In that same year the Lihue Plantation Company sponsored the separately incorporated Ahukini Terminal & Railway Company, which "was inaugurated as a common carrier railroad to operate between Ahukini and Kealia." (Condé and Best 1973:166). In 1934, the Lihue Plantation Company absorbed the AT&R, which then became an operating part of its parent company. The conversion from railroad to truck hauling began in 1957 and was completed by 1959. The 1959 annual report noted:

> With the completion of the harvesting season this year (October 10, 1959) hauling cane over our railroad system comes to an end. We are the last plantation in the Island to give up the railroad and move to truck hauling. This marks the end of an era. [Condé and Best 1973:165–169]

Lihue Plantation continued commercial sugarcane cultivation in Līhuʻe until 2000, when it finally shut down (Dorrance and Morgan 2000).

4.3.4.1.3 Makee Plantation

The first large-scale agricultural enterprise in the Kapaʻa/Keālia area was begun in 1877 in Kapaʻa by the Makee Sugar Plantation and the Hui Kawaihau (Dole 1916:8). The Hui Kawaihau was originally a choral society begun in Honolulu whose membership consisted of many prominent names, both Hawaiian and *haole* (foreigner). It was Kalākaua's thought that the Hui members could join forces with Makee, who had previous sugar plantation experience on Maui, to establish a successful sugar corporation on the east side of Kauaʻi. Captain Makee was given land in Kapaʻa to build a mill and he agreed to grind cane grown by Hui members. Kalākaua declared the land between Wailua and Moloaʻa a fifth district called Kawaihau and for four years the Hui attempted to grow sugarcane at Kapahi, on the plateau lands above Kapaʻa. After a fire destroyed almost one half of the Hui's second crop of cane and the untimely death of Captain James Makee, one of their principal advocates, the Hui began to disperse and property and leasehold rights passed on to Makee's son-in-law and the new Makee Plantation owner, Colonel Z.S. Spalding (Dole 1916:14).

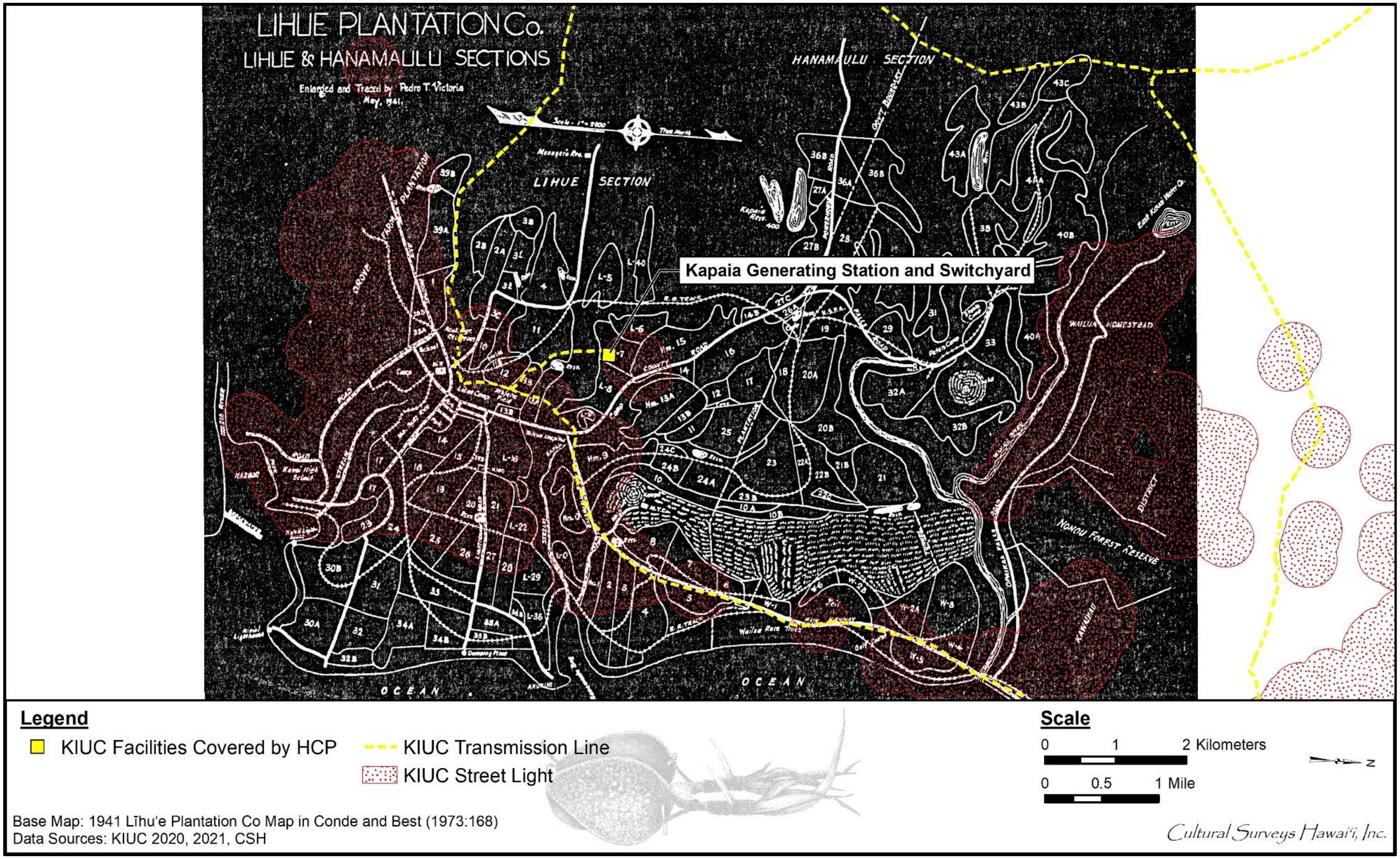


Figure 29. Lihue Plantation map (Lihue Plantation Co. 1941, reprinted in Condé and Best 1973:168)

As part of the infrastructure of the new plantation, a sugar mill was erected and the Makee Landing was built in Kapaʻa (Figure 30). Following Captain Makee's death, Colonel Spalding took control of the plantation and in 1885 moved the mill to Keālia (Cook 1999:51). The deteriorating stone smokestack and landing were still there well into the 1900s (Damon 1931:359; see Figure 30). Condé and Best (1973:180) suggest railroad construction for the Makee Plantation started just prior to the mid-1890s. There is one reference to a railroad line leading from the Kapaʻa landing to Keālia in 1891. During Queen Liliʻuokalani's visit to Kauaʻi in the summer of 1891, the royal party was treated to music by a band, probably shipped in from Oʻahu. "The band came by ship to Kapaʻa and then by train to Keālia" (Joesting 1984:252). This railroad line was part of a 20-mile network of plantation railroad with some portable track and included a portion of Keālia Valley and the *mauka* regions of the plateau lands north of Keālia (Condé and Best 1973:180).

By the late 1800s, Makee Plantation was a thriving business with more than 1,000 workers employed (Cook 1999:51). Hundreds of Portuguese and Japanese immigrants found work on Makee Plantation and the new influx of immigrants required more infrastructure. In 1883, a lease for a school lot was signed between Makee Sugar Company and the Board of Education (Kapaʻa School 1983:9). Stipulations found in the Portuguese immigrant contracts with Makee Sugar Company stated that "children shall be properly instructed in the public schools" (*Garden Island* 1983). The original Kapaʻa School was constructed in 1883 on a rocky point adjacent to the Makee Sugar Company railroad (Figure 31). Traditionally, this point was known as Kaahiahi (Kapaʻa School 1983:10). In 1908, Kapaʻa School was moved to its present site directly *mauka* on Mailihune Hill (Figure 32).

In 1933, the Lihue Plantation Company purchased all of the outstanding Makee Sugar Company stock and in the next year the Kealia Mill was dismantled and combined with the Lihue factory (Saito and Campbell 1987).

By 1934, the Lihue Plantation Company absorbed Makee Sugar Company, the last of the Wailua area plantations (Condé and Best 1973:167; Hawaiian Sugar Planters' Association 1925). The railway and rolling stock formerly owned by Makee Sugar Company became the Makee Division of the Lihue Plantation. At this time, in addition to hauling sugarcane, the railroad also was used to haul plantation freight, including "fertilizer, etc. […] canned pineapple from Hawaiian Canneries to Ahukini and Nawiliwili, pineapple refuse from Hawaiian Canneries to a dump near Anahola, and fuel oil from Ahukini to Hawaiian Canneries Co., Ltd." (Hawaiian Territorial Planning Board 1940:11). Former plantation workers and *kamaʻāina* growing up in Kapaʻa remember when the cannery sent their waste to the pineapple dump, a concrete pier just north of Kumukumu Stream, by railroad. The structure is built over the water where the rail cars would dump the pineapple waste. The current carried the waste to Kapaʻa, where the waste attracted fish and sharks (Bushnell et al. 2002).

4.3.4.2 The Pineapple Industry

The pineapple industry, following successful harvests on the island of Oʻahu, was subsequently expanded to the neighbor islands: "The pineapple plantation concept quickly spread to Kauai and Maui, perhaps because the already well-established sugar industry provided the near-ideal plantation model for those to whom it was not initially obvious" (Bartholomew et al. 2012:1392).

Figure 30. “Kapa‘a Wharf Remains, Kapa‘a, Kauai, Hawaii” (ca. 1934) also known as the Old Makee Landing (top photo). Today there is a breakwater associated with the Moikeha Canal in the general location (bottom photo) (source: Bushnell et al. 2003)

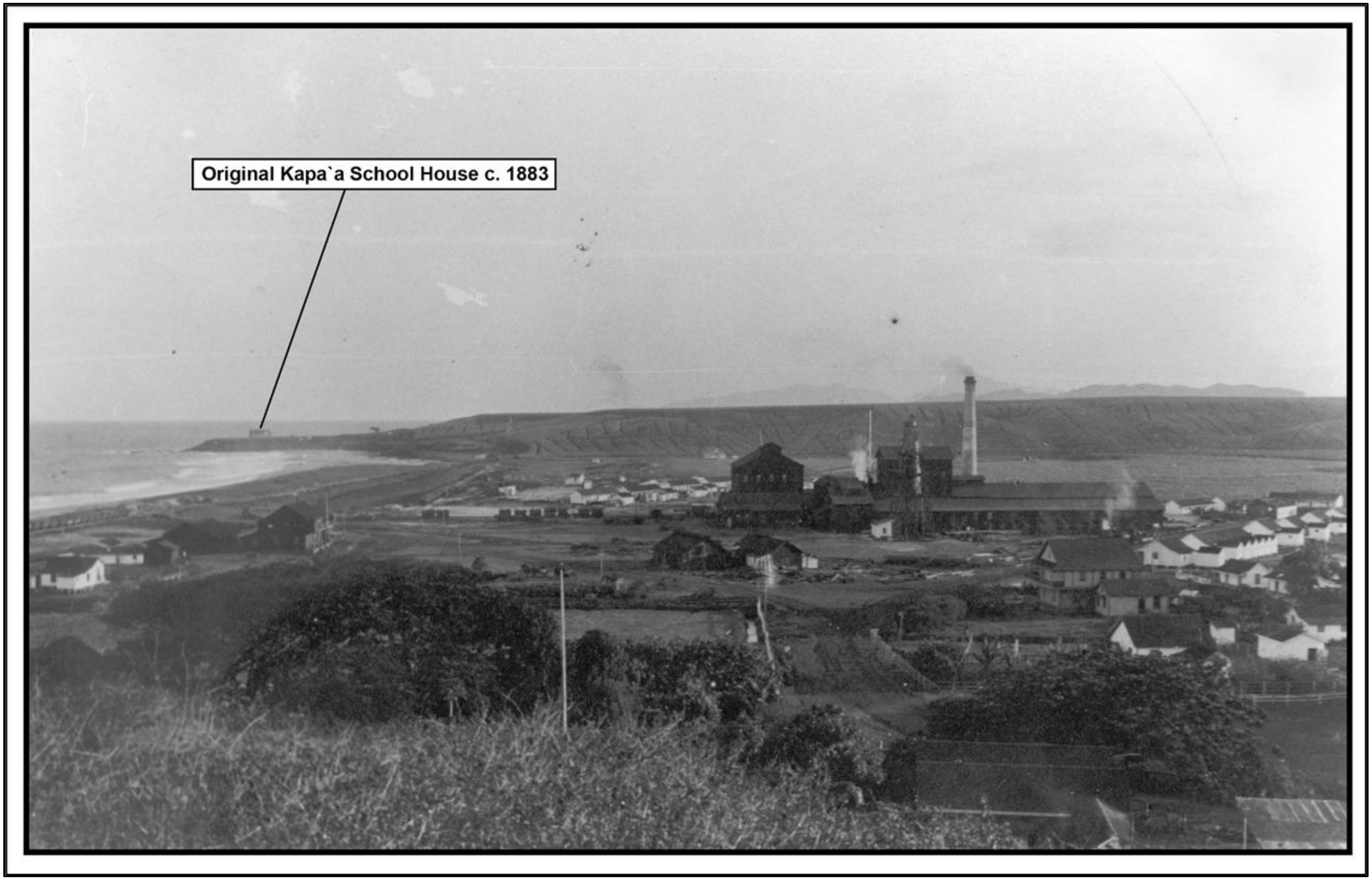


Figure 31. Historic photograph of Keālia Mill and town (courtesy of the Kaua‘i Historical Society)

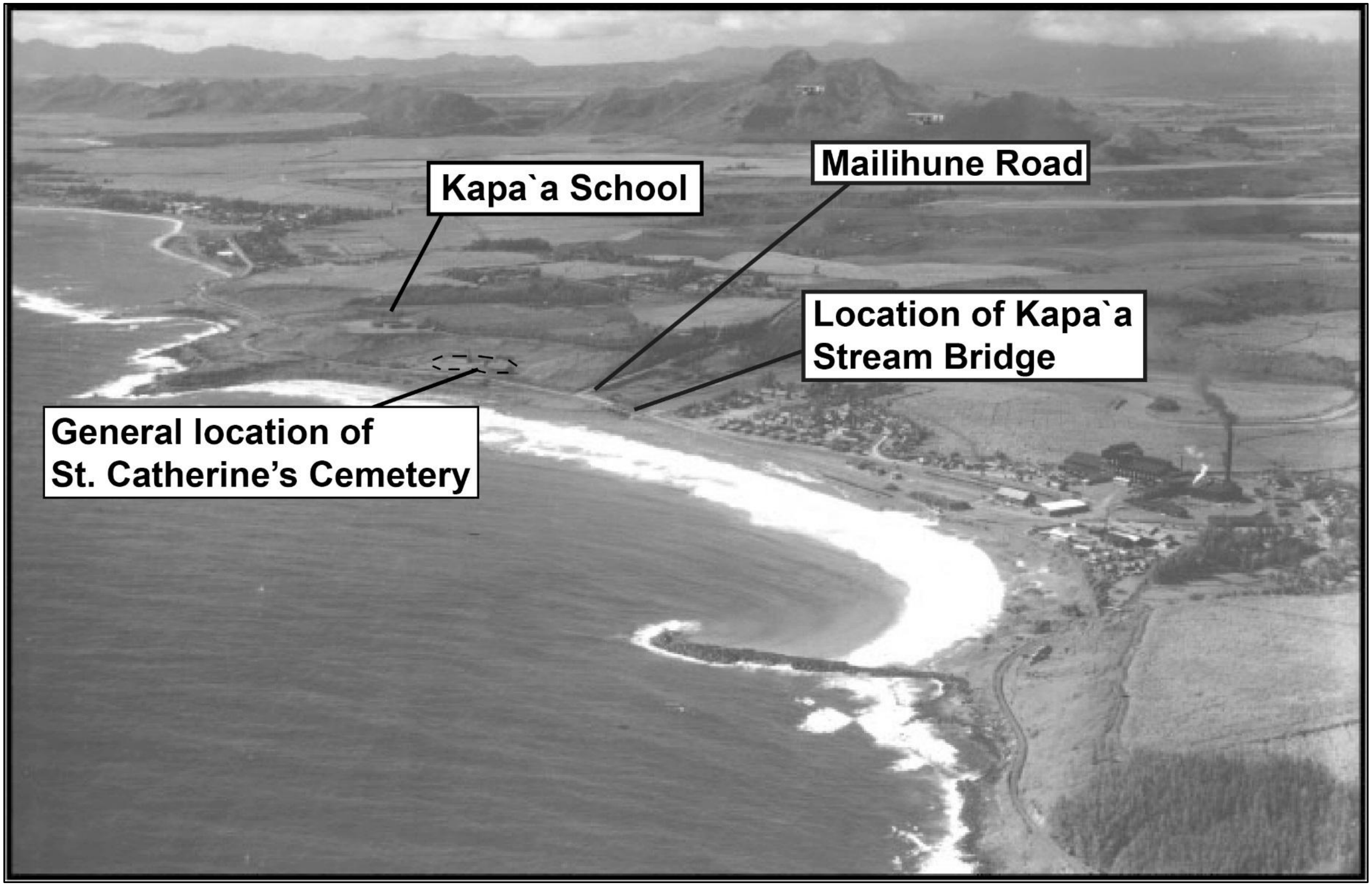


Figure 32. "Aerial View of Kealia, Kauai, Hawaii, Looking Landward" ca. 1933 (source: Bushnell et. al 2003) (note Mailihuna Road is misspelled)

The early twentieth century witnessed the emergence of four companies within Hawai‘i that would hold a monopoly on the pineapple industry well into the 1960s; these four companies were Hawaiian Pineapple Company founded by James Dole; Libby McNeil & Libby, “a major continental U.S. canner based in Chicago that became established in Hawaii in 1910”; the California Fruit Canners Association, which acquired a Hawaiian pineapple canning company in 1911; and Maui Pineapple Company headed by Alexander & Baldwin (Bartholomew et al. 2012:1392; Hawkins 2011).

According to Bartholomew et al. (2012): “The first pineapple company on the island of Kauai was established in 1906. Over the years several additional companies were organized there, some by citizens of Japanese ancestry (1392).”

Additionally, firsthand accounts of “old Kaua‘i” include descriptions of pineapple fields privately owned and operated by residents of Kapa‘a Ahupua‘a. Rita De Silva, in an editorial for *The Garden Island* newspaper, described the landscape of the *mauka* portions of Kapa‘a Ahupua‘a: “Pineapple fields were planted around Kapahi by private owners (some [Hawaiian] Fruit Packers’ employees who sold the fruit back to the cannery, which also owned fields in Kapahi” (De Silva 2016).

Hawaiian Fruit Packers, founded in 1937 through the “reorganization of a company initially started by a group of ethnic Japanese growers,” was the only Kaua‘i cannery (located in Kapa‘a on Kawaihau Road) to continue operations well into the 1960s (Bartholomew et al. 2012:1392; De Silva 2016). Stokeley-Van Camp (representing the merged Van Camp Packing Company and Stokely canned tomato company) bought stock in the company in 1939 and became the exclusive distributor for Hawaiian Fruit Packers’ pineapple production (Auchter 1951; Bartholomew et al. 2012:1392).

In 1913, Hawaiian Canneries Company, Ltd. opened in Kapa‘a at the site now occupied by Pono Kai Resort, just north of Waika‘ea Canal (Cook 1999:56). A resident of Kapa‘a described how the town “came alive” after the cannery opened (Fernandez 2009:48). Following the completion of their plantation contracts, the Japanese plantation workers moved into town and “opened mom and pop grocery stores” (Fernandez 2009):

> Portuguese opened dairy farms in the hinterland or repair shops in Kapa‘a. Former plantation laborers became farmers, raising pineapple and other crops for sale. Service businesses started: the slop-gatherer who came to homes to take the garbage as feed for his pigs, the fish monger selling fish on their street, the cattle rancher who slaughtered cows and provided fresh meat to the market, the traveling wagon man hawking fresh fruits and vegetables. [Fernandez 2009:48]

Kapa‘a became “an integrated multi-racial town, containing an extraordinary mix of people living and working together in harmony” all due to the new cannery (Fernandez 2009:48). In 1923, Hawaiian Canneries Company, Ltd. purchased the approximately 8.75 acres of land they were leasing through the Hawaiian Organic Act (Hawai‘i Bureau of Conveyances, Grant 8248). At that time the cannery only contained four structures but by 1956, 1.5 million cases of pineapple were being packed. By 1960, 3,400 acres were in pineapple and the cannery employed 250 full-time and 1,000 seasonal workers (*Honolulu Advertiser*, 20 March 1960) (Figure 33 and Figure 34). In 1962, Hawaiian Canneries went out of business due to competition from canneries in other countries.

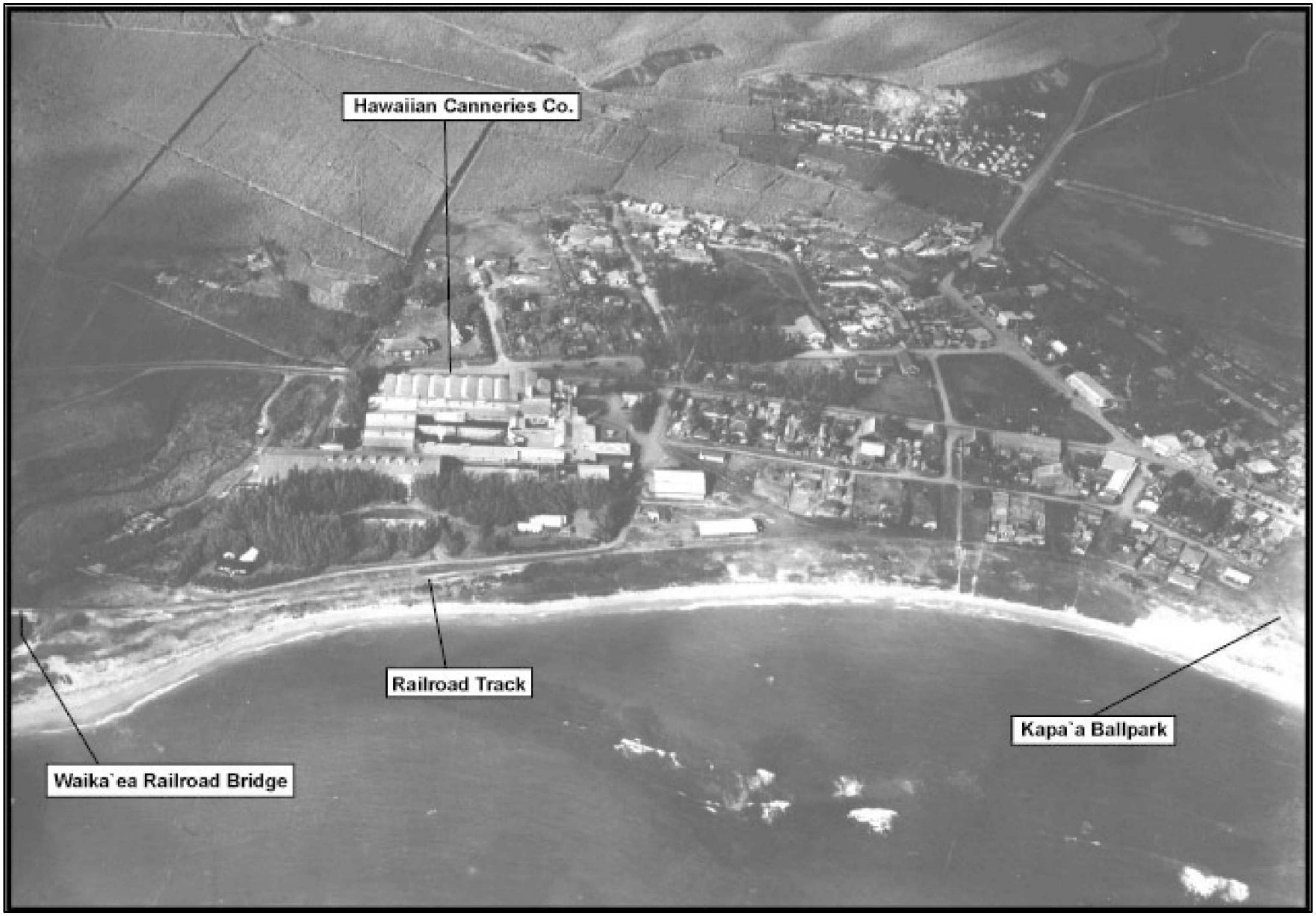


Figure 33. “Aerial View of Kapa‘a, Kauai, Hawaii, Looking Landward” ca. 1933 (figure taken from Bushnell et al. 2003)

Figure 34. Kaua'i women working in the pineapple fields of Kapa'a (date known) (*Garden Island* 1 December 2010)

4.3.4.3 Coconut Groves

Some historic accounts have suggested that coconut groves in Wailua had some traditional cultural importance. Bennett (1931:127) included a “sacred coconut grove” as part of his Site 106 (SIHP # 50-30-08-106; Holoholokū Heiau). Handy and Handy (1972:172) refer to Wailua, Kaua‘i as “the site of the famous sacred grove belonging to the reigning *ali‘i*.” Flores (2000:III-1–III-4) has carefully documented the history of the coconut plantations of Wailua and vicinity. He concludes these Wailua plantations date to a coconut plantation begun ca. 1892 by Ernest Lindemann. However, the cultural significance of the Wailua coconut groves may be a fairly recent phenomenon. Dickey (1917:17) tells a story that when dividing coconuts between the people of Puna (the early district that included Wailua) and the people of Kōloa, the Puna people “used up theirs. Hence until very lately, when the white people planted coconuts, coconuts grew in Kōloa but not in the Puna district of Kaua‘i.” The lack of coconut groves may thus offer insight into the low population numbers in the areas outside Wailua.

In 1911, Edward H.W. Broadbent planted a grove of 1,100 coconut palms at Waipouli, a portion of which extended to the coast as seen in a 1924 aerial photo (Figure 35). This grove was one of three planted between 1896 and 1920 for the production of copra from which oil is extracted. The *Garden Island* newspaper (2010) reported on the methods used by Broadbent:

> The land he planted was considered to be coral deposits and unfit for growing anything. In the interview, Broadbent explained his method. As it was not possible to blast, men created holes using a pick down through a floor of solid limestone several inches in thickness. Once through this water was struck. In these holes a square box was placed. In this was placed a tree and the richest soil that could be found. Around the outside of the tubs was placed the coral and soil from the original hole. The trees there grew as fast as any had seen. [*Garden Island* 2010]

4.3.4.4 Modern Land Use

Narrow wagon roads gave way to macadamized roads in the early part of the twentieth century. This new road was called the Kaua‘i Belt Road and parts of it are thought to have followed the “Old Government Road” (Cook 1999). In Kapa‘a, the present day Kūhiō Highway probably follows the same route as the original Government Road and subsequent Kaua‘i Belt Road. The locations of the *kuleana* awards in Kapa‘a indicate the majority of the house lots were situated along the Government Road. LCA 3243 names a “road” as one of its boundaries.

In Keālia, however, there is evidence that numerous traditional trails led to Anahola with possibly two principal routes, a *makai* route and a *mauka* route. In 1881, Z.S. Spalding, proprietor of the Makee Sugar Plantation, appealed to the Department of the Interior with a formal petition to have the *makai* road (in Keālia) officially closed, stating that members of the local populace were breaking through his fences to take shortcuts between Keālia and Anahola (Hawai‘i State Archives 1881). The exact location of the *makai* road is unknown although it is thought to have been on the plateau lands, somewhat removed from the coastline, in areas fit for sugarcane production. The route of the Old Government Road, also known as the “Mauka road” is described as “crossing the Kealia River above the Rice Plantation and passing over the hill near Mr. Spalding’s residence” (Hawai‘i State Archives 1882). When the Kaua‘i Belt Road was constructed in the first two decades of the twentieth century, a portion of the old Government Road route was

Figure 35. 1924 aerial photo of Edward H.W. Broadbent’s Waipouli coconut plantation, with racetrack visible in foreground; view to north (Kauai Museum Photograph Collection)

abandoned. The new route crossed the river at the *makai* end of Keālia Stream, paralleled the ocean and the railroad track, and then turned *mauka* passing through Keālia town and went up the hill to meet up with the "Old government Road." The Keālia Bridge built for the Kauaʻi Belt Road is thought to date to ca. 1912. A traveler writing about their travels in 1913 mentions the bridge: "In the twinkling of an eye we passed on the steel bridge of Kealia. This new bridge is beautiful" (Akina 1913a) (Figure 36).

The route between Līhuʻe and Kōloa continued to be an unpaved, dirt carriage road as described in 1895, "There had been a shower and the surface of the road was only half dry and as the horses dashed along they threw back clods of earth" (Knudsen 1991:151).

During the 1930s, federal funds became available to assist the Territory of Hawaii's highway construction program. Portions of the Kauaʻi Belt Road (present-day Kaumualiʻi Highway) were completed in the 1930s. The remainder of the Belt Road was constructed in incremental portions. In December 1950, the Kauaʻi Belt Road from Kōloa to Līhuʻe was completed, extending the Belt Road directly into Līhuʻe Town over the Līhuʻe Mill Bridge. The Federal River and Harbor Act of 2 March 1919 authorized the construction of a modern harbor at Nāwiliwili. The port officially opened on 22 July 1930, when the inter-island ship *Hualalai* steamed into the harbor. Cruise ships now use the port facilities at the mouth of Hulēʻia Stream as their terminal point.

Sometime around 1900, a horse racetrack was built along the shoreline that stretches across both North and South Olohena. The end of the track touched the boundary between North Olohena and Waipouli. The race track was used at least through 1927 and probably longer. Dagher and Dega note that during construction the site was flattened and the sand removed to the marshy area inland (Dagher and Dega 2013:27).

Dagher and Dega (2013), who performed excavations in the area in 2010, noted the track was built before 1923, and "[t]he construction of the race track is important […] due to the surface/below surface leveling required to form the track. This is one reason that many of the features discovered during the present work occurred so near the present surface" (Dagher and Dega 2011:7–8).

By the 1920s, Waipouli Beach had become a polo ground where Major George Patton, with his army team, beat a local team. Charles I. Fern, piloting the first plane to Kauaʻi in the 1920s, landed his plane in the same polo field (*Beacon Magazine* 1971:21).

A rule forbidding high-rise development on Kauaʻi was passed in the 1970s. This was due in part to increased inter-island plane travel, which in turn led the way for more development on Kauaʻi, specifically along the coastal areas (*Beacon Magazine* 1971:20). By the end of the twentieth century it was noted that "the backshore of Waipouli Beach is lined with long rows of tall ironwood trees. A shoreline pedestrian trail is used by strollers and joggers. Although most of the Waipouli shoreline is developed or privately owned, six public rights of way provide access to the beach. They are all marked and easy to locate" (Clark 1990:9).

Coastal Waipouli is now home to several resorts, tourist accommodations, Coconut Market Place, a shopping center, and condominiums.

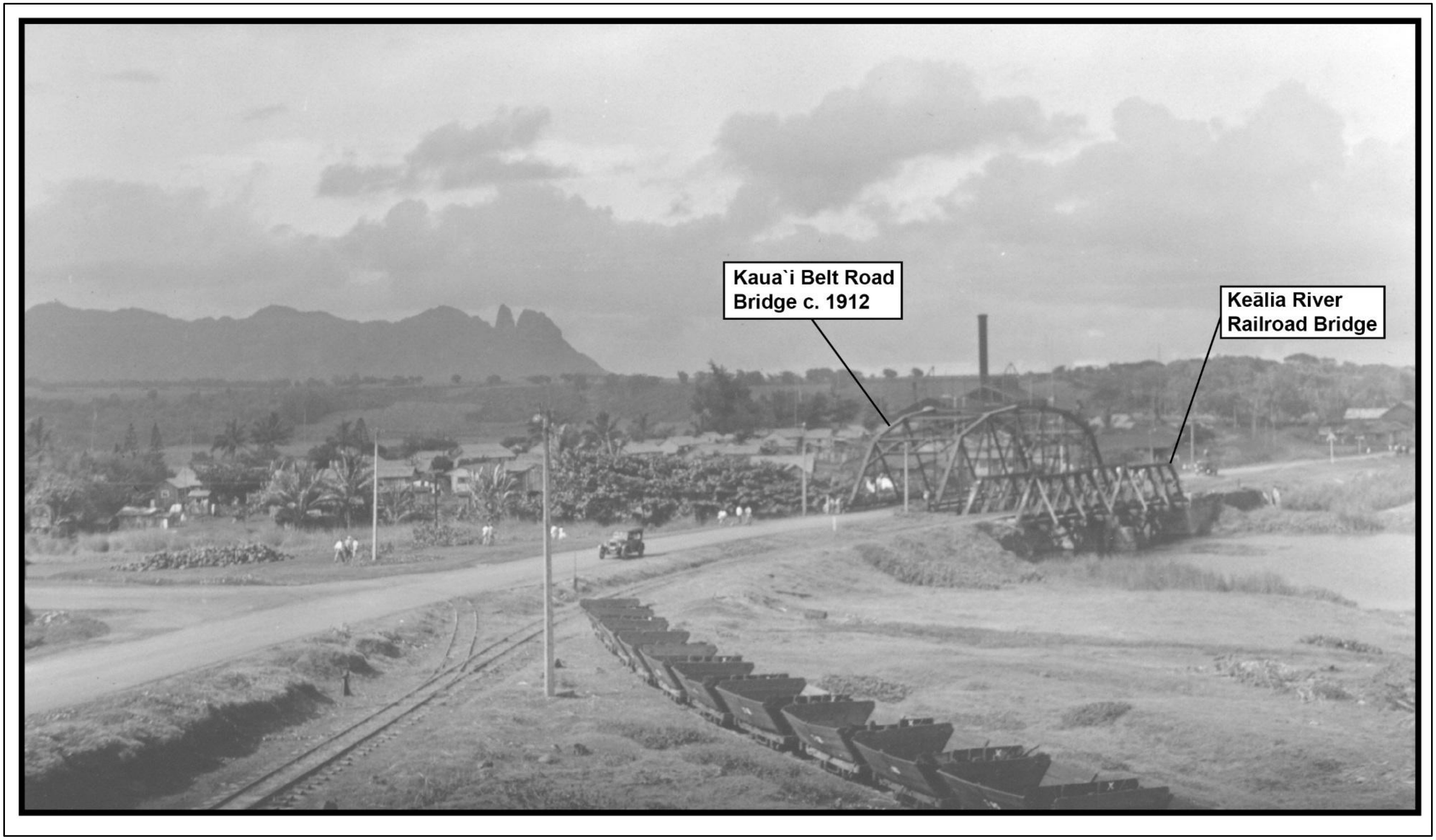


Figure 36. “Kealia in Background, Kealia, Kauai, Hawaii” ca. 1934, photograph by Funk (source: Bushnell et al. 2003)

Dr. Cyril Golding came to Kaua‘i in 1917 and purchased the property now known as Waipouli Beach Resort. Dr. Golding was the Territorial Deputy Veterinarian. Dr. Golding had formerly been a prominent California practitioner, a member of the California State Veterinary Medical Association, and a member of the San Joaquin Valley Veterinary Medical Association. On Kaua‘i, he was especially known for treating anthrax in cattle (*Hawaiian Forester and Agriculturist* 1919; *Journal of American Veterinary Medical Association* 1921:738) and no doubt he did work on the Makee Plantation animals when needed. Some of the artifacts found on the property, like glass slides and bottles, are presumably from the time Dr. Golding lived on the property. This property became the Waipouli Beach Resort.

Details about the Waipouli Beach Resort parcel in the twentieth century were provided by Mr. Ed B. Crabbe, President of Niu Pia Farms, Ltd. Mr. Crabbe’s grandfather bought the shoreward lands of Waipouli, including the Waipouli Beach Resort parcel, sometime in the first quarter of the twentieth century. A coconut grove was planted on the land just south of the Waipouli Beach Resort parcel to produce copra and animal feed. Mr. Crabbe’s father moved his family from Maui to Kaua‘i sometime in the 1940s. They occupied the former Golding house, with Mr. Crabbe living in the former office. In 1924 there was a residence, horse pasturage, and a separate building for Dr. Golding’s veterinarian practice.

Mr. Crabbe recalled there was a “double reef” formation that somehow dissipated the force of such inundations as the 1946 tidal wave that swept over the Hawaiian Islands.

The Waipouli Beach Resort parcel itself remained undeveloped. Mr. Crabbe recalls it was used only for horse pasturage and rodeo practice beginning in the 1940s. The north side of the property, which was formerly the bank of the northernmost watercourse exiting from the marsh lands, was filled when the Waipouli Drainage Canal was constructed. A portion of this canal *mauka* of Kūhiō Highway runs parallel to the shore; a branch exits to the sea and follows the natural drainage of the former Waipouli (or Konohiki) Stream. The canal was built in 1960 for flood control (Folk et al. 1991:16, 18).

Coconut Plantation is another resort in Waipouli along this coastal area. It is on the north side of the Sheridan Hotel. The Coconut Plantation is a 12-acre parcel (TMK: [4] 4-3-007:027).

In 1954, an airstrip was developed at Ha‘ikū for aerial spraying of fertilizer and herbicides. In the early 1960s the nearly 1-mile-long Kuia-Waita Tunnel was completed bringing Ha‘ikū water to the drier Kōloa side.

Port Allen, approximately 20 miles west of Līhu‘e near the town of Hanapēpē, was first established as an emergency landing strip in 1919 and later more land was purchased to establish an airport the Army Air Corps named Burns Field in 1929. Soon after World War II, the territorial government decided to build a new airport, and concluded the Līhu‘e area had the best wind conditions, level ground, and convenience to business centers to build an expanded commercial airport. The new airport was opened in 1949, replacing the smaller Port Allen airport that had been operating since 1929. It continued to see various expansions and improvements throughout the decades since (Hawaii Aviation 2013).

Modern development and land uses in the *moku* of Puna are depicted on 1970s USGS orthophotoquad aerial photographs (Figure 37 and Figure 38).

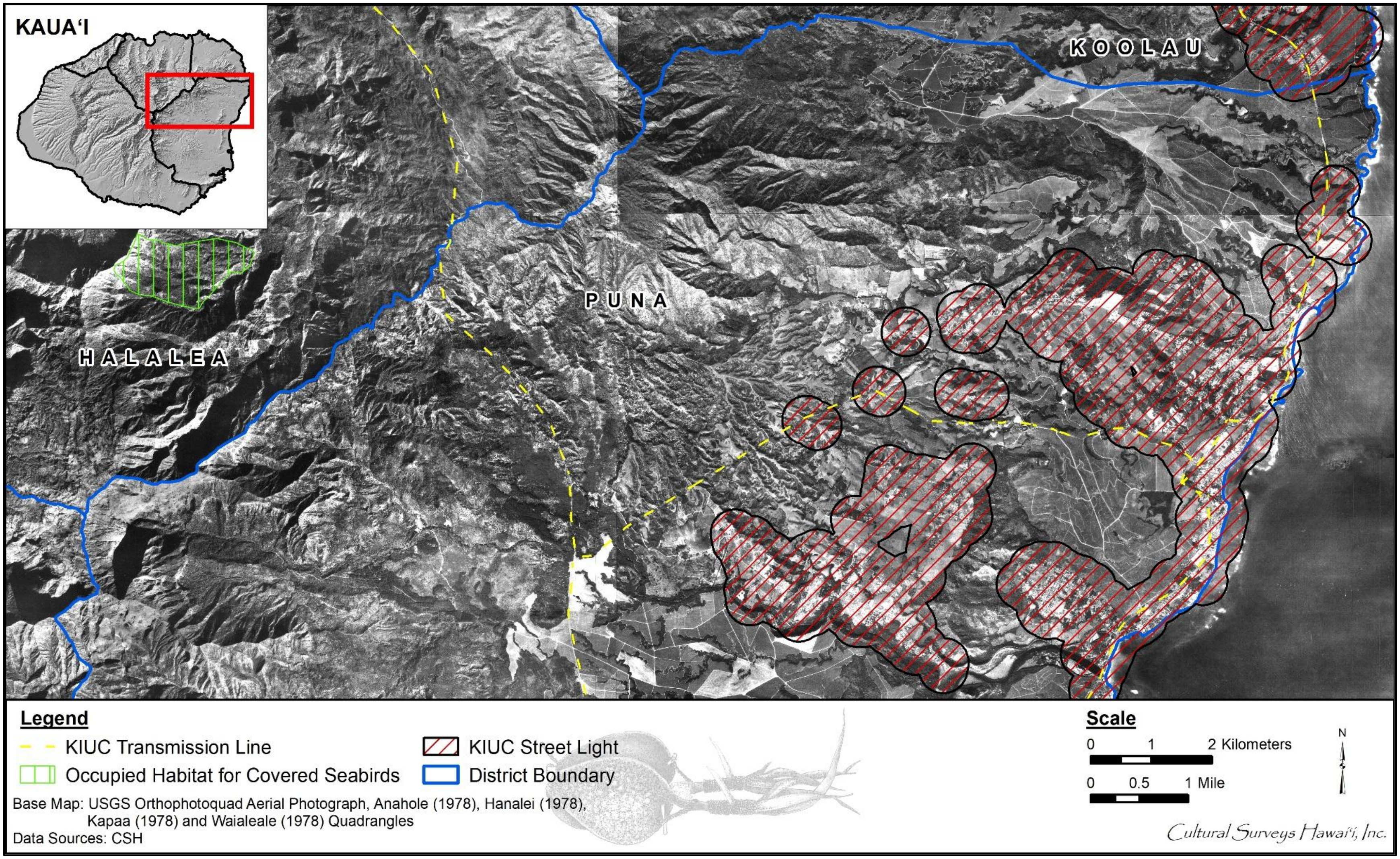


Figure 37. Portions of 1978 Anahola, 1978 Hanalei, 1978 Kapaa, and 1978 Waialeale USGS Orthophotoquad aerial photographs depicting modern development and land use in northern Puna Moku

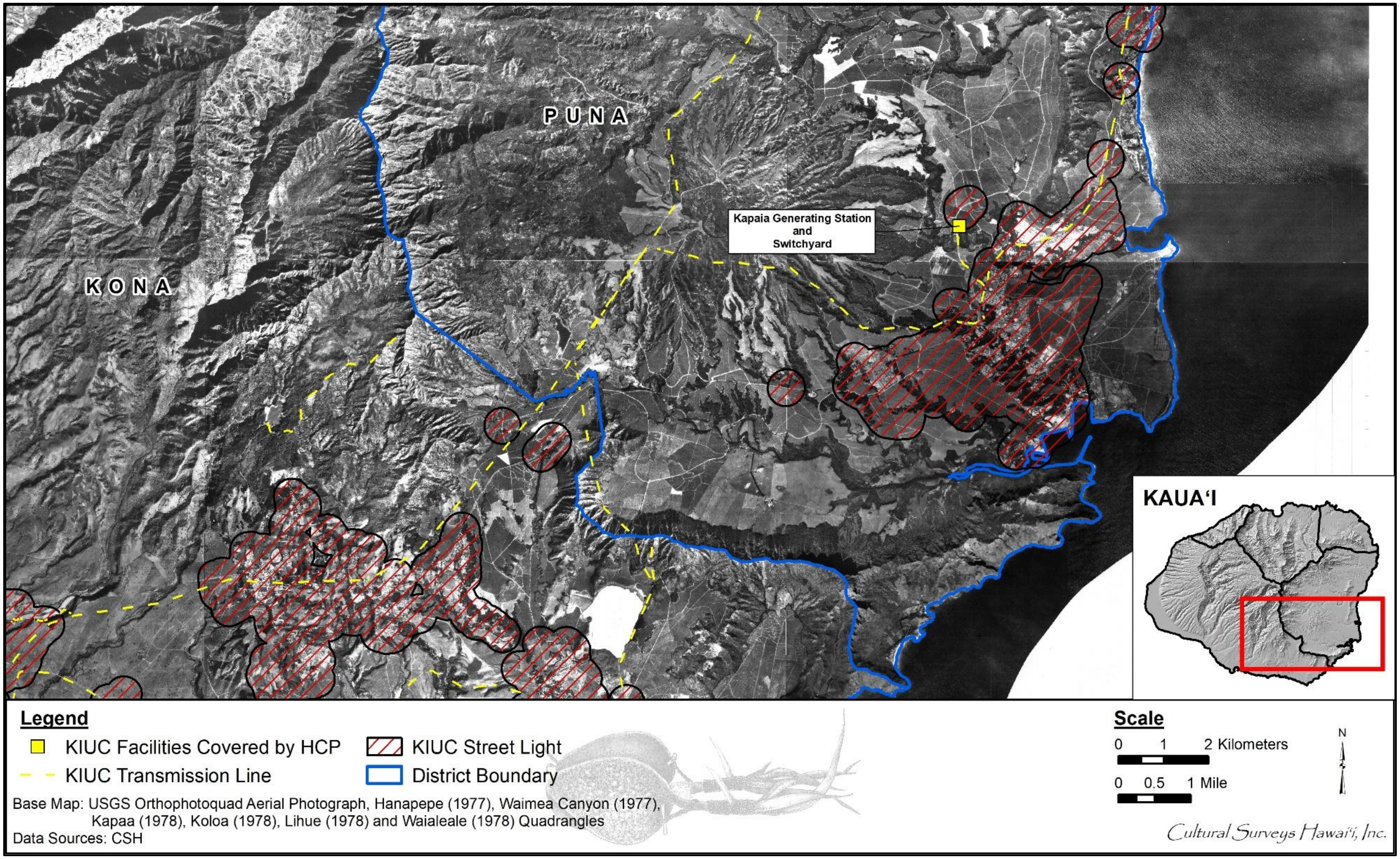


Figure 38. Portions of 1977 Hanapepe, 1977 Waimea Canyon, 1978 Kapaa, 1978 Koloa, and 1978 Lihue USGS Orthophotoquad aerial photographs depicting modern development and land use in southern Puna Moku

4.4 **Moku ʻo Kona**

Chronological analysis from Kōloa, and the two neighboring *ahupuaʻa*, Pāʻā and Weliweli, suggests an early initial occupation within the Kona District of ca. AD 535 (Walker and Rosendahl 1990:131). Initial occupation probably was characterized by temporary and/or recurrent occupation. From AD 600–1400, settlements in the Kōloa area were still limited to the coast. By AD 1040, lava tubes were used for burial and temporary habitation in the inland areas of Kōloa (Hammatt et al. 1999:7).

4.4.1 Pre-Contact to Early Post-Contact

4.4.1.1 Subsistence and Settlement Patterns

Handy and Handy (1972:152) note that in the early post-Contact period (post-1778), the leeward coast from Waimea to Wailua was noted for the inland plantations of breadfruit, bananas grown along the gulches, sweet potatoes and yams grown in the uplands and valleys, and extensive taro terraces throughout the *ahupuaʻa*.

The large size of Waimea Ahupuaʻa is admittedly unusual as single *ahupuaʻa* do not typically occupy such a large percentage of the land area of a major Hawaiian island. It could be argued that the comparatively low agricultural productivity of the Mānā plain, due to the scarcity of water, is the basis for its inclusion in Waimea. However, the same cannot be said for the well-watered valleys of Nuʻalolo and Miloliʻi, both of which could easily support typical and self-contained valley settlements of perhaps small but stable populations.

One could also speculate that Waimea, being one of the two areas of the island that traditionally served as the domain of the high chiefs (the other being Wailua), commanded the resources of the large upland region of Kōkeʻe and Alakaʻi, among them the large *koa* trees out of which the hulls of canoes were hewn, and forest birds that supplied the feathers for cloaks, capes, and other items associated with the *aliʻi*. It is quite possible that at one time, Waimea was divided into several smaller *ahupuaʻa*, perhaps before the Māhele, or even in pre-Contact times.

Waimea is thought to have first been settled by voyagers from Tahiti, led by Kūalu-nui-kini-akua. The first settlers of Waimea utilized a native tree they named *waimea* (also known as *māmaki*. *Waimea pipturus* or *Pipturus albidus*) to make *kapa* until the *wauke* trees they had brought with them were mature enough to be used (Wichman 2003). The *tapa* made from the *waimea* or *māmaki* tree was not as soft as that made from *wauke* and was thus only utilized for *tapa* production when *wauke* was unavailable. The fruit of the *māmaki* tree was also used by early Hawaiians as a laxative while the leaves, today as well as in past, are used to brew a tea that is drank to reduce blood pressure and high cholesterol (Hawaiian Electric Company and Partners 2002).

The Piʻi-aliʻi (*Colocasia esculenta*) variety of taro, brought to Kauaʻi by its name sake Piʻi-aliʻi, Kuʻalu-nui-kini-akua's *kalaimoku* (chief counselor), was used as an offering to the gods and kept for use only by *aliʻi*. Piʻi-aliʻi makes a red colored *poi* that is held in high regard for its flavor and quality. This variety of taro is one of the oldest taro varieties grown in the Hawaiian Islands and is still grown in Kauaʻi today (Wichman 2003; Whitney et al. 1939).

Under the leadership of Ola, Kūalu-nui-kini-akua's grandson, the island was further explored and many of Kauaʻi's current place names were established.

Waimea, Kauaʻi was also a site of great significance for *poʻe kuhikuhi puʻuone* (site experts) and *poʻe kilo hoku holo moana* (navigators) of the pre-Contact time. *Poʻe kilo hoku* (astronomers) of Oʻahu and Kauaʻi, "who were very skilled in discerning the ways of the sun, the moon, and the stars, as well as knowing the configuration of the earth (*papa hulihonua*)" (Kamakau 1976:14), gathered in Waimea, Kauaʻi to make their observations.

Fredrick B. Wichman, in his work *Nā Pua Aliʻi o Kauaʻi* (Ruling Chiefs of Kauaʻi) (2003), gives a rich description of the Waimea area in pre-Contact times. Wichman describes the land ashore of the Waimea River upon the arrival of voyager Kuʻalu-nui-kiniakua:

> There was abundant water from the swift rivers and streams that flowed within a protected canyon complex. The climate was warm and dry, useful for people who wore clothes of beaten bark. The area was cooled by Wai-paoa ('Scooped Water'), a daytime breeze from the sea, and Wai-paʻu ('Water Drenched') from the mountains at night. There was good soil within the canyon valleys behind the cliff that blocked easy access into the interior […] Taro could easily be grown in fields that took water from the river upstream, fed by ditches to each connected loʻi (taro patch) before returning the water to the river. Sweet potatoes and yams grew well […] [Wichman 2003:5–6]

Speaking more broadly of the early people of Kauaʻi, Wichman (2003) describes unique cultural developments on the island saying:

> From the beginning the Kauaʻi people developed unique tools never seen on other islands. These included *pohaku kuʻi poi* (ring and stirrup pounders), double-grooved stone club heads, and a broad anvil for beating kapa. They learned how to weave intricately designed mats of *makaloa* (sedge) so soft it could be used for clothing. They discovered a method for decorating their *ipu* (bottle gourds), which they used as containers for food and water. They strung the tiny seashells found on the beaches into necklaces. Brightly feathered birds abounded from seashore to mountaintop, and their feathers were collected and woven into wreaths, capes, and helmets. Throughout their entire history, the people of Kauaʻi created things of beauty from even the most ordinary objects. [Wichman 2003:6–7]

Traditional permanent habitation and associated dryland agriculture in Māna, with one exception, was undertaken at the base of the cliffs or in the valleys. A village was recorded to be situated on Niu ridge, and a *puʻu kaua* (fortress) was identified on a steep hill in Hauola Valley at the base of a ridge (Thrum 1906:64). Agricultural and habitation structures have been identified in valleys. These features included rock mounds, stone cairn, stone walls, enclosures, terracing platforms, modified cave shelters, and traditional *ʻauwai* (Sinoto 1978).

Prior to the introduction of cattle by Vancouver in 1792, the upper mountain slopes in Mānā had more forest. There are historic references made to *koa* and *kauila* growing in the valleys and on the bluffs (Lydgate, J.M. 1991:94). Handy and Handy (1972:411) mention that above the marshy plains, forests grew on the slopes and trees were being harvested for canoes in pre-Contact times. Even in the twentieth century, *koa* logs were being harvested for canoes. After the introduction of cattle in this region, forest areas and possibly the water supply were damaged by cattle. Although settlers procured large acres of land for ranching and for eradicating wild cattle, the damage was already done to the uplands and erosion prevented reestablishment of forest.

The main section of the marshlands within the plains of Mānā and Nohili expanded and contracted with the seasonal rains and the water was too unstable to be useful. Handy (1940:61) mentioned that the "fresh-water marshes" of Mānā were "presumably planted in wet taro." At the time of his survey, residents of the area recalled that "wet taro has been grown at the northern end of the Mana swamp, near the Barking Sands." Some of areas located in the wetlands were changed for use as inland fishponds containing *ʻanae* (*Mugil cephalus*), *awa*, *ʻoʻio* (*Albula vulpes*), *ʻoʻopu*, *moi* (*Polydactylus sexfilis*), *weke* (*Mullidae* spp.), and others (Yent 1992:4). These inland fishponds were classified as *loko puʻuone* which Kikuchi describes as "ponds that were formed by the stranding or a body of water by a natural sand barrier." There were four named *loko puʻuone* in Mānā: Kawaiʻeli, Kolo, Nohili, and Limaloa (Yent 1992:4; Kikuchi 1987:9). The people that managed those fishponds were *konohiki* with the assistance of a *kiʻa loko* (pondkeeper), for the *aliʻi* (Yent 1992:4).

Religious structures were also found "along the base of the cliff or on the lower elevation cliff ledges near the mouth of valleys" (Yent 1992:6). The majority of the *heiau* are located "along the *mauka* edge of the Mānā Plain with one coastal *heiau* (Elekuna) and several *mauka* structures on the ridges above the plain" (Yent 1992:6).

Information about the *ahupuaʻa* of Makaweli is sparse, though it can be compared to the adjacent land area of Waimea, which is similar in many ways. The lower portions of Kauaʻi's southwest plains, which includes Waimea and Makaweli, are dry and get little rainfall—less than 30 inches annually with an average of 20 inches per year near the coast (Juvik and Juvik. 1998:56). Water for crop irrigation and sustainability of large settlements would have been a challenge.

However, on this drier southwestern side of Kauaʻi, evidence of well-terraced and cultivated areas deep in the canyons of Waimea and Makaweli support the idea of a large inland population rather than a coastal one. Mountain trails that led to the sea allowed for trade with coastal dwellers. A particular taro variety, the *haokea*, was said to be fast-growing and well-adapted to the cold stream water and shallow soil at higher elevations. Another variety, *nā kalo a ʻOla*, was reputed to have grown in high inaccessible places deep in the canyon recesses (Handy and Handy 1972:397). Freshets from mountain streams provided freshwater fish and shell fish such as *ʻoʻopu*, *ʻōpa*, and *hihiwai*. On the hillsides above the flood plains the *mōhihi* varieties of sweet potato were planted. As in other places, *kō*, *maiʻa*, and *pia* (arrow root) would have been grown on the outer edges of cultivated patches. Other plants such as *uhi*, *ʻawa*, *wauke*, and *olonā* probably grew wild in the wet gulches. There would also have been *kukui* as well as *ʻulu* and *kī*. Native woods would have been utilized for floats, weapons, canoes and paddles. Bird catchers would have had access to feathers for *lei* (garland), royal *kahili*, capes, and helmets. All of these items would have provided the necessary food and supplies to sustain a large inland population (Handy and Handy 1972:397–400).

Though Hanapēpē is bordered by the ocean and has a large coastline, Handy and Handy (1972:268) stated that "Hanapēpē was relatively unapproachable from the sea." They speculated that Hanapēpē and other areas of canyons nearby had a *kuaʻāina* or inland population that did not frequent the sea. Handy and Handy (1972) believe these *kuaʻāina* utilized the plentiful freshwater resources of the region to develop an abundance of *loʻi* terraces, portraying a natural landscape that was lush and distinguished by taro cultivation:

> Kauai's areas of canyons (including Makaweli, Olokele, and Hanapepe-Koula, to the eastward of Waimea) possessed in the olden days something not known elsewhere in the Hawaiian Islands except in a very few localities: the anamoly of an inland (literally backland) population which had at best but infrequent contacts with the sea. In Waimea Canyon there was an estimated terrain of about 25 linear miles of varying width along watercourses on which irrigated cultivation was practicable […] It is characteristic of this, as of other less wild and inaccessible inland areas, that every foot of land that could be leveled by terracing above the floodwater stage, and to which a ditch could bring stream water, was utilized for taro lo‘i. It is said today by kama‘aina (native ‘old-timers’) that in these upland lo‘i the green-stemmed ha‘o-kea, a fast-maturing taro variety adapted to cold stream water and shallow soil, was grown. There is also a wild taro that grows in high inaccessible places in this region, and it is called na-kalo-a-‘Ola, ‘the taro of ‘Ola,’ who was an ali‘i anciently ruling all the island, and whose name appears in many of the chants of old Kaua‘i. [Handy and Handy 1972:397]

In Wahiawa, taro terraces extended down the gulches all the way to the sea, and *wauke* plantations were found inland. Wahiawa was known for a special type of taro called Palaha, which had a dark flesh and made purplish taro. On the *kula* land, houses were built and patches of sweet potatoes were grown (Handy 1940:65).

Traditional accounts of Wahiawa indicate the environment in the *ahupua‘a* was suitable for the development of an extensive agricultural system that likely supported a sizable Native Hawaiian population. Adequate rainfall, mild temperatures, and abundant spring and stream water in close association with arable land were ideal conditions for the cultivation of taro and other traditional staple foods. Keahi Luahine, a *kama‘āina* raised in Wahiawa Valley, gives the following account:

> [...] the taro terraces extended all the way down the valley to the *muliwai* (inlet). A short distance above the present highway bridge was a spring named Ka‘ulupaniau, which watered a small group of terraces. Inland from this was Kawaikapulalo [The-sacred-water-below], and here were terraces and *wauke* (paper mulberry) plantations. Above this was *kula* land named Kawaikapuluna [The-sacred-water-above], on which were the houses and sweet-potato plantations. Continuing upstream to a point opposite Pu‘u Aukai there were other terraces in the stream bed, with houses and sweet-potato plantations on *kula* land above. [Handy and Handy 1972:428–429]

Kalāheo had only a small gulch, but it was known for its dryland cultivation of sweet potatoes in the early post-Contact (and probably pre-Contact) periods, especially in the place called Kukui-o-Lono ("Lono's *kukui* trees") (Handy and Handy 1972:428).

In Handy's survey of agricultural remnants in Lāwa‘i, he found a few taro patches on flats near the sea, and also abandoned *lo‘i* on terraces along lower Lāwa‘i Stream (Handy 1940:66), suggesting dryland agriculture along the coast and irrigated taro cultivation along the lower slopes of the Lāwa‘i Stream. He could not find any terraces along the upper reaches of the stream, even though there was flat land that could have been utilized (Handy 1940:65).

In the pre- and early post-Contact periods, Kōloa had a field system that covered much of the coastal plain, fed by its many streams and a complex of terraces and ditches (Handy 1940:65).

Bernice Judd, writing in 1935, summarized most of what was known of the traditional Hawaiian life of Kōloa before the advent of large-scale sugar cultivation:

> In the old days two large ‘auwai or ditches left the southern end of the Maulili pool to supply the taro patches to the east and west. On the kuāunas [embankments] the natives grew bananas and sugar cane for convenience in irrigating. Along the coast they had fish ponds and salt pans, ruins of which are still to be seen. Their dry land farming was done on the kula (dry land), where they raised sweet potatoes, of which both the tubers and the leaves were good to eat. The Hawaiians planted pia (arrowroot) as well as wauke (paper mulberry) in patches in the hills wherever they would grow naturally with but little cultivation. In the uplands they also gathered the leaves of the hala (screwpine) for mats and the nuts of the *kukui* (candlenut) for light. [Judd 1935:53]

On Kaua‘i, the favored places for coconuts were Kōloa and Lāwa‘i (Handy 1940:193). Handy (1940) states:

> Upland kula lands that were famous for their sweet potatoes were Kukuiolono above Lāwa‘i (the present park covering the McBride [*sic*] estate) and the elevated kula lands east of Wahiawa Stream. I was unable to obtain any information as to the uplands of Kalihi and Kilauea, but this and much of the kula land from here to Kealia is the same type of terrain and presumably was once used to some extent for growing sweet potatoes by taro planters in these districts. A kamaaina of Wahiawa says that inland of the cliff named Kawaikapuluna, the people used to have taro patches in the gulch, while their houses and potato patches were on the kula land above, bordering the gulch on either side. I was told this arrangement was typical also of Nawiliwili, and presumably also of Hanamaulu, Hanapēpē, Makaweli, and Waimea in the lower sections of their canyons [Handy 1940:154]

Weliweli was a generally arid *ahupua‘a,* and probably supported taro *lo‘i* only in the upper ends of gulches, according to Handy (1940:66), in the pre-Contact and early post-Contact periods. This is probably why only one LCA to a commoner was granted in this *ahupua‘a.*

Pā‘ā was another arid *ahupua‘a*, and a large portion of the coastal land was taken up by a swamp that was not suitable for agriculture. Handy (1940:66) could find no terraces, but did see taro, breadfruit, yams, and bananas growing wild in the gulches, and indicated they were once planted there in the pre-Contact and post-Contact periods.

Māhā‘ulepū had a broad valley perfect for taro cultivation and irrigation in the pre-Contact and early post-Contact periods. In this area, taro was also planted in semi-brackish spring water, planted on mounds in the *pu‘epu‘e* method, on mounded dirt (Handy 1940:66).

4.4.2 Early Historic Period

4.4.2.1 Historic Accounts

By the time the British vessels *Discovery* and *Resolution*, under the command of Captain James Cook, anchored at Waimea Bay on 20 January 1778, the *ahupua‘a* of Waimea had long been a focus of settlement, agriculture, and *ali‘i* residence on Kaua‘i. The well-watered valley and delta of the Waimea River were ingeniously developed and engineered for wetland agriculture, and represent the epitome of the typical Hawaiian and Kaua‘i-type valley settlement (Handy and Handy 1972:393–397). Cook anchored off Waimea and observed the following:

> The road, or anchoring place, which we occupied, is on the south-west side of the island, about six miles from the west end, before a village which has the name of Wymoa [Waimea]. As far as we sounded, we found the bank has a fine grey sand at the bottom, and is free from rocks; except a little to the eastward of the village, where there spits out a shoal, on which are some rocks and breakers; but they are not far from the shore. [Cook 1821:206]

According to Hawaiian tradition, Cook’s landing site was seaward of the native village on a beach of fine black sand called Luhi or Keoneluhi (Joerger and Streck 1979:8). Luhi means “tedious or tired,” as in the saying, *Ho‘i i ke one o Luhi* (“Go back to Tired Beach”). This saying refers to one returning to an unpleasant task (Pukui et al. 1974:135). A *kama‘āina* of Waimea, quoting her father, relates that the beach was named this because warriors used the area for training, running on the sand to strengthen their legs, which made them very tired and weary (Joerger and Streck 1979:8). The *kama‘āina* reported the ancient landing site of Waimea was midway between the river mouth and the pier; this may also have been the landing area for Cook’s men.

The first contact began badly. A small landing party was sent in a small boat to reconnoiter the anchorage. As it landed, it was surrounded by about 100 Hawaiians; some jumped in the boat and one man grabbed a boat hook. Cook’s Third Lieutenant John Williamson hit the man with a rifle butt, and when the man tried to hit him, Williamson shot and killed the man.

Cook’s observations during an excursion on shore in 1778 reveal the profusion of population, agriculture, and cultural/religious expression that had evolved at Waimea by the latter eighteenth century:

> Our road […] lay through the plantations. The greatest part of the ground was quite flat, with ditches full of water intersecting different parts, and roads that seemed artificially raised to some height. The interspaces were, in general, planted with *taro*, which grows here with great strength, as the fields are sunk below the common level, so as to contain the water necessary to nourish the roots. This water probably comes from the same source, which supplies the large pool from which we filled our casks. On the drier spaces were several spots where the cloth-mulberry was planted in regular rows; also growing vigorously, and kept very clean. The cocoa-trees were not in so thriving a state, and were all low; but the plantain-trees made a better appearance, though they were not large. In general the trees round this village, and which were seen at many of those which we passed before we anchored are the *cordia sebestina* [*kou*; *Cordia subcordata*]; but of a more diminutive size than the product of the southern isles. The greatest part of the village stands near the beach, and consists of above sixty houses there; but, perhaps, about forty more stand scattered about, farther up the country, toward the burying-place [*heiau*]. […]
>
> I found a great crowd assembled at the beach, and a brisk trade for pigs, fowls, and roots going on there, with the greatest good order, though I did not observe any particular person who took the lead amongst the rest of his countrymen. [Cook 1821:189]

While provisioning on this particular excursion, Cook’s party acquired nine tons of water, 60 to 80 pigs, some fowl, potatoes, a small quantity of plantains and taro—all this in exchange for nails and iron pieces. Captain Cook’s first visit to Waimea was brief, but it left a major impact on the small village. Cook’s own lieutenants (Portlock, Dixon, Vancouver) returned to Waimea repeatedly and established it as a major port and entry point. While Waimea may have always been a royal center for the *ali‘i* of Kaua‘i, this position was greatly reinforced after Western Contact (Zulick et al. 2000:14).

The expedition’s artist, John Webber, made a sketch of the village (Figure 39), which shows the natives rolling barrels of water filled at the Waimea River for the ships. Following Cook’s visit, other foreign explorers and traders made Waimea a port of call during the remainder of the eighteenth century. In 1786 and 1787, two fur-trading ships, the *King George* and the *Queen Charlotte*, visited Waimea for revictualing and refurbishing. The ships were under the command of Captains Nathaniel Portlock and George Dixon. William Broughton, who served under Dixon, described Waimea in February 1787:

> There are a number of houses scattered here and there all the way from this village to the beach; and as we walked leisurely along, the inhabitants were continually pressing us to stop a while, and repose ourselves under the trees, which generally grow about their habitations. […]
>
> The valley all the way we walked along to the beach, is entirely planted with taro; and these plantations are laid out with a great deal of judgment. [Dixon 1789:130–131]
>
> The ground is very low, and taro grounds are entirely covered with water, and surrounded with trenches, so that they can either be drained, or fresh watered, from the river at pleasure. They are laid out in a variety of forms, according to the fancy of the different owners, whose various shares are marked with the most scrupulous exactness: these are intersected at convenient distances by raised foot-paths, about two feet wide. I should observe that these plantations range entirely along the river-side, and the houses I have been speaking of are situated to the westward of the extreme path. The trees, which are pretty numerous about the houses, are generally the cloth mulberry. [Dixon 1789:130–131]

In March 1792, Captain George Vancouver walked through the same area, but made it far enough up the valley to give the first western description of the Menehune Ditch:

> I proceeded along the river-side, and found the low country which stretches from the foot of the mountains toward the sea, occupied principally with the taro plant, cultivated much in the same manner as at Woahoo; interspersed with a few sugar canes of luxuriant growth, and some sweet potatoes. The latter are planted on dry ground, the former on the borders and partitions of the taro ground, which here, as well as at Woahoo, would be infinitely more commodious were they a little broader, being at present scarcely of sufficient width to walk upon. This inconvenience may possibly arise from the principle of economy, and the scarcity of naturally good land. The sides of the hills extending from these plantations to the commencement of the forest, a space comprehending at least one half of the island, appeared to produce nothing but a coarse spiry grass from an argillaceous soil, which had the

Figure 39. Sketch of Waimea Village by John Webber (1778), entitled “An Inland View in Atooi”

> appearance of having undergone the action of fire. […] Most of the cultivated lands being considerably above the level of the river, made it very difficult to account for their being so uniformly well watered. As we proceeded, our attention was arrested by an object that greatly excited our admiration, and at once put an end to all conjecture on the means to which natives resorted for the watering of their plantations. A lofty perpendicular cliff now presented itself, which, by rising immediately from the river, would have effectually stopped our further progress in to the country, had it not been for an exceedingly well constructed wall of stones and clay about twenty-four feet high, raised from the bottom by the side of the cliff, which not only served as a pass into the country, but also as an aqueduct, to convey water brought thither by great labour from a considerable distance; the place where the river descends from the mountains affording the planters an abundant stream, for the purpose to which it is so advantageously applied. This wall, which did no less credit to the mind of the projector than to the skill of the builder, terminated the extent of our walk; from which we returned through the plantations, whose highly improved state impressed us with a very favorable opinion of the industry and ingenuity of the inhabitants. [Vancouver 1798:1:170–171]

Archibald Menzies, a surgeon and naturalist aboard the *Discovery*, accompanied Vancouver on the inland expedition and left his own account:

> We landed on a sandy beach near the mouth of the river where we were received by the natives with great order and regularity […]
>
> I walked with Captain Vancouver into the plantation and passed over a place where a number of houses had recently burnt down. This I knew to be formerly the site of Ka‘eo’s residence, for whom these houses had been particularly tabooed, and as, according to the custom of the country, no one could inhabit them after him, it is probable that they were thus destroyed when he departed on his present warlike expedition.
>
> Through this plantation, which is tolerably level, the village of Waimea is irregularly scattered over the bottom of a valley facing the bay by a fine sandy beach, where it is about half a mile wide and gets gradually narrower as it recedes back from the shore. It is sheltered on both sides by steep, rocky banks, in the caverns of which the natives in many places form habitations. The river which here glides on so smoothly as to form a pleasing sheet of water, takes the direction of the eastern side of the valley for nearly two miles back, where it divides into two branches which fall from the mountains by separate valleys formed by steep, rocky precipices that give them a wild and romantic appearance. [Menzies 1920:28]

Ka‘eo, whose residence Menzies mentions, was the king of Kaua‘i. Since the high chiefs of the island made their principal residences in Wailua on east Kaua‘i, it is noteworthy that Ka‘eo had a residence at Waimea on the east side of the river, perhaps an indication of the area’s prestige and importance at the end of the eighteenth century. Menzies reported “several hundreds of young orange plants” brought by Vancouver’s ships to be distributed among the Hawaiian Islands. Apparently, some of these plants had been left at Waimea since, during following decades, oranges would be among the goods traded to whaling ships stopping there.

In 1786, Captain Nathaniel Portlock, after exploring the southwest shore of Kauaʻi, was "well assured that Atoui [Kauaʻi] afforded no place for the ships to ride in equal to Wymoa [Waimea] Bay" (Portlock 1968:173). By the early nineteenth century, Waimea's repute as a safe anchorage drew increasing numbers of vessels, ensuring its growth as a trading post and drawing the island's *aliʻi* to Waimea Ahupuaʻa to participate in the commerce there. The historical record of the *ahupuaʻa* in the first decades of the nineteenth century would be shaped by the exploits of the *aliʻi*, foreign adventurers, entrepreneurs, and missionaries.

Very little information is given about the early historic period of Native Hawaiians within Makaweli Ahupuaʻa. It is most likely that during much of the early historic period, Native Hawaiians in the Waimea Ahupuaʻa, specifically those nearest to Waimea River, had close association with the people on the east side of the river. Cook notes the following:

> [I] took a walk up the Valley, accompanied by Dr. Anderson and Mr. Webber; conducted by one of the Natives […] Our road lay in the plantations, which were chiefly of Tara [taro], and sunk a little below the common level so as to contain the water necessary to nourish the roots. As we ranged down the coast from the East in the Ships, we observed at every Village one or more elevated objects, like Pyramids and we had seen one in this valley that we were desireous of going to see. Our guide understood us, but as this was on the other side of the river, he conducted us to one on the same side we were upon; it proved to be in a Morai which in many respects was like those of Otaheite. [Beaglehole 1967:269–270]

Archibald Menzies visited Waimea in 1792 and describes a grass fire burning over the plains several miles to the east (which would be in the area of Hanapēpē). Captain Vancouver first supposed it to be a signal of hostilities but was told it was the annual burning to rid the plains of the old shriveled grass (*pili* grass) and stumps so the new grass crop would come up clear and free and such practice would provide the best grass for thatching houses (Menzies 1920:32).

The traditional practice of *paʻakai*, for which Hanapēpē remains famous today, benefitted British fur traders. Ethel Damon describes, "At Waimea these hardy voyagers 'wooded and watered', and found plenty of pork and salt to cure it." Salt taken aboard ship at Waimea may well have come from the *ʻili* of Ukula in Hanapēpē, as these salt lands were quite large. Damon describes the use of salt by Hawaiians:

> Owing to the presence of several salt lakes in the Sandwich Island, and to the advantage of the longer dry season, the natives here had formed the habit of drying out salt in its crystal form, and storing it carefully and of using it freely in the preservation of fish, as well as directly with their meals. [Damon 1931:228]

Historical references to Kalāheo are scarce, though they are suggestive of the importance of Kalāheo as both a center for agriculture and for religious activities.

There are few early descriptions of Kalāheo. The Rev. Hiram Bingham gives us one vivid description of the uplands between Hanapēpē and Kilohana in 1824:

> […] a country of good land, mostly open, unoccupied and covered with grass, sprinkled with trees and watered with lively streams that descend from forest covered mountains, and wind their way along ravines to the sea. It is much finer country than the western part of the island. [Bingham 1847:219]

According to Ethel Damon (1931), Nōmilu Fishpond in coastal Kalāheo was still in use in the 1860s when Judge Duncan McBryde, at the time living in nearby Wahiawa, received fish from:

> […] the natives […] always being ready to stretch their gill net for the weekly catch in the celebrated pond at Nōmilu. This is a deep pool, quite uniformly so, about twenty-four feet in a direct drop after the first narrow ledge near the rim, in structure not unlike a volcanic fire pit. [Damon 1931:552]

An early traveler to Hawai‘i, George Bates, spent the year in 1853 visiting various islands and wrote his book, *Sandwich Island Notes*. *By a Haole,* which "purports to give an account of what the author saw and heard" (Kuykendall 1968:1:419). Bates describes that "Hanapepe Valley was dotted with numerous plantations of taro, small cocoa-nut groves and native dwellings" (Coulter 1931:15).

The ABCFM missionary Samuel Whitney described, in an article in the *Missionary Herald* (June 1827:12), a visit to Kōloa with Kaikio‘ewa, the governor of Kaua‘i, in 1826:

> The people of this place were collected in front of the house where the old chief lodged in order to hear his instructions. After a ceremony of shaking hands with men, women, and children they retired [...]
>
> Our company consisted of more than a hundred persons of all ranks. The wife of the chief, with her train of female attendants, went before. The governor, seated on a large white mule with a Spaniard to lead him, and myself by his side, followed next. A large company of *aipupu*, [*‘ā‘īpu‘upu‘u*] cooks, attendants came on in the rear. [*Missionary Herald* June 1827:12]

Whitney's account suggests something of the deference paid to the *ali‘i* by the local populations and the scale at which the *ali‘i* carried out their functions. An even grander view of that deference was provided in an account of a later visit by an *ali‘i* to Kōloa. John Townsend, a naturalist staying in Kōloa in 1834, described a visit by Kamehameha III (Palama and Stauder 1973):

> In the afternoon, the natives from all parts of the island began to flock to the king's temporary residence. The petty chiefs, and head men of the villages, were mounted upon all sorts of horses from the high-headed and high-mettled California steed, to the shaggy and diminutive poney [*sic*] raised on their natives hills; men, women, and children were running on foot, laden with pigs, calabashes of *Poe* [*sic*], and every production of the soil; and though last certainly not least, in the evening there came the troops of the island, with fife and drum, and 'tinkling cymbal' to form a body guard for his majesty, the king. Little houses were put up all around the vicinity, and thatched in an incredibly short space of time, and when Mr. Nuttall, and myself visited the royal mansion, after nightfall, we found the whole neighborhood metamorphosed; a beautiful little village had sprung up as by magic, and the retired studio of the naturalists had been transformed into a royal banquet hall. [Palama and Stauder 1973:18]

In 1835, Thomas Nuttall and John K. Townsend, two American naturalists, visited the Kōloa area. They noted "fields of taro, yam, and maize (possibly sugar cane), irrigation networks and sweet potato patches in the dryer areas" (Townsend 1839:206).

4.4.2.2 Russian Fort at Waimea

On 31 January 1815, the Russian-American Company’s vessel, the *Behring*, was beached at Waimea Bay. Kaumuali‘i, the king of Kaua‘i, maintained that anything brought to land upon Kaua‘i became the king’s property and took possession of the vessel and its cargo of seal skins which were destined for the company’s headquarters at Sitka, the capital of Russian America. In May 1816, Georg Anton Schäffer, supported by an armed crew, sailed for Kaua‘i aboard the company’s 300-ton vessel, the *Otkrytie*, to recover the cargo. However, Kaumuali‘i was willing to return the *Behring*’s cargo and eager to form an alliance with the Russian Empire.

Schäffer established the Russian presence on Kaua‘i. He intended to make the island a launching point for control of the entire Hawaiian chain. In September 1816, Schäffer began construction of a lava-rock walled fort at Waimea Bay which was named after the Empress Elizabeth. He also ordered the construction on two earthenwork forts, named after General Barclay de Tolly and Emperor Alexander, at Hanalei.

Schäffer renamed the chiefs, the rivers, and valleys of Kaua‘i for ones in his homeland. His diary mentions that he has scouted out the entire island and has been given much sandalwood. Pierce claims Schäffer evidently relished the enmities between Kamehameha I and Kaumuali‘i and hoped to profit handsomely if the Russians would come to the aid of Kaumuali‘i. Schäffer states in his diary that he does not care what the islanders do because this “island belongs to the Russian American Company.” Schäffer plans, while cutting sandalwood, to plant new plants and create a permanent supply of sandalwood. He writes about his ideas of agriculture and notes, “Cotton should be Russia’s main objective in the Sandwich Islands” as it “yields in a short time more return for a small expenditure and effort than all the fur trade on the Northwest coasts.” He wants to import people from Hindustan, Africa, or China for their knowledge of how to grow and process it, “so as to teach the Russians, Aleuts, and the natives” (Pierce 1965:191). Schäffer put these ideas into practice as stated a month later; his diary records:

> [November] 30 I set out for Hanapepe, inspected the estate of Platov on the river Don, and found it extremely rich in taro fields. I ordered the dry land planted into cotton, tobacco, maize, and also transplanted here sufficient orange, lemon, and olive trees. I delivered there a number of brood sows and assigned two old Aleuts as watchmen. [Pierce 1965:187]

And later:

> [December] 23. Taboo, The wives of all the chiefs visited me today. The queen’s sister Taininoa, who previously gave the company land, today transferred also the valley of Mainauri, while Queen Monolau, whom I cured of illness, presented me with land in the Georg (Kainakhil’) Valley in the Hanapepe province. I gave her a piece of silk material. [Pierce 1965:192]

The grant from Chief Obana Platov (Opana Kupikea) for “Tuiloa on the River Don” and “Mainauri” and “Georg” are both dated 1 October 1816 (Pierce 1965:80). “Georg” is described as “a large piece of land nine versts long and fifteen wide between the port of Waimea and Hanapēpē, along the seashore where one could gather a great deal of salt” (note: 1 verst =0.66 miles). This description seems to indicate the area included the *‘ili* of Ukula, southwest of Hanapēpē Bay. Pierce believes Mainauri and the salt land may be in Makaweli, *‘ili* of Mahinauli, but these salt lands may have included the *‘ili* of Ukula. The section of salt lands that remains today has been preserved as the Salt Land State Park in Hanapēpē.

In a 1 January 1817 entry, Schäffer talks enthusiastically about the high quality of the cotton he has grown. He notes that taro and maize are two important Sandwich Islands crops that “are unrivaled as foodstuffs, and extremely suitable for transport and for prolonged storage” and he expects a high return of a new crop, little grown in the Islands before his time—tobacco—which is of far better quality than Russian snuff tobacco. Another fortune-making venture he foresees is for salt, which is plentiful in the Islands. Sugar in the islands, he says, “is of a height and quality which I have never seen anywhere else.” Schäffer writes of the promise of the fruit of the land:

> The oil nut (kukui) brings no small return. Grapes grow twice in a year; I have planted enough of one kind which if carefully prepared ought to make wine which should surpass Madeira. I need not mention the fruits of the bread plants, pineapples, coconuts, oranges, lemons, bananas, melons, etc. These items will bring no small price and if correctly handled can upset in one blow the trade of the English and Americans in China, etc.; of this I am convinced. [Pierce 1965:196]

The American traders felt threatened by Schäffer and plotted to put an end to his empire. Edward Joesting’s version of the rivalry in 1822 among Schäffer, the Americans, and King Kamehameha, notes the Americans spread word that America and Russia were at war. Schäffer rushed from where he was staying in Hanapēpē to Waimea to protect his ship. The Hawaiians and Americans made him leave Hawai‘i immediately without allowing him to take any of his possessions (Joesting 1984:84).

By the following year, 1818, the fort had become the residence of Kaumuali‘i. Peter Corney, the chief officer on Kamehameha’s schooner, *Columbia*, reported a voyage to Waimea in March 1818, where he observed the “king [Kaumuali‘i], chiefs, and about 150 warriors live within [the fort], and keep a regular guard; they have a number of white men for the purpose of working the guns” (Corney 1896:89). Corney also described the extent of the sandalwood operations at Waimea, controlled by Kamehameha. On 17 March 1818, the *Columbia*, then anchored at Honolulu, was ordered to Waimea by Kamehameha to collect a cargo of the wood:

> Teymotoo [Ke‘eaumoku], or Cox, with several other chiefs, came on board. We made sail, and on the following day came too in Whymea Roads […]
>
> Our chiefs landed, and were well received by Tamoree [Kaumuali‘i]; and the next morning they commenced sending wood on board. About 500 canoes were employed in bringing it off, and by the 25th of March we had the ship quite full. [Corney 1896:88–89]

4.4.2.3 Missionaries

The ABCFM, headquartered in Boston, sent its first company of missionaries to the Hawaiian Islands in 1819, leaving Boston on 23 October aboard the brig *Thaddeus*. The vessel came in sight of Mauna Kea on 30 March 1820 and anchored at Kawaihae Bay a couple of days later. There they learned of Kamehameha’s death in May 1819 and of the recent overturning of the *kapu* system. In May 1820, two American Protestant missionary couples landed at Waimea with the intention of establishing a station there. Their party consisted of Samuel and Mercy Whitney and Samuel and Nancy Ruggles (Damon 1931:284).

Kaumualiʻi's son, Prince George, who had been sent away to school in New England, accompanied the missionaries. Kaumualiʻi granted Waimea Ahupuaʻa to George, along with the fort and houses. In July 1820, the two missionary couples were established in a house *makai* of the fort. The house's *lanai* (porch) served as the schoolroom and meetinghouse.

By the mid-1820s, the Ruggles had left Kauaʻi and the Whitneys had moved to a new house at Māhaʻihaʻi on the east side of the Waimea River. The Whitneys were visited in 1824 by another missionary, Hiram Bingham, who described the idyllic Waimea landscape he encountered:

> The valley contains about four hundred habitations, including those on the sea-shore. The numerous patches of the nutritious arum, and the huts or cottages of the people, were beautifully interspersed with the bread-fruit, the cocoanut, and the furniture kou, the medicinal Palma Christi, and oleaginous candlenut, the luscious banana, and sugar-cane […]
>
> To a spectator from the missionary's door, or from the fort, or either precipice, is presented a good specimen of Sandwich Islands scenery. On a calm and bright summer's day, the wide ocean and foaming surf, the peaceful river, with verdant banks, the bold cliff, and forest covered mountains, the level and fertile vale, the pleasant shade-trees, the green tufts of elegant fronds on the tall cocoanut trunks, nodding and waving, like graceful plumes, in the refreshing breeze; birds flitting, chirping, and singing among them, goats grazing and bleating, and their kids frisking on the rocky cliff, the natives at their work, carrying burdens, or sailing up and down the river, or along the sea-shore, in their canoes, propelled by their polished paddles that glitter in the sun-beam, or by a small sail well trimmed, or riding more rapidly and proudly on their surf-boards, on the front of foaming surges, as they hasten to the sandy shore, all give life and interest to the scenery. [Bingham 1847:217–218]

Missionary journals and documents recount the events shaping Waimea from the 1820s onward. The people of the *ahupuaʻa* were struck, in May 1826, by an influenza epidemic and a great flood that wreaked havoc upon taro *loʻi* and damaged structures built by the missionaries. In 1828, a new stone house for the Whitney family was built on the western side of the river, and in 1848, the new missionary George Rowell built his own house. The original mission church was built in 1834 of stones and mud. Rowell began construction of a new church on the same site, built of sandstone blocks taken from a quarry in Waimea. Construction of the exterior was completed by 1854. This church was called the Waimea Foreign Church; in 1996, the church was renamed the Waimea United Church of Christ. The church has an associated cemetery. In 1874, Rowell left the Hawaii Board of Missions and started an independent church called the Waimea Hawaiian Church. This structure was located *makai* of Kaumualiʻi Highway near the *makai* end of Menehune Road.

At the end of Ola Road, the Hawaiian governor of Kauaʻi, Kaikioewa, built a house in 1826 on the bluff overlooking Waimea. The cellar was used for the burial of several high *aliʻi*. Aubrey Robinson leased the house and lot in 1915 and then bequeathed the lot to the Waimea Foreign Church in 1937. They used the buildings for their church parsonage.

In the 1850s there were "still only three foreign style houses in Waimea: Kaikioʻewa's, which now belonged to King Kamehameha, and the two missionary houses" (Kauai Bicentennial

Committee 1978: unpaginated). William E. Rowell, the son of Rev. George Rowell, who was born in 1845, recalled the Waimea of his childhood:

> It was all Kula, open country, from our house down to the sea, with no cultivation and no trees, but with an adobe wall fencing in a mission tract. Just west a little way there was a neke [*neki*; bulrush] pond, where there were ducks. […] No, there was no irrigation, and we had to depend on the river for our drinking water […] For all other purposes we used well-water.
>
> My Father had a garden up the valley, where he worked a great deal himself; he was a good gardener. He raised the first mango tree in Waimea. We had loquats, oranges, bananas, vis and peaches from this garden, the latter by the bucket. The name of the garden was Kakalae.
>
> We lived mostly on taro and sweet-potatoes, which we got largely from the natives by way of payment for their book. No, we didn't have rice much, only as a luxury, from abroad. [Kauai Bicentennial Committee 1978]

Rowell also recalled that at least one Hawaiian craft continued to prosper in Waimea: "tapa making was still a thriving industry in my boyhood days. I can remember hearing six tapa-beaters going at once in the valley, they got the wauke up in the mountains. Perhaps they raised it makai" (Lydgate, J.M. 1991:92–93). Rowell also mentions the planting of sugarcane, which was the major agricultural development within the area during the latter 1800s.

Beginning in 1831, censuses taken by Protestant missionaries throughout the Hawaiian Islands provide the earliest documentation of the size of the native population after the first decades of Western Contact. In 1833, Rev. Samuel Whitney estimated a population of 3,883 persons within 6 miles of the Waimea station. More ominously, he also estimated ten deaths were occurring for every birth (Kauai Bicentennial Committee 1978: unpaginated). Subsequent missionary station reports from Waimea recorded the continuing diminishment of the district's population. In 1838 the total population was 3,272; in 1840 it was 2,819; and in 1841 it was 2,779 (Schmitt 1973:14). Whitney himself died in 1845 and was replaced by Rev. George Rowell who moved to Waimea from Waiʻoli with his family in 1846.

The missionary Hiram Bingham described Hanapēpē in 1824:

> [Hanapēpē] lies six or seven miles east of Waimea. It is a pleasant, fertile, well watered valley, about 175 rods in width, along a mile or two from the sea-shore, diminishing in breadth and increasing in depth, as it recedes toward the mountains, till it becomes a very deep and narrow ravine, curving between precipitous and lofty cliffs, and grass-covered hills. A beautiful stream from the mountainous interior leaps down from high basaltic rocks, and forming a high cascade at the head of the valley, flows through it to the sea. Like the Waimea River and others at the islands, it is, at its mouth, obstructed by sand, by which the surf seems incessantly endeavoring to prevent its entrance into the ocean. Where it is thus retarded in its flow, it is from ten to twenty rods in width and three or four feet in depth, where we cross it in a canoe, or on horseback. It escapes by a narrow channel, where it cuts through a sand-bank.

> For the first half mile from the sea, the valley seems sterile, and is little cultivated, but has a pleasant grove of cocoanut trees. The rest of the valley, more fertile and more cultivated, is sprinkled with trees and shrubs, embracing a few orange trees, and being walled up on the east and west by bold, precipitous bluffs, rising higher and higher toward the mountains, from fifty feet to fifteen hundred, appears from one of the palis, like an extensive, well-watered plantation, interspersed with kalo beds and one hundred and forty cottages, and furnishes employment and sustenance to some seven hundred inhabitants. The immense and irregular precipices shut in by each other toward the interior, obstruct the vision of the spectator looking up the valley, but beyond the pleasant opening towards the sea, the eye reaches the distant line where the ocean seems to meet the sky.
>
> Near one of these palis, about a mile from the ocean, Mr. Ruggles chose his station and built a temporary cottage, had a house of worship erected, and opened a school, with the expectation of having a preacher from America stationed there permanently […] Here, for a time, under Kupihea and Kiaimoku, the two chieftains of Hanapepe, Mr. Ruggles, with his wife and two children, resided as the shepherd of the valley, esteemed by many of its seven hundred inhabitants and of the ten thousand of the island. [Bingham 1847:218–219]

On 31 December 1834, Peter Gulick and his family arrived in Kōloa. Apparently the first foreigners to settle in the *ahupua‘a,* they initiated the process of rapid change that would reshape the life of Kōloa in the nineteenth century. In 1835, a 30- by 60-ft grass house was erected as a meeting-house and school near the Maulili Pond. Mr. Gulick cultivated sugarcane and collected a cattle herd for the Protestant Mission. In 1837, a 45- by 90-ft adobe church was built where Kōloa Church stands today, and the first mission doctor, Thomas Lafon, arrived to assist Mr. Gulick (Damon 1931:179, 187). The Kōloa mission station apparently flourished immediately. Navy Lieutenant Charles Wilkes, a member of the U.S. Exploring Expedition, during his visit to Kōloa in 1840 recorded the following:

> The population in 1840, was one thousand three hundred and forty-eight. There is a church with one hundred and twenty-six members, but no schools. The teachers set apart for this service were employed by the chiefs, who frequently make use of them to keep their accounts, gather in their taxes &c. The population is here again increasing partly by immigration, whence it was difficult to ascertain its ratio. [Wilkes 1845:64]

James Jackson Jarves, who visited Kōloa and Kaua‘i for nine months during the early 1840s, recorded the following:

> Kōloa is now a flourishing village. A number of neat cottages, prettily situated amid shrubbery have sprung up, within two years past. The population of the place, also, has been constantly increasing, by emigration from other parts of the island. It numbers, now, about two thousand people, including many foreigners, among whom are stationed a missionary preacher, and physician, with their families. [Jarves 1844:100]

4.4.2.4 Kauaʻi Rebellion

During the early historic period, the Hanapēpē-Wahiawa area was the setting of a battle over control of Kauaʻi. This battle was part of a wider civil conflict known as the "Kauaʻi Rebellion," a last ditch effort by supporters of the Kauaʻi Island chiefs to resist takeover by Hawaiʻi Island chiefs. In 1824, Kaumualiʻi, the ruling chief of Kauaʻi and Niʻihau, became gravely ill. Nearing death, Kaumualiʻi declared "Our 'son'" to be his successor and said: "Let the lands be as they are; those chiefs who have lands to hold them, those who have not to have none" (Kamakau 1961:265). Following his death, Kahalaiʻa, nephew of Kaumualiʻi and chief from Hawaiʻi Island, was announced as the new ruler over Kauaʻi and Niʻihau. However, the people of Kauaʻi, both chiefs and commoners, expected one of Kaumualiʻi's sons, Kealiʻiahonui or Humehume, to be named as successor.

Kahalaiʻa traveled to Kauaʻi and settled at the former Russian Fort at Waimea. Soon after, a hostile sentiment spread among the people of Kauaʻi over being ruled by an *aliʻi* from Hawaiʻi. During this uneasy period, the missionary Hiram Bingham traveled to Wahiawa, leaving the following account:

> I visited the disaffected George [Humehume] at his estate—the little secluded Wahiawa. It was a small valley, running back from the sea to the mountains, containing some twenty small habitations, about a hundred souls, and some hundred acres, very little cultivated, yielding a scanty amount of the common productions of arum, bananas, cocoanuts, potatoes, sugar-cane, squashes, melons, and wild apples. At the foot of this valley, I found George living much in the original native style, in a dingy, dirty, thatched house at the sea-side, just where the surf washes a small beach between two rocky cliffs. [Bingham 1847:229]

The Kauaʻi warriors, led by Humehume, subsequently rebelled and attacked the fort at Waimea, where the Hawaiʻi chiefs had gathered. Armed with guns, the men of Hawaiʻi were able to hold off the rebels until the arrival of reinforcements from Oʻahu. More than ten ships later arrived (Kamakau 1961):

> On August 8 [1824] the battle of Wahiawa was fought close to Hanapepe. The Hawaiʻi men were at Hanapepe, the Kauaʻi forces at Wahiawa, where a fort had been hastily erected and a single cannon (named Humehume) mounted as a feeble attempt to hold back the enemy. In the evening there was an advance made, but the forces of Hawaiʻi retired to Hanapepe for the night. […] Large numbers of Kauai soldiers had gathered on the battleground, but they were unarmed save with wooden spears, digging sticks, and javelins. Many women were there to see the fight. The men acted as if death were but a plaything. It would have been well if the gods had stepped in and stopped the battle. No one was killed on the field, but as they took to flight they were pursued and slain. […] For ten days the soldiers harried the land killing men, women, and children. [Kamakau 1961:268]

The battle of Wahiawa was later known as the "'Pig eating' (*ʻAipuaʻa*) because the dead were left lying for the wild hogs to devour" (Kamakau 1961:233). Following the battle it was also noted:

> A great deal of property was taken, among other things horses and cattle, which had become numerous on Kauai because the foreigners had given many such to

> Kaumualiʻi […] After the battle the chiefs all came together and Kalanimoku redistributed the lands of Kauaʻi […] The last will of Kaumualiʻi, who had the real title to the lands, was not respected […] It was decided that Kahalaiʻa should not remain as ruler, but the islands be turned over to the young king [Kauikeaouli, Kamehameha III], and Kaikioʻewa was appointed governor and Kahalaiʻa recalled […] The lands were again divided. Soldiers who had been given lands but had returned to Oahu had their lands taken away, chiefs who had large lands were deprived of them, and the loafers and hangers-on (palaualelo) of Oahu and Maui obtained the rich lands of Kauai. [Kamakau 1961:268–269]

This defeat of the Kauaʻi chiefs marked the end of armed uprisings on Kauaʻi against the unification efforts of the Big Island and Maui chiefs. Following the rebellion, queen regent Kaʻahumanu, as she did elsewhere, ordered the old gods, idols, and sacred *pōhaku* of Kauaʻi to be destroyed (Wichman 1998:28).

4.4.3 Mid- to Late Nineteenth Century

4.4.3.1 The Māhele and the Kuleana Act

Waimea is a large *ahupuaʻa* containing many *ʻili* that may once have been separate *ahupuaʻa*, such as Kīkīaola, Mānā, Miloliʻi, Mokihana, Pokiʻi, Puʻukapele, and Waiʻawaʻawa. Each of these *ʻili* were awarded to an *aliʻi* as a Konohiki Award, although in each case, the *aliʻi* returned that land as part of their commutation fee, and they became either Crown Lands or Government Lands. All land within Waimea not covered by these aforementioned *ʻili* was awarded to Victoria Kamāmalu, who also returned this award, which then became Crown Lands. It is through records for these LCAs that the first specific documentation of life in Waimea Ahupuaʻa, as it had evolved up to the mid-nineteenth century, come to light. The *kuleana* awardees in the *ahupuaʻa* do not reflect the total population of Waimea. As Russell Apple notes:

> They probably represent the local elite, those who could afford the survey and commutation [that were part of the award procedure], had proper authority for permanent occupancy, had reputable witnesses to sustain both the authority [to occupy] and continuous use [of the parcel], and who chose to apply. [Apple 1978:62]

However, the records associated with these awards illuminate the character of the Hawaiian settlement and livelihood within Waimea by 1850. The upper and lower valleys were extensively cultivated. The Peʻekauaʻi Ditch, along with a system of lateral *ʻauwai*, watered *loʻi kalo* on the western flats of the river all the way to the shore, shown as an area labeled “taro patches” on an 1885 map of Waimea (Figure 40). Interspersed among the *loʻi* were house sites, small plots of *kula* on which were cultivated traditional native dryland crops as well as introduced ones, and also pasture land. House lots were clustered parallel to the shore, along the main coastal road. Along this alignment were also the main community structures such as stores and churches, including the first missionary church, known as the Waimea Foreign Church (see location of “Waimea Church,” see Figure 40).

Over 150 *kuleana* awards were granted in Waimea. Fifteen claims were awarded in Kīkīaola ʻIli, on the west side of Kanaʻana Ridge. Over 50 claims were awarded in the *ʻili* of Peʻekauaʻi, on the east and west sides of Kanaʻana and Pokiʻi Ridge. The land east and west of the Kanaʻana

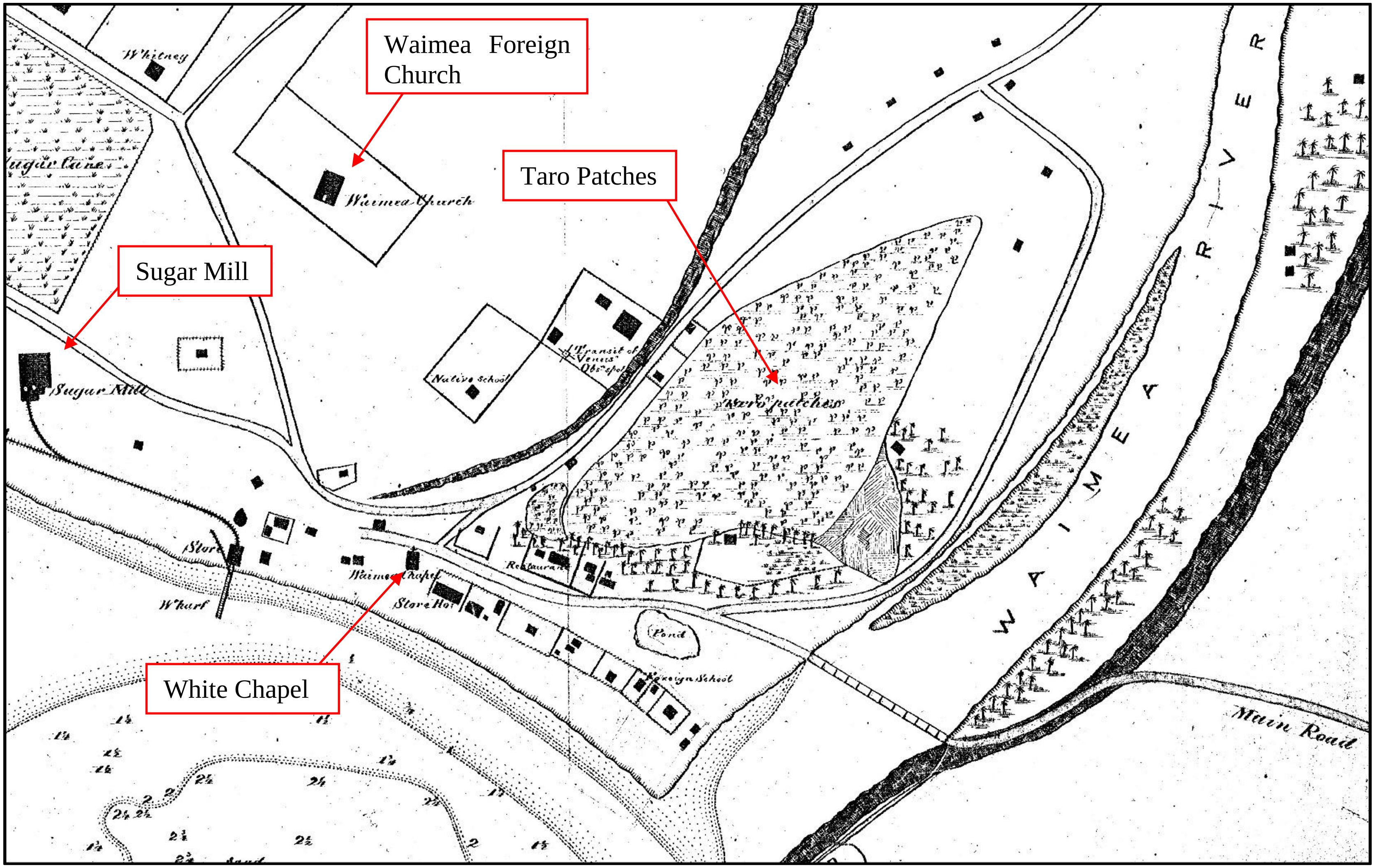


Figure 40. Portion of the 1885 map of Waimea Bay by George Jackson (RM 1358), showing the settlement pattern of Waimea Village and the locations of the taro patches, Waimea Foreign Church, and the White Chapel

Ridge was mainly Crown and Government Land, some of which had already been given or sold to individuals and associations. LCA 3310 to Manu and LCA 3593 to Keikiole were two *kuleana* claims between Menehune Road and Kanaʻana Ridge. For LCA 3310, Manu claimed two *loʻi* with *kula* for each and a fishpond called Pulia. In describing the boundary of his land, he mentioned the *ʻauwai* of Keaʻaliʻi and an unnamed *pali* to the west. For LCA 3593, Keikiole claimed two *loʻi,* a *kula*, and a house lot. In describing the boundary of his lands, he mentions a fishpond called Kealii (Keaʻaliʻi), the *ʻauwai* of Peekanai (Peʻekauaʻi), and the *pali* of Kanaʻana. This testimony indicates there were many smaller *ʻauwai*, separate or connecting to the large Peʻekauaʻi ʻAuwai, and numerous fishponds, possibly large taro patches also used to raise fish, in the land on the east slope of Kanaʻana/Pokiʻi Ridge.

At the time of the Mahele in 1848, Victoria Kamāmalu held seven *ʻāina* on the island of Kauaʻi. Five of these *ʻāina* were relinquished to the *Mōʻī* (King) and she retained two *ʻāina* for herself. The *ahupuaʻa* of Makaweli was kept for Kamāmalu (LCA 7713).

In Makaweli, a total of 111 claims were filed. There was a sizable population in Makaweli; many claims were made for the soldiers at the fort in Waimea. The majority of the Makaweli claims were located *mauka*, which supports the idea of a dense inland population.

In Hanapēpē Ahupuaʻa, 92 claims are listed, of which 66 were awarded (Soehren 2010). Land use information provided in the LCA documentation indicated settlement within the Hanapēpē Valley focused on wetland taro cultivation, with ample irrigation from the Hanapēpē River. Approximately 80 *kuleana* claimants listed 131 *ʻāpana* in use. These claims mention 528 *loʻi* or taro plots (including 200 claimed by Opae alone, LCA 10458), 29 *kula* (where dryland crops like sweet potatoes were raised), 46 *pāhale* or house lots (many noted as being in villages), ten *moʻo* with crops unspecified, ten pastures or *moʻo* specified as pastures, and 16 "other," described as including gardens, pastures, *loko*, a pigpen, and salt lands at Ukula. The majority of *kuleana* lands were located along the lower Hanapēpē River banks and floodplain. All other unclaimed lands in Hanapēpē were originally awarded to Miriam Kekauonohi, who immediately returned them to pay the commutation fee for the lands she kept. The returned land became Crown Lands. No early surveys were made on Crown Lands, thus there are no Māhele records on land use for those areas.

The missionary Reverend George B. Rowell appears to be the only westerner to receive an LCA in Hanapēpē. He is also listed as the scribe for many of the *kuleana* claims in Hanapēpē. Frazier (1979:10) noted Mr. Rowell's "solicitude for the Hawaiian claimants of land, in order that their claims might be approved by the land commission," in contrast with several cases where Governor Kanoa destroyed claims that were on dirty paper or not properly written. The Boundary Commission (1873) reports and survey maps note Rowell's lands were located in an area called Hanapēpēluna, north of ʻEleʻele and near the border of Wahiawa Ahupuaʻa.

During the Māhele, the *ahupuaʻa* of Wahiawa, consisting of approximately 5,857 acres, was awarded to Moses Kekuaīwa (LCA 7714-B). Kekuaīwa was the grandson of Kamehameha I, and as a Hawaiian *aliʻi*, he was not required to prove his tenure on the land. An additional 18 LCA claims for *kuleana* parcels within Wahiawa were made by commoners able to prove their occupation and cultivation of the land. Of the 18 claims, 15 were awarded for parcels ranging in size from less than 1 acre to a maximum of 5 acres (LCA 10273 to Meheula). In general, the *kuleana* awards in Wahiawa were for 1 to 3 acres, which is typical of LCAs in the vicinity. The awarded lands were also situated within, or in the immediate vicinity of Wahiawa Valley and

Stream, the main source of fresh water for domestic and agricultural usage within the *ahupua‘a*. The numerous *‘ili* names and references to landmarks such as *pu‘u* (peak) or the seashore in the LCA documentation indicate widespread settlement throughout both the *mauka* and *makai* regions of Wahiawa Valley. References are also made to the “community of Wahiawa” located in the vicinity of the Government Road (present day Kaumuali‘i Highway) (Native Register Vol. 9:388–389), indicating that the focus of settlement within Wahiawa Ahupua‘a was likely at this locale. The LCA documentation also indicated that nearly all of the claimants received their *kuleana* land at the time of Kakio‘ewa, evidence of the major redistribution of land within Wahiawa as a result of the battle of 1824.

Land Commission documents recording these *kuleana* land claims further clarify our understanding of the *‘āina* from the perspective of the Native Hawaiians in traditional times by defining specific land use practices within the claimed parcels. As the majority of the LCAs were located within Wahiawa Valley, adjacent to Wahiawa Stream, land use was focused on the cultivation of wetland taro (*lo‘i*). A definite pattern is observed in the available documentation, indicating dense cultivation of taro, as evidenced by large numbers of *lo‘i* within relatively small parcels of land. The claimant’s house lot was also typically located within the same *‘āpana* as his or her *lo‘i.* Additional *‘āpana* of an individual LCA were generally for discrete *kula* land located outside Wahiawa Valley. For example, within an approximately 1 acre parcel, David Papohaku (LCA 3323) claimed 40 *lo‘i*, *kula* land, and a house lot.

The ABCFM was also awarded a parcel of land within Wahiawa Valley (LCA 387:2). Testimony describing the claimed land indicated it was used for the cultivation of taro and was “known by the name of Kauaiki” (Foreign Register Vol. 2:44). LCA 387:2, located immediately *makai* of Kaumuali‘i Highway, gives a description of the parcel as taro land known as Kauaiki, along with the account stating that the Kaua‘i ‘Iki stone was removed from a taro patch during road building activities; this suggests LCA 387:2 was the original location of the legendary Kaua‘i ‘Iki stone and taro patch.

Kalāheo was given as a *konohiki* award to Kaunuohua, but he returned it and it became Crown Land. Eleven individuals made *kuleana* land claims and were awarded lands within the *ahupua‘a*.

Land Commission documents recording these awards further clarify our understanding of the *‘āina* from the perspective of the Hawaiian planter and fisherman in traditional times. Most of the awards (LCA 3395B to Keoua, LCA 6647 to Una, LCA 6745 to Oluhe, LCA 8044 to Alauka, and LCA 8840 to Kanenehakaoli) include plots of taro *lo‘i, kula,* and house lots located along Kalāheo Stream, clustered around the “Government Road.” In addition, one or more plots for sweet potato and salt making were located at the seashore in the vicinity of Nōmilu Fishpond. Only one claim of land (LCA 6520 to Waipa) was awarded in the *mauka*-most regions of Kalāheo; Waipa did not claim land elsewhere. Another claimant’s land—LCA 6584 to Paele—may have been located only at Nōmilu near the shore, although the Foreign Testimony, Native Register, and maps showing award locations do not agree on this. Three other claimant’s awards (LCA 3394B to Kaneiki, LCA 3396B to Kihei, and LCA 6688 to Laa) are located only in the uplands.

The *ahupua‘a* of Lāwa‘i was granted to James Young Kanehoa in a Māhele Award (M.A. 43). James Young Kanehoa was the son of John Young (the first foreign advisor to King Kamehameha I) and his first wife, Nāmokuelua. When Kanehoa died in 1851 he bequeathed his land of Lāwa‘i, Kaua‘i to “my married wife Hikoni,” and in a second will written a week later he bequeathed to his niece, Emma (daughter of his half-sister Fanny Kekelaokalani Young), one-third of Lāwa‘i and two-thirds of Lāwa‘i to George Davis (Junior, son of George Hueu Davis). The Court refused both wills and John Young Jr. was appointed administrator of the estate (Barrére 1994:245–247). John Young's widow Hikoni received the land. Hikoni later deeded the entire *ahupua‘a* to her niece Queen Emma.

In 1876, Queen Emma leased the land of Lāwa‘i to Duncan McBryde for 15 years, though she reserved a house lot and several acres of taro patch land. McBryde developed roads and other infrastructure. In 1886, after Emma's death, Mrs. Elizabeth McBryde bought the entire *ahupua‘a* for $50,000. The upper lands were planted to sugarcane, and the valley leased to Chinese rice growers and taro planters (Donohugh 2001:99–100).

Most of the awarded *kuleana* claims were along Lāwa‘i Stream. In the lower valley there were five awards, and two of the five (LCAs 3414 and 3417) have house lots at the shore. The LCA 9188 claim states there were nine *lo‘i* on the west side that now have no taro in them because it was all taken away by the flood (probably the great flash flood of 1846).

The Boundary Commission record of 1873 indicates there was a dispute about the boundaries near the sea beach. But "the small piece of rocky land claimed by Lāwa‘i near the beach point more than compensates for the latter land gained *mauka* or the uplands" and the commissioners advised the Crown commissioners to accept the boundary as pointed out. The *kama‘āina* informant used by James Gay to point out the boundaries was Mokuiki (LCA 3315). The boundary commission record noted the existence of many named rocks; a second stream, called Halu‘ōpae; a large hole in the ground (or lava tube) called Koakaiinahoa; on the eastern boundary *mauka* of Aepo stream another large hole, called Kapeleulo; and farther up are two more holes, one called Pu‘uakamailii, and one called Namahana (Waihona ‘Aina 2021). There is no mention of caves or lava tubes in this record, but it is possible some of these "holes" were entrances to caves.

In the early post-Contact period, the *ahupua‘a* of Kōloa was controlled by the ruling chief of Kaua‘i and was administered by lesser chiefs appointed by him. When Kaumuali‘i, last of the ruling chiefs of the island, died in 1824, his lands (Kaua‘i and Ni‘ihau) were given to the lineal descendants of Kamehameha. Queen Ka‘ahumanu redistributed the lands among chiefs of other islands who had been loyal to the bloodline of Kamehameha. Kōloa Ahupua‘a, totaling 8,620 acres, was awarded to Moses Kekūāiwa (LCA 7714-B), the brother of Alexander Liholiho (Kamehameha IV), Lot Kapuāiwa (Kamehameha V), and Victoria Kamāmalu. The awarding of the *ahupua‘a* to Kekūāiwa was an outcome of an event 25 years in the past: the crushing—by forces loyal to Kamehameha II—of the 1824 revolt on Kaua‘i, when Kaua‘i lands were divided up among the chiefs of the other islands. The next largest award in the *ahupua‘a* went to the Protestant Mission (ABCFM) (LCA 387) and consisted of approximately 825 acres. The majority of the mission lands were located in the vicinity of Kōloa Town, where the parsonage was located. Large parcels just *mauka* of Kōloa Town were utilized for sugarcane cultivation and cattle pasture.

Eighty-nine *kuleana* awards were given to individuals within Kōloa Ahupua‘a. The majority of these LCAs were located in and around Kōloa Town itself. This concentration of awards around the town area may reflect both the traditional land settlement pattern, a focus on the resources of Maulili Pool and Waikomo Stream (a permanent stream), and a more recent movement of the populace to the plantation and missionary centers.

Testimonies provided to the Land Commission by applicants of LCAs 3584, 6309, and 6667 were generally limited to stating the boundaries of their claimed lands as well as land use. All three LCAs are indicated as being enclosed by stone walls and note the presence of additional house lots and *loʻi* of other claimants in the vicinity. Of particular interest are the stated boundaries of LCA 6309, which indicated the presence of pasture lands immediately *puna* (east) of the LCA. This may explain the presence of numerous stone walls described in the land claims. These walls are likely cattle barriers used to keep cattle out of house lots and agricultural plots.

A review of LCA records indicates that land usage and activity by the mid-nineteenth century included habitation, cattle ranching, and agriculture, including the cultivation of taro, sugar, potatoes, and yams. This may reflect the continuation into that century of traditional Hawaiian land use.

Weliweli Ahupuaʻa was awarded to Kekuaiwa as a *konohiki* award, but he returned it and it became Crown Land. There was only one LCA awarded within the *ahupuaʻa* of Weliweli: LCA 5210 to Punipuu in the *ʻili* of Kahoanalua. This land included a small plot consisting of a road, several dry *loʻi*, a *kula*, and a house lot. This plot was near the shore along the coastal road from Kōloa to Māhāʻulepū (Foreign and Native Testimonies, Vol. 13:66 in Ching et al. 1974:21). The majority of the *ahupuaʻa* of Weliweli was reserved as government land.

Almost the entire *ahupuaʻa* of Pāʻā was granted to Iona Piʻikoi (LCA 10605), a member of the old ruling family of Kauaʻi who had aligned himself with the Kamehameha family. The remainder of Pāʻā was divided among 15 LCAs, some along the shoreline and some on the *mauka* slopes. *Loʻi, kula*, and house lots are mentioned, as well as salt ponds along the shoreline. Overall, the Māhele documents indicate that land usage and activity by the mid-nineteenth century included habitation as well as taro, potato, and sugar cultivation. This may reflect the continuation into that century of traditional Hawaiian land.

Māhāʻulepū was awarded to Victoria Kamāmalu, sister of the future Kamehameha IV and V, as part of LCA 7713. Twenty-seven LCAs were given to commoners. These claims mention *kalo loʻi* tended along the gulches, *kula* in the inland, potato patches along the coast, orange trees, and fishponds. At her death Kamāmalu's lands were inherited by her half-sister, Ruth Keʻelikōlani.

4.4.3.2 Trade and Commerce

By the early 1800s, Kōloa Landing had become the principal port of Kauaʻi. Shipments of North American furs and pelts to Asia depended on the provisioning of ships at Kōloa Landing, as well as other Hawaiian ports. As the fur trade grew, markets in China became aware of sandalwood (*Santalum* sp.) grown in the Hawaiian Islands. The shipment of most of Kauaʻi's sandalwood to Asia took place at Kōloa Landing, until the supply of the fragrant wood was exhausted around 1830. Kōloa Village and Kōloa Landing, at the mouth of the Waikomo Stream, became flourishing commercial centers as trade with Americans and Europeans grew. An estimate in 1857 stated that "10,000 barrels of sweet potatoes were grown each year at Kōloa, and that the crop furnished nearly all the potatoes sent to California from Hawaiʻi" (Judd 1935:326). Sugar and molasses were also chief articles of export. Whalers used the Kōloa "Roadstead" from 1830 to 1870, and took on provisions of squashes (pumpkins), salt beef, pigs, and cattle (Damon 1931:176, Figure 41). Hawaiians grew the pumpkins on the rocky land north of the landing. There were also numerous salt pans along the shore near the landing that were used to make the salt (Palama and Stauder 1973:20).

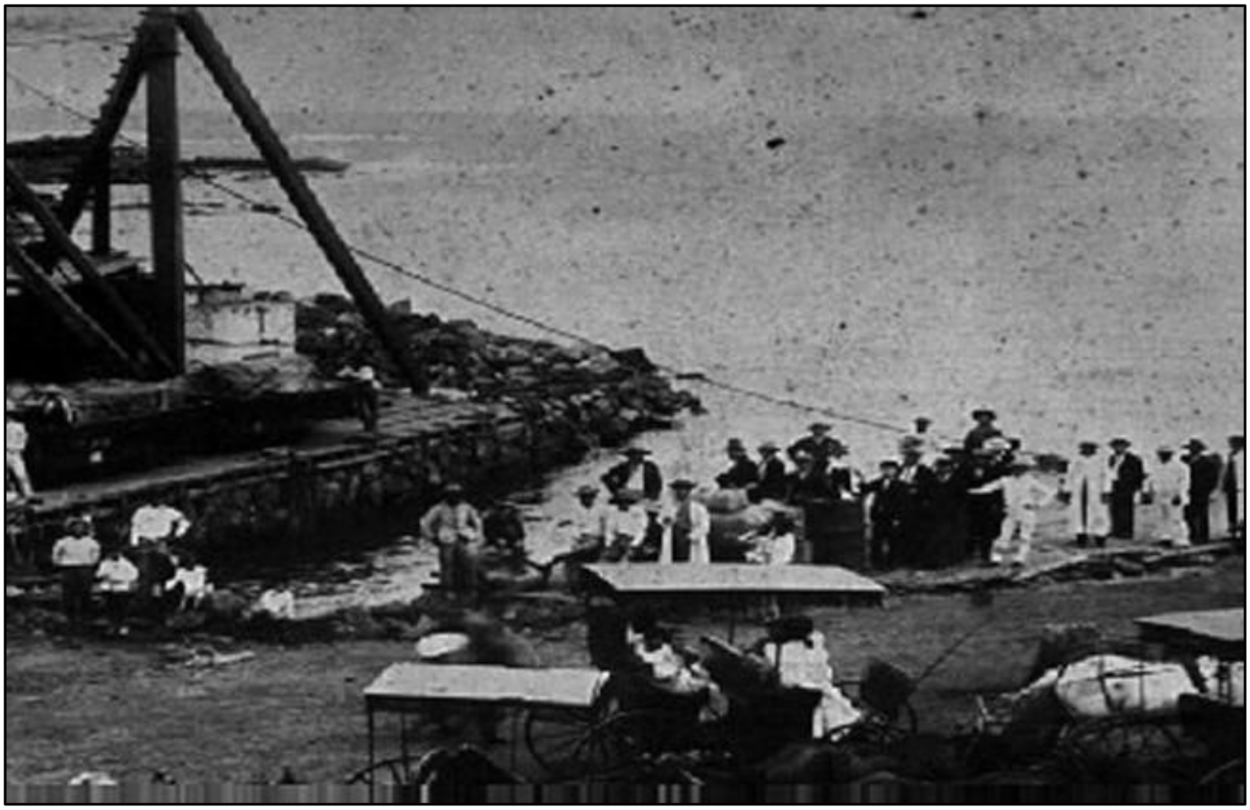


Figure 41. Photograph of Kōloa Landing, ca. 1880 (Hawaiian Stamps 2015)

Another major area of commercial enterprise was associated with the whaling industry at Kōloa Landing. Accounts of visitors suggest the inhabitants of Kōloa took advantage of their nearness to the landing to participate in the booming trade of the port. An article in the *Pacific Commercial Advertiser* 19 February 1857 described the salient characteristics of the port at mid-century and mentions the following:

> The anchorage is an open roadstead, the tradewind blowing along and a little off shore. During the prevalence of trade it is safe for ships to anchor, but they rarely do so, preferring to procure their supplies 'lying off and on'. The anchorage for schooners is close to shore, in four to six fathoms of water, where it is somewhat sheltered from the wind by a bluff. Owing to the force of the swell and the suddenness which the south wind sweeps around the head lands of the island, and the want of proper buoys, a number of coasting vessels have been wrecked of late years in this port. For the trade of the port there is a small rude pier constructed which might be improved at no greater outlay of labor. From the landing there is a good carriage road to the town, distant about two miles. Large quantities of firewood, bullocks and sweet potatoes are furnished to whalers in this port, and these chattels can no where be procured cheaper or better. It is estimated that 10,000 barrels of sweet potatoes are cultivated annually here, which are thought to be the best on the islands. Nearly all the potatoes furnished for the California market are produced here […] Sweet potatoes, sugar and molasses constitute the chief trade of the port. [*Pacific Commercial Advertiser* 19 February 1857]

In 1850, Waimea was designated a government port, opening it to foreign commerce. At the time, Waimea was exporting a variety of agricultural goods and livestock (Table 7). A report of the Royal Hawaiian Agricultural Society noted the listed exports from the port of Waimea between 1 July 1850 and 30 June 1851 (Damon 1931:291). Most of these goods, apparently, were brought to the port of Waimea for shipment off the island; they were not necessarily products of the *ahupua‘a* itself. Within a few years, the government port facility was moved to Kōloa, and Waimea declined in importance as a shipping destination.

Table 7. Waimea Port exports between 1850 and 1851

Item	**Quantity**	**Item**	**Number**
Sweet potatoes	3,009 bbls.	Oranges	4,000
Yams	9 bbls.	Squashes	100
Onions	568½ bbls.	Cattle	4
Sugar	5,000 lbs.	Sheep	108
Salt	50 lbs.	Swine	110
Pineapples	2,000	Turkeys	110
Cocoanuts	1,400	Fowls	1,202
Bananas	20 bunches	Ducks	12
Dried pork	1,200 lbs.	Total Value	$9,030.62

4.4.3.3 Commercial Agriculture and Ranching

During the early nineteenth century, western entrepreneurs turned their attention to Waimea. Among the first of them was an American, William French. He had settled in Honolulu in 1826, becoming involved in business enterprises throughout the Islands. In the early 1830s, French obtained permission to establish a sugar mill on Kaua‘i.

> In 1835 he brought from China a number of Chinese with a mill and apparatus for manufacturing sugar. After a fruitless endeavor to obtain land for a plantation [on O‘ahu] he at length engaged with Governor [of Kaua‘i] Kaikio‘ewa to take his men and machinery to Kaua‘i and there grind cane and manufacture sugar on shares, the governor supplying the cane and furnishing horses to turn the mill. The business was carried on for about two years at Waimea and French at one time had hopes of getting a tract of land for a plantation. But the hope proved delusive; French found himself in hopeless competition with the Kōloa enterprise of Ladd and Company, and in 1838 carried his mill back to O‘ahu. He is said to have lost over $3,000 through the failure of the undertaking. [Kuykendall 1938:175]

In 1835, Ladd and Company started the first successful sugar plantation in Hawai‘i at Kōloa, Kaua‘i. William Ladd, William Hooper and Peter Brinsmade took out a 50-year lease on 980 acres of land at Kōloa from Kamehameha III. As other sugar plantations were organized, more labor was needed to work the fields. Plantation owners began recruiting laborers from outside the Hawaiian Islands. The Chinese were the first to arrive in 1852, followed by the Japanese in 1868 and Portuguese workers in 1878.

Archibald Archer, an engineer of Scotch-Norwegian ancestry, settled in West Kaua‘i, to establish a tobacco plantation at Mānā. According to Ethel Damon, Archer "built a small house [...] at Halemanu [in the present Kōke‘e State Park], which was known as Little Norway and is said to have been the first foreign house in the beautiful Kokee region of the Waimea mountains" (Damon 1931: 292). Damon also notes Hawaiian traditions associated with Halemanu:

> In this lovely valley of hale-manu, Place-of-Birds, the Hawaiian bird-catchers had formerly lived to collect the little red or yellow feathers for royal cloaks at the proper seasons. And above on the ridge at Kaana was the region where departed spirits assembled to wait before springing off into the nether world, Po, near the cliffs of Polihale on the extreme west coast of the island. [Damon 1931:292]

The Reciprocity Treaty of 1876 between the United States and Hawai‘i gave impetus for the expansion of the sugar industry throughout the Islands. Valdemar Knudsen and a partner, Christian L'Orange, planted the first commercial cane in this portion of Kaua‘i in 1878 at Kekaha near Pōki‘i. Knudsen had come to Hawai‘i from Norway and settled at Wai‘awa in 1854 where he worked as a rancher, agriculturalist, and finally a sugar planter. In 1856, Knudsen bought out Archer's leases of Crown lands (the tobacco plantation had failed) and began developing a cattle business and orchard. The leased land included much of the present Kōke‘e State Park. Knudsen built a mountain cabin at Halemanu at the site of an old bird catcher's house. Eventually Knudsen would control the entire district, excluding *kuleana* lands, from Nu‘alolo to Waimea, including all the *mauka* area (Knudsen and Noble 1945:35). Valdemar's son Eric, who was born at Wai‘awa in 1872, described Kekaha and its environs (including Kīkīaola) as he knew them in the second half of the nineteenth century:

> A row of grass houses extended all the way along the foothills from Waimea to Mana. Every house site had a name. To find a man you had to find his house name. The natives seemed to know every name and would keep sending you along until you finally came to the spot you were looking for.
>
> At certain hours all the women sat in their houses and beat tapa cloth and as they beat they talked to one another in a tapa beater's code. They could send a message with great speed from Waimea to Mana. When the men returned from the mountains with fire wood or canoes, the woman that saw them at once tapped out the news and it flew from house to house with the result that every man, when he came home, found his house in order and no surprised visitors hanging around. The men tried to learn this secret code but never did, though an old man at Mana told my father that the men had tried for years to learn the secrets of the tapa code but were never able to do so. [Knudsen 1991b:100]
>
> The grass houses were all built in one general design—one big living room and two doors—one on each side and opposite to one another. One day my father noticed that all were built with their gable-ends east and west and the doors facing the ocean and the hills. He asked one of the men why that was so and he replied, 'Why, you know that Po, the abode of the dead, lies under the ocean just outside Polihale, where the cliffs and the ocean meet, and the spirits of the dead must go there. As the spirits wander along their way to Po, they will go around the gable-end of a house but if the house stood facing the other way, the spirits would walk straight

> through and it would be very disagreeable to have a spirit walk past you as you were eating your meal. In fact,’ he continued, ‘we can always tell when a battle has been fought by the number of spirits passing at the same time.’ [Knudsen 1991b:102]

In describing the conditions of Wahiawa prior to the use of irrigation, Ida Elizabeth Knudsen Von Holt writes of her father’s (Valdemar Knudsen’s) hardships during the 1850s and ‘60s: “In those early days, land was very cheap. There was no way of watering or irrigating the fields, and the grass became absolutely parched and dead during the dry months. Cattle often died for want of food and water […]” (Von Holt 1985:66).

By 1864, in a letter from Valdemar Knudsen to J.O. Dominis, Prime Minister for King Kamehameha III, Knudsen requested the right to raise the rents on Hanapēpē leased lands “since the King owns little *kalo* or rice land in Waimea, but a lot in Hanapēpē, and there is not one idle patch in Waimea, but only a few are planted at Hanapēpē” and he mentioned that “the people there hula from morning to night” (Archive Correspondence Hanapēpē 1 November 1864 in Creed 1995). In 1865 Knudsen was appointed *konohiki* of Hanapēpē Ahupua‘a and a year later he leased Hanapēpē from the King for $500 a year for 25 years (Archive Letter 9 July 1866 in Creed 1995). Knudsen’s complaint not only emphasizes that a substantial amount of *kalo* and rice land existed in Hanapēpē, but also indicates the practice of hula was being seriously pursued, and by some sizeable number of persons, despite missionary efforts to discourage it. Carol Ramelb, in her small pamphlet on the hula, records that for Hawaiian people “[b]efore a written language, the hulas and the chants accompanying them were their history and poetry” (Ramelb 1976:3). She also notes that after the coming of Christianity “In distant villages, some continued to dance behind closed doors” (Ramelb 1976:5). Hula was not officially revived until the 1870s during King Kalākaua’s reign. Another impetus for its practice, besides the traditional religious commitment, was for the entertainment of sailors of the whaling and trading ships. The roadstead of Waimea, as a nearby center of shipping interests, may have helped keep the traditions alive at Hanapēpē; the presence of strong Hawaiian traditionalists within the region may have also contributed to the perpetuation of the hula. After the cultural influence of King Kalākaua, hula became “seen as the lone surviving art of an ancient people” (Ramelb 1976:6). The people of Hanapēpē helped keep the art alive.

Eric Knudsen, son of Valdemar Knudsen, mentions passing by Hanapēpē on his first trip around the island of Kaua‘i in 1895. “We rode through the Makaweli Plantation and soon entered the beautiful valley of Hanapepe and the town of the same name—in those days it was only a small village” (Knudsen 1991a:150).

The Chinese came to the Islands as early as the late nineteenth century. They had been cooks and carpenters on western ships, but some left the boats and stayed in the Islands. They began to operate small mills to grind sugarcane to make molasses. One of these early mills was at Māhā‘ulepū around 1825-1826, but it was not successful as the owners could not negotiate with local chiefs for labor in the fields or at the mill (Donohugh 2001:87). In 1853, Mr. Marshall of Kōloa Plantation commented on the mill:

> The Chinamen’s plantation at Mahalipu [*sic*], near Koloa, is in a state of ruin, owing to pecuniary embarrassments. The mill, a primitive wooden affair, the works and building are gone to decay, and the property at present has gone out of cultivation. [letter reprinted in Damon 1931:198]

At Waimea, as in other locales, groups of Chinese began leasing former taro lands for conversion to rice farming. Sadly, the taro lands' availability throughout the Islands in the later 1800s reflected the declining demand for taro, as the Native Hawaiian population diminished. Censuses taken during the second half of the nineteenth century record the dwindling population of the Waimea District.

Commercial rice growing also came to the Kekaha-Mānā plain in the 1860s. The area's most prolific planter was Leong Pah On, a Chinese immigrant (Joesting 1984:206).

Leong Pah On started farming in Waimea Valley and eventually met Valdemar Knudsen who allowed him to cultivate the swamplands. He imported Chinese laborers, drained the swamps with ditches, brought in water buffaloes, and eventually acquired more land. At its peak, Pah On's rice lands totaled about 600 acres throughout Mānā, Kekaha, and Waimea (Char and Char 1979:21).

Pah On's enterprise ended suddenly in 1922. The leases on government lands were expiring and H.P. Fayé, manager of the Kekaha Sugar Company, convinced Pah On not to bid on new leases and let the sugar company take over control of the land. In return, Kekaha Sugar would sub-lease the rice fields back to Pah On. The successful rice grower could have easily out-bid the sugar concern but agreed to the plan. When Kekaha Sugar secured the leases its board of directors overruled Fayé and denied any subleases to Pah On (Char and Char 1979:22).

Most of the crop was grown by Chinese farmers who continued production on the valley floor well into the 1930s (Handy and Handy 1972:405; Joesting 1984:206–107). On a survey map by Fred E. Harvey (1916) a large rice mill in LCA 3284 (to Wahineaea) in the *‘ili* of Kuiloa in Hanapēpē is present. The two grants to Ah Pai and Chang may refer to two of these Chinese farmers. Many of the first Hanapēpē Town Lots were in the form of grants to inhabitants of Japanese or Chinese ancestry around 1921. "Much taro land was converted to rice during this period, not only at Waimea but in other areas of the island causing a taro shortage for a time" (Ida and Hammatt 1993). Harvey's 1916 map of Hanapēpē Valley also shows 118+ acres of rice land on both sides of the river. These areas were probably formerly used for taro *lo‘i.* Also in 1918 official correspondence notes 78 applications for homesteading in Hanapēpē (Archive correspondence of 24 May 1918 in Creed 1995).

Rice farming declined sharply throughout the Hawaiian Islands after the first decade of the twentieth century. Total acreage dropped from a high of 9,425 acres in 1909 to 1,130 acres in 1935. By the 1930s the rice industry had ceased entirely on the islands of Hawai‘i, Maui, and Moloka‘i (Coulter and Chun 1937:62). Though rice continued to be grown at Waimea into the 1930s, many of the rice fields were being reclaimed for sugar planting.

In 1831, ranching was introduced to Kaua‘i when Richard Charlton, the British consul, leased some land in the Hanalei district. He started with a herd of about 100 head of cattle. Other ranchers followed suit and in 1848 the practice of registering brands to distinguish ownership of cattle was started on Kaua‘i. Kaumuali‘i's favorite wife, Deborah Kapule, kept a large herd along the Wailua River (Ronck 1984:57). It's apparent, according to articles in Hawaiian language newspapers of the time, that "wild cattle" were a problem on all the islands even in the late 1800s. By 1899, wild cattle as well as goats had become a big problem on Kaua‘i. Notes from Henry Pratt Judd of a hunting trip to Makaweli indicate that over a 2-day period a total of 180 goats and 11 cattle were shot (Judd manuscript 1899, Kaua‘i Historical Society).

As previously mentioned, major foreign interests began to invest, following acts allowing foreigners to own lands in Hawai‘i. Duncan McBryde relocated to Wahiawa from his estate in Wailua around 1860 (Damon 1931). McBryde developed the extensive Wahiawa Ranch and ventured into sugarcane cultivation in Wahiawa and surrounding lands by 1870 (Damon 1931).

The Sinclairs arrived in Honolulu in 1863 and immediately began looking for large tracts of land to purchase. Disappointed with what they saw, the family decided to head for California in search of better prospects. King Kamehameha IV, hearing of their plans to leave, offered them the island of Ni‘ihau. Unusually heavy rainfall was recorded for 1861-1863 and Ni‘ihau was exceptionally lush and green when the two Sinclair brothers, Francis and James, did a site inspection of the island. Excited at their discovery, they hoped to re-establish the cattle and sheep business they had left behind in New Zealand. The two brothers accepted the King’s offer and purchased the island of Ni‘ihau for $10,000 in gold. There they raised Merino sheep and Shorthorn cattle from the continental United States, Australia, and New Zealand.

In 1865, Eliza Sinclair purchased the *ahupua‘a* of Makaweli (21,844 acres) from Victoria Kamāmalu Ka‘ahumanu for $15,000. A new home was built in the cool uplands at about 1,800 ft elevation that became known as the “Makaweli house” and sometime in the early 1870s the Sinclair family moved from Ni‘ihau to settle there (Dorrance and Morgan 2000, Figure 42). The Sinclair’s Makaweli lands remained relatively undeveloped.

In 1889, Francis Gay and Aubrey Robinson formed the family partnership known today as Gay & Robinson (G&R). Makaweli Mill (Figure 43) is seen in how this partnership, the various family businesses, i.e., Makaweli Ranch and Makaweli Plantation, were managed. By the early 1880s the Robinsons became involved in the sugar business not only by planting their own crops, but also by leasing large tracts of land to Hawaiian Sugar Company (Wilcox 1996). The Robinsons were always looking for new and creative ways to utilize their land. For many years, they raised bees for honey and experimented with other agricultural crops (Figure 44).

4.4.3.4 Fishing Rights

Another item of traditional Hawaiian practice found in archived correspondence is fishing rights. In early correspondence Abner Paki, father of Queen Liliu‘okalani, states in a letter to the Minister of Interior that Hanapēpē belongs to the King and that the *akule* is the *kapu* fish (letter of 20 April 1852). According to Titcomb, this fish is eaten raw, broiled, or cooked in a *ti* leaf bundle placed over the taro in the *imu* (underground oven), is good for *palu* which she says is used in a relish; and is also a favorite fish for drying (Titcomb 1972:62). In discussing fishing taboos, Mary Kawena Pukui noted that “Summer was the time when fish were most abundant and therefore the permitted time for inshore fishing. Salt was gathered at this time, also, and large quantities of fish were dried” (Titcomb 1972:14). She elaborates, saying that when the *kahuna* had decided conditions were favorable for fishing:

> For several days it remained the right of the chief to have all the sea foods that were gathered, according to his orders, reserved for his use, and that of his household and retinue. After this, a lesser number of days were the privilege of the *konohiki*. Following this period the area was declared open (*noa*) to the use of all. [Titcomb 1972]

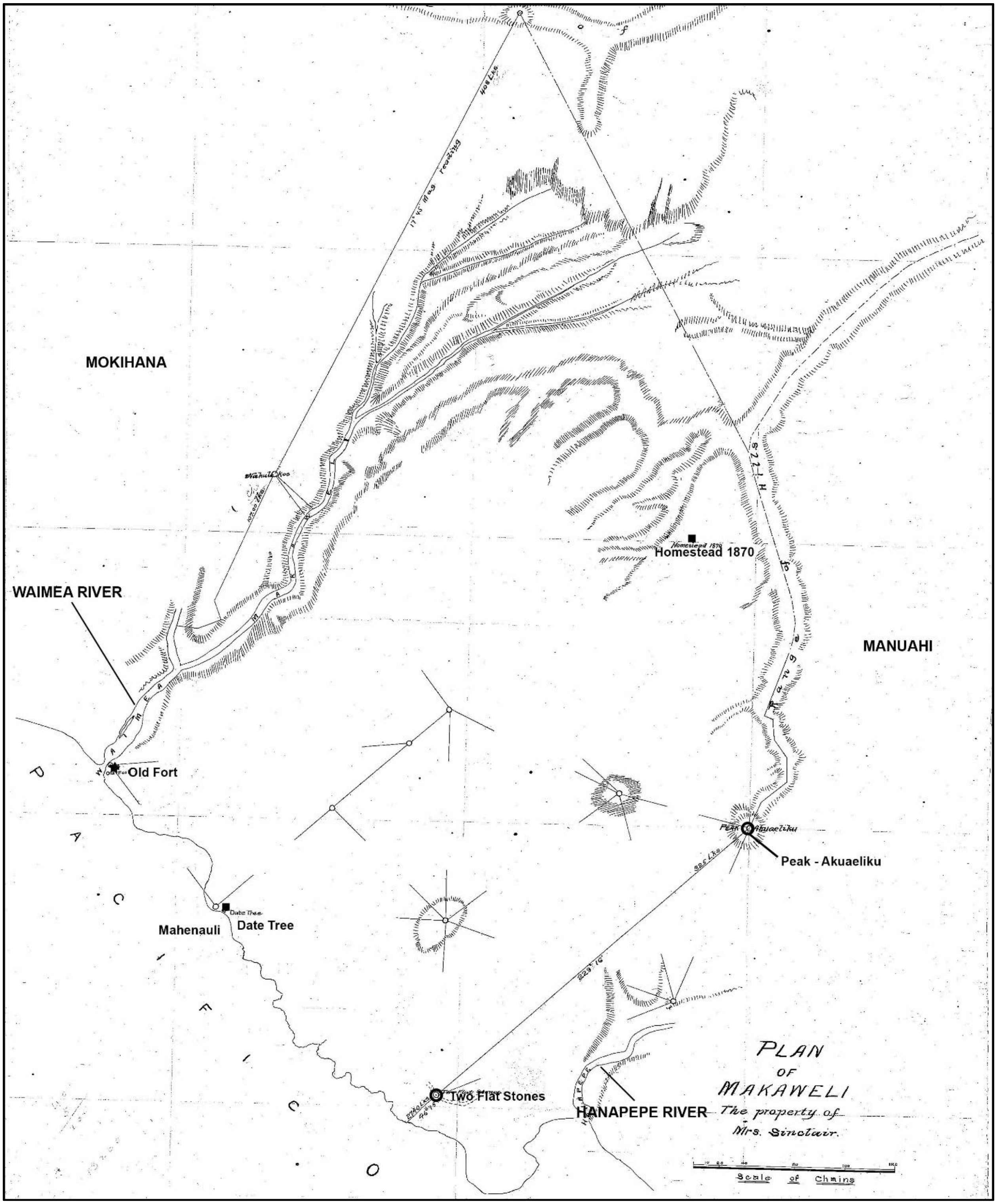


Figure 42. Gay plan view map (RM 1843) of Makaweli Ahupuaʻa bought by Mrs. Eliza Sinclair

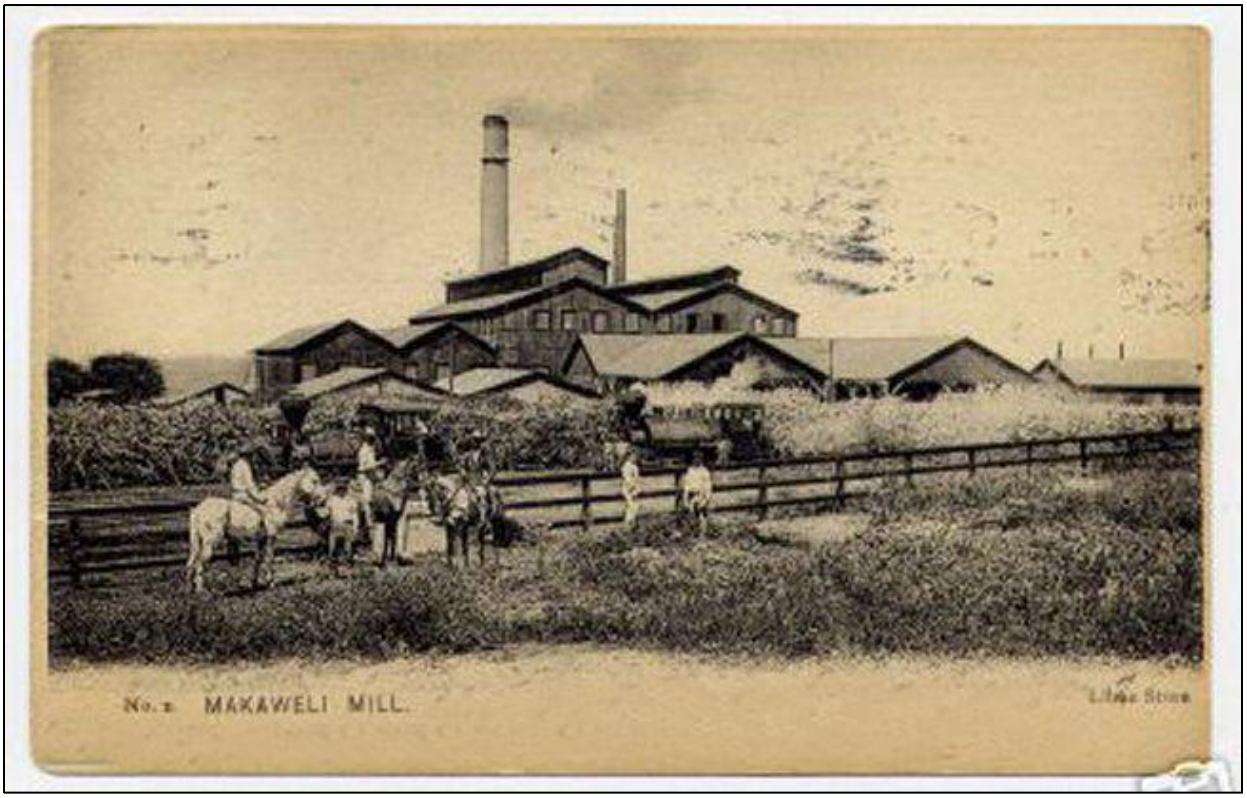


Figure 43. Makaweli Mill postcard (Post Office in Paradise 2019)

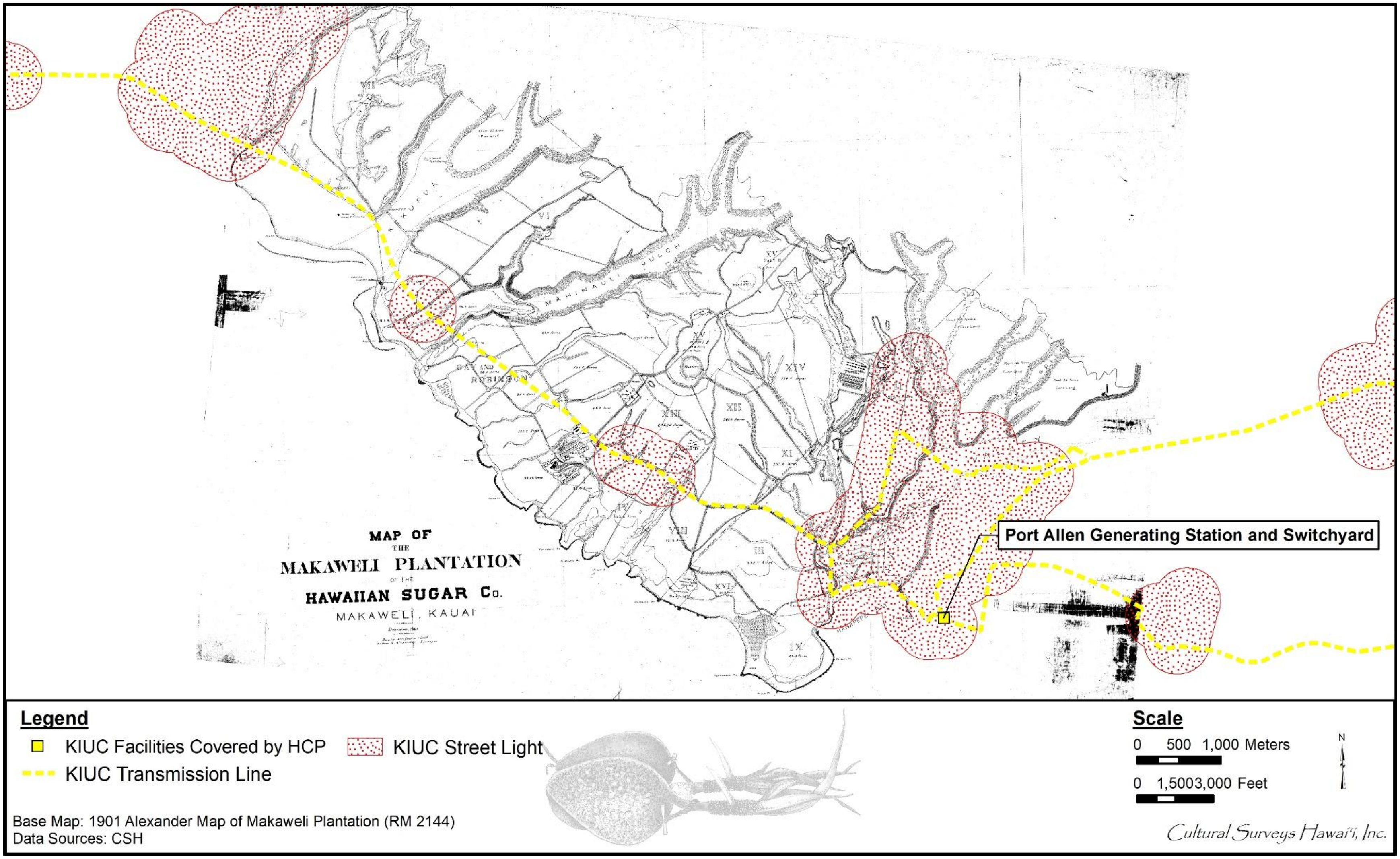


Figure 44. 1901 Alexander map of the Makaweli Plantation of the Hawaiian Sugar Company (RM 2144), showing various plantation camps and Gay and Robison residences

A Mr. Isaac Hart applied in 1866 for coastal land and rights to include the fishing boundaries for which he offered to pay $300. He was apparently granted this right; in 1870 J. and F. Sinclair, having leased or bought most of the District of Kona (Kaua‘i) by this time, wrote to Prime Minister J.O. Dominis seeking redress since they believed their original lease included these fishing rights.

Fishing rights belonged to the *konohiki* and could be used by him and often his tenants. Chapter III of the Laws of 1840 described free and prohibited fishing grounds:

> His Majesty the King hereby takes the fishing grounds from those who now possess them from Hawaii to Kauai, and gives one portion of them to the common people, another portion to landlords, and a portion he reserves to himself.
>
> These are the fishing grounds which His Majesty the King takes and gives to the people: the fishing grounds without the coral reef, viz: the Kilohee grounds, the Luhee ground, the Malolo ground, together with the ocean beyond.
>
> But the fishing grounds from the coral reef to the sea beach are for the landlords and for the tenants of their several lands, but not for others. But if that species of fish which the landlord selects as his own personal portion, should go on to the grounds which are given to the common people, then that species of fish and that only is taboo. [Kosaki 1954:31]

4.4.3.5 Queen Emma’s House and Prince Kūhiō’s Brithplace

In 1856, Alexander Liholiho, King Kamehameha IV, and Queen Emma arrived in Kōloa and stayed for three days during a royal tour of the Hawaiian Kingdom. The royal party visited Spouting Horn on the eastern shore of Lāwa‘i Ahupua‘a.

There is no record of any further visits to Kōloa by the king or queen during Liholiho’s reign. However, in 1870, following Liholiho’s death in 1863, the Dowager Queen Emma had a residence built for herself in Lāwa‘i Ahupua‘a, on a bluff east of Lāwa‘i Kai. The queen and her party arrived at Kōloa landing on 21 December 1870, intending to reside at her Lāwa‘i house until the spring of 1871. The queen described her arrival at Kōloa and the journey to her residence in a letter of 31 December to King Kamehameha V:

> We arrived late in the afternoon last Thursday & had to ride over two miles before we reached this place. The schooner left that same evening & even if I had the time, there is nothing to tell you about but your Majesty will I am sure understand how much I am gratefull [*sic*] for your kindness in sending me free of expense down here.
>
> The house we are in is one by itself for a couple of miles around, rather lonesome I fear for some. [Forbes 1970:4]

David Forbes describes the Lāwa‘i lands surrounding the queen’s residence:

> […] lonesome indeed it must have appeared to many of her party. The house that they were getting settled in stood on the bluff above Lawai-Kai. A large square frame house with a thatch roof, and with several outbuildings enclosed by a stone wall, with only a few struggling trees for shade, the house must have indeed seemed desolate to those accustomed to Honolulu. The surrounding area was an arid, stony pasture, suitable only for grazing. [Forbes 1970:4]

An historic photograph of Queen Emma's house confirms that in the late nineteenth century and before the introduction of sugarcane the area was indeed an arid, stony pasture (Figure 45).

On Lāwaʻi Beach Road, the Prince Kūhiō Memorial Park marks the birthplace on 26 March 1871 of Jonah Kūhiō Kalanianaʻole, great grandson of Kaumualiʻi, the last high chief of Kauaʻi, and son of a sister of Queen Kapiʻolani. Prince Kūhiō's career of public service included ten terms as Hawaiʻi's delegate to the U.S. Congress—where he helped create the Hawaiian Home Lands Act—from 1903 until his death in 1922. In 1902, the prince founded the Royal Order of Kamehameha I. Prince Kūhiō Memorial Park is owned and maintained by members of the Royal Order of Kamehameha I, Kaumualiʻi Chapter No. 3. The prince's birthplace and memorial park, above Hoʻai Bay, are at "Kahoʻai, a prominent Hawaiian fishing village in pre-Contact times, and chiefs of Kauaʻi would often stay there" (Donohugh 2001:261).

4.4.4 Twentieth Century to Present

4.4.4.1 Koloa Sugar Company

Koloa Sugar Company was the first plantation-organized industry in Hawaiʻi (Damon 1931:176, 198). It began in 1835 as Ladd and Company. About one thousand acres of land for silk and sugar culture were leased from the king and local chiefs, mainly in Weliweli Ahupuaʻa, for 50 years at $300 a year. The lease "allowed the use of the waterfall and an adjoining mill site at Maulili pool, not far from the thousand acres, together with the right to build roads, the privilege of unrestricted buying and selling, and freedom from local harbor dues." In subsequent years, they would buy or rent land in upland Pāʻā (1841), in Māhāʻulepū (1878), and in Kōloa Ahupuaʻa, the section east of Kōloa Stream (1881) (Alexander 1937:frontpiece, Figure 46).

Judd (1935) noted the following:

> The company was permitted to hire natives to work on the plantation provided they paid Kauikeaouli, the king, and Kaikioʻewa, the governor of Kauaʻi, a tax for each man employed and paid the men satisfactory wages. The workers were to be exempt from all taxation except the tax paid by their employers. [Judd 1935:57]

Judd further described the revolutionary implication of this arrangement: "The significance of Ladd and Company's lease lay in the fact that it was the first public admission by the Hawaiian chiefs that their subjects had rights of personal property backed with a guaranty of protection to that property" (Judd 1935:58). Local chiefs, fearful of a usurpation of their power, resisted the company's first efforts to recruit workers, forcing the king's intervention.

Ladd and Company ceased operating in 1845. Then, following a succession of individual and partnered ownerships, a new enterprise, Koloa Sugar Company, was established in 1880. In 1882, the Koloa Sugar Company announced it had ordered all the components for a plantation railroad. According to the *Planter's Monthly*, Volume 1 of 1882, "It (the railroad) will consist of four miles of 30 inch gauge track, forty cars 5 x 10 feet, and one locomotive […]" (Condé 1993:28). According to Arthur C. Alexander (1937), "Cut cane was hauled to the mill by oxcart until 1882. In that year, 3½ miles of 30-inch gauge, 18 pound railroad track and 50 cars were purchased" (Condé 1993:28).

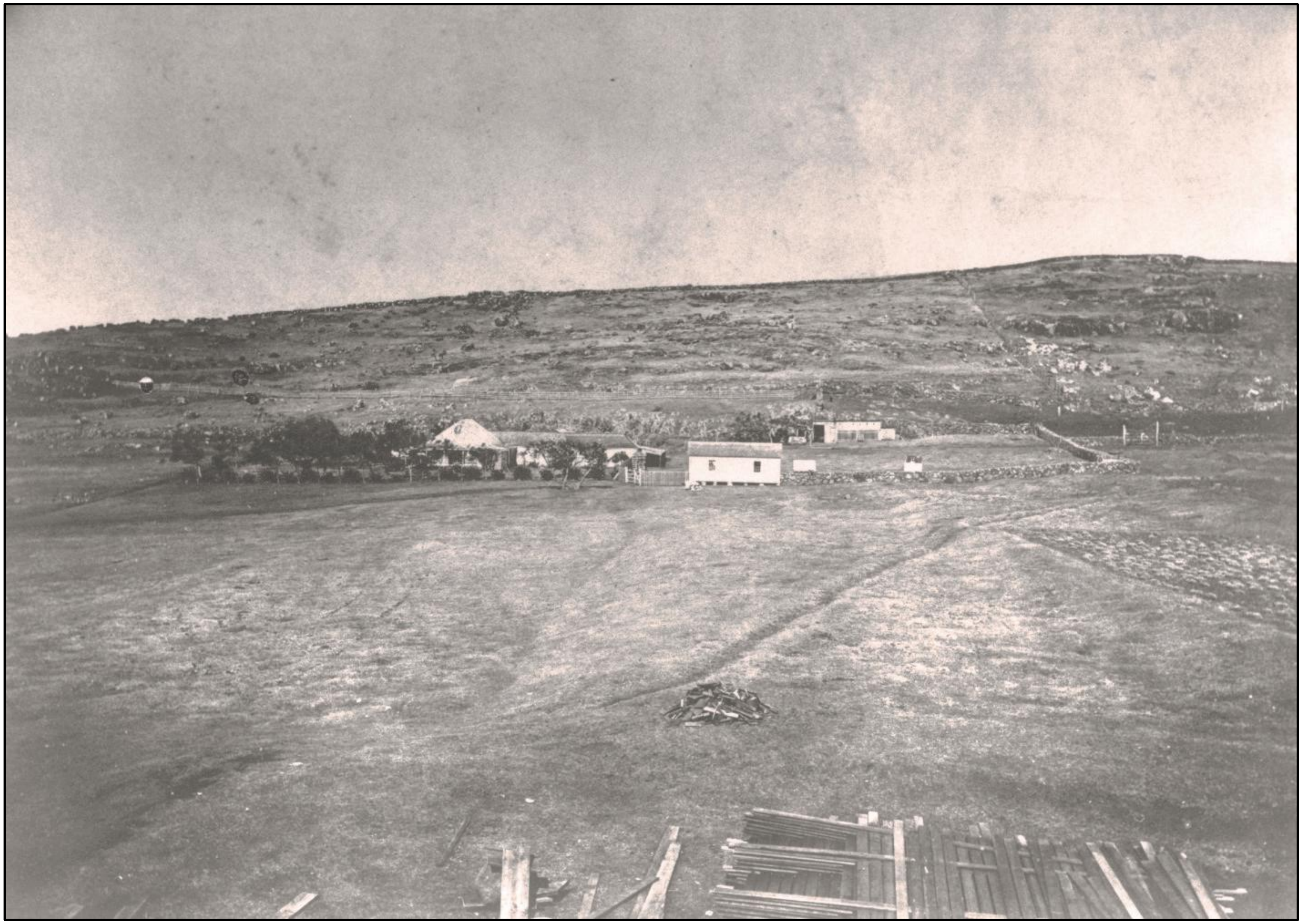


Figure 45. Photo of Queen Emma’s Home at Lāwa‘i, ca. late nineteenth century (Bishop Museum Archives)

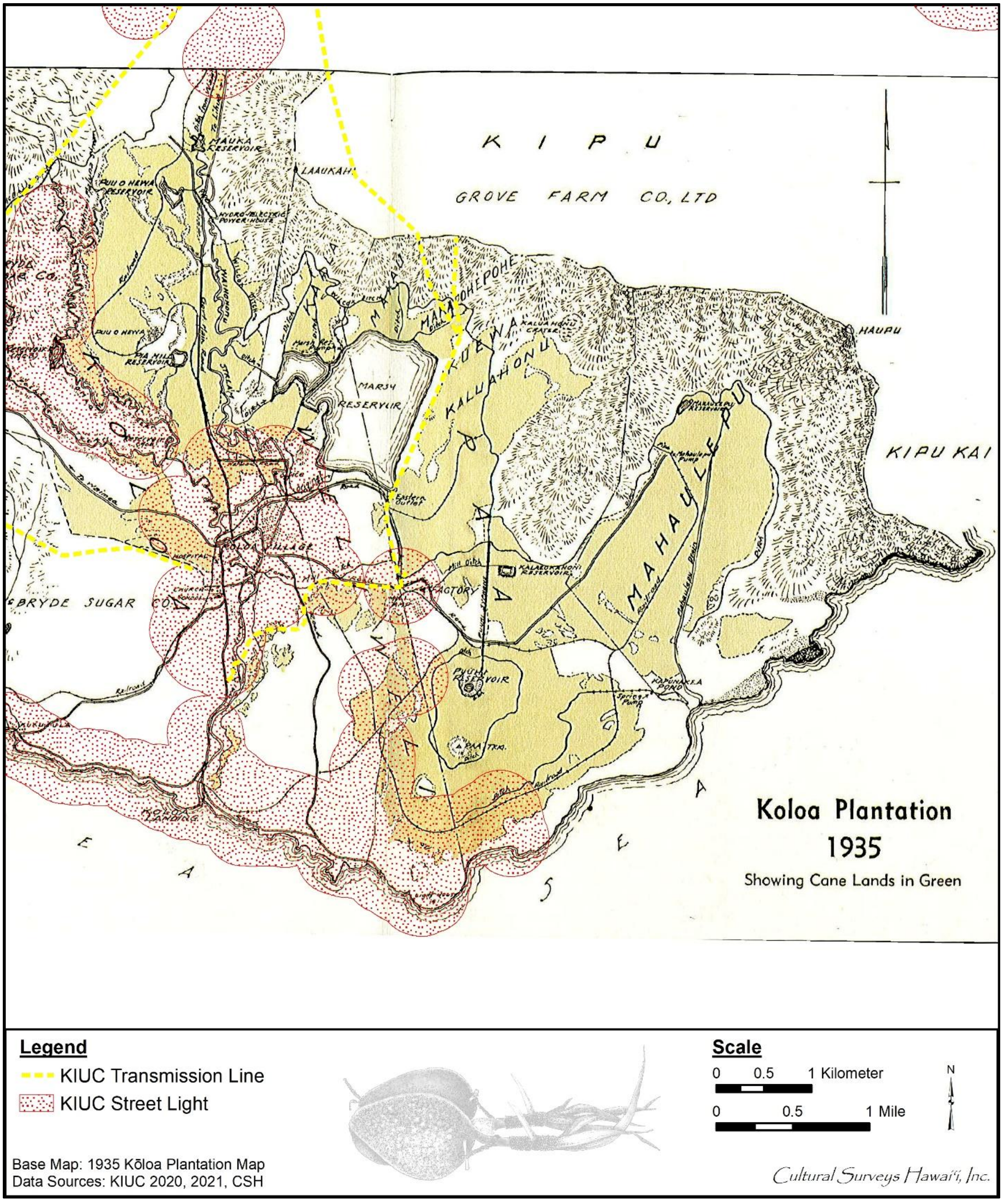


Figure 46. 1935 Koloa Sugar Company plantation lands in Kōloa, Weliweli, Pā‘ā, and Māhā‘ulepū (endpiece map from Alexander 1937)

By 1885, the railway extended to Kōloa Landing where steamers transported the bags of sugar to the mainland. A motorized derrick winched the bagged sugar from the railroad cars to the warehouse on the west side of the landing. From there, bagged sugar was loaded onto small lighters, which would row the sugar out to waiting ships in the harbor. By 1895, the railroad had extended a spur line through the coastal lands of Kōloa into Weliweli to aid in the harvest around Pā‘ā. Remnants of this spur line are seen today throughout lower Po‘ipū (Donohugh 2001:106).

The Koloa Sugar Company had previously purchased the *ahupua‘a* of Pā‘ā southeast of Kōloa town, and a large parcel, a swamp that the company drained and tried to use for sugar, was unproductive. A new and much larger mill was built there in 1912 about a mile from Kōloa (Figure 47). New railroad track was laid, and an asphalt road was built to connect the new mill with Kōloa Landing. World War I caused a huge demand for sugar. By the end of hostilities in 1918, the Koloa Sugar Company was producing 9,000 tons of sugar each year and adding additional acreage (Donohugh 2001:105).

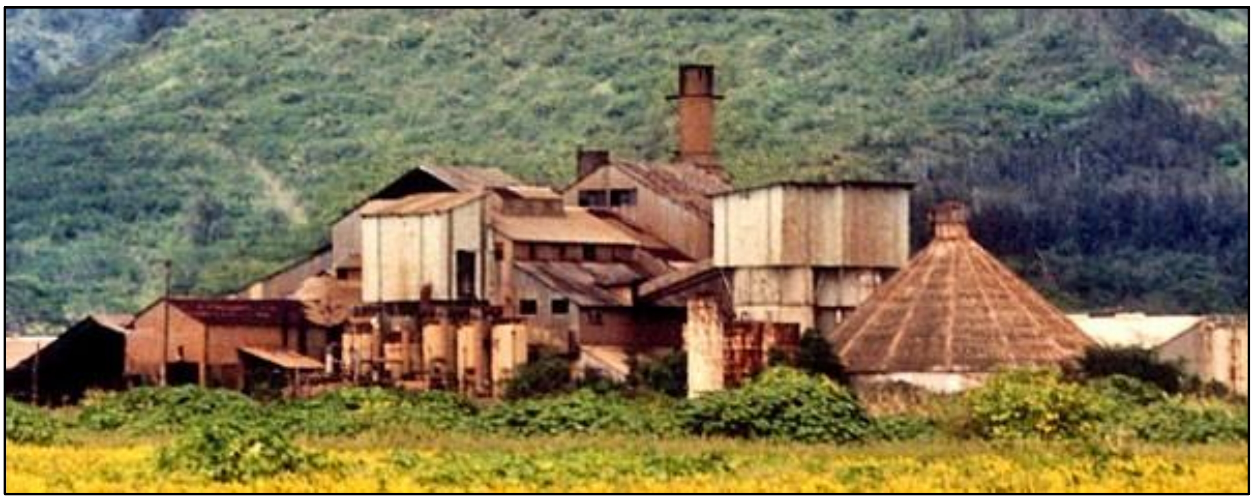


Figure 47. Photograph of Kōloa Mill, built in 1912 (Kōloa Plantation Days 2015)

Kōloa Landing was phased out around 1925 when McBryde Sugar Company and the Koloa Sugar Company began shipping their product out of Port Allen Harbor at Hanapēpē in Waimea District. The McBryde Plantation had been improving the facilities at ‘Ele‘ele Landing since the turn of the century, and a private company, the Kauai Terminal Limited Railway, had developed a modern bridge crossing the Hanapēpē River. Soon after this, the Koloa Sugar Company ceased to use the *makai* Kōloa fields, and much of the area was converted into cattle-grazing pasture by the Knudsen family. Most of the *mauka* areas of Kōloa remained under sugarcane cultivation as late as the 1970s, when these cane lands were converted into pasture (Donohugh 2001:101).

According to Wilcox’s account of the Koloa Sugar Company (Wilcox 1996:77–78), following the merger of the plantation lands of the Koloa Sugar Company and the Grove Farm Company in 1948, the combined lands under cultivation required new sources of irrigation water. In 1965, Grove Farm built a tunnel to bring the waters from Ku‘ia directly into the Waitā (Kōloa) Reservoir. Grove Farm leased these cane lands to McBryde Sugar Company when it terminated sugar operations in 1974 (Wilcox 1996). The mill in Pā‘ā was finally closed in 1996, and remains a landmark of the countryside.

4.4.4.2 McBryde Sugar Company

Duncan McBryde moved to Wahiawa from his estate in Wailua ca. 1860 (Damon 1931). He acquired a lease for lands at Wahiawa from Victoria Kamāmalu, sister of Moses Kekuaiwa. Kamāmalu inherited the unclaimed lands at Wahiawa following the untimely death of Kekuaiwa in 1848. McBryde drove his herd of cattle across the island and began the development of the extensive Wahiawa Ranch. The McBryde family estate, known as Brydeswood, was built in the uplands of Wahiawa, *mauka* of the government road. McBryde acquired land in Wahiawa, later owned in fee simple, and leased land in Kalāheo from the Crown. Eventually, the plantation covered most of the land of western Kona District, including Wahiawa, Kalāheo, Lāwaʻi, and the western section of Kōloa Ahupuaʻa, west of Kōloa Stream.

By 1870, in addition to ranching, McBryde ventured into sugarcane cultivation. The plantation primarily consisted of land already owned by the McBryde Estate, including the Wahiawa Ranch and lands in neighboring Kālaheo and Lāwaʻi. In 1899, Walter D. McBryde, son of Duncan McBryde, and W.A. Kinney founded the McBryde Sugar Company, formed by combining the lands of the Eleele Plantation in Hanapēpē Ahupuaʻa, the lands owned by McBryde in Wahiawa, Kalāheo, and Lāwaʻi, and the lands owned by the Koloa Agricultural Company (separate entity from the Koloa Sugar Company), which had lands in Kōloa Ahupuaʻa owned by the Knudsen family, west of Kōloa Stream (McBryde Sugar Company 1949:3).

Eleele Plantation was a nearby sugar plantation east of the Hanapēpē River and northeast of Hanapēpē Bay. The plantation had its own mill and its own landing at what later became Port Allen. Eleele Plantation was considered to have “the most fertile lands in the district and an ample supply of water” (Condé and Best 1973:197). The predominance of sugarcane in the area was evidenced by cane fields and railroad tracks that traversed the landscape. The *Honolulu Advertiser* in a 1949 column labelled “50 Years Ago” noted that the first electric locomotive in the Hawaiian Islands was built and operated at the Eleele Plantation, Kauaʻi, in 1899 (Condé and Best 1973).

To irrigate the mid-sized plantation (approximately 4,700 planted acres), between 1900 and 1907 the McBryde Sugar Company constructed 30 large and small reservoirs, as well as an extensive system of ditches to collect water from the uplands (Yamanaka and Fuji 2001). In addition to collecting surface water, which became insufficient for the growing plantation, McBryde Sugar Company constructed a series of wells and pumps to collect groundwater (Wilcox 1996). These plantation ditches, pumps, and reservoirs are indicated on a 1900 map of the McBryde Sugar Company lands (Figure 48). The ʻEleʻele Ditch is shown paralleling the government road.

Plantation development consisted of extensive sugarcane cultivation, with associated irrigation ditches, on the upper plateau areas outside Wahiawa Valley. It is also noted that in addition to the Eleele Ditch, several other ditches were constructed in order to take water from Wahiawa Stream to the McBryde Sugar Company cane lands. A railroad line was also constructed *mauka*, running from the McBryde Plantation Mill in the east, through Wahiawa Valley, and on to ʻEleʻele Landing in the west. Plantation camps were extensively developed to house the large numbers of plantation laborers. The structures were concentrated in the vicinity of the rail line crossing, located both within Wahiawa Valley, as well as along the upper edge of the valley. Additional plantation camp structures were located in the *makai* portion of Wahiawa Valley (Yamanaka and Fuji 2001).

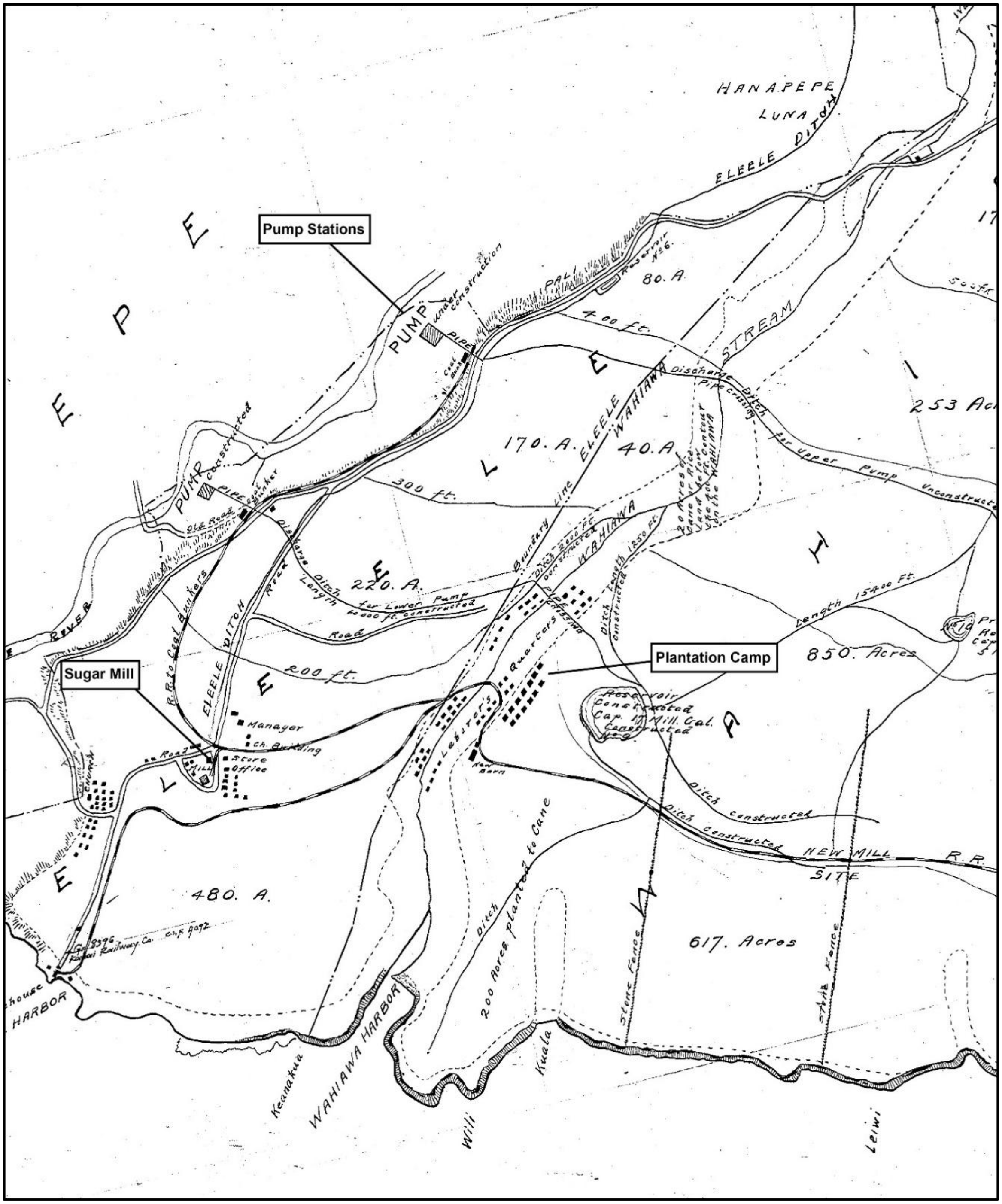


Figure 48. 1900 map of McBryde Sugar Company Lands (RM 2145), M.D. Monsarrat and McBryde Company surveyors

Following the expansion of sugar cultivation by McBryde Sugar Company, a “New Mill” (Numila) was constructed in Wahiawa by 1905 to replace the mill at ‘Ele‘ele (Figure 49 and Figure 50). Additional plantation development included the construction of a reservoir, the Kapa Reservoir. A cemetery was also located near the coast, between Wahiawa Bay and ‘Ele‘ele Harbor. The cemetery was likely established for the interment of McBryde Sugar Company plantation workers (Yamanaka and Fuji 2001).

A 1922 map of McBryde Sugar Company lands (Figure 51) shows the extent of the sugar plantation in the 1920s. Also indicated on the map is the extensive network of reservoirs, irrigation ditches, and plantation railroad lines. Despite the widespread land disturbance caused by sugarcane cultivation on the lands outside Wahiawa Valley, it appears that remnants of traditional land use were observable in the mid-1900s. The following accounts record these observations.

Of this upper area (of Wahiawa Valley) Bennett (1931:115) remarks that “the remains of terraces” were observed to be “remarkable in places for their number on a small area of land.”

> According to our own observation in the lower valley, there were house sites both above and below the present highway, and abandoned terraces below the bridge on what is now ranch land. The water which used to irrigate these terraces from Wahiawa Stream is now taken by the ‘Ele‘ele plantation ditch. [Handy and Handy 1972:429]

In 1931, Damon further describes how some of the parcels belonging to McBryde Sugar Company became lands set aside for Kukuiolono Heiau:

> Walter Duncan McBryde, by exchange of lands for the Kalaheo homestead project there and by dint of development in the pineapple industry, built a park for the island. Kukui-o-lono it is called. Torch-of-God-Lono, an ancient place-name from times when a beacon nightly shone on the hill there to direct fisher folk and travelers far out at sea. Today park and forest lands cover seventy acres immediately surrounding and in part sustained by five times that area in fields planted to pineapples, and all this fair use of the island whence it originally came into private lands. [Damon 1931:220–221]

In 1899, the three plantations—Koloa Sugar Company, Grove Farm, and McBryde Sugar Company—merged under the McBryde name. In 1933, McBryde took over 7,200 acres of the Grove Farm Plantation (Dorrance and Morgan 2000:30). In 1985, the McBryde Sugar Company ranked as Hawai‘i’s eighth largest sugar plantation. However, sugar plantations soon became unprofitable in the Islands, bringing an end to McBryde’s sugar production in 1996. Much of the former McBryde sugar lands were converted into coffee production, with the Kaua‘i Coffee Company replacing the McBryde Sugar Company. Much of the former Wahiawa and ‘Ele‘ele cane lands are presently planted in coffee (Yamanaka and Fuji 2001).

4.4.4.3 Waimea Sugar Mill Company

In the 1880s, two planters named Conrad and Borchgrevink attempted to grow cane at Waimea. They had little success, but in 1884 H. Schmidt organized the mill enterprise and other entrepreneurs on O‘ahu were organizing the Waimea Sugar Mill Company to begin operations on land leased from the Rowell family. Soon, a ditch was constructed to bring Waimea River water to the fields, which covered about 200 acres. The extent of Waimea Plantation in 1906 is shown

Figure 49. Photo of sugar mill in ʻEleʻele, ca. 1885 (Hawaiian Stamps 2015)

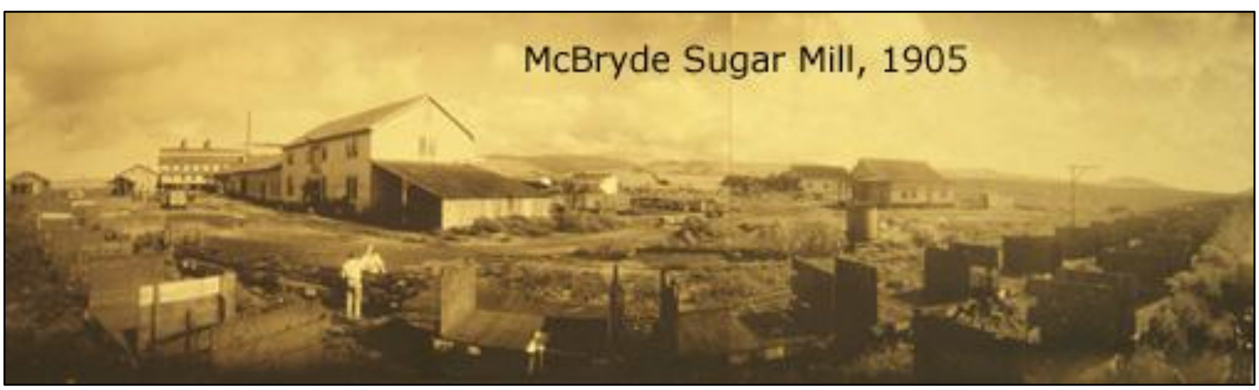


Figure 50. Photo of McBryde Sugar Mill in 1905 (Hawaiian Stamps 2015)

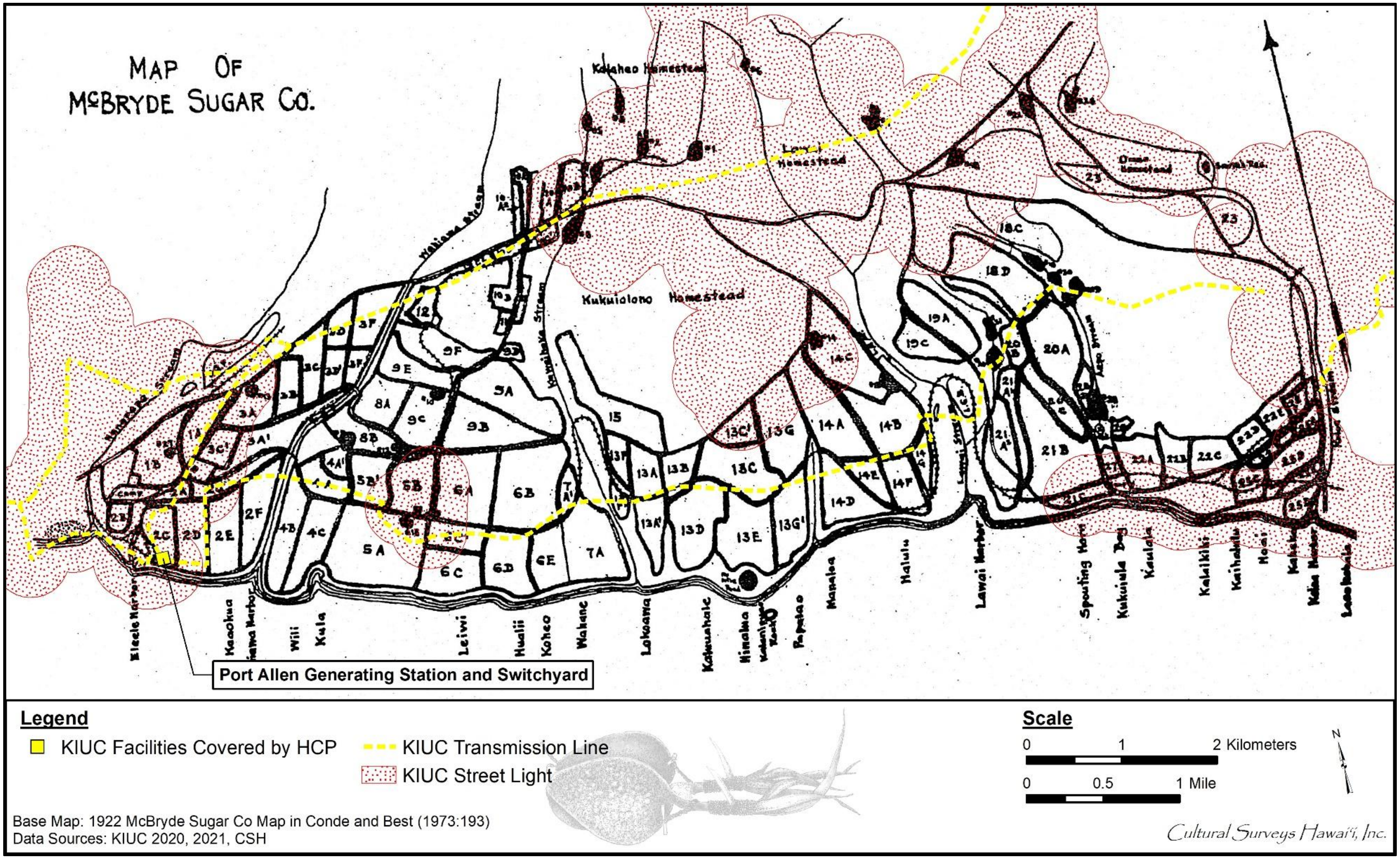


Figure 51. 1922 map of McBryde Sugar Company (adapted from Condé and Best 1973:193), showing the extent of sugarcane cultivation

in Figure 52. This map of Kaua‘i also shows the location of the wetlands, at first used for rice and then taro and the location of pasture land. Land near Waimea Town was not used for the cultivation of taro or rice, but the town is near the eastern extent of lands owned by the Waimea Sugar Plantation.

The sugar mill is shown in an 1885 sketch of Waimea Bay by the surveyor George Jackson (see Figure 40)—who made this drawing in his notebook—standing at the top of the Russian fort on the east bank of Waimea River. This sketch shows a small pier extending just *makai* of the sugar mill. In later times a railroad line ran east of the mill to the location of the present-day pier.

Hans Peter Fayé came to Kaua‘i from Norway in 1880 at the age of 21. Four years later, with a loan from Isenberg and a lease from his uncle, sugar pioneer Valdemar Knudsen, Fayé founded H.P. Fayé & Company, a sugar plantation in Mānā, the westernmost town in Kaua‘i. In 1906 Fayé acquired the Waimea Sugar Mill, which had been founded in 1884.

The Waimea Sugar Mill Company may have been the smallest (in land) of the sugar companies in the Hawaiian Islands (Figure 53). A 1910 newspaper article in the San Francisco *Chronicle* describes the sugar lands and the railroad line (probably owned by the Kekaha Sugar Company) built to haul the cane to the mill:

> Waimea has a bit of flat land hemmed in by two neighbors, Kekaha and Hawaiian Sugar Company, just over a half mile long and a little wider. It lies only a few feet above sea level. Cane is transported from the fields over a railway system which consists of two miles of permanent track and one mile of portable track, thirty-eight cars and a locomotive. [Condé and Best 1973:203]

The railroad line mentioned was actually built by the Kekaha Sugar Company about 1884, which used it to transport sugar from its own mill to the pier at Waimea Landing. Initially it stopped at the Waimea Sugar Mill to also transport their sugar to the landing. Part of this railroad line runs through the center of the plan area (parallel to the shore). It was probably dismantled around 1947, when transportation switched to truck hauling (Condé and Best 1973:141, 146). By the early 1930s, about 670 acres of land was cultivated by the Waimea Sugar Mill Company. Most of Waimea Town’s commercial buildings were constructed during this period of the sugar industry’s growth.

During World War II the U.S. Army Corps of Engineers used the plantation shop yard as their headquarters; the sugarcane from the fields was taken to Kekaha to be milled. Following World War II, the fortunes of the Waimea Company changed. The Waimea mill stopped operating in 1945, though the Waimea Sugar Company continued to cultivate cane on its lands until 1969. The milling equipment was sold, and the mill building was used for grain storage (Fayé 1997:26). After the company closed, its fields were leased to the Kekaha Sugar Company.

In 1950, the sugar company was reorganized into the Waimea Sugar Mill, Inc., which continued to process cane, and the Kikiaola Land Company, which was created to manage the property. The milling equipment was sold, and the mill building was used for grain storage (Fayé 1997:26). After the company closed, its fields were leased to the Kekaha Sugar Company. Now, only the skeletal frame of the sugar mill remains (Figure 54).

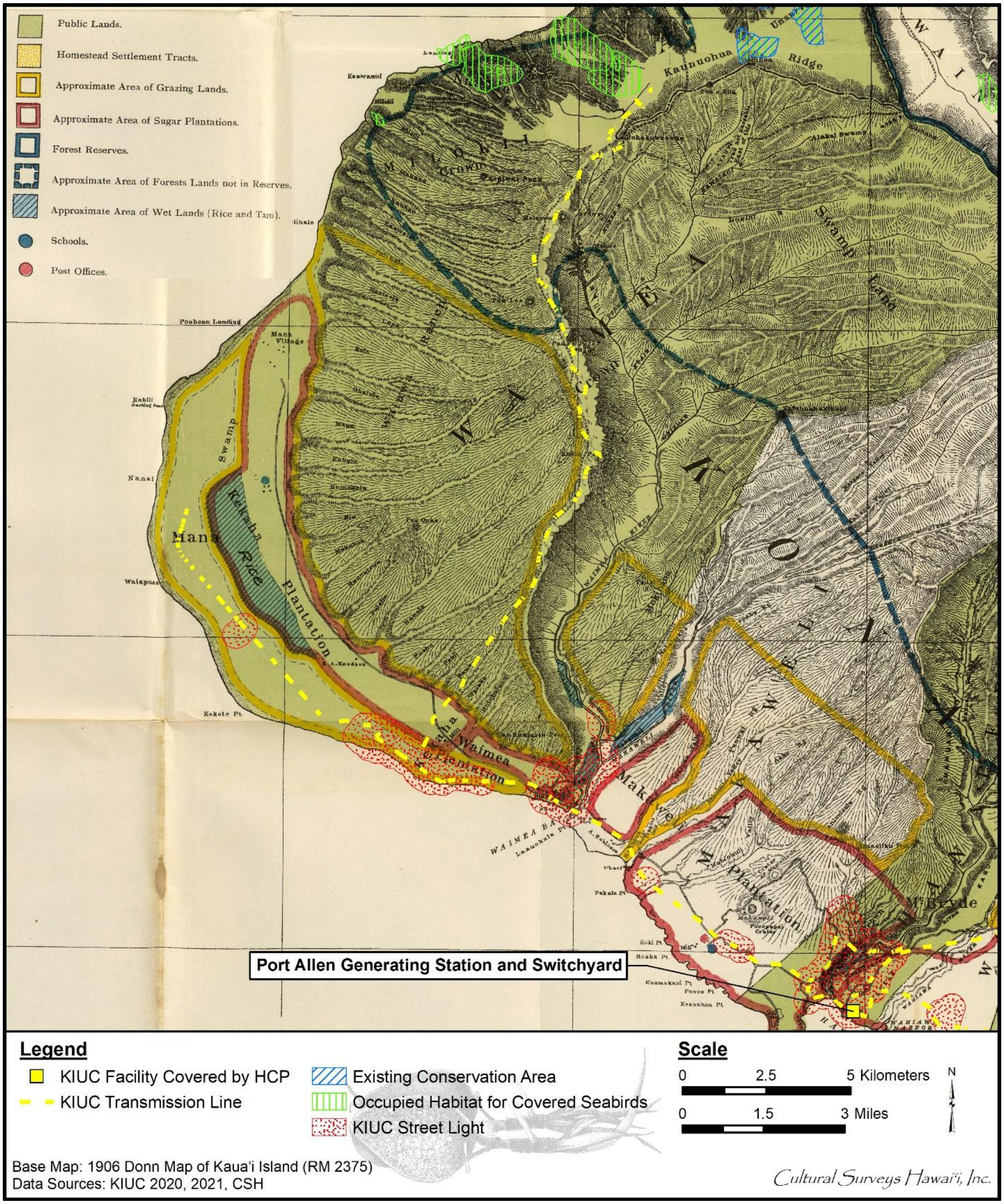


Figure 52. A portion of 1906 Donn map of Kaua‘i, showing the boundaries of land use and the sugarcane plantations within Waimea, Makaweli, Hanapēpē, and Wahiawa Ahupua‘a

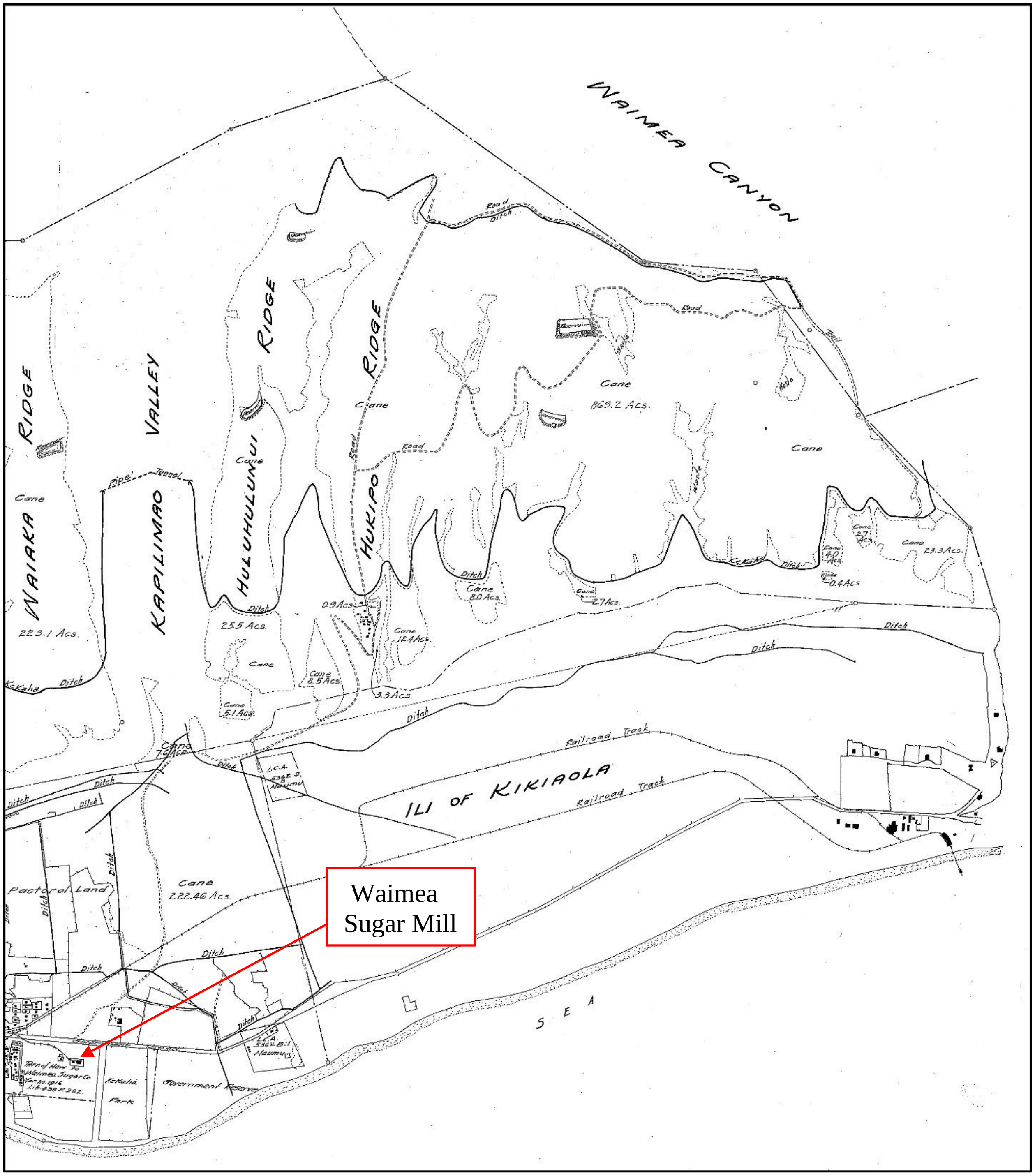


Figure 53. 1921 map (portion) of Kekaha Cane and Pasture Lands (Evans 1921), showing Waimea Sugar Mill located in the western edge of Waimea Town

Figure 54. Photograph of the remains of Waimea Sugar Mill, view to southwest

At the time of statehood in 1959, H.P. Fayé & Company was incorporated as Kikiaola Land Company, and it is still owned by about 100 of the founder’s descendants. Linda Collins, a granddaughter of H.P. Fayé is now the president of Kikiaola Land Company.

In 1982, one of the former plantation cottages opened as a vacation rental and was so successful that the Fayés decided to construct a plantation-type resort. The renovated plantation houses, built between 1900 and 1920, became part of the Waimea Plantation Cottages (Chang 1988:49–52), with 48 rental units and a conference center.

4.4.4.4 Kekaha Sugar Company

The first commercial cane in the Kekaha area was planted in 1878, near Pōki‘i, by Knudsen and a partner, Christian L’Orange. Hans P. Fayé, Knudsen‘s nephew, was brought in as another grower, and it was he who dug the first artesian wells in the islands at Kekaha. With a steady, but still small water source, investors showed interest, and the Kekaha Sugar Company was incorporated in 1898 (Joesting 1984:216–217). The mill was set up on the sand lands of Kekaha at the *makai* edge of the swamp, its foundations set deep into the underlying coral (Knudsen and Noble 1945:161–162).

In the 1900s, Kekaha Sugar Company (KSC) employed about 1,000 people. Among this work force, approximately 300 families lived in plantation houses. The Kekaha Sugar Company saw expansion after 1907 under the management of Hans Peter Fayé when construction of the plantation's major irrigation ditch was completed. Most of the cane was initially transported by flume. The engineering feat brought water to the area from 8 miles up the Waimea River via a series of ditches, flumes, tunnels, and siphons (Thrum 1908:158–159).

By 1910 the plantation had 15 miles of permanent railroad track transporting cane from collection points to the mill and then transporting bags of sugar to the steamship landing at Waimea. By 1938, a *Honolulu Advertiser* article stated that Kekaha Sugar Company was the most valuable single piece of property in the Territory. According to Hawaiian Sugar Planters Association’s (HSPA) Plantation Archives:

> The nine-roller mill at the factory produced 80 tons of sugar a day and the sugar bags were sent by rail to the steamship landing at Waimea. KSC used the cultivation contract system or piecework system whereby individuals or ‘gangs’ cultivated certain fields and were paid according to the amount of cane harvested. Kekaha Sugar employed about 1000 people in the early 1900s and approximately 300 families lived in plantation houses. Serving the plantation population were four independent stores, Waimea Hospital, public schools, and the Foreign Church. [HSPA Plantation Archives n.d.]

In 1922, Kekaha Sugar Company began to drain the Mānā swamps to produce more sugarcane land. The project took 60 years to complete. According to HSPA Plantation Archives:

> Kekaha was well known in its pursuit of diversified farming efforts. The plantation helped support a large community garden in Mānā. During the 1930s a 16-acre vegetable garden was started at an elevation of 1600 feet. One year later the garden produced approximately 95 tons of vegetables and was expanded to 24 acres, helping to make KSC self-sufficient in food supply. Currently, farming of vegetables is not done at KSC. [HSPA Plantation Archives n.d.]

In 1950, Kekaha Sugar Company rebuilt their factory. They also continued the use of land owned by them for cattle grazing. In 1951, they had a herd of 1,427 head on 10,816 acres of pasture. According to HSPA Plantation Archives:

> In 1951, KSC management changed from a system of three division; Mana, Mauka, and Kekaha, to a functional system with one superintendent for a particular function covering the entire plantation. In 1954, Honolulu Iron Works built for KSC the longest and heaviest mill train in Hawaii; a 100 foot long series of 17 rollers, capable of crushing 125 tons of cane per hour. That year a four-phase improvement plan was completed; the new crushing plant, a hydro-electric plant in Waimea Valley, a low-grade centrifugal station in the factory, and a new steam generator that replaced seven old type boilers. [HSPA Plantation Archives n.d.]

In 1969, the company again expanded, leasing the lands of the newly closed Waimea Sugar Mill Company. By 1983 Kekaha Sugar employed about 400 people and produced 54,819 tons of sugar. In 1994 Amfac/JMB consolidated many functions of Kekaha Sugar and Lihue Plantation as a cost-cutting measure (Wilcox 1996:97). By 1987, the company had a record crop of 56,618 tons of sugar. However, in 1988 KSC was sold to JMB Realty as part of the buyout of Amfac Hawaii. By 1992, the company officially became part of Amfac Sugar Kaua‘i West, and in 1995, the last sugarcane was harvested by this company on their Waimea lands. In 2000, Amfac Hawaii closed its last sugar operations at the Kekaha mill (Figure 55).

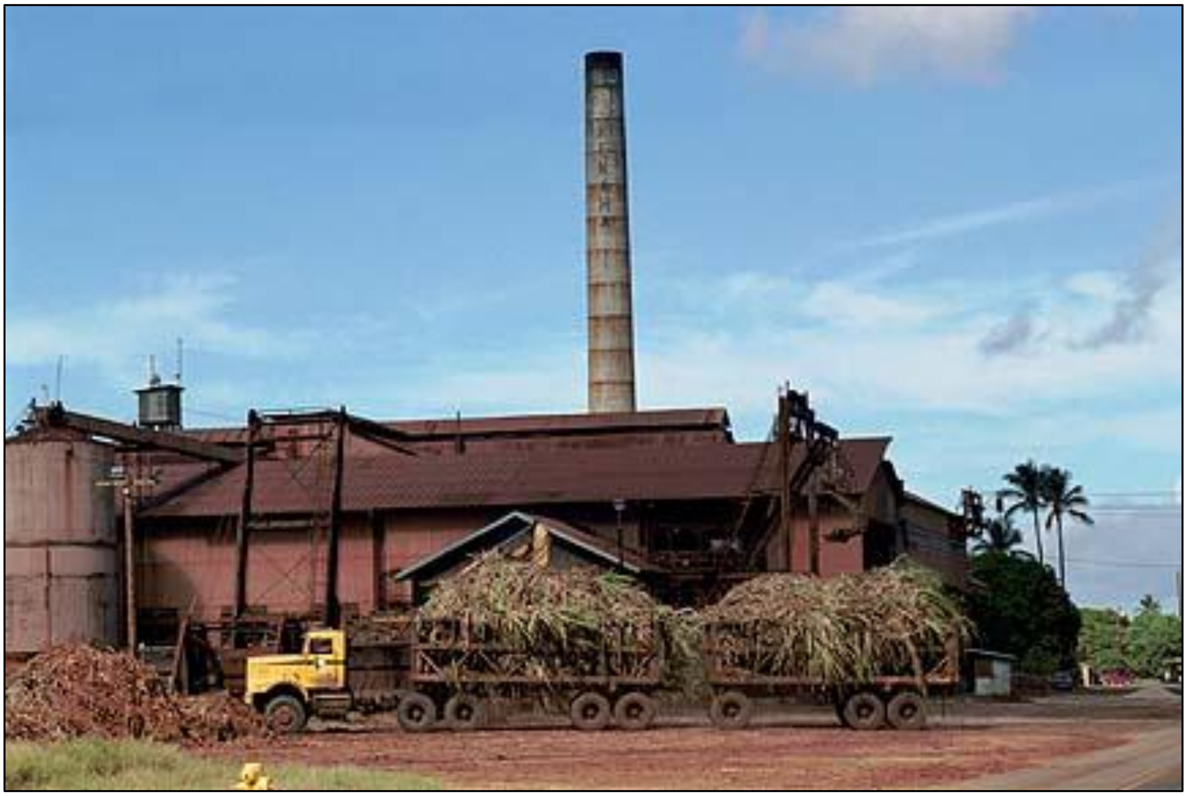


Figure 55. Photograph of Kekaha Sugar Mill (Honolulu Star-Bulletin 2001)

4.4.4.5 Hawaiian Sugar Company

The Hawaiian Sugar Company (the present Olokele Sugar Company, also known as Makaweli Plantation, named for Olokele Valley in Makaweli Ahupua‘a) was founded at Makaweli Ahupua‘a shortly after the signing of the Reciprocity Treaty of 1876 by representatives of the Scottish Mirlees, Watson & Yaryan Company. Samuel T. Alexander and Henry P. Baldwin took over the plantation, incorporating it in 1889 (Condé and Best 1973:134). A large mill was established at present day Kaumakani Town and approximately a dozen camps for sugar workers were scattered amongst the fields.

In large part, as a result of improvements to irrigation at the start of the century, Makaweli Plantation was one of the most successful and profitable plantations in Hawai‘i (Wilcox 1996:89). The Hawaiian Sugar Company was one of the first plantations to construct family housing for its workers with amenities such as a plantation store (Dorrance and Morgan 2000:33). It established 11 or 12 small camps scattered among their fields in Makaweli Ahupua‘a around the turn of the century (including camps numbered 1 through 10). The town of Kaumakani grew up from the settlements around the sugar mill known as “Makaweli Camp” and “Camp 1,” Kaawanui Village grew up from “Camp 6,” and Pakala Village grew up from “Pakala Camp.”

In 1940, however, as a result of the lack of agreement on new leasing agreements, Hawaiian Sugar Company was dissolved. Olokele Sugar Company was formed in the place of Hawaiian

Sugar Company and under the new management of C. Brewer & Company, the same plantation continued to operate (Wilcox 1996:89). C. Brewer & Company sold Olokele Sugar Company to Gay & Robinson as its lease was nearing expiration in 1994. The plantation and mill continued to operate under the name Gay & Robinson until it was closed in the first decade of the twenty-first century.

Pakala Camp, which housed many of the plantation workers, was established as a plantation labor camp during the first decade of the twentieth century. Originally the camp consisted of approximately 126 house sites, a park, and a store. By 2010, Pakala Village had 73 occupied homes, 23 vacant but habitable homes, and 30 uninhabitable homes and/or empty lots that were formerly house sites. The store is now abandoned (Gay & Robinson, Inc. 2009:1).

4.4.4.6 World War II

In 1928, 188 acres of land south of the Nohili Barking Sands in Mānā were set aside for the development of an airstrip. In 1940, the Territorial Governor's Executive Order 887 conditionally transferred 548.6 acres of government (Crown) land to the War Department. The land was used for the establishment of the Mānā Airport Military Reservation, which became the Bonham Auxiliary Airfield in 1954. In 1941, Executive Order 944 added 606 acres to the northern section of the facility toward Polihale and added an additional 902 acres to the southern portion toward Kekaha. In 1964, 1,885 acres of the land were officially transferred to the Navy (Gonzalez et al. 1990:33–34).

Military use of the area is summarized in Clark's *Beaches of Kauaʻi and Niʻihau* (1990); his description includes the following paragraphs:

> The Pacific Missile Range Facility, a multipurpose naval installation, is located on the shoreline of the Mānā Coastal Plain. Many local residents simply call the site PMR[F]. The Pacific Missile Range Facility is one of the foremost centers in the world for the detection of aircraft or vessels in the Pacific. With its highly sophisticated computer centers and electronic equipment, the facility can detect underwater activities and estimate depth, range, and bearing of a ship, submarine, or any other marine vessel. Listening devices on the ocean floor in the Underwater Range offshore of the facility can pinpoint within 10 to 15 feet a vessel's location within an area of 1,000 square miles. Radar units on base, at Makaha Ridge and at Kōkeʻe, allow detection of surface ships and aircraft over 17,000 square miles of ocean. The Pacific Missile range Facility conducts combat training exercises using its extensive resources.
>
> Radio Station WWVH is also located within the facility. This high-frequency station is one of two in the United States operated by the U.S. Department of Commerce. It broadcasts time signals to trans-Pacific ships and aircraft. [Clark 1990:50]

During World War II, Hanapēpē was part of the changes wrought by preparations for war. A civilian hospital was also located in Hanapēpē (Figure 56). *World War II on Kauai* (Klass 1970) includes two maps that show the World War II activity on Kauaʻi plus a picture of local volunteers being inducted at Hanapēpē for the 442nd Battalion. This picture mentions Burns Field near Hanapēpē, the only paved landing strip on Kauaʻi in 1941 at the beginning of the war.

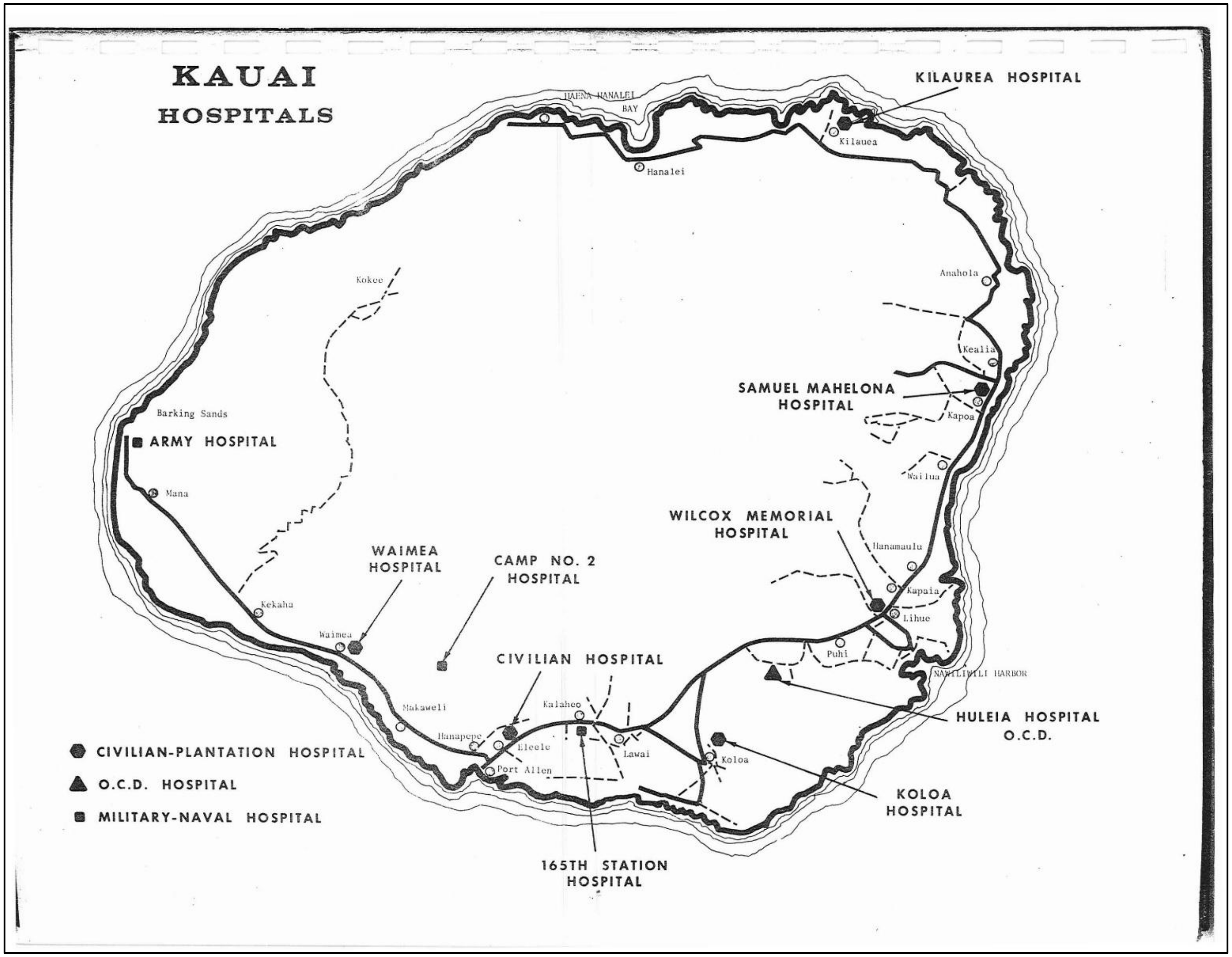


Figure 56. Map of Kaua‘i showing locations of military and civilian hospitals (Klass 1970:2)

The initial Kauaʻi garrison force consisted of elements from the 298th and 299th Infantry Regiments and numbered about 750. These former National Guard units included a large percentage of local and other Island boys and were stationed at Mānā near the newly constructed Barkings Sands airstrip, at Hanapēpē to defend Burns Field and Port Allen, and at Hanamaulu to protect the Līhuʻe airport. Commanding officer was Lieutenant Colonel Eugene Fitzgerald (Klass 1970:26). Figure 57 shows the military training areas throughout West Kauaʻi.

4.4.4.7 Modern Land Use

By the late 1960s, the main town of Kōloa experienced a type of reverse migration back to the shoreline. Although the town had established a Civic Center in 1977, the pace of tourism-driven development at the shoreline had been drawing construction and service jobs away from the town center. The Kīahuna Plantation Resort opened in 1967, followed by the construction of various condominiums throughout the 1970s and ‘80s. Finally, the Hyatt Regency Resort, with its expansive golf course, opened in 1991.

By the early 1990s, the tourist industry had successfully attached the name “Poʻipū Beach” to the entire coastline beginning at Kōloa Landing, and continuing east to Makahūʻena Ledge. With the development of the Poʻipū Bay Resort Golf Course and the Hyatt Regency Kauaʻi Resort Hotel, the Poʻipū Beach name became synonymous with all 2 miles of coastline fronting the Waiʻohai, Kiahuna, and Sheraton developments, ending at Poʻipū Beach Park (Donohugh 2001).

By 1985, annual “Plantation Days” festivals were held in the open field adjacent to the former site of the 1841 sugar mill in Kōloa Town. The Koloa Mill at Pāʻā was finally closed in 1996, and remains a landmark of the countryside as one makes the drive to Poʻipū. Future plans within the Kōloa district will place more demands on beachfront properties along the Lāwaʻi and Poʻipū coastline. Over 1,000 acres of former McBryde Sugar Company lands are slated for hotel and condominium development surrounding both coastal resort areas (Donohugh 2001).

Today, Kalāheo is a small community with a hotel, restaurants, post office, and grocery store. Pasture land is still visible along the surrounding hillsides. Remnants of the *loʻi* still remain. Donohugh (2001) explains:

> A rough hike west through the brush would bring you to a place from which you could look down on Kalāheo Gulch. The taro terraces there look as if they had been left only yesterday. Many Hawaiian house sites and a *heiau* also are in the gulch. The most fascinating finding, never reported by archeologists, is a vertical bas-relief about 2 by 3 feet with contoured human forms, not the usual stick figures Hawaiians were wont to carve. The carving is so weatherworn it is difficult to tell exactly what it portrays. [Donohugh 2001:235]

Sugarcane cultivation continued to dominate land use in Waimea and Makaweli through the mid-1900s. At the end of the twentieth century, two of the remaining three sugar plantations on Kauaʻi shut down, Kekaha and Lihue Plantation, ending the sugar plantation era on the southeast and east side of Kauaʻi. Less than ten years later, 2009 brought the last of Kauaʻi’s sugar plantation era to an end with the closing of Gay & Robinson.

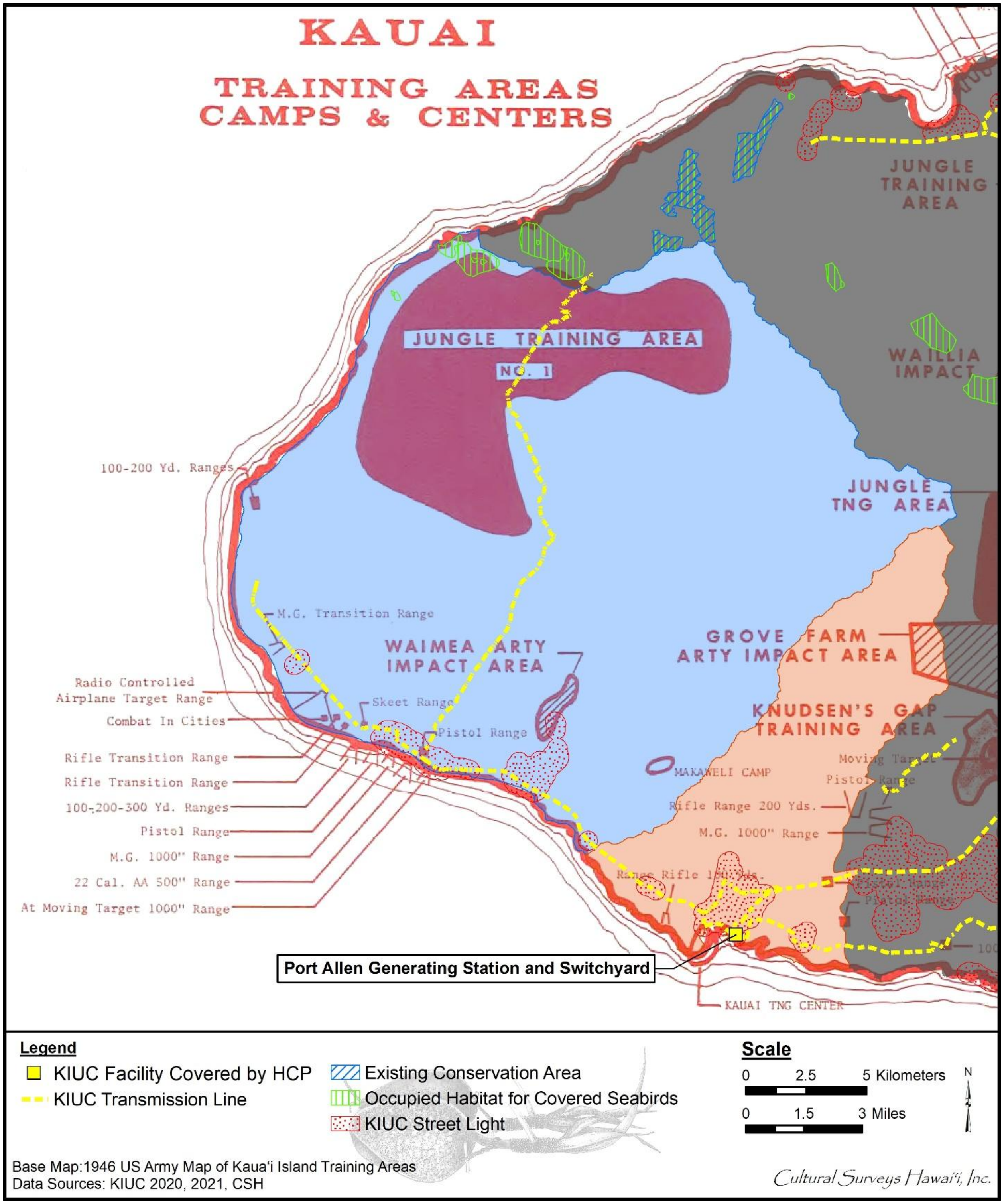


Figure 57. 1946 U.S. Army map of Kaua'i showing Training Areas

With the closing of sugar plantations and the opening of the cane lands, agribusiness companies (also known as seed companies) have migrated to the Hawaiian Islands to utilize the plantation fields and some of their infrastructure, especially on lands between Makaweli and Waimea Ahupuaʻa. By 2015, four major agribusiness companies were on Kauaʻi: BASF Plant Science (in Kekaha, north of Kekaha Road and Elementary School), Dow AgroSciences (in Makaweli, northwest of Kaumakani, north of the Highway), DuPont Pioneer (in Makaweli, north of the highway and north of Russian Fort Elizabeth (Pāʻulaʻula, SIHP # 50-30-05-01000), and Syngenta (which was bought out in 2017 and was located in Kekaha, *makai* of the highway and west of the Mānā Plains area). With the controversies such as GMO products and health issues associated with pesticides, agribusinesses companies left the island or were bought out by other agribusinesses.

Modern development and land uses in the *moku* of Kona are depicted on 1970s USGS orthophotoquad aerial photographs (Figure 58 through Figure 61).

4.5 **Moku ʻo Nā Pali**

4.5.1 Pre-Contact to Early Post-Contact Period

4.5.1.1 Subsistence and Settlement

The *moku* of Nāpali is the smallest *moku* on Kauaʻi. Nāpali is characterized by a "rugged coastline which is dissected by steep-sided, amphitheater-headed valleys" (Tomonari-Tuggle 1989:15). The largest valley in the Nāpali District is in Kalalau Ahupuaʻa. Handy and Handy (1972:415) noted Kalalau Valley was "one of the most intensively cultivated areas in the islands" with "broad, flat terraces on the level land at the seaward end of the valley" which were protected by "a sloping sea wall built with heavy stones running along the edge of the broad beach." Terraces were also located along both sides of Kalalau Stream and continued along the eastern and western branches where the stream divides (Handy and Handy 1972:416). Bennett (1931:145) also noted, "On the land between the two branches of the Kalalau stream the taro terraces are everywhere." The terraces were irrigated from a system of *ʻauwai* which received water from Kalalau Stream (Handy 1940:60). Bennett (1931:145) noted "the irrigating ingenuity is astounding." House sites, pigpens, and *heiau* were located on cliffs and on ground above the terraces (Handy and Handy 1972:416).

Bananas and sugarcane were grown on terrace walls (Handy and Handy 1972:415). Handy and Handy (1972) discuss the different types of vegetation in Kalalau:

> In the days when the *loʻi* of Kalalau were constantly cultivated this must have been a unique and densely inhabited valley. On the banks of the *loʻi* flourished bananas and sugar cane. Around houses and on slopes above the *loʻi* were sweet-potato gardens, *wauke*, and *ti*. In the upper reaches of the valley yams flourished, and there were *wauke* and *mamaki* for bark cloth, *olona* for fishlines and nets, and, in the gulches, *kukui* trees; in the lower valley and along shore grew coconut, *koa* and *hau*. The one thing that the valley lacked was large *koa* timber for making canoes. And it was possibly too wet for gourds, although these may have been raised in the lower valley during the sunny summer months. [Handy and Handy 1972:416]

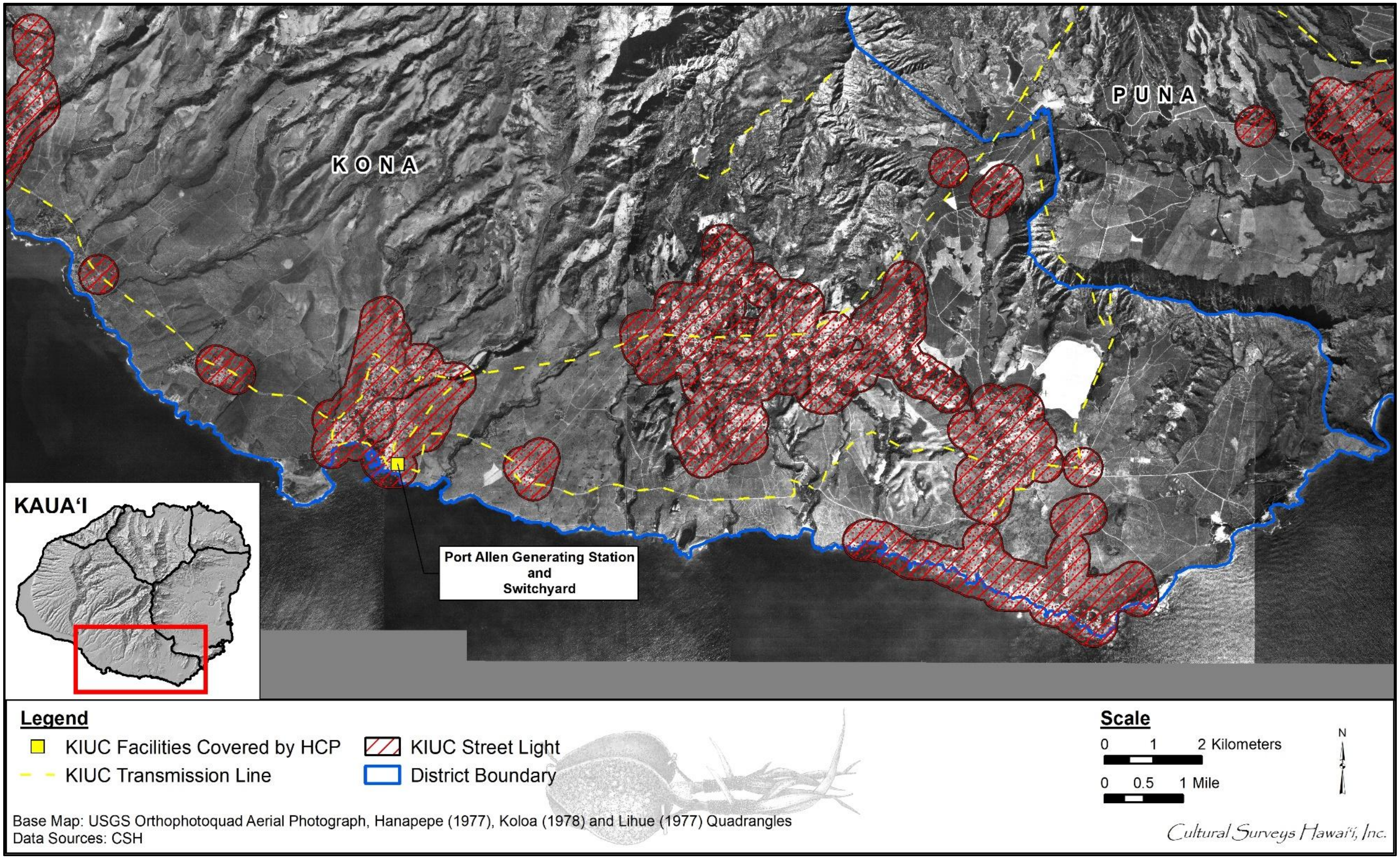


Figure 58. Portions of 1977 Hanapepe, 1978 Koloa, and 1978 Lihue USGS Orthophotoquad aerial photographs depicting modern development and land use in southeastern Kona Moku

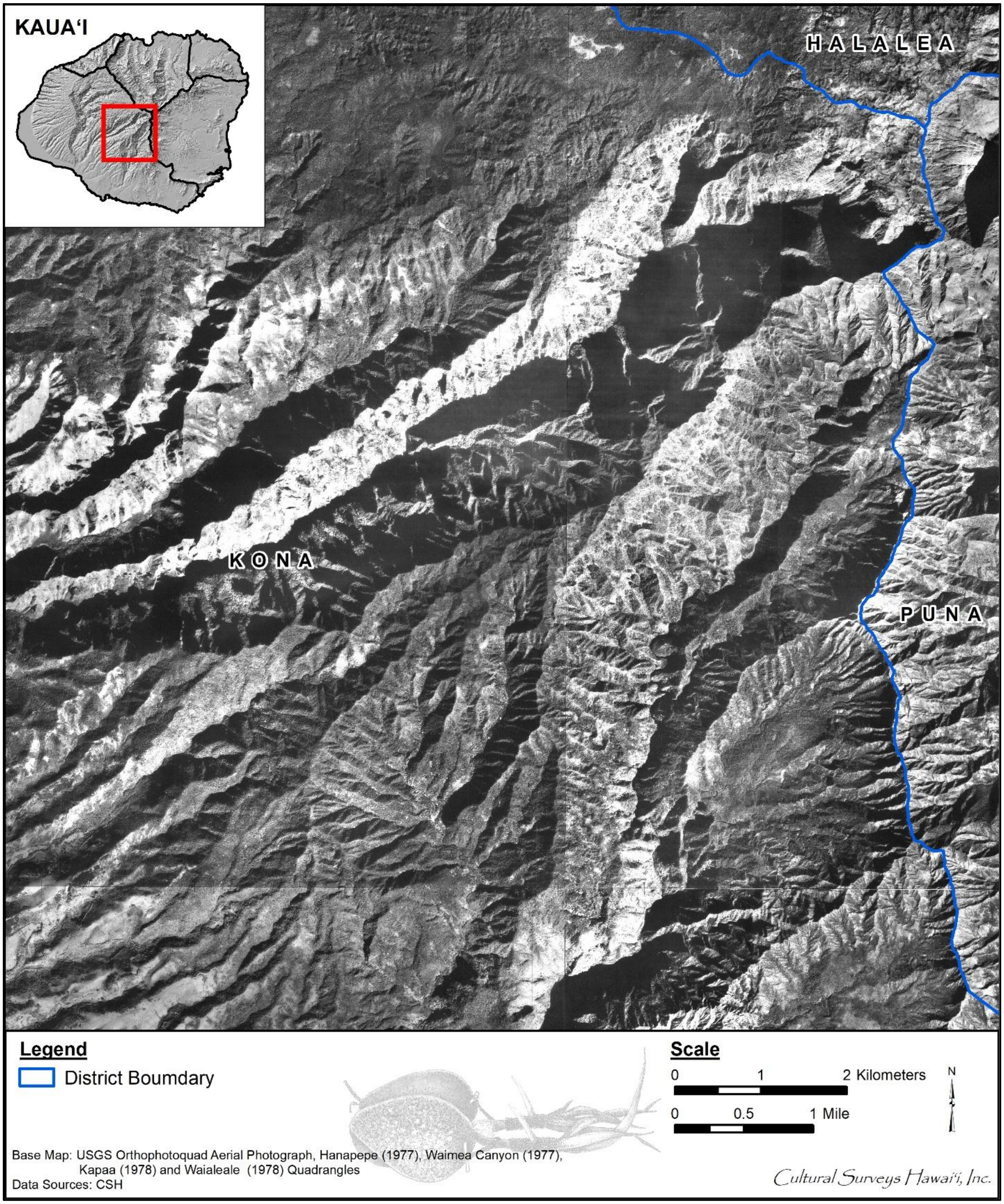


Figure 59. Portions of 1977 Hanapepe, 1977 Waimea Canyon, 1978 Kapaa, and 1978 Waialeale USGS Orthophotoquad aerial photographs depicting modern development and land use in eastern Kona Moku

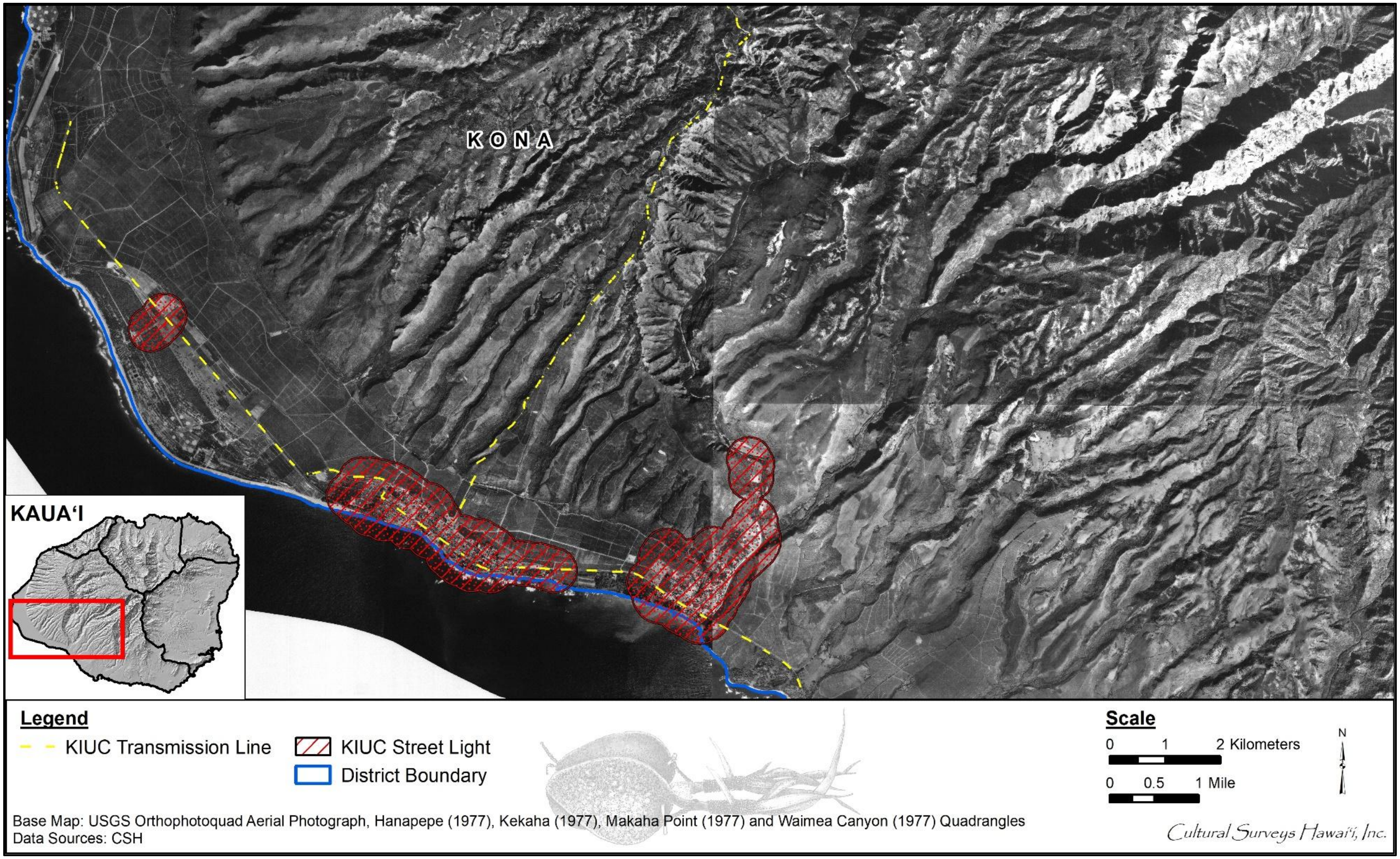


Figure 60. Portions of 1977 Hanapepe, 1977 Kekaha, 1977 Makaha Point, and 1977 Waimea Canyon USGS Orthophotoquad aerial photographs depicting modern development and land use in central Kona Moku

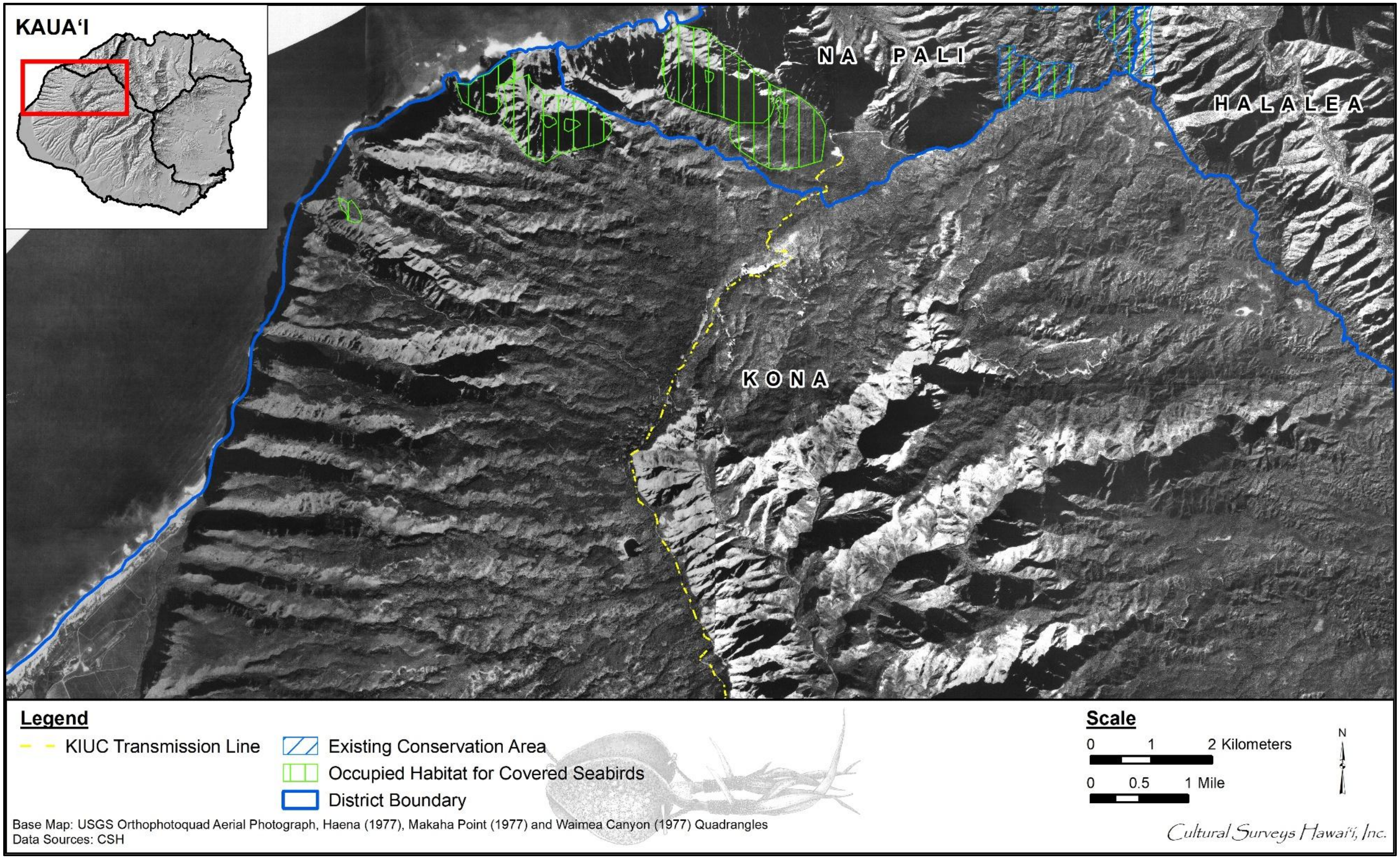


Figure 61. Portions of 1977 Haena, 1977 Makaha Point, and 1977 Waimea Canyon USGS Orthophotoquad aerial photographs depicting modern development and land use in northern Kona Moku

Tomonari-Tuggle (1989:35) states that vegetation in Kalalau is “indicative of the generally dry climatic conditions, but becomes more verdant further inland.”

> Lantana, *‘iniko* [*Indigofera suffruticosa*], and scrub Java plum are characteristic of the coastal vegetation. A high Java plum canopy with some lantana undergrowth midway up the valley gives way to a mixed canopy of Java plum, mountain apple, kukui, and guava toward the back of the valley. Various ferns, false *honohono* [*Commelina diffusa*], *honohono*, and *‘awapuhi* form the ground cover in the upper valley. Lantana grows on the upper talus slopes. Small groves of mango trees are scattered throughout the middle and upper valley, as are other fruit trees such as orange, papaya, banana, and avocado. There are also isolated groves of *hau* and bamboo. [Tomonari-Tuggle 1989:35–36]

Handy and Handy (1972:415) mention Honopū Ahupua‘a contained numerous house sites and terraces. Bennett (1931:147) also described the “extensive terracing of taro” in Honopū, and noted the “extent of the irrigating is a tribute to Hawaiian engineering.” Vegetation in Honopū consists

> […] primarily lantana and koa haole [*Leucaena leucocephala*], with a higher canopy of Java plum along the base of the pali. There is also some hau. […] Lantana is the most common vegetation and is extremely dense throughout the valley. There are several groves of hau near the front of the valley but inland, a canopy of kukui with lantana undergrowth is typical. [Tomonari-Tuggle 1989:39]

Handy (1940:61) states Awa‘awapuhi Ahupua‘a was filled with terraces which were irrigated by an *‘auwai* on the west side of Awa‘awapuhi Stream. House sites were located above the terraces. Bennett (1931:147) observed a *heiau* near the sea bluff on the eastern side of the valley. Handy and Handy (1972:415) note this “shrine” was “probably for offering taro.” Vegetation in Awa‘awapuhi is “typified by a low grass cover, with a grove of hau at the mouth of the valley and a thin canopy of kukui toward the back” (Tomonari-Tuggle 1989:39).

Pōhaku‘ao is the smallest *ahupua‘a* in the *moku* of Nāpali encompassing a series of small gulches between the valleys of Hanakoa and Kalalau (Tomonari-Tuggle 1989:31). Near the center of the Pōhaku‘ao are “two, large, level areas” known as the “Pohakuao Flats” (Tomonari-Tuggle 1989:31). Bennett (1931:138) noted remnants of terraces and house sites or pig pens at “Pohakuao Flats.” He also mentioned “a platform fishing shrine” on the trail from Pōhaku‘ao to Kalalau (Bennett 1931:49). The area is characterized by open grassland with guava, Java plum, lantana and grass (Tomonari-Tuggle 1989:31). Common vegetation in Pōhaku‘ao includes century plant or sisal on the cliffs in the southwest and *kukui*, guava, *‘awapuhi*, false *honohono*, *‘ape* (*Alocasia macrorrhiza*, *Xanthosoma robustum*), and taro in the deeper gulches (Tomonari-Tuggle 1989:31).

According to Handy and Handy (1972:416), Hanākapi‘ai Ahupua‘a was “the last of the valleys that were formerly inhabited.” They note taro *lo‘i* were cultivated on small terraces located on the southwest and northeast sides of the stream. Vegetation in Hanākapi‘ai consists of a

> […] mature forest consisting of kukui, guava, ti, and mountain apple. Isolated groves of mango trees are concentrated near stream banks. Various ferns, false honohono, and ‘awapuhi form the ground cover. There is some lantana on the east side of the valley on the upper slopes of the stream benches. *Hala* is thick along the sea *pali* and at the edge of the beach. Mountain apple trees occur mostly toward the back of the valley. [Tomonari-Tuggle 1989:25]

At the time of Handy's (1940:60) survey of the area, Hanākapiʻai was being "used only for pasturing cattle."

4.5.2 Early Historic Period

4.5.2.1 Historic Accounts

In February 1787, Captain George Dixon described the Nāpali coastline:

> Whilst we were plying in this uncertain state, we had an opportunity of viewing the north coast of Atoui, or that part of the island directly opposite Wymoa (Waimea) Bay. The shore down to the water's edge is, in general, mountainous, and difficult of access: I could not see any level ground, or the least sign of this part of the island being inhabited, at least by any considerable number of people; so that there is every reason to suppose the south side of the island contains nearly the whole of the inhabitants. [Dixon 1789:135]

In March 1794, Captain George Vancouver described the Nāpali coastline as he sailed past the area during a survey of the island of Kauaʻi. He wrote,

> […] at the distance of about two miles from the shore; passing some rocks and breakers, that extend a small distance from the west point of the bay; where the coast of Attowai assumes a very rugged and romantic appearance, riding suddenly to lofty abrupt cliffs, that jet out into a variety of steep, rugged, rocky points, apparently destitute of both soil and verdure, but terminating nearly in uniform even summits, on which, as well as in the vallies [*sic*] or chasms that were formed between the points, were small patches of lively green that produced a very singular effect. This sort of coast continued to the north west point of the island. [Vancouver 1798:73]

In the *Journal of a Canoe Voyage around the Kauai Palis, made in 1845*, Gorham Gilman (1908:7) described a visit to Nuʻalolo Kai which is located south of Honopū Ahupuaʻa in the *moku* of Kona. He described Nuʻalolo Kai as "the gathering place for canoes passing between Waimea and Hanalei, as well as for those that go over to the island of Niihau." He noted the area was associated with the traditional cultural practice of *ʻoahi* (fireworks):

> When His Majesty passes around the island, he stops here for a part or the whole of the night, to see an exhibition of fire works, got up for his entertainment. It consists of throwing light poles, which have been set on fire, from a lofty peak (Kamaile) overlooking the sea. If skillfully thrown, it will go a long distance, making a pretty show. The natives sometimes take a large bird and set it off with some burning substance attached to it. [Gilman 1908:7]

4.5.2.2 Missionaries

In 1837, the first missionaries, William Alexander and Sister E. Johnson of the Waiʻoli Mission, arrived at Kalalau (Alexander 1934b:218). Due to sea conditions, visits to Nāpali were limited to once a year during the summer (Tomonari-Tuggle 1989:18). Edward Johnson, a Waiʻoli missionary, reported that by 1852, a small school had been started and nine residents were members of the church (Johnson 1852). By 1859, half of the population of Kalalau belonged to the church (Johnson 1859). Following the introduction of Mormonism, Johnson reported that ten members of the church had “turned to “Error”” (Johnson 1863).

4.5.3 Mid- to Late Nineteenth Century

4.5.3.1 The Māhele

During the Māhele, the entire *moku* of Nāpali was claimed by Kamehameha III who gave the land to the Legislature to be managed as Government lands. In 1856-1857, government lands in the *ahupua‘a* of Kalalau, Pōhaku‘ao, and Honopū were subsequently purchased by individuals while the rest of the coastal land remained undivided (Tomonari-Tuggle 1989:18).

In Kalalau, a total of 145 acres were purchased by 24 individuals, in parcels ranging from 0.2 to 31.5 acres (Tomonari-Tuggle 1989:35). Of the 24 grants awarded, 15 consisted of multiple parcels, and 14 of those contained at least one parcel designated for cultivating *olonā*.

Three grants were awarded in Pōhaku‘ao (Grants 2170, 2172, 2176) (Tomonari-Tuggle 1989:35). Land records indicate these grants included land which was used for cultivating *kalo*/*kula* and *olonā*.

> Grant 2170: to Kamokumahakea; included 6 acres for *kalo*/*kula* cultivation and 0.67 acres for *olonā*; also a small parcel in Kalalau for *olonā* cultivation; *kalo*/*kula* land was located at the coast between Pohakuao Stream and Hakihee Ridge; *olonā* land was called ‘Kiau’ and was located east of Grant 2176 in a gulch;
>
> Grant 2172: to S. Keeia; included 0.25 acres for *olonā* cultivation (called ‘Kanakekua’) and 4.81 acres for *kalo*/*kula* cultivation; *kalo*/*kula* land was in ‘Makanikahau’;
>
> Grant 2176: to Kawika; only 0.13 acres for *olonā* cultivation; land was in a small gulch called ‘Pi‘I’. [Tomonari-Tuggle 1989:32]

Nine claims were made for land in Honopū, ranging from 0.14 to 4.75 acres (Tomonari-Tuggle 1989:40). They were used either in *kalo*/*kula* or *olonā* cultivation. Of the nine claims, four were for land in Honopū and based on their small size (0.20 to 0.25 acres) were probably used for *olonā* cultivation. Four of the remaining five claims were for multiple parcels with large *kalo*/*kula* tracts in Kalalau Valley or on Kalalau Beach and small *olonā* parcels in Honopū. Grant 2168 consisted of a little more than 5 acres on Kalalau Beach which was used for taro cultivation and a house site. The fifth claim (Grant 2413) included 4.75 acres of taro land at the mouth of Honopū.

Ten parcels under *olonā* cultivation were located in the valleys of Nanakea, Kahamama, Akauleula, and Kanakaau (Tomonari-Tuggle 1989:40).

4.5.3.2 Agriculture and Ranching

In the later nineteenth century, subsistence continued to be the primary agricultural pursuit in the Nāpali District (Figure 62). Taro and *olonā* were also grown for trade (Nakulala 1864). Coffee was cultivated commercially in Hanakapi‘ai and Hanakoa (Tomonari-Tuggle 1989:35; Daehler 1970). Ti may have also been cultivated to make *‘ōkolehao*, a liquor distilled from the root of the ti plant (Tomonari-Tuggle 1989:35; Pukui and Elbert 1984:259). Johnson (1860) reported two men from Honolulu were distilling alcohol in an uninhabited valley in Kalalau. Kalalau continued to be occupied and cultivated in “irrigated taro, olona, oranges, ti (for a profitable okolehao trade

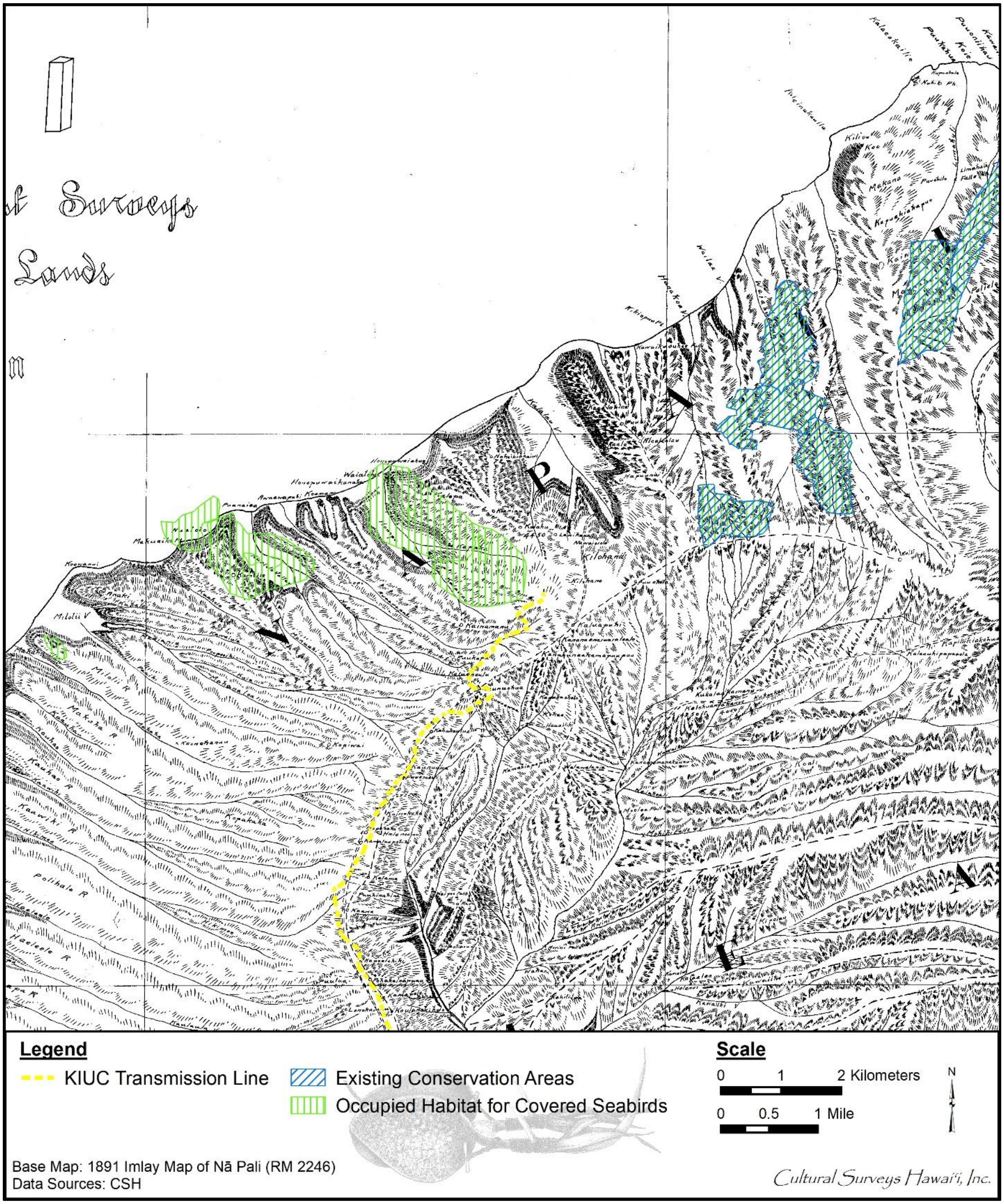


Figure 62. 1891 Imlay map of Nā Pali (RM 2246)

with Koke‘e), sugar cane, bananas, and other dry land crops" until the valley was abandoned in 1919 (Tomonari-Tuggle 1989:35, 36).

The area from Kalalau to Hanakapi‘ai was used for cattle grazing (Henke 1929). By the mid-twentieth century, this proved unprofitable, and cattle were "either shipped out by barge or led single file out along the cliff trail" (Tomonari-Tuggle 1989:19). Remnants of the Makaweli Ranch operation are still visible in Pōhaku‘ao including a Makaweli Ranch sign and wire fencing (Tomonari-Tuggle 1989:31).

4.5.4 Twentieth Century to the Present

In 1907, the Nā Pali-Kona Forest Reserve was established by Governor's Proclamation "for the purpose of protecting the water supply to adjacent agricultural lands" (DLNR 2009:2). The Nā Pali-Kona Forest Reserve is comprised of 23,000 acres of public land including Alaka‘i Wilderness Preserve, and "contains unique, high-quality native ecosystems and many rare and endangered endemic plants and animals," as well as a "small number of exotic timber plantations" (DLNR 2009:2).

In the late 1950s, Bernard G. Wheatly arrived in Kalalau, taking up residence in "one of the sea caves south of the beach" (Tomonari-Tuggle 1989:36). He survived on "taro and fruits he gathered and became skilled at catching wild goats for meat" (*Garden Island* 2007). Known as the "Hermit of Kalalau," Wheatley was the lone resident of the area until the late 1960s, when a group of transients associated with the community at Taylor Camp in Hā‘ena Ahupua‘a joined Wheatley. These new residents "modified Hawaiian terraces and habitation structures to conform to contemporary necessities" including showers, waterbeds, and saunas (Tomonari-Tuggle 1989:36). Shortly after the arrival of these new residents, Wheatley left Kalalau (*Garden Island* 2007). In 1974, Kalalau Valley was acquired the Division of State Parks and the transient residents were evicted (Tomonari-Tuggle 1989:36).

Kalalau Valley is situated within the Nā Pali Coast State Park which encompasses the valleys and coastal area from Ha‘ena to Miloli‘i Valley (Tomonari-Tuggle 1989:9). Adjacent to the Nā Pali Coast State Park is the Hono O Nā Pali Natural Area Reserve (NAR). Established in 1983 by Executive Order 3161, Hono O Nā Pali NAR was extended in 2009 by Executive Order 4270. It was created "to protect perennial streams, riparian and ridgeline habitat, lowland and montane forests, rare plants, endemic stream fauna, and forest bird habitat" (DLNR 2011:5).

Modern development and land uses in the *moku* of Nā Pali are depicted on 1970s USGS orthophotoquad aerial photographs (Figure 63).

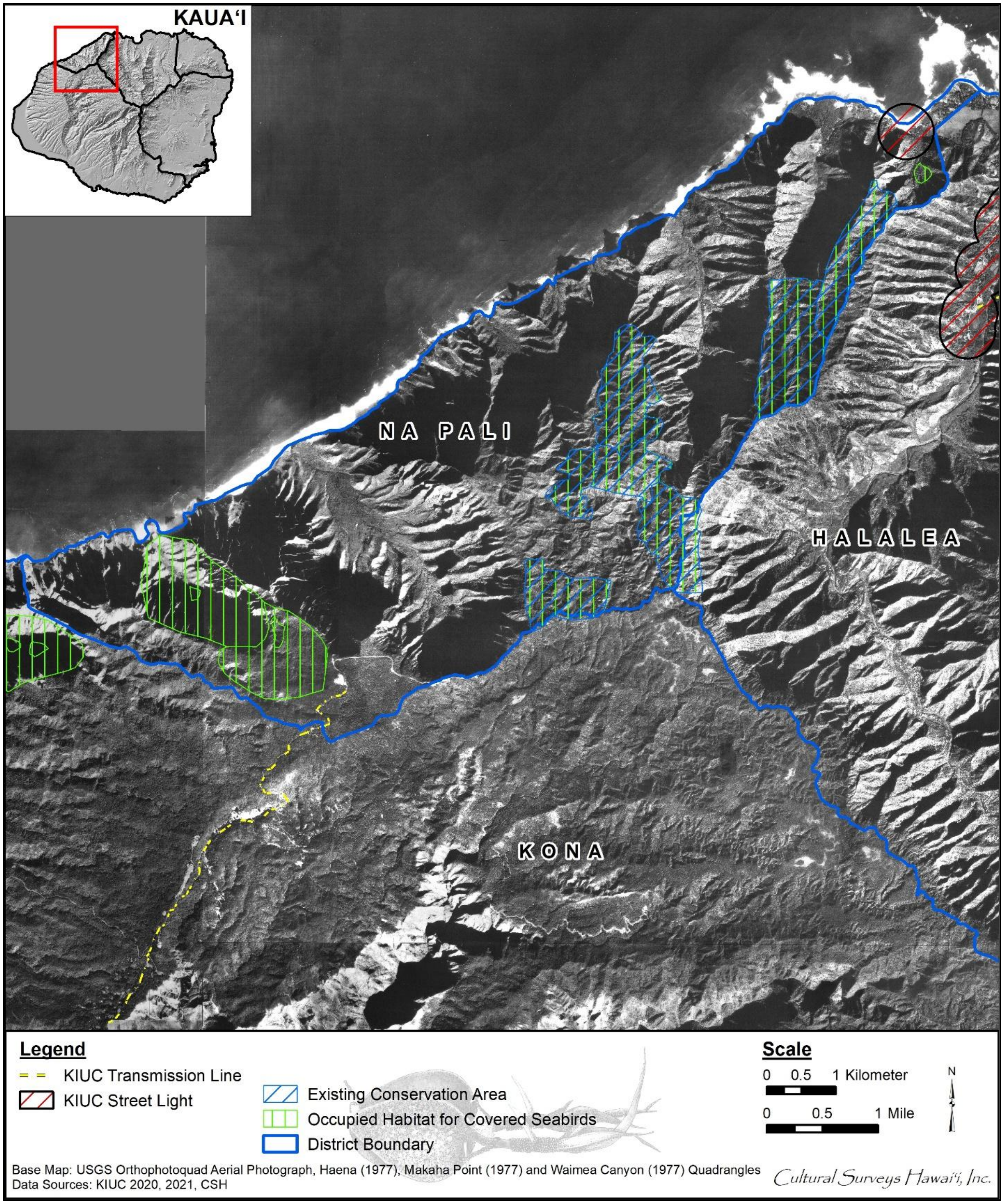


Figure 63. Portions of 1977 Haena, 1977 Makaha Point, and 1977 Waimea Canyon USGS Orthophotoquad aerial photographs depicting modern development and land use in Nā Pali Moku

Section 5 Previous Archaeological Research on Kaua‘i

CSH’s database of previous archaeological studies on the island of Kaua‘i amounts to 834 studies and a detailed review of all of these was beyond the scope of the present study. This review of previous archaeological studies and historic properties/sites on the island of Kaua‘i focuses on the uplands (above 500 ft elevation) as this area is regarded as particularly sensitive for endangered species (such as Newell’s Shearwater habitat) and because this approach allowed for detailed study of the majority of the island. A less thorough summary review of areas below 500 ft elevation is presented at the end of this study.

While the island of Kaua‘i rises to 1,598 m (5,243 ft) amsl (above mean sea level) at Kawaikini, prior archaeological studies have been focused on the lowlands where most people have lived and where most development has taken place. We show that the area of Kaua‘i above the 500-ft contour amounts to approximately 929.4 square kilometers (sq km) compared to approximately 507.5 sq km below the 500-ft contour. The total estimated area for Kaua‘i (1,436.7 sq km) may be slightly lower than reported elsewhere which is believed to reflect the difference between two-dimensional estimates of area, as used in the present study, versus three-dimensional estimates of area. For the purposes of this study the difference is suggested to be trivial. While the records of CSH include 834 archaeological studies for Kaua‘i Island, only 81 studies are located in whole or in part above the 500-ft contour (the 500-ft contour was taken as an arbitrary but convenient elevation for the purposes of this study in discussing the “uplands”). CSH records do not include all studies but a large portion of the studies conducted that can be assumed to be representative. The CSH report holdings were updated at the SHPD library in August 2021.

Table 8. Overview of archaeological studies and identified archaeological historic properties with regards to the 500 ft elevation contour on Kaua‘i

	Area Sq Km	# of Bennett (1931) Sites	Density of Bennett (1931) Sites/ Sq Km	CSH Database of Archaeological Studies	CSH Database of Archaeological Historic Properties
Below 500-ft contour	507.7 (35.3%)	173 (85.6%)	0.34	753 (90.3%)	2,009 (estimated at 94.4 % of identified historic properties)
Above 500-ft contour	929.4 (64.7%)	29 (14.4%)	0.03	81 (9.7%)	119 (51 historic properties estimated to include approx. 119 designated features, estimated at 5.6 % of identified historic properties)
Kaua‘i Island Total	1,436.7	202	0.14	834	2,128

5.1 Introduction to Archaeological Research in the Uplands of Kauaʻi

Wendell C. Bennett's 1931 study *Archaeology of Kauai* is of particular relevance because it was island-wide at a date before most development, thus avoiding the bias of only looking at an area to be developed. Bennett recorded 202 sites of which 29 (14.4 %) lie in whole or in part above 500 ft elevation. The locations of all the Bennett sites are depicted on Figure 64 with Bennett's site number and a brief description provided for his identified sites above the 500 ft elevation contour. A brief summary of Bennett's identified archaeological sites indicated as above 500 ft elevation is provided in Table 9.

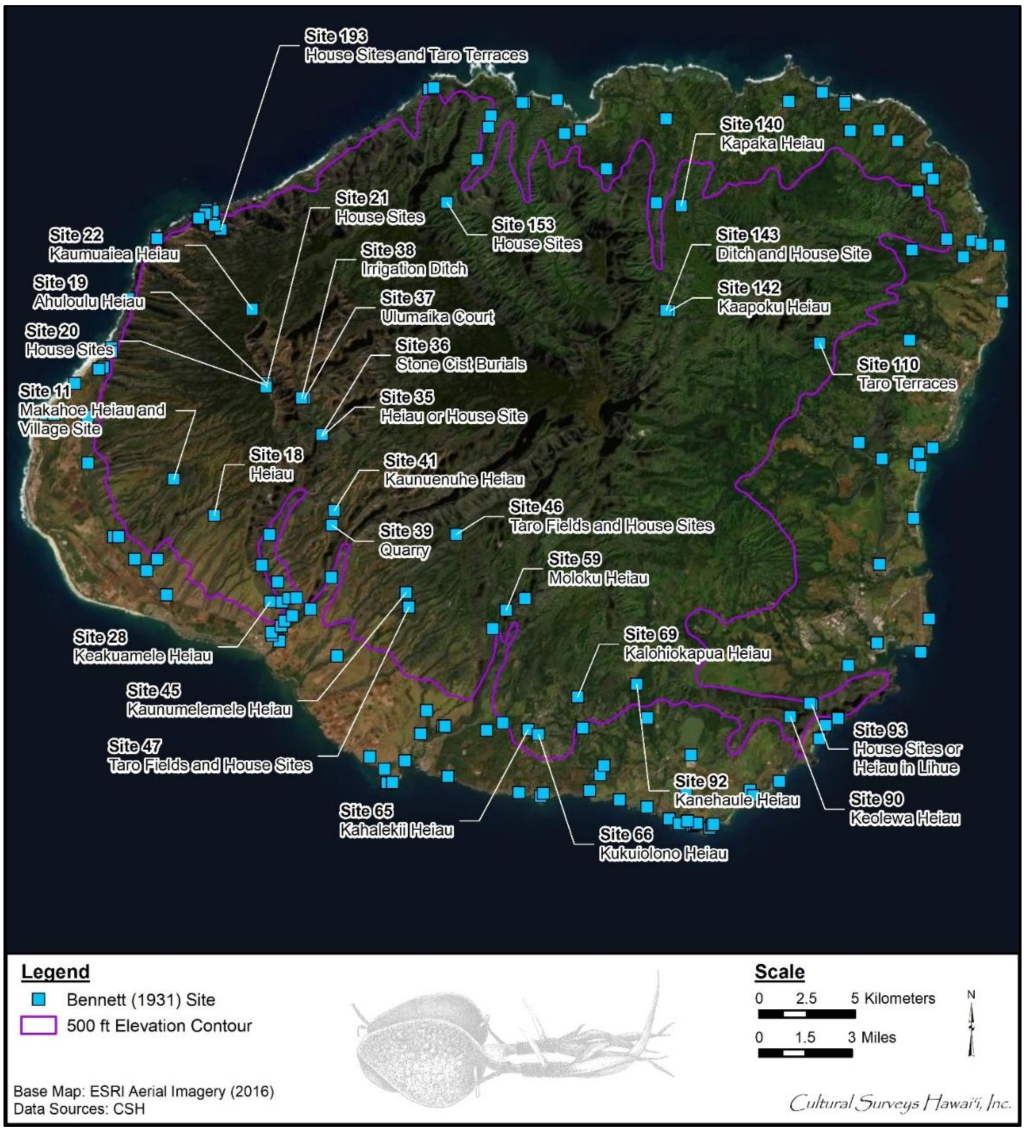


Figure 64. 2016 ESRI aerial image showing the location of 202 sites identified in Wendell C. Bennett's 1931 study *Archaeology of Kauai* with the 29 (14.4% of all Bennett sites) that lie in whole or in part above 500 ft elevation contour labelled

Table 9. Historic properties (N=29) identified by Bennett (1931) in the Uplands of Kauaʻi (above 500 ft elevation)

Site No.	General Location	Site Type	Site Name	Approx. Elevation (ft)	Comment
11	Niu ridge, Kaunalewa	*Heiau* and village	Makahoe Heiau and Village Site	1,840	A small, platform village shrine; petroglyphs reported for this area
18	On road to Kōkeʻe on Paehu ridge	*Heiau*	Heiau	1,680	On top of a small knoll with a commanding view of the country, 5 miles from the sea
19	On seaward side of Puʻu Ka Pele crater cone at edge of Waimea Canyon	*Heiau*	Ahuloulu Heiau	3,660	Back of the enclosure, a paved platform 8 by 12 ft is backed by a large rock, the plugged-up holes in the platform indicate it might have been used as a depository for umbilical cords; Bennett Sites 19–21 combined into Site 19 by Hawaii Historic Places Review Board in 1981 (McMahon 1993a:11); added to Hawaiʻi Register of Historic Places (HRHP) in 1975
20	Around crater of Puʻu Ka Pele	House sites	House Sites	3,620	Seven house sites; on top of crater cone sits a flat platform 30 ft by 30 ft, slightly terraced, in which river stones and coral found; Bennett Sites 19–21 combined into Site 19 by Hawaii Historic Places Review Board in 1981 (McMahon 1993a:11)

Site No.	General Location	Site Type	Site Name	Approx. Elevation (ft)	Comment
21	Toward sea from Puʻu Ka Pele on north side of road	House sites	House Sites	3,620	A series of house sites located on top of a flat ridge, the edge lined with stones for 50 ft or more; Bennett Sites 19–21 combined into Site 19 by Hawaii Historic Places Review Board in 1981 (McMahon 1993a:11)
22	In forest of Miloliʻi on ridge of Kaumuohua	*Heiau*	Kaumuaiea Heiau	3,440	A few stones in a rough line, but not forming a platform or definite outline
28	On a high point on west side of Waimea River	*Heiau*	Keakuamele Heiau	880	Excellent view of the valley; Thrum describes it as "An unenclosed small pile of rocks; a sacred place"; a number of small piles of rocks, any one of which could be deemed sacred, in area; location is excellent
35	Junction of Waiʻalae and Waimea rivers	*Heiau*	Heiau or House Site	600	An unpaved, walled enclosure 82 ft long and 64 ft wide; walls roughly 3 ft wide and 3 to 4 ft high
36	Junction of Waiʻalae and Waimea rivers (a short distance behind Site 35)	Burials	Stone Cist Burials	600	Two stone cist burials, one with five parallel rows of small river stones running lengthwise, connected by a row at each end
37	Between Waihalulu and Koaiʻe streams, Waimea	*Ulumaika* (bowling stone) court	Ulumaika Court	840	Nothing today to distinguish site except flatness of the land and the fact that rocks are cleared off it; many *ʻulu maika* stones reported to have been found here

Site No.	General Location	Site Type	Site Name	Approx. Elevation (ft)	Comment
38	North side of Koai‘e River, Waimea	Irrigation ditch	Irrigation Ditch	800	Stonework built up around *pali* for about 400 ft; consists of building a stone facing, well laid but not fitted, about 1.5 to 3 ft away from cliff, filling up inside with dirt and stone, and specially fixing top stones
39	On Mokihana ridge, Waimea	Quarry	Quarry	1,520	Extending several miles, seems to have been considerable quarrying done as chips and unfinished adzes found
41	On Mokihana ridge, Waimea	*Heiau*	Kaunuenuhe Heiau	1,600	Top of knoll roughly round, 80 by 96 ft; paving covers whole top of knoll which has been flattened; coral found and a few river stones
45	Located in Makaweli on ridge near junction of Hikilei and Kunalele valleys	*Heiau*	Kaunumelemele Heiau	1,100	Open platform *heiau* in good condition
46	In Kawaipapa Valley	Taro fields and house sites	Taro Fields and House Sites	2,400	Terraces and house sites on edge of valley are interesting as they show a fairly large population quite a ways inland
47	In Honua‘ula Valley	Taro fields and house sites	Taro Fields and House Sites	1,080	This valley shows considerable taro terracing, as well as walled enclosures that look like pigpens
59	In Hanapēpē near peak of Kuopoo ridge at its junction with Kahalau	*Heiau*	Moloku Heiau	1,550	Open platform *heiau*, in fair condition

Site No.	General Location	Site Type	Site Name	Approx. Elevation (ft)	Comment
65	On western slope of Kukuiolono hill	*Heiau*	Kahalekii Heiau	700	Now completely destroyed, but Thrum describes it as, "A square three-terraced heiau of large size, with several divisions, was high walled and paved"
66	Kukuiolono hill	*Heiau*	Kukuiolono Heiau	850	Now destroyed; large three-terraced *heiau*, east section 95 by 112 ft, mid-section 105 by 83 ft and west division 105 by 51 ft, giving a total length of 246 ft straight on seaward side
69	Lāwaʻi valley, inland on west side on a hill	*Heiau*	Kalohiokapua Heiau	650	Stone platform *heiau* about 20 by 20 ft, walled some 4 ft high; a place of circumcision
90	On peak of Hāʻupu	*Heiau*	Keolewa Heiau	2,280	Small *heiau* dedicated to Laka
92	At Kaunuieie, Kōloa at small east branch of ʻŌmaʻo Stream	*Heiau*	Kanehaule Heiau	600	Paved, walled enclosure of large size but destroyed; rites of circumcision performed here
93	On side of trail that leads to Kīpū Kai	House sites or *heiau*	House Sites or Heiau in Lihue	520	Large two-terraced structure; at front a stone facing 165 ft long and 15 ft wide built up 5 ft at east end, but increases to 10 ft on west end due to little gulch that cuts in
110	Back of Kapa homesteads	Terraces	Taro Terraces	520	In foothills of mountains many little valleys contain taro terraces; found bowl under a large mango tree
140	On top of Kapaka hill on east bluff of Hanalei Valley just within forest line	*Heiau*	Kapaka Heiau	1,120	Paved open platform *heiau* without walls; river stones seem to cover top of hill for a diameter of about 75 ft

Site No.	General Location	Site Type	Site Name	Approx. Elevation (ft)	Comment
142	At Kalama-iki Hanalei Valley	*Heiau*	Kaapoku Heiau	800	Small shrine consists of paved platform 18 by 20 ft made of rough stones; village was across the stream
143	Across river from Site 142 in Hanalei Valley	Ditch and house site	Ditch and House Site	720	Site also includes taro terraces and a ditch that runs from 0.5 mile or so up stream to water this plain
153	On Mauna Hina ridge in Wainiha Valley	House sites	House Sites	520	Remains of many old house sites and much irrigated land
193	In Nualolo Valley in large *kukui* grove	House sites and taro terraces	House Sites and Taro Terraces	520	Numerous house sites and terraces

A few tentative conclusions regarding the nature, density, and distribution of archaeological sites at higher elevations on Kaua'i are suggested on the basis of the Bennett (1931) data. It may be noted, for example, that 17 of the 29 sites (58.6%) were believed to include a *heiau*. As *heiau* sites were arguably of greater cultural import, they may have been more likely to have been remembered and reported to Bennett in the early 1930s than more mundane sites such as house sites and ponded fields. As a generalization, *heiau* would tend to be located in prominent locations overlooking the cultural landscape of homes and fields making them more readily identifiable. It is possible Bennett recorded the vast majority of *heiau* that will ever be recorded as it appears that since Bennett, only one probable *heiau* site has been recorded (Dye 2005).

Only nine of the higher elevation sites identified by Bennett included house sites. These were often in the *mauka* reaches of large and wide, deeply dissected valleys such as Waimea Valley (Bennett Site 35), Kawaipapa Valley, Waimea (Bennett Site 46), Honua'ula Valley, Waimea (Bennett Site 47), Hanalei Valley (Bennett Site 143), Wainiha Valley (Bennett Site 153), and Nualolo Valley (Bennett Site 193). There were a couple of exceptional areas for higher elevation habitation including the Hā'upu Headland, on the trail leading to Kīpū Kai (Bennett Site 93), and along the west margin of Waimea Valley (Bennett sites 11, 20, and 21) understood to have been a major traditional trail. These exceptional areas for inland habitation were relatively narrowly circumscribed.

Bennett only identifies four agricultural sites (all indicated as for taro cultivation) above 500 ft elevation and three of these were combined with habitation sites (Bennett Site 46 in Kawaipapa Valley, Waimea; Bennett Site 47 Honua'ula Valley, Waimea; and Bennett Site 193 in Nualolo). The one exception of a *mauka* agricultural site without closely associated habitation was in the back of Kapa'a (Bennett Site 110).

Of note, Bennett only posits a burial function to one site above 500 ft elevation, two burials (Bennett Site 36) near the junction of the Wai‘alae and Waimea rivers and quite close to a habitation (Bennett Site 35).

A logical inference of the Bennett (1931) study is that additional traditional Hawaiian site identifications in the uplands (above 500 ft elevation) of Kaua‘i might be uncommon outside certain specific areas (floors of major valleys, back of Kapa‘a, west side of Waimea Valley, Hā‘upu Headland).

5.2 Later Archaeological Studies Reporting Historic Properties Above 500 Ft Elevation in the Uplands of Kaua‘i

A summary of archaeological studies in the uplands of Kaua‘i (above 500 ft elevation) is provided in Table 10 with the locations of these studies depicted in the following series of maps (moving clockwise from north) of northern Halele‘a District (Figure 65), northeastern Ko‘olau District (Figure 66), eastern Puna District (Figure 67), south and southwestern Kona District (Figure 68), and the northeastern Nā Pali District (Figure 69). The 41 studies that report archaeological historic properties are then examined in greater detail below.

5.2.1 Kikuchi 1963 (near Kukui-o-Lono Park in Kalāheo Ahupua‘a)

William “Pila” Kikuchi (1963) prepared a summary of archaeological survey and excavations in Kona District, Kaua‘i addressing scattered historic properties from Hanapēpē to Maha‘ulepū. A great many historic properties are discussed, almost all at low elevations close to the coast. He does develop information (Kikuchi 1963:37) regarding sites above 500 ft elevation near Kukui-o-Lono Park in Kalāheo Ahupua‘a including Kukui-o-Lono Heiau, an associated path, and Kahaleki‘i Heiau, reporting that both *heiau* are completely destroyed.

5.2.2 Neller and Palama 1973 (Hā‘upu Ridge)

The Archaeological Research Center Hawaii (ARCH, Neller and Palama 1973) produced a study of the archaeology of Puna District, Kaua‘i, from Niumalu to Kīpū, that was largely focused on the Hulē‘ia River Valley area. While most of the historic properties discussed were close to the coast at low elevations, some of the sites discussed (SIHP #s 50-30-11-3003 a habitation complex, -3006 a house platform, -3007 an *‘alaea* (ocherous earth) pit, and -3008 terraces and house sites) were high on Hā‘upu Ridge (Niumalu, Ha‘ikū and Kīpū, south of Nāwiliwili Harbor).

5.2.3 Ching 1978 (Waimea Canyon)

Francis Ching reported on an archaeological reconnaissance of Kukui Trail, Waimea Canyon State Park, briefly documenting a number of well-preserved former irrigated taro fields (*lo‘i*) and terrace walls (SIHP # 50-30-06-3012).

5.2.4 Kelly and Hee and Cordy 1978 (Lumaha‘i Valley)

The Bernice Pauahi Bishop Museum produced a pair of reports (a historical survey by Marion Kelly and Clayton Hee 1978 and an archaeological survey by Ross Cordy 1978) addressing (in part) a hydroelectric power plant location in Lumaha‘i Valley. While their studies were largely focused on the floor of the valley, their maps show it as extending up to the 2,0000-ft contour. Three site areas were identified at Lumaha‘i and given temporary site numbers: Site Area 1 included three to four enclosures and a wall regarded as a dryland agricultural site, Site Area 2

Table 10. Previous archaeological studies in the uplands of Kauaʻi (above 500 ft elevation)

Author(s)	Study Type	General Location	Sites IDed	Comment
Bennett 1931	Reconnaissance	Island-wide (see Figure 64)	Y	Bennett (1931) documented 29 historic properties *mauka* of 500-ft contour (see Table 9)
Kikuchi 1963	Reconnaissance and excavation	Kona District (Hanapēpē to Mahaʻulepū) (see Figure 68)	Y	Discusses sites above 500 ft elev. near Kukui-o-Lono Park in Kalāheo Ahupuaʻa including Kukui-o-Lono Heiau, an associated path, and Kahalekiʻi Heiau reporting both *heiau* completely destroyed
Neller and Palama 1973	Reconnaissance	Puna District from Niumalu to Kīpū, largely focused on Hulēʻia River Valley area (see Figure 67)	Y	While most of historic properties discussed were close to the coast at low elevations, some sites discussed (such as SIHP #s 50-30-11-3003 a habitation complex, -3006 a house platform, -3007 an *ʻalaea* [ocherous earth] pit, and -3008 terraces and house sites) located high on Hāʻupu Ridge
Ching 1978	Reconnaissance	Kukui Trail, Waimea Canyon State Park (see Figure 68)	Y	Documented number of well-preserved former irrigated taro fields (*loʻi*) and terrace walls (SIHP # 50-30-06-3012)
Kelly and Hee and Cordy 1978	Historical survey and archaeological reconnaissance	Lumahaʻi Valley (see Figure 65)	Y	Site Area 1 included three to four enclosures and a wall regarded as dryland agricultural site; Site Area 2 included three terrace lines; Site Area 3 a dam and canal related to irrigated agriculture
Sinoto 1978	Reconnaissance	Ridges near Kekaha (Waiawa, Hōʻea, Kahoana, Waipao, Paua, Waiaka, Kapilimao, and Hukipo), Waimea (see Figure 68)	Y	While locations of all the sites and site areas not altogether clear, Sinoto (1978:9) designated *mauka* areas of Hōʻea, Kahoana, Waipao, and a coastal area of Paua as "Restricted Areas" due to their archaeological sensitivity

Author(s)	Study Type	General Location	Sites IDed	Comment
Kikuchi 1979	Reconnaissance	Anahola, *mauka* DHHL Farmlands (see Figure 66)	Y	Inspected a large quadrangular enclosure "said to be a temple"; Kikuchi thought the enclosure Bennett Site 118 and agreed with Bennett that it was an animal corral
Tomonari-Tuggle 1979	Reconnaissance	Nā Pali Coast State Park from Hanakāpīʻai to Miloliʻi (see Figure 68 and Figure 69)	Y	While most sites described were at low elevations close to the coast, some sites were quite far back in these steep valleys at higher elevations, particularly at Hanakāpīʻai (terrace sites designated HKP-12, HKP-13, HKP-17) and Kalalau (terrace sites designated KAL-1, KAL-2, KAL-17, and KAL-18)
Barrera 1980	Reconnaissance	Kōloa (see Figure 68)	N	–
Folk and Ida 1981	Reconnaissance	Wailua River Valley (see Figure 67)	Y	While most archaeological sites were close to the coast, terrace complexes SIHP #s 50-30-07 -210 and -211 were in Study Area H well inland, at close to 500 ft elev.
Barrera 1982a	Reconnaissance	Kitano Reservoir (Kōkeʻe/Waimea (see Figure 68)	N	–
Barrera 1982b	Reconnaissance	Upper Wainiha Valley (see Figure 65)	Y	Refers to possible house sites and smaller terrace systems but virtually no location data provided
Kikuchi 1982	Reconnaissance	Mākaha Ridge, Waimea (see Figure 68)	N	–
Tomonari-Tuggle 1982	Reconnaissance	Summit Camp Radio Station (Hanalei-Kawaihau ridge) 2,150 ft elev. (see Figure 65 and Figure 67)	N	–

Author(s)	Study Type	General Location	Sites IDed	Comment
Kikuchi 1983	Monitoring	Waimea Valley (see Figure 68)	Y	Documents a burial (SIHP # 50-30-09-1870?) and develops data on Pe‘e-Kaua‘i ditch and WWII hospital but these were at lower elevations
Barrera 1984	Reconnaissance	Upper Wainiha Valley (see Figure 65)	Y	Discusses two neighboring sites, SIHP #s 50-30-02-1500 and -1502; SIHP # -1500 is complex of agricultural features (“irrigated dry-terraces”), at about 770 ft elev. including designated features “A” through “AN”; SIHP # - 1502 consisted of three features (a charcoal lens and two similar pits) adjacent to and about 15 ft above SIHP # -1500
Tomonari-Tuggle 1984	Reconnaissance	Mt. Wekiu, Kapa‘a (see Figure 67)	N	–
Hammatt 1986	Reconnaissance	Makaleha Stream, Kapa‘a (see Figure 67)	N	–
Hammatt and Borthwick 1986	Reconnaissance	Upper Hanalei Valley, 40 ft elev. to 540 ft elev. (see Figure 65)	Y	Located and briefly described 14 archaeological sites; identified irrigated terrace sites, some with associated house platforms; most sites at far lower elevations but some (CSH 7 rock shelter, CSH 8 rock shelter) above 500 ft elev.
Kam 1987	Reconnaissance	Keahua Arboretum, Wailua (see Figure 67)	N	–
Nagata 1987	Reconnaissance	Lihue-Koloa Forest Reserve (see Figure 67)	N	–
Nagata and Kam 1987	Reconnaissance	Makaleha Stream, Kapa‘a (see Figure 67)	N	–
Hammatt 1988	Reconnaissance	Upper Wailua Hydroelectric	N	–

Author(s)	Study Type	General Location	Sites IDed	Comment
		Project, Wailua (see Figure 67)		
Kikuchi 1988	Reconnaissance	Keahua Arboretum, Wailua (see Figure 67)	Y	Designated “the Kauakahi adze workshop” (SIHP # 50-30-07-4000)
McMahon 1988	Reconnaissance	Kalāheo water lines along Po‘ohiwi Rd (see Figure 68)	Y	Determined stone wall and associated terraces and paved platform was Bennett Site 406 Kahaleki‘i Heiau (designated SIHP # 50 30-10-406)
Yent 1988	Archaeological inventory survey (AIS)	Keahua Arboretum, Wailua (see Figure 67)	Y	Further documents Kauakahi adze workshop (SIHP # 50-30-07-4000)
Yent 1989	Monitoring and limited survey	Miloli‘i, Honopū, and Kalalau to Hanakāpī‘ai, Nā Pali Coast State Park (see Figure 68 and Figure 69)	Y	HNP (for Honopū) 12, agricultural complex/terrace system, and HNP 13, retaining wall, above 500 ft elev. but site elev. not always clear in these very steep slopes and valleys
Rosendahl 1990	AIS	Namahana Farms, Kalihiwai (see Figure 65)	N	–
Walker and Rosendahl 1990	AIS	Included three areas at coastal Pacific Missile Range Facility and four areas at Kōke‘e Park Geophysical Observatory facility at ca. 3,755 ft AMSL. Waimea (see Figure 68)	Y	During survey, a low retaining wall noted in vicinity of “Site 2” outside fenced compound at KPGO; retaining wall appeared to be relatively recent construction and not designated as an archaeological site; no other surface cultural remains identified
Folk and Hammatt 1991	AIS	Kalāheo (see Figure 68	N	–
Hibbard 1991	Reconnaissance	Kalāheo, Kōloa (see Figure 68)	N	–
McMahon and Fujimoto 1991	SHPD burial documentation	Yamamoto Family Grave Site, Lawai Odaisan (Buddhist	Y	Documents two graves and Japanese Church site which had 88 Buddha temples

Author(s)	Study Type	General Location	Sites IDed	Comment
		church), Lāwaʻi (see Figure 68)		(strategically placed on hillside where people would go to heal themselves; some Buddhas are still there) designated SIHP # 50-30-10-1865
Pantaleo and Williams 1991	Reconnaissance	Selected portions of Port Allen-Wainiha Transmission Line Corridor (64 km long, 18 m wide) (see Figure 65 and Figure 67)	Y	Corridor passed through previously identified SIHP # 50-30-03-1006, series of pond field remnants in Hanalei Valley (below 500 ft elev.)
Yent 1991	AIS	Keahua Arboretum, Wailua (see Figure 67)	Y	No adze materials or other cultural remains observed; Kauakahi adze workshop, SIHP # 50-30-07-4000 discussed
Kikuchi and Remoaldo 1992	Cemetery study (Cemeteries of Kauaʻi)	Island-wide (documents three cemeteries above 500 ft elevation, all in Kalāheo) (see Figure 68 and Figure 70)	Y	Study of Cemeteries of Kauaʻi appears to document three cemeteries above 500 ft elev., all in Kalāheo, reported as SIHP #s 50-30-10-B001 Holy Cross Cemetery, -B002 “88 Shrines” Cemetery (a.k.a. SIHP # -1865), and -B014 McBryde Grave (a.k.a. SIHP # -3908)
Spear 1992	AIS	Site 50-30-07-4000, Keahua Arboretum, Wailua (see Figure 67)	Y	Further study of Kauakahi adze workshop, SIHP # 50-30-07-4000
Chaffee and Spear 1993	AIS	Puʻu Ka Pele Forest Reserve Waimea Canyon Park (see Figure 68)	N	–
Dowden and Rosendahl 1993	AIS	Mountaintop Sensor Waimea (see Figure 68 and Figure 69)	N	–
Hammatt and Ida 1993	Reconnaissance	Kekaha (two parcels, Parcel 3 at coast and Parcel 4B between 480-ft and 960 ft elev.) (see Figure 68)	N	–

Author(s)	Study Type	General Location	Sites IDed	Comment
McMahon 1993a	Burial report (SHPD inadvertent find documentation)	Paiwa, 6 miles up Waimea Canyon (see Figure 68)	Y	Partially sealed burial cave including remains of five individuals "surrounded by rock walls, enclosures and rock platforms" designated SIHP # 50-30-06-498
McMahon 1993b	Reconnaissance	Ridge roads Kōkeʻe Uplands (see Figure 68)	Y	5-m stone alignment, one to two courses high, believed to be planting area for sweet potato designated SIHP # 50-30-01-499
Chaffee and Spear 1994	AIS	Pole locations between Kapaʻa Substation at 8 m elev. and 304 m near Hanahanapuni Tap (see Figure 67)	N	–
Carpenter and Yent 1994	Reconnaissance	Polihale State Park and adjacent lands, particularly along coastal *pali* to 1,060 ft elev., Waimea (see Figure 68)	Y	Many historic properties (including rock shelters, house sites, *ahu*, terraces, and burials) identified along cliff line, mostly near base; some sites (like SIHP # 50-30-01-1976, a human burial) higher on the steep slope; elevation of historic properties not always clear
Hammatt and Ida 1994	Reconnaissance	Kalāheo (see Figure 68)	N	–
Yent 1994	Reconnaissance	Kukui Facility, Waimea Canyon State Park (see Figure 68)	N	–
McMahon 1995	Reconnaissance	Hanahanapuni, Shooting Range, Wailua (see Figure 67)	N	–

Author(s)	Study Type	General Location	Sites IDed	Comment
Wulzen and Jensen 1995	Reconnaissance	Two discrete project areas: coastal Barking Sands and 175 acres at Mākaha Ridge (1,400-1,800 ft elev.) (see Figure 68)	N (No sites IDed above 500 ft	Identified 53 sites at coastal Barking Sands project area but no sites located at Makaha Ridge facility
Yent 1995	Reconnaissance	Civilian Conservation Corps (CCC) Camp Kōkeʻe State Park (see Figure 68)	Y	No archaeological sites that pre-date construction of the CCC camp (in 1935) observed; camp discussed as historic property (subsequently designated SIHP # 50-30-06-9392)
Kaschko 1996	AIS	Pole locations from Wainiha powerhouse (20 ft elev.) to back of Hanalei Bay (20 ft elev.) to Kualapa Peak (2,100 ft elev.) to back of Wailua (see Figure 65 and Figure 67)	Y	Four historic properties reported, three of these at low elevations at Hanalei, SIHP #s 50-30-03-993, -994, and -1007; fourth was SIHP # 50-30-07-4000, lithic workshop area above Wailua (previously reported in Kikuchi 1988, Yent 1988, Spear 1992)
McMahon 1996	Reconnaissance	Kōloa Radio Project Paʻa (see Figure 67)	N	–
Yent 1997	Reconnaissance	Kekaha Game Management Area Waimea (see Figure 68)	N	–
Hammatt and Chiogioji 1998a	Reconnaissance	Approx. 11.5 km of Kaumualiʻi Hwy through Nāwiliwili, Haʻikū, and Kōloa Ahupuaʻa (see Figure 68)	N (No sites IDed above 500 ft	Four historic-era sites identified: Grove Farm office building in Puhi, Līhuʻe Mill Bridge, Hoʻomana Overpass Bridge, and Līhuʻe Public Cemetery all below 500 ft elev.
Hammatt and Chiogioji 1998b	Reconnaissance	Lands of Keālia Ahupuaʻa (6,690.9 acres) (see Figure 67)	Y	Keālia Stream below ʻŌpae Kalaole Falls some 80-87 separate terraced fields three or four *ʻauwai,* and four habitation sites observed

Author(s)	Study Type	General Location	Sites IDed	Comment
McDermott and Hammatt 2000	Reconnaissance	Kalāheo Water System, Kalāheo (see Figure 68)	Y	Study discusses SIHP # 50-30-10-406 consisting of apparently traditional Hawaiian archaeological features including numerous terraces, wall segments, platforms, and large multi-tiered terrace; additional site was historic ditch feature with stacked stone water-diversion feature
Hammatt 2001	Literature review	82 km (51 miles) of road corridor from Kekaha to Moloaʻa (see Figure 67 and Figure 68)	N (No sites IDed above 500 ft	Belt Hwy only ascends above 500 ft elev. in Kalāheo area, section (Section 7) from east side of Hanapēpē Valley to Rice St in Līhuʻe evaluated as of "Low" archaeological potential
Perzinski et al. 2001	AIS	Kalāheo Water System, Kalāheo (see Figure 68)	Y	Describes two historic properties at 950 ft elev., SIHP # 50-30-10-406 consisted of numerous agricultural features including terraces, rock mounds, platforms, and walls; SIHP # 50-30-10-485 was historic water diversion feature likely constructed for truck crop irrigation
Rechtman et al. 2001	AIS	Kīlauea and Kalihi Wai (1,400 acres) extending up to an elev. of 686 ft (see Figure 66)	N (No sites IDed above 500 ft	Study identified four Historic Period sites, three newly assigned (SIHP #s 50-30-03-2062 a dam complex, -2063 a flume and ditch complex, and -2064 two flume supports) and one site, SIHP # 50-30-032060, a dam, previously recorded; all below 500 ft elev.
Yorck et al. 2002	AIS	Piwai Reservoir, Kōloa (see Figure 68)	N	–
Hammatt and Shideler 2003	AIS	Kōloa (see Figure 68)	N	–

Author(s)	Study Type	General Location	Sites IDed	Comment
Chiogioji et al. 2004	Reconnaissance	Kōke‘e and Waimea Canyon State Parks (see Figure 68 and Figure 69)	Y	Three properties related to 20th century activities observed within parks area: flume segment, water tank foundation, and pair of mortared-stone walls (no SIHP #s assigned)
Yent 2004	Reconnaissance	Kōke‘e and Waimea Canyon State Parks (see Figure 68)	N	–
Yorck et al. 2004	AIS	Piwai Reservoir, Koloa (see Figure 68)	N	–
Dockall et al. 2005	AIS	Alexander Dam Irrigation Ditch project, Wahiawa (see Figure 68)	Y	Three historic properties identified consisting of SIHP # 50-30-09-3917 a remnant of an irrigation canal, SIHP # -3918 identified as Alexander Dam, and SIHP # -3919 designating a forebay feature of the dam
Dye 2005	Reconnaissance	Animal Control Fence Line, Lumaha‘i (see Figure 65)	Y	SIHP # 50-30-03-3914, platform located on top of prominent *pu‘*u; branch coral found at site indicates it is a *heiau*
Monahan and Powell 2005	AIS	Kōke‘e State Park CCC Camp (see Figure 68)	Y	Discusses CCC Camp (previously described by Yent 1995, discussed above) designated SIHP # 50-30-06-9392; no significant historic sites or features (other than CCC Camp) located
Pantaleo 2005	AIS	Manawaiopuna Falls Landing Area, Hanapēpē (see Figure 68)	N	–

Author(s)	Study Type	General Location	Sites IDed	Comment
Tulchin et al. 2005	Reconnaissance	Kukuiolono Park and Golf Course Kalāheo (see Figure 68)	Y	Five historic properties described and evaluated: SIHP # 50-30-10-3906, an assemblage of historic properties consisting of historic artifacts and historic structures within Kukuiolono Park attributed to Estate of Walter D. McBryde; SIHP # -3907, collection of traditional Hawaiian stones and artifacts assembled by McBryde; SIHP # -3908 denotes graves of McBryde and companion; SIHP # -3909, loosely stacked stone retaining wall /terrace (historic); SIHP # -3910, remnant stone wall alignment (possibly pre-Contact)
Hammatt and Shideler 2006	Reconnaissance	Eight DOE Schools (only Kalāheo E.S. is above 500 ft elev.) (see Figure 68)	N	No finds or concerns reported for Kalāheo Elementary School
Jones et al. 2006	AIS	Kukuiolono Park and Golf Course Kalāheo (see Figure 68)	Y	Reworking of much the same project area addressed in Tulchin et al. 2005 study (discussed above) with similar reporting for SIHP #s 50-30-10-3906, -3907, and -3908
Carney and Hammatt 2007	Monitoring	Waimea Canyon Lookout State Park, Waimea (see Figure 68)	N	–
Moser et al. 2010	Reconnaissance	Kalāheo (see Figure 68)	N	–
Hammatt and Shideler 2012a	Reconnaissance	Kalāheo and Wahiawa (see Figure 68)	N	–
Hammatt and Shideler 2012b	AIS	Zip Line Kōloa (see Figure 68)	N	–

Author(s)	Study Type	General Location	Sites IDed	Comment
Sinoto and Dashiell 2013	AIS	Proposed 2.63 km Makaweli Valley Ranch Road, Makaweli (see Figure 68)	N	–
Wheeler et al. 2013	Reconnaissance	Lumaha‘i (99 acres) (see Figure 65)	N	–
Ruzicka 2014	Reconnaissance	Bridge 7E Kaumuali‘i Hwy, Kōloa (see Figure 68)	Y	Determined bridge not eligible for National Register of Historic Places (NRHP) or HRHP; study noted another (reinforced concrete) bridge and box culvert in vicinity; these would need further evaluation to determine their potential significance and retained integrity; no SIHP #s assigned
Byerly and O’Day 2015	AIS	Makaweli 50-acre Aaka 3 agricultural parcel, Makaweli (see Figure 68)	Y	Survey identified one historic irrigation ditch system (SIHP # 50-30-09-2269) that included six constituent features comprised of contiguous excavated ditch with earthen berms, three concrete culverts, and two wooden floodgates dating at least in part to 1959
Kamai and Hammatt 2015	Reconnaissance	16.8 km for Līhu‘e Hanamā‘ulu New Mauka Road and future potential Mauka Road (see Figure 67)	N (No sites IDed above 500 ft	Discusses features of SIHP # 50-30-11-2218, and five newly identified plantation-era water control historic properties given temporary site #s all below 500 ft
Lyman and Dega 2015	AIS	17-acre parcel at Kekaha Ditch Siphon Headwall, Waimea between 160-ft and 520 ft elev. contours, Waimea (see Figure 68)	Y	Three new sites documented: a modified outcrop utilized for temporary habitation (SIHP # 50-30-05-2287), an agricultural alignment (SIHP # -2288), and a historic-era trail (SIHP # -2289) all near highest elevation of the 17-acre parcel

Author(s)	Study Type	General Location	Sites IDed	Comment
Kamai et al. 2016	AIS	Kalāheo and Wahiawa (see Figure 68)	Y	One historic property (SIHP # 50-30-10-2290) identified consisting of a plantation-era remnant ditch (Feature A) and concrete sluice gate (Feature B)
Yucha et al. 2016	AIS	Bridge 7E Kaumualiʻi Hwy, Kōloa (see Figure 68)	Y	SIHP # 50-30-10-2285, Bridge 7E and SIHP # -2286, earthen ditch that extends perpendicular to Kaumualiʻi Hwy and passes water through culverts of Bridge 7E

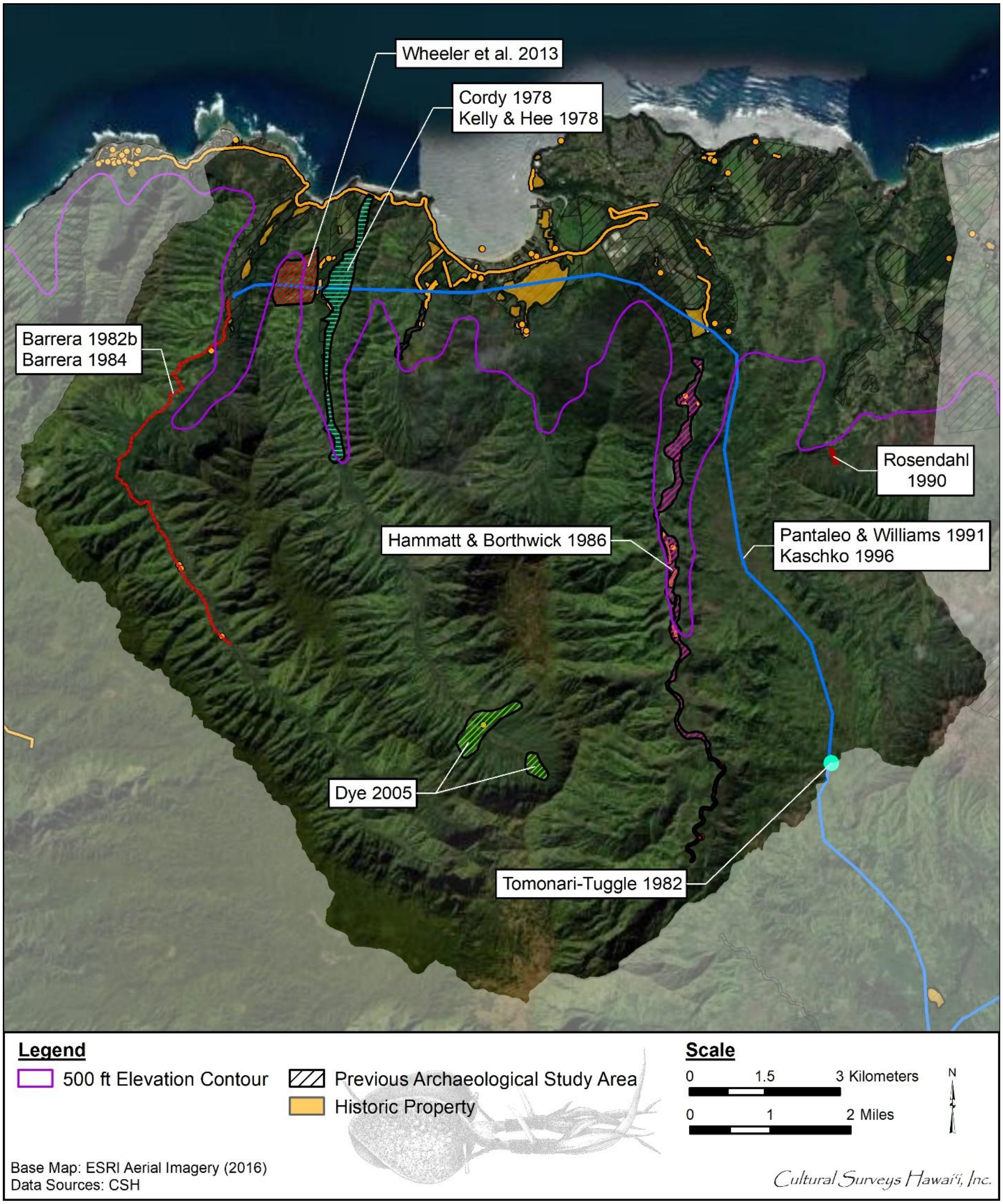


Figure 65. 2016 ESRI aerial image depicting previous archaeological studies conducted in whole or in part above 500 ft elevation in Halele‘a, Kaua‘i

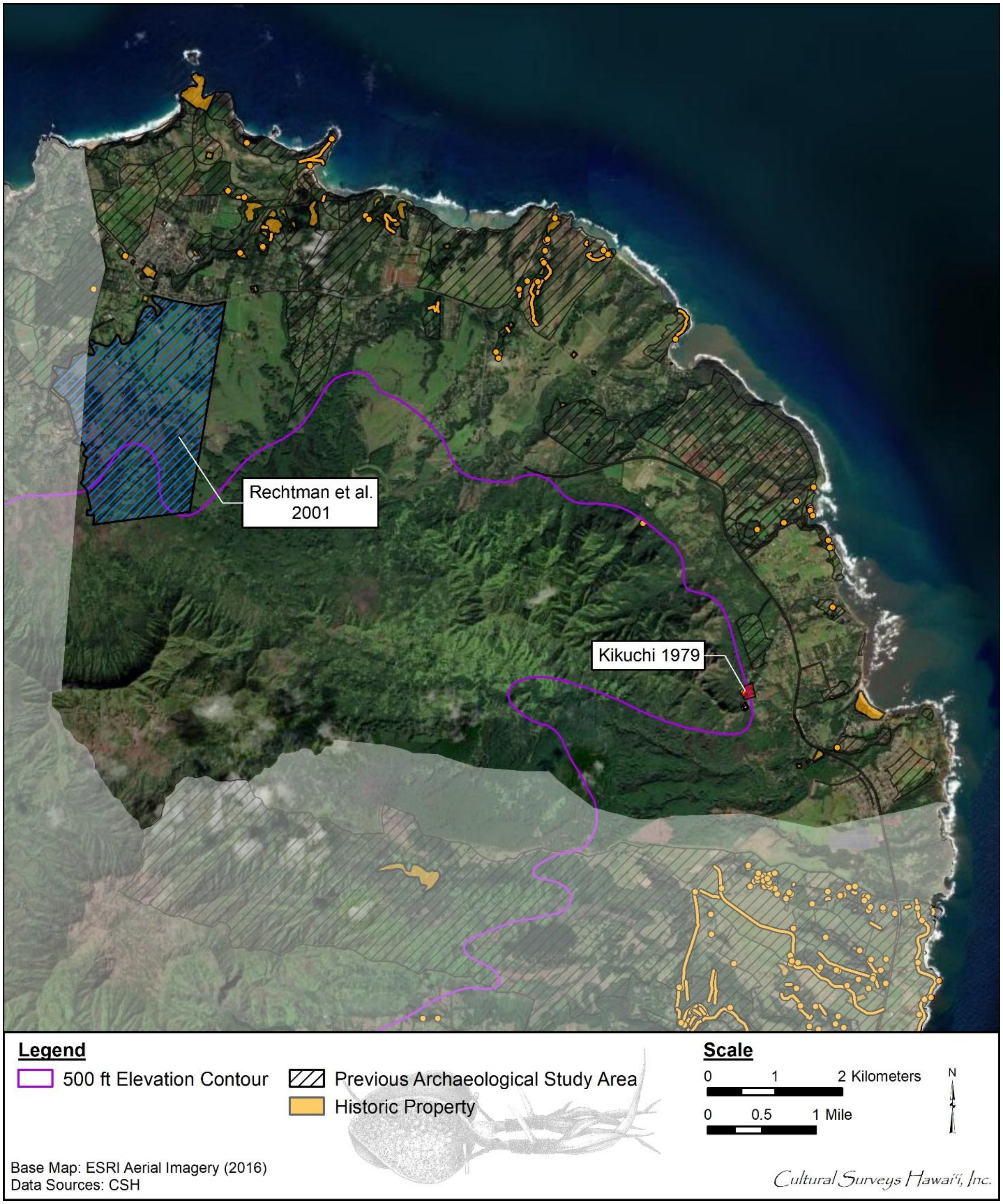


Figure 66. 2016 ESRI aerial image depicting previous archaeological studies conducted in whole or in part above 500 ft elevation in Koʻolau, Kauaʻi

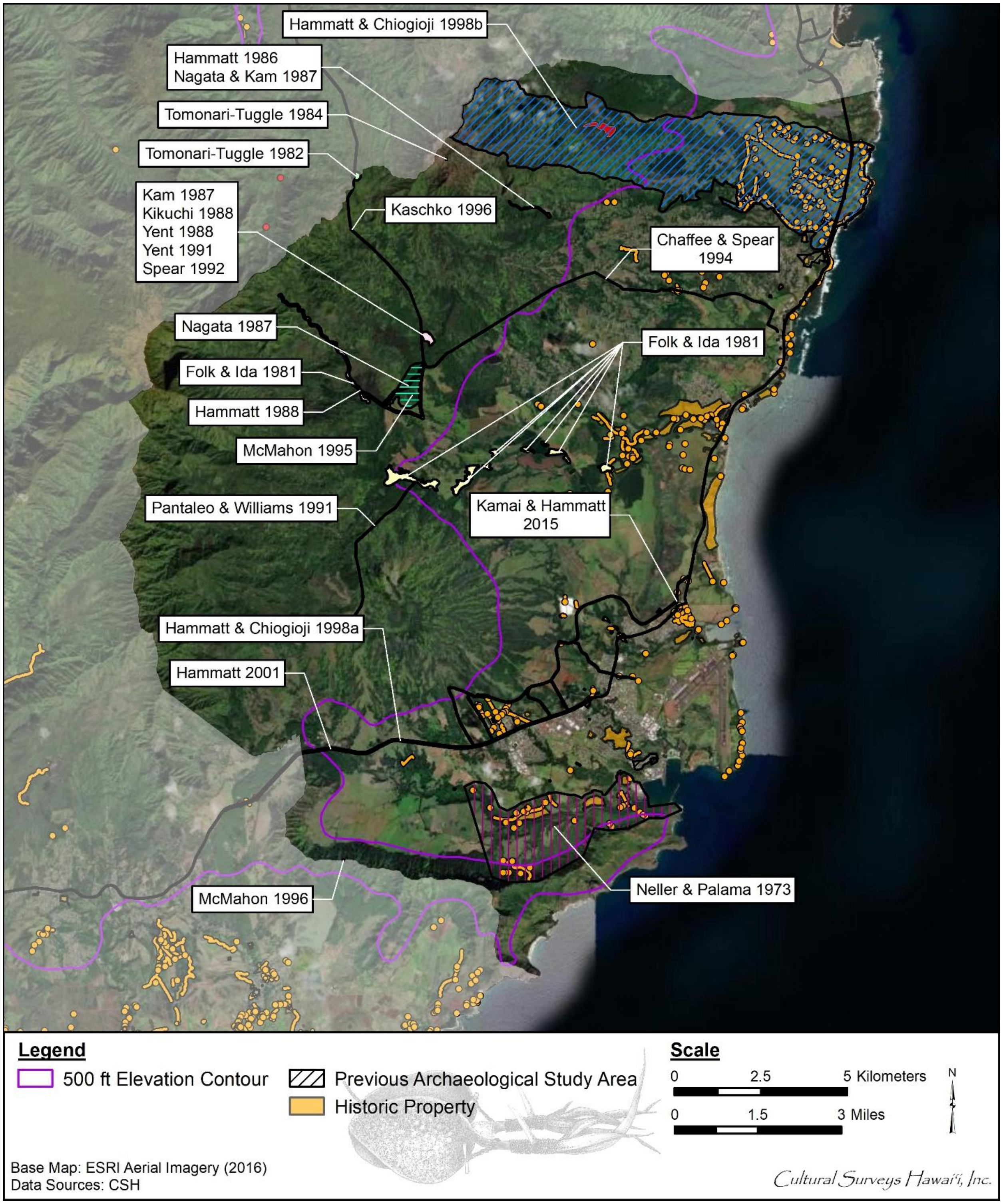


Figure 67. 2016 ESRI aerial image depicting previous archaeological studies conducted in whole or in part above 500 ft elevation in Puna, Kaua‘i

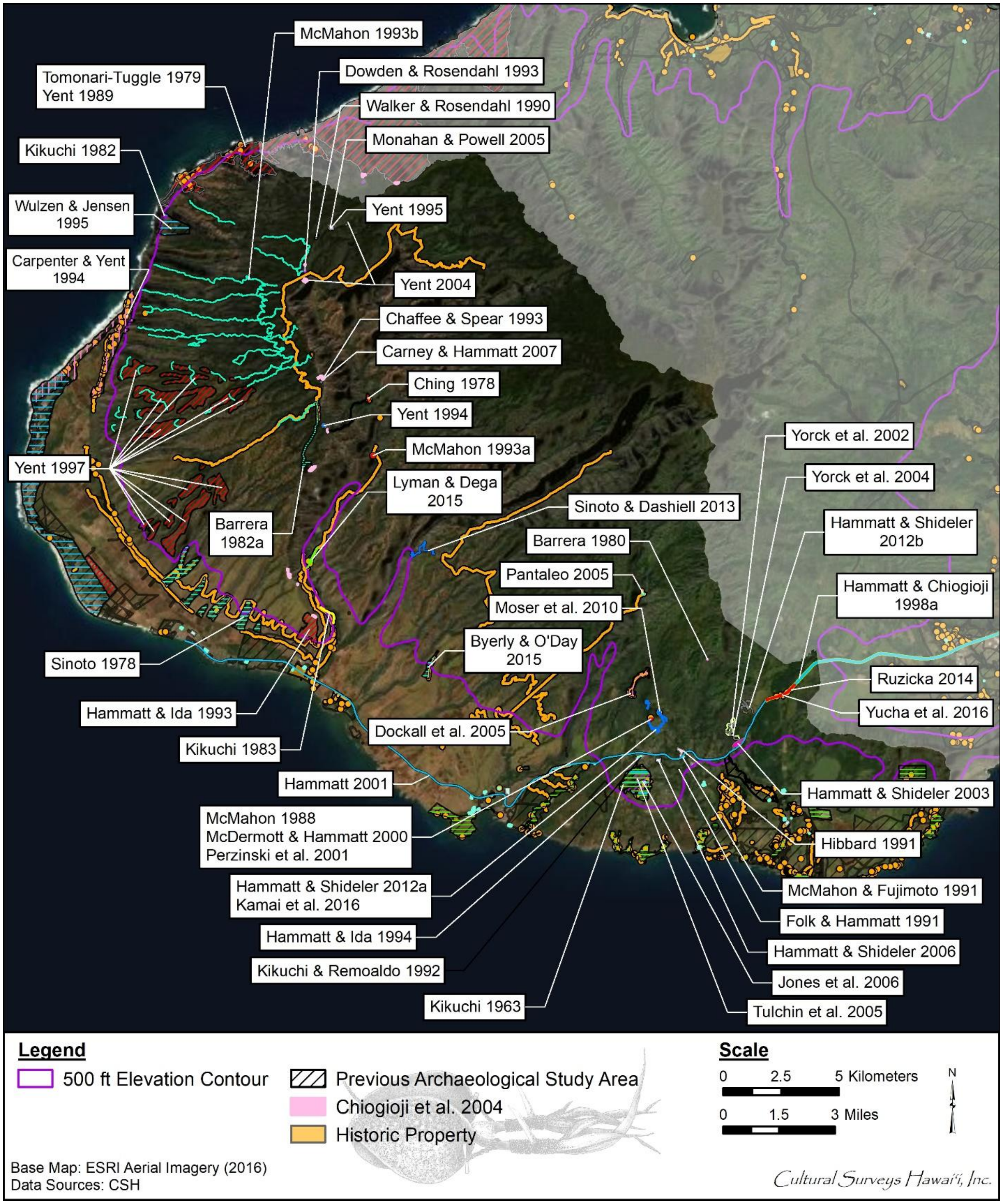


Figure 68. 2016 ESRI aerial image depicting previous archaeological studies conducted in whole or in part above 500 ft elevation in Kona, Kaua‘i

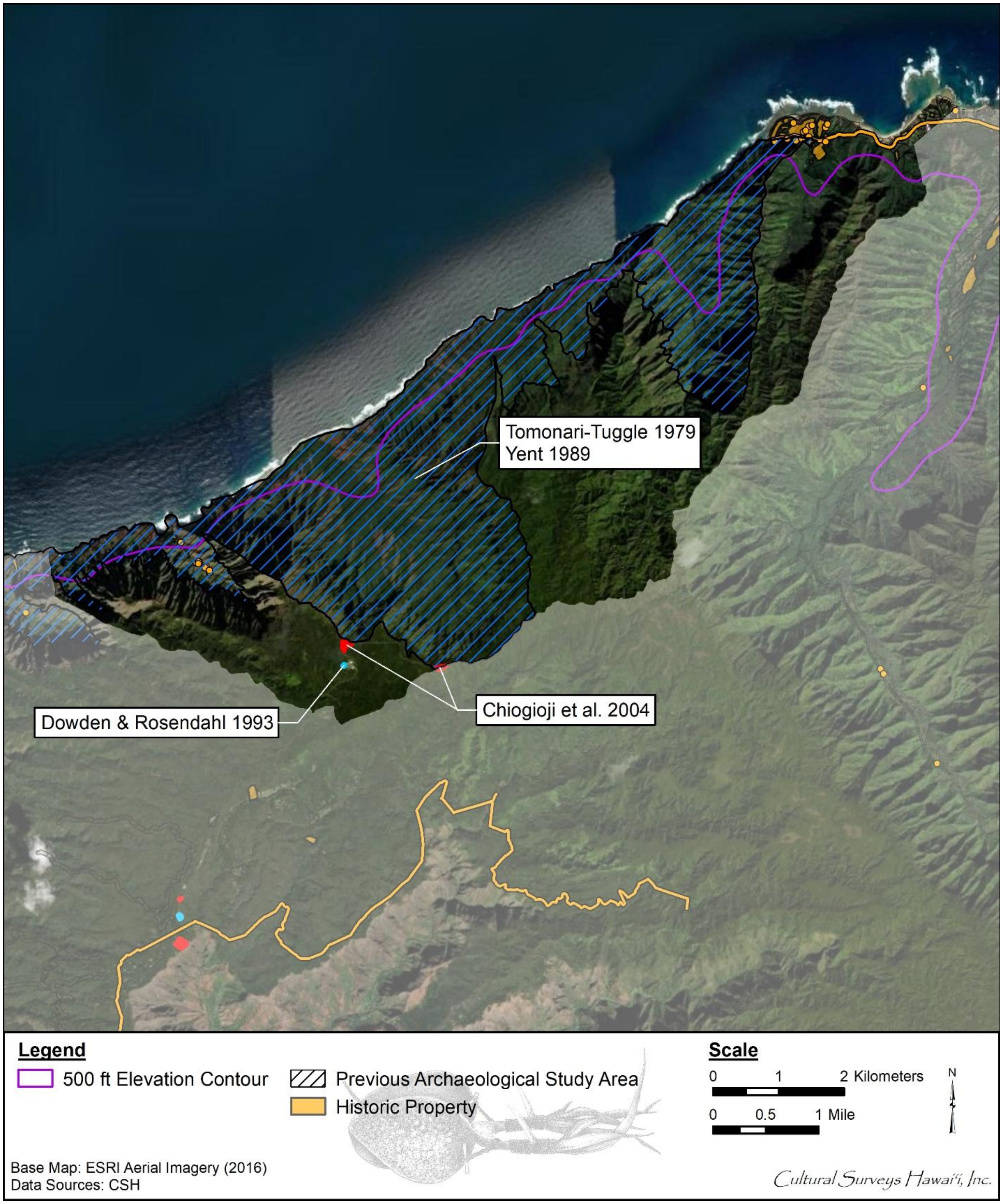


Figure 69. 2016 ESRI aerial image depicting previous archaeological studies conducted in whole or in part above 500 ft elevation in Nā Pali, Kauaʻi

included three terrace lines, and Site Area 3 was a dam and canal related to irrigated agriculture. The copy of the reports available to CSH is missing certain page sequences and bears annotation that pages pertaining to Lumaha‘i “are missing from the original.”

5.2.5 Sinoto 1978 (Ridges near Kekaha)

Aki Sinoto of the Bishop Museum (1978) carried out an archaeological reconnaissance study of several ridges and valleys near Kekaha including from west to east (Waiawa, Hō‘ea, Kahoana, Waipao, Paua, Waiaka, Kapilimao, and Hukipo) under consideration for borrow sites for stones and boulders for planned revetments on the Kekaha coastline. The study documents the following sites and site complexes. SIHP # 50-30-05-800, in Waiaka Valley, was a rectangular stone cairn thought to be a possible grave. SIHP # 50-30-05-801, also in Waiaka Valley, was a series of small overhang shelters with fronting areas modified with stone walls, terracing, and a platform. SIHP # 50-30-05-802, in Paua Valley, consisted of several crude terraces, walls, and *‘auwai*. SIHP # 50-30-05-803, in Waipao Valley included “crude terracing, stone piles, and an apparent cattle wall” (Sinoto 1978:4). SIHP # 50-30-05-804, in Kahoana Valley, included “Numerous small terraces, enclosures, wall segments, and stone piles” (Sinoto 1978:6). SIHP # 50-30-05-805, in Hō‘ea Valley, “included numerous small crudely constructed sites of a marginal nature” (Sinoto 1978:6). While the locations of all the sites and site areas are not altogether clear, Sinoto (1978:9) designated *mauka* areas of Hō‘ea, Kahoana, Waipao, and a coastal area of Paua as “Restricted Areas” due to their archaeological sensitivity.

5.2.6 Kikuchi 1979 (Anahola)

William “Pila” Kikuchi (1979) briefly reported on a “Site Survey” in which he inspected a large quadrangular enclosure in a *mauka* area of DHHL Anahola Farmlands. Kikuchi (1979:2) concluded a “site in question [that] was said to be a temple” was the same as Bennett’s Site 118 that Bennett had concluded was “probably a cattle corral.” Kikuchi (1979:2) agreed the site was “not a temple but an animal corral” but also noted “It could also be an ancient site reused or altered to a new function.”

5.2.7 Tomonari-Tuggle 1979 (Nā Pali Coast State Park from Hanakāpī‘ai to Miloli‘i)

Myra Tomonari-Tuggle 1979 reported on an archaeological reconnaissance survey of a stretch of the Nā Pali Coast State Park from Hanakāpī‘ai to Miloli‘i. While most of the sites described were at low elevations close to the coast, some sites were quite far back in these steep valleys at higher elevations, particularly at Hanakāpī‘ai (terrace sites designated HKP-12, HKP-13, HKP-17) and Kalalau (terrace sites designated KAL-1, KAL-2, KAL-17, and KAL-18).

5.2.8 Folk and Ida 1981 (Wailua Valley)

ARCH (Folk and Ida 1981) carried out an archaeological reconnaissance for a Wailua River hydropower study. The study included designated Study Area A through Study Area H generally moving inland. While most of the archaeological sites were close to the coast, the terrace complexes, SIHP #s 50-30-07-210 and -211, were in Study Area H inland near 500 ft elevation.

5.2.9 Barrera 1982b (Upper Wainiha Valley)

Bill Barrera (1982b) produced a brief report on an archaeological literature review and archaeological reconnaissance of Upper Wainiha Walley.

Barrera reports:

> Possible house sites, consisting of square to rectangular basalt-rock structures measuring approximately 3 meters on a side and standing to 50 centimeters in height, were located on a low bluff formed by a stream-cut natural terrace. Detailed inspection of the vicinity of these features was prevented by the dense vegetation and inclement weather.
>
> Smaller terrace systems were also seen in small flat areas along the route of the existing jeep trail [the proposed location of the new transmission line], as indicated by Bennett's survey. [Barrera 1982b:7]

5.2.10 Kikuchi 1983 (Waimea Valley)

William "Pila" Kikuchi (1983) reported on archaeological monitoring of a Waimea 12-inch Transmission Main reported as approximately 1.75 miles above Waimea Town. The study references a burial find (SIHP # 50-30-09-1870 ?) and develops data on the Peʻe-Kauaʻi ditch (SIHP # 50-30-05-26) and a World War II hospital but these were at lower elevations.

5.2.11 Barrera 1984 (Upper Wainiha Valley)

Bill Barrera (1984) produced a more detailed update on his (1982) studies in upper Wainiha discussing two neighboring sites, SIHP #s 50-30-02-1500 and -1502. SIHP # -1500 is a complex of agricultural features (which he called "irrigated dry-terraces") located between Wainiha Stream on the east and the steep valley slope on the west, at an elevation of about 770 ft including designated features "A" through "AN." SIHP # -1502 consisted of three features (a charcoal lens and two similar pits) exposed in the side of the pioneer roadcut through the nose of the ridge adjacent to, and about 15 ft above, SIHP # -1500.

5.2.12 Hammatt and Borthwick 1986 (Upper Hanalei Valley)

CSH (Hammatt and Borthwick 1986) reported on an archaeological reconnaissance survey in upper Hanalei Valley in association with a proposed hydroelectric project. The survey area included over 5 miles of the river valley from Kaʻapoko Stream to Hanalei Homesteads. Although the survey was constrained by heavy vegetation and steep terrain, 14 archaeological sites were located and briefly described. Irrigated terrace sites, some with associated house platforms, were found throughout the project area. The project area extended from 40 ft elevation to 540 ft elevation so most of the sites were at far lower elevations but it appears some of the sites (CSH 7 rock shelter, CSH 8 rock shelter) were above 500 ft elevation.

5.2.13 Kikuchi 1988 (Wailua)

Kikuchi 1988 reported on an archaeological reconnaissance for a Keahua Arboretum expansion project in the uplands of Wailua recording an adze workshop designated "the Kauakahi adze workshop" and SIHP # 50-30-07-4000. Kikuchi (1988:1) noted the site "may be the highest (550-600 feet elevation) adze workshop quarry site on the island of Kauaʻi." Kikuchi noted that while there was an area with a concentration of cores and flakes, the "workshop is quite widespread" (although the size of the area is not immediately clear).

5.2.14 McMahon 1988 (Kalāheo)

Nancy McMahon (1988), then staff archaeologist with SHPD, filed a memorandum on a field inspection along Poʻohiwi Road in the uplands of Kalāheo to determine if a stone wall was a historic site. It was determined that the stone wall, associated terraces, and paved platform was an historic site and that it was Bennett Site 406 Kahalekiʻi Heiau (designated SIHP # 50 30-10-406).

5.2.15 Yent 1988 (Wailua)

Martha Yent (1988) of State Parks reported on archaeological investigations at the Kauakahi Adze Workshop (SIHP # 50-30-07-4000) at Keahua Arboretum, Wailua initially reported by Kikuchi in 1988 (see above). She noted it was at approximately 520 ft elevation and discusses the presence of flake debitage, worked flakes and cobbles, cores, hammerstones, and 60 adze blanks and preforms in an area 250 m (north-south) by 350 m (east-west) or approximately 20 acres. She indicates this was only the third adze quarry documented on Kauaʻi (citing the Bennett 1931 documented Waimea Adze Quarry located on Mokihana Ridge, inland of Waimea town and the Nonou Adze Quarry located on Nonou Ridge north of the mouth of the Wailua River).

5.2.16 Yent 1989 (Nā Pali Coast State Park)

Martha Yent (1988) of State Parks reported on archaeological monitoring and limited survey: at Miloliʻi, Honopū, and from Kalalau to Hanakāpīʻai at Nā Pali Coast State Park. Most of the historic properties discussed in this very large area are immediately coastal at low elevation. At least some of the historic properties, like designated site HNP (for Honopū) 12, an agricultural complex/terrace system and HNP 13 a retaining wall, seem to be above 500 ft elevation (the actual elevation is not always clear in these very steep slopes and valleys).

5.2.17 Walker and Rosendahl 1990 (Kōkeʻe)

Paul H Rosendahl, Inc. (Walker and Rosendahl 1990) reported on an AIS of four general locations (three quite coastal at the Pacific Missile Range Facility) for a USN Radio Telescope project including four neighboring areas at a Kōkeʻe Park Geophysical Observatory (KPGO) facility located at ca. 3,755 ft AMSL. During the survey, a low retaining wall was noted in the vicinity of "Site 2" outside the fenced compound at KPGO. The wall appeared to be a foundation to retard erosion or to stabilize the soil embankment. The retaining wall appeared to be of relatively recent construction and was not designated as an archaeological site. No other surface cultural remains were identified

5.2.18 McMahon and Fujimoto 1991 (Lāwaʻi)

Nancy McMahon (1988), then staff archaeologist with the SHPD, and Debra Fujimoto (a relative of the deceased) filed a Memo/Inventory Form for Inactive Cemeteries for a Yamamoto Family Grave Site located on a hillside below what used to be the Lawai Odaisan (Church) in Lāwaʻi. The historic property included two tombstones marking the graves of Mr. and Mrs. Yamamoto, the founders of the Lawai Odaisan and seemingly also certain remains of the Japanese Church site which "at one time had 88 Buddha temples strategically placed on the hillside where people would go to heal themselves. Some of the Buddhas are still there" (McMahon and Fujimoto 1988:2). The burial site was designated SIHP # 50-30-10-1865.

5.2.19 Pantaleo and Williams 1991 (Port Allen-Wainiha Transmission Line Corridor)

The Bernice Pauahi Bishop Museum (Pantaleo and Williams 1991) reported on a reconnaissance survey of selected portions of a Port Allen-Wainiha transmission line corridor (64 km long and 18 m wide). Four segments, totaling 37 km (23 mi.les), were determined by the SHPD to be archaeologically sensitive. The remaining 27 km (17 miles) were located in areas that have been modified by pasture or sugarcane cultivation. Because of this disturbance, the SHPD did not recommend reconnaissance in those areas (at that time; thinking may have changed since). No new archaeological sites were discovered during the survey. However, the transmission line corridor passed through previously recorded SIHP # 50-30-03-1006, a series of pond field remnants in Hanalei Valley, but these are well below 500 ft elevation.

5.2.20 Yent 1991 (Wailua)

Martha Yent (1988) of State Parks reported on further archaeological survey at the Keahua Arboretum, Wailua in the context of a fancy toilet (Clivus Multrum) construction project. A concern was to avoid any impact to the Kauakahi Adze Workshop (SIHP # 50-30-07-4000) initially reported by Kikuchi in 1988 and the subject of a Yent 1988 study (see above). The adze workshop is discussed but no adze materials or other cultural remains were observed in the project area for the toilet construction.

5.2.21 Kikuchi and Remoaldo 1992 (Island-wide, cemeteries in uplands of Kalāheo)

The Kikuchi and Remoaldo (1992) study of *Cemeteries of Kauai* appears to document three cemeteries above 500 ft elevation, all in Kalāheo, reported as SIHP #s 50-30-10-B001 Holy Cross Cemetery, -B002 “88 Shrines” Cemetery, and -B014 McBryde Grave. The fact that greater than 90% of the cemeteries of Kauaʻi are below 500 ft elevation is another line of evidence showing distribution of historic properties in the coastal lowlands where the people lived.

5.2.22 Spear 1992 (Wailua)

Robert Spear (1992) reported on an archaeological survey of a portion of the known boundaries of the Kauakahi Adze Workshop (SIHP # 50-30-07-4000) documented by Kikuchi 1988 and Yent 1988 and 1991, see above) to determine the relationship of the site to a Kauaʻi Electric power line corridor. The study concluded a small portion of SIHP # -4000 (60.0 by 35.0 m) was located within the power line corridor. Further data on the site is reported.

5.2.23 McMahon 1993a (Waimea Canyon)

Nancy McMahon (1993a), then staff archaeologist with the SHPD, documented an inadvertent burial discovery and subsequent reburial at designated burial site SIHP # 50-30-06-498 at Paiwa, reported as about 6 miles up Waimea Canyon. This was a cave site that included five burials. The description follows:

> The unique cave site is surrounded by rock walls, enclosures and rock platforms. At the base of the cave site, approximately 12 feet below is a stone lined platform adjacent to the cliff. A stone piled tower rises above the platform and flushes with the cliff. Most of the stones were waterworn basalt cobbles. I believe other burials exist in this rock pile. The cave site itself, was made of pili grass and mud, which blended in with the natural colors of the cliff. [McMahon 1993a:2]

There are references to post-Contact artifacts (“modern pants,” “modern red clothes,” a “pillow”) but their relationship to the burials is unclear. The remains were reburied in the cave. McMahon (1993a:3) notes that Bennett Site 24 includes some seven caves but “Since the exact location for site 24, is not precise, this burial cave has been given a separate site number 50-30-06-498.”

5.2.24 McMahon 1993b (Kōkeʻe uplands ridges)

Nancy McMahon (April 1993b), then staff archaeologist with the SHPD, reported on an archaeological reconnaissance survey for emergency watershed protection along ridge roads in the Kōkeʻe uplands. The project area encompassed a total of just over 30 miles of roads on these ridges including a long section of a *mauka* contour road and long sections of the crest of several ridges including (from north to south) Miloliʻi Ridge, Makaha Ridge, Kauhao Ridge, Kaʻaweiki Ridge, Polihale Ridge, Haʻeleʻele Ridge, Lapa Ridge, Kolo Ridge, ʻŌhaiʻula Ridge, Mānā Ridge, Kahelu Ridge, and Niu Ridge. Only one historic property (SIHP # 50-30-01-499) was identified (at the end of Polihale Ridge Road) and it was outside the project area. SIHP # 50-30-01-499 is described as follows.

> It is a stone alignment, one to two courses high. Large basalt stones form the base with smaller cobbles on top. Earthen fill is directly behind the small 5 meter alignment. It is believed to be a planting area for sweet potato because of the soil fill behind the rock alignment. [McMahon 1993b:13]

It should be noted that the study refers to roads, a ditchman’s house, reservoirs, irrigation ditches, neighboring plantation camps, shelters, and terraces that were not documented.

5.2.25 Carpenter and Yent 1994 (Polihale State Park and adjacent lands)

The State Parks Division of DLNR (Carpenter and Yent 1994) produced an archaeological reconnaissance survey of Polihale State Park and adjacent lands addressing a long stretch of the coastal cliff in back of the State Park that steeply ascends from about 40 ft to 1,000 ft elevation. Their defined 1,050-acre survey project area rises to approximately 1,060 ft. Many historic properties (including rock shelters, house sites, *ahu*, terraces, and burials) are identified along this cliff line, mostly near the base. Some of the sites (like SIHP # 50-30-01-1976, a human burial) are higher on the steep slope. The elevation of the historic properties is not always clear.

5.2.26 Yent 1995 (Kōkeʻe State Park)

Martha Yent (1995) of State Parks reported on an archaeological survey of a CCC Camp constructed in 1935 that included 25 structures in 1938. At the time of study the camp consisted of seven wooden buildings around a grassed quadrangle in what is now Kōkeʻe State Park. A number of structures were built in the vicinity in the 1950s and 1960s. The (Yent 1995) archaeological survey of the CCC camp and the surrounding area did not locate any significant archaeological sites that pre-date the construction of the camp. The camp is discussed as a historic property but no SIHP # is mentioned (SIHP # 50-30-06-9392 was subsequently assigned).

5.2.27 Kaschko 1996 (Power line corridor from Wainiha to Wailua)

Mick Kaschko (1996) reported on an AIS for a Kauaʻi power line pole removal, replacement, and installation project’s long sprawling alignment from the Wainiha powerhouse (20 ft elevation) to the back of Hanalei Bay (20 ft elevation) to Kualapa Peak (2,100 ft elevation) to the back of

Wailua. Four historic properties were reported; three of these were at low elevations at Hanalei: SIHP #s 50-30-03-993, -994, and -1007, and the fourth was the SIHP # 50-30-07-4000, lithic workshop area above Wailua (previously reported in Kikuchi 1988, Yent 1988, Spear 1992). While the study was only of pole locations, a very long stretch in the uplands was studied with no new historic properties reported from there.

5.2.28 Hammatt and Chiogioji 1998b (Keālia Ahupua‘a, Wailua)

CSH (Hammatt and Chiogioji 1998b) carried out an archaeological reconnaissance of 6,691 acres of Keālia Ahupua‘a. Most of the historic properties described were close to the coast but they studied seven separate localities along the Keālia Stream flood plain below ‘Ōpae Kalaole Falls noting the presence of 80-87 separate terraced fields, three or four *‘auwai,* and four habitation sites at approximately 500 ft to 700 ft elevation. No SIHP #s were assigned.

5.2.29 McDermott and Hammatt 2000 (Kalāheo)

McDermott and Hammatt (2000) reported on an archaeological field inspection of proposed improvements to the Kalaheo Water System, at approximately 950 ft elevation. The study discusses SIHP # 50-30-10-406 located immediately to the east-northeast of the existing Kalaheo well site. These apparently traditional Hawaiian archaeological features consist of numerous terraces, wall segments, platforms, and a large multi-tiered terrace approximately 45-50 m long by 5-8 m wide. In addition, to the north-northeast of the extant Kalaheo well site was an historic ditch feature that comes off the natural drainage. A stacked stone water diversion feature was located within the natural drainage at the mouth of the ditch.

5.2.30 Perzinski et al. 2001 (Kalāheo)

CSH (Perzinski et al. 2001) reported on an AIS for SIHP #s 50-30-10-406 and -485 at approximately 950 ft elevation in the context of proposed improvements to the Kalaheo Water System. SIHP # -406 consisted of numerous agricultural features including terraces, rock mounds, platforms, and walls. SIHP # -485 was determined to be a historic water diversion feature likely constructed for truck crop irrigation.

5.2.31 Chiogioji et al. 2004 (Kōke‘e and Waimea Canyon State Parks)

CSH (Chiogioji et al. 2004) carried out a reconnaissance study of ten discrete localities within Kōke‘e and Waimea Canyon State Parks (all above 500 ft elevation). Three properties related to twentieth century activities within the parks area were observed: a flume segment at the potential lookout locality at mile markers 2.0 and 2.3, a water tank foundation at Waimea Canyon Lookout, and a pair of mortared-stone walls at the Kalalau Lookout. No SIHP #s were assigned.

5.2.32 Dockall et al. 2005 (Wahiawa)

CSH (Dockall et al. 2005) conducted an AIS of a 3-acre area to support the restoration of an Alexander Dam Irrigation Ditch project in Wahiawa Ahupua‘a. Three historic properties were identified consisting of SIHP # 50-30-09-3917, a remnant of an irrigation canal known locally as the Native Ditch, however, the history of the feature indicates its construction in about 1900; SIHP # -3918 identified as Alexander Dam that consists of a concrete spillway and a hydraulic filled dam with a rock-armored front; and SIHP # -3919 designating a forebay feature that receives water from outlet tunnels below the reservoir.

5.2.33 Dye 2005 (Lumahaʻi)

Tom Dye (2005) carried out an archaeological survey of two small areas for an animal control fence in Lumahaʻi Valley. A single historic site, a platform of cobbles and small boulders designated SIHP # 50-30-03-3914, was found located on top of a prominent *puʻu* immediately *mauka* of three large waterfalls that had been proposed for use as a drop site at approximately 1,802 ft elevation. Branch coral found at the site indicates it is a *heiau*.

5.2.34 Monahan and Powell 2005 (Kōkeʻe State Park)

Scientific Consultant Services (SCS) (Monahan and Powell 2005) carried out an AIS for Kōkeʻe State Park wastewater/sewer systems improvements, in a 1.0-acre portion of a CCC Camp (previously described by Yent 1995, discussed above). The camp is designated SIHP # 50-30-06-9392. A description of the historic property is provided and a Reinard and Erickson (1996) NRHP Nomination is cited. Other than the CCC Camp, no significant historic sites or features were located.

5.2.35 Tulchin et al. 2005 (Kukuiolono Park and Golf Course, Kalāheo)

CSH (Tulchin et al. 2005) completed an archaeological field inspection and literature review of the Kukuiolono Park and Golf Course, Kalāheo Ahupuaʻa between 580 ft and 900 ft elevation. Five historic properties are described. SIHP # 50-30-10-3906 is an assemblage of historic properties within Kukuiolono Park attributed to the Estate of Walter D. McBryde. Features consist of historic artifacts and historic structures. SIHP # -3907 is a collection of traditional Hawaiian stones and artifacts assembled by Walter D. McBryde. SIHP # -3908 features the graves of Walter D. McBryde and companion. SIHP # -3909 is a loosely stacked stone retaining wall /terrace thought to be post-Contact. SIHP # -3910 is a remnant stone wall alignment (possibly pre-Contact).

5.2.36 Jones et al. 2006 (Kukuiolono Park and Golf Course, Kalāheo)

CSH (Jones et al. 2006) reported on an AIS of the Kukuiolono Park and Golf Course. This was a reworking of much the same project area addressed in the Tulchin et al. 2005 study (discussed above) with similar reporting for SIHP #s 50-30-10-3906, -2907, and -3908 with significance evaluations and recommendations.

5.2.37 Ruzicka 2014 (Kōloa)

Dee Ruzicka (2014) of the architecture firm MASON prepared a *Bridge 7E Kaumualiʻi Highway Kauaʻi:. Historic Inventory Resource Form* that discussed the historic property and determined it was not eligible for the NRHP or HRHP. The study noted another (reinforced concrete) bridge and a box culvert in the vicinity and that these would need further evaluation to determine their potential significance and retained integrity. No SIHP #s were assigned. Bridge 7E would later be assigned SIHP # 50-30-10-2285 (see Yucha et al.2016).

5.2.38 Byerly and O'Day 2015 (Makaweli)

Garcia & Associates (Byerly and O'Day 2015) carried out an AIS of a 50-acre Aaka 3 agricultural parcel in Makaweli Ahupuaʻa, The survey identified one historic irrigation ditch system (SIHP # 50-30-09-2269) that included six constituent features comprised of a contiguous excavated ditch with earthen berms, three concrete culverts, and two wooden floodgates dating at least in part to 1959.

5.2.39 Lyman and Dega 2015 (Waimea)

SCS (Lyman and Dega 2015) carried out an AIS of a 17-acre parcel at the Kekaha Ditch Siphon Headwall on the east wall of Waimea Canyon between 160 ft and 520 ft elevation contours, Waimea Ahupua‘a. Three newly identified historic properties were documented: a modified outcrop utilized for temporary habitation (SIHP # 50-30-05-2287), an agricultural alignment (SIHP # -2288), and a historic-era trail (SIHP # -2289). All three sites appear to have been near the highest elevation of the project area.

5.2.40 Kamai et al. 2016 (Kalāheo)

CSH (Kamai et al. 2016) reported on an AIS for a Kaua‘i County Kalaheo Water System Improvements project at approximately 900-1,000 ft elevation. One historic property (SIHP # 50-30-10-2290) was identified consisting of a plantation-era remnant ditch (Feature A) and a concrete sluice gate (Feature B).

5.2.41 Yucha et al. 2016 (Kōloa)

CSH (Yucha et al. 2016) reported on an AIS for a Bridge 7E Replacement project, Kōloa Ahupua‘a at approximately 640 ft elevation. Two historic properties were identified consisting of SIHP # 50-30-10-2285, Bridge 7E (described in Ruzicka 2014, see above) and SIHP # -2286, an earthen ditch that extends perpendicular to Kaumuali‘i Highway and passes water through the culverts of Bridge 7E.

5.3 Archaeological Historic Properties Identified Above 500 Ft Elevation

Previously identified historic properties located in whole or in part above 500 ft elevation (not including Bennett sites depicted in Figure 64) are located in Figure 70 and are described in the following Table 11.

5.4 Previous Archaeology Summary and Predictive Model Above 500 Ft Elevation

This study sought to develop data on the nature, density, and distribution of archaeological sites on the island of Kaua‘i. Because of project constraints and to optimize efficiency, this study examined in some detail 81 previous archaeological studies on the island that were located in part or in whole above 500 ft elevation (accounting for 9.7% of the 834 archaeological studies on Kaua‘i in the CSH database). By focusing on this subset of less than 10% of the archaeological studies, it was possible to develop detailed information on the 929.4 sq km (64.7% of the island) lying above the 500 ft elevation contour.

Of the 81 previous (post-Bennett) archaeological studies on the island located in part or in whole above 500 ft elevation, 41 (52%) reported historic properties. This in itself is suggested to be significant in indicating a relatively low site density in the uplands (given that, as a generalization, archaeological studies tend to be carried out in areas that have been of interest to people in the past).

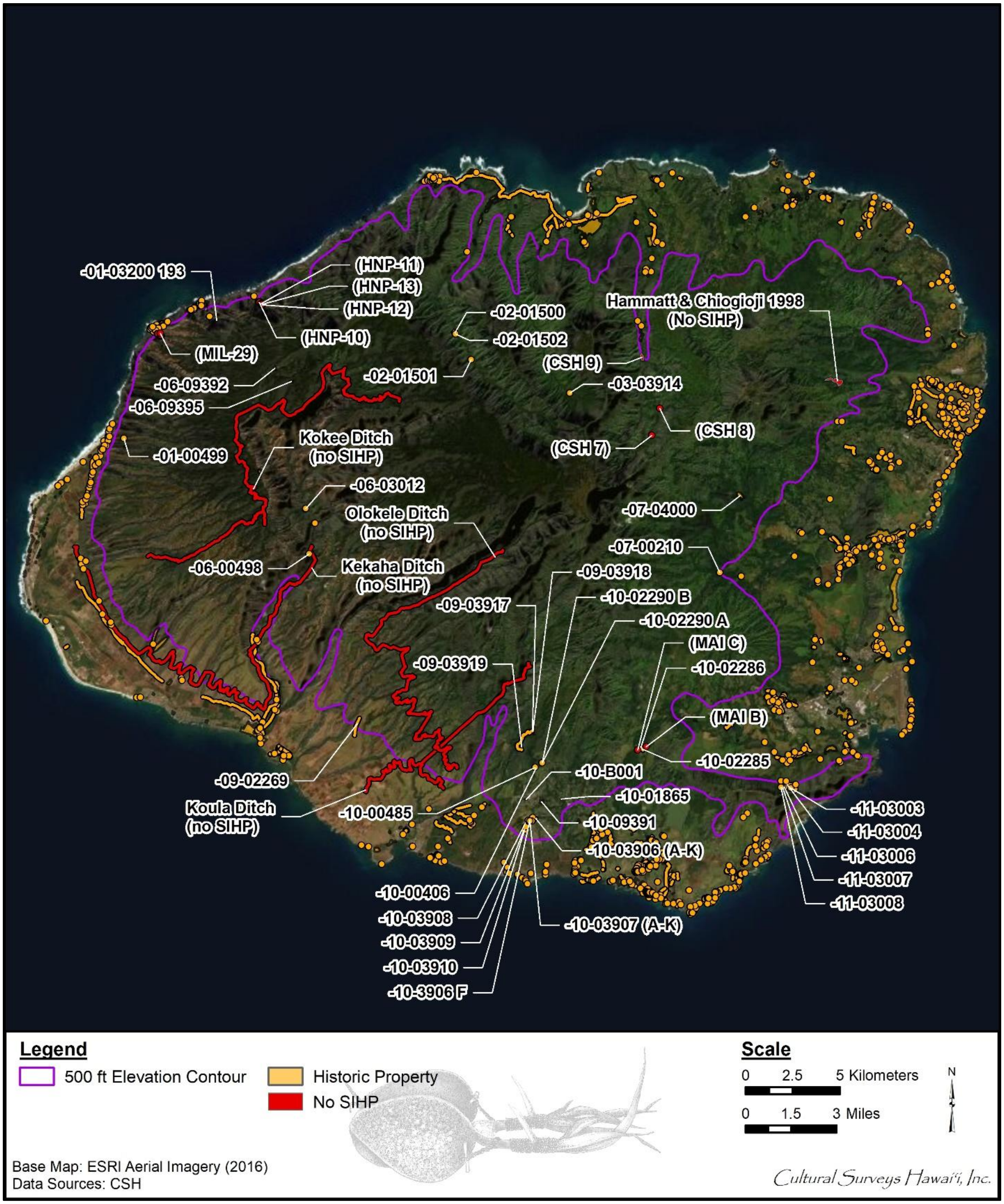


Figure 70. 2016 ESRI aerial image labeling historic properties in whole or in part above 500 ft elevation (not including Bennett sites depicted in Figure 64)

Table 11. Previously identified historic properties in whole or in part above 500 ft elevation (not including Bennett sites summarized in Table 9)

Site No. (SIHP # 50-30-)	General Location	Site Type	Approx. Elev. (ft)	Comment	Source
01-0499	Polihale, Waimea	Alignment	500 ?	Stone alignment, one to two courses high; earthen fill directly behind small 5 m alignment (for sweet potato planting)	McMahon 1993
01-3200 Site 193	Nualolo ‘Āina Valley, Nā Pali	Agricultural complex (possible *heiau*)	520	Archaeological sites (designated NUA-4 and NUA-5) extend to close to back of Nualolo ‘Āina Valley (Nā Pali Coast Archaeological District, SIHP #s 50-30-01-3200 and 50-30-02-3200 placed on HRHP and NRHP in 1984)	Tomonari-Tuggle 1979
02-1500	Wainiha Valley	Agricultural complex	770	Discusses designated Features A through AN, mostly agricultural terraces with walls and berms	Barrera 1984
02-1501	Wainiha Valley	Basalt artifact scatter	1,040	CSH shows this as consistent with Barrera 1982, 1984 studies but source could not be confirmed	Barrera 1982, 1984 ?
02-1502	Wainiha Valley	Cultural deposit	785	Discusses designated Feature A, a charcoal concentration, and features B and C, two pits in a roadcut	Barrera 1984
02-9392	Kōke‘e	Kokee CCC Camp	3,720	Constructed in 1935	Yent 1995
03-3914	Lumaha‘i Valley	*Heiau*	1,802	Platform of cobbles and small boulders located on top of prominent *pu‘u,* branch coral found at site indicates it is a *heiau*	Dye 2005

Site No. (SIHP # 50-30-)	General Location	Site Type	Approx. Elev. (ft)	Comment	Source
06-0498	Waimea Canyon	Burial cave	800	Unique cave site with five burials surrounded by rock walls, enclosures, and rock platforms	McMahon 1993
06-3012	Kukui Trail, Waimea Canyon State Park	Terrace walls and *loʻi* (agricultural complex)	680	A number of well-preserved former irrigated taro fields	Ching 1978
06-9392	Kōkeʻe State Park	Historic building complex	3,700	CCC Camp constructed in 1935 as part of larger CCC national service program consisted (in 1995) of seven wooden buildings around a grassed quadrangle, understood as on NRHP and HRHP	Yent 1995, Reinard and Erickson 1996, Monahan and Powell 2005
06-9395	Kōkeʻe State Park	Historic building complex	3,500	Camp Slogett, added to HRHP and NRHP in 1993	NRHP, HRHP
07-0210	Wailua River, Wailua	Agricultural complex	500	Several agricultural terrace complexes identified in *mauka* stretches of Wailua River Valley	Folk and Ida 1981
07-4000	Wailua (Keahua Arboretum)	Lithic work area	550	Kauakahi adze workshop (discussed in at least four field studies)	Kikuchi 1988, Yent 1988, Spear 1992, Kaschko 1996
09-2269	Makaweli	Irrigation ditch	600	Historic irrigation ditch system	Byerly and O'Day 2015
09-3917	Wahiawa	Irrigation structures	1,400-1,600	Remnant of irrigation canal known locally as Native Ditch, however, history of the feature indicates its construction in about 1900	Dockall et al. 2005

Site No. (SIHP # 50-30-)	General Location	Site Type	Approx. Elev. (ft)	Comment	Source
09-3918	Wahiawa	Dam	1,600	Identified as Alexander Dam, consists of concrete spillway and hydraulic filled dam with rock-armored front	Dockall et al. 2005
09-3919	Wahiawa	Irrigation infrastructure	1,440	Designating a forebay feature of Alexander Dam that receives water from outlet tunnels below the reservoir	Dockall et al. 2005
10-0406	Kalāheo	Agricultural complex	1,000	Concentration of 26 agricultural features believed to be post-Contact	Perzinski et al. 2001
10-0485	Kalāheo	Water dike	920	Historic water diversion structure within a gulch	Perzinski et al. 2001
10-1865	Kalāheo	Historic cemetery	500	“88 Shrines” Cemetery (two human burials ?); same as SIHP # 50-30-10-B002	Kikuchi and Remoaldo 1992, McMahon and Fujimoto 1991
10-2285	Kōloa (Kaumualii Hwy)	Bridge	640	Bridge 7E, built in 1933 of reinforced concrete consisting of two culvert cell with wing-wall abutments	Ruzicka 2014, Yucha et al. 2016
10-2286	Kōloa (Kaumualii Hwy)	Ditch	640	Earthen ditch that extends north to south and perpendicular to Kaumuali‘i Hwy, passing through culverts of Bridge 7E	Yucha et al. 2016
10-2290A	Kalāheo and Wahiawa	Ditch	1,100	Plantation-era remnant ditch	Kamai et al. 2016
10-2290B	Kalāheo and Wahiawa	Ditch infrastructure	1,100	Concrete sluice gate (related to Feature A ditch)	Kamai et al. 2016

Site No. (SIHP # 50-30-)	General Location	Site Type	Approx. Elev. (ft)	Comment	Source
10-3906 (A–K)	Kukuiolono Park, Kalāheo	Constructed features of Kukuiolono Park	Between 580 and 900	Includes entrance gate, walls, sculptures, dedication plaque stone, fountain, pagoda, microwave station	Tulchin et al. 2005, Jones et al. 2006
10-3907 (A–K)	Kukuiolono Park, Kalāheo	Hawaiian stone artifacts	Between 580 and 900	Collection of traditional Hawaiian stones and artifacts assembled by Walter D. McBryde	Tulchin et al. 2005, Jones et al. 2006
10-3908 (A–C)	Kukuiolono Park, Kalāheo	Burials (human, two, post-Contact)	Between 580 and 900	Graves of Walter D. McBryde and companion (two human burials); same as SIHP # 50-30-10-B014	Kikuchi and Remoaldo 1992, Tulchin et al. 2005, Jones et al. 2006
10-3909	Kukuiolono Park, Kalāheo	Retaining wall/terrace	Between 580 and 900	Loosely stacked stone retaining wall /terrace (historic)	Tulchin et al. 2005
10-3910	Kukuiolono Park, Kalāheo	Wall/ alignment	Between 580 and 900	Remnant stone wall alignment (possibly pre-Contact)	Tulchin et al. 2005
10-9391	Kalāheo	School campus	650	Kalāheo School Campus, placed on HRHP in 1991	HRHP
10-B001	Kalāheo	Historic cemetery	500	Holy Cross Cemetery	Kikuchi and Remoaldo 1992
11-3003	Hāʻupu Ridge	Habitation complex	600	Earth platforms, terraces, and rock walls	Neller and Palama 1973
11-3004	Hāʻupu Ridge	Trail	400-800	Kīpū Kai Trail, paved stone trail	Neller and Palama 1973
11-3006	Hāʻupu Ridge	House platform	600	Terrace-type house platform	Neller and Palama 1973
11-3007	Hāʻupu Ridge	An *ʻalaea* (ocherous earth) pit	640	Small cave along trail, possible source for clay used in coloring salt and other uses	Neller and Palama 1973
11-3008	Hāʻupu Ridge	Terraces and house sites	640	Rock-walled agricultural terraces, also possible house platforms	Neller and Palama 1973

Site No. (SIHP # 50-30-)	General Location	Site Type	Approx. Elev. (ft)	Comment	Source
No SIHP # (Kekaha Ditch)	Kekaha uplands	Ditch (post-Contact)	160-540	Kekaha Ditch	Lyman and Dega 2015, USGS map
No SIHP # (Kokee Ditch)	Waimea Canyon (west side)	Ditch (post-Contact)	1,500-3,500-	Kokee Ditch	USGS map
No SIHP # (Olokele Ditch)	Olokele uplands (Kekaha)	Ditch (post-Contact)	760-1,480	Olokele Ditch	USGS map
No SIHP # (Koula Ditch)	Hanapēpē uplands	Ditch (post-Contact)	410-750	Koula Ditch	USGS map
No SIHP #	Keālia uplands	Agricultural terraces	600	Nine terraced *loʻi* with stone retaining walls near ʻŌpai Kalaole Falls	Hammatt and Chiogioji 1998
No SIHP # (HNP-10)	Honopū Valley (Nā Pali)	Agricultural complex/ terrace system	500 ?	Series of terraces, average 6 m by 10 m (understood as part of Nā Pali Coast Archaeological District, SIHP #s 50-30-01-3200 and 50-30-02-3200 placed on HRHP and NRHP in 1984)	Yent 1989
No SIHP # (HNP-11)	Honopū Valley (Nā Pali)	Agricultural complex ?	500 ?	Retaining wall (understood as part of Nā Pali Coast Archaeological District, SIHP #s 50-30-01-3200 and 50-30-02-3200 placed on HRHP and NRHP in 1984)	Yent 1989
No SIHP # (HNP-12)	Honopū Valley (Nā Pali)	Agricultural complex/ terrace system	500 ?	Terraces, average 10 m in length (understood as part of Nā Pali Coast Archaeological District, SIHP #s 50-30-01-3200 and 50-30-02-3200 placed on HRHP and NRHP in 1984)	Yent 1989

Site No. (SIHP # 50-30-)	General Location	Site Type	Approx. Elev. (ft)	Comment	Source
No SIHP # (HNP-13)	Honopū Valley (Nā Pali)	Retaining wall	500 ?	5 m long 1 m high (understood as part of Nā Pali Coast Archaeological District, SIHP #s 50-30-01-3200 and 50-30-02-3200 placed on HRHP and NRHP in 1984)	Yent 1989
No SIHP # (MIL-29)	Upper Miloliʻi Valley	Cave shelters	500 ?	(understood as part of Nā Pali Coast Archaeological District, SIHP #s 50-30-01-3200 and 50-30-02-3200 placed on HRHP and NRHP in 1984)	Tomonari-Tuggle 1982
No SIHP # (MAI B)	Kōloa, vicinity of Bridge 7E Kaumualiʻi Hwy	Bridge (reinforced concrete)	640	Noted in vicinity of Bridge 7E Kaumualiʻi Hwy	Ruzicka 2014
No SIHP # (MAI C)	Kōloa, vicinity of Bridge 7E Kaumualiʻi Hwy	Box culvert	640	Noted in vicinity of Bridge 7E Kaumualiʻi Hwy	Ruzicka 2014
No SIHP # (CSH 7)	Upper Hanalei River	Overhang shelter	520 ?	Roughly 8 ft by 10 ft with ceiling height from 4 ft to 2 ft	Hammatt and Borthwick 1986
No SIHP # (CSH 8)	Upper Hanalei River	Overhang shelter	520 ?	15 ft from front to back (N/S) and 25 ft wide (E/W);ceiling height varies from 8 ft at front to 3.5 ft at back	Hammatt and Borthwick 1986
No SIHP # (CSH 9)	Upper Hanalei River	House site and terraces	520 ?	Complex of agricultural terraces and at least one house site	Hammatt and Borthwick 1986

5.4.1 Halele‘a District

In Halele‘a District (see Figure 65), the backs of the Hanalei River valley (house sites and terraces close to the river) and Wainiha River Valley (close to the river) have yielded site identifications but not in the density as were expected. The indication of a probable *heiau* or shrine (SIHP # 50-30-03-3914) on a hill in Lumaha‘i Valley raises the point of a heightened probability of religious sites on the summits of prominent hills. Any caves or overhangs providing shelter from the intense rain in the back of the valleys of Halele‘a would likely have been utilized.

5.4.2 Ko‘olau District

Relatively little archaeological study has been undertaken in the back of Ko‘olau District (see Figure 66) and seemingly no sites have been reported in modern studies above 500 ft elevation.

5.4.3 Puna District

In Puna District (see Figure 67), the summit spine area of Hā‘upu Ridge between Kīpū Kai and Nāwiliwili has been surprisingly rich in traditional Hawaiian sites (SIHP #s 50-30-11-3003, -3004, -3006, -3007, and -3008) including house sites and agricultural terraces. The far back of Wailua Valley is believed to be quite rich in archaeological sites close to the Wailua River valley as is the back of Keālia.

5.4.4 Kona District

The Kona District encompasses the southwest half of the island of Kaua‘i and has probably had half of the archaeological studies above 500 ft elevation (see Figure 68), probably owing in part to the relative ease of ascent up the less eroded ridges. Post-Contact activities related to agriculture such as the establishment of the Kokee, Olokele and Kekaha, Koula, and SIHP # 50-30-09-2269 (Kekaha) ditch systems and the creation of camps (SIHP # 50-30-06-9392, the CCC Camp, and SIHP # 50-30-06-9395, Camp Slogett) up at Kōke‘e account for a number of identified historic properties in the uplands of Kona District. We note the seemingly very high density of historic properties along the base of the Polihale/Mānā coastal *pali* in the far west but these typically do not extend far upslope above the base of the cliff. As a generalization, the relatively well studied table land ridges west of Waimea Canyon have proven to be relatively free of historic properties, probably as a result of most human activity extending into the uplands proceeding up the floor of Waimea Canyon or parallel up the west side of Waimea Canyon. The identified sites in Waimea Canyon have thus far proven to be very close to the valley floor.

The only identified traditional Hawaiian burial site above 500 ft elevation to date appears to be SIHP # 50-30-06-498 in upper Waimea Canyon. This mirrored the pattern reported by Bennett who only posits a burial function to one site above 500 ft elevation, two burials (Bennett Site 36) near the junction of the Wai‘alae and Waimea rivers in this immediate area.

The great slope east of Waimea Canyon to Kalāheo has generally lacked sites with the exception of additional irrigation infrastructure related sites in Makaweli (SIHP # 50-30-09-2269) and more so in wetter Wahiawa (SIHP #s 50-30-09-3917, -3918, and -3919). Kalāheo presents a relatively large, well-watered, relatively flat area above 500 ft elevation. The Kukuiolono Park hill, south of the belt Kaumuali‘i Highway in Kalāheo contains a number of sites (SIHP #s 50-30-10-3906, -3907, -3908, -3909) particularly associated with the life and activities of Walter D. McBryde.

As with the pattern of traditional Hawaiian burials, the pattern for modern burials has also been very much for burial at lower elevations with only three areas indicated for modern burials on Kauaʻi above 500 ft elevation (SIHP # 50-30-10-B001, the Holy Cross Cemetery; SIHP # -1865 "88 Shrines" Buddhist religious site [2 human burials]; and SIHP # -3908, graves of Walter D. McBryde and companion) all in the Kalāheo/Lāwaʻi area. Allied with this pattern of human activity is the fact that the only school on Kauaʻi above 500 ft elevation appears to be the Kalāheo School Campus (SIHP # 50-30-10-9391 placed on the HRHP in 1991).

North of Kaumualiʻi Highway in Kalāheo has also proved rich in sites (SIHP #s 50-30-10-406, -485, and -2290) but these have seemingly been exclusively related to post-Contact agriculture.

Sweeping along toward Līhuʻe a small grouping of sites in *mauka* Kōloa (SIHP # 50-30-10-2285, SIHP # -2286, MAI A, and MAI B) relate to modern Kaumualiʻi Highway.

5.4.5 Nā Pali District

The valleys of the Nā Pali Coast (see Figure 69) have been exceedingly rich in archaeological resources as documented in particular by Tomonari-Tuggle (1979) and Yent (1989). It is understood that most (or all) of the Nā Pali sites were lumped as part of the Nā Pali Coast Archaeological District (SIHP #s 50-30-01-3200 and 50-30-02-3200) that was placed on the HRHP and NRHP in 1984. The NRHP district nomination is a testament to the richness of the archaeological resources in this area. The relative narrowness of Honopū and Miloliʻi valleys may have led to greater documentation at higher elevations than in broader valleys such as Kalalau. Work of any scale in these valley floors would be likely to encounter historic properties. Most of the identified historic properties are close to the sea, near the mouths of the valleys, and along the valley floors below 500 ft elevation in these deeply dissected valleys but terraces and house sites continue to the back of the valley floors. Typically identified archaeological features (such as caves) do not ascend the valley walls far above the valley floor.

5.5 Previous Archaeology Summary and Predictive Model Below 500 Ft Elevation

As a generalization, archaeological studies in the lowlands (below 500 ft elevation) on Kauaʻi have been driven by development and have been undertaken near more populated areas which introduces a significant bias in the reporting of the nature, density, and distribution of historic properties. The indication is that presently undocumented historic properties are most likely to be found near where people lived in traditional Hawaiian times which is very much focused immediately along the coast and along the bottom lands of river valleys.

5.5.1 Haleleʻa District

Of all of the land forms of Kauaʻi the Hanalei Plain, watered by the relatively low gradient and manageable Hanalei, Waiʻoli, and Waipā river valleys may have supported the largest populations and would thus be expected to relate to a commensurate density of historic resources. Similarly the flood plains of the Kalihiwai, Lumahaʻi, Wainiha, Mānoa, and Limahuli streams would have supported substantial populations giving rise to a high density of historic properties (see Figure 65). As a sweeping generalization, archaeological sites would be expected close to the actual streams (as well as the coast) with the density quickly decreasing moving away from the streams.

The upper reaches of Hanalei, Lumaha‘i, and Wainiha still remain little reported on and the density of sites in these upper valley floors remains somewhat conjectural.

5.5.2 Ko‘olau District

The Ko‘olau District at the northeast corner of Kaua‘i (see Figure 66) has been relatively little studied but the general pattern seems to hold true of habitation (and in this well-watered area agriculture) near the coast, and then extending inland up the floors of major river valleys, particularly Anahola Stream but also (arcing to the north) the Pāpa‘a Stream, Moloa‘a Stream, Waipake Stream, and Kīlauea Stream.

5.5.3 Puna District

A general overview of the distribution of historic properties in Puna District can be gained from Figure 67. As a sweeping generalization, the extreme south end of the district, southeast of the Hā‘upu Ridge, was in a rain shadow and lacked major streams hence would be expected to have a lower density of historic properties once away from the coast. Just to the north, Puna District had rich, well-watered bottom lands of the Hulē‘ia Stream (with it iconic “Menehune” Alekoko fishpond), Puhi Stream, Pū‘ali Stream, and Nāwiliwili Stream. The plains that were developed into modern Līhu‘e would have been expected to have been less intensively utilized up to Hanamā‘ulu Bay and its river valley which was another locus of habitation and historic resources. The extensive lands back from the coast near Kālepa Ridge and inland would be expected to have fewer sensitive historic resources. While many plantation-related features might be expected in this area, these would be relatively identifiable and generally less sensitive. The Wailua River Valley is well-known for its riches in historic resources exemplified by the Wailua Complex of Heiau national monument. The area back from the coast between Wailua and Kapa‘a would be expected to have a significantly lower density of cultural resources. Kapa‘a and Keālia were quite well-watered and had a number of stream valleys (Konohiku Stream, Makaleha Stream, Kapa‘a Stream, Mimino Stream, Keālia Stream, Kumukumu Stream) conducive to agriculture and habitation and the creation of historic properties. This well-watered pattern drops off to the north until the Anahola Stream valley.

5.5.4 Kona District

The huge, sprawling southwestern Kona District was less well watered which may have focused agriculture and habitation and the creation of historic properties even more on the coast and the river valleys extending inland (see Figure 68). Kōloa’s Waikomo Stream valley was a major extension of traditional Hawaiian habitation inland and Lāwa‘i Stream was a lesser sibling to this pattern. The Kukuiolono landform seemed to have created a rain shadow and as a gross generalization a lower density of historic resources would be expected back from the coast between Lāwa‘i and Hanapēpē Bay. The bottom lands and lower slopes of the Hanapēpē River valley would have been a major locus of agriculture and habitation and the creation of historic properties as was the Waimea River valley with significantly lower densities of historic properties anticipated in the lands back from the coast in between. West of Waimea the lands back from the coast are understood to have been sparsely populated with a lower density of historic properties expected with the notable exception of the base of coastal *pali* in the Mānā/Polihale area which was a locus of human activity.

5.5.5 Nā Pali District

The historic resources of the Nā Pali District (see Figure 69) were determined to be of such merit to the nation as to be declared the Nā Pali Coast Archaeological District, (SIHP #s 50-30-01 -3200 and 50-30-02-3200) and to be placed on the HRHP and NRHP in 1984. While the historic properties that make up this district often extend far up these remote valleys, they tend to be at higher density close to the sea and are very much along the base of the valley floor typically extending only a very short distance up the steep valley sides and along the adjacent sea cliffs at the coast. In some of the Nā Pali valleys, the agricultural and habitation terracing forms virtual steps up the sides of the valley floor.

5.6 Summary Consideration of the Nature Density and Distribution of Historic Properties on Kauaʻi with Attention to Landforms

The preceding overview has been by necessity very "broad-brush." It emphasizes the generally tight correlation between stream valley floors and the area immediately adjacent to the coast and a higher density of historic properties. As a generalization, the table lands and ridges, and rugged interior were not utilized in ways that left archaeological traces. There were exceptions as on the Hāʻupu Ridge area and seemingly on the west side of Waimea Canyon. High densities of historic properties would be expected in places with particularly high traditional Hawaiian populations such as Hanalei Bay (and the debouching Hanalei, Waiʻoli, and Waipā river valleys), Anahola Bay and river valley, Wailua valley, Nāwiliwili Bay and associated valleys, Kōloa along the coast and extending inland along the Waikomo Stream, Hanapēpē Bay and valley, and Waimea Bay and valley. In some areas (most notably the Nā Pali valleys) the generation of historic properties seems to have been much greater than their modest populations would suggest.

It may be that further archaeological study will identify an abundance of historic properties in some places where they are not expected, but in most of the rugged cliff and valley interior, the southwestern dissected uplands of Puʻu Ka Pele and Makaweli, the *mauka* Līhuʻe basin, and the Alakaʻi High Plateau the density of historic properties is anticipated to remain low.

Section 6 Community Consultation

6.1 Introduction

Throughout the course of this assessment, an effort was made to contact and consult with Native Hawaiian Organizations (NHO), agencies, and community members including descendants of the area, in order to identify individuals with cultural expertise and/or knowledge of the plan area. CSH initiated its outreach effort in February 2021 through letters, emails, and/or telephone calls. CSH completed the community consultation in May 2022.

6.2 Community Contact Letter

Letters along with a map and aerial photograph were mailed with the following text:

> At the request of Kauaʻi Island Utility Cooperative (KIUC), Cultural Surveys Hawaiʻi, Inc. (CSH) is conducting a cultural impact assessment (CIA) for KIUC's Long-Term Habitat Conservation Plan Project, Kauaʻi Island.
>
> **Project Background**
>
> KIUC is applying for an incidental take permit (federal ITP) issued by the U.S. Fish and Wildlife Service (USFWS) and an incidental take license (state ITL) issued by the Hawaiʻi Department of Land and Natural Resources (DLNR). The federal ITP and state ITL would authorize take of species protected by the federal Endangered Species Act and its State equivalent, Hawaiʻi Revised Statutes (HRS) Chapter 195D, that is incidental to otherwise lawful activities. Specifically, the federal ITP and state ITL would authorize take resulting from operation of KIUC's power lines, operation of KIUC facility lights and streetlights, power line retrofits, and night lighting for repair of KIUC power lines and facilities (the covered activities).
>
> KIUC is developing a Habitat Conservation Plan (HCP) in support of their application for a federal ITP and state ITL. The Plan Area is the area to which the ITP applies and the approved HCP would be implemented, including where all conservation actions, impacts, and mitigation measures will occur. Because KIUC operates an island-wide system exclusively on Kauaʻi and is proposing conservation measures in remote areas of the island, the KIUC HCP plan area covers the full geographic extent of Kauaʻi. The plan area is depicted on a U.S. Geological Survey (USGS) topographic map of Kauaʻi (Figure 1), and an aerial photograph (Figure 2).
>
> The HCP covers nine species that are listed as endangered or threatened under the federal Endangered Species Act (ESA) and HRS §195D including three species of seabird, four species of waterbird, the Hawaiian goose, and the green sea turtle (Table 1). The covered species were selected based on their listing status and potential for the covered activities to result in injury or mortality to covered species due to light attraction (seabirds and green sea turtle) or collision with power lines (seabirds and waterbirds). KIUC is requesting take authorization from USFWS and DLNR for a 30-year permit term.

KIUC's conservation strategy includes implementation of management actions within existing breeding colonies of covered seabird species or at sites with suitable habitat for establishing new breeding colonies of covered seabird species. These management actions include use of predator or ungulate exclusion fencing to fence conservation sites, active predator control (with or without fencing), and development of social attraction sites to promote seabird nesting. Predator exclusion and predator control activities are targeted to exclude or control rats (*Rattus spp.*), cats (*Felis catus*), and barn owls (*Tyto alba*) as well as ungulates. Social attraction sites for nesting seabirds will be developed within predator excluded areas and will utilize call playback and artificial burrows to attract covered seabirds to the site to breed.

Table 1. Covered Species

English Name	Hawaiian Name	Scientific Name	Status
Newell's shearwater	‘a‘o	Puffinus auricularis newelli	T/T
Hawaiian petrel	‘ua‘u	Pterodroma sandwichensis	E/E
Band-rumped storm-petrel	‘akē‘akē	Oceanodroma castro	E/E
Hawaiian stilt	ae‘o	Himantopus mexicanus knudseni	E/E
Hawaiian duck	koloa maoli	Anas wyvilliana	E/E
Hawaiian coot	‘alae ke‘oke‘o	Fulica alai	E/E
Hawaiian common gallinule	‘alae ‘ula	Gallinula galeata sandvicensis	E/E
Hawaiian goose	nēnē	Branta sandvicensis	T/E
Green sea turtle	honu	Chelonia mydas	T/T

[a] Status (Federal/State):
E = Listed as endangered under the federal ESA or HRS §195D.
T = Listed as threatened under the federal ESA or HRS §195D.

Conservation sites will be located in the steep and rugged terrain of remote areas of the Nā Pali Coast that support existing colonies of nesting seabirds or where suitable habitat has been identified (Figure 1). Access to conservation sites is limited and is primarily accessed by helicopter.

Approval of the HCP and issuance of a federal ITP by USFWS and a state ITL by DLNR is subject to environmental review under the National Environmental Policy Act (NEPA) and the Hawai‘i Environmental Policy Act (HEPA), respectively. To facilitate concurrent environmental reviews, a joint federal/state Environmental Impact Statement that evaluates the impact of issuing a federal ITP and state ITL is being prepared. Pursuant to HEPA, the environmental review will include consideration of the impacts of implementing the HCP and issuance of the state ITL on the cultural beliefs, practices, and resources of native Hawaiians via a cultural impact assessment.

Purpose of the CIA

As outlined in the implementation guidelines for HRS §343, the purpose of this CIA is to gather information about the plan area and the surrounding area through research and interviews with individuals who are knowledgeable about this area in order to assess potential impacts of implementing the HCP on cultural resources, cultural practices, and beliefs. Because KIUC's infrastructure and potential conservation sites are located across the island of Kauaʻi, we are hoping to gain information on the various districts for which you have knowledge. We are seeking your *kōkua* and guidance regarding the following aspects of our study:

- Knowledge of cultural sites which may be impacted by activities covered in the HCP's plan area—for example, historic and archaeological sites, as well as burials
- Knowledge of traditional gathering practices in the plan area and districts in general, both past and ongoing, including the geographical areas where these practices typically occur
- Cultural associations of the plan area and districts, such as *moʻolelo* and traditional uses
- Referrals of *kūpuna* or elders and *kamaʻāina* (Native-born) who might be willing to share their knowledge on traditional cultural practices of the plan area and the districts more broadly
- Any other cultural concerns the community might have related to Hawaiian or other ethnic cultural practices within or in the vicinity of the plan area

If you contribute to this effort and with your permission, we would like to use your name in the report to give you proper credit.

The HCP is also subject to historic preservation review legislation including Section 106 of the National Historic Preservation Act (NHPA) and HRS §6E. Our consultation effort for the CIA may not be the only time someone reaches out to you regarding this project. The Section 106 consultation will be conducted in a separate consultation effort led by the USFWS and the Area of Potential Effect (APE) for this effort, in accordance with other state and federal regulatory processes, may differ from the project area related to the CIA. If you would like to participate in the Section 106 process, please let us know and we can relay your contact information to the appropriate party at USFWS for their consideration.

Due to the current situation with COVID-19, Cultural Surveys Hawaiʻi has temporarily halted in-person consultation as a necessary precaution. We are available to speak with you over the phone, by video chat, or you may also submit a written statement regarding the plan area, and/or your knowledge of the area more broadly. If you prefer to submit a written statement, CSH is able to provide a questionnaire that you may use as a guideline or you may answer the questionnaire directly. Please choose what is convenient for you, though the questionnaire is not

> necessary. A pre-stamped envelope will be provided to send your statement back to us.
>
> We are working primarily from home and are available at any time through email. In advance, we appreciate your assistance in our research effort. If you are interested in participating in this study, please contact Chantellee Spencer by email at cspencer@culturalsurveys.com. Your patience, understanding, and cooperation is greatly appreciated.

In most cases, two or three attempts were made to contact individuals, organizations, and agencies.

With only a few responses from the community, CSH, with guidance from KIUC representatives, drafted a second version of the consultation letter with the following text:

> At the request of the U.S. Fish and Wildlife Service (USFWS), Cultural Surveys Hawai‘i, Inc. (CSH) is conducting a cultural impact assessment (CIA) for the Kaua‘i Island Utility Cooperative (KIUC) Habitat Conservation Plan (HCP), Kaua‘i Island. This HCP will provide minimization of impacts to endangered species that are listed as endangered or threatened under the federal Endangered Species Act (ESA) and Hawaii Revised Statutes (HRS) §195D. Please note this plan does not focus on any specific KIUC project or facility, but rather encompasses the cooperative’s operations as a whole. We are reaching out to you to humbly request your *mana‘o* and *‘ike* regarding past and ongoing cultural, practices, beliefs, and resources that can inform the assessment of cultural impacts that may occur as a result of the HCP.
>
> **Habitat Conservation Plan Background**
>
> The HCP is being prepared in support of KIUCs application for a federal incidental take permit (ITP) issued by the USFWS and state incidental take license (ITL) issued by the Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife (DOFAW). The HCP being developed is aimed at minimizing impacts of the covered activities, which includes the operation of KIUCs power lines, operation of KIUC facility lights and streetlights, power line retrofits, and night lighting for repair of KIUC power lines and facilities.
>
> The Plan Area is the area to which the ITP and ITL applies and the approved HCP would be implemented, including where all conservation actions, impacts, and mitigation measures will occur. Because KIUC operates an island-wide system exclusively on Kaua‘i and is proposing conservation measures in remote areas of the island, the HCP Plan Area covers the full geographic extent of Kaua‘i. The Plan Area is depicted on a U.S. Geological Survey (USGS) topographic map of Kaua‘i (Figure 1), and an aerial photograph (Figure 2).
>
> The HCP covers nine species that are listed as endangered or threatened under the federal ESA and HRS §195D including three species of seabird, four species of waterbird, the Hawaiian goose, and the green sea turtle (Table 1). The covered species were selected based on their listing status and potential for the covered

activities to result in injury or mortality to covered species due to light attraction (seabirds and green sea turtle) or collision with power lines (seabirds and waterbirds). KIUC is requesting take authorization from USFWS and DOFAW for a 30-year permit term.

KIUC's conservation strategy includes implementation of management actions within existing breeding colonies of covered seabird species or at sites with suitable habitat for establishing new breeding colonies of covered seabird species. These management actions include use of predator or ungulate exclusion fencing to fence conservation sites, active predator control (with or without fencing), and development of social attraction sites to promote seabird nesting.

Table 1. Covered Species

English Name	Hawaiian Name	Scientific Name	Status
Newell's shearwater	ʻaʻo	Puffinus auricularis newelli	T/T
Hawaiian petrel	ʻuaʻu	Pterodroma sandwichensis	E/E
Band-rumped storm-petrel	ʻakēʻakē	Oceanodroma castro	E/E
Hawaiian stilt	aeʻo	Himantopus mexicanus knudseni	E/E
Hawaiian duck	koloa maoli	Anas wyvilliana	E/E
Hawaiian coot	ʻalae keʻokeʻo	Fulica alai	E/E
Hawaiian common gallinule	ʻalae ʻula	Gallinula galeata sandvicensis	E/E
Hawaiian goose	nēnē	Branta sandvicensis	T/E
Green sea turtle	honu	Chelonia mydas	T/T

[a] Status (Federal/State):
E = Listed as endangered under the federal ESA or HRS §195D.
T = Listed as threatened under the federal ESA or HRS §195D.

Predator exclusion and predator control activities are targeted to exclude or control rats (Rattus spp.), cats (*Felis catus*), and barn owls (*Tyto alba*) as well as ungulates. Social attraction sites for nesting seabirds will be developed within predator excluded areas and will utilize call playback and artificial burrows to attract covered seabirds to the site to breed.

Conservation sites will be located in the steep and rugged terrain of remote areas of the Nā Pali Coast that support existing colonies of nesting seabirds or where suitable habitat has been identified (Figure 1). Access to conservation sites is limited and is primarily by helicopter.

Approval of the HCP and issuance of a federal ITP by USFWS and a state ITL by DOFAW is subject to environmental review under the National Environmental Policy Act (NEPA) and the Hawaiʻi Environmental Policy Act (HEPA), respectively. To facilitate concurrent environmental reviews, a joint federal/state Environmental Impact Statement that evaluates the impact of issuing a federal ITP and state ITL is being prepared. Pursuant to HEPA, the environmental review will include consideration of the impacts of implementing the HCP and issuance of the state ITL on the cultural beliefs, practices, and resources of native Hawaiians via a cultural impact assessment.

Purpose of the CIA

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 plan area. 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 plan area and throughout Kaua‘i. 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.

As KIUC facilities cross every district of Kaua‘i, we are hoping to gain information on the various *moku* (districts) for which you have knowledge. Insights focused on the following topics on the areas shown on the figures above are especially helpful and appreciated:

- Your knowledge of traditional cultural practices of the past in the areas shown on the figures above, and on the Island of Kaua‘i generally
- Your specific traditional cultural practice and its connection to the areas shown on the figures above, and the Island of Kaua‘i generally
- The different natural resources associated with a specific traditional cultural practice
- Legends, stories, or chants associated with your specific traditional cultural practices and their relationships to the areas shown on the figures above, and to the Island of Kaua‘i generally
- Referrals to other *kūpuna*, *kama‘āīna*, and traditional cultural practitioners knowledgeable about the areas shown on the figures above, and the Island of Kaua‘i generally
- Your comments or thoughts on the potential impacts the proposed HCP may have on your ongoing traditional cultural practices and natural resources within the areas shown on the figures above, and the Island of Kaua‘i generally
- Your knowledge of cultural sites and *wahi pana* (storied places) within the areas shown on the figures above, and the Island of Kaua‘i generally
- Your comments or thoughts on the potential impacts the proposed HCP may have on cultural sites and *wahi pana* within the areas shown on the figures above, and the Island of Kaua‘i generally

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. 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. 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 HCP is also subject to historic preservation review legislation including Section 106 of the National Historic Preservation Act (NHPA) and HRS §6E. Our consultation effort for the CIA may not be the only time someone reaches out to you regarding this HCP. The Section 106 consultation will be conducted in a separate consultation effort led by the USFWS and the Area of Potential Effect (APE) for this effort, in accordance with other state and federal regulatory processes, may differ from the plan area related to the CIA. If you would like to participate in the Section 106 process, please let us know and we can relay your contact information to the appropriate party at USFWS for their consideration.

Due to the current situation with COVID-19, Cultural Surveys Hawai‘i has temporarily halted in-person consultation as a necessary precaution. We are available to speak with you over the phone, by video chat, or you may also submit a written statement regarding the plan area, and/or your knowledge of the area more broadly. If you prefer to submit a written statement, CSH is able to provide a questionnaire that you may use as a guideline or you may answer the questionnaire directly. Please choose what is convenient for you, though the questionnaire is not necessary. A pre-stamped envelope will be provided to send your statement back to us.

We are working primarily from home and are available at any time through email. In advance, we appreciate your assistance in our research effort. If you are interested in participating in this study, please contact Chantellee Spencer by email at cspencer@culturalsurveys.com. Your patience, understanding, and cooperation is greatly appreciated.

6.3 **Community Contact Table**

Table 12 and Table 13 contain the names, affiliations, dates of contact, and comments from NHOs, individuals, organizations, and agencies contacted for this project. A second list was created in due diligence to the lack of responses received from the first round of letters that were sent out beginning February 2021. Though it is not unusual to not receive comments during outreach, CSH and KIUC felt a project of this size justified numerous attempts for community feedback. It is important to note that no response, is simply, no response. It does not support nor oppose the proposed project unless otherwise stated by participating community members.

CSH reached out to a total of 73 individuals. Of the 73 individuals invited to participate in consultation, eight individuals responded either by phone or email. Attempts were made to engage in formal interviews, however, of the eight interested individuals, CSH was able to confirm and conduct only two separate interviews. Unfortunately, only one of the interviews was reviewed and approved in time for submittal of this report.

Table 12. Community Contact Table, First Round

Name	Affiliation	Comments
Ahuna, Kanoe	President/Director, EAO Hawaii Inc.	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Akana, Paula	Executive Director, Friends of ‘Iolani Palace	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Brown, Samson L.	President, Au Puni o Hawaii	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Cheek, H. Kanoeokalani	Vice President, Na Ku‘auhau ‘o Kahiwakaneikopolei	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Cortes-Kaleopaa, Abraham	CEO, Hawaiian Kingdom Task Force	Letter and Figures sent via USPS 23 February 2021 Second round letter and figures sent via USPS 30 April 2021
Danner, Robin Puanani	Chairman, Sovereign Council of Hawaiian Homestead Associations	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021 Ms. Danner emailed CSH after receiving a consultation letter forwarded from Liberta Albao. The following correspondence was

Name	Affiliation	Comments
		sent on 19 December 2013 in response to Ms. Albao’s forwarded message on 13 December 2021: *What’s fascinating about KIUC, is this coop has become a predator and violator of the habitat conservation of our lands for its owners, for the PEOPLE that are federally defined for Hawaiian Home Lands.* *Your report ought to mandate that KIUC value its obligation as a citizen coop in the state of Hawaii, that became a state in 1959, where we all (citizens and citizen orgs) embraced an obligation to fulfill the tenets of the Hawaiian Homes Commission Act of 1920.* *KIUC ignores us as PEOPLE, the source of all original culture in the Hawaiian Islands. We are invisible to their desires of our land and water resources at the Puu Opae hydro project. Completely ignoring a national best practice of including the Waitlist association, the two homestead associations in West Kauai, in simple community benefit agreements known as Homestead Benefit Agreements, as if we, the people are not the core focus of any “Cultural Impact Assessment” and instead KIUC overwhelms us by its money to conspire with state government to take what it wants from our land trust.* *Mahalo.* CSH responded on 10 January 2022: *Aloha Makahiki Hou,* *I hope this email finds you well in the new year. Please excuse the delay in my response! I appreciate your mana‘o and will be in touch with you. Please let me know if you have any questions.*

Name	Affiliation	Comments
Farden, Hailama	President, Association of Hawaiian Civic Clubs (AHCC)	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Feiteira, Blossom	President, Association of Hawaiians for Homestead Lands	Letter and Figures sent via email 25 February 2021 Email undeliverable
Gomes, Lance Kamuela	Konohiki Chief, Wahiawa Ahupuaa LCA 7714B Apana 6 RP 7813	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Gonsalves, Leon	President, Kauaʻi Chapter, Royal Order of Kamehameha III – Kaumualiʻi	Letter and Figures sent via email 25 February 2021 Email undeliverable
Heacock, Don	Nawiliwili Bay Watershed	Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via email 30 April 2021
Hussey, Sylvia M.	CEO, Office of Hawaiian Affairs (OHA)	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Ms. Hussey forwarded letter and figures to OHA Compliance 25 February 2021
Kaʻaumoana, Makaʻala	Executive Director, Hanalei Watershed Hui	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Email undeliverable Received email 12 March 2021: *Aloha Ms. Spencer,* *Mahalo for including us on the CIA for this matter.*

Name	Affiliation	Comments

		We are one of the original plaintiffs causing this action.
		
		Our specific land based kuleana is in the moku Halelea.
		
		However,
		
		• *The protection of our native seabirds is directly connected to the cultural practices and resources of our kuleana*
		• *We consider the following KIUC activities as cultural impacts:power lines: all lines in identified flyways should be lowered, camouflaged with vegetation and/or reconfigured to horizontal arrays*
		  ○ *street lights: all lighting should be downward facing and shielded*
		  ○ *exterior lighting at solar or other generation facilities must be as low as possible and shielded and aimed at the ground*
		  ○ *studies must be conducted to determine the impacts of large arrays of solar panels for their potential impacts on birds*
		  ○ *removal of predators on all KIUC property including around power poles and solar arrays.*
		
		*We have not identified specific sites as presenting potential impacts because the impacts KIUC has on the cultural resources and practices is **island wide**. If KIUC does the work we describe above and conducts the required reviews before any additional construction, other resources and practices will be protected.*
		
		***The loss of native birds on Kauai is DIRECTLY RELATED to KIUC power lines.** Mostly mauka lines which are "traps" for the birds as they take their*

Name	Affiliation	Comments
		fledgling flights and then cats as the birds crash to the ground. *Native seabirds contribute critical nutrients to the farmlands and our cultural mauka-makai connections.* CSH replied on 17 March 2021: *Aloha e Makaʻala,* *Mahalo for your response. All the points you present are critical and will be included in the report, if I have your permission. If you have time, do you think we could speak on the cultural practices and resources you mentioned? Though it is very important to report your concerns regarding the project and forward it for review, my position in this process is to also record past, current, and on-going cultural practices. I hope we can talk soon. I will make myself available if you have the time. I know there is A LOT going on on Kauaʻi right now so please reach out to me at your convenience.* *I appreciate your reply and apologize for my late response. I hope we can talk soon.* Ms. Kaʻaumoana called CSH Hilo the same day to elaborate on cultural practices and concerns regarding the project. Follow-up to be determined. CSH emailed Ms. Kaʻaumoana on 18 March 2021: Aloha Aunty Makaʻala, Thank you again for taking some time to speak with my yesterday. Attached to this email is a record of our communication and a small write-up of our telephone conversation. I tried to make the most of my chicken-scratch notes. Please review the document and make any necessary edits. You may add or delete as you wish. Also attached to this email is an authorization form giving CSH permission to use your statement (file titled

Name	Affiliation	Comments
		TelephoneStatement_3172021) in the CIA report. Please let me know if you have any questions. No response from Ms. Ka'aumoana. Sent follow up email 30 April 2021 regarding previous telephone conversation and statement. No response.
Kahalekai, Johnette	KNIBC - Lihue	Letter and Figures sent via USPS 23 February 2021 Attempts made to two different mailing addresses, both returned
Kaohelauli'i, Billy	Aha Moku Council – Kona	Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via email 30 April 2021
Kauka, Sabra	Hawaiian Studies Kumu, Island School	Letter and Figures sent via USPS 25 February 2021 Letter and Figures sent via email 25 February 2021 Ms. Kauka replied via email 25 February 2021: *I am away on a family emergency. Will look into this after I return home.* *Malama Pono,* Ms. Kauka was part of the second round of consultation. The following is correspondence from the second round of consultation: CSH replied via email 25 February 2021: *Mahalo for your quick response. We look forward to hearing from you.* CSH followed up on 15 July 2021. Ms. Kauka replied the same day with the following: *Aloha a Chantellee,* *You have an interesting job. And so do I.* *Just this last week I took a team into Nu'alolo Kai to malama 'aina. It's an all volunteer effort that gives us so much pleasure. Just to*

Name	Affiliation	Comments
		unplug from the internet, the phone and live in a place with no electricity is so refreshing. *The rainbows and sunsets, the birds and fish, the wind and rain, are all part of the experience.* *So Nu'alolo Kai is the place on Kaua'i that I am spiritually closest to. And there are no electrical lines in there, or on the ridges above. Mahalo Ke Akua.* *Lihu'e is where I live and the power lines are well established. One of your colleagues sent me a letter requesting any cultural information on a proposed development at Hoku'ala. I‘ll respond to him later.* *What compelled me to write to you first is because you included a list of native birds that are either endangered or threatened. That's a whole lot of them that are right on the edge of extinction.* *So anything that you, your firm and KIUC can do to keep those birds alive is a step in the right direction.* CSH replied 21 July 2021: *Aloha e Sabra,* *Mahalo for sharing such beautiful mana‘o. Though your connection is with Nu‘alolo Kai, would you like to speak on any traditional cultural practices that you know of or partake in that may still be practiced at other coastal areas on Kaua‘i? I have included a list of topics for your review if you‘d like to speak a little more with me. Please let me know if you‘d like to contribute to this study. I appreciate your reply and the sweet description of your ‘āina aloha.* No response. CSH followed up on 4 October 2021 requesting to speak more in-depth. No response.

Name	Affiliation	Comments
L’Hote, Yoshito	Aha Moku Council – Halele‘a/ Director, Aina Hookupu o Kilauea	Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via email 30 April 2021
Lewis, Joseph Kūhiō	CEO, Council for Native Hawaiian Advancement	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Lovell, Carol	KNIBC – Kawaihau	Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via email 30 April 2021
Marti-Kini, Aggie	Aha Moku Council – Ko‘olau	Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via email 30 April 2021
Mau-Espirito, Noa	Na Mookupuna o Wailua	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Nobrega-Olivera, Malia	President, Moku o Manookalanipo-Kaua‘i	Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via email 30 April 2021
Ofisa, Coty “Buffy”	Kamehameha Schools Resource Center, Kauai	Letter and Figures sent via USPS 25 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Quinsaat, Sandra	KNIBC - Koloa	Letter and Figures sent via email 25 February 2021 Email undeliverable

Name	Affiliation	Comments
Rogers, Puanani	Aha Moku Council - Puna	Called CSH on 26 February 2021 CSH returned her call on 2 March 2021 but no answer and unable to leave voicemail. CSH called again 15 March 2021, no answer. Voicemail. Ms. Rogers returned the call on 17 March 2021, message taken for Ms. Spencer who was not yet in office. CSH called back 17 March 2021, no answer. Voicemail. CSH called again 18 March 2021 and had a brief conversation with Ms. Rogers – consultation letter was sent to her email address for her review.
Rowe, Rupert	Hui Mālama O Kāneiolouma	Letter and Figures sent via USPS 23 February 2021 Second round letter and figures sent via USPS 30 April 2021
Santos, Donna Kaliko	Nā Kuleana o Kānaka ʻŌiwi /Aha Moku Council - Puna	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Silva, Adrian Nakea	Chairman, Hui Huliau Inc.	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Smith, Kamealoha	Board Member, Mahamoku Ohana Council/ Aha Moku Council – Koʻolau	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Mr. Smith replied via email 25 February 2021: *What about the inclusion of Native Hawaiians in the plan? We have cultural practices that require access and the idea, from a Native Worldview - Kuana Ike Hawaii is to restore, not just the habitat but also*

Name	Affiliation	Comments
		repair and restore the relationship between kanaka and aina. No conservation plan is complete without addressing the relationship. Chantelle Spencer is kanaka right? Sorry to go so hard, but been through this so many times and in the case of this KIUC project, it's on lease DLNR land right? *Always happy to contribute but need to have kanaka involved in this project as cultural monitors and long term resource managers, to ensure that the issue of the pilina between kanaka and aina can be addressed. Hopefully we can sit down and walaʻau so we can show you folks how we are working with the state to address this issue and at the same working on cultivating a more healthy & positive relationship with the County/State.* *Please let me know if you are going to hold a Zoom Meeting or something so we can walaʻau. I included another lineal descendant from the area, Steven Kaui. There are others who will likely share their mana'o with you regarding this project. Mahalo for reaching out, appreciate the letter and email.* *Ke Mahalo Mau,* CSH replied via email 25 February 2021: *Mahalo for your quick response. We will try to get answers to your questions and Chantelle or I will get back to you. We look forward to speaking with you.* Mr. Smith replied via email 16 March 2021: *Kamealoha Hanohano Pa Smith here on Kauai. Its been raining a lot and most areas on Kauai are living in flood conditions. Most of us live close by streams and rivers; rains a lot here, but what we are experiencing now is pretty overwhelming. I reached out to your office today to get an update about the KIUC Habit Conservation Plan/Project. I thought there was going to be some kind of consultation soon? Can you get back to me about this? I am trying to make sure other*

Name	Affiliation	Comments
		Hawaiian families in our area know about any proposed consultation, plus I think we'd like to approach KIUC again, maybe in April, after the rain subsides, about some access to their leased lands to engage in traditional practices, ceremonies, building an ahu, and taking opio up their for educational purposes. CSH replied via email 16 March 2021: *Mahalo for reaching out. I forwarded your email to Chantelle, she has been doing the consultation for the KIUC project. She is out of the office today, but will be available to speak with you tomorrow. Her email is* […] *if you would like to contact her and let her know if you are available to speak with her tomorrow.* Mr. Smith replied via email 16 March 2021: *I'll try to make myself available tomorrow. It depends on the content of our conversation. If she feels she needs some time, then its better if we schedule for another day. It would be great to receive an email from her directly so we can go over what she proposes to do and/or speak to us about. We've been through this process a number of times - but honestly, with not much success. Maybe a good place to start would be some background history of your organizations involvement, a timeline, projected outcomes, and some information to see where KIUC is at with some of our requests and concerns. We've heard "yes" many times, but most of that was verbal and informal, which is fine if our concerns and request were "one shot" deals but I don't think this is the case, in this situation. In any event, mahalo for the response and look forward to hearing from you folks tomorrow.* CSH replied via email 16 March 2021: *Mahalo for reaching out to CSH again. It would be better for us to reschedule for another day. I would like to do a zoom call with you but understand your commitment to*

Name	Affiliation	Comments
		your community and ‘āina at this time. I will make myself available for you when you can find time to meet. *I am aware that you are no stranger to this process and I hope to be as transparent as possible with you.* *My kuleana as a cultural researcher in regard to consultation is to speak with the community to gather information on past, current, and on-going traditional cultural practices that have been and may be affected by the proposed project.* *My kuleana as a kanaka in this field is to make certain that the appropriate parties are contacted and respectfully consulted with and that all factors are considered with the potential to be affected (physically and spiritually). I mean that in the sense that a rock is not just a rock and a tree is not just a tree and placement and location is not just coincidence.* *Any questions and concerns you have are very important as well and will be forwarded to the client for clarification and included in the report for consideration. My kuleana for this particular document and in my capacity as a (kanaka) cultural researcher is to speak with you and hope to record what you know about the ‘āina and what you are willing to share. I understand that this process is repetitive but these things need to be recorded.* *I hope we can schedule a time to meet via zoom. I will standby for your availability.*
Solis, Ka‘ahiki	Cultural Historian (Oahu, Kauai, Niihau), SHPD	Letter and Figures sent via email 25 February 2021 Ms. Solis replied via email 25 February 2021: *Please if you have not already submit this leka to intake.* *Mahalo nui*

Name	Affiliation	Comments
		CSH replied via email 25 February 2021: *I have not submitted it to intake yet. I will submit it now.* Ms. Solis replied via email 25 February 2021: *Mahalo that is our new system all emails must go to intake. Malama Pono.*
Soong, Melvin	President, The I Mua Group	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Suganuma, L. La‘akea	President, Royal Hawaiian Academy of Traditional Arts	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Trask, Mililani	Convenor, Na Koa Ikaika Ka Lahui Hawaii	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Turalde, Kane	Aha Moku Council – Kona	Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Vincent, Erika	Operations Manager, Native Hawaiian Education Council (NHEC)	Letter and Figures sent via USPS 23 February 2021 Second round letter and figures sent via USPS 30 April 2021
Wann, Presley	Hui Maka‘ainana o Makana	Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via email 30 April 2021

Name	Affiliation	Comments
Wichman, Chipper	President of National Tropical Botanical Garden Kauai	Letter and Figures sent via USPS 25 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Wichman, Randy	Former President of Kauai Historical Society	Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via email 30 April 2021
Williams, Lahela	Executive Director, Hawaiian Community Assets, Inc.	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via USPS 30 April 2021
Wise, Taffi	Executive Director, Kanu o ka ʻĀina Learning ʻOhana (KALO)	Letter and Figures sent via USPS 23 February 2021 Letter and Figures sent via email 25 February 2021 Ms. Wise replied via email 25 February 2021: *Aloha!* *I am out of the office checking email intermittently, if you need immediate kokua please call […].* *Mahalo,* **Taffi Wise** Second round letter and figures sent via USPS 30 April 2021
Yokatake, Naomi	Vice-President, Moku o Manookalanipo-Kauaʻi	Letter and Figures sent via email 25 February 2021 Second round letter and figures sent via email 30 April 2021

Table 13. Community Contact Table, Second Round

Name	**Affiliation**	**Comments**
Ahuna, Dan	OHA, Kauaʻi Island Representative	Letter and figures sent via email 13 July 2021 Second round letter and figures sent via email 13 December 2021
Albao, Liberta Hussey	*Pelekikena*, Queen Debra Kapule Hawaiian Civic Club	Letter and figures sent via email 13 July 2021 Second round letter and figures sent via email 13 December 2021
Andrade, Pelika	Education and Community Engagement Specialist, Sea Grant/ *Kamaʻāina*	Letter and figures sent via email 13 July 2021 Second round letter and figures sent via email 13 December 2021 Ms. Andrade responded on 15 December 2021: *Aloha, I don't know how much help I can be but am open to a conversation after the new year. Mahalo nui* CSH responded 22 December 2021: *Aloha e Pelika,* *Thank you for your response. Ideally, I'd like to focus on the bullet points below if you are open to sharing this information. Looking forward to speaking with you in a couple weeks. Mahalo a nui!* • *Your knowledge of traditional cultural practices of the past in the areas shown on the figures above, and on the Island of Kauaʻi generally* • *Your specific traditional cultural practice and its connection to the areas shown on the figures above, and the Island of Kauaʻi generally* • *The different natural resources associated with a specific traditional cultural practice* • *Legends, stories, or chants associated with your specific traditional cultural practices and their relationships to the*

Name	Affiliation	Comments
		areas shown on the figures above, and to the Island of Kaua‘i generally • *Referrals to other kūpuna, kama‘āina, and traditional cultural practitioners knowledgeable about the areas shown on the figures above, and the Island of Kaua‘i generally* • *Your comments or thoughts on the potential impacts the proposed habitat conservation plan may have on your ongoing traditional cultural practices and natural resources within the areas shown on the figures above, and the Island of Kaua‘i generally* • *Your knowledge of cultural sites and wahi pana (storied places) within the areas shown on the figures above, and the Island of Kaua‘i generally* • *Your comments or thoughts on the potential impacts the proposed habitat conservation plan may have on cultural sites and wahi pana within the areas shown on the figures above, and the Island of Kaua‘i generally*
Battad, Kahu Jade Wai‘ale‘ale		Letter and figures sent via email 13 July 2021 Second round letter and figures sent via email 13 December 2021
Blake, Ted	*Kama‘āina*	Letter and figures sent via email 13 July 2021 Mr. Ted Blake passed away in 2021
Ching, Milton	Cultural Monitor	Letter and figures sent via email 13 July 2021 Second round letter and figures sent via email 13 December 2021
Chun, Malia	Program Coordinator, Nā Pua No‘eau – Kaua‘i	Letter and figures sent via email 13 December 2021 Second round letter and figures sent via email 13 December 2021
Chun, Sean	*Lā‘au lapa‘au*	Letter and figures sent via email 13 July 2021 Second round letter and figures sent via email 13 December 2021

Name	Affiliation	Comments
Faye, Chris	Kōkeʻe Natural History Museum	Letter and figures sent via email 13 July 2021 Second round letter and figures sent via email 13 December 2021
Flores, Peleke		Letter and figures sent via email 13 July 2021 Second round letter and figures sent via email 13 December 2021
Fu, Jessica Kaui	*Pelekikena*, Hnalei Hawaiian Civic Club	Letter and figures sent via USPS 16 July 2021 Second round letter and figures sent via USPS 28 December 2021
Kaiaokamalie, Lea	County of Kauai Planning Department	Letter and figures sent via email 13 July 2021 Second round letter and figures sent via email 13 December 2021 Ms. Kaiaokamalie responded to CSH on 14 December 2021 with the following: *Mahalo for the email Chantelle and my apologies for a late response. I am available for an interview via Zoom or Teams. Kindly let me know your availability.* CSH responded 15 December 2021: *Aloha!* *Mahalo for getting back to me! Consultation for this project has been carrying on for almost a year and we are at the point of wrapping things up with little to no interest/response from those we reached out to. I appreciate your willingness to participate! Are you free next week Tuesday, December 21, at around 1pm?* A Microsoft Teams meeting was set up for 21 December 2021 at 1pm. CSH did not receive approval of the interview summary.
Kalama, Kumu Nathan	*Kumu Hula*	Letter and figures sent via USPS 16 July 2021 Kumu Nathan Kalama passed away in 2021
Kaohelauliʻi, John	Kauai Native Hawaiian Chamber of Commerce	Letter and figures sent via email 13 July 2021 Second round letter and figures sent via email 13 December 2021
Kaohi, Althea	Historian, Former Director, West Kauaʻi Visitor Center	Letter and figures sent via email 13 July 2021 Immediate reply, address unavailable

Name	Affiliation	Comments
Kauaʻi Historic Presevation Commission		Letter and figures sent via USPS 16 July 2021 Second round letter and figures sent via USPS 28 December 2021
Kaua'i Historical Society		Letter and figures sent via email 13 July 2021 Second round letter and figures sent via email 13 December 2021
Kaua'i Museum		Letter and figures sent via email 13 July 2021 Second round letter and figures sent via email 13 December 2021
Kauka, Sabra	Hawaiian Studies Kumu	Letter and figures sent via email 15 July 2021 Second round letter and figures sent via email 13 December 2021
Kekua, Kehaulani	*Kumu Hula*, Hālau Palaihiwa o Kaipuwai	Letter and figures sent via email 15 July 2021 Second round letter and figures sent via email 13 December 2021
Kinimaka-Alquiza, Kapu	*Kumu Hula*	Letter and figures sent via USPS 16 July 2021 Second round letter and figures sent via USPS 28 December 2021
Kualiʻi, Kipukai	Council Member	Letter and figures sent via email 15 July 2021 Second round letter and figures sent via email 13 December 2021
Makua, Kaina	Aloha Aina Poi Company	Letter and figures sent via email 15 July 2021 Second round letter and figures sent via email 13 December 2021
Mālama Hūleʻia		Letter and figures sent via email 15 July 2021 Second round letter and figures sent via email 13 December 2021
Muraoka, Beverly	*Kumu Hula*, cultural practitioner, and former entertainer at Coco Palms Hotel	Letter and figures sent via USPS 16 July 2021 Second round letter and figures sent via USPS 28 December 2021
Ofisa, Coty "Buffy"	Kamehameha Schools Resource Center	Letter and figures sent via email 15 July 2021 Second round letter and figures sent via email 13 December 2021
Pavao-Jardin, Kumu Leinaʻala	Kumu Hula, Hālau Ka Lei Mokihana o Leinaʻala	Letter and figures sent via email 15 July 2021 Second round letter and figures sent via email 13 December 2021

Name	**Affiliation**	**Comments**
Peters, Sarah	Pelekikena, Kaumualiʻi Hawaiian Civic Club	Letter and figures sent via email 15 July 2021 Second round letter and figures sent via email 13 December 2021
Rogers, Alohilani	Cultural Education Specialist, Kawaikini New Century Public Charter School	Letter and figures sent via email 15 July 2021 Kumu Alohilani responded to CSH on 20 July 2021: *Aloha Chantellee,* *I apologize for the delay in responding to you. My ʻohana and I were out of wifi/cell range since Friday.* *Mahalo for considering me to help. I have never been part of a CIA before and I am interested in learning more about how I might be of help to this project. I also know that I will be very busy as the new school year is starting up soon, so I donʻt want to commit to anything if I canʻt see it through completely. Would it be possible for us to talk/meet briefly? Perhaps Thursday or Friday?* CSH responded 21 July 2021: *Aloha mai e ʻAlohilani,* *Yes, we can absolutely meet. I am available on Thursday before 1 and anytime on Friday.* *Below are some bullet points of what I hope we could cover, if youʻd like to participate. If you can find time, a written testimony is more than lawa for this study. I understand that what Iʻm asking for is sometimes kept within ʻohana and not made available to the lehulehu but if youʻd like to touch on a few points, I would greatly appreciate your manaʻo and it would be invaluable to the study. Please let me know your availability to meet.* • *Knowledge of cultural sites which may be impacted by activities covered in the HCP's plan area—for example, historic and archaeological sites, as well as burials*

Name	Affiliation	Comments
		• *Knowledge of traditional gathering practices in the plan area and districts in general, both past and ongoing, including the geographical areas where these practices typically occur* • *Your specific traditional cultural practice and its connection to the proposed project area* • *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* • *Referrals of kūpuna or elders and kamaʻāina (Native*-born) *who might be willing to share their knowledge on traditional cultural practices of the plan area and the districts more broadly* • *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* • *Your knowledge of cultural sites and wahi pana (storied places) within the proposed project area* • *Your comments or thoughts on the potential impacts the proposed project may have on cultural sites and wahi pana within the proposed project area* Ms. Rogers replied on 22 July 2021: *Mahalo nui loa e Chantellee. I am free tomorrow anytime between 8a and 1p. Maybe a quick video call whenever is convenient for you?*

Name	Affiliation	Comments
		Following the brief video call with Ms. Rogers, CSH sent an email on 27 July 2021 with the following: *Aloha mai e ʻAlohilani,* *I hope this email finds you well in your first week back at school. I have attached the interview questions to this email. Please know that you do not need to answer every question but that you may use the questions as a guide. Whatever works best for you. Please let me know if you have any questions.* *Mahalo a nui,* *Chantellee* Another round of letter and figures were sent to Ms. Rogers on 13 December 2021. She replied the same day with the following: *Mahalo nui loa for reaching out again! So sorry that I was not able to get this information to you sooner. Initially, I had hoped to meet with a few friends to help accomplish this task, but could not find the time that everyone was available to meet. Since the invitation for manaʻo is still open, I will reach out to them again and - hopefully - get you the info you need!!* *me ke aloha,* *ʻAlohilani* CSH replied on 15 December 2021: *Aloha,* *ʻAʻole pilikia. I understand how busy life can get. Let me know if I can be of any assistance.* *Mahalo.*
Soma, Dirk	Former member of Kauai Native Hawaiian Chamber of Commerce	Letter and figures sent via email 15 July 2021 Second round letter and figures sent via email 13 December 2021
Sproat-Beck, Stacy	Executive Director, Waipā Foundation	Letter and figures sent via USPS 16 July 2021 Second round letter and figures sent via USPS 28 December 2021

Name	Affiliation	Comments
Topolinski, Kumu Kahaʻi	Kumu Hula, Ka Pā Hula Hawaiʻi	Letter and figures sent via email 15 July 2021 Immediate return, address undeliverable
Trask, Mauna Kea	Former County Attorney and Cultural Historian	Letter and figures sent via email 15 July 2021 Second round letter and figures sent via email 13 December 2021
Vidinha, Kahu Wayne	Ke Akua Mana Church	Letter and figures sent via email 15 July 2021 Second round letter and figures sent via email 13 December 2021
Wichman, Chipper	President, National Tropical Botanical Garden Kauaʻi	Letter and figures sent via email 15 July 2021 Second round letter and figures sent via email 13 December 2021
Wichman, Randy	Former President of Kauai Historical Society	Letter and figures sent via email 15 July 2021 Second round letter and figures sent via email 13 December 2021

6.4 ***Kama‘āina*** **Interviews**

The authors and researchers of this report extend our deep appreciation to everyone who took the time to speak and share their *mana‘o* and *‘ike* with CSH whether in interviews or brief consultations. We request that if these interviews are used in future documents, the words of contributors be reproduced accurately and in no way altered, and that if large excerpts from interviews are used, report preparers obtain the express written consent of the interviewee/s.

Several attempts were made to allow feedback from the community. After several rounds of mailouts only eight individuals showed interest with only four engaging in a formal meeting to discus the project. Unfortunately, CSH did not receive approval of statements. The individuals listed below approved their summaries for inclusion in this study:

6.4.1 Maka‘ala Ka‘aumoana

Aunty Maka‘ala Ka‘aumoana phoned CSH on 17 March 2021 regarding the KIUC Habitation Conservation Plan Project. An initial response from Aunty Maka‘ala sent on 12 March 2021 is included below:

> *Aloha Ms. Spencer,*
>
> *Mahalo for including us on the CIA for this matter. We are one of the original plaintiffs causing this action. Our specific land based kuleana is in the moku Halelea.*
>
> *However,*
>
> - *The protection of our native seabirds is directly connected to the cultural practices and resources of our kuleana*
> - *We consider the following KIUC activities as cultural impacts:*
>   - *power lines: all lines in identified flyways should be lowered, camouflaged with vegetation and/or reconfigured to horizontal arrays*
>   - *street lights: all lighting should be downward facing and shielded*
>   - *exterior lighting at solar or other generation facilities must be as low as possible and shielded and aimed at the ground*
>   - *studies must be conducted to determine the impacts of large arrays of solar panels for their potential impacts on birds*
>   - *removal of predators on all KIUC property including around power poles and solar arrays.*
>
> *We have not identified specific sites as presenting potential impacts because the impacts KIUC has on the cultural resources and practices is* ***island wide****. If KIUC does the work we describe above and conducts the required reviews before any additional construction, other resources and practices will be protected.*
>
> ***The loss of native birds on Kauai is DIRECTLY RELATED to KIUC power lines.*** *Mostly mauka lines which are "traps" for the birds as they take their fledgling flights and then cats as the birds crash to the ground.*

Native seabirds contribute critical nutrients to the farmlands and our cultural mauka-makai connections.

I hope you find this useful.

CSH replied to this email on 17 March 2021:

Aloha e Makaʻala,

Mahalo for your response. All the points you present are critical and will be included in the report, if I have your permission. If you have time, do you think we could speak on the cultural practices and resources you mentioned? Though it is very important to report your concerns regarding the project and forward it for review, my position in this process is to also record past, current, and on-going cultural practices. I hope we can talk soon. I will make myself available if you have the time. I know there is A LOT going on on Kauaʻi right now so please reach out to me at your convenience.

I appreciate your reply and apologize for my late response. I hope we can talk soon.

Aunty Makaʻala immediately called CSH to elaborate more on her email and to discuss traditional cultural practices and on-going concerns regarding KIUC. She mentioned paddling, crabbing, and fishing as cultural practices that will more than likely be affected by the project as her community in the Haleleʻa moku is already experiencing issues with current KIUC practices.

At the forefront of her concerns are the safety of the Newell's shearwater (*ʻaʻo*) and Hawaiian petrel (*ʻuaʻu*). KIUC power lines have become direct obstacles for these birds. When they come into contact with the power lines, in some cases where they are not immediately killed, they fall to the ground wounded. At this point, feral cats snatch up the wounded birds. Aunty Makaʻala has expressed the importance of predator control as a dual part to the power lines issue. To state obviously, if KIUC power lines are the cause for wounded birds damaged during flight, KIUC must implement a predator control plan so that even the birds that are wounded stand a chance for survival and repopulation. Aunty Makaʻala suggested trapping and dispatching feral cats by either KIUC or a hired agency.

Another issue Aunty Makaʻala mentioned was the careless handling of albizia (*Falcataria moluccana*) trees that are trimmed out of way of power lines. Most recently, debris from a recent tree trimming was dumped *mauka* of Hanalei River. Though it was promised that the debris would be removed from the area, the community has found cut logs in the streams. When these logs get into the streams they cause severe damage to stream life and can damage the reefs and the near-shore marine resources when it makes its way out of the river. These cut logs can also block access to the stream that many families use for recreational and gathering purposes. KIUC must do their due diligence in assuring proper disposal of all trimmed albizia logs.

Aunty Makaʻala is also concerned about the caution and care of native plants in the remote areas that KIUC has access to. Though these areas are out of public view, the importance of preserving native plants while accessing remote areas and installing poles and power lines, should remain a top priority.

Section 7 Traditional Cultural Practices

Timothy R. Pauketat succinctly describes the importance of traditions, especially regarding the active manifestation of one's culture or aspects thereof. According to Pauketat,

> People have always had traditions, practiced traditions, resisted traditions, or created traditions […]. Power, plurality, and human agency are all a part of how traditions come about. Traditions do not simply exist without people and their struggles involved every step of the way. [Pauketat 2001:1]

It is understood that traditional practices are developed within the group, in this case, within the Hawaiian culture. These traditions are meant to mark or represent aspects of Hawaiian culture that have been practiced since ancient times. As with most human constructs, traditions are evolving and prone to change resulting from multiple influences, including modernization as well as other cultures. It is well known that within Hawaiʻi, a "broader "local" multicultural perspective exists" (Kawelu 2015:3) While this "local" multicultural culture is deservedly celebrated, it must be noted that it has often come into contact with "traditional Hawaiian culture." This contact between cultures and traditions has undoubtedly resulted in numerous cultural entanglements. These cultural entanglements have prompted questions regarding the legitimacy of newly evolved traditional practices. The influences of "local" culture are well noted throughout this section, and understood to represent survivance or "the active sense of presence, the continuance of native stories, not a mere reaction, or a survivable name. Native survivance stories are renunciations of dominance, tragedy and victimry" (Vizenor 1999:vii). Acknowledgement of these "local" influences help 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 as were practiced within the *ahupuaʻa* in ancient times, and the aspects of these traditional practices that continue to be practiced today; however, this section also challenges "tropes of authenticity" (Cipolla 2013), and acknowledges the multicultural influences and entanglements that may "change" or "create" a tradition.

This section integrates information from Sections 3–6 in examining cultural resources and practices identified within or in proximity of the plan area in the broader context of the encompassing landscape. Excerpts from interviews are incorporated throughout this section where applicable.

7.1 Subsistence and Gathering

7.1.1 Off-Shore Fishing

Traditionally, the seashore and ocean areas were vitally important for resource extraction in the early days of settlement. Fishermen along the coast maintained a respected status within traditional Hawaiian society.

There are several regulated fishing areas on the island of Kauaʻi (DLNR 2021). The Hāʻena Community-Based Subsistence Fishing Area is in Hāʻena Ahupuaʻa in Haleleʻa Moku. Puna Moku has Hanamāʻulu Bay and Ahukini Recreational Pier in Hanamāʻulu Ahupuaʻa, Kapaʻa and Waikaʻea Canals in Kapaʻa Ahupuaʻa, and Nāwiliwili Harbor in Nāwiliwili Ahupuaʻa. Also in Puna Moku is the Wailua Reservoir Public Fishing Area located "approximately five miles mauka [inland] of Kūhiʻō Hwy, above the city of Wailua." Kona Moku has Port Allen and Waimea Bay and Waimea Recreational Pier. Also in Kona is the Kōkeʻe Public Fishing Area which includes "certain streams, reservoirs and ditches in the Kōkeʻe State Park."

The seashore and ocean also maintained spiritual significance for the people of Kauaʻi.

> The Ocean *(ka moana nui a Kane)* surrounded the earth. It was made salt by Kane so that its waters should not stink, and to keep it thus in a healthy and uninfested state is the special occupation of Kane. In imitation of Kane, the priests prepare waters of purification, prayer and sanctification (holy water) ʻ*wai hui kala*,ʼ ʻ*wai lupalupa*,ʼ and ʻ*Ke Kai olena*,ʼ wherewith to drive away demons and diseases; it was called ʻ*Ka wai kapu a Kane*.ʼ Women purified themselves after child-birth by bathing naked in the sea and sprinkling their *paʻu,* or skirt, with sea water. If they were too far from the sea, they took a calabash of salted water, and at high noon offered a prayer of blessing and poured it over their bodies. Doses of medicine (taken by fives) were followed by a sea bath. In the Pele legend, Lohiau, after being brought back to life from the dead, is bathed five times in the sea for purification. [Fornander in Green and Beckwith 1926:176]

Both seashore and ocean provided physical and spiritual sustenance (NOAA 2017) for the people of Kauaʻi. According to Malo, the ocean was divided into smaller divisions, stretching from *ʻae kai* (water's edge) to *moana* (pelagic zone) (Malo 1951:25–26). Outside the coastal areas was the belt known as *kua au*, where the shoal water ended (Malo 1951:26). Further out was the *kai au*, deeper waters designated for surfing, swimming, or spearing squid (Malo 1951:26).

The well-formed off-shore reef undoubtedly provided Wainiha valley residents with a wealth of resources. However, portions of coastal Wainiha are vulnerable to inundation by tsunamis originating in the north Pacific Ocean.

In the Wahiawa Ahupuaʻa is Pōhakuloa. Pōhakuloa meaning "long rock," was an erect stone and was one of three that stood in a line.

> Pōhakuloa on the plain, one on the seacoast that is now gone, and one out in the sea where the deep-sea fishing grounds were. These stones together were a *koʻa* (fishing shrine) where a fisherman prayed for success on his way to fish and where he left an offering of the first catch of the day on his way home. [Wichman 1998:32–33]

7.1.2 Fishing

Coastal Zones were utilized for marine resources, habitation, burials, and ceremonial structures often associated with fishing (Bennett 1930). Anahola included two reefs. The reef on the east extended to Kahala Point. On the north side of Anahola Bay, a reef extends all the way to Papaʻa Bay. It is said regarding the island of Kauaʻi that the northeast shores are closed by sand bars and afford a plentiful harvest to the fishermen (Damon 1931). Two large boulders located on the *mauka* side of ʻAliomanu Road, containing several circular and linear worn depressions on the stones' surface, suggest pre-Contact marine subsistence focus along the Anahola shoreline (Dixon et al. 1997). The depressions on the rock face are described by Kirch as bait cups (Kirch 1985:273). "The practice of chumming the water with pounded fish remains, poison, and perhaps *kukui* nut oil in order to spear fish rising to feed on the bait—a practice often conducted at night by torch light" (Dixon et al. 1997).

Abner Paki, father of Queen Liliuʻokalani, states in a letter to the Minister of Interior that Hanapēpē belongs to the King and that the *akule* is the *kapu* fish (letter of 20 April 1852). According to Titcomb, this fish is eaten raw, broiled, or cooked in a *ti* leaf bundle placed over the taro in the *imu* (underground oven), is good for *palu* which she says is used in a relish; and is also a favorite fish for drying (Titcomb 1972:62). In discussing fishing taboos, Mary Kawena Pukui noted that "Summer was the time when fish were most abundant and therefore the permitted time for inshore fishing. Salt was gathered at this time, also, and large quantities of fish were dried" (Titcomb 1972:14). She elaborates, saying that when the *kahuna* had decided conditions were favorable for fishing:

> For several days it remained the right of the chief to have all the sea foods that were gathered, according to his orders, reserved for his use, and that of his household and retinue. After this, a lesser number of days were the privilege of the *konohiki*. Following this period the area was declared open (*noa*) to the use of all. [Titcomb 1972]

In Pīlaʻa, information from the historic period indicates marine resource gathering was important, such as fishing the rich wide reef off Pīlaʻa Bay and gathering *limu kohu* from near the shore.

Traditional fishing villages were once located near the seashore at Kalapakī, east and north (around and up the coast) of Kalapakī Beach. *Loko* and small drainages were inland of these settlement areas.

7.1.3 Fishponds

Kauaʻi once had fishponds scattered throughout the coast. Many *moʻolelo* of Kauaʻi mention Menehune building fishponds around the island.

ʻAlekoko (rippling blood) fishpond was built by the Menehune at the request of Chief ʻAlekoko and his sister, Chiefess Kalālālehua. The Menehune had agreed upon the request with one condition: the two of them were not allowed to watch the Menehune work and must remain in their house until it was finished. The two of them agreed to the conditions and stayed in their house for most of the day and into the night. However, Chief ʻAlekoko's curiosity became too much for him to bear and he took a peek outside. Immediately, the Menehune chief knew and ordered everyone to stop working. The Menehune left the pond unfinished as reminder to Chief ʻAlekoko of breaking his promise (Wichman 1998:58)

According to Kikuchi (1973), Nāwiliwili was home to at least five other fishponds in addition to ʻAlekoko (Menehune) Loko. The names of two of these were unknown, but the others are Kalalalehua (near a *moʻo* of the same name), Lokoponu, and Papalinahoa (near a *moʻo* of the same name).

Kīpū Kai provided many opportunities for its people. The residents of Kīpū Kai were known to grow *ʻuala*, *ipu* (bottle gourd, *Lagenaria siceraria* or *L. vulgaris*), and *uhi* (yams). More *makai*, the people worked the salt pans and fishpond.

The Pōhakuawa is a large boulder with a bowl carved into its surface. The stone was used in traditional Hawaiian times by fisherman transporting *awa* from the brackish Nōmilu Fishpond to a large pool in the Wahiawa Stream. "The fisherman stopped the night at Pohakuawa and kept his catch alive in cool fresh water in the bowl of the rock that was draped over with vines to keep the stone cool and keep the fish from jumping out" (Sandison 1956). The *awa* fish (*Chanos chanos*) has close associations with *loko iʻa* and was a common fishpond species throughout the islands.

A noteworthy resource in Keālia was ponds or *loko wai*. Four ponds were mentioned, though no reference to location is given for two of them. Akiana Pond (LCA 8060) is thought to be located in the *ʻili* of Akiana and Loko Waipunaula (LCA 8833) is thought to be in Waipunaula ʻIli. In addition to the fishponds providing fresh fish, the Keālia records indicate freshwater fish were also caught in the rivers and streams.

In Waimea, for LCA 3310, Manu claimed two *loʻi* with *kula* for each and a fishpond called Pulia. In describing the boundary of his land, he mentioned the *ʻauwai* of Keaʻaliʻi and an unnamed *pali* to the west. For LCA 3593, Keikiole claimed two *loʻi,* a *kula,* and a house lot. In describing the boundary of his lands, he mentions a fishpond called Kealii (Keaʻaliʻi), the *ʻauwai* of Peekanai (Peʻekauaʻi), and the *pali* of Kanaʻana. This testimony indicates there were many smaller *ʻauwai*, separate or connecting to the large Peʻekauaʻi ʻAuwai, and numerous fishponds, possibly large taro patches also used to raise fish, in the land on the east slope of Kanaʻana/Pokiʻi Ridge.

Two LCA claims in Waioli mention a fishpond. In Kahili, LCAs mention *loko wai*, or freshwater ponds. Debora Kapule, the former wife of Kauaʻi sovereign Kaumualiʻi inherited two fishponds which were located on the property of the former Coco Palms Resort.

7.1.4 Freshwater Subsistence

It is also important to note the importance of streams as a soure of subsistance. Streams play a vital role in sustaining wetland wildlife and Native Hawaiian agriculture. Streams provide freshwater to *loʻi kalo* (taro patches), wetland marshes, and *loko iʻa* (fishponds). These areas are habitats for various species including *ʻoʻopu* (goby fish, families include *Eleotridae*, *Gobiidae*, and *Blennidae*), *hīhīwai* (Endemic grainy snail, *Neritinu graposa*), *ʻōpae*, *ʻalae keʻokeʻo*, *ʻalae ʻula*, *aeʻo*, and others (CWRM and RTCAP 1993).

The following *ʻōlelo noʻeau* is in reference to the fishing season of *hinana*, the spawn stage of an *ʻoʻopu*. During this season, there was such a vast amount that one could not go into the water without being touched by the fish.

> *Ka iʻa hoʻopā ʻili kanaka o Waimea*.
>
> The fish of Waimea that touch the skins of people.
>
> When it was the season for *hinana*, the spawn of *ʻoʻopu*, at Waimea, Kauaʻi, they were so numerous that one couldn't go into the water without rubbing against them. [Pukui 1983:146]

7.1.5 Salt Production

Almost equally as important as food, salt was a preserver and staple in the days of old. Keālia, in the Puna Moku, has various meanings but all meanings have a common element, *paʻakai* (salt). This place name can mean "salt encrustation," "salt land," or "salt pan" (Wichman 1998:85). Salt was a staple and was necessary for preparing food and ceremonial purposes. Also famous for salt production was Kīpū Kai which provided many opportunities for its people. The residents of Kīpū Kai were known to grow *ʻuala*, *ipu* (bottle gourd, *Lagenaria siceraria* or *L. vulgaris*), and *uhi* (yams). More *makai*, the people worked the salt pans and fishpond. Keoneloa is also known for its *kuakua paʻakai*. Nōmilu, in the Kalāheo Ahupuaʻa, is a natural salt water pond where a series of salt pans "produced the finest and most desired salt of Kauai" (Wichman 1998:34–35). The shoreline of Kōloa also consisted of salt pans. Winds blew the salt water into shallow ponds where the community carefully gathered *paʻakai*. Salt manufacturing was an important industry in Kōloa Ahupuaʻa. It was noted in Boundary Commission testimony that people "from Koolau go to Koloa for salt" (Boundary Commission 1874, Kauaʻi 1:124).

7.1.6 Farming

During the centuries before Euro-American Contact, the land and waters of Hanalei had long afforded possibilities for intensive agricultural and cultural development by *kanaka maoli*. The large alluvial flat on both sides of Hanalei River had been farmed extensively for taro for centuries. E.S. Craighill and Elizabeth Handy present the *ahupuaʻa* resources that pre-Contact Hawaiians utilized and amplified:

> Hanalei is unique on Kauai in having a broad river flowing into a magnificent level seaward area [...] The flats in which rice was planted by the Chinese had been the taro *loʻi* of the Hawaiians, amply irrigated by ditches from the Hanalei River. Sugar cane and ranching at different times have taken over most of the land where taro was originally grown. And yet in recent years some taro was still grown there and there was a *poi* mill […]
>
> Because of an abundance of foods of all sorts, Hanalei was, and still is, one of the most attractive dwelling places in the islands. In addition to its rich lands and water resources, and its beautiful beach, it was close enough to the rich deep-sea fishing grounds off the Nāpali coast to supply its people with plenty of fish. [Handy and Handy 1972:420–421]

Hāʻena is a narrow coastal strip that lies between high cliffs and mountain sides (Handy and Handy 1972:419). Hāʻena consisted of several extensive areas of *loʻi kalo* including the lower portions of Limahuli Valley and the east and west sides of the valley as well. Areas between the *makai* and *mauka* areas of Hāʻena were also filled with *loʻi kalo*. The small valley of Mānoa was also filled with irrigated terraces. East of Limahuli Stream was a swampy area where taro was grown in a unique style similar to that of Mānā and Waiʻeli located in west Kauaʻi (Handy and Handy 1972:419). Swamp mud was piled onto rafts that were partially submerged. *Kalo* was cultivated in the swamp mud on these partially submerged rafts. Sweet potatoes were grown in the sandy areas along the coast of Hāʻena. Bananas were formerly planted in Limahuli and Mānoa valleys as well as sugarcane and *ʻawa*.

Kalihikai is a small *ahupuaʻa* that "had quite extensive *loʻi* areas near the sea. There were *loʻi* back along main streams and side streams," although the valley is shallow (Handy and Handy 1972:421). The lands are described as "a rolling plain that has been gouged by small streamlets which, for the most part, drain away into the neighboring *ahupuaʻa* of Kalihiwai and Hanalei. The plain drops over low hills broken by four little gulches onto a flat strip of land. It was here that the loʻi, irrigated field ponds, were dug and taro grown, and the people lived" (Wichman 1995a:1).

7.2 **Recreation**

7.2.1 Surfing

Numerous Kauaʻi seashores have been utilized for the sport of *heʻe nalu* or surfing. Mary Kawena Pukui of the Bishop Museum made a list of surfing spots mentioned in Hawaiian oral traditions (Finney and Houston 1996:31). For Hanelei in Haleleʻa Moku, she recorded Hawaiʻiloa ("long (or distant) Hawaiʻi"), Hoʻopeʻa ("to cross"), Kūakahiunu ("standing like a fishing shrine"), Makawa, and Puʻulena ("yellow hill"). For Waiʻoli, also in Haleleʻa, she recorded Manalau ("many branches"). For Anahola in Koʻolau Moku, she recorded Kanahāwale (meaning "easily broken"). For Kapaʻa in Puna Moku, she recorded Kamakaiwa ("the mother-of-pearl eyes"), Poʻo, ("head"), and Koʻa-lua ("two coral heads"). For Wailua, also in Puna Moku, she recorded Makaiwa ("mother-of-pearl eyes") and Kaʻōhala ("the thrust passing"). In Kona Moku, she recorded Hanapēpē ("crushed bay"). For Waimea, also in Kona Moku, she recorded the names of *Kaua* ("war"), *Kualua* ("twice"), and *Poʻo* ("head").

John Papa ʻIʻī, the early Hawaiian historian, had a similar list of Kauaʻi surfing spots:

> The surf of Kamakaiwa is in Kapaa, Kauai, and so is the surf of Kaohala and one that runs to the sand of Wailua. Others are the surfs of Poo, Koalua, and the one that runs to the mouth of the sand-bottomed stream of Waimea, and the surf of Manalau is in Waioli. [ʻĪʻī 1959:135]

7.2.2 *Ulana Lauhala* (Lauhala Weaving)

Numerous accounts attest to extensive *hala* groves in the uplands of Hanalei, Kalihikai and Kalihiwai in the early nineteenth century (Alexander 1991; Bird 1890; King 1991; Lydgate, H.E. 1991). William DeWitt Alexander (1991:124) describes these groves during a trip around the island in 1849, "Five more miles of riding through woods of *hala*, brought us to the tip of the hill that overlooks Hanalei Valley [...]" William T. Brigham visited Kauaʻi in 1865 and also commented on the extensive pandanus, "Vast numbers of pandanus cover the hillsides and grow so luxuriantly as to furnish an admirable shelter from the rain" (Lydgate, H.E. 1991:139). It can be assumed that these *hala* groves were used to gather *lau* to weave mats and the like.

7.3 **Habitation**

The abundance of fresh water attracted settlers to the *moku* of Haleleʻa. Native grasses and trees including *hala*, *milo* (*Thespesia populnea*) and *kou* (*Cordia subcordata*) trees covered the plains. Earle (1978:163) relates that "only the prime areas of alluvial soils were farmed intensively aboriginally." No evidence of pre-Contact villages have been found in Haleleʻa; rather, homes were scattered around the *moku* (Wilcox 1981:141).

During the centuries before Euro-American Contact, the land and waters of Hanalei had long afforded possibilities for intensive agricultural and cultural development by *kanaka maoli*. The large alluvial flat on both sides of Hanalei River had been farmed extensively for taro for centuries.

Prior to Western Contact, the hill areas of the *ahupuaʻa* of Hanalei, Kalihiwai and Kalihikai may well have been used for gathering as part of the land open to all *ahupuaʻa* members. Economically viable plants have been identified in association with archaeological remains on the lower slopes (25 to 125-ft elevation) of the valley ridge; these have been associated with dry land or *kula* lands to supplement the crops growing in the adjoining terraces (Cleghorn 1979; Schilt 1980). The pandanus groves of the upper slopes of the valley wall would have been another resource for residents of Hanalei Ahupua‘a who would not have to travel so far *mauka* to find the *hala* needed for their mats, etc. The *ahupua‘a* all had irrigation systems in place in the 1850s to distribute stream and rain water to the extensive *lo‘i* fields.

As a result of the Māhele, Land Commission Awards (LCA) were claimed in five distinct clusters within Hanalei Ahupua‘a: the shoreline, the Maha‘ana (taro fields adjacent to Waioli Ahupua‘a), Puapuahoi-Limanui (the bottom lands of the Hanalei River), ‘Anini (on the coast northeast of Hanalei Bay), and Kīloa (inland and adjacent to Limanui).

Seventy claims were filed for Hanalei (some filed the same property under two numbers) and 49 were awarded. These claims, both awarded and not awarded, detail land usage referred to here as land use components. These components (204) comprise more than 124 taro patches or *mo‘o* (one or more taro patches in a *mo‘o*) (61.1%), 44 house lots (21.7%), 18 *kula* (8.9%), more than eight orange and more than one lemon trees (4.9%), five *loko* (2.5%) a *noni* and banana patch, 400 head of cattle and 160 acres of coffee, and a wharf (misc. 1%).

From the LCA testimony, it seems that by 1850 the people in the district had a tradition of shared resources and functioned as part of the larger district entity rather than maintaining a separate *ahupua‘a* status. Even though neighboring *ahupua‘a* would have had their own resources, LCAs show some persons had agricultural land in Wai‘oli but lived elsewhere, and some people living in Wai‘oli had agricultural land elsewhere. During early historic times Wai‘oli served as a nucleus of not only the new western culture and religion, but also as a resource garden for imported cultigens in the vicinity of the Wai‘oli Mission.

Wai‘oli, with 3,350 acres, has 154 claims for *lo‘i*, which works out to .046 *lo‘i* per acre for the entire *ahupua‘a* or probably 1.5 per acre on the 100 acres of floodplain. *Lo‘i* represent 74% of possessions claimed, *kula* 13%, house lots 12.6%, and other less than 1%. A scant 14% of the awardees claimed to have held the land prior to 1824. A quarter of the claimants received their land during the time of Davida Papohaku, *konohiki* of Wai‘oli from 1834–1837. Davida Papohaku or David Stonewall was one of the five members who came with Rev. Whitney to help organize the Wai‘oli Mission and it was his duty to correct and help Mr. Alexander translate his sermons into Hawaiian.

Wainiha is part of a larger LCA (11216.5) of M. Kekau‘ōnohi. A study of all the claims and their supporting testimony for Wainiha shows a well-developed land system in place. The overall settlement pattern, dating to the mid-1800s, exhibited habitation near the coast and agricultural undertakings in the well-watered interior areas. During his island-wide survey of Kaua‘i in 1928-1929, Bennett (1931:136) observed the remains of many terraced house sites and irrigated fields at Maunahina Ridge (Site 153), about 7.2 km (4.5 miles) from the sea. Maunahina is said to be the location of the ancient trail (Wichman 1985:114) that leads out of Wainiha, up to Kilohana at the north edge of the Alaka‘i Swamp, through Kōke‘e and down to Waimea on the southwest side of the island, used to take advantage of the resources of the Alaka‘i and as an overland alternative route to Waimea.

7.4 **Religion and Ceremony**

7.4.1 Hula

In the *moʻolelo* of Naupaka Uka and Napaka Kai, At Hāʻena in Wainiha Ahupuaʻa there was a man and a woman who were both in the same *hālau hula* (hula troupe) and were in love. It was *kapu* (taboo) for men and women in the same *hālau hula* to be in intimate relationships. Before their graduation, they ran off, asking Laka, the goddess of *hula*, for forgiveness. Kilioe, the chiefess of the school, followed them. When she caught the woman in a cave, she killed her. Kilioe then chased the man up toward the mountain, caught, and killed him.

Laka, being a kind goddess, turned both the man and woman into half flowers. *Naupaka kuahiwi* (mountain naupaka, *Scaevola gaudichardii*) is the man, while *Naupaka kahakai* (beach naupaka, *Scaevola taccada*) is the woman. "Each shrub bears only half a flower, and like the lovers they are incomplete when separated. But when they are brough together, the blossoms can be made to form a single perfect flower" (Wichman 1998:117).

Kalamaʻula (red *lama* tree) is a small pasture area within Lepeuli Ahupuaʻa. *Lama* (all endemic kinds of ebony, *Diospyros*, synonym Maba) was a type of wood associated with the practice of medicine and *hula* (dance) as another meaning for *lama* is "torch, light" (Wichman 1998:96–97).

Pūweuweu (clump of greenery) honors the goddess Laka, the goddess of hula. The term *pūweuweu* or *pūpū weuweu* is the name of a prayer chant "designed to free the *kapu* from a *hula* student at the end of a period of training" (Wichman 1998:94).

Hinaiuka, or "Hina of the uplands," is an area on the side of Hāʻupu Ridge in the shape of a woman holding her finger to her lips. A chiefess of Oʻahu, Peleʻula heard that the women of Kauaʻi were the most beautiful. She voyaged to Kauaʻi and met with Chiefess Hina. The two ended up having a contest which involved adorning themselves and showcasing a hula. Peleʻula adorned herself with *ʻilima* (a native shrub, *Sida* or *S. fallax)*, a flower that represents Oʻahu, while Hina adorned herself with *maile* (a native twining shrub, *Alyxia olivaeformis*) and *mokihana* (a native tree, *Pelea anisata*). In the end, Hina won the contest and Peleʻula declared that the women of Kauaʻi were the most beautiful and exclaimed, "you must warn future visitors" (Wichman 1998:56). Hina's profile of her face, holding her finger to her mouth, is a warning to those coming to Kauaʻi, that Kauaʻi's beauty is unmatchable.

In more recent time, in a letter from Valdemar Knudsen to J.O. Dominis, Prime Minister for King Kamehameha III, Knudsen requested the right to raise the rents on Hanapēpē leased lands "since the King owns little *kalo* or rice land in Waimea, but a lot in Hanapēpē, and there is not one idle patch in Waimea, but only a few are planted at Hanapēpē" and he mentioned that "the people there hula from morning to night" (Archive Correspondence Hanapēpē 1 November 1864 in Creed 1995). In 1865 Knudsen was appointed *konohiki* of Hanapēpē Ahupuaʻa and a year later he leased Hanapēpē from the King for $500 a year for 25 years (Archive Letter 9 July 1866 in Creed 1995). Knudsen's complaint not only emphasizes that a substantial amount of *kalo* and rice land existed in Hanapēpē, but also indicates the practice of hula was being seriously pursued, and by some sizeable number of persons, despite missionary efforts to discourage it. Carol Ramelb, in her small pamphlet on the hula, records that for Hawaiian people "[b]efore a written language, the hulas and the chants accompanying them were their history and poetry" (Ramelb 1976:3). She also notes that after the coming of Christianity "In distant villages, some continued to dance behind closed doors" (Ramelb 1976:5). Hula was not officially revived until the 1870s during King Kalākaua's reign. Another impetus for its practice, besides the traditional religious commitment, was for the entertainment of sailors of the whaling and trading ships. The roadstead of Waimea, as a nearby center of shipping interests, may have helped keep the traditions alive at Hanapēpē; the presence of strong Hawaiian traditionalists within the region may have also contributed to the perpetuation of the hula. After the cultural influence of King Kalākaua, hula became "seen as the lone surviving art of an ancient people" (Ramelb 1976:6). The people of Hanapēpē helped keep the art alive.

7.4.2 Burials

Kāmala, meaning "hut" or "garden," is a place in Māhā‘ulepū known for its many burials. Traditions explain that this area is where the slain warriors of Kamehameha's army were buried. Other accounts suggest this *wahi pana* was a burial place for commoners (Bennett 1931:120).

While traditional sources record little about Keālia Ahupua‘a during the years preceding Western Contact in the late eighteenth century, the presence of *lo‘i* and terraces on wide flats suggest it could have supported a stable population (Perzinski et al. 2000:100). Documented land use in Keālia included prehistoric burial interment. Physical evidence of prehistoric utilization of Keālia *makai* are the human burials located at the south end of Donkey Beach (SIHP # 50-30-08-1899-1, 2, 3, and 4) (Perzinski et al. 2000:100).

Nancy McMahon (1993a), then staff archaeologist with the SHPD, documented an inadvertent burial discovery and subsequent reburial at designated burial site SIHP # 50-30-06-498 at Paiwa, reported as about 6 miles up Waimea Canyon. This was a cave site that included five burials. The description follows:

> The unique cave site is surrounded by rock walls, enclosures and rock platforms. At the base of the cave site, approximately 12 feet below is a stone lined platform adjacent to the cliff. A stone piled tower rises above the platform and flushes with the cliff. Most of the stones were waterworn basalt cobbles. I believe other burials exist in this rock pile. The cave site itself, was made of pili grass and mud, which blended in with the natural colors of the cliff. [McMahon 1993a:2]

There are references to post-Contact artifacts ("modern pants," "modern red clothes," a "pillow") but their relationship to the burials is unclear. The remains were reburied in the cave. McMahon (1993a:3) notes that Bennett Site 24 includes some seven caves but "Since the exact location for site 24, is not precise, this burial cave has been given a separate site number 50-30-06-498."

The State Parks Division of DLNR (Carpenter and Yent 1994) produced an archaeological reconnaissance survey of Polihale State Park and adjacent lands addressing a long stretch of the coastal cliff in back of the State Park that steeply ascends from about 40 ft to 1,000 ft elevation. Their defined 1,050-acre survey project area rises to approximately 1,060 ft. Many historic properties (including rock shelters, house sites, *ahu*, terraces, and burials) are identified along this cliff line, mostly near the base. Some of the sites (like SIHP # 50-30-01-1976, a human burial) are higher on the steep slope. The elevation of the historic properties is not always clear.

The only identified traditional Hawaiian burial site above 500 ft elevation to date appears to be SIHP # 50-30-06-498 in upper Waimea Canyon. This mirrored the pattern reported by Bennett who only posits a burial function to one site above 500 ft elevation, two burials (Bennett Site 36) near the junction of the Waiʻalae and Waimea rivers in this immediate area.

As with the pattern of traditional Hawaiian burials, the pattern for modern burials has also been very much for burial at lower elevations with only three areas indicated for modern burials on Kauaʻi above 500 ft elevation (SIHP # 50-30-10-B001, the Holy Cross Cemetery; SIHP # -1865 "88 Shrines" Buddhist religious site [2 human burials]; and SIHP # -3908, graves of Walter D. McBryde and companion) all in the Kalāheo/Lāwaʻi area. Allied with this pattern of human activity is the fact that the only school on Kauaʻi above 500 ft elevation appears to be the Kalāheo School Campus (SIHP # 50-30-10-9391 placed on the HRHP in 1991).

7.4.3 Heiau

7.4.3.1 Haleleʻa Moku

Apaukalea Heiau resided close to Laumaki Heiau, however, due to the increase of occupation within the area "make the distinction of this heiau difficult" (Bennett 1931:135). Kaunupepeiao Heiau was a 12-foot (ft) *heiau* that was simply used to make offerings (Bennett 1931:135), however, to exactly what deity or purpose is unknown. Similar to Kaunupepeiao Heiau, little is known about Laumaki Heiau except that it was "a small, open platform, paved heiau, 2 feet high, of husbandry class" (Bennett 1931:135).

Three groves of various plants were known throughout Lumahaʻi. Kahalaomāpuana "the pandanus of Māpuana," is a grove a *hala* trees along the beach. One of these *hala* trees bears red *hala* fruit instead of the usual yellow-orange. It is said that this *hala* tree is Māpuana. Māpuana was the youngest sister of ʻAiwohikupua and the Maile sisters. Kahauomāʻihi, or "the hibiscus trees of Māʻihi," were planted along the Māʻihilaukoa Heiau. Nāʻuluoweli, or the "breadfruits of Weli," was planted by the first Menehune *konohiki* of Lumahaʻi named Weli (Wichman 1998:120–121).

Kailiopaia Heiau was located east of the Lumahaʻi stream, however, it has been destroyed and nothing remains (Bennett 1931:135).

Halaloa Heiau was said to be built for Kāne, one of the four main Hawaiian gods. This *heiau* was destroyed to make room for a mill (Bennett 1931:135).

Kaʻawakō Heiau was used by the Mū people. The *kilo iʻa* or fisher watcher would go to Kaʻawakō Heiau after placing his *ʻoʻopu* fish trap. The *kilo iʻa* would make his offering of *ʻawa* (kava, *Piper methysticum*), *maiʻa* (bananas), and *kumu kalo* (the *kumu* variety of taro). He then would brew a cup of *olonā* (a native shrub, *Touchardia latifolia*) leaves and perform chants. After the ritual was completed, he would run down to his fish trap to see all the *ʻoʻopu* that he caught (Wichman 1998:109).

A rather small *heiau*, only 18 by 21 ft, Maheu Heiau was located on the top of Puʻu Maheu (Bennett 1931:134).

Kīhei (shawl, cape, cloak) Heiau was built by Chief Kīhei. After two attempts to invade Kauaʻi, Kamehameha decided that a diplomatic approach to obtaining Kauaʻi might be best. Kamehameha sent one of his chiefs, Chief Kīhei, to Kauaʻi to meet with then ruler, Kaumualiʻi. Kaumualiʻi showered Chief Kīhei with many gifts, which led Chief Kīhei to the decision to make Kauaʻi his new home. Kaumualiʻi promoted Chief Kīhei to *konohiki* of Kalihiwai.

Chief Kīhei built this *heiau* in honor of the good fortune that had fallen on him from Kaumualiʻi and the people of Kauaʻi. When he passed away, the floor of the *heiau* was dug up and Chief Kīhei was laid to rest in that spot (Wichman 1998:107).

7.4.3.2 Koʻolau Moku

Pailio Heiau is described as a round *heiau* with a diameter of 100 ft. However, this *heiau* was destroyed when the area was used as a cane field (Bennett 1931:133).

Kāhili (feather standard) Ahupuaʻa was named after the chiefess of the same name. She, along with her husband catered a memorable feast at Hāʻulaolono Heiau in the *kukui* groves of Kaukahe.

Located amongst the *kukui* groves of Kaukahe, Hāʻulaolono (red stem of Lono) Heiau is built from water-smoothed pebbles with offerings and sacrifices being made to Lono.

Named after the *ahupuaʻa*, Pāpaʻa Heiau was dedicated to the god Kahōaliʻi, known to be the god of the underworld, and was used for human sacrifice (Wichman 1998:94–95).

7.4.3.3 Puna Moku

Māhunāpuʻuone, meaning "vapor that rises from the sand dunes," is a *heiau* that was used for human sacrifices and was built by Kawelomahamahaiʻa to celebrate the birth of his twin grandsons. Being of a certain status, everyone who came in the presence of the twins was required to lie flat on the ground; failure to do so resulted in death (Wichman 1998:88).

Kaikihāunakā (little striking blow) Heiau was built by Kawelo after he defeated ʻAikanaka. This *heiau* was used as a place of offering. Kawelo would place the first enemy warrior slain in battle at Kaikihāunakā as an offering to his war god (Wichman 1998:81).

Kukui (candlenut tree, light, enlightenment) Heiau is a rather large *heiau* built by the giant Nunui. The stones of this *heiau* were estimated to weigh several tons. The giant Nunui, after he finished building Kukui Heiau, was tired and stretched out by a nearby hilltop where he still sleeps today (Wichman 1998:81).

Holoholokū, possibly meaning "to run and stop," is a special *heiau* that gave blessings to those born within the *heiau*.

> *Hānau kea liʻi i loko o Holoholokū, he aliʻi nui;*
>
> *Hānau ke kanaka i loko o Holoholokū, he aliʻi nō;*
>
> *Hānau ke aliʻi mawaho aʻe o Hooholokū, ʻaʻohe aliʻi , he kanaka ia*.
>
> ʻThe child of a chief born in Holoholokū is a high chief.
>
> The child of a commoner born in Holoholokū is a chief.
>
> The child of a chief born outside of Holoholokū is a commoner.ʼ [Wichman 1998:66]

At Holoholokū Heiau, there are two *pōhaku* referred to as Pōhaku Hānau. One *pōhaku* is where the expectant mother would sit while the second *pōhaku* is flat where she could rest her back (Wichman 1998:66).

Wailua Ahupua‘a is home to various *heiau*. Another *heiau* known as Kaleiomanu (wreath of Manu) was located by Holoholokū Heiau. Kaleiomanu Heiau was used for sacrificial purposes. Pigs, chicken, dogs, and fish were sacrificed to the gods. Occasionally, humans were also used as a sacrifice to the gods. The bones of those sacrificed were taken to Pu‘ukī and buried there (Wichman 1998:72).

Malae Heiau was built by the Menehune along the banks of the Wailua River. Malae Heiau was used as a place where people could gather and witness ceremony. The Malae Heiau was also referred to as Maka‘ukiu Heiau, possibly after the wind of the area (Wichman 1998:68**).**

Poli‘ahu Heiau rested along the top of Kuamo‘o Ridge, close to the Wailua River. Wichman shares that Poli‘ahu Heiau was a

> […] paved and walled enclosure approximately 242 feet in length and 165 feet in width, making it one of the largest heiau on Kaua‘i […] It was covered with white tapa and kapu to all but the ali‘i nui (ruling chief) and the kahuna nui (head priest). The kahuna nui sat alone on the top floor and, with proper prayer and ritual, waited for the advice of the gods. [Wichman 1998:69]

Poli‘ahu Heiau and Malae Heiau were clearly visible to each other.

Hikinaakalā, meaning “rising of the sun,” was classified as a *pu‘uhonua* or a “place of refuge” for warriors defeated in battle. This *pu‘uhonua* was treated like a *heiau*. Warriors seeking refuge could enter this *pu‘uhonua* knowing no harmful action will befallen them. These refugees would then make an offering to the gods and be granted a stay within the safety of the *pu‘uhonua* for several days. Once some time passed, the warrior was free to leave and return to his normal life. *Pu‘uhonua* were not only for warriors, but for others in need of safe refuge such as those who break *kapu* or taboo, or those avoiding prosecution (Wichman 1998:70).

Ahukini, meaning “shrine for many blessings,” refers to a landing point overlooking Hanamā‘ulu Bay as well as a *heiau*. According to Wichman:

> Chief Ahukini lived circa 1250 A.D. and was one of the three sons of La‘a-mai-kahiki who had come from Rai‘ātea in the Society Islands to visit with his foster father Mo‘ikeha. Ahukini became *ali‘i nui* of Puna after Ka-‘ili-lau-o-ke-koa, granddaughter of Mo‘ikeha, died without children of her own. On the bluff was a *heiau* of the same name. It was a medium-sized temple, but by the turn of the century only the foundations remained. [Wichman 1998:61]

Kalauokamanu Heiau was dedicated for human sacrifice. The stench from the many bodies sacrificed was so bad that people would hurry pass the *heiau*. The *heiau* was destroyed around 1855 and the foundation used for the Hanamā‘ulu sugar mill.

Kuhiau (I gesture) is a *heiau* possibly used for ceremonial purposes as Wichman shared that “even today, it is said that one can hear the drums beating at night and see the *akua lele* (flying gods) in the form of flashing lights” (Wichman 1998:59).

7.4.3.4 Kona Moku

Bennett (1931) listed Keōlewa Heiau as being destroyed before the 1930s, and suggested the meaning of this *heiau* is “shifting sand” (Bennett 1931:121).

Kāne'aukai Heiau is dedicated to the god Kāne'aukai. His sisters were turned into fishing grounds, each dedicated to a specific species of fish. Kāne'aukai, however, turned into *wauke*.

Kāne'aukai in his human form came across some fishermen who were praying for fish, however, they did not include the name of a particular fishing god. Kāne'aukai, intrigued by this, asked the men why they did not include the god's name. The fishermen replied that they knew there was a god but they did not know his name. Kāne'aukai replied, "His name is Kāne-'aukai, and when you let down your nets again call out, 'Eia ka 'ai a me ka i'a, e Kāne'aukai,' 'Here is the food and fish, Kane-aukai,' and he will help you" (Wichman 1998:46).

Every time these men went to lay their nets out, they chanted this prayer. When it was time to bring in their nets, their nets were filled with an abundance of fish. Soon, other people began to hear of these fishermen's success and started to pray to Kāne'aukai.

Bennett (1931) records a *heiau* located on the shore in Weliweli Ahupua'a. As described by Thrum and re-recorded by Bennett, Weliweli Heiau is "a paved heiau of large size, pookanaka class […]" (Bennett 1931:120).

Built by Kapueomakawalu, Maulili Heiau was a *heiau* dedicated to human sacrifice. When Kapueomakawalu passed, this *heiau* was no longer used and was lost (Wichman 1998:41) until the time of 'Aikanaka.

> When 'Aikanaka had overcome his cousin Kawelo in the battle of stones on the plains of Wahiawa, 'Aikanaka wanted a place to sacrifice the body. He asked that the location of Maulili [Heiau] be found, but no one knew anything about it. At last, a deaf mute was asked and he knew. He led 'Aikana to the place, pointed out the remains of the stone walls, and the *heiau* was built. [Wichman 1998:41]

Louma Heiau was also built by Kapueomakawalu. This *heiau* was dedicated to Lonoikaouali'i in which pigs, red fishes, and other sacrifices were offered. Louma Heiau is located by a small pond just *mauka* of Maulili, along the mountain side of Ho'oleinakapua'a (Wichman 1998:41).

There are three *heiau* mentioned by Bennett (1931). Niukapukpau Heiau (Bennett 1931:116), which is located at the top of the hill with the same name, Niukapukapu; Kalohiokapua Heiau (Bennett 1931:116) that was used as a place for circumcision; and Mamalu Heiau (Bennett 1931:116), located near the center of Lāwa'i Valley.

On top of Kukuiolono was Kukuiolono Heiau, one of the largest *heiau* on the island (Wichman 1998:34). Kahaleki'i Heiau, located nearby Kukuiolono Heiau, is a *heiau* dedicated to Lono, one of the four major gods, who represented the clouds, winds, sea, fertility, and agriculture. Sacrifices of animals were made at Kahaleki'i, however, the animals were brough already t dead, as to not pollute the *heiau* with blood. The place where the sacrifices were killed was known as Nāpōhakuaki'i (Wichman 1998:34). Nearby Kahaleki'i Heiau was Ipuolono Heiau. This was a small *heiau* that perpetuated the spiritual values of daily prayer.

'A'akukui Heiau rests by the Kekupua Valley and has been described as "a paved and walled heiau in good preservation" by Thrum (Bennett 1931:111). Kapakaniau Heiau was unable to be located by Bennett (1931), however, it has been recorded by Thrum that Kapakaniau Heiau was "a paved, open platform heiau; in good condition" (Bennett 1931:152). Located at the ridge near Hikilei and Kunalele valleys, Kaunumelemele Heiau is said to be as Thrum describes, "an open platform heiau in good condition" (Bennett 1931:111). Kūwiliwili Heiau rested in the cane fields, by Makaweli Camp 3. Thrum has described the *heiau* as "a large, high walled enclosure of pookanaka class now destroyed" (Bennett 1931:112). Unfortunately not much is known about Mahaihai Heiau except that it was destroyed. It was previously noted on an old map by Frances Gay (Bennett 1931:111). The location of Peeamoa Heiau is unknown, however, it has been described by Thrum as "an unwalled heiau" (Bennett 1931:152).

Deemed as one of the oldest and most sacred *heiau* on Kaua‘i, Polihale (House Blossom) Heiau is dedicated to Kāne and Kanaloa as this was their first home in Hawai‘i.

7.4.3.5 Nāpali Moku

Kahuanui (big foundation) Heiau is named after Lohi‘auipo's sister, Kahuanui. Kahuanui, along with being *kumu* of a *hālau hula* in Hā‘ena, was famously known for her *kapa* making skills. It is said that when Pele first came to Kaua‘i, Kahuanui gifted Pele a *kapa* she had beaten from *laua‘e* ferns, which provided the *kapa* with a most pleasant scent (Wichman 1998:148).

Section 8 Summary and Recommendations

8.1 Results of Community Consultations

CSH made multiple attempts to contact Native Hawaiian organizations, agencies, and community members as well as cultural and lineal descendants in order to identify individuals with cultural expertise and/or knowledge of the plan area and vicinity.

CSH reached out to a total of 73 individuals. Of the 73 individuals invited to participate in consultation, eight individuals responded either by phone or email. Attempts were made to engage in formal interviews, however, of the eight interested individuals, CSH was able to confirm and conduct only two separate interviews. Unfortunately, only one of the interviews was reviewed and approved by the interviewee. Below is the name of the individual who shared her *manaʻo* (thoughts, opinions) and *ʻike* (knowledge) about the HCP, plan areas, and respective *ahupuaʻa*.

1. Makaʻala Kaʻaumoana, Executive Director, Hanalei Watershed Hui

8.2 Identification of Cultural Practices

Community consultation and background research conducted as part of this CIA has identified the following cultural, historical, and natural resources where past and ongoing cultural practices (including traditional and customary native Hawaiian rights) were/are being exercised:

1. Surfing
2. Farming, *kalo*, wetland and dryland
3. Deep-sea fishing
4. *Hula*
5. Salt Production
6. Subsistence farming (fishponds)
7. Burials and *Heiau*

8.3 Identification of Impacts to Cultural Practices

Consultation has identified a number of concerns related to the environment and the broader community:

1. Makaʻala Kaʻaumoana is concerned for the safety of the *ʻaʻo* (Newell's shearwater) and the *ʻuaʻu* (Hawaiian petrel). She says KIUC power lines have become obstacles for these birds.
2. Makaʻala Kaʻaumoana also expressed the importance of predator control. In some cases, when birds come into contact with KIUC power lines, if they are not immediately killed, they are wounded and defenseless and are easily snatched up by feral cats.
3. Makaʻala Kaʻaumoana mentioned the careless handling of albizia (*Falcataria moluccana*) trees that are trimmed out of way of power lines. Debris from recent trimming was dumped *mauka* of Hanalei River that can cause severe damage to stream life and can damage the reefs and nearshore marine resources.
4. Makaʻala Kaʻaumoana is concerned about the native plants in the remote area that KIUC has access to. She stressed the importance of preservation of these native plants while [KIUC] accesses these remote areas to install poles and power lines.

8.4 **Mitigation Recommendations**

CSH supports the following preliminary recommendations for future activities that may develop as a result of this HCP:

1. Personnel involved in related activities of the HCP 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 State Historic Preservation Division (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 related activities of the HCP, 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.

The following actions are recommended to promote and preserve cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups:

1. Makaʻala Kaʻaumoana recommends predator control by KIUC or a hired agency to address the increased population of feral cats that snatch up wounded birds who come into contact with KIUC power lines.
2. Makaʻala Kaʻaumoana insists KIUC do their due diligence in assuring proper disposal of all trimmed albizia logs.
3. It is recommended that the preservation of native/endangered plants and animals be taken into consideration for continued propagation and reproduction.
4. It is recommended that, when feasible, allowing access to certain remote areas in the *wao akua* may assist cultural practitioners in fulfilling ceremonial and religious practices. Although KIUC does not control access to the HCP areas, future activities that may occur as a result of this HCP should not create any new encumbrances to access for traditional cultural practices in areas that are not currently restricted.
5. It is recommended that future activities that may develop as a result of this HCP should strive to minimize any interference with future, current or ongoing cultural rights and practices, as well as, maintaining or considering view planes to sacred sites/markers and religious structures.

Section 9 Ka Paʻakai Analysis

9.1 Overview

In *Ka Paʻakai vs Land Use Commission*, 94 Hawaiʻi (2000) the Court held the following analysis must also be conducted:

1. The identity and scope of valued cultural, historical, or natural resources in the project area, including the extent to which traditional and customary native Hawaiian rights are exercised in the project area;
2. The extent to which those resources—including traditional and customary native Hawaiian rights—will be affected or impaired by the proposed action; and
3. The feasible action, if any, to be taken by the LUC to reasonably protect native Hawaiian rights if they are found to exist.

Based on information gathered from the cultural and historical background, and community consultation for this project, there are a number of traditional cultural practices and resources to consider.

9.1.1 Archaeological Resources

Previous archaeological studies indicate historic properties are most likely to be found near where people lived in traditional Hawaiian times which is very much focused immediately along the coast and along the bottom lands of river valleys. Archaeological sites would be expected close to the actual streams (as well as the coast) with the density quickly decreasing moving away from the streams. The tablelands and ridges, and rugged interior were not utilized in ways that left archaeological traces. High densities of historic properties would be expected in places with particularly high traditional Hawaiian populations such as Hanalei Bay (and the debouching Hanalei, Waiʻoli, and Waipā river valleys), Anahola Bay and river valley, Wailua valley, Nāwiliwili Bay and associated valleys, Kōloa along the coast and extending inland along the Waikomo Stream, Hanapēpē Bay and valley, and Waimea Bay and valley.

9.1.2 Agricultural Resources

The lands of the Haleleʻa-Nāpali districts were highly valued by the *makaʻāinana* because of the streams and fresh water resources that could be diverted into extensive *loʻi kalo* (Maly and Maly 2003:6). Hāʻena Ahupuaʻa had extensive areas of *loʻi kalo* including the lower portions of Limahuli Valley and the east and west sides of the valley (Handy and Handy 1972:419). Areas between the *makai* and *mauka* areas of Hāʻena were also filled with *loʻi kalo*. The small valley of Mānoa was also filled with irrigated terraces. Bananas, sugarcane, and *ʻawa* were also formerly planted in Limahuli and Mānoa valleys. Sweet potatoes were grown in the sandy areas along the coast of Hāʻena. In Wainiha Ahupuaʻa, sweet potatoes, bananas, yams, *olona*, *wauke*, and several varieties of *ʻawa* were grown (Handy and Handy 1972:420). Lumahaʻi Ahupuaʻa had numerous small terraces along the upper course of Lumahaʻi River (Handy 1940:72–73). Rice was also "grown west of the stream on the broad terrace lands," while ranch lands "planted in elephant grass" were located on "the broad flats at the lower end of the valley" east of the stream. Waipā Ahupuaʻa had "a sizable flatland on the southwest side of Hanalei Bay" is planted in rice (Handy

1940:72). Waiʻoli Ahupuaʻa was also "planted in rice up to the base of the hills" (Handy 1940:72). The large alluvial flat on both sides of Hanalei River had been farmed extensively for taro, sugar cane and rice (Handy and Handy 1972:420–421). Hanalei Ahupuaʻa was also a planting area for *wauke* for *kapa* (Handy 1940:198). Coconuts were grown in Hanalei (Handy 1940:193). The *ahupuaʻa* of Kalihikai and Kalihiwai had extensive *loʻi* "near the sea" and "along main streams and side streams" in the valleys (Handy and Handy 1972:420–421). Sweet potatoes were planted in the "narrow coastal strip between the hillsides and the sea at Kalihi-kai and Anini" (Handy 1940:153). *Noni* and orange trees were also known to have been cultivated in Kalihiwai (Wichman 1995b:1).

In Koʻolau Moku, Namahana, Kīlauea, and Kahili Ahupuaʻa had *kula* land good for growing sweet potato (Handy and Handy 1972:421). *Kalo* was also grown along Kīlauea Stream where the stream and floodplain broaden near the seashore (Handy and Handy 1972:421). The *ahupuaʻa* of Waiakaluaiki and Waiakaluanui had terraces "watered from several streams that originate in springs" (Handy and Handy 1972:421). Waipake Ahupuaʻa had numerous terraces along Waipake Stream (Handy 1940:70). Lepeuli Ahupuaʻa had "a number of small terrace plantations near the sea" (Handy 1940:70). Moloaʻa Ahupuaʻa had many terraces along its stream and sweet potatoes and breadfruit growing near the shore (Handy and Handy 1972:422). Pāpaʻa Ahupuaʻa had "old, small terraces" which extended "several miles inland" along Pāpaʻa Stream (Handy 1940:69). Aliomanu Ahupuaʻa had a "few small terraces" which were "watered by Aliomanu Stream" (Handy 1940:69). Anahola Ahupuaʻa contains the largest river in Koʻolau Moku. There were numerous agricultural terraces along the banks of the river (Handy and Handy 1972:423).

The early settlers of the Hawaiian archipelago would have been especially attracted to the windward side of Kauaʻi, which boasted large river valleys supporting a vast inland region of irrigated pond-fields for *kalo* cultivation that became the agricultural core of Kauaʻi. The greatest of these river valleys were around Wailua and Hanamāʻulu streams. This area was richly endowed with agricultural wealth and was a major residential and religious center for the nobility (Kirch 2010:171).

Puna Moku consists of "a broad *kula*, intersected by streams" that supported the cultivation of taro, sweet potatoes, breadfruit, and coconuts (Handy and Handy 1972:423). Kamalomaloʻo and Keālia Ahupuaʻa were relatively dry with few areas of cultivation (Handy 1940:69). There were small terraces along Kamalomaloʻo Stream (Handy 1940:69). There were also *loʻi* and terraces on wide flats of Keālia Ahupuaʻa (Perzinski et al. 2000:100). Taro terraces have been documented in the "many little valleys" of Kapaʻa (Bennett 1931:128). In Wailua, the main areas of taro cultivation were along ʻŌpaekaʻa Stream, Wailua River, and along the numerous small tributary streams (Handy 1940:153–154). Many of the former taro terrace areas eventually converted to rice cultivation. Taro was planted along Konohiki Stream in Waipouli (Handy 1940:68). The *ahupuaʻa* of Kapaʻa, Waipouli, Olohena, and Wailua had broad coastal plains bordering the sea which were suitable for growing sweet potatoes (Handy 1940:153). In Hanamāʻulu Ahupuaʻa, taro was grown in the gulches and sweet potatoes were planted on the cliffs (Handy 1940:154). There were many small terraces along Hanamāʻulu River. Nāwiliwili Valley also had a "flat valley bottom which was formerly all in terraces" (Handy 1940:67). Taro terraces were also found along Puali and Halehaka streams in Niumalu Ahupuaʻa (Handy 140:62). Hulēʻia Valley was a major area for taro cultivation. The valley, which was shared by both Haʻikū and Kīpu Ahupuaʻa, had numerous terraces along Hulēʻia Stream (Handy 1940:66). Many of these former taro lands were converted to rice paddies by the 1850s. Kīpū Kai also had small patches of taro and sweet potatoes irrigated by springs (Handy 1940:66).

In Kona Moku, Māhāʻulepū Ahupuaʻa had a broad valley perfect for taro cultivation and irrigation in the pre-Contact and early post-Contact periods. In this area, taro was planted in semi-brackish spring water and planted on mounds using the *puʻepuʻe* method, on mounded dirt (Handy 1940:66). In Pāʻā Ahupuaʻa, no terraces have been documented, however, taro, breadfruit, yams, and bananas grew wild in gulches (Handy 1940:66). Weliweli Ahupuaʻa probably supported taro *loʻi* only in the upper ends of gulches (Handy 1940:66). Kōloa Ahupuaʻa had a field system stretched across the entire *ahupuaʻa*. An extensive system of *kalo* terraces once existed in the area of Kūhiō Park, however, those lands were subsequently covered with sugarcane (Handy and Handy 1972:428). Bananas and sugarcane were grown on the banks of the *loʻi* (Judd 1935:53). Sweet potatoes were also grown on *kula* land, as well as *pia* and *wauke* (Judd 1935:53). Lāwaʻi Ahupuaʻa had a few taro patches on flats near the sea and abandoned *loʻi* on terraces along lower Lāwaʻi Stream (Handy 1940:66). Kōloa and Lāwaʻi Ahupuaʻa were the favored places for coconuts on Kauaʻi (Handy 1940:193). Kalāheo Ahupuaʻa was known for dryland cultivation of sweet potatoes (Handy and Handy 1972:428). Wahiawa Ahupuaʻa had taro terraces extending down the gulches all the way to the sea (Handy and Handy 1972:428–429). Further inland were additional taro terraces and *wauke* plantations. Wahiawa was known for a special type of taro called Palaha, which had a dark flesh and made purplish taro (Handy 1940:64). Sweet potatoes were also grown on *kula* land (Handy 1940:65).

The leeward coast from Waimea to Wailua was noted for inland plantations of breadfruit, bananas grown along the gulches, sweet potatoes and yams grown in the uplands and valleys, and extensive taro terraces (Handy and Handy 1972:152). Taro, sweet potatoes, and yams were cultivated along Waimea River (Wichman 2003:5–6). In the *ʻili* of Mānā in Waimea Ahupuaʻa, “fresh-water marshes” were also “presumably planted in wet taro” (Handy 1940:61). The *haokea* and *nā kalo a ʻOla* varieties of taro were said to have been grown and thrived in this region (Handy and Handy 1972:397). Makaweli Ahupuaʻa had terraces along the banks of Makaweli River (Handy 1940:63–64). The flatlands above the junction of Olokele and Mokuone streams were covered in abandoned terraces. Hanapēpē Ahupuaʻa had several areas of taro cultivation “along the stream below the junction of Manuahi Valley with Hanapepe Valley” (Handy 1940:64). In Waimea, Makaweli, and Hanapēpē Ahupuaʻa, the hillsides above the flood plains were planted with the *mōhihi* varieties of sweet potato with *kō*, *maiʻa*, and *pia* (arrow root) growing on the outer edges of cultivated patches (Handy and Handy 1972:397).

In Nāpali Moku, Honopū Ahupuaʻa contained numerous terraces (Handy and Handy 1972:415). In Kalalau Ahupuaʻa, Kalalau Valley was “one of the most intensively cultivated areas in the islands” with “broad, flat terraces on the level land at the seaward end of the valley” (Handy and Handy 1972:416). Terraces were also located along both sides of Kalalau Stream and continued along the eastern and western branches where the stream divides (Handy and Handy 1972:416). Bananas and sugarcane were grown on terrace walls (Handy and Handy 1972:415). Gardens of sweet potatoes, *wauke*, and ti were grown around houses and on slopes above *loʻi* (Handy and Handy 1972:416). The remnants of terraces were documented at “two, large, level areas” known as the “Pohakuao Flats” in Pōhakuʻao Ahupuaʻa (Bennett 1931:138). Awaʻawapuhi Ahupuaʻa was also filled with terraces which were irrigated by an *ʻauwai* on the west side of Awaʻawapuhi

Stream (Handy 1940:61). Hanākapiʻai Ahupuaʻa had taro *loʻi* on small terraces located on the southwest and northeast sides of the stream (Handy and Handy 1972:416).

No traditional agricultural practices or resources were identified within the KIUS HCP project area in the historic documentation, archaeological investigations, or *kamaʻāina* interviews included in this CIA and Ka Paʻakai Analysis.

9.1.3 Plant Resources

In Haleleʻa Moku, native grasses and trees including *hala*, *milo*, and *kou* trees covered the plains. Numerous accounts attest to extensive *hala* groves in the uplands of Hanalei, Kalihikai, and Kalihiwai in the early nineteenth century (Alexander 1991; Bird 1890; King 1991; Lydgate, H.E. 1991). In Lumahaʻi Ahupuaʻa, "the upper part of this broad valley bottom is covered with *hau* (*Hibiscus tiliaceus*) and guava jungle, with old mango trees marking former home sites" (Handy 1940:72–73). A variety of banana, *maiʻa Poloapola* (*Borabora banana*, *musa pehi*), grew in gulches in Wainiha Valley (Handy and Handy 1972:420).

In Koʻolau Moku, Moloaʻa Ahupuaʻa was "once a great wauke growing place" (Handy and Handy 1972:422). The hills were "so thickly overgrown that the *aʻa* (roots) of the *wauke* were *molo* (matted) together, weaving into each other like the meshes of a mat" (Handy and Handy 1972:422). Other translations of Moloaʻa attest to the importance of the crawling root of the *wauke* used as dye for *kapa* staining (Mark Boiser, 31 May 2003 personal communication in Mann et al. 2003). In Waipake Ahupuaʻa, there were a "number of old breadfruit trees" on one of the unused *kuleana* lands (Handy 1940:70). Pīlaʻa Ahupuaʻa was "famous for its great *kukui* forest" known as Kaukake (Kaukahe) (Handy 1940:70; Handy and Handy 1972:421).

In Puna Moku, forest species like *koa*, *hau*, *kukui*, and *olonā* were vastly used by Native Hawaiians for multiple purposes (Handy 1940:59). An account published in the newspaper *Kuʻokoʻa* in 1913 also mentions a "banana grove" in the *ʻili ʻāina* of Kaea in Kapaʻa (Handy and Handy 1972:423–424). In Haʻikū Ahupuaʻa, mango, breadfruit, and wild plum trees grew on the banks above the terraces along Hulēʻia Stream (Handy 1940:66).

In Kona Moku, Pāʻā Ahupuaʻa had taro, breadfruit, yams, and bananas growing wild in the gulches (Handy 1940:66). In Kōloa Ahupuaʻa, *pia* and *wauke* grew naturally in the hills and *hala* and *kukui* in the uplands (Judd 1935:53). The upland region of Waimea Ahupuaʻa had large *koa* trees which were cut into the hulls of canoes (Wichman 2003:6). The first settlers of Waimea used *waimea* (also known as *māmaki*) to make *kapa* (Wichman 2003:6). The fruit of the *māmaki* tree was also used as a laxative and the leaves were used to brew a tea that reduces blood pressure and high cholesterol (Hawaiian Electric Company and Partners 2002). The upper mountain slopes in Mānā also had more forest. Historic accounts mention *koa* and *kauila* growing in the valleys and on the bluffs (Lydgate, J.M. 1991:94). Forests grew on the slopes above the marshy plains and trees were being harvested for canoes (Handy and Handy 1972:411). In Waimea and Makaweli Ahupuaʻa, native plants including *uhi*, *ʻawa*, *wauke*, *olonā*, *kukui*, *ʻulu*, and *kī* grew wild in the wet gulches (Handy and Handy 1972:397–400).

In Nāpali Moku, Hanākapiʻai Ahupuaʻa had a mature forest of *kukui*, guava, ti, and mountain apple, groves of mango trees near stream banks, various ferns, false *honohono*, and *ʻawapuhi* forming the ground cover, lantana on the upper slopes of the stream benches on the east side of the valley, and *hala* along the shore (Tomonari-Tuggle 1989:25). Pōhakuʻao Ahupuaʻa had an open grassland with guava, Java plum, lantana, and grass (Tomonari-Tuggle 1989:31). Pōhakuʻao also had century plant or sisal on the cliffs in the southwest and *kukui*, guava, *ʻawapuhi*, false *honohono*, *ʻape*, and taro in the deeper gulches (Tomonari-Tuggle 1989:31). Awaʻawapuhi Ahupuaʻa had "a grove of *hau* at the mouth of the valley and a thin canopy of *kukui* toward the back" (Tomonari-Tuggle 1989:39). Honopū Ahupuaʻa had lantana, *koa haole*, *hau*, and Java plum along the base of the *pali*, lantana throughout the valley, several groves of *hau* near the front of the valley, and a canopy of *kukui* with lantana undergrowth inland (Tomonari-Tuggle 1989:39). Kalalau Ahupuaʻa had yams, *wauke*, and *olonā* in the upper reaches of the valley, *kukui* trees in the gulches, and coconut, *koa*, and *hau* in the lower valley and along the shore (Handy and Handy 1972:416). There were also Java plum, mountain apple, *kukui*, and guava toward the back of the valley, various ferns, *honohono*, false *honohono*, and *ʻawapuhi* in the upper valley, lantana on the upper talus slopes, and mango, orange, papaya, banana, avocado, *hau*, and bamboo in the middle and upper valley (Tomonari-Tuggle 1989:35–36).

Makaʻala Kaʻaumoana,, Executive Director, Hanalei Watershed Hui, mentioned there are native plants in the remote areas KIUC has access to.

9.1.4 Faunal Resources

Native birds flourished throughout Kauaʻi. Feathers were collected and woven into wreaths, capes, and helmets (Wichman 2003:6–7). In Kilauea Ahupuaʻa, seabirds were hunted near the coastal cliffs on which the birds nest (Kikuchi 1987, Fredericksen and Fredericksen 1989). The valley of Halemanu in Waimea Ahupuaʻa was home to bird catchers who hunted forest birds that supplied the feathers for cloaks, capes, and other items associated with the *aliʻi* (Wichman 2003:15–16).

Ms. Kaʻaumoana stated, "The loss of native birds on Kauai is DIRECTLY RELATED to KIUC power lines." She noted, "Native seabirds contribute critical nutrients to the farmlands and our cultural mauka-makai connections." She expressed concern for the safety of the *ʻaʻo* and *ʻuaʻu*, noting that power lines have become obstacles for birds. She pointed out that when birds come into contact with power lines, they are wounded or killed. She also noted wounded birds are easily "snatched up" by feral cats. She mentioned birds are also impacted by street lights, and exterior lighting at solar or other generation facilities.

9.1.5 Freshwater Resources

Streams play a vital role in sustaining wetland wildlife and Native Hawaiian agriculture by providing freshwater to *loʻi kalo*, wetland marshes, and *loko iʻa*. These areas provide habitats for various species including *ʻoʻopu*, *hīhīwai*, *ʻōpae*, *ʻalae keʻokeʻo*, *ʻalae ʻula*, *aeʻo*, and others (CWRM and RTCAP 1993).

The streams of Haleleʻa Moku include ʻAnini Stream, Hanalei River, Kalihiwai River, Lumahaʻi River, Limahuli Stream, Mānoa Stream, Puʻukumu Stream, Waikoko Stream, Waileia Stream, Wainiha River, Waipā Stream, Waiʻoli Stream, and an unnamed stream.

The streams of Koʻolau Moku include ʻAliomanu Stream, Anahola Stream, East Waiakalua Stream, East and West Waipake Stream, Kīlauea Stream, Kulihaili, Moloaʻa, Papaʻa, and Pīlaʻa Stream Stream.

The streams of Puna Moku include Hanamāʻulu Stream, Hulēʻia Stream, Kapaʻa Stream, Kawailoa Stream, Kīpū Kai Stream, Kumukumu Stream, Moikeha Canal, Nāliwiliwili Stream, Pūʻali Stream, Waikaea Canal, and Wailua Stream.

The streams of Kona Moku include Aʻakukui Stream, Hāʻeleʻele Stream, Hanapēpē Stream, Kaʻawaloa Stream, Kauhao Stream, Kaʻulaʻula Stream, Kinekine Ditch, Lāwaʻi Stream, Mahinauli Stream, Miloliʻi Stream, Nahomalu Stream, Nuʻalolo Stream, Wahiawa Stream, Waikomo Stream, Waimea Stream, and Waipao Stream.

The streams of Nā Pali Moku include Awaʻawapuhi Stream, Hanakāpīʻai Stream, Hanakoa Stream, Honopū Stream, Hoʻolulu Stream, Kalalau Stream, Maunapuluo Stream, Nakeikionaiwi Stream, Pōhakuʻao Stream, Waiahuakua Stream, and Waiolaa Stream.

Kauaʻi had *loko iʻa* scattered along the coast. In Niumalu Ahupuaʻa, ʻAlekoko (Menehune) fishpond provided fish to the *aliʻi* of the area (Neller and Palama 1973:8). The *loko* was built by the *menehune* (Wichman 1998:58). Nāwiliwili Ahupuaʻa had at least five other *loko iʻa* including Kalalalehua, Lokoponu, Papalinahoa and two *loko iʻa* whose names are unknown (Kikuchi 1973). Nōmilu Fishpond is a natural salt water *loko* in Kalāheo Ahupuaʻa; Kakalua Spring, located on the side of Nōmilu, was famous for *ʻōpae* (Wichman 1998:35).

Inland fishponds were classified as *loko puʻuone*. There were four named *loko puʻuone* in Mānā: Kawaiʻeli, Kolo, Nohili, and Limaloa (Yent 1992:4; Kikuchi 1987:9). These *loko puʻuone* contained *ʻanae*, *awa*, *ʻoʻio*, *ʻoʻopu*, *moi*, *weke*, and others (Yent 1992:4).

Loko iʻa are also mentioned in several LCA claims including LCAs 4109 and 10309 in Waioli, LCAs 8060 and 8833 in Keālia, and LCAs 3310 and 3593 in Waimea Ahupuaʻa. Multiple LCA claims in Kalapakī mention the *loko iʻa* of Koenaawa. In Kahili Ahupuaʻa, LCAs mention *loko wai*, or freshwater ponds. Debora Kapule, the former wife of Kauaʻi sovereign Kaumualiʻi, also inherited two *loko iʻa* located on the property of the former Coco Palms Resort.

Ms. Kaʻaumoana mentioned that debris from albizia trees trimmed out of the way of power lines, but not properly disposed of has entered streams, impacting stream life. She also noted debris can also block access to streams used for gathering purposes.

9.1.6 Coastal and Marine Resources

There are several regulated fishing areas on the island of Kauaʻi (DLNR 2021) including the Hāʻena Community-Based Subsistence Fishing Area in Hāʻena Ahupuaʻa in Haleleʻa Moku; Hanamāʻulu Bay and Ahukini Recreational Pier in Hanamāʻulu Ahupuaʻa, Kapaʻa and Waikaʻea canals in Kapaʻa Ahupuaʻa, Nāwiliwili Harbor in Nāwiliwili Ahupuaʻa, and Wailua Reservoir Public Fishing Area in Wailua Ahupuaʻa in Puna Moku; Port Allen, Waimea Bay and Waimea Recreational Pier, and Kōkeʻe Public Fishing Area in Kona Moku.

Several places in Kauaʻi were known for salt production. In the Kalāheo Ahupuaʻa, a natural salt water pond, Nōmilu, "produced the finest and most desired salt of Kauai" (Wichman 1998:34–35). The place name Keālia, in the Puna Moku, has been translated as "salt encrustation," "salt land," or "salt pan" (Wichman 1998:85). The *ahupuaʻa* of Kīpū Kai, the *ʻili* of Ukula in Hanapēpē, and the *ʻili āina* of Keoneloa were also known for producing salt (Clark 2002:194; Damon 1931:228; Wichman 1998:45). The shoreline of Kōloa also consisted of salt pans (Palama and Stauder 1973:20).

Ms. Kaʻaumoana mentioned crabbing and fishing will more than likely be affected by the KIUC HCP project, noting that her community in the Haleleʻa Moku is already experiencing issues with current KIUC practices. She also mentioned debris from albizia trees that has entered streams has impacted nearshore marine resources when it exits the stream and enters the ocean.

9.1.7 *Wahi Pana*

Traditionally, prior to any undertaking, prayers were offered to the multitude of ancestor gods and spirits, to *akua, ʻaumākua,* and *kupua* alike. As Mary Kawena Pukui notes, "Long before the missionaries came, Hawaiians were *haipule*, religious. Everything they did, they did with prayer" (Pukui et al. 1972:121). Formal prayers consisting of "composed, memorized, handed-down chants" were often associated with public ceremonies involving both the *aliʻi* and the priestly class. Those belonging to the royal and priestly classes prayed before *kuahu* (altars) and *heiau* (Pukui et al. 1972:123). According to Pukui et al. (1972:123), "these prayers were often accompanied by sacrifices to the gods, [and] embellished by ritual […]" It was at the *heiau,* the sacred temples, that sacrifices, or offerings were made.

Heiau of Haleleʻa Moku include Apaukalea Heiau, Laumaki Heiau, and Kaunupepeiao Heiau in Wainiha Ahupuaʻa (Bennett 1931:135); Māʻihilaukoa and Kailiopaia Heiau in Lumahaʻi Ahupuaʻa (Wichman 1998:120–121; Bennett 1931:135); Halaloa Heiau in Waipā Ahupuaʻa (Bennett 1931:135); Kaʻawakō Heiau in Hanalei Ahupuaʻa (Wichman 1998:109); Maheu Heiau in Kalihikai Ahupuaʻa (Bennett 1931:134); and Kīhei Heiau in Kalihiwai Ahupuaʻa (Wichman 1998:107).

Heiau of Koʻolau Moku include Pailio Heiau in Kīlauea Ahupuaʻa (Bennett 1931:133); Kāhili Ahupuaʻa in Kāhili Ahupuaʻa (Wichman 1998:100); Hāʻulaolono Heiau in Pīʻlaʻa Ahupuaʻa (Wichman 1998:100); and Pāpaʻa Heiau in Pāpaʻa Ahupuaʻa (Wichman 1998:94–95).

Heiau of Puna Moku include Māhunāpuʻuone Heiau in Kamalomaloʻo Ahupuaʻa (Wichman 1998:88); Kaikihāunakā Heiau and Kukui Heiau in Olohena Ahupuaʻa (Wichman 1998:81); Holoholokū Heiau, Kaleiomanu Heiau, Malae Heiau (also referred to as Makaʻukiu Heiau), Poliʻahu Heiau, and Hikinaakalā in Wailua Ahupuaʻa (Wichman 1998:66, 68, 69, 72); Ahukini Heiau and Kalauokamanu Heiau in Hanamāʻulu Ahupuaʻa (Wichman 1998:61); and Kuhiau Heiau in Nāwiliwili Ahupuaʻa (Wichman 1998:59).

Heiau of Kona Moku include Keōlewa Heiau in Māhāʻulepū Ahupuaʻa (Bennett 1931:121); Kāneʻaukai Heiau in Pāʻā Ahupuaʻa (Wichman 1998:46); Weliweli Heiau in Weliweli Ahupuaʻa (Bennett 1931:120); Maulili Heiau and Louma Heiau in Kōloa Ahupuaʻa (Wichman 1998:41); Niukapukpau Heiau, Kalohiokapua Heiau, and Mamalu Heiau in Lāwaʻi Ahupuaʻa (Bennett 1931:116); Kukuiolono Heiau, Kahalekiʻi Heiau, and Ipuolono Heiau in Kalāheo Ahupuaʻa (Wichman 1998:34, 41, 46); ʻAʻakukui Heiau, Kapakaniau Heiau, Kaunumelemele Heiau, Mahaihai Heiau, Kūwiliwili Heiau, and Peeamoa Heiau in Makaweli Ahupuaʻa (Bennett 1931:111, 112, 152); and Polihale Heiau in Mānā Ahupuaʻa (Wichman 1998:162).

Heiau of Nāpali Moku include Kahuanui Heiau in Kalalau Ahupuaʻa (Wichman 1998:148).

No *wahi pana* have been identified within the KIUC HCP project area in the historic documentation, archaeological investigations, or *kamaʻāina* interviews included in this CIA and Ka Paʻakai Analysis.

9.1.8 Hunting

Game animals hunted on Kauaʻi include pigs, goats, black-tailed deer, and a variety of game birds. Although pig hunting is not a traditional cultural practice, it remains a "cherished modern practice for island sportsmen" (Maly et al. n.d.:4) and plays a role in conservation land management. The Division of Forestry and Wildlife (DOFAW) operates two Game Management Areas (GMA) on Kauaʻi: the Wailua GMA, "a 1,697-acre public hunting area located in East Kauaʻi," and the Waimea GMA which consists of "Kolo, Ohaiʻula, Mana, Kahelu, Kaunalewa and Pulehu Ridges" on the westside of Kauaʻi (DLNR 2025a, b).

9.1.9 Recreational Activities

Mary Kawena Pukui (in Finney and Houston 1996:31) identified several surfing spots including Hawaiʻiloa, Hoʻopeʻa, Kūakahiunu, Makawa, and Puʻulena in Hanelei in Haleleʻa Moku; Manalau in Waiʻoli, also in Haleleʻa; Kanahāwale in Anahola in Koʻolau Moku; Kamakaiwa, Poʻo, and Koʻa-lua in Kapaʻa in Puna Moku; Makaiwa and Kaʻōhala in Wailua, also in Puna; Hanapēpē in Kona Moku; and Kaua, Kualua, and Poʻo in Waimea, also in Kona.

John Papa ʻĪʻī (1959:135) identified several surfing spots including Kamakaiwa, Poʻo, Koʻalua, in Kapaʻa Ahupuaʻa; Kaohala in Wailua Ahupuaʻa; Manalau in Waioli Ahupuaʻa; as well as "one that runs to the sand of Wailua," and "one that runs to the mouth of the sand-bottomed stream of Waimea."

Ms. Kaʻaumoana mentioned that paddling will more than likely be affected by the project. She noted her community in the Haleleʻa Moku is already experiencing issues with current KIUC practices. She also mentioned debris from albizia trees trimmed out of the way of power lines and not properly disposed of can block access to streams used for recreation.

9.1.10 Trails

Trails were and continue to be valuable resources for Native Hawaiian culture and life ways. In the past, trails were well-used for travel within the *ahupuaʻa* between *mauka* and *makai* and laterally between *ahupuaʻa*. There were several pre-Contact/early historic trails across the island of Kauaʻi. Many trails on the cliffs above Hanapepe, Makaweli, Mānā, Nāpali, Miloliʻi, Nualolo, and Hanapū are said to have been built by the Menehune (Rice 1977:40–42).

In Kalalau Ahupuaʻa, Kalou trail is one of the most used trails. It begins at Kilohana and leads to the Nāwaialole Valley where there is a small spring. It continues along a cliff known as Keala(a)kaʻīlio and then down the steep cliff of Kapea (Wichman 1998:144). On the eastern side of Kalalau Ahupuaʻa, Kanau trail ran along the narrow Kaloa ridge and Keʻala trail ran from the valley below up *mauka* to Keʻala Peak and continued on the Āleʻaleʻalau Peak and into Hanakoa Ahupuaʻa (Wichman 1998:146–147).

Another trail, known as Kealaokaʻiole, in ʻAliomanu Ahupuaʻa is named after a rat *kupua* who made a trail to Chief Anahola's *ʻawa* patch and ate the *ʻawa* along with other crops (Wichman 1998:92).

Another ancient trail begins at Maunahina Ridge and leads out of Wainiha Ahupuaʻa, continuing up to Kilohana at the north edge of the Alakaʻi Swamp, through Kōkeʻe and down to Waimea on the southwest side of the island (Wichman 1985:114).

No trails have been identified within the KIUC HCP project area in the historic documentation, archaeological investigations, or *kamaʻāina* interviews included in this CIA and Ka Paʻakai Analysis.

9.1.11 Burials

In Māhāʻulepū Ahupuaʻa, traditions explain that slain warriors of Kamehameha's army were buried in a place known as Kāmala (Site 82). Other accounts suggest Kāmala was a burial place for commoners (Bennett 1931:120).

Prehistoric human burials (SIHP # 50-30-08-01899-1, 2, 3, and 4) have been documented at the south end of Donkey Beach in Keālia Ahupuaʻa (Perzinski et al. 2000:100).

Burials (SIHP # 50-30-01-01976) have also been documented on the coastal cliff in the back of Polihale State Park in Waimea Ahupuaʻa (Carpenter and Yent 1994).

The only identified traditional Hawaiian burial site above 500 ft elevation to date appears to be SIHP # 50-30-06-00498 at Paiwa in upper Waimea Canyon (McMahon 1993a). This was a cave site that included five burials. Bennett (1931:28) also identified two burials (Bennett Site 36) near the junction of the Waiʻalae and Waimea rivers in this immediate area.

As with the pattern of traditional Hawaiian burials, the pattern for modern burials has also been very much for burial at lower elevations. Three areas indicated for modern burials (SIHP # 50-30-10-B001, the Holy Cross Cemetery; SIHP # -01865 "88 Shrines" Buddhist religious site [two human burials]; and SIHP # -03908, graves of Walter D. McBryde and companion) have been documented above 500 ft elevation in the Kalāheo/Lāwaʻi area (Kikuchi and Remoaldo 1992; McMahon and Fujimoto 1991).

9.2 Analysis

9.2.1 Valued Cultural, Historical, or Natural Resources in the Project Area

Makaʻala Kaʻaumoana mentioned the significance of native seabirds including the *ʻaʻo* (Newell's shearwater) and the *ʻuaʻu* (Hawaiian petrel). She noted, "Native seabirds contribute critical nutrients to the farmlands and our cultural mauka-makai connections."

Ms. Kaʻaumoana mentioned there are native plants in the remote areas KIUC has access to.

9.2.2 The Extent to which Traditional and Customary Native Hawaiian Resources will be Affected by the Proposed Action

Ms. Kaʻaumoana expressed concern for the safety of the *ʻaʻo* and *ʻuaʻu*. She stated, "The loss of native birds on Kauai is DIRECTLY RELATED to KIUC power lines." She says power lines have become obstacles for birds, noting that when birds come into contact with the lines, they are wounded or killed. She also noted wounded birds are easily snatched by feral cats. She mentioned birds are also impacted by street lights, and exterior lighting at solar or other generation facilities.

Ms. Kaʻaumoana also mentioned debris from albizia trees trimmed out of the way of power lines and not properly disposed of have entered streams, impacting stream life and damaging reefs and nearshore marine resources when it exits the stream and enters the ocean. She also noted cut logs can block access to streams used for recreational and gathering purposes.

Ms. Ka‘aumoana mentioned that paddling, crabbing, and fishing will more than likely be affected by the project, noting her community in the Halele‘a Moku is already experiencing issues with current KIUC practices. She noted KIUC’s impact on cultural resources and practices has been “island wide.”

9.2.3 Feasible Action, if any, to be taken to Reasonably Protect Native Hawaiian Rights

Ms. Ka‘aumoana recommended the implementation of a predator control plan to protect birds that have been wounded after encountering KIUC power lines. She suggested the “removal of predators on all KIUC property including around power poles and solar arrays.” She suggested KIUC or a hired agency address the increased population of feral cats.

Ms. Ka‘aumoana suggested all KIUC power lines within the identified flyways of native birds “should be lowered, camouflaged with vegetation and/or reconfigured to horizontal arrays.” She suggested all streetlights should be “downward facing and shielded.” She suggested “exterior lighting at solar or other generation facilities must be as low as possible and shielded and aimed at the ground” and “studies must be conducted to determine the impacts of large arrays of solar panels for their potential impacts on birds.”

Ms. Ka‘aumoana insists KIUC do their due diligence in assuring proper disposal of all trimmed albizia logs.

Ms. Ka‘aumoana stressed that the preservation of native plants in remote areas KIUC accesses when installing and servicing poles and power lines should remain a top priority. It is recommended that the preservation of native/endangered plants and animals be taken into consideration for continued propagation and reproduction.

It is recommended that, when feasible, allowing access to certain remote areas in the *wao akua* may assist cultural practitioners in fulfilling ceremonial and religious practices. Although KIUC does not control access to the HCP areas, future activities that may occur as a result of this HCP should not create any new encumbrances to access for traditional cultural practices in areas that are not currently restricted.

It is recommended that future activities that may develop as a result of this HCP should strive to minimize any interference with future, current, or ongoing cultural rights and practices, as well as maintaining or considering view planes to sacred sites/markers and religious structures.

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* 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.

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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