JOSH GREEN, M.D.
GOVERNOR
KE KIAʻĀINA

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF TRANSPORTATION | KA ʻOIHANA ALAKAU
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IN REPLY REFER TO:

OES-2025-025

January 30, 2026

VIA ONLINE: https://planning.hawaii.gov/erp/submittal-form/

TO: JAMES KUNANE TOKIOKA, DIRECTOR
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT, AND TOURISM

ATTENTION: MARY ALICE EVANS, DIRECTOR
OFFICE OF PLANNING AND SUSTAINABLE DEVELOPMENT

FROM: EDWIN H. SNIFFEN
DIRECTOR OF TRANSPORTATION

SUBJECT: FINAL ENVIRONMENTAL ASSESSMENT - FINDING OF NO SIGNIFICANT IMPACT FOR KALAELOA HYBRID REEF LABORATORY PROJECT LOCATED IN THE HONOULIULI AHUPUAʻA, ʻEWA DISTRICT, OʻAHU ISLAND, COASTAL AREA FRONTING TAX MAP KEY (TMK) [1]9-1-014:049

With this letter, the State of Hawaiʻi, Department of Transportation (HDOT) transmits this Final Environmental Assessment for the Kalaeloa Hybrid Reef Laboratory Project located in the Honouliuli Ahupuaʻa, ʻEwa District, Oʻahu Island, Coastal Area fronting TMK [1]9-1-014:049 for publication in the next available edition of The Environmental Notice.

If you have any questions, please contact Genevieve Hilliard Sullivan, HDOT Project Manager at (808) 587-2169 or by email at genevieve.h.sullivan@hawaii.gov.

From: dbedt.opsd.erp@hawaii.gov
To: DBEDT OPSD Environmental Review Program
Subject: New online submission for The Environmental Notice
Date: Thursday, February 12, 2026 3:18:31 PM

Action Name

Kalaeloa Hybrid Reef Project

Type of Document/Determination

Final environmental assessment and finding of no significant impact (FEA-FONSI)

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

ʻEwa, Oʻahu

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

Coastal Area Fronting (1) 9-1-1014:049

Action type

Agency

Other required permits and approvals

Table of federal and state permits and approvals are available in Chapter 1 of the Final EZ on page 4.

Proposing/determining agency

Department of Transportation

Agency jurisdiction

State of Hawaiʻi

Agency contact name

Genevieve Hilliard Sullivan

Agency contact email (for info about the action)

genevieve.h.sullivan@hawaii.gov

Email address for receiving comments

genevieve.h.sullivan@hawaii.gov

Agency contact phone

(808) 927-7568

Agency address

869 Punchbowl Street Rm 513
Honolulu, HI 96813
United States
Map It

Is there a consultant for this action?

No

Action summary

This project (Proposed Action) seeks to test and develop a living, self-healing hybrid reef to protect infrastructure and communities by mitigating damage related to coastal flooding, erosion, and storm surge. The purpose of the Proposed Action is to test the performance of a prototype hybrid reef that may attenuate wave energy more effectively than traditional hardscaping with added benefits to the marine environment and local communities. The structures are designed to mimic the function of a fringing reef and consists of two types of base structures that form arrays inspired by different zones of a natural fringing reef: the reef crest and the back reef or reef flat (shallow, shoreside). The need for the Proposed Action is to find cost-effective and novel solutions (i.e., alternatives to shoreline hardening) for protecting shorelines from storm surges and sea level rise. The project is engaged with Federal and State permitting agencies and community groups of Kalaeloa and will continue to incorporate community input throughout the permitting process and extended monitoring of this project.

Reasons supporting determination

The reef will consist of engineered structures seeded with coral fragments, arranged to mimic the structure of a natural fringing reef. Monitoring will measure its performance of dissipating wave energy, its ecological benefits, and its role in enhancing nearshore marine resources. After considering the context and intensity of potential impacts and evaluating the Proposed Action against the HEPA significance criteria, the HDOT concludes that the Kalaeloa Hybrid Reef Project will not have a significant adverse environmental impact. Potential effects are minor, temporary, or adequately avoided and minimized through project design, best management practices, monitoring, and compliance with applicable permits. Accordingly, a Finding of No Significant Impact (FONSI) is issued, and preparation of an Environmental Impact Statement is not required. The Environmental Consequences (Chapter 4) includes the impact analyses for the proposed action.

Attached documents (signed agency letter & EA/EIS)

- FEA_FONSI_Kalaeloa_Hybrid_Reef_Feb_2026.pdf
- Kalaeloa-Reef_Project_FEA_-Submittal_Letter.pdf

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 Final EA is the same as the location map for the associated Draft EA.

Action location map

- R3D-Proposed-Action-Area.zip

Authorized individual

Genevieve Hilliard Sullivan

Authorized individual email

genevieve.h.sullivan@hawaii.gov

Authorized individual phone

(808) 927-7568

Authorization

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

FINAL

ENVIRONMENTAL ASSESSMENT

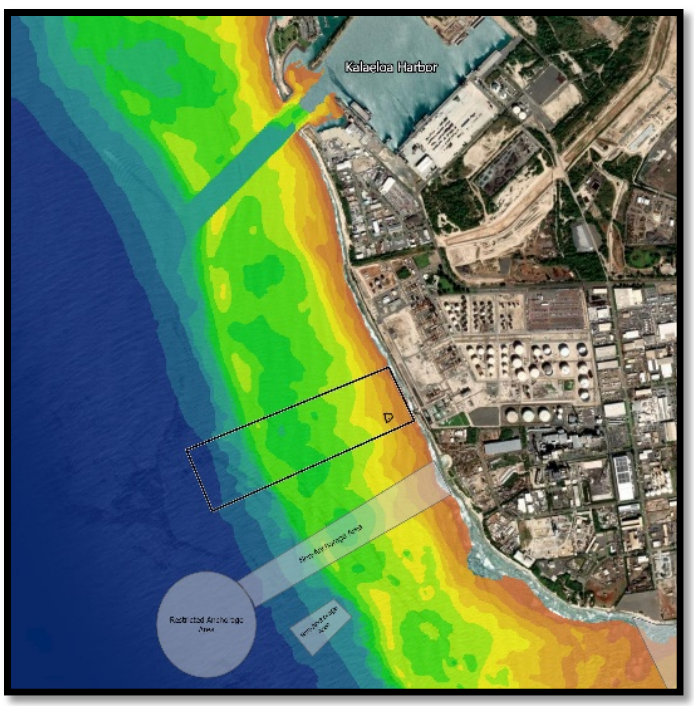
FOR

KALAELOA HYBRID REEF PROJECT

KALAELOA, HAWAIʻI

February 2026

DEPARTMENT OF TRANSPORTATION
STATE OF HAWAIʻI



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Abstract

Designation:	Final Environmental Assessment – Finding of No Significant Impact
Title of Proposed Action:	Kalaeloa Hybrid Reef Project
Project Location:	Kalaeloa, Oʻahu, Hawaiʻi
Proposing / Determination Agency:	Hawaii Department of Transportation, Administration Modal Unit, Office of Energy Security and Community Outreach
Point of Contact:	Genevieve Hilliard Sullivan, Project Manager Hawaii Department of Transportation 869 Punchbowl Street Honolulu, Hawaii 96813 Email address: genevieve.h.sullivan@hawaii.gov
Date:	February 2026

The Hawaiʻi Department of Transportation (HDOT) has prepared this Final Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) pursuant to Hawaiʻi Revised Statues (HRS) Chapter 343 also known as the Hawaiʻi Environmental Policy Act (HEPA), the State's law governing the preparation of environmental review documents. Consistent with HRS 343-5(h), whenever an action is subject to both the National Environmental Policy (NEPA) and HRS 343, State of Hawaiʻi agencies will cooperate with federal agencies to reduce the duplication of requirements.

Although separate HEPA EA and NEPA EA documents have been prepared for this Project, this EA contains similar content to the NEPA EA and Finding of No Significant Impact (FONSI) signed on October 15, 2025, by the Defense Advanced Research Projects Agency (DARPA). The NEPA EA was prepared in accordance with (42 United States Code [U.S.C.] §§ 4321 et seq.) as implemented by the Department of Defense's NEPA Implementing Procedures.

This project (the Proposed Action) seeks to test and develop a living, self-healing hybrid reef to protect infrastructure and communities by mitigating damage related to coastal flooding, erosion, and storm surge. The purpose of the Proposed Action is to test the performance of a prototype hybrid reef that may attenuate wave energy more effectively than traditional hardscaping with added benefits to the marine environment and local communities. The need for the Proposed Action is to find cost-effective and novel solutions (i.e., alternatives to shoreline hardening) for protecting shorelines from storm surges and sea level rise. The project is engaged with Federal and State permitting agencies and community groups of Kalaeloa and will continue to incorporate community input throughout the permitting process and extended monitoring of this project.

The Defense Advanced Research Projects Agency (DARPA) is providing support to University of Hawaiʻi (UH) engineers and coral researchers to develop and install a hybrid-reef prototype offshore of Kalaeloa Point on the island of Oʻahu. DARPA through its Reefense Program would fund the deployment of the hybrid-reef prototype, which would start once permitted in 2026. When the hybrid reef is deployed, ownership, maintenance, and monitoring requirements would be transferred to Hawaiʻi Department of Transportation (HDOT). HDOT would then be responsible for the monitoring, reporting, and maintenance of the hybrid reef. UH is pursuing funding to continue research and monitoring efforts of the hybrid-reef prototype.

DARPA issued a Final Environmental Assessment (FEA) and final decision document (Finding of No Significant Impact) on October 15, 2025. These documents can be found on the website - https://rapidresilientreefs.org.

After considering the context and intensity of potential impacts and evaluating the Proposed Action against the HEPA significance criteria, the HDOT concludes that the Kalaeloa Hybrid Reef Project will not have a significant environmental impact. Potential effects are minor, temporary, or adequately avoided and minimized through project design, best management practices, monitoring, and compliance with applicable permits. Accordingly, a Finding of No Significant Impact (FONSI) is issued, and preparation of an Environmental Impact Statement is not required. The Environmental Consequences (Chapter 4) includes the impact analyses for the proposed action.

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EXECUTIVE SUMMARY

Proposed Action

The Proposed Action is to deploy a hybrid reef (mixed natural and artificial structures) consisting of an arrangement of reef-mimicking structures (RMSs) offshore of Campbell Industrial Park near Kalaeloa Beach on the island of Oʻahu. The structures are designed to mimic the function of a fringing reef, and consists of two types of base structures that form arrays inspired by different zones of a natural fringing reef: the reef crest and the back reef or reef flat (shallow, shoreside).

Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to develop and test a living, self-healing hybrid reef that can attenuate wave energy more effectively than traditional hardscape solutions to protect infrastructure and people by mitigating damage related to coastal flooding, erosion, and storm surge. It is also intended to enhance the presence of marine organisms by establishing a healthy coral reef on the structures. The need for the Proposed Action is to find cost-effective and novel solutions for protecting shorelines as the impacts of storm surges and sea level rise increase. The Hawaiʻi Department of Transportation (HDOT), Climate Adaptation Action Plan, 2021 provides a roadmap for HDOT's Highways Division to make the highway system more resilient to climate-related effects. It identifies locations along the state highways that are exposed to natural hazards, and outlines strategies to be implemented and actions to be taken to incorporate resilience into its programs and policies.

The exposure assessments reveal that of approximately 564 miles of roads assessed 34% of the assessed network are exposed to passive flooding, 23% are exposed to annual high wave flooding, 11% are exposed to coastal erosion, 50% are exposed to storm surge, and 73% are exposed to Tsunami. Recent extreme weather events have resulted in significant unanticipated impacts to Hawaiʻi's highways. Coastal erosion and shoreline change are some of the most visible impacts associated with changing climatic conditions in Hawaiʻi, especially when coupled with coastal development and shoreline hardening. Storm surge resulting from tropical storms and hurricanes can exacerbate coastal erosion and cause serious damage to roads.

The severity and increased frequency of these events are attributed to weather or climate change hazards that are not typically effectively addressed in traditional highway design methods. Therefore, HDOT is piloting engineered, nature-based, and hybrid adaptive design solutions to protect vulnerable coastal roads and transportation assets. The Proposed Action to test a living, self-healing hybrid reef that can attenuate wave energy aligns with HDOT's climate adaptation efforts.

HEPA, State Permits, and Public Engagement

The Proposed Action is subject to environmental review in compliance with Hawaiʻi Revised Statute (HRS), Chapter 343, also known as the Hawaiʻi Environmental Policy Act (HEPA), prior to issuance of a submerged lands easement and other Project approvals (permits). As the Proposed Action would use state funds HRS 343-5(a) is triggered with HDOT as the proposing and determination agency for this HEPA EA. The Proposed Action occurs within the State of

Hawaiʻi marine waters under the jurisdiction of the Department of Land and Natural Resources (DLNR), Office of Conservation and Coastal Lands (OCCL). Therefore, HDOT would pursue a Conservation District Use Application (CDUA) with the Department of Land and Natural Resources (DLNR) Office of Conservation and Coastal Lands (OCCL).
Between 2021 and 2025, the UH and DARPA project team conducted multiple consultations across Oʻahu. Prior to identifying the location of the proposed action area, the team conducted many community engagements included native Hawaiian organizations and community groups in three ahupuaʻa within the Koʻolaupoko Moku. Recommendations from these engagements formed the early research phase of the project but were not specific to the selected site analyzed in this EA.

In the summer of 2025, DARPA and HDOT agreed that once the hybrid reef is deployed, ownership, maintenance, and monitoring requirements would be transferred to HDOT. At this time HDOT began community consultations with the UH researchers. In June 2025, the project team was invited to present to the Kalaeloa Heritage Park Foundation Board, where discussions began around the site's cultural and ecological significance. In July 2025, consultation with the Kalaeloa Heritage and Legacy Foundation resulted in a letter of support.

In August 2025, the Makakilo–Kapolei–Honokai Hale Neighborhood Board No. 34 received a project briefing and voted unanimously in support of the project. That same month, presentations were provided to the Kapolei Hawaiian Civic Club and the Kuaʻāina Ulu ʻAuamo (KUA) Limu Hui. Consultations with Hoʻola Hāniʻo also occurred during this period and are ongoing. Hoʻola Hāniʻo's mission is to restore the fishery of Hāniʻo and its surrounding environment; sustain the community; and encourage community members to know, celebrate, and malama their relationship with Hānio.

In November 2025, the HDOT and UH project team, Kuleana Coral Restoration staff, and DLNR Division of Aquatic Resources (DAR) staff met with Hoʻola Hāniʻo at the beach adjacent to the proposed site to discuss the proposed deployment of the reef structures at Kalaeloa. Much of the conversation focused on cultural history, environmental degradation, safety planning, and long-term monitoring plan. That same week, HDOT and the UH project team met with Hoʻola Hāniʻo and members of Neighborhood Board No. 34 to tour Jensen Infrastructure in Kapolei where the back reef structures are manufactured. The group discussed the structure design and materials as well as concrete testing, reinforcement, and quality control. Discussions included the proposed orientation and location of the prototype; ecological function of the structures; monitoring and instrumentation; safety, navigation and site marking; and ideas on how to best integrate community members as active partners in the project development, monitoring, and outreach efforts.

Overall consultations revealed a wide range of perspectives, with recurring themes reflecting both longstanding regional issues and site-specific questions about the hybrid reef. Community members often tied their feedback to broader challenges in ʻEwa and Oʻahu, such as rapid development, water diversions, loss of limu and diverse marine life, pressures on cultural sites, and distrust of projects perceived to prioritize outside interests. While many expressed support for the project's concept, skepticism remained about whether it would provide meaningful benefits or simply add to the cumulative burden of development. Key questions centered on how success would be measured, who in the community would decide if it was beneficial, and under what conditions the structure might be removed if it did not serve community interests.

Concerns were raised about whether the Kalaeloa shoreline truly required protection, and why the prototype was being tested here rather than in higher-wave energy locations such as the North Shore. The project team explained that the system needs to be designed for a specific water depth and wave climate and prototyping the system is important before installing a full-scale hybrid reef systems in other locations. Similarly, some community members argued that the coastline looked unchanged in their lifetime and questioned whether there had ever been a reef to restore. Archival maps, early explorer accounts, and historic photographs were used to demonstrate that Kalaeloa once supported more extensive reef habitat and nearshore limu beds, suggesting a long-term decline in ecological productivity.

The most significant cultural concern centered on *ʻamaʻama* (mullet). Observations regarding the ʻamaʻama seasonal presence and movement patterns in the nearshore waters were shared by Damon Duhaylonson, Poʻo Lawaiʻa of Hoʻola Hāniʻo, based on personal experience and ʻike passed down through his ʻohana. Community members emphasized that the sandy habitats offshore Kalaeloa have been culturally important for mullet spawning and migration, and that any interference would be unacceptable. While ecological studies suggest mullet are able to move around natural and artificial obstacles, assurances were requested that biodiversity monitoring will track mullet specifically, and that mitigation—including possible removal—would be considered if adverse impacts occurred. Limu was also identified as a critical resource, with mixed opinions on whether it should be actively outplanted or allowed to regenerate naturally.

Community members also questioned the footprint of the prototype, arguing that it seemed unnecessarily large for a test. The project team explained that the design reflects the minimum size needed to measure wave attenuation and that performance will be independently assessed by the U.S. Army Corps of Engineers and U.S. Geological Survey. Finally, participants asked how the community would be directly involved and if they would be compensated for their time and expertise. In response, the project team committed to involving the community in a stakeholder hui to plan and conduct long-term monitoring of the site. Overall, consultation showed strong support from most community groups in the area and cautious support from one native Hawaiian organization with close ties to the proposed project location. Overall support is tempered by some concerns about cumulative development, impacts to *ʻamaʻama* and limu, the subterranean kāluawai (water pits), 'ewahinahina (native plant) population across the beach, and trust in long-term project stewardship. Success will depend on continued transparency and data sharing, rigorous monitoring of culturally important species, and ensuring meaningful pathways for community involvement in the assessment of observed impacts and the decision-making process. The team will continue to provide updates on the project to local community groups throughout the permitting process to incorporate feedback into planned actions at the site.

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Final Environmental Assessment
Hawaiʻi Department of Transportation
Kalaeloa Reef Laboratory Project
Kalaeloa, Hawaiʻi
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LIST OF FIGURES

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Appendices

Abbreviations and Acronyms

Acronym	Definition	Acronym	Definition
°C	degrees Celsius	lbs	pound(s)
°F	degrees Fahrenheit	lidar	light detected and ranging
CCD	Coastal Consistency Determination	m	meter(s)
CEQ	Council on Environmental Quality	m^2	square meters
CFR	Code of Federal Regulations	MBTA	Migratory Bird Treaty Act
CGM	Coral growth module	MHI	Main Hawaiian Islands
cm	centimeter(s)	mi	mile(s)
CZMA	Coastal Zone Management Act	MLLW	Mean lower low water
DARPA	Defense Advanced Research Projects Agency	MMPA	Marine Mammal Protection Act
dB	decibel	MSA	Magnuson-Stevens Fishery Conservation and Management Act
dB re 1 µPa	decibels referenced to 1 micropascal	NEPA	National Environmental Policy Act
DoD	United States Department of Defense	NHPA	National Historic Preservation Act
DPS	Distinct Population Segment	NM	Nautical mile
EA	Environmental Assessment	NMFS	National Marine Fisheries Service
EEZ	Exclusive Economic Zone	NOAA	National Oceanic and Atmospheric Administration
EFH	Essential Fish Habitat	NWHI	Northwestern Hawaiian Islands
ESA	Endangered Species Act	PMUS	Pelagic Management Unit Species
FAA	Federal Aviation Administration	PVC	Polyvinyl chloride
FEP	Fishery Ecosystem Plan	RMS	Reef Mimicking Structure
FMP	Fishery Management Plan	ROV	Remotely Operated Vehicle
FONSI	Finding of No Significant Impact	SHPD	State Historic Preservation Division
FR	Federal Register	SOP	Standard Operating Procedures
ft	foot/feet	SPL	Sound Pressure Level
ft^2	square feet	UAS	Unmanned Aerial System
HAPC	Habitat Areas of Particular Concern	UH	University of Hawaiʻi
HDOT	Hawaiʻi Department of Transportation	U.S.	United States
HRS	Hawaiʻi Revised Statutes	U.S.C.	United States Code
HIMB	Hawaiʻi Institute of Marine Biology	USACE	U.S. Army Corps of Engineers
Hz	hertz	USFWS	U.S. Fish and Wildlife Service
in	inch(es)	UZELA	Underwater Zooplankton Enhancing Light Array
INRMP	Integrated Natural Resources Management Plan	VSM	Vector sensor module
kg	kilogram(s)	WPRFMC	Western Pacific Regional Fishery Management Council
kHz	kilohertz	yd	yard(s)
km	kilometer(s)		
LAT	Lowest Astronomical Tide		

1. Purpose of and Need for the Proposed Action

Introduction

The Defense Advanced Research Projects Agency (DARPA) is providing support to University of Hawaiʻi (UH) engineers and coral researchers to develop and install a hybrid-reef prototype off shore of Kalaeloa Point on the island of Oʻahu. The Proposed Action described herein would occur in the nearshore waters of Kalaeloa, within the ahupuaʻa of Honouliuli, ʻEwa District, Oʻahu.

DARPA through its Reefense Program would fund the deployment of the hybrid-reef prototype, which would start as early as 2026. When the hybrid reef is deployed, ownership, maintenance, and monitoring requirements would be transferred to Hawaiʻi Department of Transportation (HDOT). HDOT would then be responsible for the monitoring, reporting, and maintenance of the hybrid reef. UH would continue to monitor until spring of 2026 and would also pursue long term funding opportunities to continue research and monitoring efforts of the hybrid-reef prototype.

HDOT is seeking cost-effective and novel solutions (i.e., alternatives to shoreline hardening) for protecting shorelines from storm surges and sea level rise which aligns with the strategy of DARPA's Reefense program includes employing recent innovations in materials science, hydrodynamic modeling, and reef restoration to develop growing structures that are optimized to rapidly implement coastal defenses suited to a changing environment. DARPA's Reefense program involves the construction of custom wave-attenuating base structures (reef-mimicking structures—RMSs) to promote growth of reef-building organisms (e.g., coral). The reef-building organisms would enable the hybrid reef to naturally self-heal and keep pace with sea level rise over time. The living, self-healing hybrid reef can attenuate wave energy more effectively than traditional hardscape solutions to protect infrastructure and people by mitigating damage related to coastal flooding, erosion, and storm surge.

The hybrid reef would also include components to attract non-reef building organisms necessary to help maintain a healthy, growing ecosystem. Finally, new techniques and strategies for outplanting coral will be implemented to accelerate coral coverage and growth on the hybrid structure. As soon as the RMSs are deployed, they would immediately attenuate coastal wave energy. As the structures facilitate the growth of the reef-building organisms, they would provide a biological benefit (e.g., habitat for mobile reef species) in just a few months or years that would be equivalent to decades of growth for a similarly sized naturally occurring reef.

Location

Kalaeloa, at the southwestern extent of Oʻahu is located in the ahupuaʻa of Honouliuli and in the moku of ʻEwa. This point lies on an expansive coastal plain that extends southwest from Keahi point to the east and from the base of the Waiʻanae mountain range to the north. References to the area are included in traditional oral histories (moʻolelo) where it appears as a key landmark for travelers voyaging between islands by canoe. The goddess Hiʻiaka, for example, instructs a chief traveling from from Hāʻena, Kauai, to Pele's realm on Kīlauea, Hawaiʻi, to watch for a point that, "…juts out into the sea. That will be Laeloa; do not land there but continue your journey forward" (Maly 2012). The Cultural Resource Assessment (Appendix D) is focused primarily on the marine area of Honouliuli ahupuaʻa and it's associated coasts and resources. Today Kalaeloa is a mixed-use area that includes Kalaeloa Harbor, a moderately deep-draft port, and Barbers Point Marina used for recreational boating activities. Campbell Industrial Park is a major industrial and commercial hub for energy production and manufacturing that includes all of Hawaiʻi's oil refining capabilities.

The Kalaeloa coastline is characterized by ancient emergent reef pocketed by countless depressions and occasional deep sinkholes. Some narrow sandy beaches exist between the exposed reef and coastal vegetation. A site-specific benthic and reef fish survey was conducted on November 24, 2025, within the project footprint at Kalaeloa (21.3068° N, 158.1160° W) by Kuleana Coral Restoration. The survey was undertaken to characterize benthic substrate condition, coral community structure, associated invertebrates, and reef fish assemblages - the observations indicate a benthic environment with limited live coral framework, high urchin abundance, and a fish community skewed toward small, omnivorous and herbivorous reef fishes associated with turf-algal and pavement-dominated substrates. The proposed action area is subject to high wave action and is characterized as wave scoured hard bottom seabed with intermittent patches of coral and sand (Fletcher et al. 2002). The hybrid-reef would be deployed within a depth range of approximately 2-4 m (Figure 1-1).

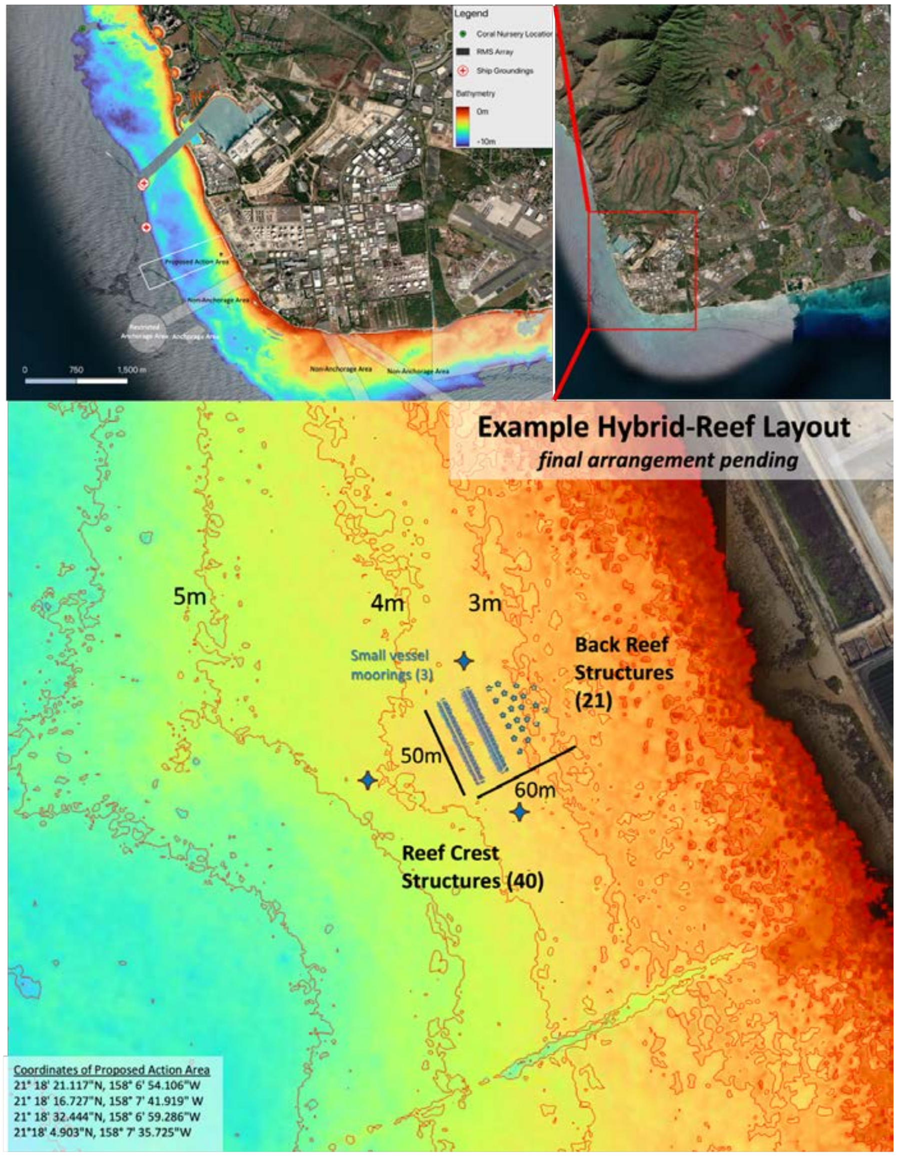

Figure 1-1. Overview of Project Location with Notional Arrangement of RMSs

Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to develop and test a hybrid reef that can attenuate wave energy more effectively than traditional hardscape solutions to protect infrastructure and communities by mitigating damage related to coastal flooding, erosion, and storm surge. It is also intended to enhance the presence of marine organisms by establishing a healthy coral reef on the RMSs. The need for the Proposed Action is to find cost-effective and novel solutions for protecting shorelines from the impacts of storm surges and sea level rise.

Scope of Environmental Analysis

This EA includes an analysis of potential environmental impacts associated with the Action Alternative and the No Action Alternative. The environmental resource areas analyzed in this

EA include the following: physical resources, biological resources, and socioeconomic and cultural resources. The area discussed and depth of discussion for each resource analyzed may differ due to how the Proposed Action interacts with or impacts the resource.

Principal Federal and State Laws Applicable to the Proposed Action

Federal, State, Local, and Regional Land Use Plans, Policies, and Controls	*Status of Compliance as of Final EA*	*Issuing / Approving Agency*
National Environmental Policy Act (NEPA);	DARPA issued a Final Environmental Assessment (FEA) and final decision document (Finding of No Significant Impact) on October 15, 2025. These documents can be found on the website - https://rapidresilientreefs.org.	DARPA is responsible for authorizing federal funds and is therefore identified as the lead federal agency for NEPA. DARPA would fund the deployment of the RMS structures.
Clean Air Act	N/A	EPA
Clean Water Act Section 404/ Rivers and Harbors Act Section 10	U.S. Army Corps of Engineers issued three nationwide permits (NWP): NWP #1, (Aids to Navigation), NWP #5 (Scientific Measurement Devices), NWP #10 (Mooring Buoys), and NWP #27 (Aquatic Restoration, Enhancement, and Establishment Activities) on November 7, 2025. The permit states that the project complies with the requirements of the Clean Water Act, Section 401 Blanket Water Quality Certification (WQC) WQC1092 issued for this Nationwide Permit by the State of Hawaii Department of Health, Clean Water Branch. The project also complies with the requirements of the Coastal Zone Management Consistency Concurrence for this NWP issued by the State of Hawaii, Department of Business, Economic Development and Tourism, Office of Planning during the NWP reissuance process in 2021.	U.S. Army Corps of Engineers (USACE)
Coastal Zone Management Act State of Hawaiʻi, Revised Statutes HRS§ 205A	A federal consistency review is required currently ongoing with the State of Hawaiʻi Office of Planning and Sustainable Development. See NWP compliance above.	Department of Business, Economic Development and Tourism, Office of Planning and Sustainable Development, Coastal Zone Management Program (DBEDT-OPSD, CZM)

Federal, State, Local, and Regional Land Use Plans, Policies, and Controls	*Status of Compliance as of Final EA*	*Issuing / Approving Agency*
Special Management Area (SMA) - Revised Ordinances of Honolulu Chapter 25	The Proposed Action is not within an SMA and does not require staging equipment within an SMA.	City and County Honolulu
Shoreline Setbacks - Revised Ordinances of Honolulu Chapter 26	The Proposed Action is not within the shoreline setback area and does not require staging equipment within the shoreline setback area.	City and County Honolulu
Submerged Lands Act	A Conservation District Use Permit (CDUP) pursuant to Hawaiʻi Administrative Rules (HAR) 13-5-24, Identified land uses in the resource subzone, R-5 Marine Construction, (D-1) *Dredging, filling, or construction on submerged lands, including construction of harbors, piers, marinas, and artificial reefs*. This use requires a CDUP approved by the Board of Land and Natural Resources. A disposition from the Department of Land and Natural Resources' Land Division may also be required.	DLNR, Office of Conservation and Coastal Lands (OCCL) DLNR, Land Division – landowner's signature for the CDUP application and Right of Entry.
National Historic Preservation Act Section 106 consultation	DARPA finding - No historic properties affected.	Advisory Council on Historic Preservation, State Historic Preservation Officer (SHPO)
Endangered Species Act	On September 10, 2025 NMFS concurred with DARPA determination that the proposed action is not likely to adversely affect the following ESA-listed species and designated and proposed critical habitats: endangered Main Hawaiian Island insular false killer whales; endangered Hawaiian monk seals; threatened Central North Pacific green turtles; endangered hawksbill turtles; threatened giant manta rays; designated critical habitat for Hawaiian monk seals; and proposed critical habitat Central North Pacific green turtles. DARPA finding - No effects determination for U.S. Fish Wildlife Service resources.	U.S. Fish and Wildlife Service; and National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS)
Magnuson-Stevens Fishery Conservation and Management Reauthorization	DARPA initiated consultation with NMFS under the MSA. NMFS provided conservation recommendations on August 7, 2025. DARPA responded with minor	National Oceanic and Atmospheric Administration, National Marine Fisheries

Federal, State, Local, and Regional Land Use Plans, Policies, and Controls	*Status of Compliance as of Final EA*	*Issuing / Approving Agency*
Act, Essential Fish Habitat coordination	modifications to the conservation recommendations. NMFS accepted DARPA's modifications on August 13, 2025, which concluded the consultation.	
Marine Mammal Protection Act	Based on the nature of the Proposed Action (e.g., small, proposed action area, short periods of time required for daytime vessel activity, no underwater noise except limited vessel noise), the impacts do not rise to a level considered as take. Therefore, there is no accompanying permit associated with this Proposed Action.	U.S. Fish and Wildlife Service; and National Oceanic and Atmospheric Administration, National Marine Fisheries Service
Migratory Bird Treaty Act	Based on the nature of the Proposed Action (e.g., all in-water work) and the lack of presence of nesting or foraging habitat for migratory birds within the proposed action area, there would be no effect from the Proposed Action on migratory birds.	U.S. Fish and Wildlife Service
Bald and Golden Eagle Protection	Based on the nature of the Proposed Action and the lack of presence of bald or golden eagle nesting or foraging habitat within the proposed action area, there would be no taking of a bald or golden eagle. Therefore, the Bald and Golden Eagle Protection Act does not require further consideration.	U.S. Fish and Wildlife Service
State of Hawai‘i HRS Chapter 343, and its implementing rules Hawai‘i Administrative Rules Chapters 11-200 and 11-201 (also referred to as HEPA)	EA (this document) and Anticipated Finding of No Significant Impact (AFONSI) of the Proposed Action forthcoming.	HDOT is the lead State agency responsible for HEPA compliance. HDOT is also responsible for the compliance and the RMS technology and maintenance requirements once RMSs are deployed.
HRS Chapter 6E-8, State Historic Preservation review	HRS 6E approval required.	Department of Land and Natural Resources (DLNR), State Historic Preservation Division (SHPD)
State of Hawai‘i (Hawai‘i Revised Statutes [HRS] 187A-6)	A Special Activities Permit (SAP) is required by the Department of Land and Natural Resources, Division of Aquatic Resources for biological collections of coral and live rock. The University of Hawaii (UH) researchers applied for the SAP permit in September 2025.	Department of Land and Natural Resources, Division of Aquatic Resources (DAR)

2. Proposed Action and Alternatives

Proposed Action

The hybrid reef that would be deployed within the proposed action area would mimic an existing fringing reef. The engineered-reef design consists of individual base structures that make up sections of a fringing reef: the reef crest (highest point of the reef) and the back reef or reef flat (shallow, shoreside). Figure 2-1 is an artist's rendering of the original concept of the hybrid-reef array and depicts the structural and adaptive biology components that could be incorporated into the project. The sections below outline the details of the project's site selection and survey; RMS design and components; deployment, and monitoring. DARPA would fund the deployment of the hybrid reef, which would start as early as 2026. After deployment, the hybrid-reef system and monitoring, reporting, and maintenance requirements would be transferred to HDOT. UH would pursue long term funding opportunities to continue research and monitoring efforts of the hybrid-reef prototype.

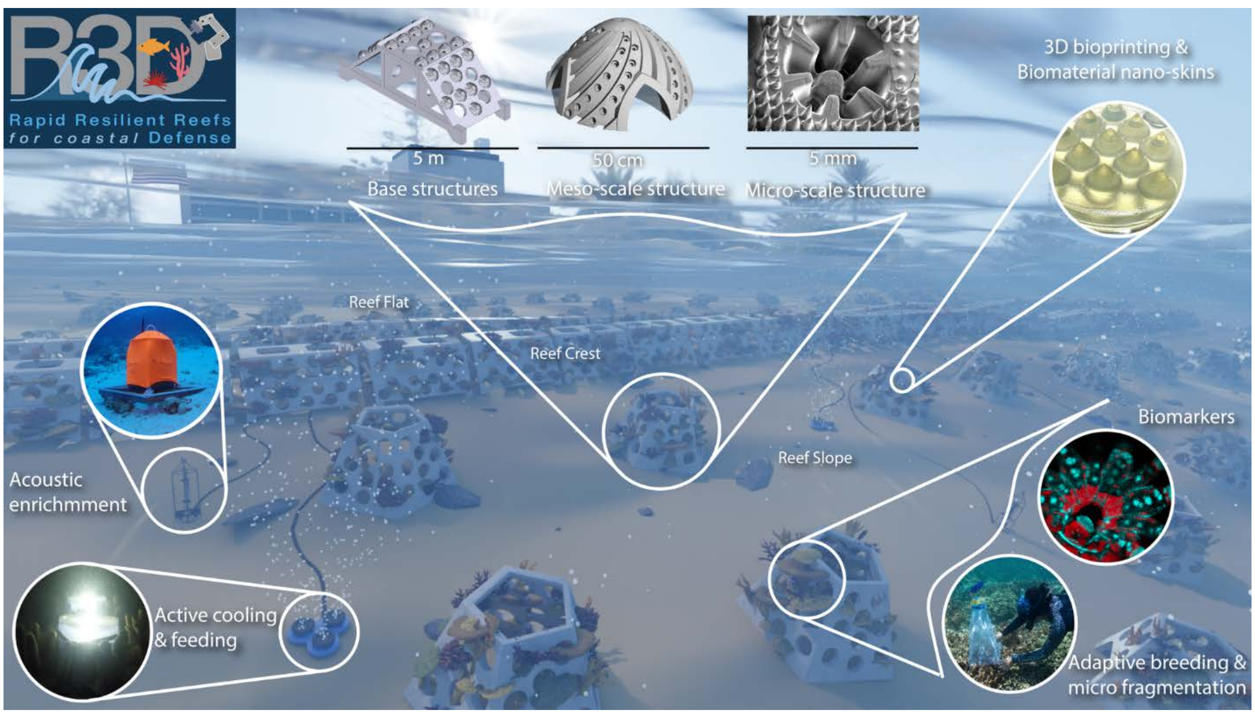

Figure 2-1. Artist Rendering of Original Hybrid-Reef Design

Screening Factors

Potential alternatives that meet the purpose and need were evaluated against the following screening factors:

- RMS designs that can attenuate coastal wave energy by 70 to 90 percent, increase cover of calcareous reef-building species (e.g., coral), grow to match sea level rise, demonstrate survivability in laboratory tests for an increase in water temperature, and have installation costs equivalent to similarly sized shoreline construction projects (e.g., rip-rap, seawalls);

- Interventions that increase coral settlement by 35 percent and reduce algal cover by 30 percent;
- Location with sufficient wave energy (ongoing or storm-driven) to allow the testing of wave attenuation success;
- Suitable bottom type for deployment and long-term presence of hybrid-reef structures;
- Proper depth to allow each designed structure to attenuate wave energy;
- Proximity to performer to allow for cost-effective installation and monitoring; and
- Lack of existing, healthy reefs within the footprint designated for deployment so that the installation would not harm naturally occurring reefs and those reefs would not interfere with the testing of the hybrid reef's wave attenuation capability.
- Lack of adverse impacts on cultural resources – these include archaeological resources, biological resources of cultural importance, intangible cultural resources, and ongoing cultural practices.

HEPA Significance Criteria

The Proposed Action was evaluated pursuant to Chapter 343, Hawaiʻi Revised Statutes, and Hawaiʻi Administrative Rules §11-200.1. Based on the analyses contained in this Environmental Assessment, consultation with regulatory agencies, and consideration of public comments, the Hawaiʻi Department of Transportation finds that the Kalaeloa Hybrid Reef Project will not have a significant effect on the environment.

The project proposes installation and monitoring of a prototype hybrid reef designed to attenuate wave energy, enhance ecological function, and support climate adaptation objectives along the Kalaeloa shoreline. Potential environmental effects were evaluated against the HEPA significance criteria, and the findings are summarized below:

1. Irrevocable commitment of resources.
The project does not irrevocably commit natural, cultural, or historic resources. Construction occurs within coastal waters using modular, reversible components, and no known historic properties will be adversely affected.

2. Curtailment of beneficial uses.
The Proposed Action will not curtail beneficial environmental uses. Public access and marine uses will remain substantially unchanged, and the project is intended to improve coastal resilience and ecological productivity.

3. Consistency with environmental policies.
The action supports State climate adaptation, shoreline management, and habitat enhancement goals by testing hybrid reef infrastructure intended to mitigate erosion, flooding, and storm surge risks.

4. Economic, social, or cultural welfare.
No substantial adverse impacts to economic or social welfare are anticipated. The project may

provide long-term benefits through reduced coastal hazards and improved environmental conditions.

5. Public health.
Construction activities will follow established safety and permit requirements. No substantial adverse impacts to public health are expected.

6. Secondary impacts.
The project will not induce population growth or increased demand on public infrastructure. Secondary impacts are anticipated to be negligible.

7. Environmental quality degradation.
Short-term turbidity, noise, and construction disturbances will be temporary and minimized through best management practices. Long-term environmental degradation is not anticipated.

8. Cumulative impacts or precedent-setting actions.
The prototype reef is limited in scale and does not constitute an irreversible commitment to larger development. When considered with other coastal projects in the region, cumulative impacts are not expected to be significant.

9. Threatened or endangered species.
Project design and monitoring measures avoid and minimize impacts to protected species and habitats. No substantial adverse effects are anticipated.

10. Air, water quality, or noise.
Construction-related emissions and noise will be localized and temporary. Water quality impacts will be minimized through turbidity controls and regulatory compliance.

11. Environmentally sensitive areas.
Although located in coastal waters subject to hazards such as erosion and sea-level rise, the project is specifically intended to improve resilience to those conditions and will not substantially degrade sensitive environments.

12. Scenic vistas and view planes.
The low-profile offshore structures will not substantially alter scenic vistas or identified view planes.

13. Energy use and greenhouse gases.
Energy use and greenhouse gas emissions will be limited to short-term construction activities. The project supports long-term climate adaptation objectives and does not require substantial operational energy consumption.

After considering the context and intensity of potential impacts and evaluating the Proposed Action against the HEPA significance criteria, the Hawaiʻi Department of Transportation concludes that the Kalaeloa Hybrid Reef Project will not have a significant environmental impact. Potential effects are minor, temporary, or adequately avoided and minimized through project design, best management practices, monitoring, and compliance with applicable permits. Accordingly, a Finding of No Significant Impact (FONSI) is issued, and preparation of an Environmental Impact Statement is not required. The Environmental Consequences (Chapter 4) includes the impact analyses for the proposed action.

Alternatives Considered but not Carried Forward for Analysis

The design of the Kalaeloa Hybrid Reef prototype being carried forward as the Proposed Action is the culmination of an iterative process that included wave flume testing of RMSs, computer modeling efforts testing of different configurations and sizes of RMSs, and other preliminary research. Alternatives for the final design were considered but not carried forward for detailed analysis in this EA as they did not meet the purpose of and need for the project and satisfy the reasonable alternative screening factors presented in Section 2.2. These alternatives included an additional array of large fore-reef structures and a larger array of back-reef structures. Through modeling and analysis of wave flume tests, it was determined that neither of these arrays of additional structures would provide enough wave-energy attenuation to justify the cost or potential impact to the site.

Public comments also suggested incorporating additional design features, such as modifying the reef configuration to create a recreational surf site or expanding nighttime lighting to enhance opportunities for marine wildlife viewing. These suggestions were considered but not carried forward, as they are outside the purpose and need of the project and could introduce additional operational, environmental, and safety considerations beyond the scope of this EA.

An alternative site was also considered at Ulupaʻu/Fort Hase off Marine Corps Base Hawaiʻi. However, due to complex stakeholder relationships at the site, it was eliminated from further analysis.

Alternatives Carried Forward for Analysis

Based on the reasonable alternative screening factors and meeting the purpose of and need for the Proposed Action, the project team identified the Proposed Action and the No Action Alternative as the only practicable alternatives to be examined within this EA. DARPA and UH have invested extensive time and research to shape the hybrid-reef design and deployment details, eliminating alternative designs that ultimately did not meet the screening factors (Section 2-2) through their preliminary research. As the purpose of the Proposed Action is testing of this carefully selected design, no reasonable alternatives exist that would meet the purpose and need while offering fewer environmental impacts. Therefore, only the Proposed Action and No Action alternatives will be considered in this EA.

No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur. No deployment of RMSs would occur within the proposed action area. The No Action Alternative would not meet the purpose of and need for the Proposed Action because there would be no furthering of research on shoreline protection alternatives to hard armoring; however, the No Action Alternative is carried forward for analysis in this EA to provide a baseline for measuring environmental consequences of the Proposed Action.

Action Alternative (Proposed Action)

The sections below outline the details of the project's site selection and survey; RMS design and components; and deployment, and monitoring.

Site Selection and Surveys

The Kalaeloa coastline is characterized by ancient emergent reef pocketed by countless depressions and occasional deep sinkholes. Some narrow sandy beaches exist between the exposed reef and coastal vegetation (Fletcher et al. 2002). The proposed action area is characterized as wave scoured hard bottom seabed with intermittent patches of coral and sand. This area is subject to high wave action with a depth range of approximately 0-50 ft (0-15 m). A notional layout within the proposed action area (Figure 1-1 and Figure 2-2) that would minimize impacts to marine resources is based on a 1-m resolution lidar survey, conducted in 2013 that provides general bathymetry for the area. The exact location of the deployment within the proposed action area may change based on a detailed photogrammetry survey conducted in 2025, oceanographic monitoring, structural testing, and to avoid adverse impacts onbiological and cultural resources such as coral. After deployment of the hybrid reef, an additional survey would be conducted to map the final locations of each RMS. Divers would conduct a survey close to deployment to identify coral colony locations. Coral cover in the proposed action area is low—less than 5%—(Franklin et al. 2013; Franklin et al. 2014) and distributed intermittently across the seafloor. Any non-encrusting corals greater than 4 in (10 cm) in height that could potentially be disturbed during the deployment of the RMSs or associated instruments and components would be collected and cached at deeper sites close by, per procedures developed by Kuleana Coral Restoration (Kuball et al. 2024). These coral would be fragmented and attached to the RMSs after installation. Additionally, corals of opportunity, sourced from the proposed action area may also be outplanted to the hybrid reef.

Kuleana Coral Restoration performed a benthic survey on November 24, 2025 (Appendix F) and found that the project footprint is characterized by low live coral cover, high turf algal dominance, and very high densities of rock-boring urchins (*Echinometra mathaei*). Coral colonies were sparse, generally small, and patchily distributed, with *Porites lobata* and *Pocillopora meandrina* comprising most colonies greater than 10 cm in height. These patterns are consistent with a low-relief reef flat where bioerosion and algal growth are prominent features of the habitat.

The fish assemblage was dominated by juvenile size classes (0–10 cm) of common wrasses, damselfishes, and surgeonfishes, with relatively few larger individuals or higher-trophic-level species observed. This size structure and species composition are typical of algae-dominated, low-complexity habitats that provide limited structural refuge.

Taken together, the observations indicate a benthic environment with limited live coral framework, high urchin abundance, and a fish community skewed toward small, omnivorous and herbivorous reef fishes associated with turf-algal and pavement-dominated substrates.

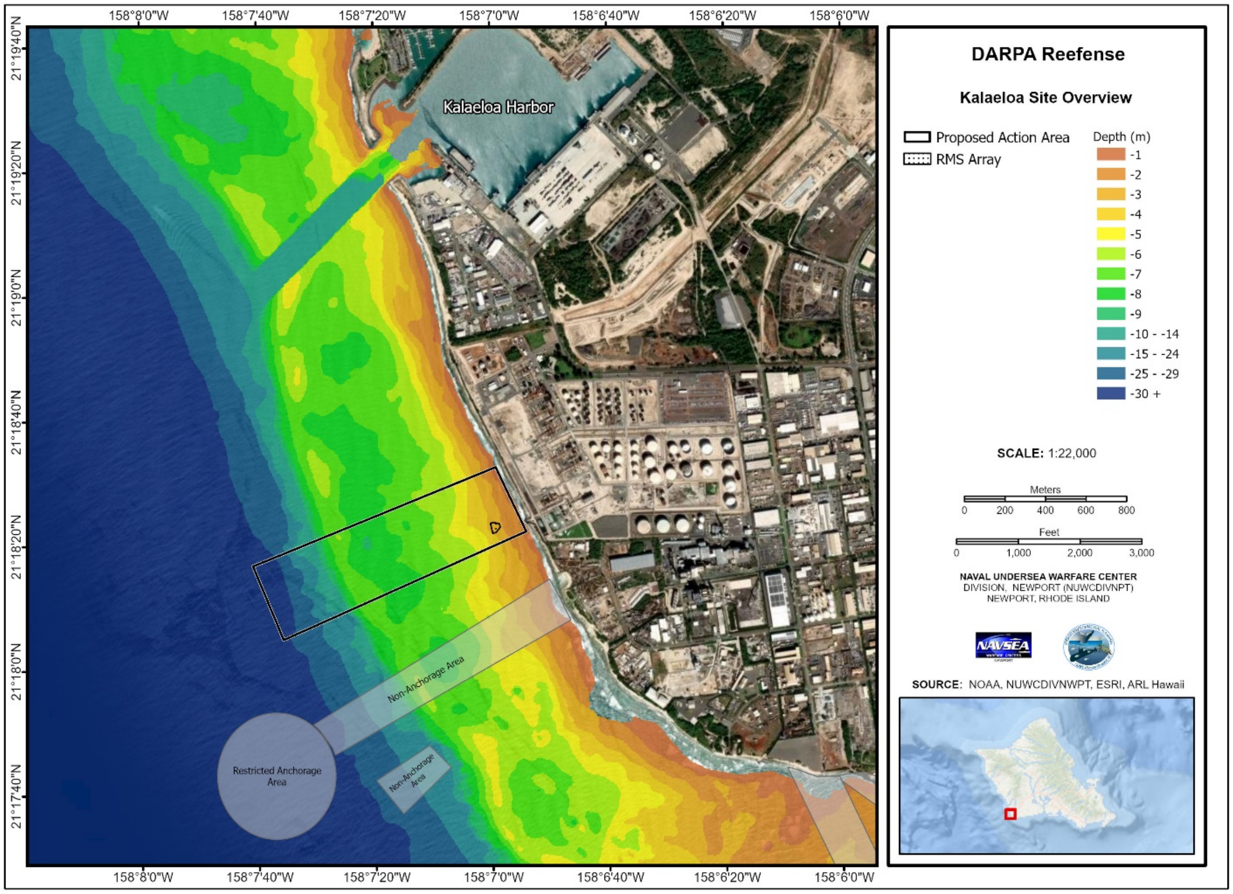

Figure 2-2. Proposed Action Area

Table 2-1 lists details about the surveys within/near the proposed action area.

Table 2-1. Site Surveys

Date	***By***	***Location***	***Data collected***	***Purpose***
09/2013	USGS	Oahu	Topobathy LiDAR	Topographic and shallow-water (0-30m) bathymetric surveys
04/2025	UH	Kalaeloa (21.306, -158.117)	Underwater imagery (random points)	Initial site suitability assessment
06/2025	UH	Kalaeloa (21.306, -158.117)	Underwater imagery and video (transects)	Preliminary benthic cover assessment
11/2025	UH	Kalaeloa (21407, -158.116)	Photogrammetry	Detailed benthic cover assessment.
11/2025	UH/ Kuleana Coral Restoration	Kalaeloa (21.3068, -158.1160)	Benthic cover, coral colonies (>10 cm), macroalgae, invertebrates, reef fish belt transects	Detailed benthic and reef fish baseline characterization within project footprint.
UH: University of Hawaiʻi, USGS: United States Geological Service				

RMS Design and Components

Table 2-2 summarizes the different components of the hybrid-reef array. All RMSs would be constructed from concrete reinforced with glass fiber and stainless-steel prestressing strand. Three-dimensional printed meso-scale and micro-scale habitat structures would be mounted to the RMSs. Meso-scale structures would add relief and geometric complexity to encourage the recruitment of coral, other sessile invertebrates (e.g., sponges, tunicates, oysters), and herbivorous reef fish. Micro-scale structures would be coated with materials that inhibit the growth of algae and include sections of natural biofilm to encourage coral settlement and growth. Appendix A has more detail on these structures and solutions. RMS designs have been tested for loading and stability via extensive scale-model testing exceeding 20-year storm events. These tests, in concert with in-water anchor testing in Hawaiʻi, validate survivability of the structures in anticipated wave environments. Additionally, manufacturers of RMSs and an external validation and verification team have performed industry-standard tests for reinforced concrete as part of the quality control process to validate long-term durability of the RMSs. Concrete samples have passed American Society for Testing and Materials (ASTM) tests including compressive-, tensile- and flexural-strength, surface resistivity, and lengthening tests. Compressive strength tests included dry and seawater-conditioned tests (Wood and Arthur 2025).

Table 2-2. Components of the Hybrid Reef Project

Component	*Description*
Biological components[1]	Local reef-building species: *Montipora capitata, M. flabellata, M. patula, M. studeri, Pavona duerdeni, P. varians, Pocillopora grandis, P. ligulata, P. meandrina, P. acuta, Porites compressa, P. lobata, P. evermanni, P. brighami, P. stellata, Leptastrea bewickensis, L. purpurea, Cyphastrea ocellina, Psammocora stellata, P. explanata* Native sea urchins: *Tripneustes gratilla* Native limu (algae): To be determined
Biofilms[1]	Alginate, crustose coralline algae exo-metabolites, gelatin, mineral oil, polyethylene glycol, polydimethylsiloxane, silica, liposomes, hydroxyapatite, calcium carbonate, and cellulose
Bottom type for structure deployment	Wave-scoured hard bottom with intermittent patches of coral and sand
Weight for single RMS	Reef crest: 11 metric tons Back reef: 4.5 metric tons
Length	Up to 164 ft (50 m)
Area	Reef crest: 40 structures; height 7.9 ft (2.35 m); width 7.9 ft (2.44 m) Back reef: 21 structures; height 5.3 ft (1.57 m); width 13.8 ft (4.15 m) Total Number of RMSs: 61 Approximate Total Footprint: 8,945 square feet (ft^2; 831 square meters [m^2])
Materials	Primarily concrete reinforced with glass fiber rebar and stainless-steel prestressing strand loops for anchoring
Anchoring method[1]	Anchor bars would be drilled into the seabed for some or all of the RMSs and secured in place with epoxy
Moorings and navigational markers[1]	3 subsurface day-use moorings 10 white marker poles

Component	*Description*
Reef enrichment	Healthy coral reef soundscape would be played at night; plankton-attracting lights
Oceanographic monitoring equipment[2]	Standard oceanographic equipment would be attached directly to RMSs as well as placed adjacent to the structures on the seafloor. Equipment on the seafloor would be weighted but not anchored; ballasted grid frames would be deployed with equipment to keep it in place. The equipment would monitor structural integrity, flow patterns, and environmental conditions.

[1] Details in Appendix A
[2] Details in Appendix B

Figure 2-3 shows the two different designs of the RMSs as well as 20-in (50-cm) diameter dome-shaped coral settlement modules that would be attached to the structures. The reef crest structures have four stainless-steel strand loops at the feet to connect anchors and may have four steel lifting eyes (removable) on the top that pass through holes. A maximum of 61 RMSs would be placed on the seafloor (40 reef crest; 21 back reef). The total array may be deployed in stages in order to evaluate anchoring and stability on a subset of the structures prior to deploying the complete 164 ft (50 m) array. Each RMS would be designed with perforated holes (diameter of 0.9 to 2.7 ft [30 to 82 cm]) that attenuate wave energy through generation of turbulence and allow for egress of mobile marine species. Deployment of the back reef array would likely precede the reef crest array. All structures would be deployed in 6.5 to 13 ft (2 to 4 m) water depth. The engineering designs of both types of RMSs and more details on the vertical clearance and the addition of navigational aids to the hybrid-reef array can be found in Appendix A.

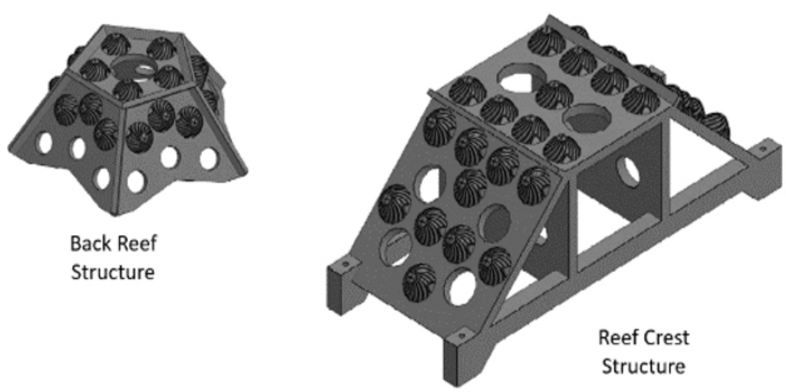

Figure 2-3. Notional Design of Hybrid Reef Base Structures and Meso-scale Structure Layout

Deployment and Monitoring

The specific vessels and plan are to be determined closer to installation and are subject to availability, final design, and the development of a safe installation methodology. Deployment of the RMS units would likely occur using a dynamically positioned vessel approximately 181 ft (55 m) long by 34 ft (10 m) wide with a 12 ft (3.7 m) draft. RMS units would be transported with temporary buoyancy systems to their shallow water deployment locations. A workboat with twin engines, approximately 84 ft (25.5 m) in length, and a small, rigid inflatable or whaler-type boat less than 26 ft (8 m), also referred to as a daughter craft, would assist the final stages of deployment and operate at 5 knots or less in the proposed action area. Below are two deployment options, providing solutions based on available vessels and budget.

One option would be to lower the RMSs into the water alongside a deep-water-positioned dynamic positioning vessel, supported by temporary buoyancy (Figure 2-4). In this case, smaller vessel(s) such as a rigid inflatable boat, would maneuver the RMS unit, supported by temporary buoyancy, into the shallow water deployment site, where the buoyancy would be reduced and the RMS unit placed slowly onto the seabed.

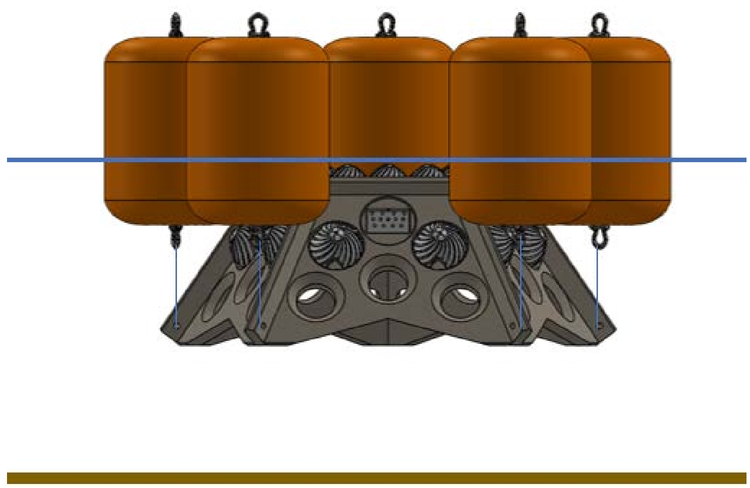

Figure 2-4. A Drawing of a Backreef RMS Unit Supported with Air Filled Lift Bags, to Enable Towing Into Shallow Water

A second option is to use a custom built deployment catamaran vessel (Figure 2-5) to buoyancy support up to four RMS units for a tow using a small support vessel from the staging/launching site to the deployment site. Once in position at the deployment location within the proposed action area one of the following methods would occur to deploy the RMS unit(s): (1) the RMS units would be lowered in a controlled manner from the floating catamaran vessel or (2) the catamaran vessel itself, including RMSs, would be submerged in a controlled manner, by flooding the sponsons. Once the RMSs are on the seabed in position, the RMSs are diconnected from the catamaran frame by divers and (if needed) the sponsons are refilled with air using a compressor on a small surface vessel to allow the catamaran vessel to refloat to the surface.

In most cases, divers would assist in the anchoring and placement of RMS units, if it is safe to do so, to avoid placement on non-encrusting corals. RMS installation would take periods of several days and may last several months overall. The supporting vessels would transit from Kalaeloa harbor during the installation period to reload RMS units and avoid unfavorable weather conditions.

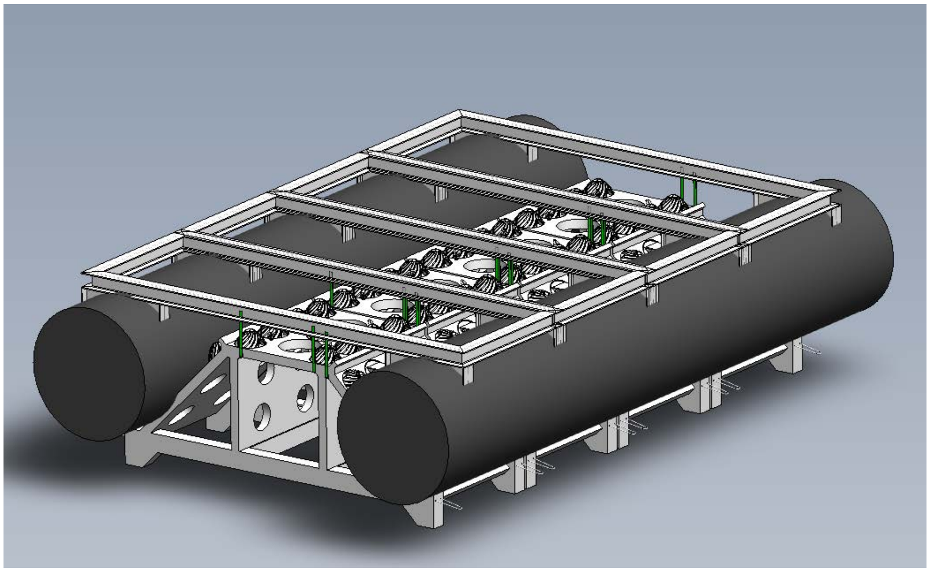

Figure 2-5. Custom Deployment Catamaran, With Buoyant Pipe Sponsons for Float Out Operation of up to Four Reef-Crest RMS Units

Anchoring and supplementary ballast may be required to ensure the RMSs stay in place on the seafloor. Ballast would likely be in the form of several tons of steel blocks or chain clumps incorporated/connected into the structure close to the seabed. Anchors would consist of a steel bar in a drilled rock socket with a maximum of 10 ft (3 m) embedment, held in place with a two-part mortar epoxy (i.e., HIT-RE 500 V3). When injecting epoxy into the annulus (i.e., the space between the drill string and the inside diameter of the hole being drilled), the gap at the seabed surface around the anchor bar is small, and the process would be monitored with sensors and cameras. During the injection process, significant loss of epoxy is not anticipated. Once the annulus is filled, a permanent cap would be placed over the pile that would have the effect of preventing loss of epoxy while it cures. The drilled hole would be less than 6 in (15 cm) in diameter, and the bar would be less than 3 in (8 cm) in diameter. The anchor bars would either be installed by divers with a handheld drill or with a remotely operated vehicle (ROV) drilling rig that would be temporarily lowered to the seafloor and tended from a surface vessel. Provided it is safe to do so, divers would be present in the water when the ROV is in operation to ensure impacts to corals are avoided.

One to four anchor bars would be required per RMS (no more than 124 anchor bars total), and each anchor would take approximately one hour to install. Anchor bars would be installed by a single team operating one drilling spread. The drilled anchors may be installed after the RMSs have been deployed. Alternatively, the drilled anchorages may be pre-installed using a seabed template for alignment, and the RMSs would be installed subsequently. The anchors would be drilled through holes at the base of each RMS, or the drilled anchors would be set into the seabed in close proximity (up to 10 ft [3 m]) to the RMSs and connected via a steel plate, tendon, chain, or turnbuckle. This mechanical connection between the anchor and the RMS would be made by divers immediately after each RMS is deployed. The frequency range of hydraulic drills similar to those that would likely be used in the Proposed Action have been measured from 10 hertz (Hz) to 40 kilohertz (kHz) (Department of the Navy 2003; John J. McMullen Associates 1984). Studies determined sound pressure levels (SPLs) of underwater tools similar to those used during the Proposed Action measured 159–161 decibels referenced to 1 micropascal (dB re 1 µPa) at 1 m from the source (Anthony et al. 2009; Nedwell et al. 2004). Based on these reports, DARPA assumes an approximate level of 161 dB re 1 µPa at the source for the hand drills used in the Proposed Action.

To facilitate deployment and installation activities and limit impacts to the seafloor, up to three subsurface moorings would be deployed within the proposed action area. Anchoring of the subsurface moorings would be similar to the RMS anchoring process. More details on the anchor bars and subsurface moorings can be found in Appendix A.

Once the RMSs are deployed, structural and biological components (Appendix A), as well as scientific monitoring equipment (Appendix B), would be deployed onto and adjacent to the RMSs. Up to 30 autonomous cameras would be deployed within the proposed action area and these cameras would be used to monitor fish settlement on the RMSs. Half of the cameras would be accompanied by an underwater light, so the cameras can take photographs of activity at night. The lights would activate for five seconds every five minutes over the course of 12 hours (assumed nighttime duration). The lights would emit white light and be housed in polyvinyl chloride (PVC) housings attached to the RMSs, which would limit each light to a directional beam of no more than 1.6 by 1.6 ft (0.5 by 0.5 m) to illuminate a single dome-shaped coral settlement module.

At a minimum, UH would conduct surveys immediately after the hybrid reef is deployed and two-months post deployment. Additionally, divers would survey the structures every five years to assess anchoring system integrity until the living breakwater system is deemed to be self-secured/attached. These surveys would include general assessment of system health and stability. UH will seek further funding for long-term surveys to understand the effectiveness of the system. These will include the following: quarterly underwater photogrammetry to assess coral health, recruitment and growth; continuous passive acoustic surveys with data being analyzed quarterly; and periodic environmental DNA sampling to measure the changes in quantity and relative abundance of the corals between a control site and the proposed action area. All additional diver surveys listed here would include removal of any marine debris from the structures that may create a hazard to the hybrid-reef system or marine life in the area.

Coral Nursery

Per the procedures developed by Kuleana Coral Restoration (Kuball et al. 2024), corals within the hybrid reef footprint and any corals of opportunity (recoverable coral fragments that have broken off of reefs) would be removed within the proposed action area (Figure 2-2) prior to the hybrid reef deployment and installation and be temporarily cached (stored) for future use on the hybrid reef. The corals would be cached at a previously established coral nursery approximately 2.2 nautical miles (NM) to the north of the deployment site (21.338N, 158.136W, Figure 2-6). The site was selected for a coral nursery because it is located at least 200 ft (61 m) from hard substrate, live coral, and seagrass beds and it is protected from wave energy by steeply sloping walls on either side of the sand channel. As a part of the Proposed Action, additional coral nursery tables would be installed at the site to provide additional space to safely store the corals removed the proposed action area. The tables would elevate the corals from the seabed to limit sedimentation. After installation of the coral tables, only simple hand tools would be used at the site in accordance with Occupational Safety and Health Administration, scientific diving exemptions (50 Federal Register [FR] 1050, January 9, 1985). Any ephemeral disturbances from divers working at the nursery are expected to be below background levels generated by local wave action.

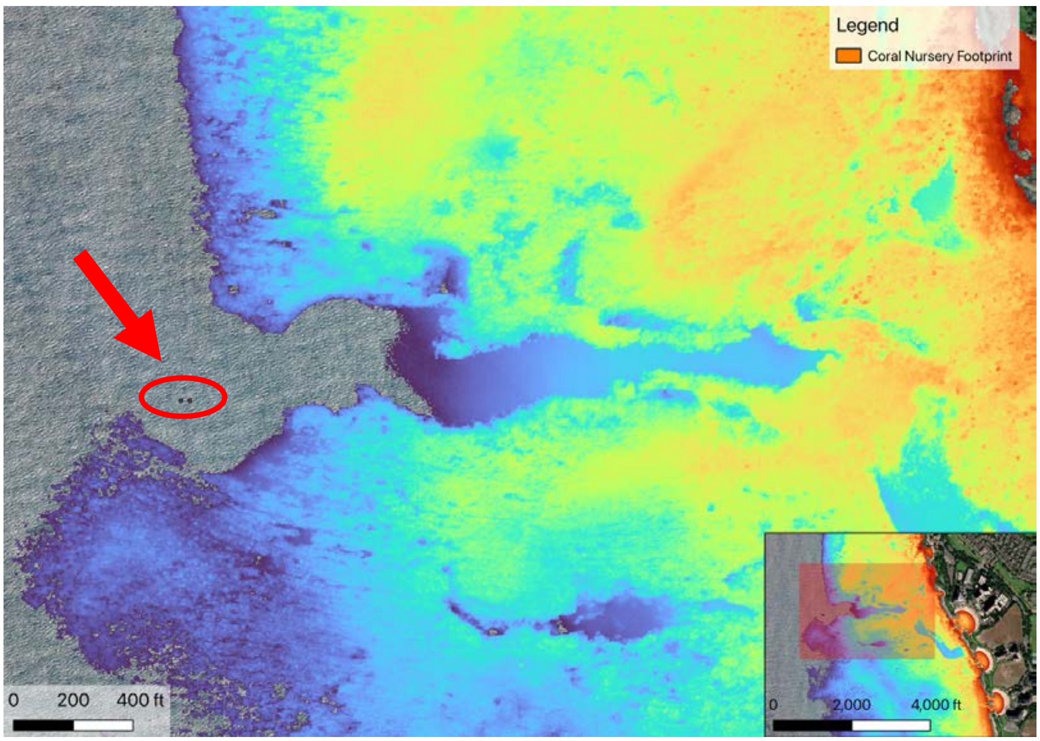

Figure 2-6. Coral nursery location offshore of the Ko Olina resort in ahupuaʻa Honouliuli. Two small red squares at the mouth of the channel represent the footprint (to scale) and approximate location of the proposed coral tables.

As part of the Proposed Action, two 10 ft by 10 ft (3 m by 3 m) tables would be installed for caching several hundred coral colonies and corals of opportunity (coral fragments). The nursery tables are constructed with a steel frame and a fiberglass grating tabletop and weigh approximately 4,800 lbs each. Tables with the same design and construction are currently being used for restoration projects in Maunalua Bay (Figure 2-7). These tables have reinforced-steel struts on the legs as well as longitudinal bracing across the table to allow the tables to withstand loading from larger wave events. A flat bar (0.25 in by 3 in [0.64 cm by 7.6 cm]) creates a 2 in (5 cm) lip on the sides of the table to help prevent corals from falling off the sides. A fiberglass grating covers the table, allowing corals to be zip tied or secured by other means as needed. The tables' frames are 4 ft (1.2 m) tall with no closed walls, allowing water to flow naturally in the channel. The tables at their highest points would be approximately 35 ft (10.7 m) below sea level, and thus would not constitute a high point navigational hazard as deemed by U.S. Coast Guard or be visible from shore.

Figure 2-7. Example of the Coral Nursery Table Design on the Seabed at Maunalua Bay

The tables would be installed at a depth of about 40 ft (12 m) and placed approximately 20 ft (6 m) apart. The tables would be deployed via a vessel-mounted crane which would be used to lower the structures to the seabed. Divers may be required to secure the legs of the structures to the seabed using an anchoring system appropriate for the substrate (hard substrate or sand). The direction of swell and heavy weather events would be taken into consideration when determining the deployment location of the tables. All work would be conducted in a controlled manner with minimal or no impact anticipated to the benthic habitat.

Effects of the nursey table installation would be monitored when divers return to the coral nursery site to move corals between the nursery and RMS deployment site. Kuleana Corals Restoration would act as the stewards of the nursery and would monitor and maintain the tables for the foreseeable future. It is anticipated that the tables would be used for other coral restoration and/or hybrid reef.

Reef Enrichment

Acoustic enrichment devices would be used to play back the sounds of a healthy active reef environment in order to attract and recruit fish larvae and juvenile fish to the proposed action area. Recordings would be obtained from a productive, adjacent reef in the Kalaeloa region with higher densities of similar species composition than the proposed action area. Sound levels would be played back with a 10 decibels (dB) higher level than recorded to be detectable above ambient levels out to a 66-ft (20-m) range from the speaker. If play back occurred at the same level, the sound would not be detectable compared to actual background levels at any range. Frequencies below 20 Hz and above 20 kHz are removed before playback. Acoustic enrichment devices would be located near the center of the hybrid reef or in the center of the back reef RMSs. The sound emitted would likely remain within the proposed action area since playbacks are estimated to drop to ambient noise levels within 66 ft (20 m) of the source. Unless otherwise stated, all reef enrichment devices would be internally powered by batteries and deployed by divers. Some instruments would be retrieved monthly or bi-monthly for data download. The majority of the retrievals would occur during the summer when larval fish recruitment peaks.

Speakers that play back healthy reef sounds at close to ambient volume would be mounted directly onto or outside a RMS unit, most likely using tie wraps and/or hose clamps. Three cylindrical pressure cases filled with nickel-metal hydride batteries would be attached using zip ties or hose clamps. Each case would be 3.2 ft (1 m) long by 10 in (25.6 cm) in diameter, with a submerged weight of 50 pounds (lbs; 22 kilograms [kg]) each. An underwater speaker (0.32 m x 0.32 m x 0.16 m; center of Figure 2-8 [left]) may also be mounted on or between the RMSs. The speakers may play continuously for up to 12 hours, primarily during evening hours. The broadband acoustic output of the speaker is estimated to be 120 dB re 1 µPa at 1 m (root mean square) between 1 and 20 kHz. Figure 2-8 shows how these devices would be set-up on the seafloor.

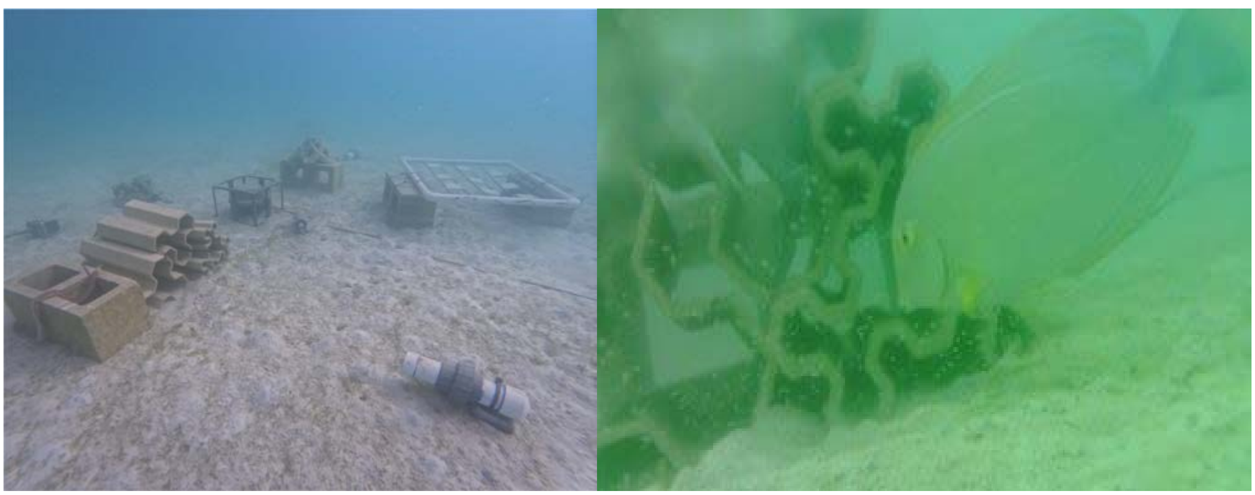

Figure 2-8. Acoustic Enrichment Devices (left); Acoustic Playback Attracting Larvae and Large Fish (right)

In addition to acoustic enrichment, plankton-attracting lights called an Underwater Zooplankton Enhancing Light Array (UZELA) may be added to some RMSs to encourage nighttime feeding of newly recruited corals and adult coral colonies, which would support the overall survivorship and growth of the corals. Up to 10 of the coral growth modules (CGMs) and coral settlement modules (Figure A-1 and Figure A-4) may have battery-powered coral feeding UZELA units (Figure A-5). Lights would be programmed to turn on for one hour each night, starting approximately 30 minutes after sunset. The UZELA would emit white light at a maximum of 700 lumens, and the cone of light emitted would have a diameter of approximately 20 in (50 cm) when not enclosed by a module. However, it is anticipated that the light emitted would be lessened due the restriction of the beams by the modules and the absorption of light from the water. Based on observations of other similar projects, light from UZELA would only be visible from the surface right above the lights. The lights would not be visible from even several meters away.

Additionally, up to 5,000 native collector urchins (*Tripneustes gratilla*), a non-boring species, may be released in the proposed action area to reduce the overgrowth of invasive algae that competes with coral. The released urchins would be those bred at the Division of Aquatic Resources Anuenue Sea Urchin Hatchery facility. One million urchins have already been released in multiple bays across Oʻahu (NOAA 2023). The project team is working with the community about potentially outplanting native limu (algae) to the RMSs. Native limu is also propagated at the Division of Aquatic Resources Anuenue facility.

Up until the middle of the 20th Century, Hawaiians frequently built Umu Kai, which are arrays of artificial reefs (or fish houses) to attract fish to otherwise barren areas (Kikiloi 2003). Umu Kai function similarly to a coral reef by providing habitat for fish to congregate and reproduce. These umu (heap of rocks) can be up to 4 ft by 8 ft (1.2 m by 2.4 m) and are constructed with loosely stacked rocks or coral with an opening at either end to let the current run through. Native limu naturally settle on the rocks, which would be eaten by fish and/or harvested by the fishermen. Small fish hide and feed on the growth inside, and these smaller fish attract larger predator fish, who also enter the chamber, although the larger fish cannot reach all of the hiding spaces. Fish known to associate with Umu Kai include squirrelfish (*Myripristis* spp.; *uʻu*), unicornfish (*Naso unicornis; kala*), surgeonfish (*Acanthurus triostegus; A. manini),* goatfish (*Parupeneus multifasciatus; moano*), greater amberjack (*Seriola dumerili; kahala*), parrotfish (*Scarus* spp.; *uhu*), and eels (Muraenidae; *puhi*). This practice is popular across Polynesia and is continued by local communities today. Umu Kai could be deployed on the seafloor, either inside or adjacent to the RMSs within the proposed action area as a reef enhancement measure only if requested by Native Hawaiian cultural practitioners and families of the area.

3. Affected Environment

This chapter presents a description of the environmental resources and baseline conditions that could be impacted from implementing the Kalaeloa Reef Laboratory alternative.

All potentially relevant environmental resource areas were initially considered for analysis in this EA. In compliance with HEPA's implementing rules §11-200.1-18 – the preparation and contents of a final environmental assessment - the data and analyses in a final EA is commensurate with the importance of the impact, and less important material is summarized, consolidated, or simply referenced. Therefore, the level of detail in this section used in describing a resource is commensurate with the anticipated level of potential environmental impact. This section includes physical, biological, socioeconomic and cultural resources.

Physical Resources

This discussion of physical resources includes an analysis of the benthic habitat (e.g., bathymetry, substrate, habitat type) and water column characteristics (e.g., wave energy, ambient background noise levels) in the proposed action area. Federal and state laws applicable to physical resources and compliance status is listed in Table 6-1.

The proposed action area is located just south of Kalaeloa Harbor at the southwestern extent of Oʻahu, Hawaiʻi. The proposed action area is characterized by wave scoured hard bottom seabed with intermittent patches of coral and sand. The area is subject to high wave action. The depth range within the proposed action area is approximately 0–50 ft (0–15 m). There is no data on the underwater acoustics of the proposed action area, but anthropogenic activities would be limited. Fishing, surfing, and other recreational activities occur within or near the proposed action area but are limited due to the rocky beach with limited access. Accordingly, the most common anthropogenic noise in the action area would likely be transiting vessels.

Biological Resources

Biological resources include living, native, or naturalized plant and animal species and the habitats within which they occur. Within this EA, biological resources are divided into seven major categories: (1) vegetation, (2) invertebrates, (3) birds, (4) fish, (5) EFH, (6) sea turtles, and (7) marine mammals. Federal and state laws applicable to physical resources and compliance status is listed in **Error! Reference source not found.**.

A site-specific benthic and reef fish survey was conducted on November 24, 2025 (Appendix F) within the project footprint at Kalaeloa by Kuleana Coral Restoration, at the request of community partner Hoʻōla Hāniʻo. The survey was undertaken to characterize benthic substrate condition, coral community structure, associated invertebrates, and reef fish assemblages to inform project planning, community consultation, and impact assessment for the Proposed Action.

Methods

The assessment included three benthic belt transects (25 m × 1 m) paired with three reef fish belt transects (25 m × 5 m). Transects were oriented at headings of 300°, 120°, and 30° to ensure representative spatial coverage across the proposed action area. Divers recorded benthic cover type, coral species presence, live coral colonies greater than 10 cm in height, macroalgal taxa, key invertebrates, and reef fish species abundance and size class.

Benthic Substrate and Algae

Across all transects, the benthic habitat was dominated by consolidated pavement with high turf algal cover and scattered encrusting coral morphologies. Live coral cover was visually estimated to be less than five percent (<5%). Macroalgae occurred as small, localized clusters and included *Halimeda* spp., *Padina* spp., *Martensia* spp., *Neomeris* spp., and *Dictyosphaeria* spp. Turf algae represented the predominant benthic cover throughout the footprint.

Coral Community

Live coral abundance was low and patchy across the survey area. Most observed colonies were small (<10 cm) and exhibited encrusting or low-relief growth forms. Colonies greater than 10 cm in height were limited in number and consisted primarily of *Porites lobata* and *Pocillopora meandrina*, with isolated observations of *Porites compressa* and *Porites evermanni*. These patterns are characteristic of shallow, wave-exposed reef flat habitats where physical disturbance and bioerosion limit coral framework development.

Invertebrates

Very high densities of the rock-boring urchin *Echinometra mathaei* were observed along all transects, exceeding 100 individuals per transect. Additional urchin species, including *Diadema* spp., *Tripneustes gratilla*, and *Echinothrix* spp., occur at low densities. One white-spotted sea cucumber (*Actinopyga varians*) was recorded. The dominance of *Echinometra* and turf algae is indicative of a bioeroded, pavement-dominated reef flat system.

Reef Fish Community

Reef fish assemblages were dominated by juvenile size classes (0–10 cm) across all transects. Commonly encountered taxa included juvenile wrasses (*Thalassoma duperrey*, *Stethojulis balteata*), damselfishes (*Plectroglyphidodon imparipennis*), and surgeonfishes (*Acanthurus triostegus*, *A. nigrofuscus*). Larger individuals and higher-trophic-level species were uncommon, reflecting the low structural complexity of the habitat.

Summary

Overall, the proposed action area supports a low-relief reef flat characterized by turf algae-dominated pavement, sparse and patchily distributed coral colonies, high densities of rock-boring urchins, and a reef fish community dominated by juvenile, herbivorous, and omnivorous species. These baseline conditions indicate limited existing coral framework and ecological complexity and provide an appropriate reference for evaluating project-related effects and post-deployment monitoring.

Vegetation

Vegetation within the proposed action area primarily includes three diverse taxonomic /ecological groups: microalgae (e.g., phytoplankton), macroalgae (e.g., seaweed), and vascular plants (e.g., seagrasses). Factors that influence the distribution and abundance of vegetation in the proposed action area are the availability of light, nutrients, water quality, salinity, seafloor type, storms and currents, temperature, and grazing by herbivores (Short et al. 2007). Table lists the major taxonomic groups of vegetation that may be encountered within the proposed action area. No ESA-listed vegetation species occur within the proposed action area.

Table 3-2. Major Taxonomic Groups of Vegetation that May Occur within the Proposed Action Area

Common Name (Species group)	*Description*
Diatoms (Phylum Ochrophyta)	Single-celled algae with a cylindrical cell wall (frustule) composed of silica. Diatoms are a primary constituent of the phytoplankton group.
Blue-green algae (Phylum Cyanobacteria)	Photosynthetic bacteria that are abundant constituents of phytoplankton and benthic algal communities, accounting for the largest fraction of carbon and nitrogen fixation by marine vegetation; existing as single cells or filaments, the latter forming mats or crusts on sediments and reefs.
Dinoflagellates (Phylum Dinophyta)	Most are single-celled, marine species of algae with two whip-like appendages (flagella). Some live inside other organisms, and some produce toxins.
Coccolithophores (Phylum Haptophyta)	Single-celled marine phytoplankton that surround themselves with microscopic plates of calcite. They are abundant in the surface layer of the ocean.
Brown algae (Phylum Ochrophyta)	Brown algae are large multi-celled seaweeds that include vast floating mats of *Sargassum* spp. seaweeds.
Green algae (Phylum Chlorophyta)	May occur as single-celled algae, filaments, and seaweeds.
Red algae (Phylum Rhodophyta)	Single-celled algae and multi-celled large seaweeds; some form calcium deposits. Most species occur close to shore and in coral reefs.

Sources: (Species 2000 and Catalogue of Life 2019; U.S. Department of the Navy 2018)

Invertebrates

Invertebrates are classified within major taxonomic groups, generally referred to as phyla. Table depicts invertebrate phyla found within the proposed action area (benthic or pelagic) in juvenile and adult form. Larvae of most species are water-column associated. No ESA-listed invertebrate species would be expected to occur within the proposed action area.

Table 3-3. Major Taxonomic Groups of Invertebrates that May Occur within the Proposed Action Area

Common Name (Species group)	*Description*	*Preferred Habitat*
Foraminifera, radiolarians, ciliates (Phylum Foraminifera)	Benthic and pelagic single-celled organisms; can be planktonic or benthic infaunal (live in the sediment); shells typically made of calcium carbonate or silica.	Water column and seafloor
Sponges (Phylum Porifera)	Sessile epibenthic filter feeders; large species have calcium carbonate or silica structures embedded in cells to provide structural support.	Seafloor
Corals, hydroids, jellyfish (Phylum Cnidaria)	Group contains motile and sessile benthic and pelagic animals with stinging cells; can be solitary or colonial; some form hard calcium carbonate exoskeletons.	Water column and seafloor
Flatworms (Phylum Platyhelminthes)	Mostly benthic infauna; simplest form of marine worm with a flattened body.	Water column (rare) and seafloor
Ribbon worms (Phylum Nemertea)	Mostly benthic infaunal marine worms with a long extension from the mouth (proboscis) that helps capture food.	Water column (rare) and seafloor
Round worms (Phylum Nematoda)	Small marine worms; many live in close association with other animals (typically as parasites).	Water column and seafloor
Segmented worms (Phylum Annelida)	Mostly infauna, highly mobile marine worms; many tube-dwelling species.	Seafloor
Bryozoans (Phylum Bryozoa)	Lace-like animals that exist as filter feeding colonies attached to the substrate.	Seafloor
Cephalopods, bivalves, sea snails, chitons (Phylum Mollusca)	A diverse group of soft-bodied invertebrates with a specialized layer of tissue called a mantle; can be active swimmers and predators (e.g., squid), mobile predators or grazers (e.g., sea snails), or sessile filter feeders (e.g., bivalves).	Water column and seafloor
Shrimp, crab, lobster, barnacles, copepods (Phylum Arthropoda – Crustacea)	Contains many benthic epifaunal or infaunal taxa, as well as many pelagic and demersal zooplankton taxa; distinguished by jointed exoskeleton; some are sessile, but most are motile; all feeding modes from predator to filter feeder.	Water column and seafloor
Comb jellies (Phylum Ctenophora)	Gelatinous, pelagic animals that primarily propel themselves with large numbers of cilia; capture prey using sticky cells (colloblasts).	Water column
Sea stars, sea urchins, sea cucumbers (Phylum Echinodermata)	Epibenthic predators and filter feeders with tube feet.	Seafloor

Sources: (University of California Museum of Paleontology 2022; World Register of Marine Species Editorial Board 2015)

Many invertebrate species may occur within the proposed action area, but coral are the most notable, and applicable to this Proposed Action. Franklin et al. (Franklin et al. 2013; Franklin et al. 2014) studied the seafloor around Oʻahu between 0-30 m to map the following coral species: *Montipora capitata*, *M. flabellata*, *M. patula*, *Porites compressa*, *P. lobata*, and *Pocillopora meandrina.* Based on this data there is estimated to be less than 5% coral coverage within the proposed action area. Additional surveys of coral within the proposed action area will be conducted by UH before deployment of the hybrid reef.

Although no ESA-listed coral species occur in Hawaiʻi, two species of stony coral have been identified by the International Union for Conservation of Nature as threatened – blue rice coral (*Montipora flabellata*) and sandpaper rice coral, both of which occur offshore Oʻahu (Naval Facilities Engineering Command 2020). Although many areas around Oʻahu have extensive coral reefs, the proposed action area has less coral cover due to high wave action scouring the seafloor. Back-reef areas exposed to higher energy have limited coral growth dominated by crustose coralline algae (*Hydrolithon onkodes*) with occasional stout branching *Porolithon gardineri* (Fletcher et al. 2008). The reef crest, where wave energy is greatest, is dominated by encrusting *Porites lobata*, *Montipora patula*, *M. capitata*, and *H. onkodes* (Fletcher et al. 2008). In the reef flat where wave energy is reduced, mixed colonies of large *Porites lobata* occur along with encrusting *Porites lobata*, *M. patula*, and *M. capitata* (Fletcher et al. 2008). Deeper areas of reduced wave energy can support more diverse communities, including *Porites compressa*, *M. patula*, *M. capitata*, and *Porites lobata* (Fletcher et al. 2008).

Other than coral, common invertebrates that occur within Hawaiʻi's waters include crustaceans (e.g., regal slipper lobster [*Arctides regalis*], splendid pebble crab [*Etisus splendidus*]), echinoderms (e.g., rough-spined urchin [*Chondrocidaris gigantea*], crown-of-thorns star [*Acanthaster planci*]), mollusks (e.g., day octopus [*Octopus cyanea*], fragile file shell [*Limaria fragilis*]), bryozoans (e.g., blue fan bryozoan [*Bugula dentata*]), sponges (e.g., black reef sponge [*Spongia oceania*]), cnidarians (e.g. ghost tube anemone [*Isarachnanthus bandanensis*], luminescent jellyfish [*Pelagia noctiluca*]), and worms (e.g., lined fireworm [*Pherecardia striata*]) (Hoover 1998).

Birds

Marine birds are a diverse group that are adapted to living in marine environments, using nearshore (i.e., coastal) waters, offshore waters (i.e., continental shelf), or open-ocean areas (Enticott and Tipling 1997; Harrison 1983). Some marine birds forage by gliding just above the sea surface, whereas others dive to variable depths to obtain prey (Burger 2001). Many marine birds spend most of their lives at sea and come to land only to breed, nest, and occasionally rest (Schreiber and Chovan 1986). Most marine bird species nest in colonies on the ground of coastal areas or oceanic islands. This document will briefly describe bird orders likely to occur within the proposed action area (e.g., flying over), but only birds that may forage within the proposed action area (e.g., waterfowl, seabirds that forage in coastal waters) would be likely to occur at or near the water's surface where they could be affected by the Proposed Action. Therefore, the discussion within this document will focus on these coastal foraging species.

There are eleven orders of birds that may occur within the proposed action area. Table provides general distribution on each order, although the information provided does not necessarily apply to all species within each order. No ESA-listed bird species would be expected to occur within the proposed action area.

Table 3-4. Major Orders of Birds that May Occur within the Proposed Action Area

Taxonomic Order (Representative Species)	*Distribution Within the Proposed Action Area*
Accipitriformes and Falconiformes (osprey, hawks, falcons)	Rare. Primarily associated with land, but some species may forage and migrate offshore (Xirouchakis and Panuccio 2019), such as the peregrine falcon.
Anseriformes (ducks, sea ducks)	Common. Includes birds that inhabit aquatic environments, including lakes, ponds, streams, rivers, swamps, and marine environments. Those found in marine environments forage for insects, plankton, mollusks, crustaceans, and small fish. Some species flock together outside the breeding season and may form groups ranging in size from a few individuals to many thousands. (Campbell and Lack 1985; del Hoyo et al. 1992)
Charadriiformes (phalaropes, terns, kittiwakes, noddies)	Seasonally common. Primarily coastal birds; some are long-distance migrants, like terns and kittiwakes, which may enter the proposed action area during migration (Frederiksen et al. 2012).
Gaviiformes (loons)	Present in winter. Loons use large lakes and bays during migration and coastal ocean waters during the winter. They move almost constantly when foraging, scanning the water's surface by dipping the head, then diving to pursue fish. They can locate prey while flying, often in large, dispersed flocks that quickly descend when schools of fish are detected (Holm and Burger 2002; Kenow et al. 2009).
Pelecaniformes (pelicans, egrets, ibis, herons)	Potential. Could overlap with the proposed action area when foraging. All members of this group hunt for fish and other aquatic prey by diving or swimming (Ashmole 1971), and they could feed within the proposed action area.
Phaethontiformes (tropicbirds)	Seasonally common. Several species of tropicbirds visit and forage around the Hawaiian Islands, and some species breed on the islands (Vanderwerf and Young 2007).
Podicipediformes (grebes)	Potential. Although they breed near freshwater, they migrate over marine environments where they may congregate in large numbers. Mostly they are solitary or live in small groups. They are underwater hunters (Stidworthy and Denk 2018). During migration and while foraging, grebes may enter the proposed action area.
Procellariiformes (albatrosses, petrels, shearwaters)	Potential. Highly pelagic and prolific seabirds that spend most of their lives at sea except during breeding and nesting seasons (Schreiber and Chovan 1986).
Suliformes (boobies, cormorants, frigatebirds)	Potential. These are primarily oceanic birds, but some species (e.g., the brown booby [*Sula leucogaster*]) are endemic to Hawai'i.

Fish

Many factors impact the abundance and distribution of fishes; however, the primary driving factors include temperature, salinity, pH, physical habitat, ocean currents, and latitudinal gradients (Helfman 2009; Nelson et al. 2016). A species' mobility at various life stages (e.g., pelagic larvae versus demersal adult) also affects distribution (Bowen and Avise 1990). In general terms, coastal ecosystems like the proposed action area support a greater diversity of fish species, including fish that spend their entire lives in these environments and others that use coastal environments periodically for feeding, breeding, or juvenile nursery habitat (Moyle and Cech Jr 2004; Nelson et al. 2016). The following discussion provides an overview of the predominant fish species known to occur in the proposed action area. Fish hearing is detailed in Section 3.2.8.

In the marine waters of Hawaiʻi, fish aggregate in areas of high habitat complexity (Grigg 1994). Species composition is fairly consistent throughout the Hawaiian Archipelago, and habitat type is a larger influence on species composition than geographic location (Grigg 1994). Coral reef fish of the Main Hawaiian Islands (MHI) are dominated by herbivores and low trophic level carnivores, with only three percent of fish biomass represented by apex predators (Friedlander and DeMartini 2002). Common fish present within Hawaiian coral reefs include wrasses, goatfishes, damselfishes, parrotfishes, filefishes, jacks, and sharks (Friedlander and DeMartini 2002).

Only one ESA-listed fish species could occur in the proposed action area: the giant manta ray (*Mobula birostri*). No critical habitat is designated within the proposed action area.

Essential Fish Habitat

EFH may be designated within the water column, in benthic habitat, or both. Pelagic or water column EFH would not be affected by the Proposed Action since associated stressors would not alter the water column's ability to function as a habitat. As such, water column EFH is not discussed further herein.

The WPRFMC has used the best available scientific information to describe EFH that provides information on the biological requirements for each life stage (i.e., egg, larvae, juvenile, adult) of all Management Unit species. In 2010, the WPRFMC ceased the practice of issuing FMPs for a singular Management Unit (e.g., Bottomfish) and now uses a geographic approach. Therefore, the EFH for Bottomfish and Seamount Groundfish, Crustaceans, Precious Corals, and Coral Reef Ecosystems Management Units are captured in the Fishery Ecosystem Plan (FEP) for the Hawaiian Archipelago (WPRFMC 2009a) and its amendments, although management units are still referenced within the FEP. WPRFMC manages pelagic fishery resources separately through the Pacific Pelagic FEP (WPRFMC 2009b).

To provide the reader with full context on the extent of EFH, each Management Unit's entire EFH description is provided in Table, even though some portions may be outside of the proposed action area. The descriptions in the sections below provide more detail on EFH within the proposed action area.

Amendment 5 to the FEP for the Hawaiian Archipelago (84 FR 2767; March 11, 2019) reclassified the Coral Reef Ecosystem (all life stages) and some species of spiny and slipper lobsters as Ecosystem Component Species, for which EFH and HAPC are no longer designated. Therefore, EFH for the Coral Reef Ecosystem Management Unit and spiny and slipper lobsters will not be analyzed in this document.

Table 3 -5. Management Units with EFH Designated within the Proposed Action Area

Management Unit	***Species Complex***	***Essential Fish Habitat (EFH)***
Bottomfish	Shallow	**Egg/larvae**: Pelagic zone of the water column in depths from the surface to 240 m, extending from the official US baseline to a line on which each point is 50 miles from the baseline.
		Post-hatch Pelagic: Pelagic zone of the water column in depths from the surface to 240 m, extending from the official US baseline to the EEZ boundary.
		Post-settlement and Sub-adult: Benthic or benthopelagic zones, including all bottom habitats, in depths from the surface to 240 m bounded by the official US baseline and 240 m isobaths.
		Sub-adult and adult: Benthopelagic zone, including all bottom habitats, in depths from the surface to 240 m bounded by the official US baseline and 240 m isobath.
	Intermediate	**Egg/larvae**: Pelagic zone of the water column in depths from the surface to 280 m (*A. rutilans* and *P. filamentosus*) or 320 m (*H. quernus*) extending from the official US baseline to a line on which each point is 50 miles from the baseline.
		Post-hatch Pelagic: Pelagic zone of the water column in depths from the surface 280 m (*A. rutilans* and *P. filamentosus*) or 320 m (*H. quernus*), extending from the official US baseline to the EEZ boundary.
		Post-settlement: Benthic (*H. quernus and A. rutilans*) or benthopelagic (*A. rutilans* and *P. filamentosus*) zones, including all bottom habitats, in depths from the surface to 280 m (*A. rutilans* and *P. filamentosus*) or 320 m (*H. quernus*) bounded by the 40 m isobath and 100 m (*P. filamentosus*), 280 m (*A. rutilans*) or 320 m (*H. quernus*) isobaths.
		Sub-adult/Adult: Benthic (*H. quernus*) or benthopelagic (*A. rutilans and P. filamentosus*) zones, including all bottom habitats, in depths from the surface to 280 m (*A. rutilans and P. filamentosus*) or 320 m (*H. quernus*) bounded by the 40 m isobath and 280 m (*A. rutilans* and *P. filamentosus*) or 320 m (*H. quernus*) isobaths.
	Deep	**Egg/larvae**: Pelagic zone of the water column in depths from the surface to 400 m, extending from the official US baseline to a line on which each point is 50 miles from the baseline.
		Post-hatch Pelagic: Pelagic zone of the water column in depths from the surface to 400 m, extending from the official US baseline to the EEZ boundary.
		Post-settlement: Benthic zone, including all bottom habitats, in depths from 80 to 400 m bounded by the official US baseline and 400 m isobaths.
		Sub-adult/Adult: Benthic (*E. carbunculus* and *P. zonatus*) or benthopelagic (*E. coruscans*, and *P. sieboldii*) zones, including all bottom habitats, in depths from 80 to 400 m bounded by the official US baseline and 400 m isobaths.
Pelagic	Temperate Complex Tropical Complex	**Egg, Post-hatch Pelagic, and Post-settlement**: The water column down to a depth of 200 m, from the shoreline to the outer limit of the EEZ.

Management Unit	***Species Complex***	***Essential Fish Habitat (EFH)***
	Sharks Squid	**Sub-adult / Adult**: The water column down to a depth of 1,000 m.
Crustacean	Kona Crab	**Egg, Post-hatch Pelagic, and Post-settlement**: The water column from the shoreline to the outer limit of the EEZ, to a depth of 150 m throughout the Western Pacific Region.
		Sub-adult/ Adult: All of the bottom habitat from the shoreline to a depth of 100 m throughout the Western Pacific Region.
References(WPRFMC 2009a, 2009b); Amendment 5 (WPRFMC 2018)		

Sea Turtles

Two sea turtle species would be expected to occur within the proposed action area (Table) and both are ESA-listed species.

Table 3-6. Presence of Sea Turtles within the Proposed Action Area

Common Name	***Scientific Name***	***ESA Status (Distinct Population Segment [DPS])***	***Likelihood of Occurrence within the Proposed Action Area***	***Critical Habitat within the Proposed Action Area***
Green sea turtle	*Chelonia mydas*	Threatened (Central North Pacific DPS)	Likely	Proposed
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	Potential	None

The green sea turtle (*Chelonia mydas*) is listed as threatened under the ESA (43 FR 32800; July 28, 1978). In 2016, NMFS and the USFWS reclassified green sea turtles into 11 different Distinct Population Segments (DPSs) (81 FR 20058; April 6, 2016). Green sea turtles from the threatened Central North Pacific DPS may occur within the proposed action area. Critical habitat has been proposed for the species (88 FR 46572; July 19, 2023), and overlaps with the proposed action area.

Green sea turtles are the most common sea turtle species in the waters surrounding the Hawaiian Islands, occurring in the coastal waters of the MHI throughout the year (Seminoff et al. 2015). The diet of green sea turtles differs between life stages (Bjorndal and Bolten 1988). Pelagic hatchlings' and juveniles' diets include mollusks, jellyfish, sponges, sea pens, and crustaceans (Hatase et al. 2006; Seminoff et al. 2015). Their diet shifts to feeding on seagrasses and macroalgae as they grow to adults and move closer to shore. Based on the behavior of post-hatchling and juvenile green turtles raised in captivity, it is presumed that those in pelagic habitats live and feed within 10 ft (3 m) of the surface (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998). Sub-adults routinely dive to 66 ft (20 m) (Lutcavage and Lutz 1997). The green sea turtle is the only species of sea turtle that, as an adult, primarily consumes vegetation (Mortimer 1995; Nagaoka et al. 2012). Adults tend to be associated with shallow waters with abundant submerged aquatic vegetation close to reefs or rocky areas (Holloway-Adkins 2006; Seminoff et al. 2015; Seminoff et al. 2002). Because the proposed action area would have limited or no submerged aquatic vegetation present, adult green sea turtles would be expected to merely be transiting through the proposed action area, not foraging.

The one unit of proposed critical habitat that overlaps with the proposed action area is HI06: O‘ahu, which is designated around the island of O‘ahu from the mean high water line to 66 ft (20 m) depth. NMFS identified four features that are essential to the conservation of least one DPS for the proposed critical habitat, although only two of these essential features would be applicable for the HI06: O‘ahu unit and are described below:

1. Reproductive. From the mean high water line to 66 ft (20 m) depth, sufficiently dark and unobstructed nearshore waters adjacent to nesting beaches designated

as critical habitat by the United States Fish and Wildlife Service (USFWS), to allow for the transit, mating, and internesting of reproductive individuals and the transit of post-hatchlings.

2. Benthic foraging/resting. From the mean high water line to 66 ft (20 m) depth, underwater refugia and food resources (i.e., seagrasses, macroalgae, and/or invertebrates) of sufficient condition, distribution, diversity, abundance, and density necessary to support survival, development, growth, and/or reproduction.

The hawksbill sea turtle (*Eretmochelys imbricata*) is listed as endangered under the ESA (35 FR 8490; June 2, 1970). Critical habitat has been designated, but does not overlap with the proposed action area (63 FR 46693; September 2, 1998). While hawksbill sea turtles are known to occasionally migrate long distances in the open ocean, they are primarily found in coastal habitats and use nearshore areas more exclusively than other sea turtles. Hatchlings are believed to occupy the oceanic zone where water depths are greater than 656 ft (200 m) (Avens et al. 2021), so this life stage would not occur within the proposed action area. Juveniles leave the open-ocean habitat after three to four years and settle in coastal foraging areas (Mortimer and Donnelly 2008), so juveniles and adults would be the life stage that is expected to occur within the proposed action area. Hawksbill sea turtles are the second most common species in the offshore waters of the Hawaiian Islands, yet they are far less abundant than green sea turtles (Chaloupka et al. 2008). Hawksbill juveniles forage on sponges, sea squirts, algae, mollusks, crustaceans, jellyfish, and other invertebrates (Bjorndal 1997). Older juveniles and adults are more specialized, feeding primarily on sponges (Meylan 1988; Witzell 1983).

Marine Mammals

Jurisdiction over marine mammals is maintained by NMFS and the USFWS. NMFS maintains jurisdiction over whales, dolphins, porpoises, seals, and sea lions. USFWS maintains jurisdiction over certain other marine mammal species, including walruses, polar bears, dugongs, sea otters, and manatees. No USFWS marine mammal species would be expected to occur within the proposed action area. All marine mammals are protected under the MMPA, and some are additionally protected under the ESA.

Marine mammal species likelihood of occurrence in the proposed action area is designated as “likely” (regular year-round or seasonal occurrence), “potential” (short seasonal presence or occurs in region in low numbers), or “rare” (known only from occasional sightings or strandings in the region) based on NMFS stock assessment reports and species-specific literature research. Basic distribution information is provided for each species within Table .

Table 3-7 Marine Mammals that May Occur within the Proposed Action Area

Common Name (Scientific Name)	NMFS Recognized Stock	Occurrence
Suborder Mysticeti (baleen whales)		
Family Balaenopteridae (rorquals)		
Minke whale *(Balaenoptera acutorostrata)*	Hawaiʻi	Rare; individuals occur seasonally around the Hawaiian Islands (Barlow 2003; Rankin and J. Barlow 2005) and have been acoustically detected around the islands (NOAA Fisheries 2021); unlikely to occur within the shallower waters of the proposed action area
Humpback whale *(Megaptera novaeangliae)*	Hawaiʻi	Potential; humpback whales winter in Hawaiʻi, but they would be unlikely to occur within the shallower waters of the proposed action area
Family Delphinidae (dolphins)		
Pygmy killer whale *(Feresa attenuate)*	Hawaiʻi	Rare; known to occur within the U.S. EEZ off Hawaiʻi, although rarely; individuals appear to be resident in Oʻahu (Baird 2016; Pryor et al. 1965);
Short-finned pilot whale *(Globicephala macrorhynchus)*	Hawaiʻi	Potential; summer/fall shipboard surveys of the waters within the U.S. EEZ of the Hawaiian Islands (Barlow 2003; Bradford et al. 2017; Yano et al. 2018); some sightings reported individuals foraging off of Oʻahu (Baird et al. 2013)
Killer whale (*Orcinus orca*)	Hawaiʻi	Rare; known to occur within the U.S. EEZ off Hawaiʻi
Melon-headed whale *(Peponocephala electra)*	Hawaiʻi	Rare; known to occur within the U.S. EEZ off Hawaiʻi; species is more likely to occur farther offshore than the proposed action area
False killer whale[1] *(Pseudorca crassidens)*	Main Hawaiian Islands Insular[1]	Potential; occur in nearshore waters throughout the Hawaiian archipelago (Baird et al. 2013), but prefer waters deeper than 3,300 ft (1,000 m) (National Marine Fisheries Service 2022)
Pantropical spotted dolphin *(Stenella attenuata)*	Hawaiʻi	Potential; known to occur in nearshore waters of Oʻahu
Common bottlenose dolphin *(Tursiops truncatus truncatus)*	Hawaiian Islands Stock Complex	Likely; commonly found in shallow inshore waters and deep waters of the Hawaiian Islands, including Oʻahu
Family Ziphiidae (beaked whales)		
Blainville's beaked whale *(Mesoplodon densirostris)*	Hawaiʻi	Potential; commonly present off the Waianae Coast of Oʻahu for prolonged periods annually (Shallenberger 1981); have been observed in nearshore waters of Oʻahu, although not as shallow as the proposed action area
Order Carnivora, Family Phocidae (seals)		
Hawaiian monk seal *(Neomonachus schauinslandi)*	Hawaiʻi[1]	Likely; could occur in the proposed action area year-round and critical habitat for this species overlaps the proposed action area; however, it is not expected on the shore/terrestrial portion of the proposed action area due to the rocky conditions of the shoreline habitat. This area of shoreline is not known or identified as a pupping location for Hawai'ian monk seals.

Sources: (Carretta et al. 2021; Hayes et al. 2020; Hayes et al. 2022; Jefferson et al. 2014; Marine Corps 2023; National Oceanic and Atmospheric Administration 2022; Reeves et al. 2002)

[1] Species/stock listed as endangered under the ESA

The two ESA-listed marine mammals that may occur within the proposed action area are the false killer whale (*Pseudorca crassidens*) and the Hawaiian monk seal (*Neomonachus schauinslandi*).

The MHI Insular False Killer Whale DPS is the only false killer whale DPS that would be expected to occur within the proposed action area. This DPS is listed as endangered under the ESA (77 FR 70915; November 28, 2012) and depleted under the MMPA. NMFS designated critical habitat for this DPS in waters from 148 to 10,499 ft (45 to 3,200 m) in depth surrounding the MHI (83 FR 35062; August 23, 2018). Due to the shallow depth of the proposed action area, false killer whale critical habitat does not overlap with the proposed action area. Individuals that are part of the MHI insular DPS move widely among the islands, inhabiting waters up to 75 mi (120 km) from shore (Baird 2016), in shallow (less than 164 ft [50 m]) (Baird et al. 2010) to very deep (greater than 13,000 ft [4,000 m]) water (Baird et al. 2010; Baird et al. 2011; Oleson et al. 2010), although they prefer waters deeper than 3,300 ft (1,000 m) (National Marine Fisheries Service 2022). It is possible, but unlikely, that an individual of this DPS may occur in the proposed action area.

The Hawaiian monk seal is listed as endangered under the ESA (41 FR 51611; November 23, 1976). Critical habitat was designated in six areas in the MHI that contain one or a combination of habitat types: preferred pupping and nursing areas, significant haul-out areas, and/or marine foraging areas (80 FR 50926; September 21, 2015).

Monk seals are benthic foragers, feeding on fish, cephalopods, and crustaceans. Adults are typically nocturnal hunters, foraging in waters 3 to 1,640 ft (1 to 500 m) in depth (National Marine Fisheries Service 2007, 2014; Parrish and Littnan 2007). The inner reef waters next to the islands are critical to weaned pups learning to feed (Gilmartin and Forcada 2009). Feeding has been observed in reef caves, and monk seals feed on fish hiding among coral formations (Parrish et al. 2000; Parrish et al. 2008). When foraging, Hawaiian monk seals spend most of their time in nearshore, shallow marine habitats but can rapidly cover large areas (e.g., hundreds of miles in a few days) in search of food (D'Amico 2013; Littnan 2011; Stewart et al. 2006; Wilson et al. 2012).

Hawaiian monk seal critical habitat was revised in 2015 (80 FR 50925; August 21, 2015) to include specific areas and physical or biological features considered essential to monk seal conservation. The specific areas include six sites around the MHI out to the 656 ft (200 m) depth contour, including the seafloor and all subsurface waters, and marine habitat within 33 ft (10 m) of the seafloor. The final rule identified two terrestrial (number one and three below) and one marine (number two below) essential features:

1. Terrestrial areas and adjacent shallow, sheltered aquatic areas with characteristics preferred by monk seals for pupping and nursing
2. Marine areas from 0 to 646 ft (0 to 200 m) in depth that support adequate prey quality and quantity for juvenile and adult monk seal foraging
3. Significant areas used by monk seals for hauling out, resting, or molting

In this assessment, NMFS also identified major categories of activities with potential to threaten essential features and included the following: (1) in-water and coastal construction (including development); (2) dredging (including disposal of dredged materials); (3) energy development (including renewable energy projects); (4) activities that generate water pollution; (5) aquaculture (including mariculture); (6) fisheries; (7) environmental response activities (including oil spills, spills of other substances, vessel groundings, and marine debris clean-up activities; and (8) military activities. The potential for impact of critical habitat depends upon the location, essential features present, and scope of the specific activity.

Since the Proposed Action does not occur on land, only the second essential feature will be considered in this analysis.

Hearing Ranges for Biological Resources

Hearing ranges for biological resource groups that overlap the proposed action area are included in Table below.

Table 3-8. Hearing Ranges for Biological Resources

Biological Resource Group	Frequency
Invertebrates[1]	Largely unknown, can detect particle motion, some species may be able to hear low-frequency sounds less than 1 kHz
Birds[2]	In-air: 1-5 kHz Underwater: 1-4 kHz
Fish[3]	40 Hz – above 4 kHz
Sea Turtles[4]	In-air: 50-800 Hz Underwater: 50 Hz – 1.6 kHz
Marine Mammals[4, 5]	Mysticete: 30 Hz – 30 kHz (best hearing) Odontocete: 150 Hz – 160 kHz Hawaiian monk seal: 0.2 – 33 kHz (best hearing)

[1] (Hawkins and Popper 2017; Mooney et al. 2010; Popper and Hawkins 2018)
[2] (Crowell et al. 2015; Hansen et al. 2017; Johansen et al. 2016; Larsen et al. 2020; McGrew et al. 2022; Therrien 2014; Therrien et al. 2012)
[3] (Casper and Mann 2009; Mickle and Higgs 2022; Mickle et al. 2020; Myrberg 2001; Popper 2003; Popper 2005; Popper 2008; Popper 2014; Popper and Fay 2011; Slabbekoorn et al. 2010)
[4] (Bartol and Ketten 2006a; Bartol and Ketten 2006b; Eckert et al. 2012; Harms et al. 2014; Ketten and Bartol 2006; Lavender et al. 2014; Martin et al. 2012; Piniak et al. 2016; Ridgway et al. 1969)
[5] (Sills et al. 2021; Southall et al. 2007; Southall et al. 2019)

Socioeconomic Resources

This section discusses socioeconomic resources (e.g., population demographics, economic activity, and other data providing key insights into socioeconomic conditions) that might be affected by the Proposed Action. Socioeconomic data shown in this section are presented to characterize baseline socioeconomic conditions in the context of regional, state, and national trends. Data have been collected from previously published documents issued by federal, state, and local agencies, and from state and national databases and other relevant sources.

Socioeconomics describes the basic attributes and resources associated with the human environment, particularly with regard to population and economic activity. Examples of economic activity typically include employment, personal income, and industrial or commercial growth. However, because the Proposed Action does not include any land-based activity, the impacts on socioeconomic resources would be limited, and unaffected resources (e.g., schools, housing, tax revenue) will not be considered further herein. This section will focus on socioeconomic resources within and near the proposed action area. The areas adjacent to the proposed action area are Campbell Industrial Park and Kalaeloa Harbor to the north.

Located in the southwestern portion of the 'Ewa *moku* (district) of Oʻahu, the Kalaeloa region has a long history of use and management. The 'Ewa *moku* was one of the original districts of the Hawaii, ruled by chiefs throughout the history of the island, and served as the political center of Oʻahu several centuries ago (Hawai'i 2018). After purchasing large portions of the region in the 19th century, the industrialist James Campbell used the 'Ewa plain as a sugar plantation for nearly a century. In 1958, the coastal portion of the Campbell estate was developed into the Campbell Industrial Park (Kapolei Properties 2018). In 1985, Barbers Point Deep Draft Harbor (Kalaeloa Harbor) was constructed, expanding the existing barge basin constructed by the Campbell estate in 1961; the Kalaeloa Harbor was again expanded in 1999 to better accommodate shipment and transshipment of bulk industrial goods (U.S. Army Corps 2025).

Over the past 75 years, the industrial park and harbor have expanded in size and use, resulting in new construction and other efforts such as dredging. This development has resulted in much of the local area being composed of industrial and commercial operations (Kappel et al. 2017b). This has led to pollution including, for instance, heavy metal contamination of the industrial park's soils (Gomes 2010; Hollier 2011), as well as incidents such as two large ship groundings just outside Kalaeloa Harbor, damaging local corals (NOAA 2025a). Coastal habitat modification, such as new construction near the shore or hardened structures, has also occurred with the expansion and development of the industrial park adjacent to the proposed action area (Kappel et al. 2017a). Currently, beach water quality monitoring does not occur near the proposed action area. Neither the state of Hawaii nor the Surfrider Foundation, which also conducts water quality monitoring on Oʻahu, have noted water quality advisories or other events (e.g., sewage spills) in or near the proposed action area in the past 7 years (Hawaii Department of Health 2025a; Surfrider Foundation 2024). Onshore drainage ponds associated with Par Hawaii Refining lie adjacent to the proposed action area, but are no longer in use. A stormwater overflow pipe to the south of the proposed action area is rarely used during significant storm events, and the valve is currently closed (Par Hawaii 2025). As a result, while drainage or runoff may have impacted nearshore waters in the past, particularly during storm events, there is limited information to show that pollution has historically been an issue in or near the waters of the proposed action area, and the current presence of corals suggests water quality is acceptable.

Alongside industrial development in the region, the local population has grown, primarily east of the industrial park in the city of Kapolei—a planned community developed largely on land owned by the Campbell estate. Kapolei is one of the fastest growing communities on Oʻahu, and its population has more than doubled to over 21,000 people in the past 20 years. Given its inland location, while direct effects of population growth would not be anticipated to overlap the proposed action area, indirect impacts including increasing recreational activities (e.g., fishing) may occur. Consequently, boating, fishing, and other activities may increase in and around the proposed action area in the reasonably foreseeable future, resulting in more vessel traffic in and out of Kalaeloa Harbor, in particular.

Data on the ocean economy are skewed by the fact that the proposed action area lies within Honolulu County, the state's largest economic entity. The county's marine economic activity is dominated by tourism and recreation, with marine transportation, shipbuilding, and marine construction the next three most important activities. These latter sectors comprised nearly 10,000 jobs and $1 billion in local gross domestic product in 2021, a significant portion of which was generated in and around Campbell Industrial Park (in comparison, tourism and recreation comprised over 50,000 jobs and $4 billion in gross domestic product within the county) (NOAA 2025b). A recent business news article, for instance, noted that more than 200 businesses operate in Campbell Industrial Park, including all of Hawaii's oil refining, 40 percent of the island's electricity generation, and the majority of its waste management (Genegabus 2024). Other operations include paving, recycling, chemical reclamation, auto repair, construction, food product, and warehousing businesses.

While the Campbell Industrial Park and Kalaeloa Harbor have expanded significantly over the past half century, the industrial park now operates at limited vacancy (0.46 percent at the end of 2023) and space for further development is extremely limited (Colliers 2024). Consequently, although businesses and operations may change within the park in the reasonably foreseeable future, it is unlikely that significant expansion of park operations would be able to occur. As such, actions related to coastal development, shoreline habitat modification and management, or risks of pollution and contamination would be expected to continue at levels similar to recent decades, or be reduced as, for example, state and federal management agencies initiate stricter pollution control, prevention, and cleanup programs (see, e.g., Hawaii's Hazard Evaluation and Emergency Response Office, which identifies multiple pollution sites adjacent to the proposed action area (Hawaii Department of Health 2025b).

Kalaeloa Harbor includes Barbers Point Deep Draft Harbor and Malakole Harbor, which contains Ko Olina Marina. The former receives all bulk items such as fuel oil, coal, lumber, and gravel that are shipped to Hawaii; these materials are then transshipped from Barbers Point Harbor to neighboring islands (U.S. Army Corps 2025). The latter, Malakole Harbor, is used for recreational vessels, including private and charter fishing boats and yachts. Southeast of the proposed action area, Kalaeloa Airport and the adjacent U.S. Coast Guard Air Station Barbers Point are located within the Kalaeloa census designated place along the southern shore of Oʻahu, while Barbers Point lighthouse and its associated beach park are located at the southwest corner of Oʻahu.

While a variety of commercial and industrial activities occur onshore, few are present in waters in or near the proposed action area, with limited exceptions such as two anchorage areas just to the south. No undersea transmission cables, sewer lines, or dumping grounds are near the proposed action area (PacIOOS 2025a). Furthermore, although a public access point is located south of the proposed action area onshore, the beach adjacent to the area is rocky and has limited access. As a result, few people use the beach and waters in and around the proposed action area for recreational activities like shore fishing, swimming, snorkeling, or surfing. A surf break has historically existed nearby the proposed action area (Clark 2002), however limited access and the presence of other popular breaks north and south of the proposed action area (e.g., near Barbers Point Lighthouse or north of Kalaeloa Harbor) mean its current use by surfers, if any, is extremely limited.

Commercial, recreational, and subsistence fishing occur off the coast of Oʻahu and, given its proximity to Kalaeloa Harbor, may occur in or near the proposed action area. Recreational fishing is part of the tourism and recreation sector, described above, while commercial fishing is included within the county's living resources sector, which generated 386 jobs and $91 million in 2021 (NOAA 2025b). The leeward (west) coast of Oʻahu is a popular fishing destination for deep water species such as marlins and tunas, and fishing charters run out of Ko Olina marina. While these charters would not fish near the proposed action area, nearshore fishing also occurs on Oʻahu for species such as jacks, snappers, and lobsters. The southern coast is the more popular destination, but as charters also run out of Ko Olina, nearshore charter and recreational fishing may occur near the proposed action area. Hook and line, spear fishing, and lobster diving have been observed in and near the proposed action area for recreational and subsistence purposes. Commercial fishing occurs within southwest Oʻahu coastal waters; however, catches are limited compared to waters north and southeast of the proposed action area (PacIOOS 2025b), and have not been observed in or near the proposed action area.

Other socioeconomic activities, including recreational activities like windsurfing, kiteboarding, or paddling, are unlikely to occur in or near the proposed action area given its rocky shoreline and undesirable access. Scientific research and management activities occur coastwide on Oʻahu for purposes including fish and water quality monitoring, and, consequently, may occur in or near the proposed action area. These activities are carried out by state agencies, universities, and other entities. For example, Hawaiian Electric Company conducts ecological monitoring in the waters near the Campbell Industrial Park to monitor changes in biological communities due to power generation (Rodgers et al. 2024). Three of the long-term monitoring stations are located close to the proposed action area and are used to conduct annual coral and fish transect surveys.

Because the shoreline next to the proposed action area borders Campbell Industrial Park, recreational activities on the beach and in the water are limited. Furthermore, the beach and nearshore bottom are rocky and difficult to access. A surf break exists near the proposed action area, and was apparently historically used; however, little information exists on current use. Other nearby surf breaks north and south of the harbor and industrial park, respectively, are more popular with surfers. Fishing, including both recreational and commercial activities, has historically taken place in and around the proposed action area, although locations further offshore and along the southern coast of Oʻahu are more productive and popular. Fisheries management and other management activities are generally carried out by state and federal agencies. For example, the proposed action area falls within coral conservation or dolphin monitoring management areas for NOAA. Marine scientific research conducted near the proposed action area has been carried out by state and federal agencies and others, such as Hawaiian Electric, which monitors the impacts of power generation at Campbell Industrial Park on nearshore reef fishes (Rodgers et al. 2024). In part because of its proximity to Joint Base Pearl Harbor-Hickam (JBPHH), located southeast of the proposed action area on Oʻahu's southern coast, military activities have occurred near the proposed action area; however, overlap with the proposed action area rarely, if ever, has occurred, as these activities are typically carried out further offshore or at JBPHH.

Cultural Resources

This section discusses cultural resources (e.g., archaeological resources, cultural items, and other properties of cultural significance) that might be affected by the Proposed Action. The Cultural Resource Assessment for the Proposed Action is found in Appendix D.

Cultural resources are governed by federal laws and executive orders: the Archeological and Historic Preservation Act (Public Law 93-291; incorporated into 54 U.S.C. §§ 312501 *et seq.*), American Indian Religious Freedom Act (42 U.S.C. § 1996), Archaeological Resources Protection Act of 1979 (16 U.S.C. §§ 470aa *et seq.*), Executive Order 13007, Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. §§ 3001 *et seq.*), and Section 106 of the NHPA (54 U.S.C. §§ 300101 *et seq.*).

Articles IX and XII of the State Constitution, other state laws, and the courts of the state require government agencies to protect and preserve cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups. To assist decision makers in the protection of cultural resources, Chapter 343, HRS and Hawaiʻi Administrative Rules (HAR) § 11-200 dictate that the environmental impact assessment process requires project proponents to assess proposed actions for their potential impacts to cultural properties, practices, and beliefs.

This process was clarified by the Act 50, Session Laws of Hawaiʻi (SLH) 2000. Act 50 recognized the importance of protecting Native Hawaiian cultural resources and required some environmental review documents include the disclosure of the effects of a proposed action on the cultural practices of the community, state, and the Native Hawaiian community.

Specifically, the Environmental Council suggested the CIAs should include information relating to practices and beliefs of a particular cultural or ethnic group or groups. Such information may be obtained through public scoping, community meetings, ethnographic interviews, and oral histories. It is important to note that while similar in their areas of studies, archaeological surveys and CIAs are concerned with distinct and different foci. Archaeological studies are primarily concerned with historic properties and tangible heritage, whereas CIAs look at cultural practices and beliefs, which can be associated with a specific location, but also often are intangible in nature.

The State and its agencies have an affirmative obligation to preserve and protect Native Hawaiians' customarily and traditionally exercised rights to the extent feasible.[1] State law further recognizes that the cultural landscapes provide living and valuable cultural resources where Native Hawaiians have and continue to exercise traditional and customary practices, including hunting, fishing, gathering, and religious practices. In *Ka Paʻakai*, the Hawaiʻi Supreme Court provided government agencies with an analytical framework to ensure the protection and preservation of traditional and customary Native Hawaiian rights while reasonably accommodating competing private development interests. This is accomplished through:

1) The identification 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 to reasonably protect Native Hawaiian rights if they are found to exist.

The relevant information about the ahupuaʻa of Honouliuli has been gathered, focusing on areas near or next to the project site. A detailed analysis of this project and its possible effects on cultural resources, historical resources, and archaeological sites is included in the Cultural Resource Assessment (CRA) found in Appendix D that provides an overview of cultural and historic resources in the project area through thorough literature review, consultation with community members and cultural practitioners, and high-level, project-specific surveys. The CRA emphasizes identifying areas where disturbance should be avoided or minimized to reduce impacts on historic properties or culturally important features. The primary goal is to prevent impacts by avoiding sensitive areas and only mitigating impacts if avoidance is not feasible.

Kalaeloa, located in the district of ʻEwa and the ahupuaʻa Honouliuli is rich with tradition in native Hawaiian history and stories recounting the importance of coastal resources. Many moʻolelo refer to the region of Kalaeloa as a landmark for travelers approaching the southern coast of Oʻahu and as a launching point for travel to other islands (Sterling 1978). Often these stories describe the abundance of marine resources along the coast. One such story tells of Hiʻiaka (youngest sister of Pele) traveling to and from the island of Kauai. She gives her traveling companions the advice to use Kalaeloa, the tip of Oʻahu that juts out into the sea, as a landmark. This would be used as a reference to find their way to ʻEwa and on to Puʻuloa where

[1] Article XII, Section 7 of the Hawaiʻi State Constitution, *Ka Paʻakai O Ka ʻĀina v. Land Use Commission*, 94 Haw. 31 [2000] (*Ka Paʻakai*), Act 50 SLH 2000.

they would find women gathering pāpaʻi (crabs), limu (seaweed), and mahamoe—edible bivalves (Emerson 1915).

Community members and cultural practitioners also provided place-based knowledge regarding the coastal resources of Kalaeloa. Observations regarding the seasonal presence and movement patterns of ʻamaʻama (mullet) in the nearshore waters were provided by Damon Duhaylonsod, Poʻo Lawaiʻa of Hoʻola Haniʻo, who shared this ʻike based on personal experience and knowledge passed down through his ʻohana. These observations informed the discussion of cultural concerns related to ʻamaʻama within the project area and are reflective of the continued practice and transmission of traditional ecological knowledge (Appendix D and I).

Known cultural sites (current and historical) near the proposed action area are limited (Figure 3-1 and Figure 3-2). The closest known cultural resources are three precontact sites approximately 700 yards north of the proposed action area on the coast: beach midden site (SIHP ID: 50-80-12-02722) and two subsurface cultural deposits (SIHP ID: 50-80-12-04526). None of these sites are expected to be impacted by activities at the proposed action area. Preliminary in-water surveys of the proposed deployment location have revealed no archaeological sites or artifacts present in the proposed action area.

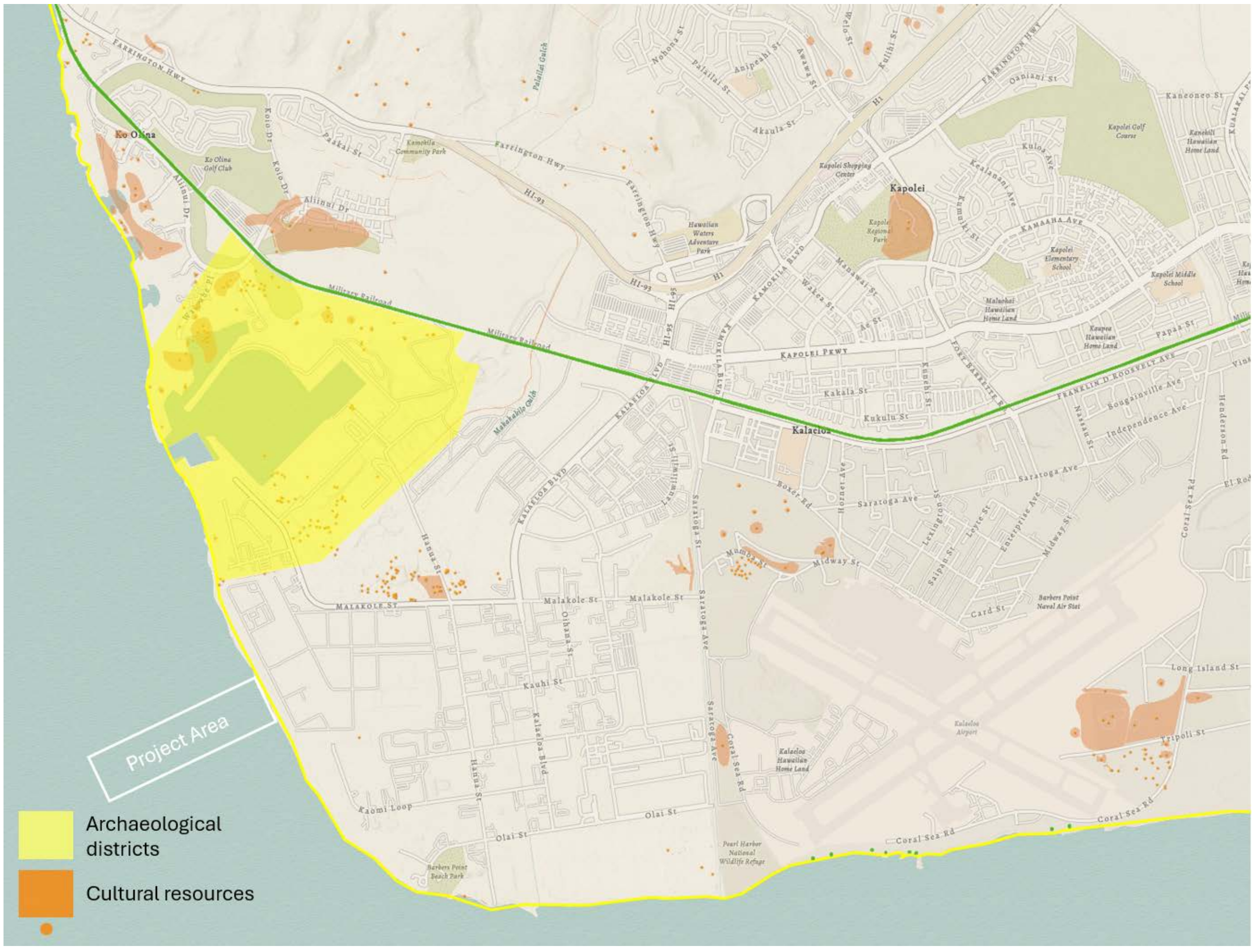

Figure 3-1. Archaeological districts in Honouliuli with project site overlaid (adapted from (Wahl 2021)).

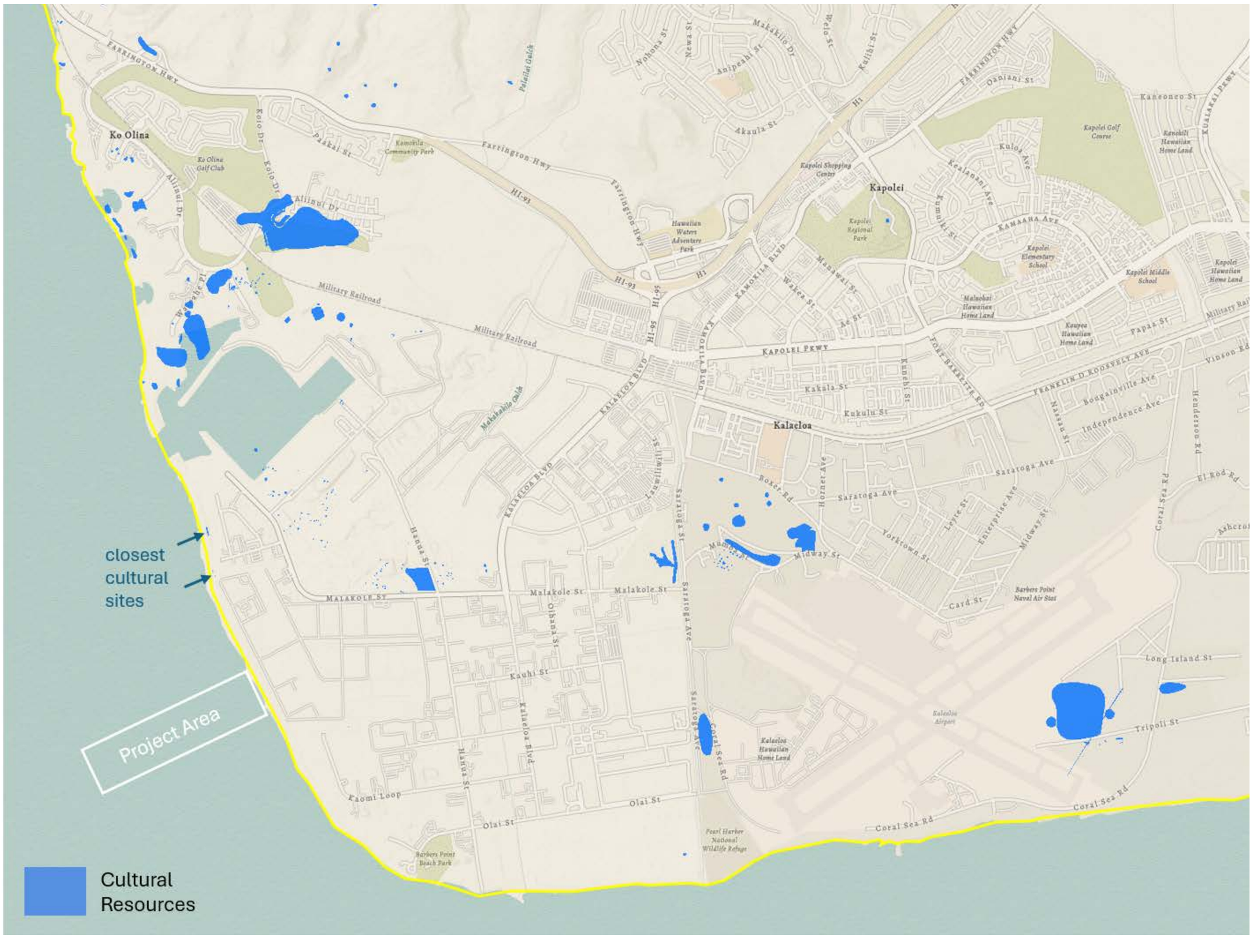

Figure 3-2. Traditional Hawaiian sites in Honouliuli with project site overlaid (adapted from (Wahl 2021)). Closest cultural resources denoted with arrows.

4. Environmental Consequences

This chapter presents an analysis of the potential direct and indirect effects of the Action Alternative and the No Action Alternative on the affected environment (Chapter 0). The approach to the analysis in this EA included the following general steps:

(1) Identification of potential stressors associated with the deployment/installation of the hybrid reef; and

(2) Analysis of the potential impact of these stressors on each resource, including the following:

(a) Examination of the temporal nature, spatial extent, and intensity of the stressors;

(b) Examination of the potential for stressors to alter the function or habitat provided by the physical resource or for stressors to result in population-level impacts to the biological resource; and

(c) Consideration of Standard Operating Procedures (SOPs) and protective measures to reduce potential impacts (Chapter 0).

HEPA Significance Criteria

The proposed action is a self-healing hybrid reef that can attenuate wave energy more effectively than traditional hardscape solutions to protect infrastructure and people by mitigating damage related to coastal flooding, erosion, and storm surge. The proposed action is not expected to have a significant impact on or more of the following:

1. Irrevocably commit a natural, cultural, or historic resource. No

2. Curtail the range of beneficial uses of the environment. No

3. Conflict with the State's environmental policies or long-term environmental goals established by law. No – project aligns with climate adaptation objectives.

4. Have a substantial adverse effect on the economic welfare, social welfare, or cultural practices of the community or State. No – See Appendix D – Cultural Resource Assessment.

5. Have a substantial adverse effect on public health. – No

6. Involve adverse secondary impacts, such as population changes or effects on public facilities. No – impacts minor and localized.

7. Involve a substantial degradation of environmental quality. No – limited footprint.

8. Be individually limited but cumulatively have substantial adverse effect upon the environment or involve a commitment for larger actions. No – low baseline habitat complexity documented.

9. Have a substantial adverse effect on a rare, threatened, or endangered species, or its habitat. No – NMFS concurred that the proposed action is not likely to adversely affect the ESA-listed species and designated and proposed critical habitats.

10. Have a substantial adverse effect on air or water quality or ambient noise levels. No

11. Have a substantial adverse effect on or be likely to suffer damage by being located in an environmentally sensitive area (such as flood plain, tsunami zone, sea-level rise exposure area, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters). No

12. Have a substantial adverse effect on scenic vistas and view planes (day or night) identified in county or state plans or studies. No proposed action is underwater.

13. Require substantial energy consumption or emit substantial greenhouse gases. No

After considering the context and intensity of potential impacts and evaluating the Proposed Action against the HEPA significance criteria, the Hawaiʻi Department of Transportation concludes that the Kalaeloa Hybrid Reef Project will not have a significant environmental impact. Potential effects are minor, temporary, or adequately avoided and minimized through project design, best management practices, monitoring, and compliance with applicable permits. Accordingly, a Finding of No Significant Impact (FONSI) is issued, and preparation of an Environmental Impact Statement is not required.

Potential Stressors Dismissed from Further Analysis

Stressors considered but not analyzed are detailed in Table 4-1.

Table 4-1 Stressors Dismissed from Analysis

Resource	Reason for Dismissal
Hazardous/foreign materials	Ocean chemistry would not be impacted by the following: hybrid reef and monitoring equipment made of concrete reinforced with glass fiber or steel/basalt rebar, leaching of materials (low rate of emissions and rapid dispersal in the ocean), algae prevention solutions (Appendix A) that may be used on mesoscale structures (naturally occurring and biodegradable), batteries (as they are fully encased and checked or replaced during monitoring).
Diver/snorkeler disturbance	SOPs and protective measures (Chapter 0) prevent harassment to marine species from divers or snorkelers
Entanglement	Minimal risk of entanglement from lines associated with hybrid reef. All lines from/associated the hybrid reef and anchoring of the vessels would be taut with no excess slack. SOPs for ensuring proper anchorage and mooring of vessels would be employed (Chapter 0). Monitoring would ensure there is no indirect entanglement. Fishing line, nets, and marine debris would be removed during monitoring events to prevent entanglement of marine species.

Any impact associated with these stressors on the physical, biological, socioeconomic or cultural resources within the proposed action area would be minimal and of short duration. None of these stressors would have more than a negligible impact on any resource, so they will not be considered further herein.

Additionally, potential sediment disturbance and turbidity associated with deployment and installation of the RMSs will not be considered in this analysis. The proposed action area is a hard bottom area with minimal soft sediment to be disturbed, and the structures would be lowered slowly to the seafloor creating negligible risk of disturbance of even small amounts of sediment.

Stressors Associated with the Proposed Action

Stressors resulting from the Proposed Action that may adversely impact the physical, biological, socioeconomic, or cultural resources within the proposed action area include the following:

- Underwater noise (vessel noise, drilling noise, acoustic enrichment),
- Vessel movement,
- RMS deployment and installation,
- Coral outplanting, and
- Light sources
- Sea Level Rise

A summary of the stressors analyzed, and the resources potentially impacted by each stressor, is presented in Table 4-2.

Table 4-2 Stressors Associated with the Proposed Action

Resources		***Underwater Noise***	***Vessel Movement***	***RMS Deployment/ Installation***	***Coral Outplanting***	***Light Sources***
Physical Resources	Benthic Habitat	n/a	n/a	x	n/a	n/a
Biological Resources	Vegetation	n/a	n/a	x	n/a	n/a
	Invertebrates	x	x	x	x	x
	Birds	x	x	n/a	n/a	n/a
	Fish	x	x	x	n/a	x
	EFH	n/a	n/a	x	n/a	n/a
	Sea Turtles	x	x	x	n/a	x
	Marine Mammals	x	x	x	n/a	x
Socioeconomic and Cultural Resources		n/a	x	x	n/a	x

No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur. No deployment of hybrid reef would occur, and the area would be left undeveloped unless/until other in-water construction is proposed as part of a future project. The No Action Alternative would result in no impacts to physical, biological, socioeconomic, or cultural resources in the immediate future. However, the No Action Alternative would not meet the purpose of and need for the Proposed Action. The analysis below focuses on the stressors associated with the action alternative.

Underwater Noise

Potential underwater noise associated with the Proposed Action would include vessel noise, underwater tool noise, and acoustic enrichment.

During the Proposed Action, vessel noise would be generated from the vessels used to deploy and install RMSs and conduct monitoring surveys. It is expected that the vessels would generate noise at a frequency between 1 and 7 kHz (Richardson et al. 1995). DARPA assumes an approximate level of 175 dB re 1 µPa at 1 m at the source for all vessels (Miles et al. 1987; Richardson et al. 1995). Vessel noise would cover a wide bandwidth but would be loudest in low frequencies, similar to other ocean-going vessels.

Although vessels used for deployment and installation may be present within the proposed action area over several months, they would not be continuously present. Rather, the vessels would be present within the proposed action area for several consecutive days to deploy or monitor the structures, as time allows. While present, the vessels may operate up to 12 hours per day, but they would only remain in a single area long enough to install or monitor the RMSs at that location. Therefore, exposure to vessel noise would be intermittent for animals within the proposed action area.

Another source of underwater noise would be underwater drills used during RMS installation. Anchoring and supplementary ballast would be required to ensure the RMSs stay in place on the seafloor. The anchor bars would either be installed by divers with a handheld drill or with a ROV drilling rig. Four to five anchor bars would be required per RMS. A maximum of 340 anchor bars may be required; however, one anchor bar would be installed at a time and would take approximately one hour. Noise from underwater drilling would be intermittent and punctuated, rather than constant, for that duration. The frequency range of hydraulic drills similar to those that would likely be used in the Proposed Action have been measured from 10 Hz to 40 kHz (Department of the Navy 2003; John J. McMullen Associates 1984). Studies determined SPLs of underwater tools similar to those that would be used during the Proposed Action measured 159–161 dB re 1 µPa at 1 m from the source (Anthony et al. 2009; Nedwell et al. 2004). Based on these reports, DARPA assumes an approximate level of 161 dB re 1 µPa at the source for the hand drills used in the Proposed Action.

As discussed in Section 2.4.2.4 acoustic enrichment devices would be used to play back the sounds of a healthy, active reef environment in order to attract and recruit fish larvae and juvenile fish to the proposed action area. Recordings would be obtained from a productive, adjacent reef in the Kalaeloa region with higher densities of similar species composition than the proposed action area. Sound levels would be played back with a 10 dB higher level than recorded to be detectable above ambient levels out to 66 ft (20 m) range from the speaker. Frequencies below 20 Hz and above 20 kHz are removed before playback. The sound emitted would drop to ambient noise levels before extending beyond the proposed action area. The speakers may play continuously for up to 12 hours, primarily during evening and night hours. The broadband acoustic output of the speaker is estimated to be 120 dB re 1 µPa at 1 m (root mean square) between 1 and 20 kHz.

Although acoustic enrichment would be audible above ambient noise within the proposed action area, the playback is of natural sounds of local reef communities. No anthropogenic sounds would be anticipated. Additionally, the acoustic enrichment is designed to attract fish and encourage larval recruitment, promoting faster reef development and overall positive benefits. No adverse impacts would be anticipated from acoustic enrichment.

Marine species within the proposed action area may be exposed to underwater noise if they occur within the vicinity of a support vessel as it transits through the proposed action area or where a structure is being installed. However, since the Proposed Action only includes support vessels traveling at relatively low speeds (maximum of five knots) and use of tools for brief periods of time, only physiological or behavioral responses would be expected (i.e., no physical injury or hearing threshold shift). Therefore, only behavioral and physiological responses to marine species will be discussed in the subsections below.

The behavioral response of a marine species to an anthropogenic sound depends on the frequency, duration, temporal pattern, and amplitude of the sound, as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). Common behavioral responses include an alert, avoidance, or other behavioral reaction (NRC 2005; Williams et al. 2015). Some marine species may have habituated to regular vessel noise in the area and may, therefore, have reduced reactions.

If a sound is detected (i.e., heard or sensed) by an animal, a stress response can occur. The generalized stress response is characterized by a release of hormones (Reeder and Kramer 2005) and other chemicals (e.g., reactive oxygen species and other free radicals) (Henderson et al. 2006). A physiological response may contribute to an animal's decision to alter its behavior. Marine animals may exhibit short-term behavioral reactions, such as alertness, startle, avoidance, or cessation of feeding, resting, or social interaction (Fleuren et al. 2018 ; Richardson et al. 1995). A common response is to leave the vicinity of a sound if that option is available to the individual, which would be the case for the Proposed Action.

In general, vessel noise and underwater tool noise would be short-term, and thus, any disturbance would be temporary during the short period of time that a structure is being installed. Analysis of the potential for underwater noise associated with the Proposed Action to impact invertebrates, birds, fish, sea turtles, and marine mammals are analyzed in the subsections below.

Invertebrates

Hearing capabilities of invertebrates are largely unknown (Hawkins and Popper 2017). However, research has suggested that the major cephalopod and decapod species perceive sounds below 1 kHz (Hawkins and Popper 2017; Mooney et al. 2010), which would include broadband sounds produced by vessels and underwater drills. Therefore, invertebrates within the proposed action area would likely perceive underwater noise generated by the support vessels and underwater tools.

Invertebrates within close proximity to a support vessel or drilling work could experience physiological effects or behavioral reactions. However, most marine invertebrates are known to detect only particle motion associated with sound waves (Graduate School of Oceanography 2021), which drop off rapidly with distance, limiting the exposure to the short period when an invertebrate is very close to a support vessel or drilling work.

Behavioral effects resulting from vessel noise playback have been observed in various crustacean, cephalopod, and bivalve species and include shell closing and changes in feeding, coloration, swimming, and other movements. In addition to disruption of important processes, like feeding or seeking shelter, behavioral reactions can result in increased energy expenditure (Hudson et al. 2022). Vessel noise may contribute to masking of relevant environmental sounds, such as predator detection or communication (Staaterman et al. 2011). Overall, underwater vessel noise associated with the Proposed Action would be similar to other vessels in the area. The short-term presence of the support vessels would not substantially elevate ambient noise levels, and what elevation occurs would be limited to the short time that vessels would be present within the proposed action area.

Vessels would remain within the proposed action area only long enough to complete installation tasks (several consecutive days at a time, potentially lasting several months). Vessel presence for monitoring would be shorter than installation. Therefore, exposure of invertebrates to underwater noise would be intermittent as vessels would move to new specific installation sites and may leave the proposed action area entirely between work sessions (e.g., cessation for unfavorable weather conditions).

Acoustic enrichment would be incorporated into the hybrid reef to promote recruitment of larval fish and coral. This practice aims to promote faster reef development by increasing the population of herbivorous fishes in the area that graze on algae that compete with juvenile larvae for space on suitable hard substrate.

Although underwater noise may cause some short-term physiological or behavioral effects, any disturbance would be temporary, and any exposed invertebrates would be expected to return to normal behavior shortly after the exposure. Reactions would not be expected to disrupt behavioral patterns to a point where the behavior would be abandoned or significantly altered. No population-level impacts would be expected. A summary of potential impacts to resources can be found in Section 4.3.

Birds

Given the location of the proposed action area in the nearshore, birds that are most likely to be present and exposed to underwater noise are waterfowl, especially birds that dive underwater to forage. Birds foraging on or in the water would be able to detect sound from the vessels and underwater drilling, but they would be unlikely to detect the acoustic enrichment, as it would be played during nighttime when diving birds would not likely be foraging.

Although some seabirds (e.g., red-footed booby, wedge-tailed shearwater) may forage within the proposed action area, due to the relatively small size of the proposed action area, they could easily move to a nearby foraging ground if disturbed. Additionally, given that the shallow, nearshore proposed action area that is exposed to high wave energy, few birds would be expected to occur at or under the water's surface. Diving birds typically spend extended periods on land, so their exposure to underwater noise associated with the Proposed Action would be limited to the occasions when they would be in the water foraging during the limited periods of time when a vessel is present or underwater drilling is occurring.

Noise from the vessels or underwater drill may elicit short-term behavioral or physiological responses in exposed birds, such as an alert or startle response or temporary increase in heart rate. A behavioral response may include increased alertness, birds moving away from the area, or the disruption of feeding. Vessel noise associated with the Proposed Action would be similar to other vessels in the area, so birds within the proposed action area may be habituated to vessel noise.

Although underwater noise may cause some short-term physiological or behavioral effects, any disturbance would be temporary, and any exposed birds would be expected to return to normal behavior shortly after the exposure. Reactions would not be expected to disrupt behavioral patterns to a point where the behavior would be abandoned or significantly altered. No population-level impacts would be expected. A summary of potential impacts to resources can be found in Section 4.3.

Fish

It is believed that most fish, including the ESA-listed giant manta ray, have their best hearing sensitivity from 100 to 400 Hz (Popper 2003; Popper et al. 2014), which would include the broadband sounds produced by the support vessels and underwater drills. Underwater noise associated with the Proposed Action is unlikely to result in injury or hearing threshold shift, so the most likely impacts from underwater noise would be physiological or behavioral responses.

The use of slow vessel speeds reduces the amplitude of the vessels' sound signature, reducing the distance at which the sound would persist at levels substantially elevated above ambient noise levels. Vessel noise associated with the Proposed Action would be similar to other vessels operating in the area. Accordingly, potential responses to vessel noise would be expected to be limited because of the minimal sounds generated and the likely habituation of fish within the area to vessel noise.

Like vessel noise, underwater drilling noise may cause a behavioral or physiological reaction in fish, such as a startle response. However, the sound source would remain in one place during the installation of a single anchor bar, so disturbed fish would be expected to swim away from the sound and resume normal behavior a short distance away.

Given the short-term nature of vessel presence and underwater drilling, the Proposed Action would be unlikely to cause any significant, lasting increase in the ambient noise of the proposed action area. However, exposure to underwater noise could result in masking of biologically relevant sounds or short-term behavioral reactions, such as an alert or avoidance (NRC 2003, 2005; Williams et al. 2015). Because the distance over which most fish are expected to detect sounds is limited and because most underwater noise would be transient or intermittent (or both), most behavioral reactions and masking effects from the Proposed Action would likely be short-term, ceasing soon after the vessel passes by or the use of the underwater drill stops.

While it is unclear how giant manta rays would react to the sounds from the acoustic enrichment device, the practice is designed to attract reef fish to the hybrid reef. As such, adult reef fish and fish larvae may recruit to the hybrid reef and even remain there to utilize the structures as permanent habitat. Therefore, this type of underwater noise may result in behavioral changes to fish that are considered to be a benefit to the overall ecosystem, by adding biodiversity to the hybrid reef.

Although underwater noise from vessels and underwater drilling may cause some short-term physiological or behavioral effects, any disturbance would be temporary, and any exposed fish would be expected to return to normal behavior shortly after exposure. Reactions would not be expected to disrupt behavioral patterns to a point where the behavior would be abandoned or significantly altered. No population-level impacts would be expected. Additionally, acoustic enrichment would provide a benefit by recruiting adult and larval fish to the hybrid reef. A summary of potential impacts to resources can be found in Section 4.3.

Sea Turtles and Marine Mammals

Sea turtles and marine mammals can perceive the low frequency sound from vessels and underwater tools. More specific hearing ranges can be found in Table. The underwater tool noise would be expected to be within sea turtles' hearing range, but it would not reach the assumed behavioral thresholds for effects to sea turtles (175 dB re 1 µPa root mean square). Most marine mammals would be rare within the proposed action area, and only the common bottlenose dolphin and ESA-listed Hawaiian monk seal would be expected to occur near underwater drilling associated with the Proposed Action. Although, the likelihood of these species occurring within close proximity to drilling activities is unlikely. The visual cues of people and equipment are likely to discourage seals or dolphins from approaching the divers closely. In addition, SOPs (Chapter 0) would ensure that drilling activities would not take place if sea turtles or marine mammals are spotted by lookouts. If a marine mammal were present and undetected during tool use, reactions would be similar to those associated with vessel noise – a brief behavioral or physiological reaction. However, the sound source would remain in one place, so disturbed mammals would be expected to swim away from the sound and resume normal behavior a short distance away.

The role of underwater low-frequency hearing in sea turtles is unclear. It has been suggested that sea turtles may use acoustic signals from their environment during migration and as a cue to identify their natal beaches (Lenhardt et al. 1983). Although it is likely that sea turtles would be able to perceive the low-frequency sounds of the support vessels and underwater drills, sea turtles appear to rely on senses other than hearing for foraging and navigation. Accordingly, masking is not anticipated to be a significant concern.

Marine mammals have been recorded in several instances altering and modifying their vocalizations to compensate for the masking noise from vessels, or other similar sounds (Holt et al. 2011; Pine et al. 2021). Changes to vocal behavior and call structure may result from a need to compensate for an increase in background noise. In cetaceans, vocalization changes have been reported from exposure to anthropogenic sources, such as sonar, vessel noise, and seismic surveying.

There is little information on assessing behavioral responses of sea turtles to vessel noise. Lacking data that assesses sea turtle reactions solely to vessel noise, the American National Standards Institute Sound Exposure Guidelines (Popper et al. 2014) suggest that the relative risk of a sea turtle behaviorally responding to a continuous noise, such as vessel noise, is high when near a source (tens of meters), moderate when at an intermediate distance (hundreds of meters), and low at farther distances. While it is reasonable to assume that sea turtles may exhibit some behavioral response to vessel noise, numerous sea turtles bear wounds and scars that appear to have been caused by propeller cuts or collisions with vessel hulls (Hazel et al. 2007; Lutcavage and Lutz 1997). These injuries may have been exacerbated by a sea turtle's surfacing reaction or lack of reaction to vessels.

Most studies have reported that marine mammals react to vessel sounds and traffic with short-term interruption of feeding, resting, or social interactions (Huntington et al. 2015b; Magalhães et al. 2002; Merchant et al. 2014; Pirotta et al. 2015; Richardson et al. 1995; Williams et al. 2014). Behavioral effects may include disruption or alteration of natural activities, such as swimming, feeding, breeding, and migrating. Sea turtles or marine mammals may exhibit startle or alert reactions, disruption of current behavior, changes in respiration, alteration of swim speed or direction, diving, and area avoidance (Huntington et al. 2015a; Pirotta et al. 2015; Williams et al. 2014).

The support vessel and divers operating underwater drills would only remain in a single area long enough to install or monitor the RMSs; therefore, exposure of sea turtles and marine mammals to high-intensity underwater noise would be short-term at the proposed action area. Additionally, the support vessel would have lookouts monitoring for sea turtles and marine mammals (Chapter 0) to stop or pause activities if sea turtles or marine mammals are spotted.

Acoustic enrichment would be incorporated into the hybrid reef to attract adult and larval fish as well as encourage coral larval recruitment. This practice would promote faster reef development and create overall positive benefits to coral growth. As such, acoustic enrichment would provide an indirect benefit to sea turtles and marine mammals by enhancing their habitat by increasing biodiversity and potential prey abundance in the proposed action area.

Although underwater noise may cause some short-term physiological or behavioral effects, any disturbance would be temporary, and any exposed sea turtle or marine mammal would be expected to return to normal behavior shortly after exposure. Given the slow speed of the vessels associated with the Proposed Action (maximum of five knots) and the presence of lookouts who would halt or pause operations within 200 yd (183 m) of a marine mammal (Chapter 0), and the limited presence of most mammals within the proposed action area, underwater noise would have periodic, short-term impacts on marine mammals and sea turtles. Reactions would not be expected to disrupt behavioral patterns to a point where the behavior would be abandoned or significantly altered. No population-level impacts would be expected. Additionally, acoustic enrichment would provide an indirect benefit to sea turtles or marine mammals by enhancing their habitat. A summary of potential impacts to resources can be found in Section 4.3

Vessel Movement

As described in Section 0, the Proposed Action would involve the use of various support vessels. After installation, smaller vessels would be employed for monitoring and maintenance of the hybrid reef. All vessels would not exceed five knots within the proposed action area (Chapter 5).

The deployment of the hybrid reef would be short term in nature and would not be expected to last longer than a few consecutive days in one location, operating up to 12 hours per day while present. Any vessel would remain in a small area to support the installation of each RMS. Any impact from vessel movement would be minimal due to the low speeds and short-term presence of the vessels.

Marine species within the proposed action area may encounter the vessels if they occur near the surface of the water column as the vessels transit through the proposed action area. Vessels have the potential to strike marine resources at the surface; however, since the Proposed Action only includes vessels traveling at relatively low speeds (maximum of five knots), the risk of strike is low. Vessel movement also could elicit a behavioral response from species that encounter the vessel. Reactions to vessels often include changes in general activity (e.g., from resting or feeding to active avoidance), changes in surfacing-respiration-dive cycles, and changes in speed and direction of movement. Past experiences of the animals with vessels are important in determining the degree and type of response elicited from an animal-vessel encounter.

Analysis of the potential for vessel movement associated with the Proposed Action to impact invertebrates, birds, fish, sea turtles, marine mammals, socioeconomic resources, and cultural resources are analyzed below.

Invertebrates

Vessels have the potential to harm marine invertebrates by disturbing the water column or directly striking organisms. The only contact the support vessels may have with the seafloor would be limited anchoring, so impacts on benthic invertebrates would be extremely limited, especially because anchorages would be surveyed by diver prior to use and submerged buoys would be used when practicable. Vessel movement could affect pelagic invertebrates throughout the vessel’s presence within the proposed action area.

Most vessels have hydrodynamic hulls that allow water to flow around their hulls, so smaller organisms (e.g., pelagic invertebrates) are more likely to be disturbed rather than struck. Vessel movement may result in short-term and localized disturbances to invertebrates, such as zooplankton and cephalopods, utilizing the upper water column. Propeller wash (i.e., water displaced by propellers used for propulsion) from vessel movement can potentially disturb marine invertebrates in the water column and would be a likely cause of zooplankton mortality (Bickel et al. 2011). However, most invertebrates are broadcast spawners and experience high mortality rates under normal conditions. Any additional impacts caused by vessel movement would be considered biologically insignificant (U.S. Department of the Navy 2018), and no population-level impacts would occur since the number of organisms, eggs, and larvae exposed to vessel movements would be low relative to total biomass of the species. Similarly, anchoring of a support vessel could cause behavioral responses in mobile benthic invertebrates or crush and kill immobile benthic invertebrates. However, given the extremely small footprint that would be affected by periodic anchoring, any adverse impacts to benthic invertebrates would be immeasurably small.

Chapter 5 outlines SOPs and protective measures that describe best practices for anchoring. SOPs would require vessel anchors to be monitored to prevent dragging. Additionally, protective measures state that vessel anchor placement would not occur on any non-encrusting corals over 4 in (10 cm) in height found within the proposed action area. Provided it is safe to do so, divers (or small ROVs) would assist in the placement of the vessel anchors to avoid non-encrusting coral over 4 in (10 cm) in height, when necessary. Vessels associated with the Proposed Action would utilize the subsurface moorings as much as practicable to avoid directly anchoring on the seafloor.

Overall, vessel movement associated with the Proposed Action would be expected to have no more than a minor, short-term impact on invertebrates. No population-level effects would be expected. A summary of potential impacts to resources can be found in Section 0.

Birds

Vessels associated with the Proposed Action would have limited overlap with birds. Any impact from vessel movement would be minimal due to the slow speeds and temporary nature of the support vessel activities within the proposed action area and the limited density of birds expected within the proposed action area.

The risk for birds to be struck by vessels when they are foraging or resting on the water's surface would be extremely low given the slow speed of the vessels, the fact that most birds would be alert while on the surface, and early detection by birds who would hear the approaching vessel. The more likely impacts from vessel movement would be physiological or behavioral responses. Bird reactions to vessel movement would be the same as for vessel noise as it is unclear in most circumstances whether a bird is responding to the sound or visual presence of a vessel. Birds would be expected to move away from the vessel and quickly resume normal behavior.

Overall, vessel movement associated with the Proposed Action would be expected to have no more than a minor, short-term impact on birds. No population-level impacts would be expected. A summary of potential impacts to resources can be found in Section 0.

Fish

Vessel movement has the potential to impact fish by causing a physiological or behavioral reaction from operating near a fish or mortality or serious injury from a collision between a vessel and a fish. While vessels do not usually collide with adult fish, most of which can detect and avoid them, some species may be more susceptible than others. Vessel strike poses a risk of mortality for adult fish, as shown with previous studies of Atlantic sturgeon in the Delaware estuary (Brown and Murphy 2010). In general, vessels pose greater risks of strikes to slow-moving animals (e.g., sea turtles and marine mammals) than fish. However, the risk does depend on the size and speed of the vessels, navigational clearance (i.e., depth of water and draft of the vessel) in the area where the vessel is operating, the behavior of fish in the area (e.g., foraging, migrating), and the geographic conditions (e.g., narrow channels, restrictions) during active operation. The location of the proposed action area is in a shallow (0–50 ft [0–15 m]), nearshore area, and there are no physical barriers like narrow channels to restrict fish movement when moving away from vessels.

Fish are capable of detecting approaching objects by sound (pressure and particle motion), water movement, or vision (Becker et al. 2013; Misund 1997). The likelihood of collision between vessels and adult or juvenile fish would be extremely low because fish are highly mobile and would avoid an approaching vessel, especially one moving slowly (Becker et al. 2013; Misund 1997), such as the vessels associated with the Proposed Action (maximum speed of five knots). Due to slow vessel speeds, short-term presence of the vessels, and the highly mobile nature of fish, strike and/or injury is unlikely to occur.

In summary, vessels could strike and injure or kill a relatively small number of pelagic fish, but most fish encountering a vessel would be expected to incur only a temporary physiological or behavioral response. Temporary behavioral reactions caused by vessel movement associated with the Proposed Action would not be expected to result in significant changes to an individual fish's fitness. Population-level impacts are not anticipated. A summary of potential impacts to resources can be found in Section 4.3.

Sea Turtles and Marine Mammals

Sea turtle and marine mammal responses to vessel movement would be similar to disturbances caused by vessel noise. Reptiles need to surface to breathe, so any sea turtle present within the proposed action area has the potential to co-occur with the support vessels, creating the potential for behavioral reactions or strike. DARPA has adopted SOPs and protective measures (Chapter 0), including use of trained lookouts, to reduce the potential for collisions with surfaced sea turtles and marine mammals. These SOPs and protective measures would be implemented to avoid collision with any object within the water, maintain minimum safe maneuvering distances, and conduct visual scans of the area around the support vessel to detect marine species. The relatively slow speed (maximum of five knots) of the vessels and the presence of a lookout monitoring for sea turtles and marine mammals would make the risk of strike extremely low.

As described in Section 4.2, as a vessel approaches, a sea turtle or marine mammal could have a detectable behavioral or physiological response (e.g., swimming away or increased heart rate). Behavioral reactions to vessels often include changes in general activity (e.g., from resting or feeding to active avoidance) and changes in speed and direction of movement. Temporary behavioral reactions (e.g., temporary cessation of feeding or avoidance response) would not be expected to affect the individual fitness of a sea turtle or marine mammal, as individuals would be expected to resume normal behavior after the vessel passes through the area.

In summary, a support vessel could strike and injure a sea turtle or marine mammal, but this would be extremely unlikely to occur. The most likely impact of vessel movement on a sea turtle or marine mammal would be a temporary physiological or behavioral response. Temporary behavioral reactions caused by vessel movement would not be expected to result in significant changes to an individual's fitness. No population-level impacts are anticipated. A summary of potential impacts to resources can be found in Section 4.3.

Socioeconomic and Cultural Resources

Vessel movement associated with the Proposed Action could minimally displace other uses within the proposed action area while deployment and monitoring occur. This movement, however, is unlikely to result in more than minor effects on cultural resources. Recreational activities, such as surfing and fishing may be disturbed when the vessel is in the proposed action area. When the vessel is in the proposed action area fishing may be less effective given the likelihood of fish to leave the proposed action area during these periods (Section 4.2). Therefore, while a vessel is present within the proposed action area, fishing, recreational, and research activities could potentially be impacted. During deployment, monitoring, and transit, vessels would avoid nearby anchorage areas and would not interact with any other underwater socioeconomic features (e.g., cables or pipelines). Further, although the research vessel would be transiting from Kalaeloa Harbor, it would follow typical navigational procedures and its presence would not substantially change baseline vessel traffic around the harbor, which includes vessels ranging from small private boats to large cargo ships. Prior to installation of the RMSs, a Notice to Mariners would be issued informing the local populace that an action would be occurring, so potential users of the site would know in advance and could make alternate plans. Any impacts on socioeconomic activities would be minor and temporary. A summary of potential impacts to resources can be found in Section 4.3.

RMS Deployment and Installation

The Proposed Action would include deployment and installation of the hybrid reef, Coast Guard approved marker poles, monitoring instrumentation, and coral nursery tables. RMSs and equipment would be slowly lowered alongside a vessel supported by temporary buoyancy (Figure 2-4) or from a custom built catamaran vessel (Figure 2-5) and installed on the seafloor.

Coral nursery tables would be deployed via a vessel-mounted crane. Structures and equipment would be lowered in a slow and controlled manner to avoid increasing local turbidity.

The Proposed Action would involve the deployment of multiple RMSs of varying design and size (Section 0). The deployment of the hybrid reef would not exceed a total footprint of 8,945 ft^2 (831 m^2). The deployment would occur non-continuously over several months, with most work happening in periods of several consecutive days as resources and weather allow. Once installed on the seafloor, the hybrid reef would remain in place long term and would have no adverse impact on marine species. The RMSs would have holes that would allow for the passage of small marine species, therefore, no entrapment risk is anticipated. Additionally, as described in Section 0, the Proposed Action would include the deployment of two 10 by 10 ft (3 m by 3 m) coral nursery tables that would be anchored to the seafloor.

Based on two years of platform observations to date in Maunalua Bay, there is no evidence that coral tables have caused any significant change to that ecosystem. Specifically, the tables do not appear to be serving as fish aggregating devices or affecting the benthic habitat by causing algae growth due to shading (Kaleana Coral Restoration 2025). Similar results are expected at the Kalaeloa coral-nursery site.

While the installation and deployment activities may have minimal and short term adverse impacts on some environmental resources, the Proposed Action's goal is to prove the RMSs ability to attenuate wave energy effectively and when scaled to a larger area, would protect the shoreline from storm surge and sea level rise.

Analysis of the potential for RMS deployment and installation to impact benthic habitat and vegetation, invertebrates, fish, EFH, sea turtles, marine mammals, and socioeconomic and cultural resources are analyzed below. Deployment and installation would not affect birds as the analysis of this stressor is focused on impacts to the water column and seafloor. Any impacts to birds that could result from deployment activities would result from vessel presence in the proposed action area. Those impacts are considered in the analysis of vessel noise and vessel movement (Section 4.2).

Benthic Habitat and Vegetation

As described in Section 0, the proposed action area (Figure 2-2) is characterized as a wave-scoured hard bottom seabed, with intermittent patches of coral and sand that is subject to high wave action. There is no known macrovegetation within the benthic habitat of the proposed action area.

Recent site-specific benthic and reef fish surveys conducted within the proposed action area documented low live coral cover (<5%), limited coral colony size and abundance, turf algae-dominated pavement substrate, and a fish assemblage dominated by juvenile herbivorous and omnivorous species. Given these baseline conditions, installation of the hybrid reef structures would not result in the loss of extensive, high-quality coral reef habitat. With implementation of avoidance measures, pre-deployment coral relocation procedures, and post-installation monitoring, impacts to benthic and biological resources are anticipated to be minor and localized, with potential long-term beneficial effects through increased structural complexity and habitat availability.

Given the nature of the proposed action area, the RMSs would be deployed on primarily hard bottom, although some may cover soft bottom if placed upon a patch of sand. Generally, covering hard bottom with a hard structure would not alter the benthic habitat. Any structures placed on a patch of sand would cause obstruction of existing soft sediment, covering that sediment with hard surfaces. This would be a long-term impact as the hybrid reef would be permanently deployed on the seafloor. However, these impacts would be minimal as the majority of the proposed action area is hard bottom.

An additional impact to benthic habitats would come from drilling anchors for the structures. Placement of the 340 anchors would destroy the small area of benthic habitat directly drilled for anchor installation, although the end result would be replacing small portions of natural hard bottom with another hard surface – the anchor and RMS.

Additionally, by attenuating the wave action landward of the structures, the RMSs could protect benthic habitat landward of their location from erosion and other harm caused by storm-driven waves and currents.

Overall, deployment and installation of the hybrid reef and associated structures and equipment may cause long-term changes to the benthic habitat, but these changes would affect a very small footprint. Deployment and installation associated with the Proposed Action would have no impact on vegetation because there is no known macrovegetation within the proposed action area. A summary of potential impacts to resources can be found in Section 0.

Invertebrates

Objects would be deployed at such a slow rate that there would be no impacts to organisms in the water column would be more likely to be dispersed than destroyed, so no adverse effects would be expected. Mobile invertebrates, such as cephalopods, may have brief behavioral reactions, moving away from the deployment location. Due to the slow, controlled descent of objects through the water column, strike of mobile invertebrates by structures is unlikely to occur. Additionally, object descent would be so slow that creation of sediment plumes is not anticipated, particularly in light of the limited loose sediment present within the proposed action area.

RMS deployment would target areas away from corals based on pre-deployment surveys. Additionally, if non-encrusting coral over 4 in (10 cm) in height would be disrupted by the deployment of a RMS, those corals would be moved to the coral nursery and may later be outplanted onto the RMSs (Section 2.4). Other immobile invertebrates (e.g., encrusting corals, sponges) on the seafloor may become covered, crushed, or smothered by deployed objects. However, due to the small footprint of the structures (8,945 ft^2 [831 m^2]), any impacts would be minimal. Mobile benthic invertebrates would be expected to move away during deployment due to the slow descent of the objects.

Once deployed, the RMSs would have no adverse impact on invertebrates. The RMSs would have holes that would allow for the passage of mobile invertebrates (e.g., crabs) in and out of the structures without risk of trapping. Sessile (e.g., corals) and mobile invertebrates would likely recruit to these hard surfaces, and additional measures will be put in place to encourage recruitment (e.g., acoustic enrichment, lighting).

Overall, deployment of the RMSs during the Proposed Action may cause short-term disturbance or limited mortality of invertebrates within or immediately adjacent to the footprint of the RMSs. After the RMSs settle on the seafloor, their presence would not present any additional risk to invertebrate communities and would instead provide enhanced habitat for invertebrate species.

Overall, deployment and installation of the RMSs and other equipment associated with the Proposed Action would result in no more than a minor, short-term impact on invertebrate communities. Although some mortality could be associated with deployment and installation, it would be extremely limited. No population-level effects would be expected. The long-term presence of the RMSs would be expected to have positive impacts on invertebrate communities. A summary of potential impacts to resources can be found in Section 4.3.

Fish

With the deployment of the RMSs and other scientific instruments and structures, disturbance would occur throughout the water column and at the seafloor as each object descends and settles. Due to the mobile nature of fish and the slow, controlled descent of objects through the water column, strike of fish by structures is not expected to occur. Therefore, the only anticipated impacts to fish during deployment and installation would be physiological and behavioral responses.

Deployment activities could potentially cause momentary behavioral reactions in fish. Many fish species engage in fast maneuvers, often termed fast-start responses, for predator avoidance or by predators to surprise and catch prey. These fast-start responses also function as a startle response, such as to an object breaking the water's surface (Fleuren et al. 2018). A fish is likely to detect and evade an object, potentially resulting in a cessation of current activity (e.g., foraging). Affected fish are likely to resume their normal behaviors readily, and no long-term behavioral effects are anticipated.

Invertebrates (e.g., corals, sponges) would be expected to recruit to the structures, and reduction in wave energy could promote development of vegetation (e.g., seagrass, algae) within the proposed action area. Therefore, the long-term impact of deployment and installation of the RMSs would be creation of habitat for fish, potentially increasing fish recruitment to and utilization of the proposed action area.

Overall, the deployment/installation of the RMSs and other instruments in the proposed action area may result in no more than minor, short-term and local disturbance of fish. It would be expected that any fish temporarily displaced during object deployment would resume normal behavior once the installation is completed or the fish has left the immediate area. Temporary behavioral reactions caused by deployment/installation are not expected to result in significant changes to an individual fish's fitness. Population-level impacts are not anticipated. The long-term presence of the RMSs would be expected to have positive impacts on fish communities. A summary of potential impacts to resources can be found in Section 4.3.

Essential Fish Habitat

EFH designated by the WPRFMC that overlaps with the proposed action area includes the following Management Units: Bottomfish and Seamount Groundfish, Crustacean, and Pelagic. No HAPC have been designated within the proposed action area.

The Proposed Action has the potential to impact benthic EFH. Both benthic substrate and biogenic habitats are assessed. Benthic substrate is inorganic seafloor habitat, and biogenic habitats include organisms and their byproducts that create physical structure for other organisms to utilize as habitat (e.g., coral reefs) (Tyrrell 2005). The Proposed Action would not impact water column EFH. Impacts to water column EFH would not result from turbidity associated with the deployment of the RMSs due to the nature of the seafloor of the proposed action area, which is hard bottom with only intermittent patches of coral and sand. Because the Pelagic Management Unit only has water column EFH designated, the Proposed Action would have no impact on EFH for the Pelagic Management Unit, so it will not be addressed further herein.

The total area of seafloor occupied by RMSs would be approximately 8,945 ft^2 (831 m^2). Video transect surveys of the notional deployment footprint were conducted in June 2025 and covered approximately 4,036 ft^2 (375 m^2). Estimations of coral size and count that may be disturbed within hybrid reef footprint are described in Table 4-3.

Table 4-3 Observed and Estimated Corals within Proposed Footprint of Hybrid Reef

Coral Type	***Estimated Coral Size and Counts***	
Mounding Corals	***0-10 cm***	***10 cm or taller***
Observed count on transect	26	65
Estimate per m^2	0.07	0.17
Estimate within hybrid reef footprint	**57**	**142***
Encrusting Coral		
Observed count on transect	66	10
Estimate per m^2	0.17	0.03
Estimate within hybrid reef footprint	**144**	**25**
*Corals that would be translocated as a part of Protective Measures (Chapter 6)		

Potential Impacts to Benthic Substrate

Bottom disturbance associated with the deployment/installation of the RMSs and coral nursery tables may result in impacts to benthic substrate designated as EFH for the Bottomfish and Seamount Groundfish and Crustacean Management Units. The extended deployment of the hybrid reef has the potential to physically alter the existing hard bottom substrate by creating more structurally and biologically diverse habitat over otherwise wave-scoured hard bottom seabed with intermittent patches of coral and sand.

As described in Section 2.4, seafloor anchors would be drilled several feet into the seabed and fixed with epoxy mixture to secure the RMS structures in the proposed action area and coral nursery tables at the coral nursey site. This would permanently alter the existing benthic habitat. Once all structures have been installed, they are designed to be stationary and would not move with waves or currents, thus preventing damage to the structures as well as the seafloor. Using the two different types of RMSs, the design of the hybrid-reef project would create a more structurally diverse habitat, which would both promote coral colonization (through anthropogenic and natural means). Although the RMSs would alter existing hard bottom, any benefits to the overall habitat would likely outweigh any damage to the existing seafloor.

It is unlikely that bottom disturbance associated with the deployment/installation activities would cause sediment suspension. Large amounts of suspended sediments are not anticipated because the proposed action area only has intermittent patches of coral and sand and all structures would be lowered slowly to the seafloor. Additionally, if any sediment were suspended, it would disperse quickly due to the high wave action.

Potential Impacts to Biogenic Habitats

Bottom disturbance associated with the deployment/installation of the RMSs and coral nursery tables may result in localized alterations to biogenic habitats, such as benthic invertebrates (e.g., corals, echinoderms, hydroids, amphipod tubes, bryozoans), which may in turn impact fish species that depend on these habitats. Bottom disturbance may impact habitat designated as EFH for the Bottomfish and Seamount Groundfish and Crustacean Management Units. The RMSs are designed with an intricate surface structure to promote colonization by coral (both anthropogenic and naturally) and other benthic invertebrates (e.g., oysters, sponges, worms, sea squirts). As such, the RMSs would augment the seafloor habitat, which is wave-scoured hard bottom, and promote biogenic habitat.

Marine invertebrate populations typically extend across wide areas containing hundreds or thousands of discrete patches of suitable habitat. Sessile invertebrate populations may be maintained by complex currents dispersing adults and young (Toonen et al. 2011). Disturbances to biogenic habitats from deployment/installation activities would be limited to the immediate area under the RMSs once they are deployed. Due to the short-term duration of deployment/installation activities, the potential for the Proposed Action to impact fish and mobile invertebrate populations dependent on this habitat would be minimal. Physical strike or disturbance may impact individual organisms directly or indirectly, but any impact would not be to the extent that the viability of populations would be impacted. Negative impacts to habitat would be largely temporary. Additionally, divers would assist in the placement of anchors to prevent damage to coral and other biogenic habitats when necessary, as long as it is safe to do so. Suspended sediment resulting from deployment/installation activities is expected to be minimal due to the intermittent patches of coral and sand in the proposed action area.

As described in Section 2.4, part of the Proposed Action involves removing corals from the proposed action area and attaching juvenile and adult corals (outplanting) to the RMSs once they are deployed. Any corals over 4 in (10 cm) in height that would be disrupted by the deployment/installation of the RMSs would be removed from the seafloor and temporarily cached (stored) for future use on the hybrid reef. The corals would be cached at a previously established coral nursery approximately 2.2 NM to the north of the deployment site (21.338N, 158.136W, pink dot Figure 1-1).

A summary of potential impacts to resources can be found in Section 4.3.

Sea Turtles and Marine Mammals

Due to the mobile nature of sea turtles and marine mammals; the slow, controlled descent of objects through the water column; and established SOPs and protective measures (Chapter 5) that dictate that deployment would not occur within a 200 yd (183 m) radius of an observed sea turtle or marine mammal, strike by structures is not expected to occur. Therefore, the only anticipated impacts to sea turtles and marine mammals during deployment and installation would be physiological and behavioral responses.

Sea turtles and marine mammals may exhibit avoidance behavior from the descent of structures through the water column. Sea turtles and marine mammals have well-developed underwater vision and would likely detect objects descending through the water column (Southwood et al. 2008; Wartzok and Ketten 1999). Object avoidance behavior similar to avoidance behavior displayed with a slow moving vessel, would be short and of low intensity, such as moving a short distance away (Hazel et al. 2007; Richardson et al. 1995), and therefore, the descent of the RMSs would not increase the likelihood of injury or disruption of breeding, feeding, or sheltering. Sea turtles and marine mammals within the proposed action area may be temporarily displaced during RMS deployment, but they would be expected to resume normal behavior shortly after exposure, likely swimming away from the area and resuming normal behavior a short distance away.

Once the RMSs are deployed, foraging or basking adult sea turtles or marine mammals would be able to ingress and egress between the seaward and landward side of the RMSs, as well as within the hybrid reef. As shown in Figure 1-1, the design of the hybrid reef considered a distance between the individual back reef structures, a distance between the two rows of reef crest structures as well as openings in the individual RMSs (diameter of 0.9 to 2.7 ft [30 to 82 cm]), to model that of a natural fringing reef. The distance between the two rows of reef crest structures and the distance between the shoreward row of reef crest structures and the back reef structures would be at least 20 ft (6.1 m). Thus, the notional arrangement of the hybrid reef was designed to minimize the risk of entrapment (Figure 1-1).

Additionally, invertebrates (e.g., corals, sponges) would be expected to recruit to the structures, and reduction in wave energy could promote development of aquatic vegetation (e.g., algae, seagrasses) within the proposed action area, creating a more balanced ecosystem and enhancing foraging opportunities for sea turtles and marine mammals, especially vegetation-eating green sea turtles. Therefore, the long-term impact of deployment and installation of the RMSs would likely have a positive impact on sea turtles and marine mammals.

Critical Habitat

RMS deployment and installation is not likely to adversely affect proposed green sea turtle critical habitat. As noted in Section 0, the essential features of this critical habitat are rooted in oceanographic conditions, allowance of sea turtle passage, and forage conditions. Installation of the RMSs would not affect the oceanographic conditions identified as essential features. Although the Proposed Action would involve placement of RMSs in the proposed critical habitat, the structures would not present a barrier to sea turtle movement. Additionally, underwater refugia and food resources for green sea turtles are not associated with the proposed action area. Site selection for the RMSs required wave-scoured areas of low relief that are devoid of encrusting organisms (e.g., large surface dwelling sponges), corals, and large areas of submerged aquatic vegetation so that the RMSs would be better situated on the seafloor. As such, the deployment of the RMSs would not target underwater refugia or food resources for green sea turtles. The only potential affect to food resources (e.g., seagrasses, macroalgae, and/or invertebrates) would be a likely increase in those resources as sessile invertebrates and vegetation would be expected to recruit to the RMSs. Therefore, there would be no reduction or loss to the essential features.

The marine essential feature relevant for the Hawaiian monk seal critical habitat relates to adequate prey quality and quantity. If practicable based on safety conditions, divers would assist in deployment of all structures and anchor placement. Additionally, all structures and anchors would be set in a slow and controlled manner, and if practicable, would be placed in open areas with a minimum distance of 6.5 ft (2 m) from any non-encrusting corals greater than 4 in (10 cm). As such, deployment and installation activities would not destroy refugia, food resources, or potential habitat for motile prey species for Hawaiian monk seals. Overall, the deployment of RMSs and other equipment in the proposed action area may result in no more than minor, short-term and local disturbance of sea turtles and marine mammals. Due to protective measures (Chapter 0) halting deployment of RMSs within a 200 yd (183 m) radius around any observed sea turtle or marine mammal, encounters with descending RMSs are unlikely. However, if a sea turtle or marine mammal were temporarily displaced during object deployment, it would be expected to resume normal behavior shortly after the encounter. Infrequent, minor, and short-lived behavioral disturbances would not affect an individual's fitness, and no population-level impacts would be anticipated. The long-term presence of the RMSs would be expected to have positive impacts on sea turtles and marine mammals utilizing the proposed action area and the adjacent shoreline. A summary of potential impacts to resources can be found in Section 4.3.

Socioeconomic Resources

During deployment and installation, recreational activities may be disturbed nearby the activity, and fishing may be less effective given the likelihood of fish to leave the proposed action area during these periods.

The long-term presence of the RMSs would not be expected to impact boat traffic within the proposed action area because aids to navigation would be in place to warn vessels of the hybrid reef's presence (Appendix A). Prior to installation of the RMSs, a Notice to Mariners would be issued informing the local populace that an action would be occurring. The structures would only be visible above the surface at low-tide, and they would have a natural look that would minimize visual impacts. Because the location of the RMSs would be visible and apparent, impacts to other recreational users such as surfers would also be minimal, as the small size of the proposed action area could be easily avoided.

In the long term, the presence of the RMSs would benefit socioeconomic resources within the proposed action area and beyond it. Within the area, the creation of new habitats (e.g., coral reefs) would attract more fish to the area, which could benefit fishing and recreational uses. The purpose of the Proposed Action is to demonstrate that hybrid reefs, are more effective at protecting shorelines from the impacts of storm surge and sea level rise than traditional hardscaping solutions, thereby indirectly benefitting shoreline uses. While the amount of RMSs being deployed as part of the Proposed Action is too small to effectively protect the shoreline, the Proposed Action's goal is to demonstrate that the hybrid reef would attenuate wave energy effectively if scaled to a larger area.

The nearby population center of Kapolei has grown rapidly in recent years; its expansion may be expected to continue. Given its inland location, while direct effects of population growth would not be anticipated to overlap the proposed action area, indirect impacts including increasing recreational activities (e.g., fishing) may occur. Consequently, boating, fishing, and other activities may increase in and around the proposed action area in the reasonably foreseeable future, resulting in more vessel traffic in and out of Kalaeloa Harbor, in particular.

Overall, impacts to socioeconomic resources from RMS deployment and installation would be short-term (several consecutive days at a time) and minor (inability of a small number of individuals to access a small area). The potential benefits of the project would substantially outweigh any minor adverse effects. A summary of potential impacts to socioeconomic resources can be found in Section 4.3.

Cultural Resources

The Cultural Resource Assessment for the Proposed Action is found in Appendix D and concludes that, although the project is not expected to cause lasting harm to cultural resources or traditional practices, the means and methods of construction will need to be assessed. Depending on the chosen methods, temporary access to coastal areas may be disrupted, but such effects are not expected to cause long-term impacts to traditional practices. Furthermore, the project, as planned, is unlikely to negatively affect public trust resources. If successful, the project could find innovative ways to protect and restore coastal reefs, potentially providing a net cultural and ecological benefit by boosting marine resources for subsistence and supporting cultural activities like fishing.

This CRA supports compliance with Hawaiʻi Revised Statutes (HRS) Chapter 343, Act 50 (2000), and the *Ka Paʻakai* framework, ensuring that cultural practices and resources are identified, impacts are assessed, and feasible protections are recommended. In doing so, it affirms the significance of Kalaeloa's tangible and intangible heritage and highlights the project's potential not only to avoid adverse effects but to actively enhance the cultural and ecological vitality of the ʻEwa coastline.

Coral Outplanting

As described in Section 2.4, the Proposed Action involves attaching juvenile and adult corals (outplanting) to the RMSs once they are deployed and utilizing an established protocol and coral nursery located nearby. Since coral cover is considered low (less than 5%) (Franklin et al. 2013; Franklin et al. 2014) and distributed intermittently across the seafloor at Kalaeloa, any non-encrusting corals greater than 4 in (10 cm) in height that could potentially be disturbed during the deployment of the hybrid reef would be collected and cached at the coral nursery site. These corals would be fragmented and attached to the RMSs after installation. Additionally, others corals of opportunity (fragments), sourced from the proposed action area may also be cached and later outplanted to the RMS.

The only resource that may be affected by coral outplanting would be corals. Coral would be outplanted directly onto the RMSs only, so any potential effects to other resources would be captured by the RMS deployment and installation discussion. Coral outplanting may have indirect positive benefits for vegetation, fish, EFH, sea turtles, and marine mammals by encouraging creation of enhanced habitat, but no adverse impacts would be anticipated, thus are not considered herein.

As described in Section 2.4 and Appendix A, the Proposed Action involves attaching juvenile and adult corals to the RMSs (outplanting) once the structures are deployed. The outplanting process presents the potential for mortality during the process or if corals do not adhere well and grow on the RMSs following outplanting.

The most likely adverse impacts to invertebrates from coral outplanting would be potential mortality of the outplanted corals themselves. Boström-Einarsson et al. (2020), conducted a literature review on coral restoration that spanned 229 species and found an average survival rate of outplanted corals across all studies to be between 60 and 70 percent. Twenty percent of the studies showed a greater than 90 percent success rate (Boström-Einarsson et al. 2020). Hawaiʻi Institute of Marine Biology (HIMB) has a proven track record of outplanting success at two sites: Kāneʻohe Bay and Māmala Bay (Forsman et al. 2015; Henley et al. 2022; Knapp et al. 2022; Westbrook et al. 2015). Preliminary data shows that the majority of coral species at the Māmala Bay site exhibited 100 percent survivorship 20 months post-outplanting (when still observed at the site). *Porites spp.* had slightly lower survivorship, with *P. lobata* at 98 percent survivorship and *P. compressa* at 80 percent. “Higher” and “lower” refer to the level of heat tolerance of 23-25 colonies at each of the 26 outplanting sites (n=243 colonies). For the Kāneʻohe Bay site, two months of monitoring has shown survivorship is 100 percent, although 10 of the 126 fragments popped off the plug it was outplanted on (adherence failure of approximately eight percent) (Knapp et al. 2022). Factors such as the outplanting method, substrate onto which the corals were outplanted, temperature of the water during coral outplanting, and more can all influence the survival of outplanted corals (Boström-Einarsson et al. 2020; Foo and Asner 2020; Sujirachato et al. 2013). Recent outplanting efforts on the West coast of Oahu have shown 82% survivorship over a six-month period (Kaleana Coral Restoration 2025). Mortality will likely occur to a percentage of outplanted corals since many factors play into coral survival. However, a high percentage of outplanted corals would be expected to survive.

As coral outplanting would not be expected to adversely affect invertebrates naturally occurring within the proposed action area, any adverse impacts would be limited to potential mortality of corals specifically reared for outplanting. A summary of potential impacts to resources can be found in Section 0.

Light Sources

White light sources would accompany some monitoring equipment and reef enrichment devices that would be deployed with the RMSs. As described in Section 0, underwater white lights would accompany autonomous cameras (kilocams) to capture photographs of nighttime fish activity among the RMSs from May through August. Beams of light would activate for five seconds, every five minutes over the course of the 12-hour nighttime period. Up to 15 kilocam lights would be utilized, and each would emit a directional beam of no more than 1.6 by 1.6 ft (0.5 by 0.5 m).

Plankton-attracting lights, UZELA, would also be incorporated into the RMSs (Section 0). UZELA would emit a steady beam of white light for one hour each night, starting approximately 30 minutes after sunset. The UZELA would be utilized for a duration of six to nine months to support survivorship of coral fragments (i.e., ramets) that would be manually attached to the CGMs, and UZELA may be utilized for longer durations to support coral recruits (corals that attached to the coral settlement modules through natural recruitment) if deemed necessary after the first nine months. Up to 10 CGMs would utilize UZELA, and each unit would emit a cone of light with a diameter of approximately 20 in (50 cm), although much of that light would be blocked by the module or absorbed by the water within a short distance of the module. Light would only be visible at the surface directly above the module.

These light sources are not anticipated to elicit more than a behavioral response in the species that may occur in the proposed action area. However, the different ways the light would be emitted (flashes over the course of a 12-hour period versus a steady stream for one hour) may cause different behavioral responses in different species.

In general, light emitted by UZELA would have minimal impact given the use for only one hour shortly after sunset, and the only expected impacts would be attraction of zooplankton and the possible attraction of larger species attracted to the zooplankton. The kilocam lights may cause temporary behavioral disturbances due to the intermittent nature of the light. Analysis of the potential for light sources to impact invertebrates, fish, sea turtles, marine mammals, and socioeconomic and cultural resources are analyzed below. Benthic habitats and EFH do not possess features that may be affected by light. Vegetation would experience no adverse impacts from light, and the UZELA lights may encourage additional vegetation growth on the structures. Birds would not be expected to be affected by either light source due to the minimal visibility above the surface and the likelihood that birds would be resting on land or the surface at night rather than foraging.

Invertebrates

The UZELA are designed to attract zooplankton, so this light source would cause a behavioral reaction for nearby zooplankton, attracting them to congregate around the RMSs. By itself, this would not have any adverse impacts on the zooplankton, although the aggregation may lead to increased predation as fish may be attracted to the lights and zooplankton aggregations. However, this impact would be no different than any naturally-occurring aggregation of zooplankton (e.g., towards natural light, nutrient sources).

The kilocam lights would be unlikely to affect most invertebrates. Immobile species would not be affected because the short periods of light exposure would not be expected to alter their physiological processes. Zooplankton similarly would be unlikely to be attracted to such short periods of light. Mobile invertebrates could have a startle response if they happen to occur close enough to the affected 1.6 by 1.6 ft (0.5 by 0.5 m) beam of light to perceive it. However, no more than a temporary behavioral disturbance would be expected, and these brief disturbances would not be expected to affect the individual’s fitness. No population-level effects would be anticipated. A summary of potential impacts to resources can be found in Section 0.

Fish

Fish would be expected to be present on the RMSs at night when the lights would be in use. Depending on the species, fish may be foraging or resting at night. There are no known aggregations of ESA-listed giant manta rays in waters off of Oʻahu, but individuals may occur within the proposed action area.

Many fish species, including the giant manta ray, feed predominantly on zooplankton, which are attracted to bright steady beams of white light at night. As such, the plankton-attracting lights have the potential to indirectly attract fish to the RMSs. Although the plankton-attracting lights would turn on consistently every night, they would only emit light for a relatively short period of time (one hour). Any large congregations of zooplankton that were attracted during that period would likely dissipate after the lights turned off, decreasing the chance of a fish being attracted to the RMSs. Therefore, the window of foraging on large congregations of zooplankton is limited to one hour. Any change in foraging behavior due to the plankton-attracting lights is not expected to occur on a population level. Additionally, attraction due to the aggregation of prey would not have adverse effects for affected fish.

Unlike the steady lights associated with the UZELA, the kilocam lights would turn on and off throughout the night. The brief flashes of light have the potential to startle fish that happen to be foraging or resting close enough to the affected 1.6 by 1.6 ft (0.5 by 0.5 m) area of light. Fish are highly mobile, transient species, so the flashes of lights emitted from the kilocam lights are not anticipated to elicit more than a temporary behavioral disturbance if a fish were affected, and these brief disturbances would not be expected to affect the individual's fitness. No population-level effects would be anticipated. Overall, light sources associated with the Proposed Action would be expected to elicit no more than brief, minor behavioral reactions from fish. A summary of potential impacts to resources can be found in Section 0.

Sea Turtles and Marine Mammals

Newly hatched sea turtles are known to be attracted to both naturally occurring (the moon) and artificial (streetlights) bright, white light on land. However, both the UZELA and the kilocam lights would only be visible within several meters of the source. As there are no known nesting sites on the shoreline adjacent to the proposed action area, the potential for a hatchling to occur within the proposed action area is unlikely. However, even if a hatchling did see the light, the source of the light would still lead the turtle to the ocean rather than toward a land-based structure. Additionally, the UZELA would only turn on for one hour each night, and the kilocam lights are intermittent, so impacts from light sources would be short-term and minimal.

While adult sea turtles and marine mammals that transit the proposed action area may detect both types of light sources, they are not expected to have more than a minor change in behavior. Additionally, the majority of marine mammals inhabit deeper waters than the proposed action area, including the ESA-listed false killer whale. Since the lights would only shine at night, they are not expected to disrupt or alter adult sea turtle foraging behavior, as foraging mostly occurs during the day. Additionally, the wave-scoured seafloor of the proposed action area is not a prime sea turtle foraging ground for adults. Although this light source could potentially interrupt nocturnal feeding of Hawaiian monk seals or common bottlenose dolphins by scaring their prey, that is considered unlikely due to the focused, small diameter beam of light creating a small likelihood that a foraging seal or dolphin would happen to overlap with a kilocam light beam. As such, sea turtles and marine mammals within the proposed action area may detect the light sources and continue normal behavior or have a brief behavioral reaction if disturbed by a flash from a kilocam light if a turtle or marine mammal happens to be in close proximity to one of those lights.

The UZELA light may indirectly support sea turtle and marine mammal prey populations. Studies conducted by HIMB showed that coral growth was 2-4 times greater with the use of UZELA lights when compared to similar coral life stages growing without the added light source. As such, over time, healthy coral populations on the hybrid reef could create an overall increase in biodiversity in the proposed action area, including an increase in sea turtle and marine mammal prey species, enhancing the proposed action area as foraging habitat.

Critical Habitat

As described in Section 3.2, both the reproductive and benthic foraging/resting essential features of proposed green sea turtle critical habitat overlap with the proposed action area. The addition of light sources would not affect the essential features associated with benthic foraging/resting. However, the reproductive essential feature defines a requirement for waters to be "sufficiently dark" (88 FR 46572; July 19, 2023). Although the light sources would add light to waters that sea turtle may transit at night, the light sources added to the RMSs are so dim that they would only be visible from above the structure, decreasing the possibility of disrupting green sea turtles that utilize the area as habitat.

Light sources would be expected to cause no more than brief behavioral responses if a foraging or resting marine mammal or sea turtle happens to co-occur with one of the relatively narrow light beams. However, any affected individual would quickly be expected to resume normal behavior after the initial reaction. Temporary behavioral reactions would not be expected to result in significant changes to an individual marine mammal's fitness. No population-level impacts would be anticipated. A summary of potential impacts to resources can be found in Section 4.3.

Socioeconomic Resources

There is a potential that night lighting used on the RMSs could be visible above the surface directly above the structures. However, any light that reaches the surface would be minimal, and it would be unlikely to be visible from land given the low light intensity and its location near the seafloor. As the light may attract biological resources (Section 4.2), it could make the area more appealing for recreational uses, such as fishing. However, given nearshore fishing is not popular around the proposed action area in comparison with other coastal areas of Oʻahu, any actual changes to recreational uses would be minimal. A summary of potential impacts to socioeconomic resources can be found in Section 4.3.

Cultural Resources

There is a potential that night lighting used on the RMSs could be visible above the surface directly above the structures. However, any light that reaches to the surface would be minimal, and it would be unlikely to be visible from land given the low light intensity and its location near the seafloor.

When the Hawaiʻi State Legislature passed Act 50 in 2000, the purposes of the Act were clear: "1) Require that environmental impact statements include the disclosure of the effects of a proposed action on the cultural practices of the community and State; and 2) Amend the definition of "significant effect" to include adverse effects on cultural practices" (Act 50, SLH 2000).

HRS 343-2, as amended per Act 50, defines an "Environmental impact statement" (EIS) as "an informational document prepared in compliance with the rules adopted under 343-6 and which discloses the environmental effects of a proposed action, effects of a proposed action, effects of a proposed action on the economic welfare, social welfare, and *cultural practices of the community and State*, effects of the economic activities arising out of the proposed action, measures proposed to minimize adverse effects, and alternatives to the action and their environmental effects" (emphasis added) (HRS Chapter 323-2).

Under the same part, "Significant effects" is defined under state law as "the sum of the effects on the quality of the environment, including actions that irrevocably commit a natural resource, curtail the range of beneficial uses of the environment, are contrary to the State's environmental policies or long-term environmental goals as established by law, or adversely affect the economic welfare, social welfare, or *cultural practices of the community and State*" (emphasis added) (HRS Chapter 323-2). Therefore, an adverse effect to cultural practices of the community or state constitutes a "significant effect" under Chapter 343.

The purpose of this Cultural Resource Assessment (CRA) is to identify and evaluate the range of cultural resources that may be present in the project area. These include archaeological resources, biological resources of cultural importance, intangible cultural resources, and ongoing cultural practices. The assessment then considers whether or not the proposed action may have an adverse impact on any of these resources.

This CRA identifies and evaluates tangible or physical impacts to historic sites, as well as impacts to flora and fauna, to the extent that such impacts affect cultural resources or cultural use. While the archaeological and biological sections of the Environmental Assessment (EA) provide more technical analysis of those respective areas, the CRA addresses them in relation to their cultural meaning and significance. In this way, the CRA provides a holistic view that integrates archaeological, biological, and intangible cultural dimensions, with a focus on how they relate to Native Hawaiian practices and values, as required under Hawaiʻi Revised Statutes Chapter 343.

The standard under which an Environmental Impact Statement (EIS) is considered sufficient is also well-established in Hawaiʻi case law. As the Hawaiʻi Supreme Court has held:

> …an EIS need not be exhaustive to the point of discussing all possible details bearing on the proposed action but will be upheld as adequate if it has been compiled in good faith and sets forth sufficient information to enable the decision-maker to consider fully the environmental factors involved and to make a reasoned decision after balancing the risks of harm to the environment against the benefits to be derived from the proposed action, as well as to make a reasoned choice between alternatives. *Price v. Obayashi Hawaii Corp.*, 81 Hawaiʻi 171, 182 (1996), upheld in *Kaleikini v. Yoshioka*, 283 P.3d 60, 74 (2012).

Consistent with this standard, the CRA does not attempt to provide exhaustive detail on every conceivable aspect of the project area. Rather, it seeks to provide a good-faith and sufficiently thorough evaluation of the cultural resources potentially affected, so that decision-makers and the public can fully consider environmental factors, balance risks and benefits, and make reasoned choices about the proposed action.

Impacts to Flora

Conservation measures developed in consultation with NMFS and DARPA specifically require avoidance of placing anchors or reef structures on existing seagrass or coral colonies, therefore no impact to these resources is anticipated. Outplanted corals, propagated limu, and potentially other culturally informed installations will actively reestablish marine biodiversity and integrate Native Hawaiian stewardship practices into the project's ecological design. This explicit blending of cultural knowledge and ecological restoration demonstrates the recognition that protecting native and culturally significant flora is central to both community well-being and project success.

Impacts to Fauna

The Kalaeloa Reef Project intersects with species that are ecologically and culturally vital. Consultation with NMFS emphasized the need to protect ESA-listed turtles, coral-dependent fish, and limu-associated invertebrates. The project's biodiversity monitoring program includes species such as ʻamaʻama, ʻopelu, mullet, octopus, and limu, ensuring that cultural resources are explicitly considered in scientific assessments.

By integrating cultural knowledge with ecological science, the project has the potential not only to avoid adverse impacts but to foster restoration. Protecting and enhancing faunal populations strengthens subsistence practices, sustains kilo traditions, and reinforces cultural continuity in Kalaeloa.

The fauna of Kalaeloa embody the intimate ties between people and place. From mullet migrations to nesting seabirds, these species anchor traditional knowledge, subsistence practices, and ceremonial life. Archaeology, moʻolelo, and living traditions affirm their centrality. The proposed project must carefully monitor and protect these resources, acknowledging that cultural resilience is inseparable from ecological health. If successful, the reef restoration may provide a model for how science and cultural practice can work together to revitalize marine life and sustain Hawaiʻi's living heritage.

Impacts to Historic Sites

Impacts to historic sites with the project are unlikely. There is always the potential for the identification of human remains in coastal regions, but the likelihood of the project impacting burials is low.

Puhilele

The Puhilele site, despite being identified on historic maps, has gone largely undocumented in cultural resource reports. This section documents and evaluates the site within the context of the region as part of a potential cultural landscape. The ʻEwa Plain and the coastal lands of Kalaeloa (Barbers Point) form one of the most archaeologically significant landscapes on Oʻahu. For centuries, Native Hawaiians occupied and utilized this region, leaving behind a record of habitation, subsistence, and ritual features embedded in the coral limestone substrate. Salvage excavations conducted in 1977 ahead of harbor development revealed evidence of temporary shelters, sinkhole use, and specialized fishing technology (Sinoto, 1978). More recently, surveys and preservation planning associated with the closure of the Naval Air Station at Barbers Point led to the creation of Kalaeloa Heritage Park, which protects over 177 relatively undisturbed archaeological features including habitation sites, agricultural complexes, and religious structures such as a heiau. Taken together, these findings and preservation efforts demonstrate that Kalaeloa was not marginal but central to coastal lifeways, particularly fishing and gathering, and remains critical to cultural identity and education.

Salvage Archaeology and Coastal Adaptation

The 1977 salvage project focused on a sample of the coastal plain, documenting roughly twelve percent of the planned development area. The karstic environment of the ʻEwa Plain is riddled with sinkholes, and these features became focal points for both paleontological and archaeological evidence. While many contained only fossilized bird remains deposited naturally, several clearly showed cultural use: ash deposits, midden, and artifacts were recovered that point to short-term habitation and subsistence activity.

At Site B6-70, archaeologists uncovered a U-shaped stone structure built to shield occupants from the trade winds, located beside a sinkhole filled with midden. The midden included bird bone, ash, and abundant marine shell, notably *Brachidontes cerebristriatus*, the Hawaiian mussel known as *kio nahawele*. This species thrives in intertidal environments, and its presence indicates systematic shellfish gathering. The site also produced basaltic glass flakes, a hematite chip, and a drilled bird bone fragment—possibly crafted from an extinct seabird species. This combination of artifacts and ecofacts suggested that B6-70 functioned as a temporary shelter for coastal foragers and fishers, who consumed shellfish and disposed of waste in the sinkhole.

Site B6-78 contained dense avifaunal remains but few cultural indicators, while Site B6-100 yielded more robust evidence of human use. Here, midden deposits contained fire-cracked basalt, ash, and thirteen artifacts, including basaltic flakes, an adze fragment, and a coral abrader. The basalt, not native to the ʻEwa limestone plain, must have been imported by canoe from volcanic uplands, demonstrating integration of inland and coastal zones. Coral files were likely used for finishing bone fishhooks, directly connecting the site to fishing technology. Fireplaces and cooking debris suggested habitation during short-term fishing trips, with on-site tool maintenance.

Site B6-119 consisted of a rectangular enclosure with limited cultural material, while Site B6-138 provided some of the strongest evidence of fishing. Ash and midden deposits there were associated with coral abraders and a fishhook fragment made from human bone. This fragment was part of a composite hook used to catch pelagic species such as *aku* (bonito) or octopus (*heʻe*). The presence of this artifact, alongside coral tools for hook production, indicated that B6-138 was a fisherman's shelter where catches were processed and gear repaired before returning to inland settlements.

Across these sites, midden contents consistently reflected reliance on coastal resources. Shellfish, especially *kio nahawele*, were abundant, showing that intertidal harvesting was routine. Bird bone, including extinct species, highlighted the ecological richness of the plain, while ash deposits marked food preparation. Imported volcanic rock showed broader transport and exchange networks, with canoe travel bringing tools and resources to the limestone coast.

Broader Archaeological Landscape

While the salvage excavations provided detailed snapshots of coastal lifeways, later surveys expanded the picture of Kalaeloa's archaeological significance. The closure of Naval Air Station Barbers Point in 1999 triggered a Section 106 consultation process under the National Historic Preservation Act. This process required the Navy to identify historic properties, evaluate impacts, and consult with state and community stakeholders. As part of the redevelopment planning, more than 177 archaeological features were documented and preserved within what became the Kalaeloa Heritage Park.

These features included stacked coral dwellings, agricultural sites, religious structures such as a heiau, modified sinkholes, and traditional trails. The diversity of site types demonstrated that Kalaeloa supported not only temporary fishing shelters but also long-term habitation and ritual activity. Oral traditions had long placed early Polynesian migrants in the ʻEwa Plain, and the archaeological record now confirmed a complex pattern of use that included subsistence, ceremony, and settlement.

The establishment of Kalaeloa Heritage Park in partnership with the Kalaeloa Heritage and Legacy Foundation ensured that these resources would be preserved and interpreted for the public. The park highlights both pre-contact Hawaiian archaeology and later layers of land use, including plantation-era ranching and military occupation. This integrated history reflects the ongoing cultural presence of Native Hawaiians in the region and provides opportunities for education about subsistence practices, including fishing, gathering, and farming, which shaped the landscape for centuries.

Ecological and Cultural Integration

The archaeological data reveal a system of adaptation finely tuned to Kalaeloa's ecological zones. The reef and offshore waters provided pelagic species, exploited with composite fishhooks such as that found at Site B6-138. The intertidal zone supplied *kio nahawele* mussels and other shellfish, as seen in the midden of Site B6-70. Inland karst sinkholes served as shelters and refuse pits, where bird bone, ash, and artifacts accumulated. Together, these zones structured a subsistence strategy where temporary coastal camps were linked to inland agricultural bases, and canoe transport integrated resources from across Oʻahu.

The role of seabirds in this system is notable. Dense deposits of avifaunal bone at sites such as B6-78, though not always cultural in origin, illustrate the ecological abundance of the coast. Bird species may have supplemented diet or provided raw material for tools, as seen in the drilled bird bone artifact from B6-70. Their presence adds another layer to the picture of Kalaeloa as a productive environment that supported both terrestrial and marine harvesting.

Evaluation of Significance

The archaeological record of Kalaeloa demonstrates that the ʻEwa coastal plain was far from marginal. Although its arid, limestone terrain was not suited to intensive agriculture, the coast was a dynamic zone of subsistence and settlement. Short-term camps, shelters, and sinkhole middens preserve evidence of fishing, gathering, and tool production. Finds such as human bone fishhook fragments, coral abraders, and *kio nahawele* shells confirm the exploitation of reef and intertidal resources, while imported basalt indicates integration with inland and offshore transport systems. Later preservation efforts reinforced the significance of this record.

The Puhilele site itself has been destroyed by military activity and replaced with the Barbers Point Light, which itself is now a historic site on the National Register of Historic Places. While Puhilele no longer retains integrity as an individual property, it may continue to contribute to a larger cultural landscape. As Puhilele as an individual site no longer retains integrity, it is not eligible for the Hawaiʻi Register of Historic Places.

Through the Section 106 process for the closure of Naval Air Station Barbers Point, the establishment of Kalaeloa Heritage Park occurred, and as a result of this preservation effort, over 177 features, including heiau, habitation sites, and agricultural complexes, are now protected. This park ensures that the archaeological evidence of subsistence and cultural practice is not only preserved but shared with the community. The integration of salvage data, heritage preservation, and ecological context shows Kalaeloa as a key locus of Hawaiian adaptation, where fishing, gathering, and sailing formed the foundation of life along the ʻEwa coast. The park itself is not on the HRHP or NRHP, but individual sites located in the park have been determined eligible for the NRHP.

Impacts to Intangible Cultural Resources

The proposed project will have no significant impact on intangible cultural resources**.** Intangible cultural resources at Kalaeloa include the values, beliefs, and traditions tied to the coastal landscape, such as the oral histories of ʻEwa, the chants and sayings that reference its fisheries, and the sense of place associated with historic practices of gathering, fishing, and canoe travel. These resources are not solely dependent on the physical footprint of the project area, but rather on broader cultural identity, narratives, and community memory.

Because the project avoids direct disturbance to known archaeological sites and maintains the integrity of the surrounding heritage landscape, the intangible qualities associated with Kalaeloa are not anticipated to be diminished. The coastal viewsheds, sounds, and general character of the area will remain intact, preserving the setting in which moʻolelo, ʻōlelo noʻeau, and cultural memory are grounded. Continued access to cultural resources further ensures that the transmission of values and stories tied to the coast can continue uninterrupted.

Additionally, the project offers opportunities to showcase and interpret intangible cultural heritage through educational outreach and cultural signage. Such measures may strengthen public awareness of Kalaeloa's history and contribute positively to the perpetuation of cultural knowledge. On this basis, the project is determined to have no adverse effect on intangible cultural resources.

Impacts to Cultural Practices

Cultural practices at Kalaeloa have long centered on the use of marine and coastal resources**.** Archaeological evidence, including fishhook fragments, coral abraders, and midden rich in *kio nahawele*, demonstrates the historical importance of fishing and shellfish gathering. Oral traditions and historic accounts further document surfing at noted breaks, canoe launching, and limu collection along this coast. Today, cultural practitioners continue to value Kalaeloa for subsistence fishing, education, and ceremonies that reinforce ancestral connections to the sea.

The proposed project has the potential to temporarily disrupt these practices**.** Construction may temporarily limit access to shoreline areas used for fishing and gathering. Increased activity or modification of reef structures could alter nearshore habitats, potentially reducing the abundance of marine species relied upon by practitioners. The introduction of modern infrastructure also risks diminishing the cultural atmosphere that supports practices like fishing or ceremonial observances, where a sense of continuity with ancestors is essential.

However, with careful planning, impacts can be minimized. Access routes to the shoreline can be maintained or enhanced, ensuring that cultural practitioners retain entry to fishing grounds and gathering areas. Consultation with lineal descendants and community organizations can identify periods of sensitivity, such as seasonal fishing runs or ceremonial events, during which activities should be restricted. Restoration efforts—such as limu planting or water quality improvements—can also offset some project effects, directly supporting cultural use of the area.

In sum, while development has the potential to adversely affect cultural practices, proactive mitigation and partnership with the community can not only protect but also revitalize traditional uses. This ensures that fishing, gathering, and ceremonial connections to Kalaeloa remain vibrant elements of Native Hawaiian life.

Cumulative and Indirect Impacts

Adverse cumulative and indirect impacts to cultural resources are often overlooked in CIAs, as they are difficult to assess. Cumulative impacts are cultural impacts that result from the incremental impacts of an activity when added to past, present, and reasonably foreseeable future actions and activities. Indirect impacts are impacts on cultural resources which are not a direct result of the project, but a secondary or tertiary result of the project. DLNR intends to develop the project area, and this development is unlikely to result in any adverse cumulative and indirect impacts given the extensive agricultural development previous conducted on the project area. Therefore, there are no anticipated cumulative or indirect cultural impacts to the area.

Mitigation and Best Management Practices

Per the recommendations of Shad Kane, it is advised that the project incorporate and include traditional place names whenever possible, be it the naming of certain halls, or generally included in planning and development. As noted in his interview, it is important to Mr. Kane to see the place names of ʻEwa included in future projects so that the cultural integrity of the place is not lost. An option for this would be to pursue obtaining an State Inventory of Historic Places number for Puhilele, which is not otherwise recognized in existing archaeological surveys, including any of the NRHP documents for the area. This would be keeping in line with Mr. Kane's request.

Should burials be identified on the property, this adverse effect would need to be resolved in consultation with SHPD. It is recommended by local practitioners that the project include cultural monitoring throughout the construction phase.

Should a community advisory council be formed, it should include members of nearby cultural organizations, like Kalaeloa Heritage Park, Ulu Aʻe, or the Hoakalei Cultural Foundation. Community members from the nearby homestead communities should also be invited to participate, as they are the closest Hawaiian communities residing near the Project Area. Reporting to these communities on the results of the efforts is also recommended. Community engagement on monitoring efforts, if implemented, should also include these groups.

Sea Level Rise (SLR) Analysis

As per Hawaiʻi Administrative Rules (HAR) 11-200.1 under Hawaiʻi Revised Statutes (HRS) 343) updated through State Act 17, SLH 2018, the Sea Level Rise Exposure Area (SLR-XA) for the combined effects of passive flooding, annual high wave flooding, and coastal erosion are shown for the coastline adjacent to the proposed action area (Fig 1). Note that the SLR high wave flooding scenario provides most the coastal inundation impacts, with erosion and passive flooding showing minimal contributions (Figures 1-4).

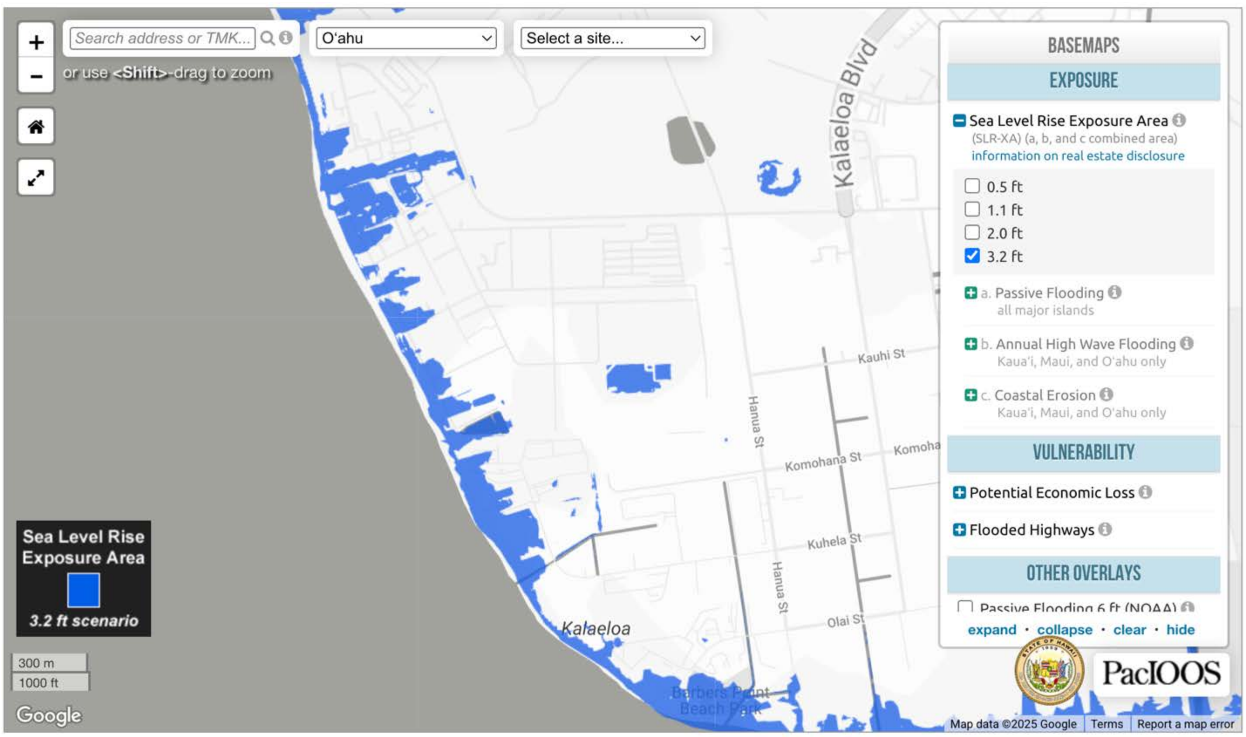

Figure 1. SLR-XA model showing results for sea level rise exposure for the coastline adjacent to the proposed action area for a 3.2ft SLR scenario. Proposed action area in black box.

Impact Analysis

Considering the proposed action will already be submerged, and the facilitation of rapid coral growth on the structures is designed to ensure the structures retain their functionality as sea level increases, SLR will not impact the stability or functionality of the proposed action. Additionally, the proposed action is designed to reduce impacts of annual high wave flooding events rather than having an adverse effect on the adjacent coastline, which is projected to have moderate economic value ($2-10M/acre) (Figure 5). The impact of the proposed action on sediment transport dynamics has been identified and mitigated by the porous design of the structures, which facilitates waterflow through the structures. Additionally, Figure 4 indicates this section of coastline is particularly resilient to coastal erosion, even in sea level rise scenarios, probably due to the presence of fossilized reef at the sea-land interface.

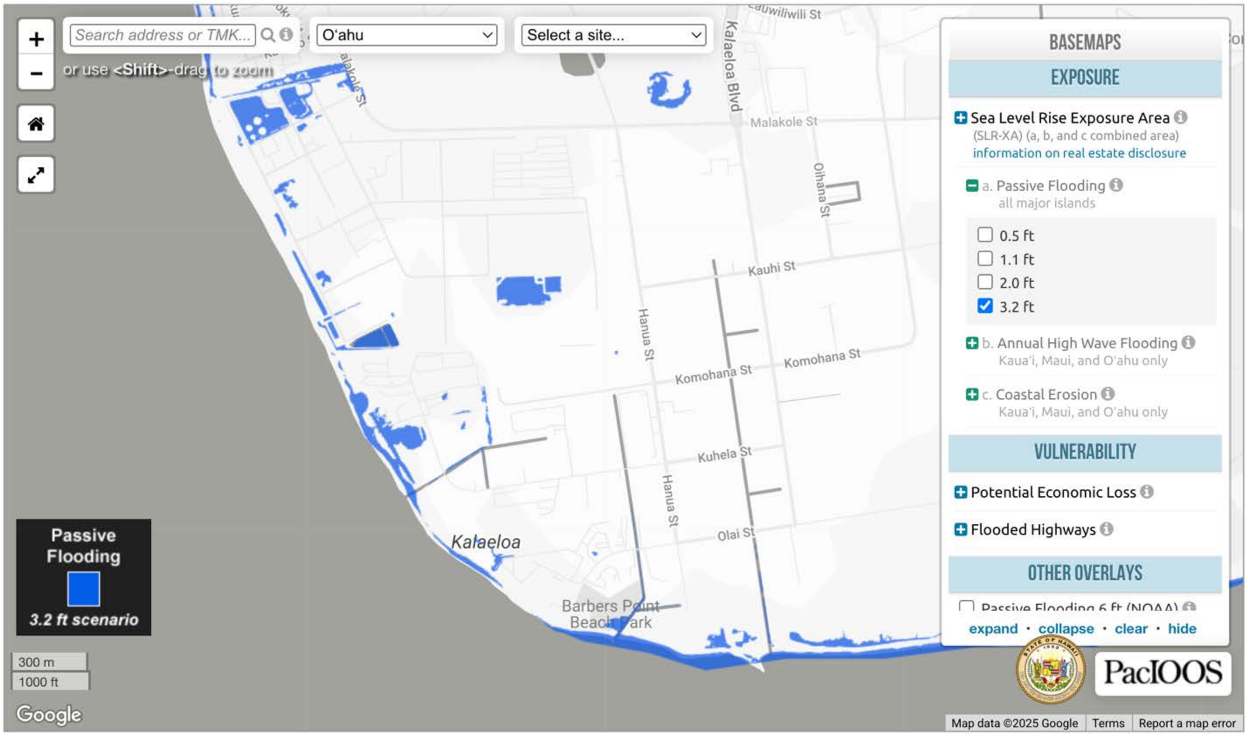

Figure 2. SLR-XA model showing results for passive flooding for the coastline adjacent to the proposed action area for a 3.2ft SLR scenario. Proposed action area in black box.

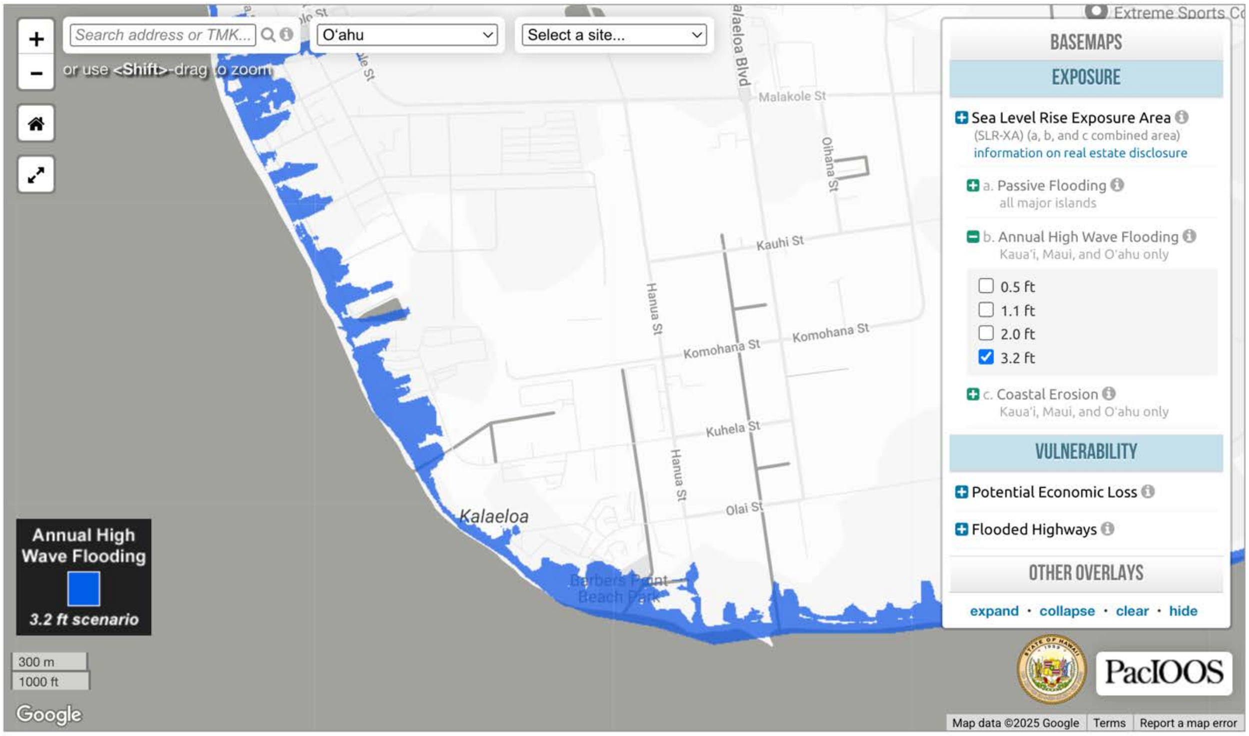

Figure 3. SLR-XA model showing results for annual high wave flooding for the coastline adjacent to the proposed action area for a 3.2ft SLR scenario. Proposed action area in black box.

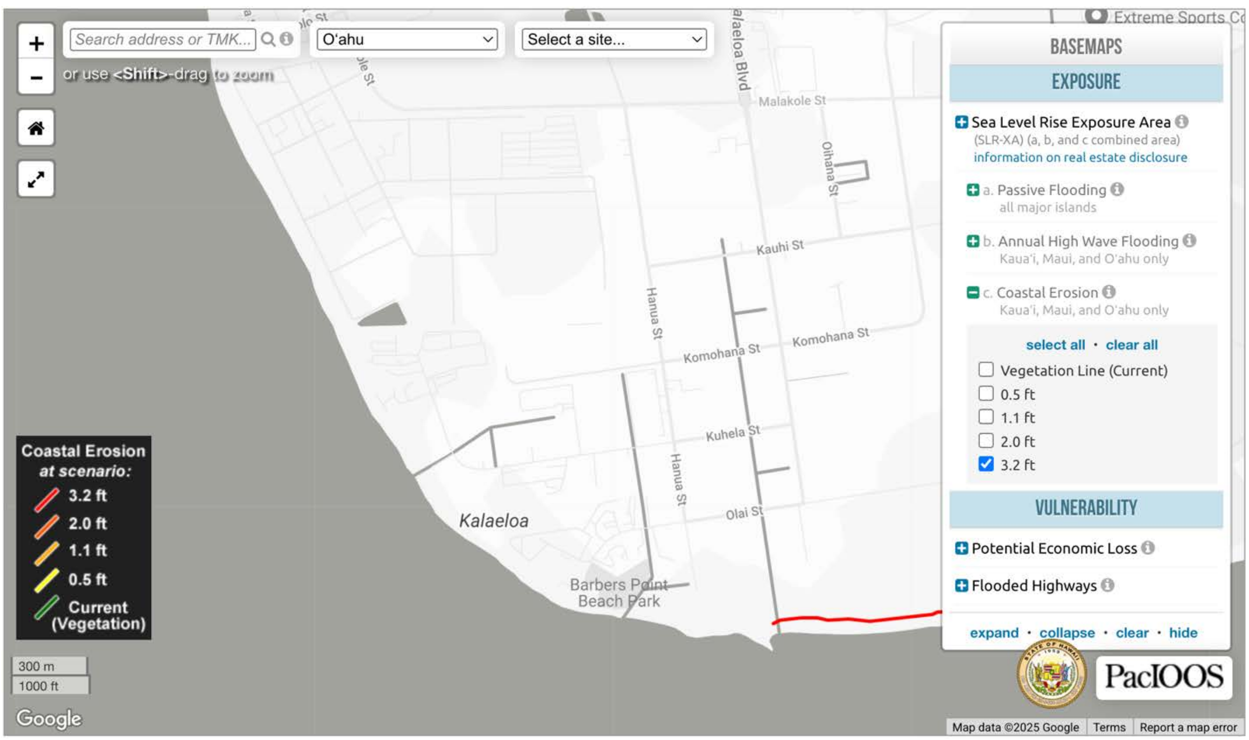

Figure 4. SLR-XA model showing results for coastal erosion for the coastline adjacent to the proposed action area for a 3.2ft SLR scenario. Note the directly coast adjacent to the proposed action area does not have any anticipated erosion impact. Proposed action area in black box.

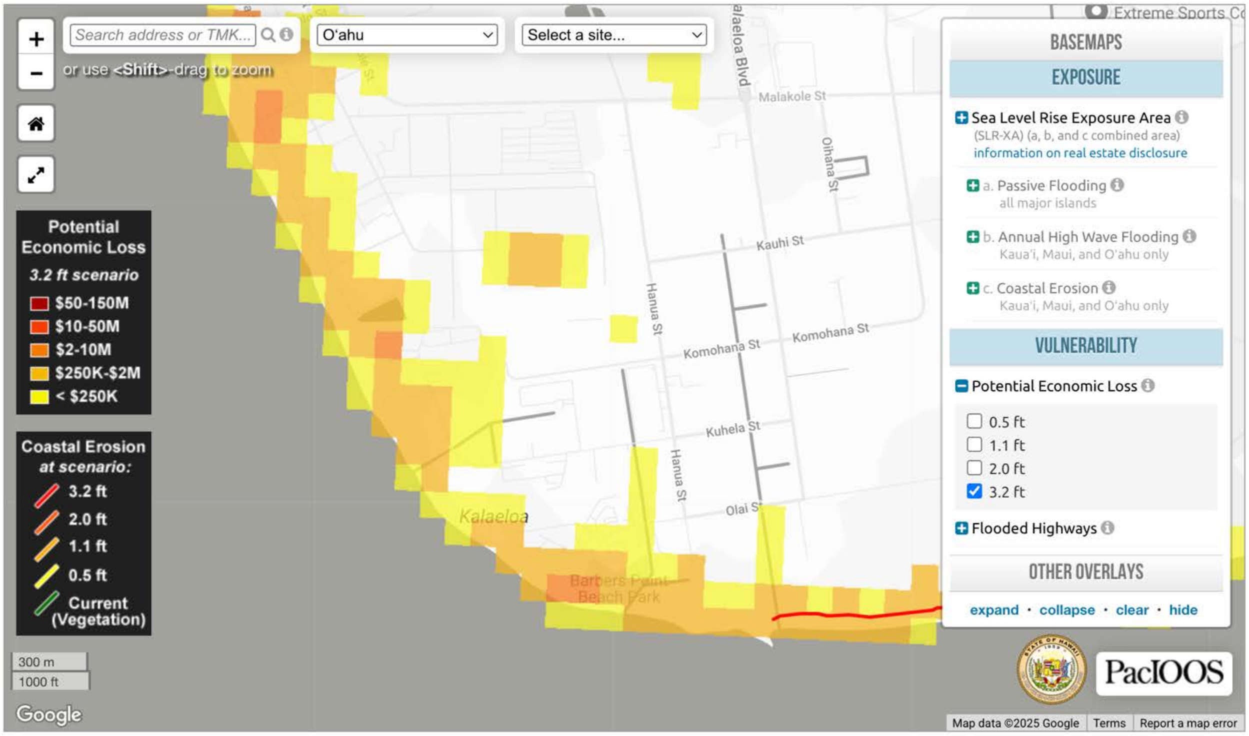

Figure 5. SLR-XA model estimate of potential economic loss of the coastline adjacent to the proposed action area for a 3.2ft SLR scenario. Proposed action area in black box.

Summary of Potential Impacts to Resources and Impact Avoidance and Minimization

A summary of the potential impacts to resources for the Action Alternative (Proposed Action) and the No Action Alternative are presented in Table 4-4. These conclusions consider both the impact analyses presented in this chapter as well as SOPs and protective measures (Chapter 5).

Table 4-4. Summary of Conclusions

Resource	*Underwater Noise*	*Vessel Movement*	*RMS Deployment and Installation*	*Coral Outplanting*	*Light Sources*
Benthic Habitat and Vegetation	No impact	No impact	Although some potential impacts may be long-term (i.e., drilling of permanent anchors into hard bottom), they would be minimal (maximum footprint of 8,945 ft^2 [831 m^2]). Additionally, the changes would have positive impacts in creating a more diverse structural habitat and demonstrate wave attenuation. There is no known macrovegetation within the proposed action area and disturbance of phytoplankton would be minimal. **NEPA/ HEPA :** No significant impacts **CZMA:** HDOT is currently conducting a federal consistency review with the Hawaiʻi Office of Planning and Sustainable Development.	No impact	No impact
Invertebrates	May cause some short-term physiological or behavioral effects, but invertebrates would be expected to return to normal behavior shortly after the exposure. Population-level impacts are not	No more than a minor, short-term impact. Population-level impacts are not anticipated. **NEPA/ HEPA:** No significant impacts	No more than a minor, short-term effect. Population-level impacts are not anticipated. **NEPA/HEPA**: No significant impacts	As coral outplanting would not be expected to adversely affect invertebrates naturally occurring within the proposed action area, any adverse impacts would be limited to	May cause some short-term physiological or behavioral effects (attracting zooplankton, startling mobile species), but invertebrates would

Resource	*Underwater Noise*	*Vessel Movement*	*RMS Deployment and Installation*	*Coral Outplanting*	*Light Sources*
	anticipated. **NEPA/ HEPA:** No significant impacts			potential mortality of corals specifically reared for outplanting. **NEPA**: No significant impacts	be expected to return to normal behavior shortly after the exposure. Population-level impacts are not anticipated. **NEPA**: No significant impacts
Birds	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA/HEPA:** No significant impacts	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA/HEPA:** No significant impacts	No impact	No impact	No impact
Fish (ESA-listed giant manta ray)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA/HEPA:** No significant impacts **ESA:** NLAA[1]	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA/HEPA:** No significant impacts **ESA:** NLAA[1]	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA/HEPA:** No significant impacts **ESA:** NLAA[1]	No impact	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA/HEPA:** No significant impacts **ESA:** NLAA[1]

Resource	*Underwater Noise*	*Vessel Movement*	*RMS Deployment and Installation*	*Coral Outplanting*	*Light Sources*
Essential Fish Habitat	No impact	No impact	May have long-term impacts (i.e., increasing habitat complexity), but limited to a very small footprint, which is minimal in comparison to the total amount of EFH designated and would be a habitat benefit rather than adverse effect. **NEPA/HEPA:** No significant impacts **MSA[2]:** DARPA has initiated consultation with NMFS under the MSA, and has concluded that the Proposed Action may permanently alter the seafloor habitat within the proposed action area by enhancing the existing habitat and augmenting its physical and biological function. However, the bottom disturbance associated with the Proposed Action, in both the proposed action area and the coral nursery site, would only result in a temporary and localized reduction in the quantity and/or quality of benthic habitat EFH designated for the Bottomfish and Seamount Groundfish Management Unit and the Crustacean Management Unit during the	No impact	No impact

Resource	*Underwater Noise*	*Vessel Movement*	*RMS Deployment and Installation*	*Coral Outplanting*	*Light Sources*
			Proposed Action.		
Sea Turtles (ESA-listed green sea turtle (and proposed critical habitat), hawksbill sea turtle)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. No effect to proposed green sea turtle critical habitat. **NEPA/HEPA:** No significant impacts **ESA[1]:** NLAA (both species), no effect (proposed critical habitat)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. No effect to proposed green sea turtle critical habitat. **NEPA/HEPA:** No significant impacts **ESA[1]:** NLAA (both species), no effect (proposed critical habitat)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. No reduction or loss to critical habitat essential features. **NEPA/HEPA:** No significant impacts **ESA:** NLAA (both species and proposed critical habitat)	No impact	Potential impacts would be limited to temporary behavioral disturbances and minimal modification to proposed critical habitat. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA/HEPA:** No significant impacts **ESA:** NLAA (both species and proposed critical habitat)
Marine Mammals (ESA-listed false killer whale and Hawaiian monk seal (and critical habitat))	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA/HEPA:** No significant impacts **ESA:** NLAA (both species), no effect (critical habitat)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA/HEPA:** No significant impacts **ESA:** NLAA (both species), no effect (critical habitat)	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. Anchor placement in critical habitat may briefly affect prey quantity, but would not destroy refugia, food sources, or potential prey habitat. **NEPA/HEPA:** No significant impacts **ESA:** NLAA (both species and	No impact	Potential impacts would be limited to temporary behavioral disturbances. No significant changes to an individual's fitness or population-level impacts are anticipated. **NEPA/HEPA:** No significant impacts **ESA:** NLAA (both species), no effect (critical habitat)

Resource	*Underwater Noise*	*Vessel Movement*	*RMS Deployment and Installation*	*Coral Outplanting*	*Light Sources*
			critical habitat)		
Socioeconomic Resources	No impact	Potential impacts would be limited to minor and short-term displacement of recreational activities within the proposed action area. **NEPA/HEPA:** No significant impacts	The proposed action area was extensively surveyed and no cultural or archaeological resources were found. Potential impacts would be limited to minor and short-term displacement of limited (due to security buffer) recreational activities within the proposed action area. Potential long-term benefits of demonstrating wave attenuation. **NEPA/HEPA:** No significant impacts	No impact	Any potential impacts would be minimal and likely beneficial (i.e., more attractive recreational opportunities from a thriving reef). **NEPA/HEPA:** No significant impacts
Cultural Resources	No impact	No impact	The proposed action area has been surveyed and researched.	No impact	No impact

Reasonably Foreseeable Effects

The scope of the analysis involves both the geographic extent and time frame of the effects. The Proposed Action would not have any effects beyond the small geographic area of the proposed action area, and therefore, the effects from the Proposed Action would not aggregate with effects from actions beyond this geographic extent. The time frame for reasonably foreseeable effects will focus on actions that would co-occur with the deployment of the RMSs or any actions preceding deployment if that action's effects would linger. Reasonably foreseeable actions will only be considered if their effects would aggregate with the physical existence of the RMSs once they are deployed. Recently completed, ongoing, or anticipated future activities that have potential for reasonably foreseeable impacts with the Proposed Action are presented in Table.

Table 4-5. Past, Present, and Reasonably Foreseeable Future Actions

Action Projects	*Action Proponent*	*Level of NEPA/HEPA Analysis and Date Documentation Complete*
Hawaiʻi-Southern California Training and Testing	U.S. Navy	Environmental Impact Statement/Overseas Environmental Impact Statement, 2018
Enhancing Protections for Hawaiian Spinner Dolphins to Prevent Disturbance	NOAA	Environmental Impact Statement, 2021
Naval Special Operations Training in the State of Hawaii	U.S. Navy	Environmental Assessment, 2021
Proposed Dredging of Kalaeloa Barber's Point Harbor	U.S. Army Corps of Engineers	Environmental Assessment, 2015
Coral Reef Conservation Program	NOAA	Environmental Impact Statement, 2020
Hawaiki Cable Landing Expansion Project	Hawaiki Submarine Cable USA, LLC	Draft Environmental Assessment, 2024

Over the past 75 years, Campbell Industrial Park and harbor have expanded in size and use, necessitating new construction and other efforts such as dredging. This development has resulted in much of the local area being composed of industrial and commercial operations (Kappel et al. 2017b). This has led to pollution including, for instance, heavy metal contamination of the industrial park's soils (Gomes 2010; Hollier 2011), as well as incidents such as two large ship groundings just outside Kalaeloa Harbor, damaging local corals (NOAA 2025a). Coastal habitat modification, such as new construction near the shore or hardened structures, has also occurred with the expansion and development of the industrial park adjacent to the proposed action area (Kappel et al. 2017a). Neither the state of Hawaii nor the Surfrider Foundation, which also conducts water quality monitoring on Oʻahu, have noted water quality advisories or other events (e.g., sewage spills) in or near the proposed action area in the past seven years (Hawaii Department of Health 2025a; Surfrider Foundation 2024). Onshore drainage ponds associated with Par Hawaii Refining lie adjacent to the proposed action area, but are no longer in use. A stormwater overflow pipe to the south of the proposed action area is rarely used during significant storm events, and the valve is currently closed (personal communications with Par Hawaii representative). As a result, while drainage or runoff may have impacted nearshore waters in the past, particularly during storm events, there is limited information to show that pollution has historically been an issue in or near the waters of the proposed action area, and the current presence of corals suggests water quality is acceptable.

Because the shoreline next to the proposed action area borders Campbell Industrial Park, recreational activities on the beach and in the water are limited. Furthermore, the beach and nearshore bottom are rocky and difficult to access. A surf break exists near the proposed action area, however, little information exists on current use. Other nearby surf breaks north and south of the harbor and industrial park, respectively, are more popular with surfers. Fishing, including both recreational and commercial activities, has historically taken place in and around the proposed action area, although locations further offshore and along the southern coast of Oʻahu are more productive and popular.

While the Campbell Industrial Park and Kalaeloa Harbor have expanded significantly over the past half century, the industrial park now operates at limited vacancy (0.46 percent at the end of 2023) and space for further development is extremely limited (Colliers 2024). As such, actions related to coastal development, shoreline habitat modification and management, or risks of pollution and contamination would be expected to continue at levels similar to recent decades, or be reduced as, for example, state and federal management agencies initiate stricter pollution control, prevention, and cleanup programs (see, e.g., Hawaii's Hazard Evaluation and Emergency Response Office, which identifies multiple pollution sites adjacent to the proposed action area (Hawaii Department of Health 2025b)). It is expected that this and other marine scientific research and monitoring in and near the proposed action area would continue at levels similar to past efforts in the foreseeable future.

The nearby population center of Kapolei has grown rapidly in recent years; its expansion may be expected to continue. Given its inland location, while direct effects of population growth would not be anticipated to overlap the proposed action area, indirect impacts including increasing recreational activities (e.g., fishing) may occur. Consequently, boating, fishing, and other activities may increase in and around the proposed action area in the reasonably foreseeable future, resulting in more vessel traffic in and out of Kalaeloa Harbor, in particular.

Few of the past, present, and reasonably foreseeable actions would be expected to impact physical, biological, and socioeconomic resources in the proposed action area. Because of the proposed action area's location near a relatively rocky shoreline at an industrial park, many recreational uses are limited and their impacts minor (e.g., recreational fishing, boating). With the exception of potential indirect impacts (e.g., runoff from impervious surface coverage), onshore development would have limited impacts on biological resources in the proposed action area. The Proposed Action would not increase any of these impacts further; in contrast, the coral reef may serve as nursery habitat or coverage for other marine species in addition to corals, improving local biological conditions. While maintenance or other research activities could periodically disturb marine species, these localized disturbances would be short term with no long-term impacts on biological organisms or socioeconomic resources. As a result, expected impacts on local fish or benthic organisms would be minimal. Marine species would be expected to avoid areas of disturbance in favor of similar habitat nearby for feeding and foraging during periods of disturbance, reactions similar both for the Proposed Action and other current and reasonably foreseeable actions. Implementation of the Proposed Action combined with other past, present, and reasonably foreseeable actions would not result in significant impacts within the proposed action area.

5. Standard Operating Procedures, Protective Measures, and Conservation Measures

Both SOPs and protective measures would be implemented during the Proposed Action. SOPs serve the primary purpose of providing for safety and mission success, and they are implemented regardless of their secondary benefits (e.g., to a resource). Protective measures are used specifically to avoid or reduce potential impacts to a resource. Table 5-1 lists the SOPs, protective measures, and National Oceanic and Atmospheric Administration (NOAA) Office of Coastal Management Recommended Drone Best Management Practices for the Proposed Action. As described in Section 0, lidar surveys would be conducted of the proposed action area. NOAA's best practices will be followed when Unmanned Aerial Systems (UAS) are used for surveys.

Table 5-1. SOPs, Protective Measures, and Drone Best Management Practices

Measure	Details
SOPs	Personnel on lookout onboard the vessels would conduct visual monitoring for marine species during all operations.
	All lookouts aboard platforms involved in the Proposed Action would review the NMFS-approved Marine Species Awareness Training material prior to RMS deployment.
	Lookouts shall be trained in the most effective means to ensure quick and effective communication to facilitate implementation of mitigation measures if marine species are spotted.
	Personnel on lookout on the deck of the vessels would have a set of binoculars available for each person to aid in the detection of large fish, marine mammals, and sea turtles.
	All vessels would use extreme caution and proceed at a "safe speed" so proper and effective action can be taken to avoid a collision with any sighted object or disturbance, and the vessel can be stopped within a distance appropriate to the prevailing circumstances and conditions.
	Movement of the vessels would be limited to a maximum speed of five knots within the proposed action area.
	Any temporary equipment deployment and retrieval would not occur under high surf conditions, except for efforts to avoid or minimize resource damage.
	Minimize anchor drag by periodic visual observation to monitor dragging and to identify if proper tension is being maintained on the line and monitor ocean conditions that might affect the anchor's functionality.
Protective Measures for Deployment/Installation and Monitoring Activities	The action agency and any permittee shall ensure that all personnel associated with the project are instructed about the potential presence of species protected under the ESA and the MMPA. All on-site project personnel are responsible for observing water-related activities for the presence of protected species. All personnel shall be advised that there are civil and criminal penalties for harming, harassing, or killing listed species and all marine mammals. To determine which protected species and critical habitat may be found in the proposed action area, personnel will review the relevant marine mammal and ESA-listed species at Find A Species (https://www.fisheries.noaa.gov/findspecies) and the consultation documents that have been completed for the project.
	All work shall be postponed or halted when ESA-listed marine species are within 164 ft (50 m) of the proposed work, and will only begin/resume after the animals have voluntarily departed the area. If ESA-listed marine species are noticed within 164 ft (50 m)

Measure	Details
	after work has already begun, that work may continue only if, in the best judgement of a biologist, the activity will not adversely affect (i.e. disturb or harm) the animal(s). For example: divers performing underwater work (excluding the use of toxic chemicals) such as surveys would likely be permissible, whereas operation of heavy equipment is not.
	Temporary deployed monitoring equipment and RMSs deployment/installation would not occur within a 164 ft (50 m) radius around any observed marine mammal or sea turtle.
	In-water surveys would be conducted in the site prior to the deployment of RMSs.
	When a diver is involved in the proposed action area, the diver would do their best to avoid ESA-listed species. If an animal traverses within 164 ft (50 m), however, the diver would take into account his/her own personal safety.
	In-water lines would be non-looping with no excess line allowed in the water (i.e., taut at high tide).
	Vessel anchor placement and temporary equipment deployment would not occur on any non-encrusting corals over 4 in (10 cm) in height found within the proposed action area. Provided it is safe to do so, divers (or small ROV) would assist in the placement of the vessel anchors to avoid non-encrusting coral over 4 in (10 cm) in height, when necessary.
	Monitoring will occur post-deployment, two months post-deployment, and every five years to assess the anchoring system. At the time of this consultation, UH is seeking additional funding for long-term surveys to understand the effectiveness of the hybrid-reef system. Long-terms surveys will include the following: quarterly underwater photogrammetry to assess coral health, recruitment and growth; continuous passive acoustic surveys with data being analyzed quarterly; and periodic environmental DNA sampling to measure the changes in quantity and relative abundance of the corals between a control site and the proposed action area. Any diver surveys would include identification and removal of any marine debris from the structures that may create a hazard to the hybrid-reef system or marine life in the area.
	If any RMS was deployed in an area where there was non-encrusting coral over 4 in (10 cm) in height and there was no other suitable location for the RMS then that coral would be used as a coral of opportunity and transplanted to the designated coral nursey (Section 0).
	Mortar epoxy (e.g., HIT-RE 500 V3) that is needed to secure the anchor bars up to 10 ft (3 m) into the seafloor would only be used within the seafloor to secure the anchor bars. It would not be used in the benthic environment where any foraging would occur or have the potential to leach into the environment. Additionally, once mortar epoxy has hardened it is certified safe by the National Science Foundation.
	Monitoring equipment would be placed in open areas with a minimum distance of 6.5 ft (2 m) from any non-encrusting corals greater than 4 in (10 cm) in height, when practicable.
	Monitoring equipment would be placed in open areas with a minimum distance of 6.5 ft (2 m) from any non-encrusting corals greater than 4 in (10 cm) in height, when practicable.
	Vessels would reduce speeds to 5 knots or less when approaching the proposed action area and even less when deploying RMSs.
	Provided it is safe to do so, divers would be present in the water during ROV installation of anchor bars to ensure environmental impacts are avoided.
	Equipment would be lowered to the seafloor slowly to ensure turbidity from deployment of equipment would be minimal and any suspended sediment would quickly settle and for the safety of equipment.
	Temporary deployed equipment would be clean and free of pollutants.

Measure	Details
	If an ESA-listed species is adversely affected as a result of the project, all work must stop until coordination with NMFS has been completed.
	All interactions with listed species must be documented and reported to NMFS in daily monitoring logs. The monitoring logs will be submitted in a digital and searchable format to NMFS, with the following information: Total hours and dates of monitoring, Identification of which ESA species were observed and in what location and circumstances, including date, numbers of individuals of species observed, the outcome of the species observance relative to the authorized project, and any factors which may have affected visibility If applicable, observed ESA species behaviors and movement types relative to the project activity at time of observation All monitoring logs must be submitted to the NMFS within 90 calendar days of the completion of the project.
(NOAA) Office of Coastal Management Recommended Drone Best Management Practices	Drone operators must follow all established NOAA, Federal Aviation Administration (FAA), and International Civil Aviation Organization requirements and practices, including: (i) Drone operators must be certified with a FAA Part 107 drone pilot license; (ii) Drone operators must yield the right of way to manned aircraft; (iii) Drones will not fly directly over people; (iv) Drone operations will occur only during civil daytime; (v) Visual line-of-sight must be maintained by the operator or a visual observer who can provide immediate flight commands to the operator; and (vi) Drone operators will actively avoid aerial hazards (i.e., other aircraft, birds, and vessels).
	Drones shall be operated in a way as not to disturb wildlife.
	Any action involving drone operations with sustained flight below 100 m will require discussion and potential consultation or permitting under the ESA, Migratory Bird Treaty Act, Airborne Hunting Act, and/or Fish and Wildlife Coordination Act with the USFWS Migratory Bird and Ecological Services Divisions prior to the action to complete environmental compliance.
	If marine mammals are hauled out, the drone operator will not fly the drone within 200 feet of the mammal.
	Drones will not approach within 20 meters of ESA-listed butterfly habitat.
	Drones will not approach within 200 feet of ESA-listed birds or bats, as well as occupied habitat. Prior to drone use, the flight path will be inspected for potential occupancy by ESA-listed species.
	Deviation from these practices will also require discussion and potential consultation or permitting under the Endangered Species Act, Migratory Bird Treaty Act, Airborne Hunting Act, and/or Fish and Wildlife Coordination Act with the USFWS Migratory Bird and Ecological Services Divisions and / or NMFS PRD prior to the action.
	For areas with established drone operations manuals and guidance, such guidance must be discussed with the USFWS and / or NMFS and amended as appropriate if such discussions and revisions have not already taken place. When such manuals or guidance are established, they must be followed for all drone operations. Deviations from requirements here in related to wildlife protection are acceptable if approved by USFWS and / or NMFS for their respective trust resources.
	Any behavioral disturbances from ESA-listed species must be reported immediately to NMFS. Examples include: (i) Hauled out pinnipeds move or alter body position to look up; (ii) Animals purposefully moving away, including entering the water; (iii) Diving to get away.
	Should any UAS make an emergency landing in the water, the UAS will be retrieved as immediately as possible to minimize potential for pollution to the marine environment small boats will be deployed.

Relationship between Short-Term Use of the Environment and Long-Term Productivity

NEPA requires an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This refers to the possibility that choosing one development site reduces future flexibility in pursuing other options, or that using a parcel of land or other resources often eliminates the possibility of other uses at that site.

In the short-term, effects to the human environment with implementation of the Proposed Action would primarily relate to disturbance of the seafloor and biological resources within the immediate vicinity during deployment of the RMSs. These impacts would be minimal and short-term. In contrast, the Proposed Action would have beneficial long-term effects to the human environment. The RMSs would act as hybrid reefs, encouraging increased biomass and biodiversity within the area, and demonstrate wave attenuation for shoreline protection. As such, the Proposed Action would not result in any impacts that would significantly reduce environmental productivity or permanently narrow the range of beneficial uses of the environment.

Irreversible or Irretrievable Commitments of Resources

Resources that are irreversibly or irretrievably committed to a project are those that are used on a long-term or permanent basis. This includes the use of non-renewable resources such as metal and fuel, or natural resources. These resources are irretrievable in that they would be used for this project when they could have been used for other purposes. Human labor is also considered an irretrievable resource. Another impact that falls under this category is the unavoidable destruction of natural resources that could limit the range of potential uses of that particular environment.

Although the Proposed Action would use non-renewable resources (e.g., boat fuel, concrete for RMSs) and natural resources (e.g. live rock and coral), the mission of the Reefense program is intended to create a hybrid reef. Non-renewable resources would create a structure that is self-sustaining, and not require future inputs of non-renewable resources. Long-term, the Kalaeloa Hybrid Reef project provides a prototype solution that is less dependent on non-renewable resources than similarly sized hardscape solutions (e.g., breakwaters), that require additional inputs of resources for repair. As such, the Proposed Action would not result in significant irreversible or irretrievable commitment of resources.

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Appendix A Details of Biological and Structural Components

Up to 1,300 coral settlement modules would be attached to the RMSs to add three-dimensional habitat and encourage recruitment of coral, other sessile invertebrates (e.g., sponges, tunicates, oysters) and herbivorous reef fish. The two control and three treatment designs are patented (Figure A-1). All are made of concrete and have a diameter of 19.6 inches (in; 50 centimeters [cm]), a height of 9.8 in (25 cm), and a weight of no more than 50 pounds (lbs; 22 kilograms [kg]). Coral settlement modules have internal cave systems and would be attached to the perforations in the RMSs by underwater drilling (Section 0). A 1 in (2.54 cm) diameter polyvinyl chloride (PVC) pipe may be inserted across some of the coral settlement modules to provide additional habitat for fish larvae recruited to the reef.

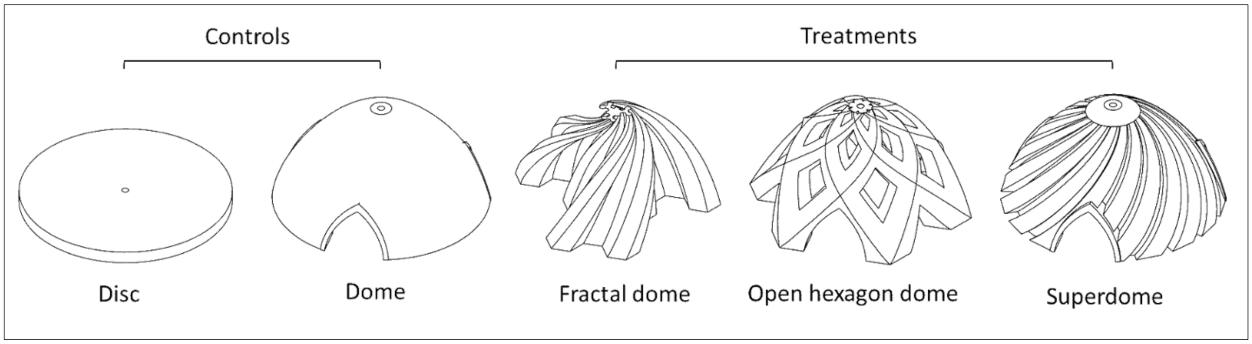


Figure A-1. Coral Settlement Modules

Portions of the RMSs and coral settlement modules would be coated with a solution to enhance coral recruitment and reduce algae growth (Figure A-2). Less than 20 liters of solution would be used, and it would be from locally-sourced materials, such as alginate from seaweed and components isolated directly from local crustose coralline algae and corals. Additional biodegradable and non-toxic molecules may be included (less than 20 liters total) to concentrate the solution for the experiment. Other molecules may include gelatin (used in food preparation), mineral oil (used in moisturizers), polyethylene glycol (used in laxatives), polydimethylsiloxane (used in children's toys, including silly putty and kinetic sand), silica (used in food and cosmetics), liposomes (used in gel capsules for human consumption), hydroxyapatite (mineral in bones), calcium carbonate (mineral in coral skeletons), and cellulose (molecule from plant cell walls). Researchers may also use up to 5 liters of solution with less than 1% volume of biomass containing the bacterium *Cellulophaga lytica* and up to 5 liters of solution with less than 1% volume of biomass of green micro algae *Marinichlorella kaistiae* both sourced from Hawaiʻi (provided by Kewalo Marine Laboratory).

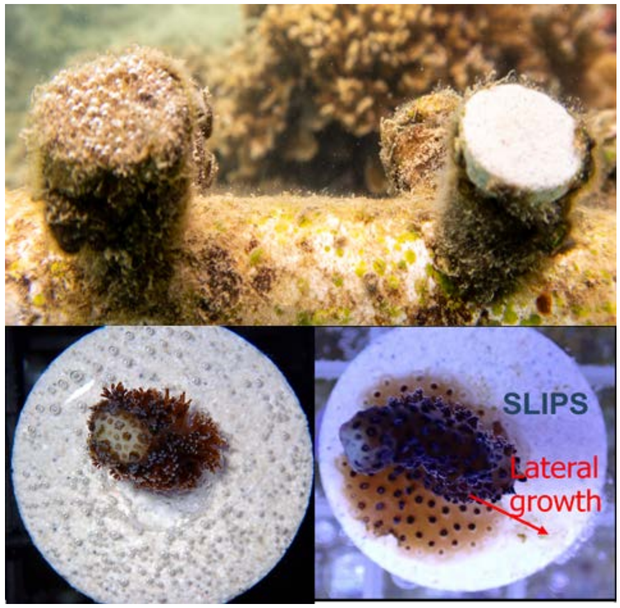


Figure A-2. Natural Solution used to Reduce Algal Growth (top right) and Enhance Coral Growth (bottom)

Coral growth modules (CGMs) would also be attached to the RMSs to stimulate rapid coral growth and provide additional fish habitat, wave attenuation, and structural support, thus improving the ecological function and resilience of the entire hybrid reef. Corals would be directly attached to the RMSs (up to 1,000 corals) or attached to up to 500 CGMs, which are then attached to the RMSs. In total, this process would create up to 8,073 square feet (ft^2; 750 square meters [m^2]) of coral cover. Coral stock would primarily be from loose corals not attached to an intact reef or preemptively removed from the proposed action area to avoid negative impacts from deployment of RMSs. These corals are referred to as "corals of opportunity" and could originate from the Kalaeloa area. Coral species may include *Montipora capitata, M. flabellata, M.patula, M. studeri, Pavona duerdeni, P. varians, Pocillopora grandis, P. ligulata, P. meandrina, P. acuta, Porites compressa, P. lobata, P. evermanni, P. brighami, P. stellata, Leptastrea bewickensis, L. purpurea, Cyphastrea ocellina, Psammocora stellata, P. explanata*. (Figure A-3).

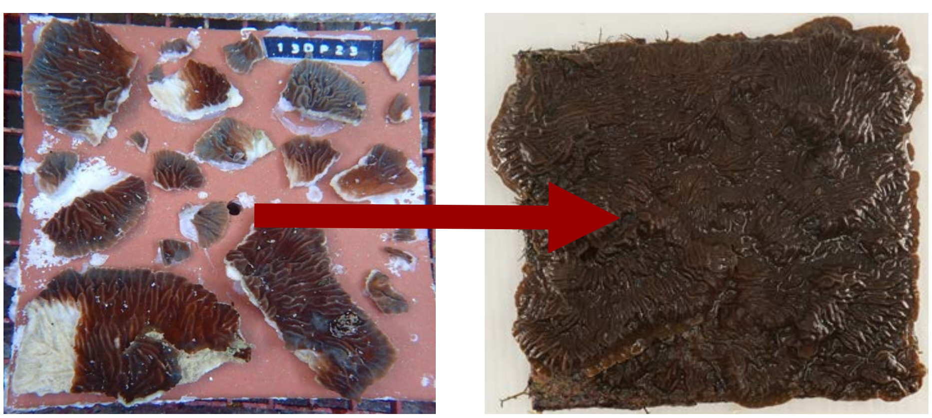


Figure A-3. Concrete CGM Grown Over by Adult Fragments that Fused into a Whole Colony

The coral fragments would be attached to CGMs via cyanoacrylate glue, marine epoxy, and/or LOCTITE HY 4090. CGMs would be attached to the RMSs on land, prior to deployment, using stainless steel threaded rods capped with a nut and washer, and reef-safe epoxy (e.g., Loctite HY; cyanoacrylate, silicone, and/or polyurethane) or a similar method. CGMs may be attached to the tops and sides of the RMSs, and possibly also over footings with anchor bars. Additionally, 56 "mini-ARMS" consisting of up to 10 layers of plastic sheets (20 cm x 20 cm x 20 cm total) would be attached to 28 of the reef crest structures (2 CGMs per reef crest structure) to test the effect of coral diversity on coral growth and general biodiversity. Researchers would attach mini-ARMS using threaded bolts that have been glued to the top of the CGMs. Mini-ARMS would be scraped and recruited organisms would be consumed during post-processing.

Figure A-4. CGM (left) with Pre-drilled Holes to Fit Aragonite Plugs that Hold Juvenile Corals (right)

Up to 10 of the CGMs and coral settlement modules may have battery-powered coral feeding units (Underwater Zooplankton Enhancing Light Array [UZELA]) (Figure A-5) within the module to encourage nighttime feeding of newly recruited corals and adult colonies, especially during periods of temperature stress when the corals may be compromised (e.g., bleached) and unable to gain nutrients via photosynthesis. Lights would be programmed to turn on for one hour each night. Full reef designs are provided in Figure A-6 (reef crest) and Figure A-7 (back reef).

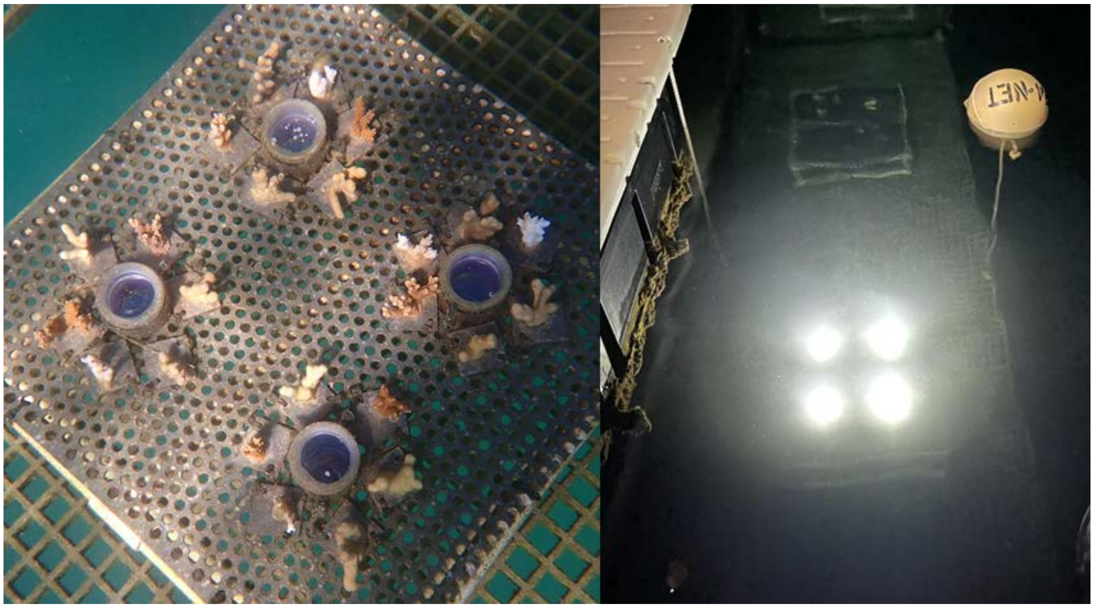


Figure A-5. UZELA Underwater Lights

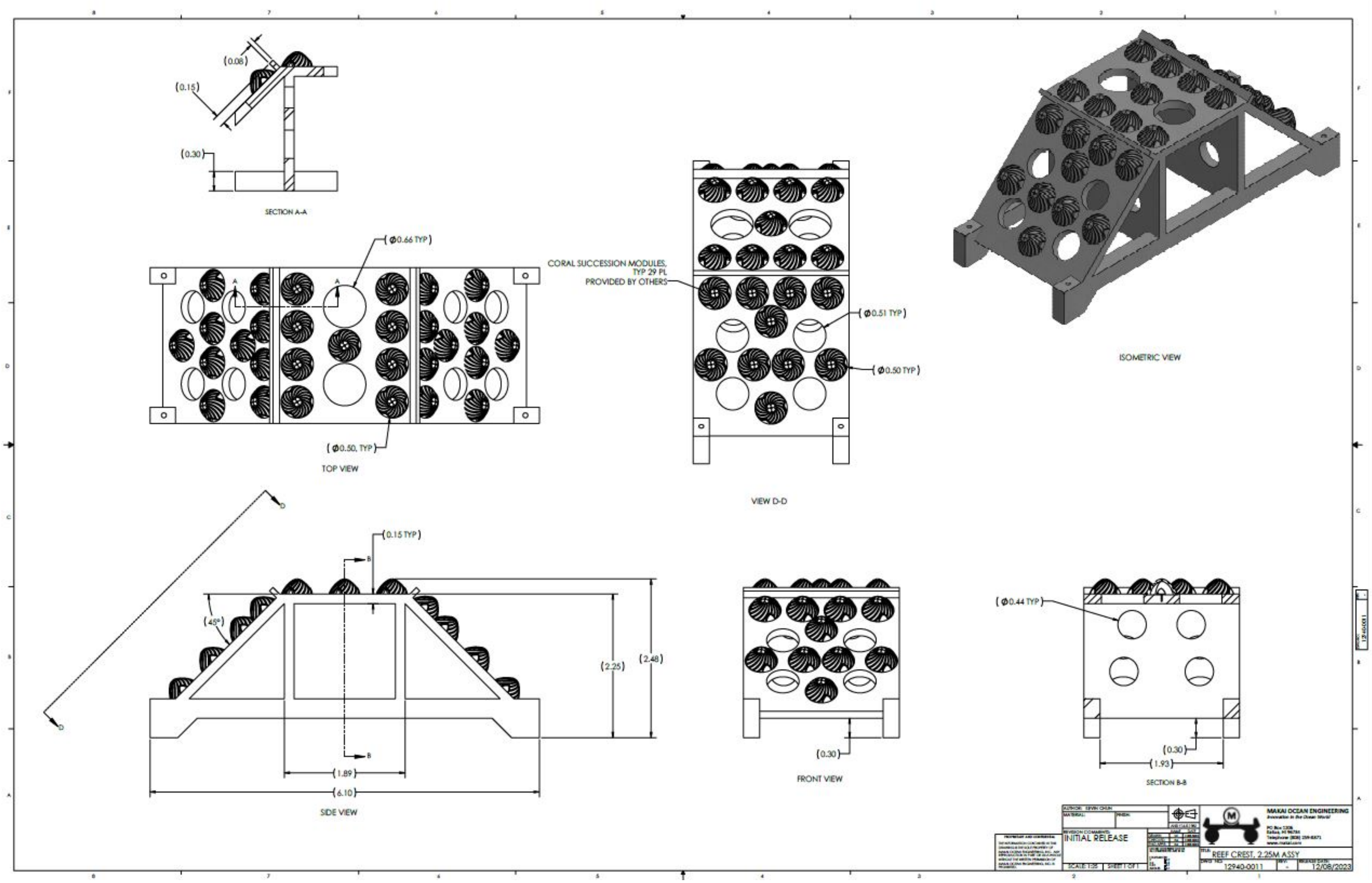


Figure A-6. Reef Crest Design Drawings (units in meters)

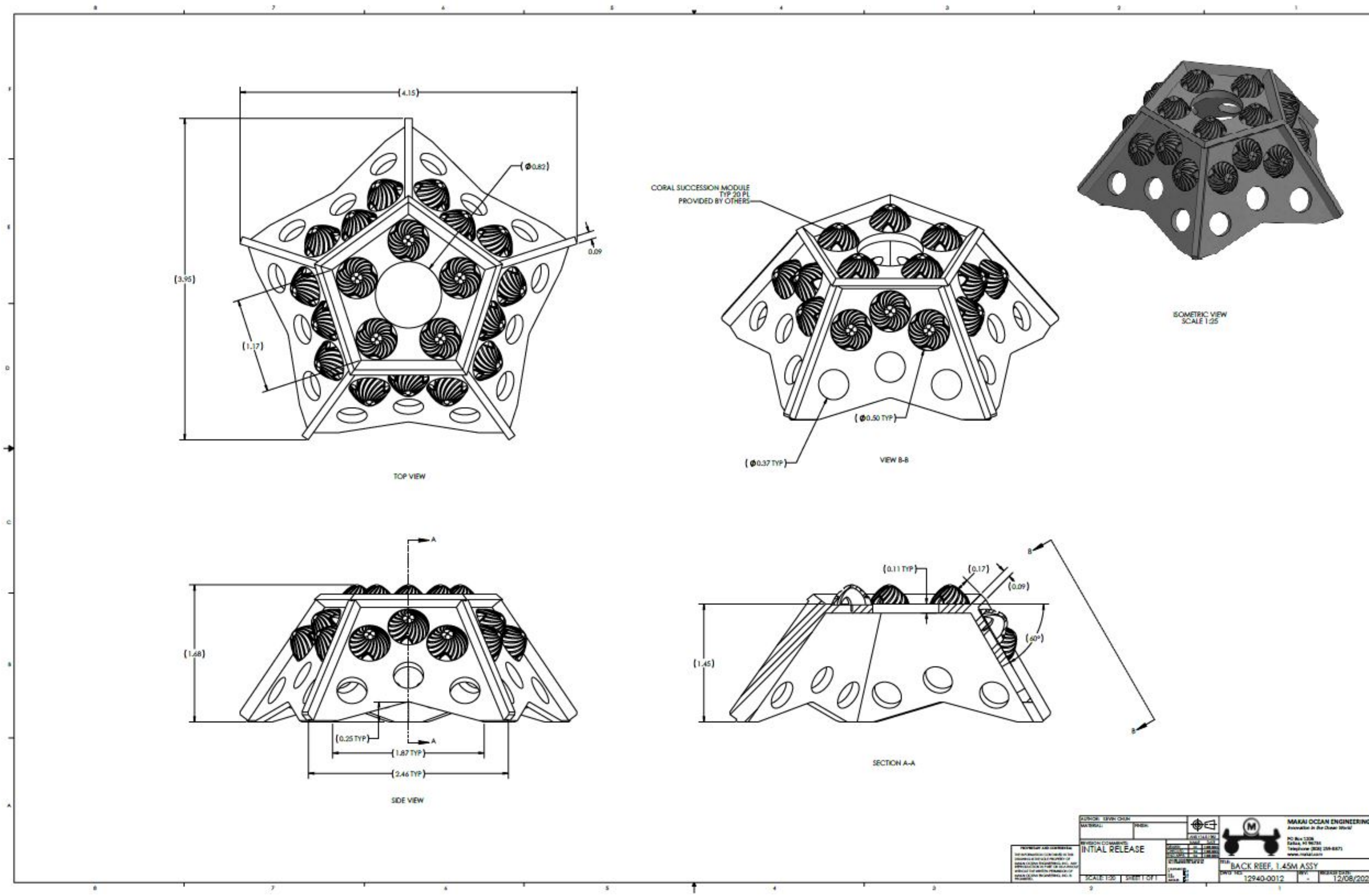


Figure A-7. Back Reef Design Drawings (units in meters)

Vertical Clearance of Hybrid Reef Array and Navigational Aids

Similar to nearby fringing and patch reefs, tides and weather conditions would determine whether RMSs would be fully submerged or at the water surface level. Vertical clearance is helpful for ingress/egress of marine life, reducing potential navigational hazards, and leaving the sight lines and aesthetics of the shoreline intact. The shallowest reef crest structures would be fully submerged, at an estimated 1.31 ft (0.40 m) depth below the water's surface at Mean Lower Low Water (MLLW) and 0.93 ft (0.28m) below water's surface at the Lowest Astronomical Tide (LAT). There may be other structural components attached to the top of the RMSs (such as coral settlement modules and/or CGMs with intentional gaps between each as shown in Figure A-6 and Figure A-7). These components would add approximately 0.82 ft (0.25 m) to the prototype height, resulting in the shallowest reef crest structures being 0.82 ft (0.25 m) below the surface at MLLW and 0.43 ft (0.13 m) below the surface at LAT. The shallowest back reef structures are estimated to be 2.23 ft (0.68 m) below the surface at MLLW and 1.84 ft (0.56 m) below the surface at LAT. If coral settlement modules are attached to the top of the back reef structures, these structures would be an estimated 1.80 ft (0.55 m) below the surface at MLLW and 1.42 ft (0.43 m) below the surface at LAT. Due to the sloping bottom, these numbers represent the shallowest structures in the array.

Up to 10 white marker poles would be deployed to designate the boundaries of the hybrid-reef array. The marker poles would be attached directly to RMSs at the corners and sides of the array. These marker poles would be similar to those deployed by the Department of Aquatic Resources to designate patch reef locations in Kāneʻohe Bay (Figure A-8).

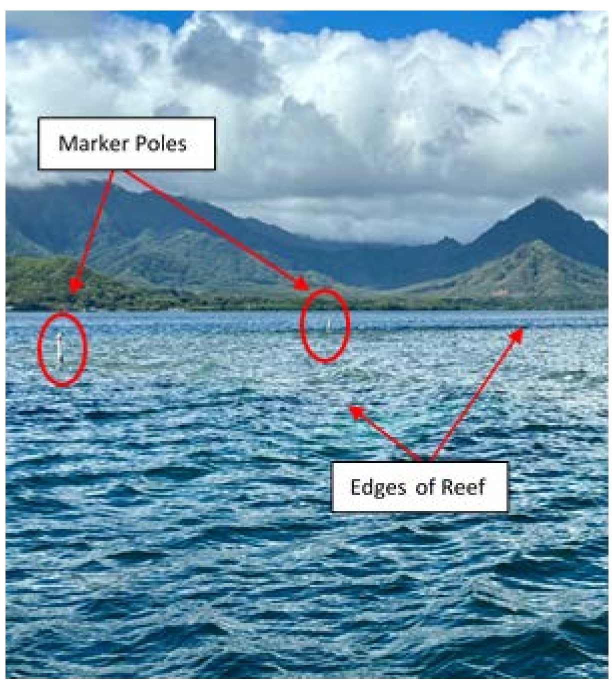


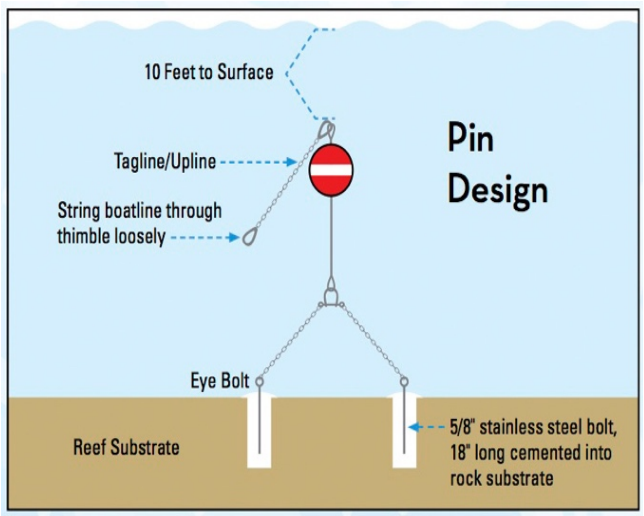
Figure A-8. Marker Poles Identifying a Patch Reef in Kāneʻohe Bay, Oʻahu

Anchor Bars and Subsurface Moorings

A cross section of an anchor bar installed into the substrate is shown in Figure A-9 (left). The anchor bar will be less than 3.15 in (8 cm), shown in Figure A-9 on the top right. Figure A-9 on the bottom right shows where the anchor bars will be placed on a RMS.

Figure A-9. Anchor Bar Design and Placement

Day-use moorings have proven to be an effective tool to prevent reef damage by enabling boats to tie up to mooring buoys instead of dropping anchors that would potentially land on coral reefs (Malama Kai Foundation 2024). To ease operations and limit impacts to the site, three subsurface moorings would be deployed within the proposed action area. One subsurface mooring would be deployed along each side of the hybrid reef. Anchoring of the subsurface moorings would be similar to the RMS anchoring process (Section 0). This method would have the least impact on the substrate. Depending on results of the load testing, up to two mooring plates (24 by 64 in each) (Figure A-10) per subsurface float may be placed on the seabed (up to 10 mooring plates total). Each plate is held down by up to three anchor bars, with a welded padeye and shackles that would connect to a stainless steel chain or nylon line and a subsurface float (diameter of approximately 18 in). This method is rated for 90,000 lbs (40,800 kg), which aligns with the proposed vessels and activities for this project.



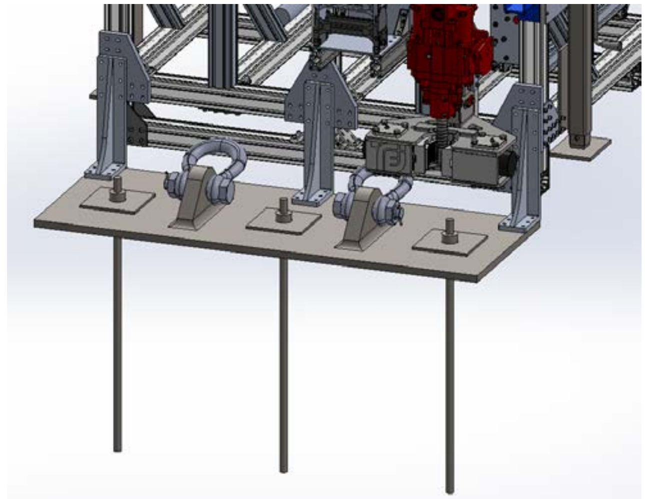


Figure A-10. Subsurface Moorings Design

Appendix B Monitoring Equipment

Monitoring equipment in Table B-1, Figure B-1, and Figure B-2 would be attached directly to RMSs. Equipment would either be attached to the RMSs prior to deployment and lowered with the RMSs from the barge or installed by divers via a support craft (Section 0) post- deployment of the hybrid-reef array. The instruments are small standard oceanographic testing equipment that would be attached (via bolts, zip ties, or similar method) to monitor structural integrity, flow patterns, and other environmental conditions.

Table B-1. Monitoring Instruments Attached Directly to the RMSs

Instrument Name	***Function***	***Count***	***Area (m^2)***	***Length (m)***	***Width (m)***	***Height (m)***
Acoustic Doppler Velocimeter (ADV)	Measures instantaneous velocity at a point	12	0.04	0.23	0.16	0.18
Strain Gauge	Measures strain on the RMS	12	0.009	0.17	0.05	0.05
SeaBass system main bottle with a 3-10m cable	Helps resolve sediment dynamics near the toe of the reef structure	1	0.14	0.63	0.22	0.22
SeaBASS system Blueview M900-2250 sonar	Helps resolve sediment dynamics near the toe of the reef structure	1	0.03	0.21	0.13	0.13
RBR Solo-DWave16 data logger	Pressure sensors which provides high resolution wave data	5	0.03	0.4	0.07	0.07
Odyssey PAR logger + Wiper	Measure photosynthetic active radiation near coral	3	0.02	0.16	0.09	0.09

Figure B-1. RBR Solo-DWave16 Data Logger (left); Strain Gauges (middle), Acoustic Doppler Velocimeter (right)

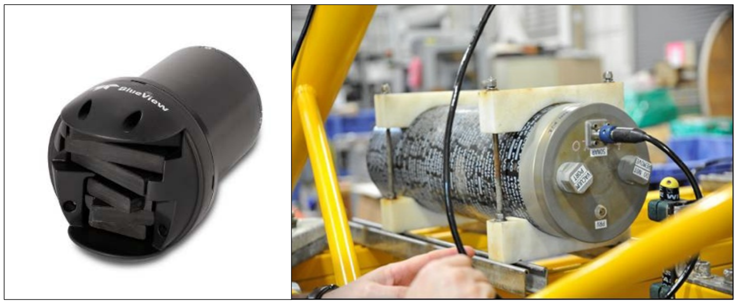


Figure B-2. SeaBASS System Blueview M900-2250 Sonar (left); SeaBass System Main Bottle with Cable (right)

Monitoring equipment described in Table B-2 through Table B-5 and displayed in Figure B-3 through Figure B-5 would be placed on the seafloor adjacent to the hybrid-reef array. These instruments would either be lowered from the barge or installed by divers via a support craft (with a liftbag if necessary) post-deployment of the array. The instruments are standard oceanographic testing equipment to monitor oceanic conditions, flow patterns, and other environmental conditions. The instruments would not require anchoring, but they would be weighed down by ballasted grid frames. Their footprint on the seafloor would be less than 11 ft^2 (1 m^2) each. The tables and figures below are organized by each instrument set that would be deployed together on the same ballasted grid frame, in no particular temporal order.

Table B-2. Instrument Deployment #1: Instruments Deployed Adjacent to the Hybrid Reef Array

Instrument	*Count*	*Function*	*Depth (m)*	*Area (m^2)*	*Length (m)*	*Width (m)*	*Height (m)*	*Weight (lb)*
Nortek Acoustic Wave & Current Profiler (AWAC)	1	Acoustic surface tracking to measure wave height, direction, and current profile	6-8	0.57	0.61	0.92	0.61	150-200 (*frame*)
Battery Canisters	2							

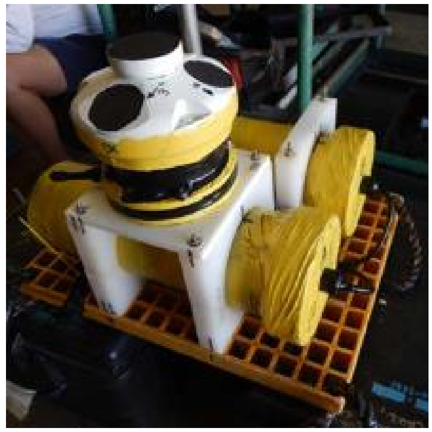


Figure B-3. Instrument Deployment #1. A Nortek Acoustic Wave and Current Profiler (AWAC) and Two Battery Canisters Attached to a Flat Gridded Plate (600 kHz Acoustic Transmission with Four Beams; Three are Slanted at 25 degrees and One is Vertical with 3.1 Degree Beam Width) Deployed

Table B-3. Instrument Deployment #2: Instruments Deployed Adjacent to the Hybrid Reef Array

Instrument	*Count*	*Function*	*Depth (m)*	*Area (m^2)*	*Length (m)*	*Width (m)*	*Height (m)*	*Weight (lb)*
Nortek Signature 1000	3	Releases sound waves to measure the speed & direction of currents	4-6	0.32	0.61	0.61	0.51	150-200 (*frame*)
RBR Virtuoso Dwave Logger	1	Pressure logger						
Seabird MicroCAT	1	Conductivity & temp. recorder						
RBR Tu with ZebraTech Hydro Wiper	1	Turbidity logger						
HOBO Water Level Data Logger	10	Measures water level	2-10	0.007	0.16	0.04	0.04	0.4
Surface floater	10	Locates the HOBO sensors	2-10	0.13	0.31	0.36	0.36	5
Lead weight	20	Secures the floaters	2-10		0.18	0.11	0.06	10-20
Rope	10	Connects the floater to the lead weights	2-10	0.052-0.26	4-20m	0.013	0.013	2.5

Table B-4. Instrument Deployment #3: Instruments Deployed Adjacent to Hybrid Reef Array

Instrument	*Count*	*Function*	*Depth (m)*	*Area (m^2)*	*Length (m)*	*Width (m)*	*Height (m)*	*Weight (lb)*
Nortek Signature 1000	1	Sound waves to measure the speed & direction of currents	4-6	0.38	0.61	0.61	0.51	150-200 (*frame*)
RBR Virtuoso Dwave Logger	1	Pressure logger						

Figure B-4. Instrument Deployment #2/#3: One Nortek Signature 1000 (right); One RBR Virtuoso Dwave Logger (left; black star); One Seabird MicroCAT (bottom right); One RBR Tu (middle-bottom; blue star) Deployed Together on a Ballasted Frame with a Vertical Bar for Securing the Sensors

Table B-5. Instrument Deployments #4-9: Monitoring Equipment Deployed Adjacent to the Hybrid Reef Array

Instrument	*Count*	*Function*	*Depth (m)*	*Area (m^2)*	*Length (m)*	*Width (m)*	*Height (m)*	*Weight (lb)*
RBR Virtuoso Dwave Logger	1 per frame *(total of 6)*	Pressure logger	1-6	0.38	0.61	0.61	0.51	100 (*frame*)

Figure B-5. RBR Virtuoso Dwave Logger Would be Deployed Individually on Ballasted Frames at Six Locations Across and Adjacent to the Hybrid Reef Array

Kilocams and Lights

Kilocam cameras (Figure B-6; bottom right) would be used to monitor fish settlement. Up to 30 autonomous kilocams would be mounted in PVC housings (9 in [23 cm] long; 2 in [5 cm] diameter; submerged weight 1.1 lbs [0.5 kg]) to RMSs using zip ties and hose clamps. Half of the cameras would be accompanied by an underwater light inside PVC housings (13.8 in [35 cm] long; 2 in [5 cm] diameter). The lights would also be directly attached to RMSs using zip ties and hose clamps. The lights would emit white light with a daylight spectrum for five seconds every five minutes with the intention of allowing cameras to take pictures of nighttime activity of fish settlement.

Passive Acoustic Monitoring Equipment

Up to nine passive acoustic "SoundTrap" recorders would be deployed to record the activity of fish and other biota (e.g., crustacean) in the vicinity of each recorder as well as to assess the impacts of the underwater speakers across a gradient. Each SoundTrap is roughly the size of a soda can (4.7 in [12 cm] long by 1.57 in [4 cm] in diameter). They would be mounted on a sand anchor that is attached to the seafloor, attached to another seafloor-mounted instrument, or mounted on the end of a 2-ft (0.6-m) rod, with the other end mounted to a hybrid-reef base unit. These devices cannot be attached directly to a RMS because the dynamic fluid flow occurring through the energy-dissipating holes in the RMSs generates acoustic flow noise that interferes with the monitoring. The sand anchors would be deployed next to the RMSs, evenly spaced along the lateral dimensions of the structure (i.e., possibly placed every

20 ft [6 m] along the shoreside of the hybrid reef array). Submerged weights would be 1.1 lbs (0.5 kg) each.

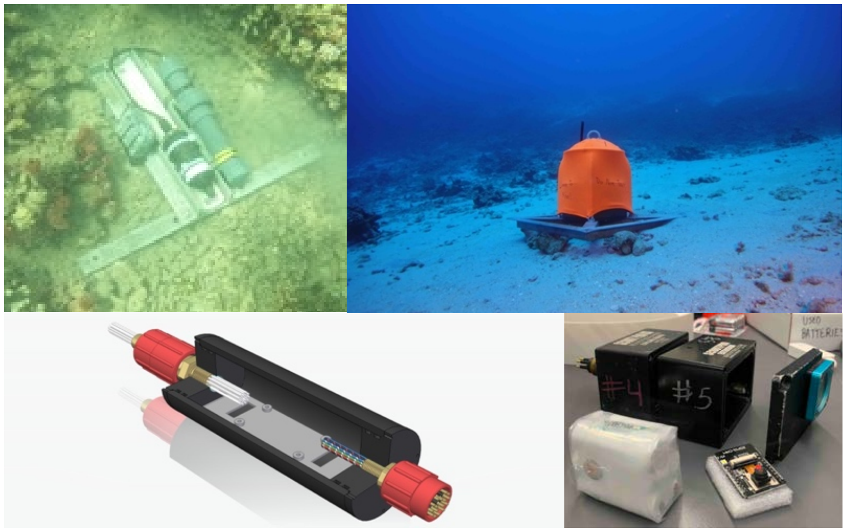


Figure B-6. Reef Sounds can be Recorded using a Soundtrap (top left), DASAR (top right), or Wilcoxon Recorder (bottom left). Productivity at a Playback Site would be Monitored by Kilocams (bottom right).

Vector sensor modules (VSMs) would be deployed to record directionality of fish and crustacean activity within 66 ft (20 m) of each recorder. Up to six “Wilcoxon” VSMs would be evenly-spaced along the hybrid-reef array using sand anchors attached directly to the seafloor or mounted on another seafloor-mounted instrument. The dimensions of the pressure cases for the VSMs are 14 in (36 cm) long with a diameter of 5.1 in (13 cm). Submerged weights would be 2.2 lbs (1 kg) each. An additional two “DASARs” would be deployed for specialized detection of low-frequency fish sounds for two months a year during the summer. A DASAR has a 2 ft (60 cm) by 2 ft (60 cm) footprint on the seafloor, using sand anchors or stakes attached directly to the seafloor. The DASAR height is about 2 ft (60 cm).

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Appendix C Public Outreach and Community Engagement

Additionally, DARPA and the UH team have engaged with the public in a variety of ways:

- Ongoing engagements with community representatives on long-term monitoring plan (December 2025-present).
- Site visit to RMS manufacturing site at Jensen Infrastructure precast yard with Hoʻola Hāniʻo and Makakilo–Kapolei–Honokai Hale Neighborhood Board No. 34 (November, 2025).
- Site visit to beach adjacent to proposed project site with Hoʻola Hāniʻo (November, 2025)
- Presetation to Makakilo–Kapolei–Honokai Hale Neighborhood Board No. 34 (August 2025).
- Presentation to Kapolei Hawaiian Civic Club and Kuaʻāina ulu ʻAuamo (KUA) Limu Hui (July 2025).
- Presentation to Kalaeloa Heritage and Legacy Foundation Board (July 2025).
- Presentation to Shad Kane of the Kalaeloa Heritage Park (June 2025).
- Presentation to Kāneʻohe Neighborhood Board (June 2024).
- Presentation to Dept. of Land and Natural Resources Fishers Working Group (Dec. 2024)
- Presentation to Kailua Neighborhood Board Planning, Zoning, and Environment Committee (March 2024)
- Presentation to Kailua Neighborhood Board (March 2024).
- Discuss in person with Hui o Koʻolaupoko (March 2024).
- Presentation to Ke Kula Nui o Waimānalo/Waimānalo Pono Research Hui (January 2024).
- Engagement with Koʻolaupoko Hawaiian Civic Club (multiple 2021- 2024).
- Email communications with Kimeona Kane (808 Cleanups/Waimānalo Neighborhood Board; October 2022).

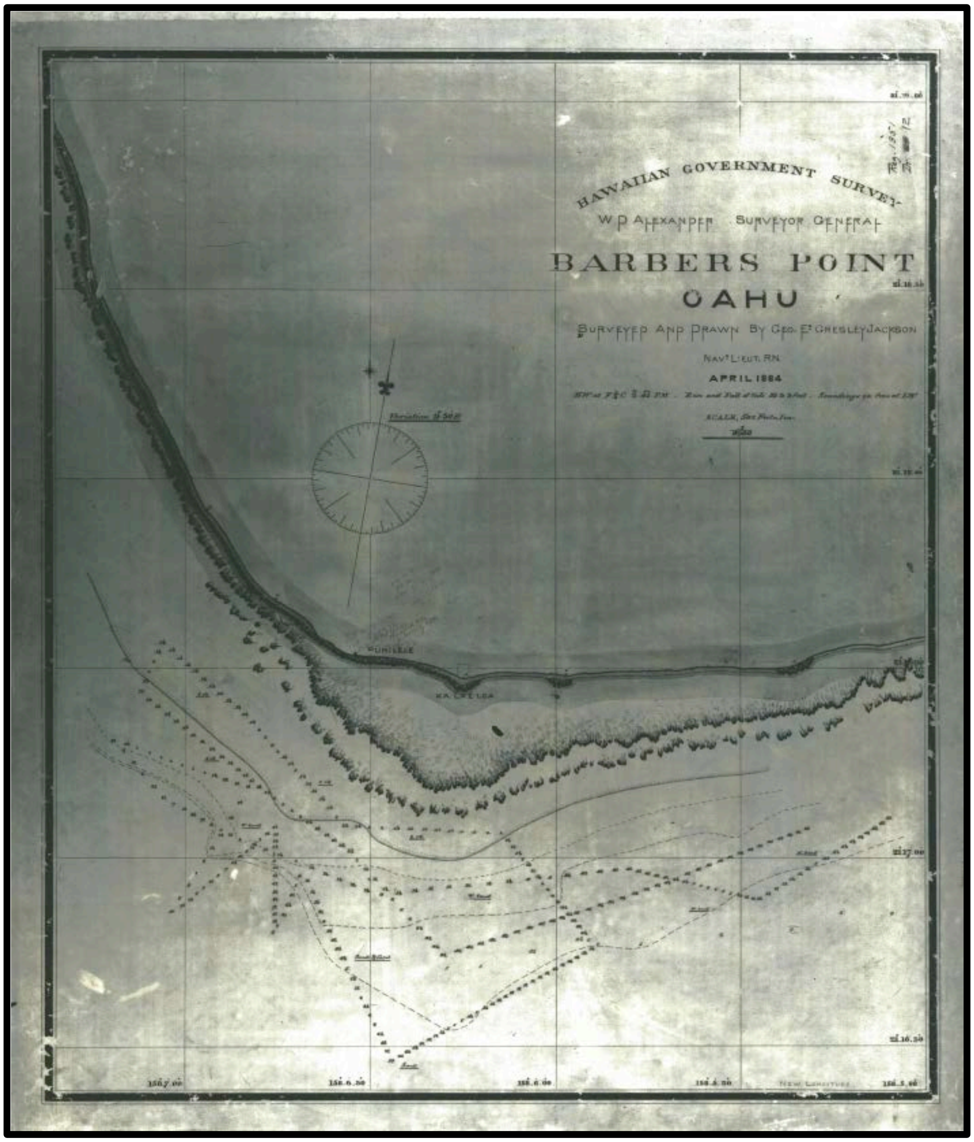
Researchers from UH have developed numerous outreach materials for the Proposed Action:

- Portable wave tank with 3D printed RMS units;
- Large poster map of RMS layout in location (with satellite view);
- 3D model with RMS layout;
- Coral bleaching and resilience kit;
- Informational pamphlets;
- Powerpoint presentation; and
- Copies of articles released about the project.

- News releases:
  - "Researchers Hope a New Hybrid Reef Will Help Save Coral in Hawaii", *Honolulu Civil Beat*, April 12, 2023.

- "UH to develop living coastal-protection system inspired by coral reefs", *University of Hawaiʻi News,* June 17, 2022
- University of Hawaiʻi New Video, *YouTube*, June 17, 2022
- Voice of the Sea Episode, *YouTube*, August 10, 2023
- "Coral Reefs Inspire Hawaiʻi Coastal Protection System", *Big Island Video and News,* June 18, 2022
- "Can Hybrid super reefs defend the coasts? UM leading research for military project," *WUSF NPR,* January 14, 2023
- "Makai part of $25M Artificial Reef Project led by University of Hawaii", *Makai Ocean Engineering,* August 10, 2022
- "Makai Ocean Engineering to Participate in $25M Artificial Reef Project," *Ocean News,* August 2, 2022
- "Makai Ocean Engineering to Participate in $25M Artificial Reef Project," *Environmental, Coastal and Offshore,* August 2, 2022
- "UH developing engineered living defense- inspired by coral reefs- to project coastline," *Maui Now,* June 17, 2022
- "UH to Develop Living Coastal-Protection System Inspired by Coral Reefs," *Kauaʻi Now*, June 27, 2022
- "UH to Develop Living Coastal-Protection System Inspired by Coral Reefs," *Big Island Now*, June 27, 2022
- "DARPA Funds Partly Natural, Partly Man-made Coral Reef," *Sea Technology,* August, 10, 2022
- "UH is Awarded $25M to create Hybrid Reef," *Star Advertiser*, June 17, 2022
- "UC San Diego Researchers Part of $25M Project to Build Artificial Coral Reefs for Coastal Protect," University of California, San Diego, June 21 2022
- Seminar, Rapid Resilient Reefs for coastal Defense (R3D), SOEST, UH Manoa

Appendix D Cultural Resource Assessment for Kalaeloa Reef Project



Cultural Resource Assessment for the Kalaeloa Reef Project

Honouliuli Ahupuaʻa, ʻEwa District, Oʻahu Island

Coastal Area fronting TMK [1]9-1-014:049

Prepared for the Hawaii Department of Transportation

Prepared by

September 2025

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Note on Hawaiian language usage

In keeping with other Hawaiian scholars, we do not italicize Hawaiian words. Hawaiian is both the native language of the pae ʻāina (archipelago) of Hawaiʻi and an official language of the State of Hawaiʻi. Some authors will leave Hawaiian words italicized if part of a quote; we do not. In the narrative, we use diacritical markings to assist our readers, except in direct quotes, in which we keep the markings used in the original text. We provide translations contextually when appropriate.

Front Cover Credit

1884 Registered Map showing Puhilele and Project Area

Executive Summary

The Kalaeloa Reef Project**,** part of the University of Hawaiʻi's Rapid Resilient Reefs for Coastal Defense (R3D) initiative, is designed to enhance coastal protection and restore marine ecosystems through the installation of a hybrid coral reef system offshore of Kalaeloa in the ahupuaʻa of Honouliuli, ʻEwa District, Oʻahu. The project aims to reduce wave energy, protect vulnerable coastlines, and foster coral reef restoration while also contributing to long-term coastal resilience. As part of this effort, a Cultural Resource Assessment (CRA) was conducted to identify and evaluate archaeological, cultural, historical, and natural resources in the project area, to assess potential impacts to traditional and customary Native Hawaiian practices, and to recommend measures for resource protection.

The CRA draws upon a range of sources, including Hawaiian- and English-language archival records, oral traditions, ethnographic interviews, historic maps, archaeological investigations, and early consultation with the State Historic Preservation Division (SHPD) and community stakeholders. The findings reveal that Kalaeloa, meaning "long cape," is a wahi pana, or storied place, long recognized in moʻolelo, navigation, fishing traditions, and place names within Honouliuli. Its coastline historically supported marine subsistence activities, including fishing, shellfish gathering, and limu harvesting, all of which remain central to the cultural memory of the ʻEwa region.

Archaeological resources provide important context for this cultural landscape. The most significant data derive from Yosihiko Sinoto's 1977 salvage excavations at Barbers Point, which documented temporary shelters, habitation features, fishing gear such as coral abraders and fishhook fragments, and midden deposits dominated by *Brachidontes cerebristriatus* (*kio nahawele*, Hawaiian mussel). These findings underscore the importance of the nearshore zone for both subsistence and specialized marine exploitation. Later studies at Kalaeloa Heritage Park supplement this baseline, adding evidence of dwellings, agricultural features, and heiau, yet Sinoto's work remains the primary archaeological dataset for the coastal environment.

Traditional cultural practices, including fishing, limu gathering, diving, and surfing, are closely tied to the Kalaeloa shoreline. The area also supported kilo, or environmental observation practices, such as those associated with Puhilele**,** which has been identified as a newly recognized cultural site within the project's cultural landscape. Puhilele is associated with kilo practices and was likely used to guide fishing and seasonal cycles. Its recognition highlights the importance of intangible cultural knowledge linked to specific places on the coast and reinforces the interconnectedness of the natural and cultural environment at Kalaeloa. The site no longer retains individual integrity and therefore, the project will not adversely impact this site.

Historic records, such as Boundary Commission testimonies, Land Commission Awards, and Registered Map 896 by Monsarrat (1881), confirm that the Honouliuli coastline was characterized by alternating rocky shores and sandy beaches, features that created natural landing places for canoes and gathering areas for shellfish and limu. These records situate the project area within the larger ahupuaʻa system, where inland agriculture and coastal subsistence were interconnected.

The CRA concludes that, although the project is not expected to cause lasting harm to cultural resources or traditional practices, the means and methods of construction will need to be assessed**.** Depending on the chosen methods, temporary access to coastal areas may be disrupted, but such effects are not expected to cause long-term impacts to traditional practices. Furthermore, the project, as planned, is unlikely to negatively affect public trust resources. If successful, the project could find innovative ways to protect and restore coastal reefs, potentially providing a net cultural and ecological benefit by boosting marine resources for subsistence and supporting cultural activities like fishing.

This CRA supports compliance with Hawaiʻi Revised Statutes (HRS) Chapter 343, Act 50 (2000), and the *Ka Paʻakai* framework, ensuring that cultural practices and resources are identified, impacts are assessed, and feasible protections are recommended. In doing so, it affirms the significance of Kalaeloa's tangible and intangible heritage and highlights the project's potential not only to avoid adverse effects but to actively enhance the cultural and ecological vitality of the ʻEwa coastline.

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Abbreviations and Acronyms

A.B.C.F.M.: American Board of Christian Foreign Missions
ALFRI: Archaeological Literature Review and Field Inspection
BMP: Best Management Practice
CIA: Cultural Impact Assessment
CRA: Cultural Resource Assessment
DLNR: Department of Land and Natural Resources
EaB: Ewa Silty Clay Loam, 3-6% slope
EIS: Environmental Impact Statement
ʻEwa Plantation: The ʻEwa Plantation Company
GIS: Geographic Information System
HAR: Hawaiʻi Administrative Rules
HRS: Hawaiʻi Revised Statutes
ICH: Intangible Cultural Heritage
Ka Paʻakai: *Ka Paʻakai O Ka ʻĀina v. Land Use Commission*, 94 Haw. 31 (2000)
L.C.A.: Land Commission Awards
MBTA: Migratory Bird Treaty Act
MCAS ʻEwa: ʻEwa Marine Corps Air Station at Barbers Point
NASBP: Naval Air Station at Barbers Point
OEQC: Office of Environmental Quality Control
OR&L: The Oʻahu Railway & Land Company
O.R. & L. Co.: The Oʻahu Railway & Land Company
OSC: Oʻahu Sugar Company
rSY: Stony Steep Land
SHPD: State Historic Preservation Division
SLH: Session Laws of Hawaiʻi
TMK: Tax Map Key
U.S.: United States
USGS: United States Geological Survey

1.0 Project Background

The Kalaeloa HyReef Project, part of the University of Hawaiʻi's *Rapid Resilient Reefs for Coastal Defense (R3D)* initiative, proposes the installation of a hybrid coral reef system in the nearshore waters of Kalaeloa, within the ahupuaʻa of Honouliuli, ʻEwa District, Oʻahu. The prototype reef, designed to combine natural and artificial components, aims to reduce wave energy, protect vulnerable coastlines, and support coral reef restoration. The State Department of Transportation is preparing an Environmental Assessment for the project, which will include this assessment as part of its overall evaluation.

This Cultural Resource Assessment (CRA) identifies and evaluates cultural, historical, and natural resources that may be present in the project area; considers the potential impacts of the proposed activity on traditional and customary Native Hawaiian practices; and recommends feasible measures to reasonably protect those rights and resources. The assessment integrates historical archival research, prior cultural impact assessments, oral histories, ethnographic interviews, and early consultation with agencies and community organizations.

2.1 Project Description

The project entails the construction and installation of a hybrid reef approximately 50 meters by 60 meters (165 by 200 feet) offshore of Kalaeloa. The reef will consist of engineered structures seeded with coral fragments, arranged to mimic the structure of a natural fringing reef. Monitoring will measure its performance in dissipating wave energy, its ecological benefits, and its role in enhancing nearshore marine resources.

The project area is located off Kalaeloa Point (Barber's Point), a region with deep cultural, ecological, and historical significance. Kalaeloa, meaning "long cape," is a storied wahi pana (sacred or storied place), referenced in multiple moʻolelo and historically recognized as an important navigational landmark.

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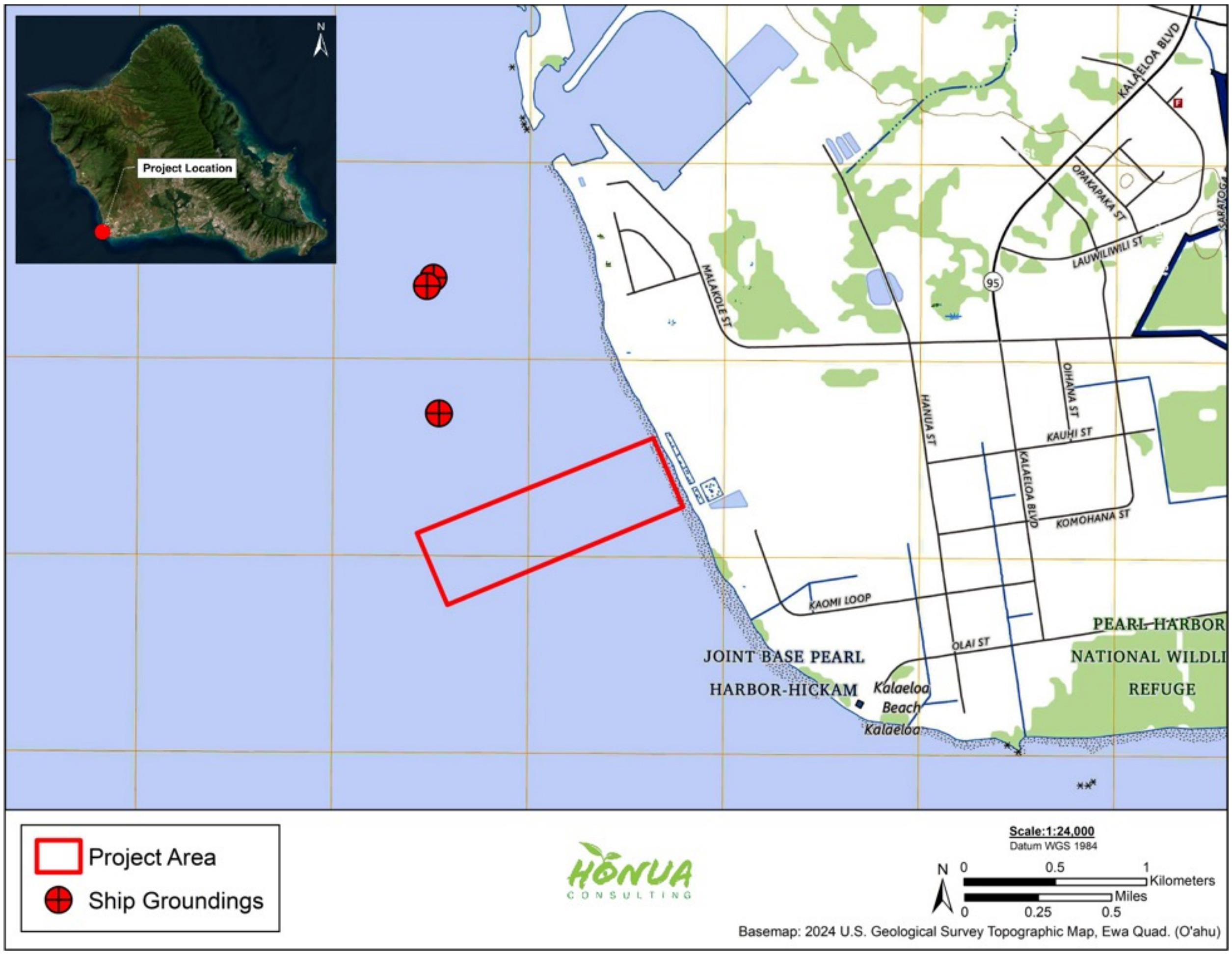

Figure 3. Topographical map showing the Project Area.

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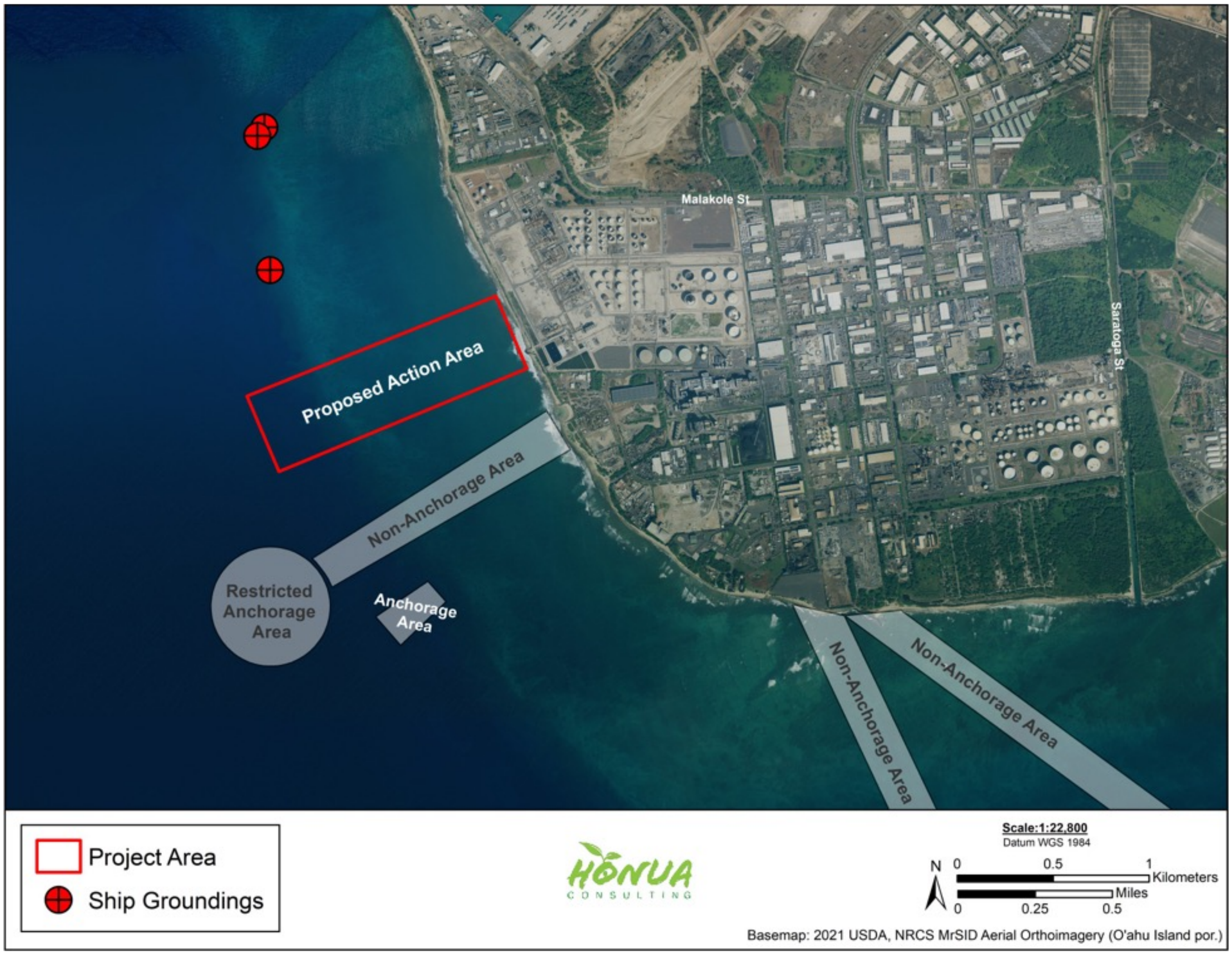

Figure 4. Aeriel image showing the Project Area.

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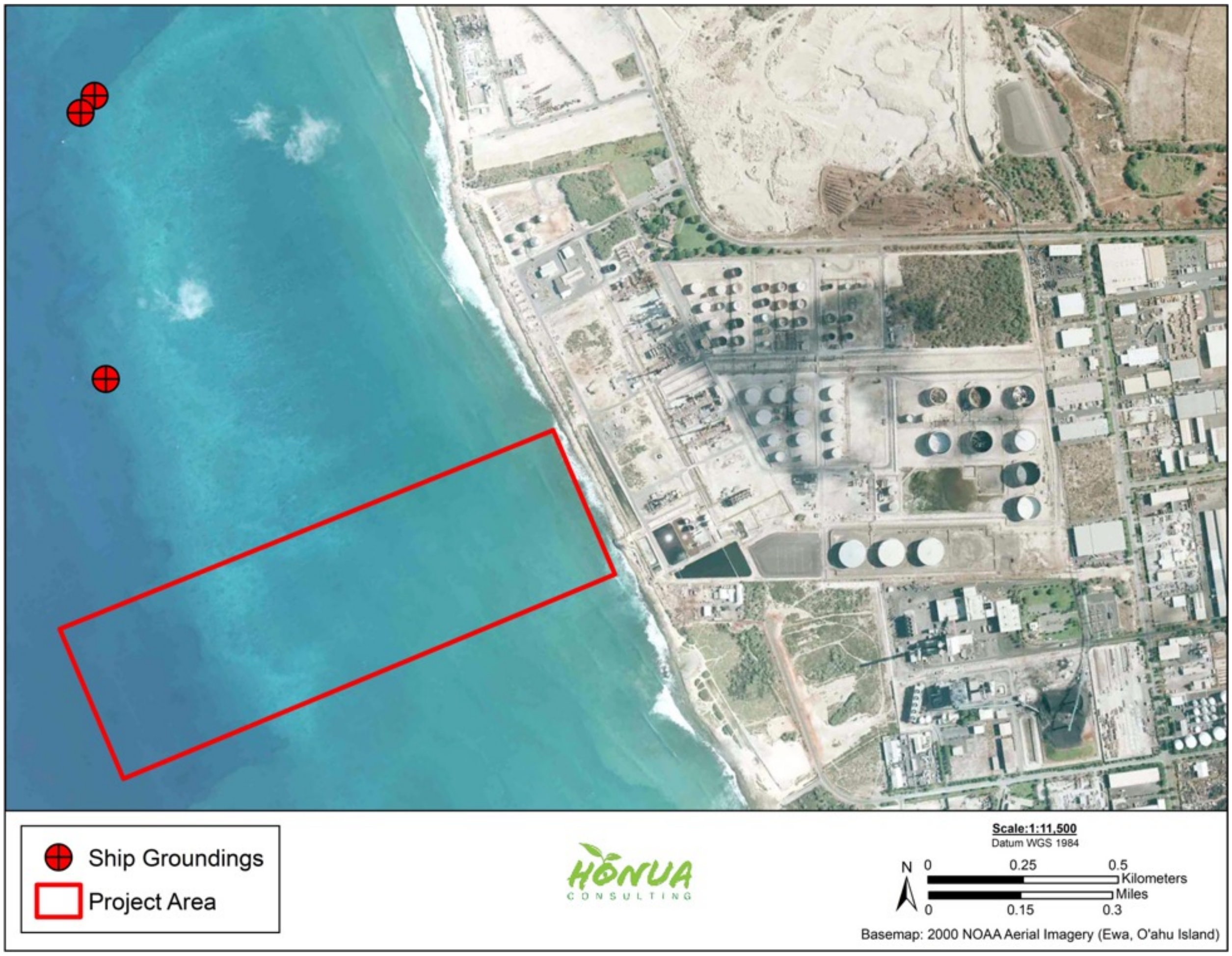

Figure 5. Close up of the Project Area.

1.2 Basis of Cultural Assessments

Articles IX and XII of the State Constitution, other state laws, and the courts of the state require government agencies to protect and preserve cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups. To assist decision makers in the protection of cultural resources, Chapter 343, HRS and Hawaiʻi Administrative Rules (HAR) § 11-200 dictate that the environmental impact assessment process requires project proponents to assess proposed actions for their potential impacts to cultural properties, practices, and beliefs.

This process was clarified by the Act 50, Session Laws of Hawaiʻi (SLH) 2000. Act 50 recognized the importance of protecting Native Hawaiian cultural resources and required some environmental review documents include the disclosure of the effects of a proposed action on the cultural practices of the community, state, and the Native Hawaiian community. Specifically, the Environmental Council suggested the CIAs should include information relating to practices

and beliefs of a particular cultural or ethnic group or groups. Such information may be obtained through public scoping, community meetings, ethnographic interviews, and oral histories. It is important to note that while similar in their areas of studies, archaeological surveys and CIAs are concerned with distinct and different foci. Archaeological studies are primarily concerned with historic properties and tangible heritage, whereas CIAs look at cultural practices and beliefs, which can be associated with a specific location, but also often
are intangible in nature.

The State and its agencies have an affirmative obligation to preserve and protect Native Hawaiians' customarily and traditionally exercised rights to the extent feasible.[2] State law further recognizes that the cultural landscapes provide living and valuable cultural resources where Native Hawaiians have and continue to exercise traditional and customary practices, including hunting, fishing, gathering, and religious practices. In *Ka Pa'akai*, the Hawai'i Supreme Court provided government agencies with an analytical framework to ensure the protection and preservation of traditional and customary Native Hawaiian rights while reasonably accommodating competing private development interests. This is accomplished through:

4) The identification 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;
5) The extent to which those resources—including traditional and customary Native Hawaiian rights—will be affected or impaired by the proposed action; and
6) The feasible action, if any, to be taken to reasonably protect Native Hawaiian rights if they are found to exist.

The relevant information about the ahupua'a of Honouliuli has been gathered, focusing on areas near or next to the project site. A detailed analysis of this project and its possible effects on cultural resources, historical resources, and archaeological sites is included in this survey.

This Cultural Resource Assessment (CRA) provides an overview of cultural and historic resources in the project area through thorough literature review, consultation with community members and cultural practitioners, and high-level, project-specific surveys. The CRA emphasizes identifying areas where disturbance should be avoided or minimized to reduce impacts on

2 Article XII, Section 7 of the Hawai'i State Constitution, *Ka Pa'akai O Ka 'Āina v. Land Use Commission*, 94 Haw. 31 [2000] (*Ka Pa'akai*), Act 50 SLH 2000.

historic properties or culturally important features. The primary goal is to prevent impacts by avoiding sensitive areas and only mitigating impacts if avoidance is not feasible.

1.3 Geographic Extent

The geographic extent for impacts to cultural resources and historic properties includes the project area and localized surroundings. Because this report meets the requirements for Act 50, it also reviews some of the resources primarily covered by the regulatory review. It primarily researches and reviews the range of biocultural resources identified through historical documents, traditional knowledge, information found in the Hawaiian language historical cache, and oral histories and knowledge collected from
cultural practitioners and experts.

The best practice for CIAs is to define a geographic extent beyond the identified or typical boundaries of the geographic project area. The recommended area is typically the size of the ahupuaʻa or moku, but this can be larger or smaller depending on what best helps to identify the resources appropriately.

The geographic extent of the CIA is based on the position that the "Project Area" is part of a cultural landscape or cultural landscapes, and therefore it is most appropriate to set and study the proposed alternatives within that cultural context. This CRA follows that model, and as such this assessment focused primarily on the marine area of the Honouliuli ahupuaʻa and its associated coasts and resources.

1.4 Goal of Cultural Resource Assessment

CIAs typically aim to determine the project's potential impacts on historic and cultural resources and, at a minimum, describe: a) Any valued cultural, historical, or natural resources in the area in questions, including the extent to which traditional and customary Native Hawaiian rights are exercised in the area; b) The extent to which those resources – including traditional and customary Native Hawaiians rights – will be affected or impaired by the Project; and c) The feasible action, if any, to be taken to reasonably protect Native Hawaiian rights if they are found to exist.

The goal of the Cultural Resource Assessment (CRA) is broader. It aims to identify both archaeological and cultural practices that the project may impact, in order to fulfill the obligations under HRS Chapter 343. If resources are identified that may be affected, it suggests appropriate mitigation measures or processes to determine suitable mitigation, ensuring compliance with HRS Chapter 343

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2.2 Methodology

The approach to developing this cultural resource assessment (CRA) is as follows:

1) Gather Best Information Available
    a) Gather historic cultural information from stories and other oral histories about the affected area to provide cultural foundation for the report;
    b) Inventory as much information as can be identified about as many known cultural, historic, and natural resources, including previous archaeological inventory surveys, CIAs, etc. that may have been completed for the possible range of areas; and
    c) Update the information with interviews with cultural or lineal descendants or other knowledgeable cultural practitioners.
2) Identify Potential Impacts to Cultural Resources
3) Develop Reasonable Mitigation Measures to Reduce Potential Impacts
    a) Involve the community and cultural experts in developing culturally appropriate mitigation measures; and
    b) Develop specific Best Management Practices (BMPs), if any are required, for conducting the project in a culturally appropriate and/or sensitive manner as to mitigation and/or reduce any impacts to cultural practices and/or resources.

While numerous place names and primary source historical accounts (from both Hawaiian and English language narratives) are cited in this document, it is impossible to tell the whole story of these lands in any given manuscript. A range of history, spanning generations, has been covered. Importantly, the resources herein are a means of connecting people with the history of their communities—that they are part of that history. Knowledge of place will, in turn, promote appreciation for place and encourage acts of stewardship for the valued resources that we pass on to the future.

Background research was conducted using materials obtained from the State Historic Preservation Division (SHPD) library in Kapolei and the Honua Consulting LLC report library. On-line materials consulted included the Ulukau Electronic Hawaiian Database (www.ulukau.com), Papakilo Database (www.papakilodatabase.com), the State Library on-line (http://www.librarieshawaii.org/ Serials/databases.html), and Waihona ʻĀina Māhele database (http://www.waihona.com). Hawaiian terms and place names were translated using the on-line Hawaiian dictionaries (Nā Puke Wehewehe ʻŌlelo Hawaiʻi) (www.wehewehe.com), and *Place Names of Hawaiʻi* (Pukui et al., 1976), and *Hawaiʻi Place Names* (Clark, 2002). Historic maps were obtained from the State Archives, State of Hawaiʻi Land Survey Division website (http://ags.hawaii.gov/survey/map-search/), and the UH-Mānoa Maps, Aerial Photographs, and Geographic Information System (GIS) website (http://guides.library.manoa.hawaii.edu/magis).

Maps were geo-referenced for this report using ArcGIS 10.3. It should be noted that GIS is not 100% precise and historic maps were created with inherent flaws; therefore, geo-referenced maps should be understood to have some built-in inaccuracy.

While conducting the research, primary references included, but were not limited to: land use records, including the Hawaiian Land Commission Awards (L.C.A.) records from the Māhele ʻĀina (Land Division) of 1848; the Boundary Commission Testimonies and Survey records of the Kingdom and Territory of Hawaiʻi; and historical texts authored or compiled by numerous native and foreign writers. The study also includes several native accounts from Hawaiian language newspapers (primarily compiled and translated from Hawaiian to English by Kepā Maly), and historical records authored by nineteenth century visitors, and residents of the region.

Historical and archival resources were located in the collections of the Hawaiʻi State Archives, Survey Division, Land Management Division, and Bureau of Conveyances; the Bishop Museum Library and Archives; the Hawaiian Historical Society and the Hawaiian Mission Children's Society Library; University of Hawaiʻi-Hilo Moʻokini Library; the National Archives and Records Administration, Maryland; the Library of Congress, Washington D.C.; the National Oceanic and Atmospheric Administration National Library, Maryland; the Smithsonian Institution Natural History and National Anthropological Archives libraries, Washington, D.C.; the Houghton Library at Harvard; the United States Geological Survey (USGS) Library, Denver; the Paniolo Preservation Society and Parker Ranch collections; private family collections; and in the collection of Kumu Pono Associates LLC. This information is generally cited in categories by chronological order of the period depicted in the narratives.

M. P. Nogelmeier (2010) discusses the adverse impacts of methodology that fails to properly research and consider Hawaiian language resources. He strongly cautions against a mono-rhetorical approach that marginalizes important native voices and evidence from consideration, specifically in the field of archaeology. For this reason, Honua Consulting consciously employs a poly-rhetorical approach, whereby all data, regardless of language, is researched and considered. To fail to access these millions of pages of information within the Hawaiian language cache could arguably be a violation of Act 50, as such an approach would fundamentally fail to gather the best information available, especially considering the voluminous amounts of historical accounts available for native tenants in the Hawaiian language.

Hawaiian culture views natural and cultural resources as largely inextricable: without the resources provided by nature, cultural resources could and would not be procured. From a Hawaiian perspective, all natural and cultural resources are interrelated, and all natural and cultural resources are culturally significant. Kepā Maly (2001), ethnographer and Hawaiian language scholar, points out, "In any culturally sensitive discussion on land use in Hawaiʻi, one must understand that Hawaiian culture evolved in close partnership with its natural environment. Thus, Hawaiian culture does not have a clear dividing line of where culture ends and nature begins" (p. 1). As leading researchers and scholars on Hawaiian culture, Maly, along with his wife, Onaona, have conducted numerous ground-breaking studies on cultural histories throughout Hawaiʻi. A substantial part of the archival research utilized in this study was previously compiled and published by Kepā and Onaona Maly, who have granted their permission to use this important work and are identified properly as associated authors and researchers to this study.

This study also specifically looks to identify intangible resources. Tangible and intangible heritage are inextricably linked (Bouchenaki, 2003). Intangible cultural resources, also identified as intangible cultural heritage (ICH), are critical to the perpetuation of cultures globally. International and human rights law professor Federico Lenzerini (2011) notes that, "At present, we are aware on a daily basis of the definitive loss—throughout the world—of language, knowledge, knowhow, customs, and ideas, leading to the progressive impoverishment of human society" (p. 12). Lenzerini (2011) goes on to warn that:

> The rich cultural variety of humanity is progressively and dangerously tending towards uniformity. In cultural terms, uniformity means not only loss of cultural heritage—conceived as the totality of perceptible manifestations of the different human groups and communities that are exteriorized and put at the others' disposal—but also standardization of the different peoples of the world and of their social and cultural identity into a few stereotyped ways of life, of thinking, and of perceiving the world. Diversity of cultures reflects diversity of peoples; this is particularly linked to ICH, because such a heritage represents the living expression of the idiosyncratic traits of the different communities. Preservation of cultural diversity, as emphasized by Article 1 of the UNESCO Universal Declaration on Cultural Diversity, 'is embodied in the uniqueness and plurality of the identities of the groups and societies making up humankind'. Being a 'source of exchange, innovation and creativity', cultural diversity is vital to humanity and is inextricably linked to the safeguarding of ICH. Mutual recognition and respect for cultural diversity—and, *a fortiori*, appropriate safeguarding of the ICH of the diverse peoples making up the world—is essential for promoting harmony in intercultural relations, through fostering better appreciation and understanding of the differences between human communities. (p. 103)

Therefore, tradition and practice, as elements of Hawaiian ICH, are essential to the protection of Hawaiian rights and the perpetuation of the Hawaiian culture.

2.3 Identifying Traditional or Customary Practices

Through this contextual lens of tradition and practice serving as elements of Hawaiian ICH, Honua Consulting developed a framework to define traditional or customary practices (Figure 6).

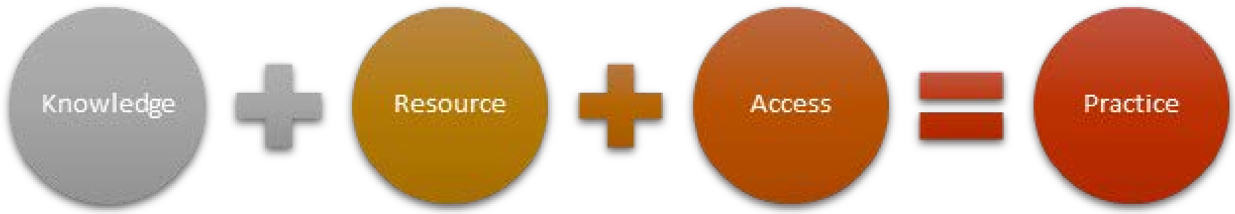

Figure 6. Diagram of Elements that Contribute to Traditional or Customary Practices (Honua Consulting)

The first element, knowledge, has been referred to as traditional ecological knowledge, Indigenous local knowledge, or ethnoscience. In the context of this study, knowledge is the information, data, or expertise Native Hawaiians or local communities possessed or possess about an area's environment. In a traditional context, this would have included information Hawaiians possessed to have the skills to utilize the area's resources for a range of purposes, including, but not limited to, travel, food, worship or habitation. This element is largely intangible.

The second element is the resources themselves. These are primarily tangible resources, either archaeological resources (e.g., habitation structures, walls, etc.) or natural resources (e.g., plants, animals, etc.). Resources can also be places or geographic features, such as a wahi pana (legendary places) or sacred/culturally important sites. While wahi pana may sometimes be construed as general locations, their importance and value need not be diminished. It is important to recognize that potential eligibility as a "historic site" on the National Register of Historic Places would require identifiable boundaries of a site.

The third element is access. Access serves as the important catalyst through which the first two elements, knowledge and resource, can be operationalized for traditional and customary practices to take place. In this way, practitioners must have access to the resource to practice their traditional customs. Importantly, access as defined here expands beyond mere physical access but also includes the ability to access resources. For example, if a particular plant species is used for medicinal purposes, a sufficient population of that plant species must be accessible to practitioners for use. In this example, an action that would adversely impact the population of the culturally important plant species would impact practitioners' ability to access that plant. By extension, the action would also adversely impact the traditional or customary practice.

Traditional or customary practices are, therefore, the combination of knowledge, resource(s) and access. Each of these individual elements should be researched and identified in assessing any potential practices or impacts to said practices.

2.4 Traditional Knowledge, or Ethnoscience, and the Identification of Cultural Resources

The concept of ethnoscience was first established in the 1960s and has been defined “the field of inquiry concerned with the identification of the conceptual schemata that indigenous peoples use to organize their experience of the environment” (Roth, 2019). Ethnoscience includes a wide range of subfields, such as ethnoecology, ethnobotany, ethnozoology, ethnoclimatology, ethnomedicine and ethnopedology. All these fields are important to properly identify traditional knowledge within a certain area.

Traditional Native Hawaiian practitioners were scientists and expert natural resource managers by necessity. Without modern technological conveniences to rely upon, Hawaiians developed and maintained prosperous and symbiotic relationships with their natural environment for thousands of years. Their environments were their families, their homes, and their laboratories. They knew the names of every wind and every rain. The elements taught and inspired. The ability of Indigenous people to combine spirituality and science led to the formation of unique land-based methodologies that spurred unsurpassed innovation. Therefore, identifying significant places requires a baseline understanding of what made places significant for Hawaiians.

Hawaiians were both settlers and explorers. Krauss (1993) explains: “Exploration of the forests revealed trees, the timber of which was valuable for building houses and making canoes. The forests also yielded plants that could be used for making and dying tapa, for medicine, and for a variety of other artifacts” (p. 1). Analysis of native plants and resource management practices reveals the depth to which Hawaiians excelled in their environmental science practices:

> [Hawaiians] demonstrated great ability in systematic differentiation, identification, and naming of the plants they cultivated and gathered for use. Their knowledge of the gross morphology of plants, their habits of growth, and the requirements for greatest yields is not excelled by expert agriculturists of more complicated cultures. They worked out the procedures of cultivation for every locality, for all altitudes, for different weather conditions and exposures, and for soils of all types. In their close observations of the plants they grew, they noted and selected mutants (spores) and natural hybrids, and so created varieties of the plants they already had. Thus over the years after their arrival in the Islands, the Hawaiians added hundreds of named varietis of taro, sweet potatoes,

> sugarcane, and other cultivated plants to those they had brought with them from the central Pacific. (Krauss, 1993, p. 3)

Thus, Native Hawaiians reinforced the biodiversity that continues to exist in Hawaiʻi today through their customary traditional natural resource management practices.

The present analyses of archival documents, oral traditions (oli [chants], mele [songs], and/or hula dances and haʻi moʻolelo [storytelling performances]), and Hawaiian language sources including books, manuscripts, and newspaper articles, are focused on identifying recorded cultural resources present on the landscape, including: Hawaiian and non-Hawaiian place names; landscape features (ridges, gulches, cinder cones); archaeological features (kuleana parcel walls, house platforms, shrines, heiau [places of worship], etc.); culturally significant areas (viewsheds, unmodified areas where gathering practices and/or rituals were performed); and significant biological, physiological, or natural resources. This research also looks to document the wide range of Hawaiian science that existed within the geographic extent.

2.5 Moʻolelo ʻĀina: Native Traditions of the Land

Among the most significant sources of native moʻolelo (history, narrative, story) are the Hawaiian language newspapers which were printed between 1838 and 1948, and the early writings of foreign visitors and residents. Most of the accounts that were submitted to the papers were penned by native residents of areas being described and noted native historians. Over the last 30 years, Kepā Maly has reviewed and compiled an extensive index of articles published in the Hawaiian language newspapers, with particular emphasis on those narratives pertaining to lands, customs, and traditions. Many traditions naming places around Hawaiʻi are found in these early writings. Many of these accounts describe native practices, the nature of land use at specific locations, and native moʻolelo. Thus, we are given a means of understanding how people related to their environment and sustained themselves on the land.

2.6 Historic Maps

There are also numerous, informative historic maps for the region. Surveyors of the eighteenth and nineteenth centuries were skilled in traversing land areas and capturing important features and resources throughout Hawaiʻi's rich islands. Historic maps were carefully studied, and the features detailed therein were aggregated and categorized to help identify specific places, names, features, and resources throughout the study area. From these, among other documents, new maps were created that more thoroughly capture the range of resources in the area.

2.7 Archaeological Studies

Archaeological investigations within the Kalaeloa region have been relatively limited compared to other parts of Oʻahu, but key studies provide important baseline information about cultural use of the ʻEwa coastal plain. The most significant source of data remains the salvage excavations conducted in 1977 by the Bishop Museum under the direction of Dr. Yosihiko Sinoto. This work was undertaken in advance of harbor construction at Barbers Point and is documented in the report *Archaeological and Paleontological Salvage at Barbers Point, Oʻahu* (Sinoto, 1978).

The Sinoto report represents the most detailed scientific study of archaeological resources in this portion of the ʻEwa Plain. The project investigated approximately twelve percent of the proposed development area and focused heavily on karst sinkholes and associated surface features. The results revealed a pattern of short-term habitation, midden disposal, and specialized subsistence activities, particularly fishing and shellfish gathering. Artifacts such as coral abraders, basalt flakes, and a human bone fishhook fragment provided direct evidence of fishing technology, while midden deposits rich in *Brachidontes cerebristriatus* (*kio nahawele*) confirmed intertidal shellfish collection.

While subsequent cultural resource surveys have documented additional features across the Kalaeloa Heritage Park area, the Sinoto excavations remain the primary archaeological dataset for understanding traditional use of the immediate coastal zone. Accordingly, this Cultural Resource Assessment relies on the Sinoto report as its foundational source for archaeological interpretation. Later studies and oral traditions supplement this record, but the Sinoto findings continue to form the core scientific evidence of Hawaiian use of the Kalaeloa coastline.

2.8 Ethnographic Methodology

Information from lineal and cultural descendants is instrumental in gathering insights about the project area's transformation over time and its evolving uses. The information gathered through research helped to focus interview questions on specific features and elements within the project area. Descendants and cultural practitioners from the area were contacted and interviewed for this CIA. These interviews summaries are included in **Section 6.0 (Ethnographic Data)**.

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3.0 Historic Background

Traditionally, ʻEwa Moku was inhabited and stewarded by Native Hawaiians for centuries. ʻEwa was ruled by chiefs and kings of the Maweke-Kumuhonua lineage, with the royal center at Līhuʻe in the uplands of Honouliuli (Beckwith, 1970; Fornander, 1996). From the 1500s to 1700s, there were several political power shifts including the defeat of the ʻEwa chief by Peleioholani, a son of Kualiʻi, around 1740. In 1778, Kahahana, who was from the ʻEwa line of chief but raised in Kahekili's Maui court, took control of Oʻahu and ʻEwa until King Kamehameha unified the islands around 1810. Following Kamehameha's conquering of Oʻahu, at least two of his chiefs lived in Puʻuloa, and later, Liholiho (Kamehameha II) built a house in Puʻuloa (Kamakau, 1992, p. 255).

Background research indicates traditional settlements in Honouliuli were situated near irrigated taro fields located along West Loch and were concentrated around small marshes and wet sinks found throughout an otherwise semi-barren landscape. The wide coastal zone was dependent on mixed marine exploitation and agricultural cultivation. A network of established trails provided routes from the coast around West Loch through the Honouliuli lowlands to Puʻu o Kapolei, the Waiʻanae coast, and other parts of Oʻahu (ʻĪʻī, 1959). The trail system was a major route joining coastal resources with inland areas.

The history of Hawaiʻi is recorded in oral tradition as told through moʻolelo, early historic accounts, historic maps and land records. The following research summarizes myths and place names of the area and describes how the land has been utilized over time. As Honouliuli is a very large ahupuaʻa, there is a substantial amount of documentation about the area. The moʻolelo and historical events most relevant to the project area have been included herein to illustrate the changing landscape of Honouliuli ahupuaʻa over time.

3.1 Inoa ʻĀina (Place Names)

The focus of the inoa ʻāina is within the ahupuaʻa of Honouliuli, although some references in mele and moʻolelo extend to specific notable points (e.g. hills and mountaintops) just outside the ahupuaʻa boundaries. Notable inoa ʻāina memorialize geographic and environmental features of the larger ʻEwa region.

In ancient times, named localities served a variety of functions, telling people about: (1) places where the gods walked the earth and changed the lives of people for good or worse; (2) heiau or other features of ceremonial importance; (3) triangulation points such as koʻa (ceremonial markers) for fishing grounds and fishing sites; (4) residences and burial sites; (5) areas of planting; (6) water sources; (7) trails and trail side resting places (oʻioʻina), such as a rock shelter or tree shaded spot; (8) the sources of particular natural resources/resource collections areas, or any number of other features; or (9) notable events which occurred at a given area. Through place names, knowledge of the past and places of significance were handed down across countless generations.

At the time of the Māhele ʻĀina, few kuleana land applications were submitted by native tenants. In many cases, land divisions would be referred to as both ahupuaʻa and ʻili, depending upon the document. It was also unclear from documents where land was identified as ʻili as to if the ʻili were simply a subdivision of larger ahupuaʻa or if they were ʻili kūpono, distinct land areas unto themselves. From the historical land records, there appeared to be little concern for specific boundaries, as foreigners, many of them missionaries who converted to businessmen, eagerly maneuvered their relationships with the new formalized government to acquire themselves strategically located parcels of land that proved valuable as new economy industries like sugar developed on Oʻahu.

Following the Māhele ʻĀina, there was a growing movement to fence off the land areas and control access to resources that native tenants had traditionally used. In the 1860s, foreign landowners and business interests petitioned the Crown to have the boundaries of their respective lands, which became the foundation for plantation and ranching interests, settled. In 1862, the King appointed a Commission of Boundaries (the Boundary Commission) and tasked them with collecting traditional knowledge of place, land boundaries, customary practices, and deciding the most equitable boundaries for each ahupuaʻa that had been awarded to Aliʻi, Konohiki, and foreigners during the Māhele ʻĀina.

The commission proceedings were conducted under the courts and as formal actions under law. As the commissioners on the various islands undertook their work, the kingdom hired or contracted surveyors to begin the surveys. In 1874, the commissioners were authorized to certify the boundaries for lands brought before them (Alexander, 1891, pp. 117-118).

Records from the ʻEwa District were recorded between 1868 and 1904, with the proceedings from Honouliuli being held between 1873 and 1874. The records included testimonies of elder kamaʻāina who were either recipients of kuleana in the Māhele ʻĀina or were the direct descendants of the original fee-simple title holders. The narratives cited in this report include several types of documentation such as the preliminary requests for establishing the boundaries, letters from the surveyors in the field, excerpts from surveyor's field books (Register Books), the record of testimonies given by native residents of the lands, and the entire record of the Commission in certifying the boundaries of each ahupuaʻa. The resulting documentation offers descriptions of the land extending from ocean fisheries to the mountain peaks, traditional and customary practices, land use, changes in the landscape witnessed over the informants' lifetime, and various cultural features.

The native witnesses usually spoke in Hawaiian and in some instances, their testimony was translated into English and transcribed as the proceedings occurred. Other testimonies were transcribed in Hawaiian but have now been translated for inclusion in this study.

The Boundary Commission proceedings documented many traditional place names and features along the boundaries of the ahupuaʻa, with locations extending from the sea (including fishponds and fisheries) to the mountain peaks. These names demonstrate Hawaiian familiarity with the resources, topography, sites and features of the entire ahupuaʻa. Coulter (1935) observed that Hawaiians had place names for all manner of feature, ranging from "outstanding cliffs" to what he described as "trivial land marks" (p. 10). History shows that named locations were significant in past times: "Names would not have been given to [or remembered if they were] mere worthless pieces of topography" (Handy et al., 1972, p. 412).

The 105 place names that follow below are a sampling of over 200 named localities that stand out as being significant indicators of cultural attachment for locations in Honouliuli Ahupuaʻa (Table 1). The inoa ʻāina marked with an asterisk are cited in the Honouliuli Boundary Proceedings included in Appendix II.

Table 2. Selected Inoa ʻĀina in and around Honouliuli Ahupuaʻa

Inoa ʻĀina	Description
honu	*Lit.* Eat turtle. A moʻo[3] cited in L.C.A. 831 of the Māhele ʻĀina.
ʻAimea	A kōʻele[4] cited as claim number 1666B of the Māhele ʻĀina.
Ako	A loʻi (irrigated terrace) cited in L.C.A. 763 of the Māhele ʻĀina.
Akupu	A spring and puʻu (hill) mentioned in Sterling and Summers (1978): "All water for Akupu [camp] was brought up from the Akupu Spring, which was carved out of the solid rock below the ridge, a distance of over a mile from camp" (pp. 35-36).
Alea	A kōʻele and loʻi cited as claim number 1580B of the Māhele ʻĀina.
Akaka*	A lele[5] cited in claim number 3848 and L.C.A. 5930 of the Māhele ʻĀina.

3 A moʻo is a narrow strip of land, smaller than an ʻili (land section next in importance to ahupuaʻa and usually a subdivision of an ahupuaʻa).
4 A kōʻele is a small land unit farmed by a tenant for the chief. Also a small pond, reserved for a chief, where fish could be kept alive until required.
5 A lele is a detached part or lot of land belonging to one land division, but located in another land division.

Inoa ʻĀina	Description
ʻAuiʻole*	An ili kūpono[6] cited in L.C.A. 1021 and 10184 of the Māhele ʻĀina.
Awanui	*Lit.* Big harbor. A stream that rises about 2000 ft. elevation, joining Palailai stream at about 97 ft. elevation and Makaiwa stream at less than 20 ft., before flowing to the sea.
ʻĒkahanui*	*Lit*. Large birds'-nest fern. A gulch/stream that rises at about 1900 ft. elevation under Puu Kaua, joins Poliwai Gulch at about 315 ft., joins Waikele Stream at about 300 ft. (Pukui et al., 1976, p. 27).
ʻEwa	*Lit.* Crooked. A plantation, plantation town, elementary school and quadrangle west of Pearl Harbor. Legend states that Kāne and Kanaloa threw a stone to determine the district boundaries; this stone was lost but found later at Pili-o-Kahe (Pukui et al., 1976, p. 28).
Haʻalelenui	*Lit*. Big Haʻalele. A loʻi cited in L.C.A. 1570 of the Māhele ʻĀina.
Hākelo	*Lit.* Slimy. A loʻi cited as claim number 1605B of the Māhele ʻĀina.
Haleʻauʻau	*Lit.* Bathhouse. A gulch and heiau site cited in the tradition of Hiʻiaka-i-ka-poli-o-Pele
Haleokane	A loʻi cited as claim number 5654:2 of the Māhele ʻĀina.
Halulu	*Lit.* To roar, thunder; a legendary man-eating bird. A moʻo cited in L.C.A. 898 of the Māhele ʻĀina.
Hanohano*	*Lit.* Majestic. An ʻili kūpono retained by Puhalahua and the site of Waipahu High School. Cited in L.C.A. 5930 of the Māhele ʻĀina.
Haole	*Lit.* A white person, foreigner. A moʻo cited in L.C.A. 839 of the Māhele ʻĀina.
Hiwa	A moʻo cited in L.C.A. 763 and 874 of the Māhele ʻĀina.
Hōʻaeʻae	*Lit.* To make soft or fine. A land section and point in ʻEwa. A stone called Pōhakupili (clinging rock) is on the edge of the cliff on the boundary of Hōʻaeʻae and Waikeke; it belonged to the gods Kāne and Kanaloa (Pukui et al., 1976, p. 47).

[6] An ʻili kūpono is a nearly independent ʻili land division within an ahupuaʻa, paying tribute to the ruling chief and not to the chief of the ahupuaʻa. Transfer of the ahupuaʻa from one chief to another did not include the ʻili kūpono located within its boundaries. Often abbreviated to ʻili kū.

Inoa ʻĀina	Description
Hoakalei	*Lit.* Lei reflection. A coastal spring famed in mele from the tradition of Hiʻiaka-i-ka-poli-o-Pele, where Hiʻiaka picked lehua flowers here to make a lei and saw her reflection in the water (Pukui et al., 1976, p. 119).
Hōmaikaiʻa*	*Lit.* Give me the fish. A land division cited in L.C.A. 1616, 5606, 5998B, 8241G, 8241SS, 8241K, and 8241CB of the Māhele ʻĀina.
Honouliuli	*Lit.* Dark bay. Ahupuaʻa cited in L.C.A. 11216 as being retain by Kekauonohi. A land division, village, forest reserve and gulch (Pukui et al., 1976, p. 51).
Hopeiki	*Lit.* Small behind. A moʻo cited in L.C.A. 1701 of the Māhele ʻĀina; spans 0.802 acre.
Hopenui	*Lit.* Big behind. A moʻo cited in L.C.A. 1701 of the Māhele ʻĀina; spans 0.087 acre.
Huliwai	*Lit.* Water search. A stream and gulch of Honouliuli.
Hunehune	*Lit.* Tiny. A gulch and stream rising at about 640 ft. elevation under Puu Makakilo, joining Kaloi stream at 86 ft.
ʻĪao	*Lit.* Cloud supreme. A loʻi cited as claim number 5653 of the Māhele ʻĀina.
Kaʻaikukui	*Lit.* The candlenut food. A stream rising at about 2600 ft. elevation under Palikea, joining Palawai Gulch at about 700 ft. to form Honouliuli Gulch.
Kaʻaimanō	*Lit.* The shark food. A loko (pond) cited as claim number 5653B of the Māhele ʻĀina.
Kaʻaiʻōpelu	A loʻi cited as claim number 1570 of the Māhele ʻĀina.
Kaʻamaikeaha	A loʻi cited as claim number 5653C in L.C.A. 751 of the Māhele ʻĀina.
Kahakūmaka	*Lit.* Place (for) seeing. A loʻi cited as claim number 5653 of the Māhele ʻĀina.
Kahapapa*	*Lit.* The rock stratum. A land division of Waiʻanae cited in L.C.A. 884, 903, and 2951 of the Māhele ʻĀina.
Kaihuopalaʻai	*Lit.* The nose of Palaʻai. An ʻili and fishery. Cited in claim 5670B of the Māhele ʻĀina. This place was famed in ancient times for its ʻanae (mullet). Kaʻulu and ʻApokaʻa (a husband and wife; also named localities) were the parents of two human children and two supernatural children, Kaihuopalaʻai (a son) and Kaihukuʻuna (a

Inoa ʻĀina	Description
	daughter). When Kaihuopalaʻai matured, he married Kaʻōhai. To Kaihuopalaʻai and Kaʻōhai were born Pūhi Lo Laumeki (a son) and Kapapapūhi (a daughter). Their story is told in the traditions of Ka ʻAnae o Kaihuopalaʻai and Makanikeʻoe.
Kāʻilikahi	*Lit.* Snatch once. An ʻili ʻāina (land division whose chief pays tribute to the chief of the ahupuaʻa rather than to the king) cited in L.C.A. 752 and 839 of the Māhele ʻĀina.
Kalaeloa (Laeloa)*	*Lit.* The long point. The old name for Barber's Point.
Kalaeokāne (Laeokāne)*	An area disputed between the people of Honouliuli and Waikele. Site of the ancient village, Kupaliʻi. The name translates as "The point of Kāne," and may be suggested to be associated with the tradition of a visit by the gods Kāne and Kanaloa to the region. Cited in the tradition of Maihea.
Kalahu	A loko cited in claim number 1570C of the Māhele ʻĀina.
Kalanimua*	Marks the boundary point between Waiʻanae and ʻEwa ahupuaʻa.
Kalawaha	A loʻi cited in claim number 1580 of the Māhele ʻĀina.
Kaloʻi (Kaloi)	A traditional name used in several areas of Honouliuli that are all connected by a series of gulches from the uplands near the 2,200 ft. elevation to the shore. Following the ethno-historical record, the names Kaloʻi, Kaloʻi iki, Kaloʻi liʻiliʻi and Kaloʻi loa follow from the uplands to the taro land region of Honouliuli, with the latter names being cited in L.C.A. 901, 1570, and 1713.
Kalokoloa	*Lit.* The long pond. A loʻi cited in claim number 5654 of the Māhele ʻĀina.
Kamaʻiʻeleʻele	A loʻi cited in claim number 5653 of the Māhele ʻĀina.
Kamalua	A loʻi and moʻo cited in claim number 5950 of the Māhele ʻĀina.
Kamaʻomaʻo	An area on the kula lands within view of Puʻu o Kapolei, and associated with Kaupeʻa. Named for a supernatural woman who dwelt in the area. The flat land plains of wandering spirits (also see Kaupeʻa). Cited in the tradition of Hiʻiaka-i-ka-poli-Pele and in historical narratives.

Inoa ʻĀina	Description
Kamoʻoiki	*Lit.* The small moʻo. An ʻili and loʻi cited in L.C.A. 911 of the Māhele ʻĀina.
Kānehili	Honouliuli/Puʻuloa. An open kula land, noted in tradition for its association with Kaupeʻa, and as a place of wandering spirits. An inhospitable zone. Cited in the tradition of Hiʻiaka-i-ka-poli-o-Pele and in historical narratives.
Kānehoa	A mountain pass, famed in traditional lore and mele. Noted for its growth of kupukupu ferns, and the wind, Waikōloa, which blows from the mountains to the sea. Cited in the traditions of Hiʻiaka-i-ka-poli-o-Pele and in historical narratives.
Kapākule	*Lit.* The akule fish enclosure. A loko iʻa (fishpond) on the inner shore of Puʻuloa (across from Hālawa), made by the gods Kāne and Kanaloa for the benefit of Hanakāhi, who faithfully worshipped them.
Kapālaha	A loʻi cited in claim number 5670C of the Māhele ʻĀina.
Kapapapūhi (Papapūhi)*	A small point on the shore between these two Honouliuli and Hōʻaeʻae. Also the name of a fishery for Honouliuli. Kapapaapūhi was named for the daughter of Kaihuopalaʻai and Kaʻōhai, whose history is told in the traditions of Makanikeʻoe and Pūhi o Laumeki. Cited in L.C.A. 173, 767, 845, 887, 892, 914, 1565, 1598, and 10933 of the Māhele ʻĀina.
Kapoepoe	A loʻi cited in claim number 5653 of the Māhele ʻĀina.
Kapuna*	A place of kapa makers, loʻi kalo (irrigated terraces of taro [*Colocasia esculenta*]), and houses. The fishery fronting Kapuna belonged to Honouliuli. The people of Kapuna had a way of avoiding the payment of tribute. When the Waikele collector came along, they would claim that they were of Honouliuli; when the Honouliuli collector came along, they would claim they were of Waikele. Their homes were in Waikele, but their fish belonged to Honouliuli (ʻĪʻī, 1959, p. 32). Kapuna was a cave in which chiefs of ancient times once lived. Cited in Na Wahi Pana o Ewa.
Kaʻulu*	Hōʻaeʻae-Honouliuli boundary zone. An ancient village site, known as "Coneyville" in historic times–named for John H. Coney, who was married to Ami, sister of Amoe Haʻaleleleʻa, from who he

Inoa ʻĀina	Description
	purchased the ahupuaʻa of Honouliuli. Reportedly named for the chief, Ka-ʻulu-hua-i-ka-hāpapa (Pukui et al., 1974, p. 93).
Kaupeʻa	*Lit.* Crisscross, interwoven. An area noted as the wandering place of the spirits of the dead, who are seeking their way to another realm. An uninhabited plain with wiliwili trees and ʻōhai plants and associated with Kānehili and Leiolono. From Kaupeʻa, one may see Leiolono where unclaimed spirits are lost on never ending darkness.
Keahi*	*Lit.* The fire. A point west of Pearl Harbor, noted for ʻōʻio fish and as a surfing site.
Keanapuaʻa	*Lit.* The pig's cave (Kamapuaʻa slept here). Cave near Pearl Harbor.
Kīhewamakawalu	A loko cited in claim number 1605B of the Māhele ʻĀina.
Kohepalaoa	An ʻili and loko iʻa cited in claim numbers 5584, 5977, and 5594 of the Māhele ʻĀina.
Koʻolina*	A site near the boundary of ʻEwa and Waiʻanae. Historically it was a vacationing place for chief Kakuhihewa and the priest Napuaikamao was caretaker (Sterling & Summers, 1978, p. 41).
Kuaihoe	A loʻi cited in claim number 5653C of the Māhele ʻĀina.
Kuaiʻōpelu	*Lit.* To disembowel, clean ʻōpelu fish. An ʻili and loʻi cited in L.C.A. 1570 of the Māhele ʻĀina.
Kuaʻipuaʻa	*Lit.* To disembowel pig. A loʻi cited in claim number 5670B of the Māhele ʻĀina.
Kuaka	A loʻi cited in L.C.A. 901 of the Māhele ʻĀina.
Kualakaʻi	*Lit.* Tethys (a sea creature). An ancient village site situated on the western shore of Honouliuli near Barber's Point.
Kumuhau	*Lit.* Hibiscus tree. An ʻili and moʻo cited in L.C.A. 848 of the Māhele ʻĀina.
Kunia	*Lit.* Burned. An upland ʻili part of the larger Keahumoa plains and site of a battle in the time of Kūaliʻi. Cited in claim number 764 of the Māhele ʻĀina.
Līhuʻe*	*Lit.* Cold chill. An upland plain and lower mountain region. Waikōloa is a strong wind of Līhuʻe that blows from the uplands to the lowlands (cited in the tradition of Ku-a-Pakaa). Mauʻunēnē is a light

Inoa ʻĀina	Description
	breeze that blows down the slopes of Līhuʻe to the lowlands of ʻEwa. Cited in Na Wahi Pana o Ewa.
Limaloa	*Lit.* Long arm. A gulch named for a luckless lover in the Kamapuaʻa legend (Pukui et al., 1976, p. 133).
Makaīwa	*Lit.* Mother-of-pearl eyes. Gulch/stream that rises about 1600 ft. elevation to join Awanui stream.
Makakilo	*Lit.* Observing eyes. Gulch/stream that rises about 1000 ft. elevation to join Makalapa stream, ending at Renton Road.
Makalapa	*Lit.* Ridge features. Gulch/stream that rises at about 600 ft. elevation to join Makakilo stream, ending at Renton Road.
Manawaiʻelelū*	*Lit.* Cockroach water branch. A gulch near Poliwai and site of an ancient hōlua (ancient sled course) track.
Miki*	*Lit.* Quick, active, nimble. A land division of Waikele cited in L.C.A. 1597, 1712B, 7260, and 10184.
Moanalua	Land division, park, playground, golf course, residential area, shopping center, schools, and stream near Fort Shafter, Honouliuli. Said to be named for two encampments (moana lua) at loʻi kalo, where travelers bound for Honolulu from ʻEwa rested (Pukui et al., 1976, pp. 152-153).
Mokumeha	A puʻuone (pond near the shore) named for a son of Kaihuopalaʻai and Kaʻōhai, the brother of Laumeki. Cited in the tradition of Pūhi o Laumeki. Cited in L.C.A. 1570B of the Māhele ʻĀina.
Mokuʻumeʻume	*Lit.* ʻUme game island (famous for this sexual game). Old name for Ford Island, Pearl Harbor. Water was brough for melons raised here (Pukui et al., 1976, p. 156).
Moʻoiki	*Lit.* Small moʻo. A loʻi and moʻo cited in L.C.A. 1570B and 5670C of the Māhele ʻĀina.
Nalowale	*Lit.* Lost, forgotten. A heiau on Kapolei hill. Described by Thrum (1906) as "size and class unknown. Its walls thrown down for fencing" (p. 46).
Nāmakaokapāōʻo	An area of māla ʻuala (sweet potato fields) situated on the plain of Keahumoa, a short distance below Kīpapa. Named for a youth who once lived nearby. Cited in the tradition, "Kaao no Namakaokapaoo."
Nāmoʻopuna	*Lit.* The grandchildren. A stream/gulch that rises at about 2000 ft. elevation, joining Mauwaikealae Gulch.

Inoa ʻĀina	Description
Nānākuli	*Lit.* Look at knee, or look deaf. Land section, town, school, forest reserve, stream, valley, beach park, and surfing area. Ahupuaʻa to the west of Honouliuli.
Nāwahineokamaʻomaʻo	An area on the kula lands named for a companion of Puʻu o Kapolei. Cited in the tradition of Hiʻiaka-i-ka-poli-o-Pele.
Oneʻula	*Lit.* Red sand. A beach park on the southern shore.
Pālāʻau	*Lit.* Wooden fence or enclosure. An ʻili and loʻi cited in L.C.A. 848 of the Māhele ʻĀina.
Pālailai	*Lit.* The young lai fish. A stream/gulch that rises at about 1200 ft. elevation, joining Awanui stream.
Palakai	*Lit.* Sickly, stunted. A loʻi cited in claim number 1580 of the Māhele ʻĀina.
Pānaʻenui	An ʻauwai (ditch, canal) cited in claim number 5670B of the Māhele ʻĀina.
Papio	An area in the bay fronting Honouliuli where the chiefess of the same name was killed in an act of anger by the shark-goddess, Kaʻahupāhau. Koihala, Kaʻahupāhau's human attendant, was insulted by Papio and asked that she be killed. The site is also referred to as "Kanahunaopapio." The coral body form of Kaʻahupāhau is also found near this site.
Peʻekāua	Situated on the plain between Puʻuokapolei and Waimānalo. A place famed in the tradition of Hiʻiaka's journey across ʻEwa. Peʻekaua is found on the mauka side of the trail, where there is a large rock standing on the plain. Cited in the tradition of Hiʻiaka-i-ka-poli-o-Pele.
Piliokahe (Pili o Kahi)*	*Lit.* Clinging to Kahe. The boundary marker between Honouliuli, ʻEwa, and Nānākuli of the Waiʻanae District. The boundary was made during the journey of Kāne and Kanaloa across ʻEwa. During their game of ulu-maika, the boundaries were set by where the stone stopped rolling. Cited in traditions and historical accounts.
Pōhākea	A famed mountain pass over which an ancient trail between Honouliuli and Waiʻanae was crossed. Noted in several native traditions for its commanding view plane to the lowlands and noted places of the ʻEwa District. One branch of the trail to Pōhākea passed near Puʻuokapolei. Cited in the traditions of Kāne, Kanaloa

Inoa ʻĀina	Description
	and Hiʻiaka-i-ka-poli-o-Pele.
Pōhaku Mokomoko	A stone on the shore marking the boundary between Honouliuli and Hōʻaeʻae, situated along the side of the government road.
Pōhaku Pālahalaha*	*Lit.* Flat rock. The boundary marker between Honouliuli and Hōʻaeʻae ahupuaʻa.
Poʻohilo	An ʻili named from events following a battle in the Kīpapa-Waikakalaua region, in ca. 1400s, in which the head of Hilo (an invading chief) was placed on a stake at this site and displayed. Cited in L.C.A. 763, 827, 828, 831, 832, 834, 839, 847, 848, 911, 1570, 1666, 1666B, 1701, 5653B and claim numbers 844, 883, 946, 9351 of the Māhele ʻĀina.
Pouhala*	*Lit.* Pandanus post. An ʻili kūpono of Waikele cited in L.C.A. 857, 858, 858B, 858C, 896, 1005, 1013, and 1018 of the Māhele ʻĀina.
Puhilele	Navigational light site, Kalaeloa, Oʻahu. Location of the Barbers Point Light. Lit., leaping eel.
Puʻuloa*	*Lit.* Long hill. This land was traditionally an ʻili of Honouliuli and marked the entrance to Ke awa lau o Puʻuloa (The many bays of Puʻuloa – Pearl Harbor, Pearl River or Wai Momi). The waters of Puʻuloa were protected by the shark goddess Kaʻahupāhau, her brother, Kahiʻukā, and the little shark god Ka-ʻehu-iki-manō-o-Puʻuloa.
Puʻu Kuina	A heiau site described by McAllister (1933) as "located in a gulch at the foot of Mauna Kapu. The suggestion of a terrace is about all that remains…" (p. 107).
Puʻu Kuʻua*	*Lit.* Relinquished hill. A hill and heiau site described by McAllister (1933) as "located on the ridge overlooking Nanakuli, as well as Honouliuli, at the approximate height of 1800 feet. Most of the stones of the heiau were used for a cattle pen… That portion of the heiau which has not been cleared for pineapples has been planted in ironwoods. (p. 108)
Puʻu Manawahua*	*Lit.* Great grief hill or nausea hill. A hill on the boundary of Nānākuli ahupuaʻa.
Puʻuokapolei (Puʻukapolei)	Translated as "beloved Kapo," this hill was named for the goddess Kapoʻulakīnaʻu, an elder sister of Pele. It was also the home of the supernatural grandmother of the demigod, Kamapuaʻa (He

Inoa ʻĀina	Description
	Moolelo no Kamapuaa); a storied hill on the plains of Honouliuli (Na Wahi Pana o Ewa). Kamakau (1976) recorded the tradition that Puʻuokapolei was used by the people of Oʻahu to mark the seasons of the year. When the sun set over the hill, it was Kau (summer). When the sun moved south, setting beyond the hill, it was Hoʻoilo (winter) (p. 14). The old government road passed behind this puʻu. Puʻukuʻua is viewed further inland from this hill. The plains around this region were covered with sugarcane by the late 1890s. A heiau once situated on this hill and a rock shelter were destroyed in the early 1900s (McAllister, 1933, p. 108).
Puʻu o Makakilo	*Lit.* Observing eyes. A crater, land division, and gulch (Pukui et al., 1976, p. 140).
Puʻu Pālailai	*Lit.* Young lai fish hill. A hill situated north west of Puʻu o Kapolei. Pālailai is cited in mele recorded in the tradition of Hiʻiaka-i-ka-poli-o-Pele.
Waieli (Kawaieli)*	*Lit.* Dug water. A stream rises at 2200 ft. elevation under Puʻu Kamakaliʻi on the northern fork; it rises at 1550 ft. at Kolekole Pass on the southern fork. Joins Waikakalaua Stream to form Waikele Stream.
Waikakalaua*	*Lit.* Water rough [in] rain. An ʻili kūpono of Waikele retained by the Crown; a portion of the land was taken by Wheeler Air Force Base in 1922 and added to Wahiawa in 1925. Also a stream of Waikele rises at 2500 ft. elevation, joining Kawaieli at 550 ft. for form Waikele Stream.
Waimānalo*	*Lit.* Potable water. An ʻili and stream. This is one of the wai (watered lands) granted to priests of the Lono class by the demigod, Kamapuaʻa. During the time of Kākuhihewa (King of Oʻahu, ca. 1500s), Waimānalo was home of a priest named Nāpuaikamaʻo. It was this priest who traveled to Koʻolina, where Kākuhihewa was waiting and foretold that Kalelealuakā would gain victory in the battles being brought to Oʻahu's shores.

Honouliuli, as opposed to Kapolei, would have been the more proper name for the project area because it is the name of the traditional ahupuaʻa. The project area may have also been traditionally known as Waimānalo, as depicted in Registered Map No. 618 (Figure 7). Waimānalo is also name of an ahupuaʻa of East Oʻahu in Koʻolaupoko moku, and this name is more commonly associated in this area than that of West Oʻahu. Widespread use of the name in two locations would have likely caused extensive confusion; therefore, the name Kapolei was chosen, inspired by the scared area Puʻukapolei, the small hill located in the middle of the area.

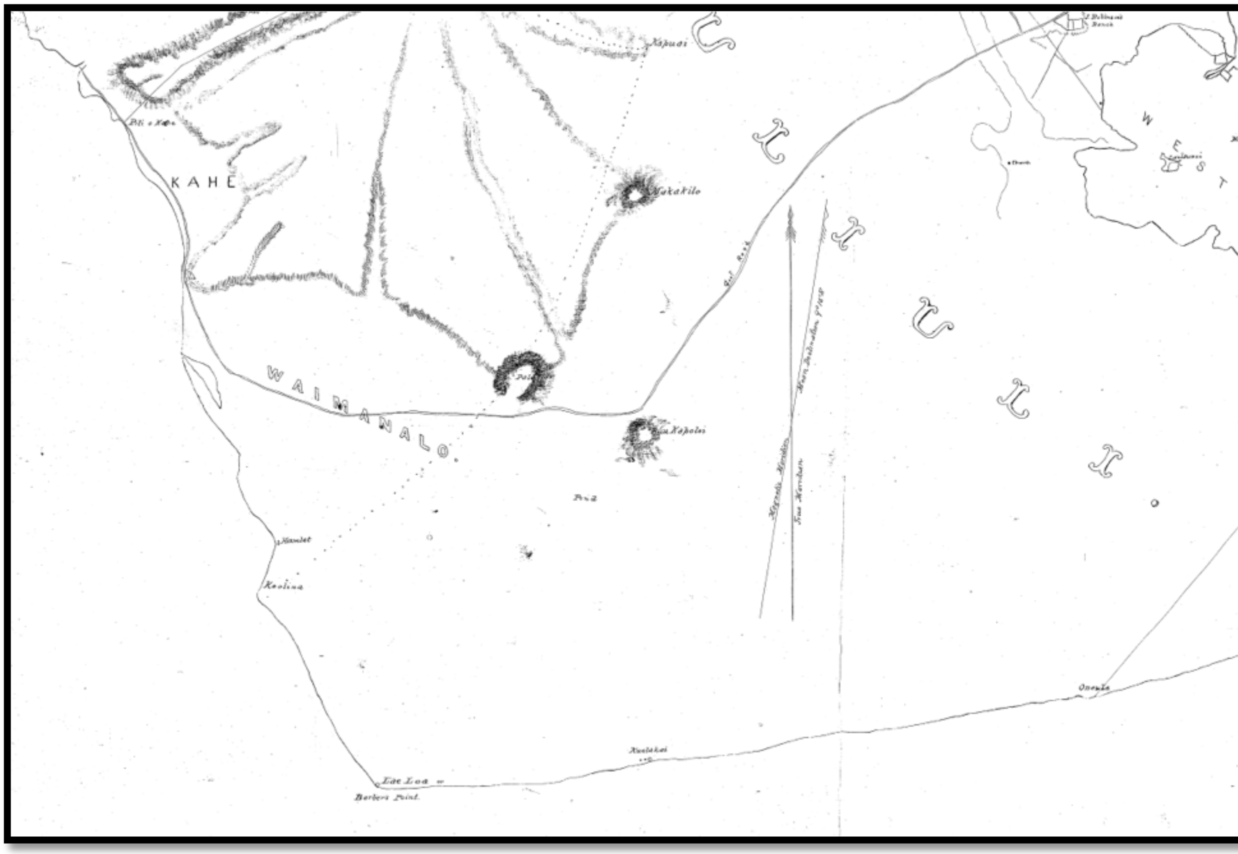


Figure 7. Portion of Map of Honouliuli, Oahu (Registered Map No. 618, W.D. Alexander, 1873)

3.2 Traditional Period – Honouliuli as Recorded in Moʻolelo

In Hawaiian moʻolelo are found expressions of native beliefs, customs, practices and history. The Hawaiian landscape itself is storied, and each place name is associated with a tradition ranging from the presence and interactions between gods and people, to documenting an event or characteristics of a given place. Unfortunately, many of moʻolelo have been lost, but through the moʻolelo that have survived we are able to catch a glimpse at the history of the land and people of Honouliuli (**Figure *8***).

The following narratives focus on some of the notable traditions and history of Honouliuli. In following the history of the land from the period of early Hawaiian residency to modern day,

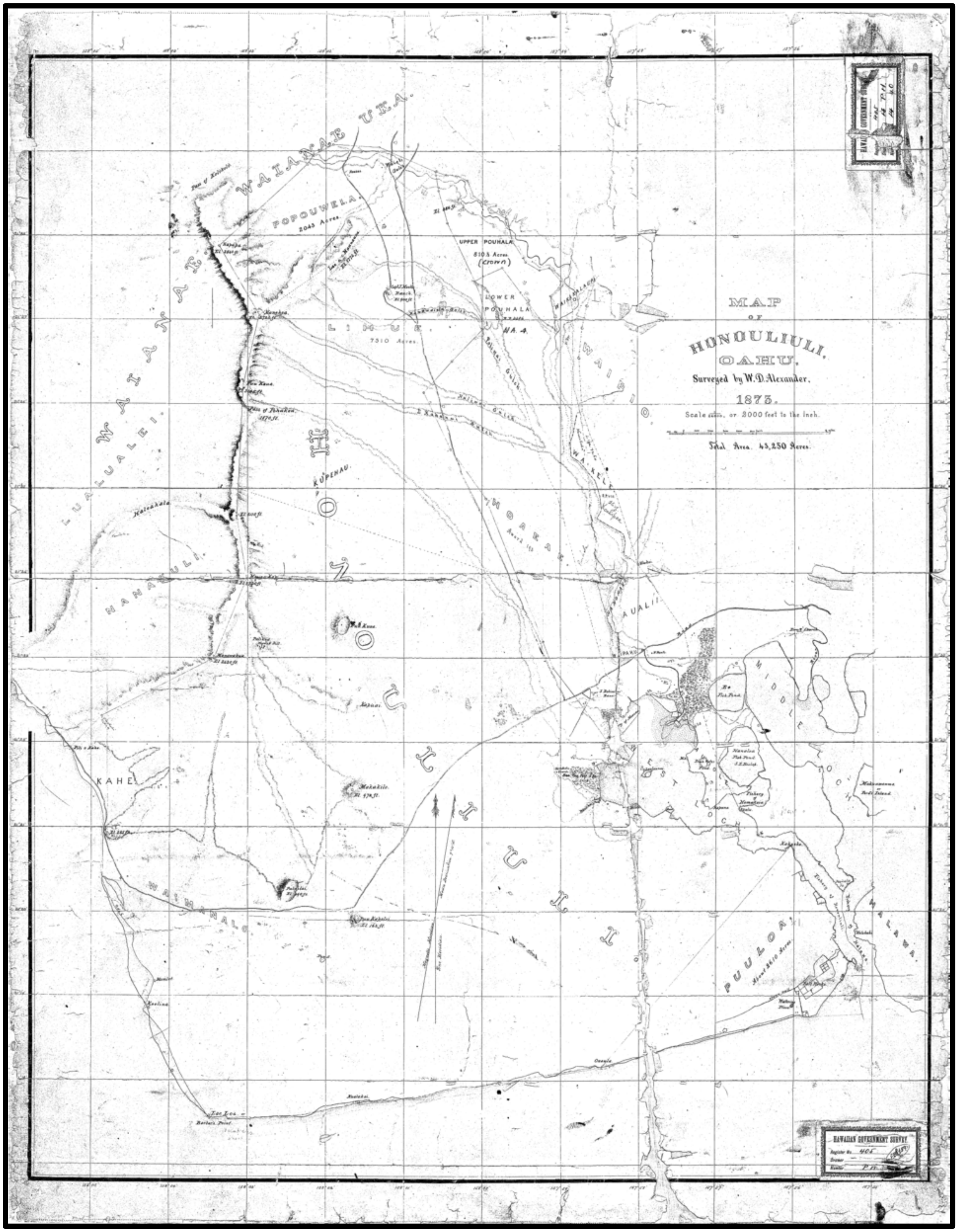


Figure 8. Map of Honouliuli, Oahu (Registered Map No. 404, W.D. Alexander, 1873)

accounts from neighboring ahupuaʻa, larger regions, and even cross-island are cited as they connect people, storied places, and land use beyond the boundaries of Honouliuli. The narratives are generally organized chronologically by period of time or events, such as when the gods walked the land, touching the lives of the people, or when chiefs engaged in conflicts on the land. In many instances, wahi pana were named in the traditions as a means of commemorating notable events in history. The important inoa ʻāina of Honouliuli – as identified in **Table 1** – are underlined in the following passages and excerpts.

1.8.1 Traditions of Hiʻiaka-i-ka-poli-o-Pele

The epic tradition of the goddess Pele and her youngest sister, Hiʻiaka-i-ka-poli-o-Pele (Hiʻiaka), spans the entire Hawaiian Archipelago and beyond to Kahiki, the ancestral home of the gods. The tradition is the source of many descriptions of places, place names, beliefs, traditional knowledge and customary practices. As in the account below, "He Wahi Kaao a me kekahi Mele pu" (1860), portions of the tradition were also cited in excerpts to remind people of various facets of knowledge that was recorded in the larger account. Of particular interest in the narratives below are references to Hiʻiaka's travels on Oʻahu and descriptions of various places in the ʻEwa and Kona districts. There is also an important reference to the goddess "Kiha," a moʻo (water-spirit) whose mana (divine power) was called upon in the making of chiefs and whose form was a part of the circuit gods who traveled around the island in the Makahiki celebrations. The name Kiha is commemorated in the place name Ka-puka-o-Kiha in Kalauao ahupuaʻa.

Ka Hae Hawaii
He wahi kaao a me kekahi mele pu.

Iulai 4, 1860 (aoao 60)

O Lohiau me Kaleiopaoa, he mau kanaka no Kauai, o Haena ko laua wahi noho; Ua launa kino wailua wale o Pele me Lohiau, ua ku a aloha loa o Pele ia Lohiau: no ka nui o kona makemake kenaʻku la oia ia Hiiaka e kii ia Lohiauipo i Haena a loaa. Eia ka laua Berita, "e kii oe ia Lohiau a loaa mai me oe a laa iaʻu, Oia ka aoao 1. Eia hoi ka ka aoao elua, e malama oe i kuu aikane ia Hopoe, a hoi mai au;" alaila, hele o Hiiaka i Kauai.

A hiki o Hiiaka me Wahineomao i Haena, ua make o Lohiau, lapaau oia a ola, hoi mai lakou a ekolu o Lohiau, me Wahineomao, a me Hiiaka, a hiki i Oahu, pae o Hiiaka mauka o Waianae, ma ka waa no o Lohiau a me Wahineomao, a hiki i Puuloa. Ia hele ana o Hiiaka mauka, a hiki oia maluna o Pohakea, i nanaʻku ka hana ua make o Hopoe, e ami mai ana i ke kai, alaila hu mai la ke aloha o Hiiaka no ke aikane ana.

A hiki ma Puuloa, kau hou lakou ma ka waa, a hiki i Mamala, halawai me Peleula ma e heenalu ana, hoi lakou i uka i ka hale, hookipa maikai ia po, lealea lakou ia po, he Kilu ka hana ilaila i ike ai o Hiiaka i ka lea o Lohiau.

Haalele ia Honolulu, hiki lakou i Molokai, noho i ke kaha o Palaau, a make i ka make a ka pololi, lohe mai lakou he hale komo ko Olepau ke alii o Maui, manao aku hoi e ola ka pololi ilaila, i ua la nei i komo ai ka hale o Olepau hiki lakou a ekolu ilaila. I ka ike ana mai o Waihinalo ka wahine a Olepau, ua maopopo iaʻku kona ano, he ano pi.

Hoohuli ae la, oia ia Olepau iluna ke alo, hukihuki i ka umiumi. Alaila hapai ae la o Hiiaka i keia mele, a pane aku ia Waihinalo.

Mehameha kanaka ole ka hoi Puuomoeawa--e,
O Kaupea i ka aina kanaka ole,

B. Kalaiohauola. Wailua, Kauai, Iulai 4, 1860.

Hiʻiaka and her companion Wahineʻōmaʻo traveled to Hāʻena, Kauaʻi and returned Lohiʻauipo (Lohiʻau), Pele's mortal lover, to life. Hiʻiaka, Wahineʻōmaʻo and Lohiʻau then departed from Kauaʻi on their journey to the island of Hawaiʻi where Lohiʻau would be reunited with Pele. Arriving at Waiʻanae, Hiʻiaka went overland, instructing Lohiʻau and Wahineʻōmaʻo to continue by canoe, where she would later rejoin them at Puʻuloa.

Hiʻiaka walked inland and passed over the summit of Pōhākea, from where she looked to Hawaiʻi and saw her beloved friend, Hōpoe dancing on the shore. She then descended (across Honouliuli), and arrived at Puʻuloa where she boarded their canoe and traveled on to Māmala and then met with the chiefess Peleʻula (for whom the place in Honolulu is named). They then traveled by canoe on to Molokaʻi and then to Maui.

While on Maui, Hiʻiaka chanted a mele in which she described certain places where she had traveled. One of the lines returns to the plains of Honouliuli in which she said:

"O Kaupea i ka aina kanaka ole…"
(Kaupeʻa is a land without people…)

Between 1860 and 1928, several important Hawaiian language publications provided variations in the telling of the epic tradition of Pele and Hiʻiaka. The narratives cited below were published in the Hawaiian newspaper *Ka Hoku o Hawaii* from September 18, 1924 to July 17, 1928 through the partnership of Julia Keonaona, Steven L. Desha Sr., Isaac Kihe, and others. They artfully retold this tradition, embellishing it with descriptions of places and events in history, thus bringing the knowledge of place forward to later generations.

The following translated excerpts offer important details pertaining to wahi pana, traditional and customary practices, and the naming of places visited by Hiʻiaka as she traveled into and across lands of the Honouliuli ahupuaʻa.

Ka Hoku o Hawaii
He Moʻolelo Kaʻao no Hiʻiakaikapoliopele…

January 18, 1927 (page 1)

Seeing the beauty of Kaʻala, Hiʻiaka chanted:
Beloved is the dew of Kaʻala,
That dew which bears the fragrance of the nene grasses,
[fragrant dew which] Kissed the natives of Puʻuloa,
One searches far for love...

January 25, 1927 (page 1)

…As Hiʻiaka and her companions prepared to depart from Pōkaʻī, she told Lohiʻau and Wahineʻōmaʻo, that they would travel by canoe, while she would travel for a while over land. They would meet again at Kou [Honolulu], and she instructed them "As you travel, you will arrive at a place where a point juts out into the sea. That will be Laeloa; do not land there. Continue your journey forward, and as you continue your journey, you will see a place where the ocean lies calmly within the land. That will be ʻEwa; do not land there. Continue your journey and you will reach a place where the mouth [of the land] opens to the sea (hamama ana ka waha i ke kai). That is Puʻuloa, do not land there either. That is the entry way to ʻEwa...The travelers then parted and began their journeys.

February 8, 1927 (page 1)

Hiʻiaka continued to the uplands along the trail which passes through Waiʻanae. Now the trail upon which Hiʻiaka chose to travel, is the trail which passes through the heights of Pōhākea. Hiʻiaka passed along the kula [plain] of Māʻili, and then turned to look at the uplands. She saw the dazzling light of the sun on the uplands of Lualualei and Hiʻiaka chanted:

The sun is hot!

The sun is hot!
The heat of the sun is on the plain of Lualualei
The sun chews it up entirely...

Hiʻiaka then continued her ascent on the trail in the stifling heat of the sun, and she chanted:

The path is at Waikonene,
Ascending at Kamoaʻula,
The heat of the sun is upon the breast,
ʻĪlio is born upon the back of Pūhāmaloʻo,
The nāulu winds rage,
Breaking the stream, but the breast of Pūhāwai is quiet,
The kaiaulu breeze seems to fight and rebel against the people,
Striking and causing the noses to rage,
The mucus flows freely,
In the hot sun of Lualualei.

From the heights of Pōhākea, Hiʻiaka looked to the shores of ʻEwa, where she saw a group of women making their way to the sea. The women were going down to gather pāpaʻi [crabs] and limu [seaweed], and to gather the mahamoe, ʻōkupe [both edible bivalves], and such things as could be obtained along the shore of that land. Hiʻiaka then began to chant about those ladies:

The Kehau breeze is there below Waiʻōpua,
Bearing the fragrance of the kupukupu ferns across the plain,
The coolness is laid upon the grasses,
A coolness laid upon the sea of ʻEwa,
ʻEwa is made cold [unfriendly] because of the fish which hushes voices,
Be silent in that breeze.

Hiʻiaka saw the women moving ahead to the shoreline, just like the cold Waikoloa wind that blew from the uplands of this place. And this was why Hiʻiaka had chanted to them. Hiʻiaka then turned towards the canoe on which her companion and the man [Lohiʻau] were traveling. They were paddling and were no longer talking, for Hiʻiaka had admonished them, warning—

ʻEwa is made cold because of the fish that hushes voices,
Be silent!

Now, the famous fish of ʻEwa in those days when the wind blew because of conversations, was the pipi [pearl oyster]. Only when it was very calm could one go to catch the pipi. If anyone spoke while going to get the pipi, the breeze would cause rippling on the water's surface, and the pipi would be hidden from sight.[7] In this way, Hiʻiaka had instructed Wahineʻōmaʻo and Lohiʻau to be quiet like the women of ʻEwa who were going fishing. If one spoke, the angry winds would blow and bring misfortune...

February 15, 1927 (page 1)

...Turning her gaze towards the island of Hawaiʻi, she could see the flames of Pele in the lehua forest of Hōpoe, and she chanted out—

Beautiful is Pālailai, sacred assembly of the woman,
I set up the drum of the sacred voice,
The voice of the ocean is what I hear,
The natives hear it
The birds drink the water caught in the noni leaves,
The billowy clouds pass in the calm,
The fires of Hawaiʻi rise above me...

...Hiʻiaka then departed Pōhākea, descending to the plain of Keahumoa [in the uplands between Waipiʻo and Honouliuli]. It was at this place that she saw several women gathering the blossoms of the maʻo [*Gossypium tomentosum*, an endemic yellow-flowered hibiscus that grows on the dry land plains] with which to string garlands for themselves. She then saw them sit down and begin to string and complete the garlands for themselves, so that they could adorn their necks. These women adorned themselves in the maʻo garlands and were really quite beautiful. Hiʻiaka then felt her own neck, for she was without a lei. Hiʻiaka then thought about what to say to the women regarding the garlands with which they had adorned themselves. She then thought within herself, I am going to ask them for a lei that they had been burdened with making. If they have aloha for me, then there is no kindness which they shall not have, but if they deny me, so it will be. Hiʻiaka then offered a chant to the women who had strung their garlands upon the plain which is burned by the sun.

The plain of Keahumoa wears the maʻo blossoms as its lei
Adorning the women who string garlands in the wild

[7] It was believed that talking would cause a breeze to blow that would, in turn, frighten the pipi (Pukui, 1983).

It is like the lehua blossoms of Hōpoe
Lehua blossoms upon which the sun beats down
On the nodding koaiʻa flowers of the cliff
On the rooftops of the houses at ʻĀpuku
Rising in the presence of the cliff of Puʻukuʻua
The land is indeed a chief
Man is indeed a slave
I am indeed a slave to aloha—love
It is love which invites us two—come
I come–

Then one of the women answered her in a kindly manner, "Wait stranger, before you go on your way, here is your lei." It is true what you have said, "He kauwa ke kanaka na ke aloha, a na ke aloha no e kono, ao ka naue holookoa no ia o ke kino." [Man is a slave of love or compassion, and it is aloha which beckons to us and moves us to come forth.] The woman then moved forward and placed her lei upon Hiʻiaka, and the other women did the same as well. The women then saw the true beauty of Hiʻiaka and they urged her to join them for a meal at their home on the shore of ʻEwa.

Hiʻiaka then spoke to them, "I am not hungry, for your kindness has satisfied me. Here are the words which I share with you—In your dwelling, if one of you should meet with trouble, or if one of the people for whom you have aloha is in need, offer the chant which I offered to you, asking without shame for garlands that you had made. The chant is a prayer for the passing of troubles from you or your loved ones. Now come and kiss me, and I will depart from this long open plain."

The women stepped forward to kiss Hiʻiaka, and as they rubbed noses each one of them remembered the chant which Hiʻiaka offered when she asked for their garlands of maʻo. Thus this chant became a prayer for those women in their days of trouble. Hiʻiaka then departed from those women who strung garlands of maʻo on the plain and traveled towards the shore of ʻEwa, towards Puʻuloa. Turning towards the ocean of Honouliuli, Hiʻiaka saw the expanse of Leinono[8] and she said within herself:

Say! I have not forgotten you Leinono, though perhaps you think I am no good because I don't know you. Therefore, I call to you Leinono with this chant:

[8] Leinono, also written as Leilono (Kamakau, 1968, pp. 47-49).

Bright eye, the rising sun,
Companion that travels arm-in-arm with the expanse of ʻEwa,
The Amu wind that causes dust to mound up,
Is the first born of the Moaʻe wind,
A child that is embraced by the ʻEwa-loa [expanse of Ewa],
Hail Leinono,
Our companion.

Finishing her chant, Hiʻiaka then turned and saw her companion and Lohiʻau paddling their canoe. And her love welled up for her traveling companions. It was also then, that Hiʻiaka came to understand that Lohiʻau would be killed by Pele when they reached Hawaiʻi. Hiʻiaka then turned and continued her journey along the path that crossed this unpeopled plain. While walking along, she saw two women who were busy stringing garlands of ʻilima [*Sida fallax*] blossoms. The women were sitting alongside the trail upon which Hiʻiaka was traveling. Now when these two women saw Hiʻiaka, one said to the other, "Say, this is Hiʻiaka who is descending along the path, we must depart with haste, lest she kill us."

The two women hastily departed, and reached a stone that was situated along the side of the trail which continued on to Waiʻanae. It was at this stone that the two women transformed themselves into their supernatural moʻo forms.

One of the lizards then went and hid in a little space on the stone, and the other went nearby. One moʻo said to her companion moʻo...

February 22, 1927 (page 1)

…"It is fortunate that we have hidden ourselves at this place, so that we may escape being killed by Hiʻiaka." Now from ancient times till recently, the place at which this stone was situated, was called "Peʻe-kāua" [We two hidden]. Now that the road has been made, the stone at which these two moʻo wahine [lizard women] has been destroyed.

When Hiʻiaka saw that these two women had fled and taken their moʻo forms to hide on the stone along the trail, she chanted out to them:

Greetings to you two women of the plain,
It is a barren plain in the sun,

Where the sun bears forcefully down,
Having gone to hide,
We two are hidden at Peʻe-kāua,
Aloha to you two,
Here I am traveling on.

Hiʻiaka then continued walking towards the shore. Hearing Hiʻiaka's chant of affection, these two moʻo women said to one another, "Say, this is truly remarkable, for we will not die, but have been saved by Hiʻiaka. She has given us her aloha as she descends in the heat of the sun, and so it is that we shall remain upon this plain."

Descending to the flat lands of Honouliuli, Hiʻiaka then turned and looked at Puʻuokapolei and Nāwahineokamaʻomaʻo who dwelt there in the shelter of the growth of the ʻōhai [*Sesbania tomentosa*], upon the hill, and where they were comfortably refreshed by the blowing breezes. Hiʻiaka then said, "Puʻuokapolei and Nāwahineokamaʻomaʻo, do not forget me, lest you two go and talk behind my back and without my knowing, so here is my chant of greeting to you:"

Greetings to you two o Puʻuokapolei and companion
O Nāwahineokamaʻomaʻo
Set there, and dwelling
In the shade of the ʻōhai
Stringing garlands of kukui in the day,
Adorning yourselves in the garlands of the maʻomaʻo
Kaunaʻoa [*Cuscuta sandwichiana*] is the lei of the shores of Kaʻōlino[9]
There is joy in traveling.

When Hiʻiaka finished her chant, Puʻuokapolei said, "Greetings. Love to you, o Hiʻiaka! So it is that you pass by without visiting the two of us. Lo, we have no food with which to host you. Indeed, the eyes roll dizzily with hunger. So you do not visit us two elderly women who have cultivated the barren and desolate plain. We have planted the ʻuwala [sweet potato] shoots, that have sprouted and grown, and have been dedicated to you, our lord. Thus as you travel by, pull the potatoes and make a fire in the imu, so there will be relief from the hunger. For we have no food, we have no fish, and no blanket to keep us warm. We have but one kapa [covering], it is the pilipiliʻula [the grass *Chrysopogon*

[9] Kaolino (the brightness) appears to be a variation of Koʻolina (interpretively translated as "Joyous").

aciculatus]. When it blossoms, we go and gather the grass and plait it into coverings for us. But in the time when the grasses dry, and none is left on the plain, we two are left to live without clothing. The cold breeze blows in the night, the Kehau and Waikōloa, the cold does not remain though, and when the grasses of the land which give us warmth, begin to grow again, our nakedness is covered, and we are a little better off than the flowers of the maʻo. It is because we are left without our covering of the pilipiliʻula grass, that many people have come to say, "Waiho wale iho ka mauu o Kaiona" [Kaiona is left exposed by the grasses; (Nothing is left to the imagination)]. Aloha to you, and aloha be with you in your travels o Hiʻiaka-i-ka-poli-o-Pele, our lord.

Hiʻiaka then turned and continued her walk in the stifling heat of the sun on the plain of <u>Puʻuokapolei</u>. Hiʻiaka saw a maʻo blossom as she descended, and she picked it in the heat of the sun and chanted out:

> Kona is made dizzy in the long days of Makaliʻi [in the summer]
> The wiliwili [*Erythrina*] trees sway, then comes the calm,
> The birds of <u>Kānehili</u> endure,
> The sun is exceedingly hot on <u>Puʻuokapolei</u>,
> The maʻo growth is stunted on the seaward plain,
> The nohu [*Tribulus cistoides*] flowers are like a halakea [kapa] covering
> The puaʻula [young kūmū] fish seem to flash along the shores of <u>Kaupeʻa</u>
> A companion [is the] Nāulu wind,
> It is a traveling companion for me.

When Hiʻiaka finished her chant, she continued toward the shore, and looking to the ocean, she saw the canoe of her friend and Lohiʻau, and chanted:

> My man on the many harbored sea of <u>Puʻuloa</u>,
> As seen from the plain of <u>Peʻekāua</u>,
> Let us dwell upon the ʻōhai covered shore,
> Where the noni blossoms are twisted together,
> Descending along <u>Kānehili</u>
> I am winding along

Hiʻiaka then turned and looked back to <u>Puʻukuʻua</u>, <u>Kānehoa</u>, and <u>Haleʻauʻau</u> and said, "Do not forget me <u>Puʻukuʻua</u> mā [and companions]. And so you do not think that I will forget you, here is a chant of endearment for you:"

It is I who travel along the shore of Puʻuloa,
Where the ʻōhai is at Kaupeʻa,
In the awe-inspiring sun,
It is seen,
It has been seen by me,
At the mountain cliffs,
Puʻukuʻua at Haleʻauʻau,
The sprouting of the kukui growth,
Dancing in the sun of Kānehoa,
Love to you my companions.

...Upon finishing her chant, Hiʻiaka continued down the trail and arrived at Kualakaʻi. At Kualakaʻi, the trail took her to a spring of cool water. Looking into the spring, she saw her reflection shining brightly upon the water's surface. Hiʻiaka also saw two lehua trees [*Metrosideros polymorpha*] growing on each side of the spring. Now these two lehua trees were completely covered with blossoms. She then picked the lehua blossoms of these two trees and made garlands for herself.

Hiʻiaka fashioned four strands to her lei, she then removed the garlands of maʻo which she had received when descending from Pōhākea, and set them aside.

She then took the garlands which she had made, and adorned herself with them. Hiʻiaka then heard the voice calling out from the area of Kānehili:

Hiʻiaka is the woman
Who picked the flowers of Hoʻākalei,
And with a needle strung and made them into four garlands, the sectioned lei of the woman,
O my younger sibling.
My younger sibling who came from the place where the dusty wind rises from below
Overturned in the sea of Hilo-one,
The aloha is for Hilo,
Love for the lei.

That place, Hilo-one, which is mentioned in the mele, is situated on the northern side of Kualakaʻi, towards Kalaeloa. And the name of the spring in which Hiʻiaka looked and saw her reflection was Hoakalei. It was at this place that Hiʻiaka saw the two lehua trees growing, from which she picked the blossoms too make her four garlands.

Hearing the chant, Hiʻiaka turned toward where it had come from, and saw her older sister Kapo looking at her. Kapo had arrived at Oʻahu from Maui, where she was teaching the practices of the hula. Seeing Kapo, Hiʻiaka cried out with affection for her older sister…

March 1, 1927 (page 1)

So, it is you o Waialua-iki,
Of the sun darkened cliff of Uli,
Liawahine has gone traveling,
O woman that stands calling from the cliff,
I am adorned with a lei,
Yes, I am wearing garlands of the misty-centered lehua blossoms,
The lehua that grows along the water's edge at Hoakalei,
My lehua of Hilo-one,
On the shores of Kaʻōlina and Kaupeʻa,
I am adorned.

The reason that Hiʻiaka presented this chant to her elder sister Kapo, saying, "kui pua lei, o Hoakalei" [stringing flower garlands of Hoakalei] was because in her chant, Kapo had inquired about Hiʻiaka's picking the flowers from the spring of Hoakalei and making them into four garlands for herself… As it is seen in this mele, Hilo-one is on Oʻahu, there at Kualakaʻi, near Kalaeloa.

Thus it is understood that through traditions like this, we are given direction in knowing about the names of various places of the ancient people, and which are no longer known in this time… Hiʻiaka then continued her journey toward the shore of Puʻuloa, and she thought about the words that she had earlier spoken to Wahineʻōmaʻo and Lohiʻau, and she chanted:

I will not travel to the shore of Kaupeʻa,
To Kaupeʻa where the ʻōhai of Kānehili are found,
I will turn away…

…Hiʻiaka then arrived at a place where many people were gathered together, and she overheard them talking about preparations for a journey to Kou, which is the old name for Honolulu. The people were preparing to go to the court of the chiefess Peleʻula, who was hosting kilu[10] games…

March 8, 1927 (page 1)

…Learning of the contest that was to be held at Kou, Hiʻiaka had reservations about having Lohiʻau stop at the court of the chiefess Peleʻula. So she chanted, calling to Lohiʻau, telling him to bring the canoe to shore at Puʻuloa. When Hiʻiaka chanted, everyone became quiet, because they were awed by the beauty of her chanting voice. One of the women in the group then called to Hiʻiaka, "You are a stranger to us in appearance, but your chant indicates that you are very familiar with this shore, how is that so?" Hiʻiaka confirmed that she was indeed a visitor, and yet familiar with the places of this land. She then said, "Ua maikai no kau noi e ke kamaaina maikai, aka, i Kou hoi e hui aku ai na maka" [You have asked a good question, kind native, but, it is at Kou, that all the faces (eyes) shall meet].

Thus it is seen that when Hiʻiaka responded to the woman of Puʻuloa, that this famous saying of the people of Oʻahu came about, "Hui aku na maka i Kou" [The faces shall meet at Kou]… Now, Lohiʻau had heard the chant of Hiʻiaka, and he drew the canoe to the shore. When Hiʻiaka boarded the canoe, she bid farewell to the people of Puʻuloa and said, "Hui aku o na maka i Kou" [We will meet again].

They then directed their canoe seaward, and went out of opening of Puʻuloa. Hiʻiaka turned and looked towards the land where she saw the dwelling places of Kinimakalehua, Leinono, and Keālia. She called out to them, "So you do not forget me, here is a chant for you" —

> Reddish yellow are the rains of Kinimakalehua,
> Leinono is the companion above, and Puʻuloa is shoreward,
> The journey across the expansive sands of ʻEwa has been made arm-in-arm,
> I am at ʻEwa, I greet you o Leinono, We are all companions

In this chant of Hiʻiaka, she spoke the famous saying that is the pride of the descendants of ʻEwa; "Ke one kui-lima laula o ʻEwa" [The sands of ʻEwa, across which everyone joined hand-in-hand]. These words of Hiʻiaka are a famous saying of this land to this day. As the canoe continued toward Kou, passing the land of Kalihi, Hiʻiaka looked again towards

[10] Kilu is a Hawaiian game in which a gourd or halved coconut shell is tossed at an opponent's pob (something like horseshoes). The individual who successfully hit the pob that he or she had selected was the winner and could claim a kiss or some other favor from the opponent (Malo, 1951, p. 216).

Leinono and Keālia, and she chanted:

Hail to you o Leinono, o Kinimakalehua, o Keālia who is below, aloha,
Here is the supplication, the offering, of the one who has traveled by.
It is a voice or song, only a voice—

She then turned forward and the canoe arrived at Nuʻuanu…

3.2.2 He Moʻolelo no Kamapuaʻa (A Tradition of Kamapuaʻa)

S.W. Kahiolo contributed the tradition of Kamapuaʻa to the native newspaper *Ka Hae Hawaii* in 1861. This is the earliest detailed account of Kamapuaʻa, a multi-formed deity of traditional significance on Oʻahu and all the major islands of the Hawaiian group. Kamapuaʻa is a part of the Lono god-force and possessed many kino lau (body forms), representing both human and various facets of nature. He was born in pig-form to Hina (mother) and Kahikiʻula (father) at Kaluanui in the Koʻolauloa moku of Oʻahu.

Translated excerpts from Kahiolo's accounts provide details on places of traditional cultural significance in the ʻEwa moku. This moʻolelo offers traditions associated with the naming of, or traditional importance and uses of, localities from Honouliuli to Moanalua. Waimānalo, Waikele, Waipiʻo, Waiawa, Waimano, Waimalu, Puʻuokapolei, Keanapuaʻa, Puʻuloa, Moanalua, Waipahu, and Kuolohele are named in the following excerpts.

Ka Hae Hawaii
He Moʻolelo no Kamapuaʻa.

July 10, 1861 (page 60)

…When the chief Olopana was killed, the island of Oʻahu became Kamapuaʻa's. He then fetched his people [who he had hidden] from above Kaliuwaʻa and brought them down, and they then returned to their lands. The priest [Lonoawohi] asked Kamapuaʻa if he could be given some lands for his own as well. He asked, "Perhaps the water lands might be mine." Kamapuaʻa agreed. This was something like a riddle that the lands which have the word "water" [wai] in their names would be his, like: Waialua, Waiʻanae, Waimānalo, Waikele, Waipiʻo, Waiawa, Waimano, Waimalu, Waikīkī, Waiʻalae, Wailupe, Waimānalo 2, Waiheʻe, Waiāhole, etc.

The parents of Kamapuaʻa [Hina and Kahikiʻula] thought that this amount of land was too great, and they criticized Kamapuaʻa for agreeing to it. But his elder siblings and grandmother did not criticize him, agreeing to the priest's request. The remainder of the lands went to Kamapuaʻa's family…

Following a journey to Hawaiʻi where Kamapuaʻa fought with Pele, he returned to Oʻahu and learned that the island was under the rule of another chief and that his parents had been chased to Kauaʻi; his favorite brother Kekeleiaiku had been killed. The following excerpts include accounts describing sites and activities in ʻEwa.

August 7, 1861 (page 76)

…Kamapuaʻa walked to Keanapuaʻa, on the shore at Hālawa, and he slept there. When he woke up from his sleep, he urinated in the sea, and that is why the fish of Puʻuloa have a strong smell to them, so say the uninformed.

From there, he went to Honouliuli and saw his grandmother, Kamauluaniho, sitting along the side of a taro pond field. She was looking with desire to the lands below, where some of the men of the king were working and wishing that they would leave even a little bit of taro behind for her to eat. Kamapuaʻa then went and stood next to her and greeted her. She replied, greeting him, but did not recognize him as her grandson. He then asked her why she was sitting there. She told him, "I am looking to the lowlands, where the men of the chief are working, and wishing that they would leave a little behind so that I may have some food." Kamapuaʻa then said to his grandmother, "How did you live before?"

She answered, "What is it to you? My grandchildren have died, one in a battle with Pele, another buried, and one on Kauaʻi." This is how she spoke, not understanding that the one before here was her own grandson. Kamapuaʻa then answered, "I am going to get some food for me." She asked, "Where will you get your food?" He told her, "I will go and perhaps ask for some, and maybe they will give me some of their food."

August 14, 1861 (page 80)

Kamapuaʻa went and said to one of the men who was pulling taro, "Let the two of us pull taro for us." The man agreed, and the two of them pulled taro, some for the man and some for Kamapuaʻa. Kamapuaʻa pulled a large quantity and then carried it up to his grandmother. Because of the large load that he carried, Kamauluaniho suspected that the man was indeed her own grandson, Kamapuaʻa. She chanted a name song to Kamapuaʻa and he chanted to her as well. Together, they carried the taro to the house she shared with another old woman, at Puʻuokapolei. Setting down their bundles of taro, Kamauluaniho placed Kamapuaʻa on her lap and wept over him. The two were joined by the other old woman and she was introduced to Kamapuaʻa, who she thought had been lost. Preparations were made for a meal, and Kamapuaʻa and the old woman went out to her garden to collect sweet potatoes. They then returned to the house and ate…

August 21, 1861 (page 84) – August 28, 1861 (page 88)

…Kamapuaʻa went to Nuʻuanu and performed a ceremony, bringing his brother, Kekeleiaiku, back to life. He then traveled to Kou where he killed the chiefs and people who had killed his brother and forced his family into their lives of despair… Returning from Kou, Kamapuaʻa met his friend Kuolohele and the two of them walked from Moanalua. They reached Waiawa and continued on to Waipahu. Standing on the edge of the stream there, Kuolohele went to bath in the stream. Kamapuaʻa noticed that Kuolohele had a large lump [puʻu] on his back. Picking up a stone, Kamapuaʻa struck the lump on Kuolohele's back.

Kuolohele cried out, thinking that he was about to be killed. Kamapuaʻa reassured him that he was not going to die, but that instead, he would be healed. He then instructed Kuolohele to touch his back. In doing so, Kuolohele found that the lump was gone.

Kamapuaʻa then picked up the stone and set it on the cliff-side. That stone remains there at this time, and it is a stone which many travelers visit [the stone is named Kuolohele]… Kuolohele and Kamapuaʻa continued traveling together for a short distance, until Kuolohele reached his destination. Kamapuaʻa continued to Puʻuokapolei, where he met with his grandmother and brother. He told them what had transpired, and he then set off for Kauaʻi, to bring his parents back to Oʻahu…

3.2.3 Moʻolelo no Puapualenalena (The Tradition of Puapualenalena)

Puapualenalena was a supernatural dog who lived during the time of Hakau, the half-brother of Hawaiʻi's ʻUmi-a-Līloa; ca. AD 1525. His primary residence and adventures occurred on Hawaiʻi, but he also traveled across the islands. While on Oʻahu, the heights of Pōhākea where the mountain trail descends into Honouliuli were mentioned. From there he traveled to the shore of Puʻuloa.

Ka Nupepa Kuokoa
Moʻolelo no Puapualenalena.

February 24, 1866 (page 1)

…While sailing from Kauaʻi, Puapualenalena and his companions reached the Waiʻanae coast. Puapualenalena leapt to shore and traveled across the land to Pōhākea from where he looked upon the lands of ʻEwa and Waialua… He then went down to the shore of Puʻuloa where the canoes had landed and joined the travelers to continue the journey to Hawaiʻi…

3.2.4 He Moʻolelo Kaʻao Hawaiʻi no ka Pūhi o Laumeki (A Hawaiian Tradition of Deified Eels and how the ʻAnae-holo came to Travel around Oʻahu)

"He Moolelo Kaao Hawaii no ka Puhi o Laumeki, ka Mea i Like me ka Ilio Puapualenalena" was published in the Hawaiian language newspaper *Nupepa Ka Oiaio,* between November 8, 1895, and February 14, 1896. The moʻolelo was submitted to the paper by native historian, Moses Manu. The moʻolelo primarily focuses on wahi pana and features associated with the lands of ʻEwa, Oʻahu, recounting events associated with the birth and deification of a pūhi (eel) guardian of fisheries and his siblings, among whom was Mokumeha. The narratives include important descriptions of Honouliuli as the source of the ʻanae (mullet) holo, annual migration, and fisheries around the island of Oʻahu. It should be noted that the following installments are summaries and not direct translations of these primary resource documents.

Nupepa Ka Oiaio
November 8, 1895 (page 4)

It is perhaps not unusual for the Hawaiian people to see this type of long fish, an eel, about all the shores and points, and in the rough seas, and shallow reefs and coral beds of the sea. There is not only one type of eel that is written about, but numerous ones that were named, describing their character and the type of skin which they had. In the ancient times of our ancestors, some of the people of old, worshipped eels as Gods, and restrictions were placed upon certain types of eels. There are many traditions pertaining to eels. It is for this fish that the famous saying "An eel of the sea caverns, whose chin sags."[11]

Indeed, this is the fish that was desired by Keinohoʻomanawanui, the eels of the fishpond of Hanaloa, when he was living with his friend, Kalelealuaka, above Kahalepōʻai at Waipiʻo uka, when Kākuhihewa was the king of Oʻahu.

It is said in this account of Laumeki, that his true form was that of an eel. His island was Oʻahu, the district was ʻEwa, Honouliuli was the land. Within this land division, in its sheltered bay, there is a place called Kaihuopalaʻai. It is the place of the ʻanae, which are

[11] According to Pukui (1983), this ʻōlelo noʻeau is an expression that was used to describe a prosperous person (p. 167).

known about Honolulu, and asked for by the people, with great desire.

Kaihuopalaʻai was human by birth, but he was also a kūpua who was born at Honouliuli. His youngest sister was known by the name of Kaihukuʻuna. In the days that her body matured and filled out, she and some of her elders left ʻEwa and went to dwell in the uplands of Lāʻiemaloʻo, at Koʻolauloa, where she met her husband. The place known by the name Kaihukuʻuna, at Lāʻiemaloʻo, is the boundary of the lands to which the ʻanae of Honouliuli travel.

At the time that Kaihukuʻuna was separated from her elder brother and parents, Kaihuopalaʻai had matured and was well known for his fine features, and his red-hued cheeks. He was known as the favorite of his parents and all the family. There was a young woman, who like Kaihuopalaʻai, was also favored by her family. Her name was Kaʻōhai, and she lived at the place where the coconut grove which stands at the estuary of Waikele and Waipiʻo. Thus, these two fine children of the land of the fish that quiet voices [Ka iʻa hāmau leo], that is ʻEwa, were married in the traditional manner.

In their youth, the two lived as husband and wife in peace. And after a time, Kaʻōhai showed signs of carrying a child. This brought great joy to the parents and elders of these two youth. When the time came for Kaʻōhai to give birth, her child was born, a beautiful daughter, who also had the same red-hued nature as her father. While Kaʻōhai was cleaning the child and caring for the afterbirth, she looked carefully at her daughter and saw a deep red-spotted mark that looked like an eel, encircling the infant. Everyone was looking at the mark, contemplating its meaning, and Kaʻōhai was once again taken with birth pains. It was then understood that perhaps there would be a twin born as well. But when the birth occurred, an eel was seen moving about in the blood, on the side of Kaʻōhai's thigh. This greatly frightened the family and attendants, they fled, taking the child who had been born in a human-form, with them. Kaihuopalaʻai also separated himself from his wife. Kaʻōhai remained with the blood stains upon her, and no one was left to help her.

It was the eel which had been born to her, that helped to clean Kaʻōhai. He worked like a human, and Kaʻōhai looked at the fish child which had been born to her, and she could find no reason to criticize or revile him. Kaʻōhai then called to her husband, Kaihuopalaʻai, telling not to be afraid, and he returned. They both realized the wondrous nature of this child and cared for him at a good place, in the calm bay of Honouliuli. The named this eel child, Laumeki, and his elder sister, born in human-form, was named Kapapūhi. This eel became a cherished child, and was cared for as a God. Laumeki, the one who had been consecrated, asked that the first-born, his sister, also be cared for in the same manner, and a great affection was shared between the children born from the loins of one mother.

November 15, 1895 (page 4)

Thus, it is told in this tradition, that this is the eel Laumeki. It is he who caused the ʻanae to remain at Honouliuli, and why they are known as "Ka Anae o Kaihuopalaai" [The mullet of Kaihuopalaʻai]. With the passing of time, the forms of this eel changed. At one time, he was red with spots, like the eel called pūhi paka, at other times he was like the Laumilo eel.

A while after the birth of Laumeki, another child was born to Kaʻōhai, a son. He was named Mokumeha, and he was given to Wanue, an elder relative of Kaihuopalaʻai's, to be raised. There are at Honouliuli, ʻEwa, places named for all of these people. The natives of that land are familiar with these places. For this Wanue, it is recalled in a song:

> The thoughts are set upon the sea at Wanue,
> I am cold in the task done here…

…The eel-child Laumeki, followed the fish around in the expanse of the sea, and on the waves of this place. This was a work of love and care, done for his parents and family, that they would have no difficulties. In those days, this eel lived in the sea at a place where a stone islet is seen in the bay of Honouliuli, and he would not eat the fish which passed before him. He did these things for his parents and sister Kapapapūhi.

Laumeki was very watchful of his family, protecting them from sharks, barracudas, and the long billed marlin of the sea which entered into the sheltered bay of Honouliuli, the land of his birth. Because of his nature, Laumeki did many wondrous things. It was Laumeki who trapped the Pūhilala that had lived out in the sea, in the pond of Hanaloa. This Pūhilala was the one who bragged about his deeds, and when he was trapped his eyes glowed red like the flames of and earthen oven.

It is perhaps worthy here, my readers that we leave Laumeki and speak of Mokumeha and his journey around Oʻahu. At the time when the sun rested atop the head [describing Mokumeha's maturity], and his fine features developed. He was very distinguished looking. At that time, he determined to travel around the island of Oʻahu. He asked his parents and guardian permission, and it was agreed that he could make the journey.

Mokumeha departed from Honouliuli and traveled to Waiʻanae, and then went on to Lāʻiemaloʻo, at Koʻolauloa, the place where the youngest sister of his father dwelt. She [Kaihukuʻuna] was pounding kapa with her beater and thinking about her elder brother.

She rose and went to the door of her house and saw a youth walking along the trail. Seeing the youth, her thoughts returned once again to her brother Kaihuopalaʻai and his wife Kaʻōhai. The features of this youth in every way, looked like those of his father, and upon seeing him, tears welled up in Kaihukuʻuna's eyes. She called to the youth inquiring about his journey, and he responded, answering each of the questions. The moment the youth said the name of his parents, and the land from which he came, Kaihukuʻuna wept and greeted her nephew in the custom of the people of old.

This greatly startled her husband who was out in the cultivated gardens tending to his crops. He thought that perhaps one of his own family members had arrived at the house. When he reached their house, he saw the strange youth and he quickly went to prepare food for their guest. In no time, everything was prepared, and he then went to his wife asking her to stop her crying, and invite the visitor to eat of the food that had been prepared. He told his wife, "Then, the talking and crying can resume." She agreed and they sat down together and ate, and had a pleasant time talking.

Kaihukuʻuna then asked Mokumeha about the nature of his trip, and he explained that he was traveling around Oʻahu on a sight-seeing trip. Kaihukuʻuna told him, "It is wonderful that we have met you and can host you here." She then asked him to consider staying with her and her husband at Lāʻiemaloʻo, where all of his needs would be met. "We have plenty of food and if you desire a wife, we can arrange that as well." Mokumeha declined the invitation, explaining his desire to continue the journey and then return to Honouliuli.

November 22, 1895 (page 4)

Now it is true that at this place, Lāʻiemaloʻo, there was grown great quantities of plant foods, but the one thing that it was lacking was fish. Mokumeha, his aunt, and her husband, Pueo, spoke about this, and it was determined that Pueo should go to ʻEwa. Mokumeha instructed him to seek out Kaihuopalaʻai, Kaʻōhai, Kapapapūhi, and Laumeki, and to ask for fish. He told them that "Laumeki will be able to lead the fish to you here at Lāʻiemaloʻo."

Pueo departed for Honouliuli [various sites and features are described along the way]… and he met with Kaihuopalaʻai. Kaihuopalaʻai's love for his sister welled up within him, and it was agreed that fish would be given to her and her family. But rather than sending fish home with Pueo in a calabash—fish which would be quickly consumed, causing Pueo to continually need to make the journey between Lāʻiemaloʻo and Honouliuli—Kaihuopalaʻai said that he would "give the fish year round."

November 29, 1895 (page 4)

When Kaihuopalaʻai finished speaking, Pueo exclaimed, "This is just what your son said you would do!" Kaihuopalaʻai and Pueo then went to the house of Kapapapūhi, who, when she learned that Pueo was her uncle, leapt up and greeted him. They discussed the request for fish, and ate while speaking further. Kaihuopalaʻai then asked, "Where do you come from?" Pueo answered, "Lāʻiemaloʻo," and he described the land to her.

The next day, Kapapapūhi and Pueo went on a canoe out to the stone islet where Laumeki lived. They took with them food, and as they drew near the stone, the water turned choppy like the water of the stormy winter season. The head of Laumeki rose out of his pit and remained on the surface of the water. Kapapapūhi offered him the ʻawa and food she had brought with her. This eel was cared for just as a chief was cared for. When he had eaten his food and was satisfied, he rested on the surface. Kapapapūhi explained to Pueo that he too would need to care for and feed Laumeki, in order to obtain the fish he needed. Kapapapūhi then called out to Laumeki, "Here is an elder of ours, tomorrow you will go with him and take the fish of our parents with you."

December 6, 1895 (page 4)

...The next day, Pueo rose while it was still dark, and the stars, Aea, Kapawa and Kauopae were still in the heavens. He prepared the foods needed for Laumeki, and prepared the canoes. He and his wife's family and attendants then went towards Laumeki's house, where he was resting. When Laumeki saw the canoes coming toward him from Lae o Kahuka, he rose up before them. Together, they passed Kapākule, the place where the sharks were placed in ancient times as play things of the natives of Puʻuloa. When the canoes and people aboard reached the place where the waves of Keaʻaliʻi break, Laumeki cared for them, to ensure that no harm would befall them. This place is right at the entrance of Puʻuloa.

As the rays of the sun scattered out upon the water's surface, the people on the canoes saw the red-hues upon the water and upon those who paddled the double-hulled canoes. Pueo then saw something reflecting red, beyond the paddlers, and below the water's surface. Pueo realized that it was Laumeki with the ʻanae fish. The ʻanae traveled with Laumeki outside of Kumumau, and past Āhua. They continued on past the Harbor of Kalihi at Kahakaʻaulana, with the fish being urged on, by the people back at Kalaekao, Puʻuloa, and Laumeki was at the front, leading the fish at Māmala… They continued on around Kawaihoa, Makapuʻu, and traveled passed Koʻolaupoko, and on past Laniloa at Lāʻiemaloʻo, Koʻolauloa…

December 27, 1895 (page 4)

…This is how the mullet came to regularly travel between the place called Kaihukuʻuna at Lāʻiemaloʻo and Honouliuli at ʻEwa…

January 10, 1896 (page 1) and January 17, 1896 (page 1)

…Mokumeha and Laumeki returned to Honouliuli, and Mokumeha offered a prayer chant to his elder brother:

> O eel,
> O Laumeki,
> Who passed before the point,
> Dwelling in the pit,
> Eel of the cavern,
> You of the kauila [body] form,
> That is the form of the Laumilo,
> Your wooden body,
> It is Laumeki.
> Amen, it is freed…

…While Laumeki was resting at Honouliuli, Mokumeha set off once again to visit various locations around the island of Oʻahu. He bid aloha to his family and walked across the broad plain of ʻEwa. He arrived at Kapūkakī, which is the boundary of the land of the streaked seas, that land in the calm, reddened by the dirt carried upon the wind. This is where ʻEwa ends and Kona begins…

3.2.5 He Kaʻao no Kauʻilani (A Tradition of Kauʻilani)

The tradition of Kauʻilani spans various islands of the Hawaiian Archipelago and follows the children of chiefly parents with a godly lineage. The parents of Kauʻilani and Lepeamoa were Keāhua and Kauhao, both of whose names are commemorated as places in the Mānana-Waimano vicinity of ʻEwa. Kauhao's parents were Honouliuli (kāne) and Kapālama (wahine); the lands which are known by those names honor them. The daughter, Lepeamoa, was born in a supernatural form possessed of both nature and human body-forms. She participated in histories of great importance during the reign of Kākuhihewa as king of Oʻahu. This account, published in *Ka Nupepa Kuokoa* between September 18, 1869 and October 30, 1869, was submitted by S. Kapohu and offers richer details to place, practices and history than those cited later by Westervelt (1915, pp. 204-245) and Beckwith (1970, pp. 428-429). The following English text is a summary of events described in the traditional accounts taken from Hawaiian language resources; they are not direct translations.

Ka Nupepa Kuokoa
September 18, 1869 (page 1)

Kauʻilani was the son of Keāhua [k] and Kauhao [w], and he was the younger brother of Lepeamoa [w]. The family resided at Wailua Kauaʻi, where Keāhua was the high chief. Kauʻilani was descended from high chiefs of Kahiki and Hawaiʻi, and both Kauʻilani and his elder sister, Lepeamoa, were possessed of supernatural powers.

The elders of Kauhao were Kapālama [w] and Honouliuli [k], and the lands on which they lived are now named for them. When Lepeamoa was born, she was born in the form of a hen's egg. Discerning the supernatural nature of her granddaughter, Kapālama and Honouliuli sailed to Kauaʻi on their canoe, Pōhakuokauaʻi, and retrieved the egg. With the egg, they then returned to Kapālama, where they cared for the egg until it hatched. While sailing from Kauaʻi to Oʻahu, the canoe passed by Pōkaʻī, Waiʻanae, and sailed along the fine shore of Kualakaʻi, ʻEwa. From there, they sailed to the many harbored bay of Puʻuloa, and entered into the opening of Puʻuloa where they landed their canoe on the side of the bay. From there, they traveled along the plain to Kapālama…

The story continues, describing the care given to the egg-grandchild, Lepeamoa. When she hatched, she was in the form of a beautiful bird with many brightly colored feathers.

September 25, 1869 (page 1) – October 2, 1869 (page 1)

After Lepeamoa was taken to Oahu, her younger brother, Kauʻilani was born. He was taken and reared by his paternal grandparents, Laukaʻieʻie [k] and Kaniaʻula [w], in the uplands of Wailua. Kauʻilani was bathed in a sacred pool, which caused him to mature quickly, and his grandparents instructed him in various skills and forms of Hawaiian combat. During this time, a god Akua-pehu-ʻale rose up and fought against Keāhua and his people, capturing them and holding them prisoner. Following the instructions of his grandparents, Kauʻilani fought against the god, and vanquished him, returning the rule of Kauaʻi to Keāhua…

October 9, 1869 (page 4)

After the battle, Kauʻilani and his father were reunited, and in this way, the youth learned that he had a sister who was being raised on Oʻahu, by the elders of Kauhao. Kauʻilani determined to go and seek out his sister, and Kauhao instructed him about the lands he would pass and how he would know his sister.

She told him that he must sail from Wailua and along the coast of Waiʻanae, and along the shore of Puʻuloa, where he would find a landing and the path to Kapālama. Before his departure, Kauhao also gave Kauʻilani a supernatural spear named Koawī Koawā, which would help him along his journey, and lead him to his elders on Oʻahu.

Departing from Wailua, Kauʻilani traveled to the shore at Nukoliʻi. He threw the spear, and then took off after it, across Kaʻieʻiewaho channel, sailing to Oʻahu. In his canoe, Kauʻilani passed the coastline of Waiʻanae, and he then drew near the shore of Kualakaʻi where the spear had landed. While Kauʻilani was traveling from Kauaʻi to Oʻahu, two sisters, Kamalulena and Keawalau, who had been surfing at Kualakaʻi, returned to the shore and found the spear. Seeing the spear, and recognizing its excellent quality, the sisters hid it, seeing no man who could claim it.

Shortly thereafter, Kauʻilani passed the coast of Waiʻanae and landed on the shore of Kualakaʻi to retrieve his spear. Upon landing, Kauʻilani saw the two sisters and noted that his spear was nowhere to be seen. Kauʻilani inquired of the sisters if they had seen the spear, which they denied. Kauʻilani discerned that they were lying, and told them so, and he then called out to his traveling companion, the spear, Koawī Koawā. The spear answered from where the sisters had hidden it, and Kauʻilani picked it up and threw it again. It landed near the entry way to Puʻuloa.

October 23, 1869 (page 4)

Arriving where the spear landed, the spear then told Kauʻilani to climb a wiliwili tree that was growing nearby. From there, he would see a rainbow at the shore, and a person picking limpets, octopus, and other things. That person would be Lepeamoa, Kauʻilani's sister. Kauʻilani climbed the wiliwili tree and saw a red patch of a rainbow upon the water near the shore. He asked Koawī Koawā about this, and learned that it was the rainbow shroud of his sister, who was in her bird form near the shore…

3.2.6 Ka Moʻolelo o Kalelealuakā (The Tradition of Kalelealuakā)

The tradition of Kalelealuakā touches on places throughout the Hawaiian Islands. Kalelealuakā and his father, Kaʻōpele, possessed supernatural attributes and their story describes several places in Honouliuli and the larger ʻEwa District. The tradition was published in *Ka Nupepa Kuokoa* and was submitted by J.W.K. Kaualilinoe between April 9, 1870 and June 4, 1870. There are several wahi pana named in the tradition with descriptions of place and how the names were given.

Ka Nupepa Kuokoa

April 9, 1870 (page 1) and April 23, 1870 (page 1)

Kaʻōpele [k] and Makalani [w] were the parents of Kalelealuakā [k]. Kalelealuakā was born on Kauaʻi, the native land of his mother. His father had been born at Waipiʻo, Hawaiʻi, and possessed certain supernatural powers. Kaʻōpele was a great cultivator of the land, and he is credited with the planting of large fields on Hawaiʻi, Maui, Oʻahu, and Kauaʻi. On Oʻahu, it was at Kapapakōlea in Moanalua, and at Līhuʻe, in the district of ʻEwa that Kaʻōpele had cultivated large tracts of land. While Kaʻōpele worked the land with great speed, he was also overcome by a deep sleep that lasted for six months at a time. On many occasions, it was thought that Kaʻōpele had died, and then he would reawaken and resume his tilling of the land. When Makalani became pregnant, Kaʻōpele gave her certain items to identify the child as his own, and shortly before giving birth, Kaʻōpele went to sleep.

April 30, 1870 (page 1)

Kalelealuakā was born and grew quickly. When Kaʻōpele woke up from his sleep, he instructed his son in various techniques of fighting, and Kalelealuakā became known as an exceptional warrior, who moved so swiftly, that no one could even see him…One day, when looking out across the ocean, Kalelealuakā saw a land in the distance, and he inquired of Kaʻōpele, "What land is that?" Kaʻōpele told him that is was "Kaʻena on the island of Oʻahu. Kalelealuakā then asked, "What is the village that is there beyond the point?" Kaʻōpele answered, telling him that it was "Waiʻanae." When Kalelealuakā expressed a desire to travel and see that land more closely, Kaʻōpele made a canoe for his son to travel on.

When preparations were being made for Kalelealuakā's departure, he befriended a youth named Kaluhe, and it was agreed that Kaluhe would travel with Kalelealuakā. When everything was made ready, Kaʻōpele told Kalelealuakā:

> Sail until you reach the point outside of the village of Waiʻanae, then travel across the plain to a place where there is a pool of water. That will be the pool of Lualualei. They you will ascend the pass of Pōhākea, from where you will see the flat lands spread out before you. You may also see the expansive cultivated fields of Keahumoe which I planted before coming to Kauaʻi…

May 7, 1870 (page 4)

Kalelealuakā and Kaluhe sailed to Oʻahu and passed the heiau of Kānepūniu and landed on the shore. There Kalelealuakā was met by a group of youth who were surfing. One of the youth inquired about the journey of the two travelers, and one asked if he might accompany Kalelealuakā and his companion. Kalelealuakā agreed, and the group walked across the plain and found the pool of Lualualei. From there, they then ascended the mountain, to the pass at Pōhākea, from where they looked out across the broad flat lands of Keahumoe. Descending the slope, they found a large banana patch that had been planted by Kaʻōpele.

Kalelealuakā then shot his supernatural arrow, and it flew down slope, passing the plains of Puʻunahawele and Kekuaʻōlelo, and it landed at Kekuapōʻai, awaiting Kalelealuakā's arrival. This was at Waipiʻo, above ʻEwa. The people of the area saw the flight of the arrow, and cried out "Ka pua lele hoi e!" ["How the arrow flies!"] That is why the place is called "Lele-pua" [Flying-arrow], to this day…

Kalelealuakā stayed in the uplands above Lelepua, at Kahalepōʻai, and asked his companions to go and fetch the arrow. He also told them to gather some clumps of ʻawa and sedges for straining it. The two companions went and arrived at the edge of the stream called Kaniukūlou, where they saw some women bathing. They asked, "Have you perhaps seen our arrow?" The women denied having seen it, hoping that they might keep it for themselves. Because they had found it and greatly admired its beauty. Sensing that they were lying, Kaluhe called out to the arrow, and it leapt from the place at which it had been hidden, into his hands. The women were frightened by this, and fled away.

Kaluhe and his companion left the stream and arrived at a large house with clumps of ʻawa planted all about it. Looking around, they found no one in the house or in the surrounding lands, so they began to gather some of the ʻawa. While picking the ʻawa, they heard a voice call out to them, "Set aside that which you have taken, or I shall return." Startled by this command, they dropped the ʻawa and fled, returning to Kalelealuakā, and describing the house, its surroundings, and events to him. They noted that the house was an excellent one, and only lacked sleeping mats inside.

Kalelealuakā had them gather rolled sleeping mats and kapa and they then traveled to the house. Entering the house, they found that all was in order, and they prepared food, ate, and drank ʻawa, with no other voices calling to them. The next day, Kalelealuakā arose, and he and his companions planted large fields with various crops. The field planted by Kalelealuakā extended from the uplands of Kahalepōʻai to the lowlands of Puʻunahawele. When the work was completed they returned to the house and prepared pōpolo, ʻāheahea, and ʻinamona as their food. These were the only things which presently grew around the house that could be eaten until their own gardens matured. While they were eating, The youth from Oʻahu, ate with great haste and ferocity, and Kalelealuakā called to him, urging him to eat with patience. Because of this, the youth from Oʻahu, came to be called “Keinohoʻomanawanui.”

One of the problems in living in the uplands was that there were plenty of plant foods to be had, but there was no fish. One day, while preparing their food, Keinohoʻomanawanui was making ʻinamona (kukui nut relish). When he struck a broiled kukui nut, the shell flew up and struck him in the eye, blinding him in that eye. Kalelealuakā then took up the task of preparing the food…

May 14, 1870 (page 1)

Kalelealuakā told Keinohoʻomanawanui, “I will prepare that food which we two desire.” Keinohoʻomanawanui said, “That which I desire are the sweet potatoes of the planted fields below, and the eels of the pond at Hanaloa.” Kalelealuakā told Keinohoʻomanawanui, that “in time, you will have your desire.” Now these foods were the property of the king Kākuhihewa, and they were kapu to all but him and his people. Kalelealuakā told Keinohoʻomanawanui, “Tomorrow, Kākuhihewa and his people will arrive here in the uplands of Waipiʻo, to gather wood with which to make new houses in the lowlands.”

Now while Kalelealuakā and Keinohoʻomanawanui were discussing these things, Kākuhihewa himself had come to the uplands to gather some of the ʻawa that grew at Kahauone. Seeing the large house in which Kalelealuakā and his companions dwelled, he quietly drew near and overheard the conversation, curious about who these men were. He set a wooden image in the ground near the house to mark the area, and then departed, returning to Puʻuloa. Kākuhihewa thought about what he had heard, and the bold remarks that they would soon eat the favored eels of Hanaloa. Kākuhihewa spoke of this with his advisors and war leaders, some of whom suggested that a party go to the uplands to kill the impertinent youth.

Instead, Kākuhihewa sent to Waimānalo for his priest, Nāpuaikamao. Nāpuaikamao traveled to Koʻolina where Kākuhihewa was staying, and listened to the words of his chief, describing the youth and their conversation. Nāpuaikamao thought about their words, and the symbolism of the desire for the eels of Hanaloa, and discerned that one of the youth was the great warrior, Kalelealuaka, of Kauaʻi. Now at this time, Kākuhihewa was at war with a chief named Kūaliʻi, the two kings seeking to rule all of Oʻahu. Nāpuaikamao told Kākuhihewa, that it was Kalelealuakā who would bring victory to his side, and that he should prepare a house for the youth and allow them to fulfill their desires.

Kākuhihewa agreed, and ordered preparations to be made. He then had his counselor, Maliuhaʻaino go to the uplands of Waipiʻo and invite Kalelealuakā and his companions to the shore…

May 21, 1870 (page 1)

Maliuhaʻaino arrived before the youth, and following a discussion, it was agreed that they would meet with Kākuhihewa… Descending to the coast, they passed the plain of Puʻunahawele. They then passed below Puʻukuʻua which is near the mountain ridge, and descended to the shore of Puʻuloa. Kalelealuaka and his companions were shown the houses and foods that had been prepared for them, and they took up residence at Puʻuloa…

[During this time, the identity of Kalelealuakā remained hidden from Kākuhihewa and his people. Because the king had heard Keinohoʻomanawanui speaking about his desire for the eels of Hanaloa, and because Keinohoʻomanawanui told people that he had been blinded in one eye by a spear, it was assumed that Keinohoʻomanawanui was the great warrior that they sought.]

With the passing of several periods of ten days [anahulu], a messenger from the king, Kūaliʻi, arrived bearing the message that Kūaliʻi challenged Kākuhihewa to a battle on the field at Kanalua [Kauālua], in Moanalua… The warriors met, and a great battle took place in which the champion of Kūaliʻi was killed. It was thought that Keinohoʻomanawanui [mistaken as being Kalelealuakā] had secured the victory for Kākuhihewa… During this battle, Kalelealuakā had stayed behind at Puʻuloa, and after the battle began, ran secretly with great speed to the battle ground, and killed Kūaliʻi's champion…

May 28, 1870 (page 1)

At each of the subsequent battles between the warriors of Kākuhihewa and Kūaliʻi, Keinohoʻomanawanui was credited with, and accepted the honor of having defeated Kūaliʻi's champions. Because Kalelealuakā moved so swiftly, no one even saw him enter the battle field. Kalelealuakā had stayed behind at Puʻuloa, and secretly entered into the battle, killing Kūaliʻi's champions, and taking their capes and feather helmets, with which he returned to Puʻuloa, hiding the items in his house.

June 4, 1870 (page 4)

At the last battle between Kākuhihewa and Kūaliʻi's champions, the forces met near

Waolani, and Kalelealuakā killed all of the warriors of Kūaliʻi. Great honor was to be bestowed upon Keinohoʻomanawanui, but Kalelealuakā arrived before the assemblage and claimed the privilege. Kalelealuakā accused Keinohoʻomanawanui of deception, and challenged him to a fight to prove it. As quickly as the battle began, Keinohoʻomanawanui was killed, and Kalelealuakā took his head to Maliuhaʻaino.

Seeing that all of his warriors had been killed, Kūaliʻi, thought that his life too was forfeit, but Kalelealuakā invited him to live under Kākuhihewa, to which Kūaliʻi agreed. The head of Keinohoʻomanawanui was taken to Puʻuloa and then set atop an ʻaʻā hillock above Kalauao… Kalelealuaka, Kākuhihewa and Kūaliʻi, and their people lived out their days in peace…

3.2.7 Nā Wahi Pana o ʻEwa i Hoʻonalowaleia i Keia Wa a Hiki Ole ke Ikeia (Storied Places of ʻEwa, That are now Lost and Cannot be Seen)

Between June 3, 1899 and January 13, 1900, the Hawaiian newspaper, *Ka Loea Kalaiaina,* published a series of articles titled "Na Wahi Pana o Ewa i Hoonalowaleia i Keia Wa a Hiki Ole ke Ikeia," which can be translated to "The noted places of ʻEwa that have been forgotten at this time and can no longer be seen." The author of the series is not identified, but it is a rich resource of traditions, named places and history of the district. Excerpts pertaining to Honouliuli as published in various issues are presented below. A careful review of the original Hawaiian texts has been made and the translations compiled with reference to notes developed by Mary Kawena Pukui.

Ka Loea Kalaiaina

Na Wahi Pana o Ewa i Hoonalowaleia i Keia Wa a Hiki Ole ke Ikeia	**The noted places of ʻEwa that have been forgotten at this time and can no longer be seen**
Ianuali 13, 1900 (aoao 1)	**January 13, 1900 (page 1)**
Aia no i keia aina kekahi puu kaulana o Puuokapolei, i keia wahi i noho ai o Kamauluaniho me kana moopuna me Kekeleaiku, kaikuaana o Kamapuaa. Mahope iho oko lakou haalele ana ia Kaliuwaa Kaluanui Koolauloa. Aole nae au e kamailio iki ae a e hoi au no Puuokaplei.	There is on the land a famous hill, Puʻuokapolei. It was at this place that Kamauluaniho lived with her grandson, Kekeleaiku, the older brother of Kamapuaʻa. This was after they left Kaliuwaʻa, Kaluanui at Koʻolauloa. I did not speak much earlier about it so I will return to Puʻuokapolei.
Ina e hele ana kamahele ma ke alanui	If a traveler should go along the government

aupuni no Waianae, aia a haalele ia Honouliuli ke kulanakauhale o ke Gula, e loaa mua mai ana ia ia ke kula o Puuainako, a hala ia, hele mai o Keoneae, alaila, pii aku no i ka piina o ka Puuokapolei, a ilaila, haliu ae oe a nana makai o ke alanui aupuni e ku ana ua wahi puu ala ia, oia hoi o Puuokapolei, na keia wahi puu i alai ia Ewa, ke huliaku hoi oe ma kela aoao o Waimanalo pau kou ike ana ia hope nei, hele aku he mau hoalu liilii a holo aku oe he kula, o keia kula, oia ke kula o Pukaua [Puʻukaua], aia mauka io ke alanui e ike ai oe he pohaku nui e ku ana i ke kula. Eia kahi moolelo i kaulana ai kela kula.

road to Waiʻanae when he leaves Honouliuli, the city of Gold, he will first come to the plain of Puʻuainako (Mounds of cane debris), and passing from there, arrive at Keoneʻae (The fine soil or cinder), and then from there shall go straight the ascent to Puʻuokapolei. Then when you look around, towards the shore side of the government road, this is the hill. It is Puʻuokapolei. When you go to the side towards Waimānalo, you see no more of the sight back here. This hill shields/blocks ʻEwa from view. When you are done, you go down a little on the plain. This plain is the kula of Puʻukaua. It is there above the government road that you will see a large stone situated on the plain. Here is a famous story of this plain land.

He wahi luahine kupua, a i ole Ia he mau luahine hooehaa, he mau wahi luahine hahapaiea paha, no laua o Puukaua; ia laua i kai o Kualakai i ka lawaia i ke ahiahl, i kai no laua a i ka lawaia a wanaao hoi mai. Eia ka laua mau wahi iʻa, he Aama ua iʻa, he Pipipl ua iʻa, a me na ano iʻa like ole apau e loaa aku ana i ko laua nei mau lima. Ia laua nei e hoi ana i ke kula mai kahakai mai, me ko laua manao ana la e hiki poeleele aku ana la laua i kauhale, aole nae pela. Ua halawai laua me ka maka paa, oiai, laua e hookokoke aku ana i ua kula ala, ua malamalama loa ae la,a ua hiki ke ike ia aku na kanaka ke hele ae, a eia no nae laua nei ma kai o ke alanui e hoi nei, a no ko laua nei makau o ike ia laua e na kanaka.

There were some supernatural women, or peculiar women who possessed strange powers, they were of Puʻukaua; they would regularly go down to the shore of Kualakaʻi to go fishing in the evening. The would stay at the shore fishing until early morning. Here are the things they would catch, ʻAʻama crabs, pipipi shellfish, and all manner of fish, whatever they could catch with their hands. As they were returning to the plain from the shore and thinking of getting home before morning came, that it would still be dark. But it was not so. They met a blind person as they were getting close to the plain and it was getting light, and they could be seen by the people that were traveling by. They were still on the shoreward side of the trail, and they were afraid of being seen by people.

Ia wa ua hoomaka mai la laua e holo, oia holo ko laua nei, oia lele, a hina a palaha

They then started running, and as they ran, eia no nae, ala no holo no, a helelei aku la ka Aama a me ka limu, aohe nae he nana ia iho. Aia ka pono o ke kaa aku mauka o ke alanui, eia nae ua pale pono, oiai, ua ao loa ae la. I kela wa olelo aku la kahi luahine i kahi luahine o laua:

they lept, fell and sprawled out, and their ʻAʻama, and limu all scattered about, but they took no care. Then one old woman said to the other of them:

> “E pee kaua, o ike ia mai auanei kaua e na kanaka?” a o ko laua nei pee iho la no ia. Lilo koke ae la ko laua kino i kino pohaku. A oia ke kaulana o keia kula i keia kino pohaku a hiki loa mai I keia wa.

> “Let us hide, unless we be seen by the people.” And so they hid. Their bodies were then turned into a stone body. Their stone body is one of the famous things on this plain to the present day.

O keia ka pau ana o ko laua moolelo. O ke kaahele malahini ana a hiki ia kula, aole no he hewa ke alawa ae mauka o ke alanui i ike ia laua i ke ku mai a i ke kula.

This is the end of their story. So when one visits the plain, there is nothing wrong with glancing above the trail to see them standing there on the plain.

E nee mai kakou i Puuokapolei. O keia pu kekahi puu kaulana loa i ka wa kahiko. Mai keia puu mai i haku ia ai kekahi mele i kamaaina i ka poe lealea o ka wa kahiko, ua haku ia apuni Oahu nei, a ma ia mele e oli ai ka poe Pukaula a me ka poe Ukeke laau, ka poe kimo pohaku, hua Noni, hua kukui paha.

Let us go on to Puʻuokapolei. This was one of the most famous hills in ancient times. It is from this hill that chant was composed by the natives, and those who were skilled in the games of olden times. It was composed to go around the Oʻahu. It was with this chant that the people who played pū kaula (a guessing game) and those who played the wooden ʻūkēkē (a native bow string instrument), and those who juggeled stones, noni fruit or kukui nuts.

Ua helu ia ka inoa o keia mele ma kainoa o ka aina, a oia kaʻu e panee aku nei imua o ka poe aole i loaa a paa naau i neia mele. E like me na mele kahiko i loaa ole i kekahi poe, a loaa hoi kahi i kekahi poe:

This was a chant to recount land names, and I present it before the people, who may not have it memorized. It is like the old chants that are not known by some people, though it is familiar to other people [the chant is

E Kawelo e, e Kawelo — e
E Kawelo mainui o Puuokapolei

O Puuokapolei—

Uliuli ka Poi a kaua e ai nei –
O Honouliuli
Aeae ono—a Paakai e Hoaeae
O Hoaeae
Pikele, Pikele ka iʻa e Waikele—
O Waikele
Ka Hale pio ka hua moa —
O Waipio
E ku a ai kaua i ka Ia loko awa —
O Waiawa
Mai hoomanana ia kua —
O Manana
Kini kahawi he lau he mano —
O Waimano
Ko ia kaua e ke au —
O Waiau
Kukui malumalu o kaaua [kaua] —
O Waimalu
E ala kaua ua ao —
O Kalauao
E kipa kaua e ai —
O Aiea
Mai hao halawa ia kaua —
O Halawa
E hoi kaua e noho i ka lua —
O Moanalua
Hooipoipo hau kaua —
O Kahauiki
E pii kaua i ka lama —
O Kapalama
E nunu a haawe kaua —
O Honolulu
Kiki kuoha ilaila —
O Waikiki
Kike ka hua a kaalae —
O Waialae
He wahine hoolupe keia —
O Wailupe

presented in a riddle stylem, stating a question and answering it by speaking the place name]:

O Kawelo, o Kawelo — e
Kawelo with the large genitals, of Puʻuokapolei,
It is Puʻuokapolei.
The poi that we eat dark —
It is Honouliuli
Fine and delicious is the salt of Hōʻaeʻae —
It is Hōʻaeʻae
Tiny and numerous are the fish of Waikele
It is Waikele
A House arched like an egg —
It is Waipiʻo
Stop and eat of the awa fish —
It is Waiawa
Let us not spread out the limbs —
It is Mānana
Many streams, hundreds and thousands —
It is Waimano
We two are drawn in by the currents
It is Waiau
We two are in the shade of the kukui trees
It is Waimalu
Let us get up for it is day —
It is Kalauao
Let be hosted to eat —
It is ʻAiea
We two were almost plundered —
It is Hālawa
Let us two go and dwell in a pit —
It is Moanalua
We make love in the hau —
It is Kahauiki
Let us go up to the lama trees —
It is Kapālama

Mauna kuu hoa i ka lua —
O Maunalua
He wahine heekoko keia —
O Koko
Puo ka lau o ka niu —
O Niu
Pauma na waa i ke kai —
O Hanauma
He wahine makapuu keia —
O Makapuu

E na hoa e kala mai oukou iaʻu. O keia ae la kahi i paa iaʻu o keia mele, a he mea nui no hoi i na hanaua hou, ka loaa ole ana o na mea kahiko…

E waiho kakou i na wahi pana o Honoluliuli i koe aku a hiki i ka kupono.

E nee mai ana kakou i Hoaeae, aia ilaila o Waihi a aia no ma ia wahi i ka huli e nana iho ana i ke alahao he wahi Owawa, ua pili loa i ke alahao. Oia kahi i make ai o ka Moi Oahu nei, oia o Kahahana.

Ua olelo ia o Kahahana he keiki hookama na Kahekili, ke alii o Maui, a i ole he keiki no paha na Kahekili. O ka nohoalii ana o Kahahana he nohoalii ino, he hookuli, a hoopale i na olelo ao a ke kahuna, na kakaolelo, a me na kuhikuhi puuone…

Let us two make a bundle and carry it—
Honolulu
Spurting there —
It is Waikīkī
Cracked is the egg of the mud hen
It is Waiʻalae
This is a woman who flies a kite —
It is Wailupe
My companion bruised in a pit —
It is Maunalua
This is menstruating woman —
It is Koko
Gathered are the leaves of the coconut —
It is Niu
Plying the canoes in the sea —
It is Hanauma
A pop-eyed woman is she
It is Makapuʻu.

My friends, pardon me for this is. This is that is known to me of the chant. This may be an important thing for the new generation who may not receive the things of old.

Let us not leave the other storied places of Honouliuli until a time when it appropriate.

We are now moving to Hōʻaeʻae, Waihi is there. This place is found by looking down towards the rail line, is it a gulch adjoining the railway track. It is the place where the King of Oʻahu, Kahahana, died.

It is said that Kahahana was an adopted son of Kahekili, the King of Maui, or perhaps the own son of Kahekili. The rule of Kahahana was an evil rule. He ignored and rebuked the

> advise of his priests, counselors, and those who interpreted the nature of the land…

3.2.8 Ka Moʻolelo Hawaiʻi – O kekahi mau mea i manaʻo nui ia o ke kupapaʻu (Hawaiian History – Some things which are of importance pertaining to the dead)

Care for the dead (kupapaʻu), respect of the graves (ilina) and traditions associated with the spirit after death are subjects of great significance to Hawaiians – past and present. S.M. Kamakau (1968) shared a collection of traditions and practices pertaining to the dead and identified some of the places of importance in these practices. These narratives are of particular importance to lands and specific wahi pana of Honouliuli and are connected across the landscape to Moanalua.

> ***Ke Au Okoa***
> **O kekahi mau mea i manao nui ia o ke kupapau.**
>
> **ʻOkakopa 6, 1870 (aoao 1, Helu 43)**
>
> …Hookahi anahuna kaulana ma Oahu. O Pohukaina ka inoa, aia ma ka pali o Kanehoalani mawaena of Kualoa a me Kaaawa, aia ka puka i manao ia ma ka pali o Kaoio e huli la i Kaaawa, a o ka lua o ka puka, aia ma ka punawai o Kaahuula-punawai. He anahuna alii keia, a he nui ka waiwai huna iloko a me naʻlii kahiko. O Hailikulamanu, oia kekahi puka, aia a kokoke makai o ke ana Koluana i Moanalua, aia ma Kalihi, ma Puiwa, oia na puka ekolu o Pohukaina ma Kona, a o Waipahu ma Ewa, aia ma Kahuku i Koolauloa kekahi puka, a o kauhuhu o kaupaku o keia hale anahuna, oia no ka mauna o Konahuanui a iho i Kahuku. Ua olelo ia ma ka moolelo a kanaka, ua nui ka poe i komo iloko me na ihoiho kukui, mai Kona aku nei a puka i Kahuku…
>
> A maloko o keia anahuna, he mau halokowai, he mau muliwai a mau kahawai, ua hana kinohinohi ia, a ma kauwahi aku, he mau aina palahalaha...
>
> **Na uhane mahope o ka make ana o ke kino.**
>
> ...O ke ao kuewa; a o ke ao auana kekahi inoa; I ka make ana o ke kanaka kuleana ole, ua auana kuewa hele kona uhane me ka lalau hele i ka nahelehele, a ua hele wale i [Kamaomao], a i ka wiliwili o Kaupea, a hiki kona uhane i Leilono, aia malaila ka Uluolaiowalo; a i loaa ole kona uhane aumakua i maa mau ia ia, a aumakua kokua hoi, alaila, e lele kona uhane ma ka lala ulu popopo a haule ilalo lilo i ka po pau ole i o Milu la…
>
> O Leiolono; Oia kekahi wahi e make ai na uhane i ka po pau ole. Aia o Leiolono kokoke i

ka pohaku o Kapukaki a ma nae aku, e kupono ana i puu hoilina kupapau o Aliamanu, a huli i ka aoao akau o Hokupaa, aia ma ke kapaluna o ke alanui kahiko, aia he hapapa pahoehoe pohaku, aia maluna he wahi ponaha, he alua paha kapuai ke anapuni, oia ka puka e iho ai ilalo, o ka nuu ia o Papa-ia-Leka he ao aumakua ia wahi, aia ma ka puka e iho ai o ka puka o Leiolono, he ulu o Leiwalo, elua lala ma ka hikna kekahi a ma ke komohana kekahi, he mau lala ulu hoopunipuni keia, a o kekahi lala niu, he lala e lele ai i ka po pauole, a o ka lua o ka lala ulu, aia a kokua ia mai e ka uhane aumakua kokua, alaila, e ike auanie maia ao aumakua, i na kupuna i olelo ia o Wakea a me ka huina kupuna a pau, a me ko ke ao holookoa e hele nei, i ka lakou huakai; a o kekahi hapa, aia ma kela lala ulu hoopunipuni i ka po pauole. O ka palena o Leilono, o Kapapa-kolea ka palena hikina, he peelua nui launa ke kiai hikina o Koleana; a o Napeha ka palena komohana, a he moo ke kiai malaila, a i makai i keia mau kiai, alaila hoi hou i hope, a i kokua hou ia e na uhane aumakua, alaila, ua hou, a ua alakai ia i ke ao aumakua.

A i makau i ka peelua e alai ana i ke alanui mai kela aoao mai o Alia, kiei ke poo ma ka pali o Kapakolea, alaila makau ke uhane a auwana, a pili aoao ma ke kahawai ma ka hale hana ili, aole he alanui aupuni mamua, aka, he alanui kamaaina no Kauhilaele, a ua oleloia aia a komo ka auwana maloko o na palena, he make wale no kona uhane, a o ke lele i ka po pau ole; aka, ua oleloia ua ola mai no kekahi poe uhane auwana ke loaa i na uhane aumakua kokua, a o ka poe kokuaole, e make no i ka po pauole, a i o Milu la. Aia ma ke kula o Kaupea, ma ke kaha o Puuloa, e hele ai na uhane auwana e poipoi pulelehua, a e poipoi nanana, oiai aole e hele loa na uhane auwana i na wahi i olelo ia mamua, a i loaa paha i na uhane aumakua e poipoi nanana ana, a ua hoopakeleia, a o ka poe uhane kokua ole, he poe uhane haukae lakou, a mai ka wiliwili i Kaupea, i Kanehili, he nui no na wahi i oleloia ma keia inoa. O Kaleia-a-kauhane [Ka-leina-a-ka-uhane], a me ka Ulu o Leiwalo, aia ma Hawaii, ma Maui, ma Molokai, ma Lanai, ma Kauai a me Niihau, hookahi no moolelo like no keia mau wahi…

Translation by M.K. Pukui from original accounts by S.M. Kamakau (1968)

Some things which are of importance pertaining to the dead.

There is only one famous hiding cave [ana huna] on Oʻahu. It is Pohukaina. The opening on Kalaeokaʻoʻio that faces toward Kaʻaʻawa is believed to be in the pali of Kanehoalani, between Kualoa and Kaʻaʻawa, and the second opening is at the spring Kaʻahuʻula-punawai. This is a burial cave for chiefs, and much wealth was hidden away there with the chiefs of old. On the Kona side of the island the cave had three openings, one at Hailikulamanu—near the lower side of the cave of Keleana in Moanalua—another in

Kalihi, and another in Puʻiwa. There was an opening at Waipahu, in ʻEwa, and another at Kahuku in Koʻolauloa. The mountain peak of Konahuanui was the highest point of the ridgepole of this burial cave house, which sloped down toward Kahuku. Many stories tell of people going into it with kukui-nut torches in Kona and coming out at Kahuku. Within this cave are pools of water, streams, creeks, and decorations by the hand of man (hana kinohinohiʻia), and in some places there is level land. (p. 38)

The leina a ka ʻuhane on Oʻahu was close to the cape of Kaʻena, on its right (or north, ʻakau) side, as it turns toward Waialua, and near the cutoff (alanui ʻoki) that goes down to Keaokuʻukuʻu. The boundaries of this leina a ka ʻuhane, it is said, were Kahoʻihoʻina-Wakea, a little below Kakaheʻe, and the leaping place (kawa-kai) of Kīlauea at Keawaʻula. At these places would be found helpful ʻaumakua souls who might bring back the spirit and restore life to the body, or if not, might welcome it to the realm of the ʻaumakua. Places within the boundaries mentioned were where souls went to death in the po pau ʻole, endless night.

Leilono at Moanalua, Oʻahu, was close to the rock Kapukaki and easterly of it (a ma ka naʻe aku), directly in line with the burial mound of Aliamanu and facing toward the right side of the North Star (a huli i ka ʻaoʻao ʻakau o ka Hokupaʻa). On the bank above the old trail there was a flat bed of pahoehoe lava, and on it there was a circular place about two feet in circumference. This was the entrance to go down; this was the topmost height (nuʻu) of Kapapaialaka, a place in the ʻaumakua realm. Here at the entrance, ka puka o Leilono, was a breadfruit tree of Leiwalo, he ʻulu o Leiwalo. It had two branches, one on the east side and one on the west.

These branches were deceiving. From one of them, the soul leaped into the po pau ʻole; if he climbed the other, it would bring aid from helpful ʻaumakua (ʻaumakua kokua). From that branch the soul would see the ʻaumakua realm and the ancestors spoken of, Wakea and all the rest, and those of the entire world who had traveled on this same journey.

The boundaries of Leilono were, Kapapakolea on the east, [with] a huge caterpillar (peʻelua nui) called Koleana as its eastern watchman, and the pool Napeha on the west, with a moʻo the watchman there. If the soul was afraid of these watchmen and retreated, it was urged on by the ʻaumakua spirits, then it would go forward again and be guided to the ʻaumakua realm. If a soul coming from the Alia (Aliapaʻakai) side was afraid of the caterpillar, whose head peered over the hill Kapapakolea, and who blocked the way, it would wander about close to the stream by the harness shop. This was not the government road (alanui aupuni) of former times, but was a trail customarily used by "those of Kauhila'ele" [figuratively, the common people; the la'ele, old taro leaves, as contrasted with the liko, the new and choicer leaves—that is, the chiefs]. It was said that if a wandering soul entered within these boundaries it would die by leaping into the po pau 'ole; but if they were found by helpful 'aumakua souls, some wandering souls were saved. Those who had no such help perished in the po pau 'ole of Milu.

On the plain of Kaupe'a beside Pu'uloa, wandering souls could go to catch moths (pulelehua) and spiders (nanana). However, wandering souls would not go far in the places mentioned earlier before they would be found catching spiders by 'aumakua souls, and be helped to escape. Those souls who had no such help were indeed friendless (he po'e 'uhane hauka'e lakou), and there were many who were called by this name, po'e 'uhane hauka'e.

There were Leina-a-ka-'uhane and 'Ulu-o-Leiwalo on Hawai'i, Maui, Moloka'i, Lāna'i, Kaua'i, and Ni'ihau as well as on O'ahu. The traditions about these places were the same. They were where spirits were divided (mahele ana) to go into the realm of wandering spirits, the ao kuewa or ao 'auwana; or to the ancestral spirit realm, the ao 'aumakua; or to the realm of endless night, the po pau 'ole.

The places said to be for wandering spirits were: Kama'oma'o for Maui; Uhana [Mahana] at Kahokunui for Lāna'i; Ma'ohelaia for Moloka'i; Mana for Kaua'i; Halali'i for Ni'ihau; in addition to Kaupe'a for O'ahu. In these places the friendless souls ('uhane makamaka 'ole) wandered. (pp. 48-49)

3.2.9 Alahula Pu'uloa, he Alahele na Ka'ahupāhau (The Swimming Trails of Pu'uloa, are the Trails Traveled by Ka'ahupāhau)

In 1870, Kamakau wrote about several practices and beliefs pertaining to manō (sharks) in ancient life. One practice of note in the Pu'uloa region was the practice of transforming deceased family members into manō as 'aumākua (family gods/guardians). These family 'aumākua would help their relatives when in danger on the sea, such as if a canoe capsized or a man-eating shark was threatening attack. Hawaiians also worked with and tamed manō so that one could ride them like a horse, steering them to where one wished to go (Kamakau, 1976). There were two basic classes of sharks — manō kānaka (sharks with human affiliations) and manō i'a (wild sharks of the sea–man eaters). The manō kānaka were revered and cared for, while the manō i'a were at times hunted and killed following ceremonial observances. The practice of chiefs hunting sharks using the flesh of defeated enemies or sacrificial victims as kūpalu manō (shark fishing chum) and of commoners using rotted fish as kūpalu manō are further described in several historical narratives.

Ke ʻAwalau o Puʻuloa (the many bays of Puʻuloa) are famed in traditional and historical accounts of manō. The traditions center around the several deified sharks, foremost of whom is the goddess Kaʻahupāhau, then followed several others, including Kahiʻukā, Kūhaimoana, Komoawa, Kaʻehuikimanōopuʻuloa, Keliʻikau-o-Kaʻū (Kealiʻikauaokaʻū) and Mikololou. With the exception of Mikololou, these shark gods were friendly to people and dedicated to keeping manō iʻa out of the Puʻuloa-ʻEwa waters.

Traditions of Ke ʻAwalau o Puʻuloa detail that one of the most important kānāwai (laws) governing manō was that they would not attack humans. This kānāwai was created by the shark gods themselves. Kamakau (1968) wrote about the establishment of this kānāwai:

> Oahu was made a kapu land by this kanawai placed by [the shark gods] Kanehunamoku and Kamohoaliʻi. But their sister Kaʻahupahau broke the law and devoured the chiefess Papio. She was taken and "tried" (hoʻokolokolo) at Ulukaʻa [the realm of these gods], but she escaped the punishment of death. It was her woman kahu who paid the penalty of the law because it was her fault—she reviled Papio. The trouble arose over a papahi lei of ʻilima flowers which belonged to Kaʻahupahau that her kahu was wearing. [The kahu refused to give it to Papio, and] Papio said, "I am going bathing, but when I come back you shall be burned with fire." But Kaʻahupahau devoured Papio before she could carry out her threat, and she was punished for this. That is how Puʻuloa became a [safe] thoroughfare (alahula). After her confinement ended several years later, Kaʻahupahau was very weak. She went on a sightseeing trip, got into trouble, and was almost killed. But she received great help from Kupiapia and Laukahiʻu, sons of Kuhaimoana, and when their enemies were all slain, the kanawai was firmly established. This law—that no shark must bite or attempt to eat a person in Oahu waters—is well known from Puʻuloa to the Ewas. Anyone who doubts my words must be a malihini there. Only in recent times have sharks been known to bite people in Oahu waters or to have devoured them; it was not so in old times. (p. 73)

Several place names commemorate the shark gods of Puʻuloa. Among them are three recorded in the *Saturday Press* of December 29, 1883 (page 6):

> Keaalii—A cave in the sea at the entrance to Puuloa harbor, and known by the natives to have been formerly the home of a large shark called Komoawa, who has been generally credited as the watchman on guard at the entrance of Kaaahupahau's waters. The latter's royal cave-dwelling was in the Honouliuli lagoon…

> Kuhialoko—"Called after Kuhia, one of the butlers or purveyors to Kaahupahau, the shark

> queen of Ewa"; Land in Waiawa, Ewa, Oahu.
>
> Kuhiawaho—Called after the same useful shark in the legend or belief in connection with Kaahupahau, and belonging to the shark belief of Ewa: Land in Waiawa, Ewa, Oahu.

Nahu-Papio or Ka-nahuna-Papio (The biting or shredding of Papio) (Na wahi pana o Ewa, 1899-1900), is found along the shore of the Waipiʻo Peninsula, south east of Hōmaikaiʻa or Walker Bay (Registered Map No. 322) (Figure 9). This place name identifies the location where Kaʻahupāhau killed Papio.

The role of Kaʻahupāhau as a goddess and guardian in the waters of the Puʻuloa bays remains alive in the minds of natives in the ʻEwa moku. Her brother Kahiʻukā (the smiting tail) is also remembered and it is said that with his great tail, Kahiʻukā was responsible for destroying any foreign sharks "that offended his sister" Kaʻahupāhau (Pukui, 1943, pp. 57-58). His cave is reported in several locations, including Drydock No. 1 between Mokuʻumeʻume and Keanapuaʻa, and another in the Waiawa Estuary. The cave, destroyed in the construction of Drydock No. 1, was once his home.

Another locational reference to a cave, and the home of Kaʻahupāhau, is found in the cartographic records of the Kingdom, cited on Registered Map No. 322 (Figure 9). On the map, the cave is dentified as "Shark's Den" along the Honouliuli shoreline of the West Loch, a short distance inland from the old boundary wall between the ʻili of Puʻuloa and the larger ahupuaʻa of Honouliuli. These storied places are a part of the fabric of Hawaiian history and breathe life into the traditions of old.

In addition to the traditions of Kaʻahupāhau, two other accounts center around the nature of sharks in the ʻEwa moku and battles that were fought to kill offending sharks. In the early 1820s, members of the Protestant mission station traveled to the ʻEwa moku and learned something about the shark gods of Puʻuloa.

Hiram Bingham accompanied King Kamehameha II (Liholiho), the royal family, and attendants to ʻEwa in 1823, where they stayed near the shore of Puʻuloa. During the visit, the King and party, along with Bingham, visited the dwelling place of a noted shark god. The name of the god was not recorded in Bingham's journal, though one must infer that it was either the goddess Kaʻahupāhau or her brother, Kahiʻukā. Bingham (1969) wrote:

> I one day accompanied the King [Liholiho] and others by boat to see the reputed habitation of a Hawaiian deity, on the bank of the lagoon of Ewa. It was a cavern or fissure in a rock, chiefly under water, where, as some then affirmed, a god, once in human form,

> taking the form of a shark, had his subterraqueous abode. Sharks were regarded by the Hawaiians as gods capable of being influenced by prayers and sacrifices, either to kill those who hate and despise them or to spare those who respect and worship them. It had been held that, when a mother gave her offspring to a shark, the spirit of the child dwelt in it, and the shark becoming an akua, would afterwards recognize and befriend the mother on meeting her, though ready to devour others… (p. 177)

Elisha Loomis traveled to ʻEwa and stayed along the Puʻuloa shore, as referenced in his journal entry on January 18, 1825 (Loomis, 1825, as cited in Westervelt, 1937). During his visit, Loomis learned the name of the shark goddess who protected the waters of the Pearl Harbor region and reported hearing about a war between the good sharks and those who sought to eat human flesh. It will be noted that due to his limited Hawaiian language skills, Loomis apparently transposed “she” for “he” in his journal.

> After supper I conversed with them a long time on the subject of religion… during the conversation one of them mentioned that in former times there dwelt at Puuloa a famous shark named Ahupahau. He had a house in the hole of a rock. He was one their gods. On one occasion a strong shark 3 or 4 fathoms long came into the channel to make war upon the sharks and upon the natives that dwelt there. Ahupahau immediately communicated to the natives information advising them to get a net out and secure him. They took the hint and spread their nets, and in a little time the stranger was captured. (Loomis, 1825, as cited in Westervelt, 1937)

Loomis’s reference to a “war” between an invading shark coincides with the traditions of Ka-ʻehu-iki-manō-o-Puʻuloa, Mikololou, and Kealiʻikauaokaʻū, in which battles between sharks are fought in order to protect the people of the ʻEwa region from attacks by manō iʻa.

J.S. Emerson presented a paper titled “The Lesser Hawaiian Gods” before the Hawaiian Historical Society on April 7, 1892. In this report, Emerson (1892) details Kaʻahupāhau, Kahiʻukā, and Mikololou in the history of ʻEwa and the waters of Puʻuloa:

> One reason for the affection shown to the shark aumakuas was the fact that so many of them claimed human parentage, and were related by ties of kinship to their kahus. Such was the case with Kaahupahau and her brother Kahiʻuka, the two famous shark-gods of the Ewa Lagoon on this island. Their birth and childhood differed in no essential features from that of other Hawaiian children up to the time when, leaving the home of their parents, they wandered away one day and mysteriously disappeared. After a fruitless search, their parents were informed that they had been transformed into sharks. As such,

> they became special objects of worship for the people of the districts of Ewa and Waianae, with whom they maintained the pleasantest relations, and were henceforth regarded as their friends and benefactors. After a time the man-eating shark, Mikololou, from the coast of the island of Maui, paid them a visit and enjoyed their hospitality until he reproached them for not providing him with his favorite human flesh. This they indignantly refused to give, whereupon, in spite of their protest, he made a raid on his own account upon the natives, and secured one or more of their number to satisfy his appetite. Kaahupahau and her brother promptly gave warning to their friends on shore of the character of this monster that had invaded their waters. To ensure his destruction they invited their unsuspecting guest to a feast made in his honor at their favorite resort up the Waipahu river. Here they fed him sumptuously, and at length stupefied him with the unusual amount of awa which they supplied him. While he was in this condition, their friends, who had come in great numbers from the surrounding country, were directed to close up the Waipahu river, which empties into the Ewa Lagoon, with their fish nets, brought for the purpose, while they attacked him in the rear. In his attempt to escape to the open sea he broke through one net after another, but was finally entangled and secured. His body was then dragged by the victorious people on shore and burned to ashes, but a certain dog got hold of his tongue, and, after eating a portion, dropped the remainder into the river. The spirit of the man-eater revived again, and, as a tongue, now restored and alive, made his way to the coasts of Maui and Hawaii, pleading with the sharks of those waters for vengeance upon the sharks of the Ewa Lagoon. They meantime secured the aid of Kuhaimoana and other notable sharks from the islands of Kaula, Niihau, Kauai, and Oahu. A grand sight it was to the numerous spectators on the shore when these mighty hosts joined combat and began the great shark-war. It was a contest of gods and heroes whose exploits and deeds of valor have long been the theme of the bards of the Hawaiian Islands… [I]n the first great battle the friends and allies of the cruel man-eater were routed by the superior force of their opponents, which the good Kaahupahau and her brother long continued to enjoy the affectionate worship of their grateful people. It is said that she is now dead, while her brother Kahiʻuka still lives in his old cave in the sea, where he was visited from time to time by his faithful kahu, Kimona, now deceased. Sometimes Kimona missed his fish nets, when he was pretty sure to find that Kahiʻuka had carried them to a place of safety, to preserve them from destruction by hostile sharks. (pp. 10-11)

Pukui also wrote about visits she made to ʻEwa and the Puʻuloa region in 1907. She observed that the name "Kaʻahupāhau" could be translated as "Cloak well cared for." Her place in the history of the land is commemorated in the saying, "Alahula Puʻuloa he alahele na Kaʻahupahau, Everywhere in Puʻuloa is the trail of Kaʻahupahau" (Pukui, 1943, p. 57).

3.2.10 He Moʻolelo Hawaiʻi – No Nā ʻAumākua Moʻo (A History of Hawaiʻi – About the Moʻo Guardians/Ancestral Gods)

In this excerpt from "A History of Hawaiʻi," the moʻo goddess, Kānekuaʻana, is detailed. It was to her that the heiau waihau (heiau specifically for moʻo spirits) were established along the Puʻuloa lochs to ensure the abundance of bivalves for which ʻEwa's inland fisheries were famed. Among the kapu (restrictions) of Kānekuaʻana was that fisher-people needed to be very quiet when going to sea to gather the pipi (pearl oysters, *Pinctada maculata*) and bivalves. The slightest voice would cause the wind to blow, thus making the pipi and other bivalves sink deep into the sands where they would be difficult to find. It is because of this kapu associated with Kānekuaʻana that the famous ʻōlelo noʻeau of ʻEwa, "ka i-a hāmau leo o ʻEwa" (the fish of ʻEwa that silences the voices), came into being.

Ka Nupepa Kuokoa

He Moolelo Hawaii	**A History of Hawaiʻi**
Mokuna VII.	**Chapter VII.**
No Na Aumakua Moo.	**About the Moʻo Ancestral Gods**
Mei 20, 1893 (aoao 1)	**May 20, 1893 (page 1)**
…Kanekuaana ko Ewa moo kiai, hilinai nui ko Ewa poe kamaaina iaia, mai Halawa a Honouliuli. Ina e pilikia i ka ia, hoeu like na kanaka i na waihau e pili ana iaia, a o ka ho-a no ia o ke ahi e hoala i ka pomaikai o ka aiona. O ka Pipi ka ia kaulana o Ewa. Aole e hala na mahina eono e ku ai ka lala hau ua piha ka aina i ka Pipi, mai Namakaohalawa a na pali o Honouliuli, mai na kua-pa o uka a na pa akule [Pākule]; mai ka hohonu a ka papa nahawele o kula; mai kaliawa a ka pohaku ona loko a pela aku.	…Kānekuaʻana is the moʻo guardian of ʻEwa; many of the natives of ʻEwa, from Hālawa to Honouliuli followed [believed] in her. If there was trouble with the fishing, the people dedicated her temple [Waihau] with the lighting of a fire to bring about blessings upon the land. The pipi is the famous fish of ʻEwa. Before six months would pass the hau branches would take hold, and the land would be filled with the pipi, from Nā-maka-o-Hālawa to Honouliuli, from the inland pond walls to the Pā-akule. From the depths to the nahawele reefs and flats. From the channel inlet to the stone-lined ponds, and so forth.
Aia maloko o ka io o ka Pipi momi nani, e like ka nunui me ka onohi ia; he onohinohi keokeo kekahi, ua kapaia he	There is within the flesh of the pipi a beautiful pearl, its size is similar to the eyeball of a fish. Some are like the shiny white of an eye, and are called mūheʻe kea. Others are shiny red,

muhee kea; onohinohi ulaula kekahi me he anuenue la, he muhee makoko ia. He liilii a nunui kekahi; a he waiwai kumukuai nui ko ia mea.

O ka Opaehuna a Opaekala kekahi ia; paapu mailoko o ke kai a na loko kua-pa a no loko puuone.

O ka nehu pala kekahi ia; piha mai ka nuku o Puuloa a uka o na Ewa, pela me na nuku awalau a pau; no laila ka olelo ia ana:

"He kai puhi nehu puhi lala
Ke kai o Ewa—e.
E noho i ka lai o Ewanui—
A Laakona—a."

He Mahamoe kekahi ia kaulana, a he Okupe a mau ia e ae no kekahi. A ina i ike ia keia mau ia a pau alaila, eia ka olelo a na pulapula:

"Hoi mai nei ua luahine nei mai na kukulu mai o Kahiki; noho mai la paha a aloha i na moomoo ana."
O lakou no kekahi i hai mai i ke ano o na pae aina o Kahiki a me na aina e ae i ike ole ia…

…O Hauwahine, he kiai ia no na loko o Kawainui a me Kaelepulu. O Laukupu ko Moanalua; he malama lakou i ka

like a rainbow, and are called mūheʻe mākoko. Some are small and others are larger, and they are highly valued.

The ʻōpae huna and ʻōpae kala [types of shrimp] are other fish, that are in the sea, the walled ponds, and dune banked ponds.

The nehu pala is another fish which fills the waters from the entrance of Puʻuloa to the coastal flats of ʻEwa. It is the same with all of the lochs [awalau]. This is why the saying is told:

"Nehu appear to be blown upon the sea,
causing the water to shine
It is the sea of ʻEwa,
Dwelling in the calm of great ʻEwa, of Laʻakona"

The mahamoe is another famous fish, and the ʻōkupe, another, and there are others. And if all these fish are seen there, here are the words of the natives of the land:

"The old woman [Kānekuaʻana] has returned from the foundations of Kahiki; she dwells here perhaps for the love of her descendants…"
They are the ones spoken of coming from the Kahiki and the other lands which have not been seen…

…Hauwahine is the guardian of the ponds of Kawainui and Kaʻelepulu. Laukupu is of Moanalua; it is they who tend to the blessings, protecting the lands and people from trouble…

pomaikaʻi, e pale ana i na pilikia maluna
o ke kina a me ka ohana…

3.2.11 He Moʻolelo Kaʻao Hawaiʻi no Laukaʻieʻie… (A Hawaiian Tradition of Laukaʻieʻie…)

Hawaiian historian M. Manu penned several lengthy traditions for the native newspaper *Nupepa Ka Oiaio*, in which he included detailed accounts of a wide range of practices, including those associated with fisheries and deified guardians of the ocean and freshwater fisheries. The following account, "He Moolelo Kaao Hawaii no Laukaieie…," was published between January 5, 1894 and September 13, 1895. The tradition is a rich and complex account with island-wide place name references and details for Honouliuli and the larger ʻEwa moku. The tradition also includes descriptions of fisheries and aquatic resources, history, and mele, interspersed with accounts from other traditions and references to nineteenth century events.

The following excerpts of Manu's account were translated by Maly and include an overview of the moʻolelo and reference narratives which recount the travels of Makanikeʻoe, one of the main figures in the account. During his travels, Makanikeʻoe sought out caves and tunnels that served as underground trails. Through the description of his travels, some of the wahi pana and resources of the lands through which he traveled are detailed.

The following accounts, describing places of ʻEwa and neighboring lands, are excerpted from the longer narratives which describe the travels of Laukaʻieʻie, her younger brother Makanikeʻoe, and their companions. The lei momi (pearl garlands) of ʻEwa were described while Laukaʻieʻie and her companions were at Kaʻana, Molokaʻi:

March 9, 1894 (page 4)

Leiomanu (a youth of Kaʻala, Oʻahu) gave Kaʻana of Molokaʻi, and Kawelonaakalāilehua, the prized lei momi of <u>ʻEwa</u> as gifts. The characteristics of these pearls included those with a fine yellowish tint, others had bumps like diamonds, and some were bluish-yellow. There were many types of pearls, and they were once regularly seen in the sheltered bays of <u>ʻEwa</u> at Oʻahu. They came from the Pipi (oysters), and the pearls were found near the edges of the Pipi shell. They were a thing greatly cherished by the chiefs of old and worn in lei. This is why it is said:

My fish which quiets the voices,
You mustn't speak or the wind will blow.

This is the famous thing of <u>ʻEwa</u>, where the fish quiet the voices, to these new times. This is the type of lei which had been given to the aliʻi of Lehua, the island which snatches the sun…

April 19, 1895 (page 1)

…Laukaʻieʻie and her companions, Hinahelelani and Koʻiahi arrived at Honouliuli and were greeted by the natives of that land. Koʻiahi, a chiefess from Mākua, Waiʻanae, was related to Kahoʻonani (w), ʻUlalena (w), and Kauakiʻowao (k), the aliʻi of Honouliuli. It is for these aliʻi that the chant is sung:

Kahoʻonani resides upon the plain,
ʻUlalena is completely surrounded by the Kauakiʻowao rains…

While they were being hosted at the house of these natives, they saw the beginnings of a red-hued rainbow form near the shore and knew that Kauakiʻowao, the elder brother of the two beautiful sisters, was crossing the flat lands, drawing near to house. When he arrived, Hinahelelani asked Koʻiahi to invite Kauakiʻowao to accompany them on their journey to Kauaʻi… The party departed from the residence at Honouliuli and traveled to Puʻuokapolei, where the met the young maidens Nāwahineokamaʻo and Peʻekāua, the beauties who dwelt upon the lowlands of Puʻuloa. These two maidens accompanied the travelers to Waimānalo and Kaiona, for which the song writer of the late chiefess Bernice Pauahi Bishop wrote:

Respond o woman,
Who travels the plain of Kaiona,
Pursuing the mirages,
On the plain covered with ʻōhai blossoms.

Thus, all these beautiful residents of the land of Honouliuli were gathered together, by the famous beauty of Waiʻanae (Koʻiahi), who is there on the resonating and fine sands of Mākua…

April 26, 1895 (page 1)

…While Laukaʻieʻie and her companions were traveling through Waiʻanae, Makanikeʻoe was following behind. Having landed on the shores of Māmala, he then traveled to Kahakaʻaulana and the landing at Kalihi. He then looked down along the glistening sands and waters where the mullet are found, outside of Keāhua, at the place called Keawakalai. There he saw a crevasse open in the sea. In this place, were sleeping many sharks and turtles, almost as if under the sand. Makanikeʻoe quickly entered into the cave with the turtles and sharks, to see them more closely. Because of his great speed, they didn't know that he had entered their house. Makanikeʻoe crawled along one of the crevasses in the sea, and going beneath the land, he exited out at Āliapaʻakai, at the place called Manawainuikeoʻo. That is the entrance of the sea into that great salt water pond of Moanalua…

Let the author explain here, that this channel was first made when Pele traveled along the islands making craters here and there. This crater is something like the crater of Kauhakō, at Kalaupapa, Molokaʻi.

By this little explanation my readers, you may also know that the remaining crater is there above Āliamanu, the hiding cave of the chief Kahahana, his companion, Alapaʻi, and his beautiful wife, Kekuapoʻi. He (Kahahana) is the one who killed the priest Kaʻōpulupulu and his son Kahulupue, at Waiʻanae. This is how the famous words of the priest came to be spoken:

Strive for the sea my son,
for from the sea shall come (others of) another land.

And this cave has been given the name "Pililua" from the time of the death of the chief Kahahana.

Pililua, the two of you shall go to ʻEwa,
You are like a canoe,
Pulled by the rope,
To the cliff of Keālia,
At Kamaʻomaʻo,
There at Kinimakalehua.

After seeing these places, Makanikeʻoe then went to the top of Leilono, one of the deity of ancient times. There is a pit dug there in which the foul smelling bodies of the dead and the defiled matter of the dead are thrown.

Makanikeʻoe left that place and went to a place that was covered with something like a rough pahoehoe surface, below the present-day 5 mile marker on the road at Kapūkakī. There he saw the spirit of a woman moving swiftly over a portion of the pāhoehoe. Makanikeʻoe recognized that this was a spirit form rather than that of a living woman, and he felt compassion for her. He then saw that there was a deep pit there, filled with the spirits of dead people, swaying back and forth, and crying out, with moaning and wailing. This is the pit which in ancient traditions is called Kaleinaakaʻuhane. The spirits of the dead go there and can only be freed if their ʻaumakua fetches them. They might even be returned back to life again…

Now you may be wondering my readers, what was the name of this woman that Makanikeʻoe took up in his hands. Well the writer will tell you the name of this beautiful young woman of Kaiʻahāmauleo o ʻEwa-nui-a-Laʻakona [The fish that quiets the voice of Great-ʻEwa-of-Laʻakona], it was Kawailiʻulā. She was a native of two lands of ʻEwa, Waiau and Waimano. And it is for this woman that Kawailiʻulā, between the 9 and 10 mile markers from Waiau and Mānana 2nd is named; it is near the present-day court house of ʻEwa…

At this place, Kaleinaakaʻuhane, hundreds and thousands of spirits have been lost…

May 3, 1895 (page 1)

…Makanikeʻoe then went to the uplands, atop the cliffs and ridges of Koʻolau, where he looked down and chanted:

Beautiful is Hālawa in the Waʻahila rains,
Which visits also, the heights of ʻAiea,
The heat and warmth travels across the plain of Kalauao.

It is true, that he then went to Kalauao, where he saw the pool of Kahuawai. He turned to the uplands and saw the source of the water coming out of the earth, near the top of the cliff of Waimalu. The source of this water, from where it flows, cannot be easily seen because it comes out from the ground in an area where there are many deep holes hidden on the side of the cliff of Waimano. It is from one of these pits that the water flows. It is also at one of these places that the body of David Malo[12] was laid to rest.

This place, between Waiau and Waimano, called Waipuhia, is the place of Kawailiʻulā, who was brought back to life at Kaleinaakaʻuhane, at Kapūkakī…

Kawailiʻulā invited Makanikeʻoe to her home where food was prepared, the ʻanae from the pond of Welokā and the famous foods of the land. Kawailiʻulā invited Makanikeʻoe to stay with her, but he declined, explaining that his elder sister and her companions were

[12] This is not David Malo of Lahaina Luna, but a namesake, who was also a historian and active church member.

waiting for him at Waiʻanae… Kawailiʻulā bid farewell to Makanikeʻoe and he disappeared from sight, born by the wind, Moaʻekū of ʻEwa.

Makanikeʻoe then traveled to Mānana, now the 10 mile marked, and the place where the court house of ʻEwa stands. This is the place where ʻOulu, the famous warrior of Kahekili, king of Maui, was surrounded by warriors who thought to take him prisoner. It is there that ʻOulu fought like the eel, Palahūwana, and with great strength and skill, overcame those who fought against him. The place where this fight occurred is called Kaoinaomakaiʻoulu to this day.

Makanikeʻoe then followed the trail to a place where he saw a large gathering of youth along the trail, at the place called Nāpōhakuhelu. The activity of the children at this place was the shooting of arrows, something that was always done by the youth of those times.

There was among this gathering of youth from Waiawa, a handsome boy named Kanukuokamanu (not to be confused with a place of the same name in Hilo, Hawaiʻi). His place of residence was on the shoreward side of the government road, a place something like a hillock from where one can look to the estuary of Waiawa. It is about at the ten and a half mile point, and the place is known by the name of this youth today.

When Makanikeʻoe arrived at the place where the youth were playing, he was saddened at seeing the young boy crying. This was because the older children had taken all the arrows, and left none for the younger child to play with. Makanikeʻoe took the young boy away from the group to a place off to the side. He told the boy "Stop crying and I will give you an arrow of your own. This arrow will fly farther than any of the arrow of your friends." Makanikeʻoe then gave the boy an arrow like none other he'd seen.

Now Kanukuokamanu was the son of the chief of Waiawa… When he returned to the group of other children who were still playing, he prepared to compete as well. He chanted first to his arrow:

Kaʻailehua flies,
Kaʻiniki flies,
Ahuahu flies…

May 10, 1895 (page 1)

Kanukuokamanu shot his arrow and it flew beyond all the other arrows of the competitors. It flew all the way to "the end of the nose of the pig" at Waimano, and then returned to the youth who had shot it…

Makanikeʻoe then departed and was lost from sight. Looking seaward, Makanikeʻoe saw the fin of a shark passing by, in front of a stone in the estuary of Waiawa, on the west side of Kanukuokamanu, next to Piliaumoa. Seeing the shark, Makanikeʻoe drew nearer and he saw that it was Kahiʻukā, a native of this estuary. His cave was comfortably situated on the side of the stone. Kahiʻukā was a good shark, and in his story, he is the guardian of Mānana and Waiawa.

The author has met a man at Mānana who was known by the name, Kahiʻukā. He learned the traditions of this shark in his youth, and was taken by this shark for a period of time, and returned again to the land in good health. The man has since died, but his daughter is still alive, and his story is an amazing one.

After seeing the house of this hero of the sea (Kahiʻukā), Makanikeʻoe turned and walked along the place where the waters flow from the land at Piliaumoa, Mokaʻalina, Pānaio, Kapuaihalulu, Kapāpaʻu, and Manuea. The trail then turned and went to the top of Hāʻupu, where the foundation of the Luakini (church) of ʻEwa was later situated. Near there, was a large pond in which awa (milkfish), ʻanae, and āholehole (*Kuhlia sanvicensis*) fish were found.

Oh readers, let the author explain something here. At the time Lūʻau came from Maui to dwell on Oʻahu, he arrived at Waiawa, ʻEwa. He saw some men thatching dried ti leaves on the Luakini that was being built there. Lūʻau asked some people, “Who is the one that is having this important house built?” They answered, “Kānepāiki.” Lūʻau then stated, “The house shall not be finished to its ridge pole before the one who is having it built dies.” The people asked, “Why?” Lūʻau answered, “The house is atop the Heiau and the fishpond is below, it is because the waters (life and wealth) are flowing out from this place. (So too shall the life flow out.)” These words of Lūʻau were true, the Luakini of Waiawa was not completed before Kānepāiki died. His body was buried in the uplands of Waimalu.

These were the words of Lūʻau. The one who discerned the nature of the land in the time of the King Kauikeaouli K. III. And his descendants are still living at Kanaio, Honuaʻula, Maui…

From this place, Makanikeʻoe then turned and looked to the calm waters of Kuhia Loko and Kuhia Waho. He went to the ponds and saw water bubbling out, and in the pond were many fish of the sea. It was of this pond, that Kāne and Kanaloa spoke, while in Kahiki, as heard by the prophet Makuakaumana, who crossed the sea and traveled to Hawaiʻi:

The mullet are at Kuhia-loko,
The seaweed is at Kuhia-waho,
The salt is at Nīnauele,
The nehu pala are at Muliwai
The lone coconut tree stands at Hape,
The taro leaves are at Mokaʻalika,
The water is at Kaʻaimalu,
The awa is gathered at Kalāhikiola.
Behold the land.

All of these places named by the gods can be seen, extending from the sea of Waiawa, to Halalena at Waiawa uka.

From this place, Makanikeʻoe then went to a large deep spring which flows from waters beneath Waipiʻo and Waiawa. At a place where the priests discard their offerings. He then came upon another spring at the entrance of the estuary of Waiawa. The trail then turned towards Palea and Pipiloa, where there grew groves of kou and hau in ancient times, and it was the residence of the rulers of Oʻahu. This is the place where the king of Oʻahu, Kūaliʻi-a-Kauakahiakahoʻowaha, found his first wife, Kawelaokauhuki, who was of the uplands of Waimano. It is this Kūaliʻi who built the long house called Makanaʻole, on the inland plains of Mānana 2nd. It is near the place now called Kūlanakauhale Momi (Pearl City).

Makanikeʻoe then traveled to the fishponds of Hanaloa and ʻEo, the great ponds of ʻEwa. It is for these ponds that the lines of the song say:

The water of ʻEo is not fetched,
It is the sea of Hanaloa that ripples forth.

At this pond, Makanikeʻoe saw a deep crevasse and inside, there was a giant eel sleeping. The name Hanaloa was given because of the great amount of work that was done by the chief and the people in carrying the stones with which to surround the crevasse and build the pond wall. Thus the pond was built. And it is a famous pond for it is rich with fish, and for the eels which Keinohoʻomanawanui desired to eat.

From the pond, Makanikeʻoe then walked to a place where there were several small points of land, near where Pāpio was bitten and where the sea enters Honouliuli. He noticed how very calm the surface of the water was here, but he also saw that it was agitated in its depths. Looking more closely, he saw in the depths some very large fish, as if guarding the entrance to the harbor. One of these two large fish was like a marlin with a long bill and rows of teeth. The other one was a barracuda whose teeth protruded out of both side of its mouth. These two fish of the bays of ʻEwa, had ears with which to hear. They leapt in the ocean like flying fish, and are spoken of in some of the traditions of Hawaiʻi.

The marlin is the one, who with his sharp bill, divided the waters that enter into ʻEwa. Thus, Makanikeʻoe understood the nature of these fish, and what their work was. They were the guardians of the place. It is true also, that in a short while Makanikeʻoe saw a procession of many sharks arrive. There was in this group, the famous chiefess, Kaʻahupāhau, of Puʻuloa, and the messengers of the king shark (Kamohoaliʻi) of Kahoʻolawe. She was taking them on a tour and to drink the waters of Waipahu and Waiʻāhualele, and to drink the awa from Kahauone, in Waipiʻo uka…

Makanikeʻoe then turned again to the place where Pāpio had been bitten as a result of her asking for the ʻilima (*Sida fallax*) garlands of the old woman, Koihala. This is what the old woman told Pāpio:

The beautiful girl asks,
That the garlands of the old woman be given to her.
Heed my words dirt of the dog, dirt of the pig,
String your own garland and let it wilt.

Makanikeʻoe then departed from this place, turning to the plain of Puʻuloa. He passed many pits in this place where the bones of men have been left. He then followed the trail to the of the breadfruit tree, Leiwalo, at Honouliuli. This is the breadfruit tree of the expert sailor, Kahaʻi (Kaʻuluakahaʻi), so told in his story.

There are also many pits in which were planted sugarcane and bananas, and planting mounds. He also saw manu ʻōʻō (honey creepers) sipping the nectar of noni (mulberry, *Morinda citrifolia*) blossoms. There were also two ducks that had gone into a pit, and with a great strength, they were trying to push a stone over, to hide the pit. This Makanikeʻoe knew what the ducks were trying to do. They wanted to hide a spring of water which flowed underground there. It is this spring which in calm times could be heard, but not found by the people who passed through this area. It was a secret spring, known only to certain native residents of the area, and its name is recorded in the last line of the song:

The ʻōʻū is the joyful bird of Kaupeʻa,
The joyful voiced ʻōʻō is of Puʻuloa,
Softening the blossoms of the wiliwili,
Drinking the drops of nectar from the noni,
The birds drink and pass time,
The eyes cast about seeking,
The water of the natives,
The eyes seek the water of Kaiona.

This hidden spring, known only to the natives, was not hidden to Makanikeʻoe. From there, Makanikeʻoe then turned back towards Honouliuli and saw the pit of the native eel, Kapapapūhi, the elder of Laumeki, whose stone-form body is there at the base of Kaʻuiki, Hāna, Maui. He was an eel of Oʻahu who traveled to Hāna where he stayed and was turned into stone.

There is also at this place, Kaihuopalaʻai, where the ʻanae begin their journey from Honouliuli to Kaihukuʻuna at Lāʻiemaloʻo, Koʻolauloa.

Seeing this pit, Makanikeʻoe swiftly ran back to Waipahu, where he looked at the source of the water, where it came out of the earth, and flowed to the estuary of Waikele. Makanikeʻoe dove into the water to determine its hidden source. He swam underground, and first arrived at Kahuaiki, at Waipiʻo, for which the song is sung:

Return to the coolness of Waipiʻo,
The cold water of Kahuaiki…

He then dove under and came out on the plain of Puʻunahawele, that barren and peopleless plain. There he saw the source of the water of Kahuaiki. It is near a hidden stone (shaped like a hook pendant) and close to Kekuaʻōlelo, along the trail which ascends straight up to Waipiʻo uka. Makanikeʻoe then turned and followed the water path, and with great strength, he arrived at Kawaipūʻolo, at Waialua. There, he saw the pool of Laniwahine in the famous pond of ʻUkoʻa. He then quickly went from Waialua to Kawela, and from there, to Punahoʻolapa, a deep spring on the plain of Kahuku. There he found the water source that the kapa anvil fell into and was carried to Waipahu, at ʻEwa. Makanikeʻoe the crawled along another path and arrived at Punamano, also at Kahuku…

(Makanikeʻoe continued his journey through the various springs of Oʻahu, until he rejoined his sister and companions at Waiʻanae. The group then continued on their journey to Kauaʻi…)

3.2.12 He Moʻolelo Kaʻao Hawaiʻi no Keliʻikau o Kaʻū (A Hawaiian Tradition of Keliʻikau o Kaʻū)

Keliʻikau-o-Kaʻū was a shark god who traveled to Puʻuloa from the island of Hawaiʻi. The tradition appears only in the short-run Hawaiian language newspaper *Home Rula Repubalika* and is incomplete. This account differs in relation to the events and their outcome than those found in more widely reported narratives. There is no specific reference to the source of the account and only two articles in the series are available. These narratives offer some details on named localities and events that are of significance in the history of Puʻuloa at Honouliuli. The translation and summary of this tradition was completed by Kepā Maly.

Home Rula Repubalika
He Moolelo Kaao Hawaii no Keliikau o Kau.

January 6, 1902 (page 7-8)

Summary — A Hawaiian Tradition of Keliʻikau-o-Kaʻū

Keliʻikau-o-Kaʻū was born to his mother as the result of her relationship with the spirit form of Kalani, a king of the sharks. He was a favorite of Kalani, and transformed into a shark, whose body was almost three fathoms long.

At this point in our story, we now look to another mysterious formed shark, and his death at the entrance of Puʻuloa at ʻEwa. His name was Mikololou, it was him who was killed at Puʻuloa, and this is why Keliʻikau-o-Kaʻū went there. The background of this shark, Mikololou is given in the traditions Kāneialehia, and Pāpaʻi and Paukūpahu of Puna, Hawaiʻi. Kāneialehia, protected the lands from Leleiwi and Makaokū, near the low islet of Mokuola, and all the way to Makahanaloa of Hilo Palikū. Under the law of Kāneialehia, it was forbidden to kill any human. Kāneialehia saw swimming past the cliffs, and discerned Mikololou's nature as an spirit-transformed shark, he also recognized that Mikololou was a man-eater.

Kāneialehia decided to take Mikololou as an attendant, perhaps even as a foster-son, and to teach him how to live under the law of not killing humans…

We know from various accounts, as cited earlier in this section of the study, that Mikololou departed from Hawaiʻi in the company of other man-eaters and traveled to Puʻuloa, where he was eventually killed by Kaʻahupāhau, Kahiʻukā and the people of ʻEwa. Based on other accounts, Mikololou was restored to life, and returned to Hawaiʻi, where he enlisted the aid of Keliʻikau-o-Kaʻū and other sharks to avenge his treatment by the sharks and people of Puʻuloa. The issues of the paper with this portion of the tradition are missing, and the account is picked up again on March 15, 1902.

> **March 15, 1902 (page 7)**
>
> Keliʻikau-o-Kaʻū fought with and killed Kaʻahupāhau, and it is because of this event, that the famous saying, "Mehameha Puʻuloa, ua make o Kaʻahupāhau" (Puʻuloa is alone, for Kaʻahupāhau is dead), came about. Keliʻikau-o-Kaʻū assumed various body forms he possessed and attacked Kaʻahupāhau from within and outside her body. Kaʻahupāhau went in spirit form to her attendant, Koihala, calling to her, saying that she was dying. Upon her death, Keliʻikau-o-Kaʻū called out to Kamoana and Kahiʻukā, taunting them. He then proceeded to swim through Puʻuloa, biting and tearing at the native sharks of the region, throwing their bodies up onto the dry land from Kalaekao, Kapuaʻikāula, Keanapuaʻa, Kamokuʻumeʻume, Aiea, Kalauao, Waimalu, Waiau, Waimano, the two lands of Mānana, Waiawa, Hanapōuli, Waipiʻo, Waikele, Hōʻaeʻae, Honouliuli, Kalaeokahuka, Kanahunaopāpio, Kepoʻokala and Puʻuloa. Upon her death, Kaʻahupāhau's body became a coral formation near the place called Pāpio, and that place is still seen on the side of Honouliuli to this day.
>
> Following the death of Kaʻahupāhau in this war between the sharks, the shark chiefs of both sides met in council and agreed to no further wars should be fought between them…

It should be noted here, the elder kamaʻāina of the ʻEwa moku still claim that Kaʻahupāhau was seen and cared for during their lifetime.

3.2.13 Kaʻao no Nāmakaokapāoʻo (Tradition of Nāmakaokapāoʻo)

There are several traditions pertaining to a youth named Nāmakaokapāoʻo that have been published in the Hawaiian language newspapers, with lengthy accounts in print between the 1877 to 1917. An account published in *Ka Lahui Hawaii* in March 1877 references the sweet potato fields of Nāmakaokapāoʻo, observing that Nāmakaokapāoʻo was the skilled fighter of the cliffs of Līhuʻe.

Later accounts of the tradition provide detailed narratives of events on Maui and Kauaʻi, with passing, poetic references to Oʻahu, Hawaiʻi, Niʻihau, and other locations. Abraham Fornander (1918) details the life and deeds of Nāmakaokapāoʻo on Oʻahu, with several names and features of the ʻEwa District described:

> Namakaokapaoo was a very brave little boy, and very strong for his young years. He had no compeer in these Islands from Hawaii to Niihau, according to his size for bravery. His father was Kauluakahai of Kahikipapaialewa, a land in great Kahiki. Pokai was his mother. His father was a great chief and had a godly relationship. Hoaeae, in Ewa, was the place where they met as man and wife and begat Namakaokapaoo. When Pokai was enciente of Namakaokapaoo, Kauluakahai went back to his own land, leaving Pokai in that condition until childbirth.
>
> When the child was born Pokai and her child Namakaokapaoo were quite destitute, and while they were in that condition of life a good man named Pualii came from Lihue to fish at Honouliuli. He turned in at the home of Pokai. He looked at her and had a yearning for her. He said: "I desire you to be my wife." Pokai returned: "How could you have a desire for me, seeing that I have already given birth to a child, and my body is defiled?" Pualii answered: "There's nothing in those things if you desire our union." Pokai then assented and went with her husband Pualii, and resided at the plans of Keahumoa. (Kula-o-Keahumoa.)
>
> They lived there tilling the soil. Pualii had two large potato patches which remain to this day; they are called Namakaokapaoo. When the potatoes were ripe Pualii made a vow that when the head of an ulua fish and the potatoes were roasted, and Pualii had first eaten thereof, then the potatoes would be free, and that his wife and others could eat thereof. Therefore Pualii went down to Honouliuli to catch the fish to be eaten together with the potato.
>
> When Pualii was gone Namakaokapaoo, with seventeen other youngsters, went to Pualii's potato patches. Namakaokapaoo was only a very small child then, standing two and a half feet high, had not eaten adult food. He had not worn a girdle (malo), and was yet in a state of nudity.
>
> When they arrived at the potato patches he told the boys to dig up the potatoes and pull up all the vines, and allow nothing to stand in the patches. But the boys were afraid and only dug up the potatoes without pulling up the vines. Namakaokapaoo then Started to pull up everything from both patches until the vines were piled up high in stacks. There were forty such stacks from the two fields. He thereafter started a fire and roasted thereon four clusters of potatoes.

While he was cooking his potatoes his stepfather came home and asked his mother Pokai: “Did you send your child to pull up my potatoes?” Pokai said: “No.” Pualii then said “Well, this day his head and eyes will be meat for my potato meal. This day he shall die at my hands.” He seized an axe and went out to the field where he found Namakaokapaoo roasting his four clusters of potatoes in the fire. All the other boys ran off and stood at a distance for fear of Pualii.

Pualii then said to Namakaokapaoo: “Say, I have in my hand an axe with which to cut off your head this day, and when your head is off it will be roasted with potatoes so that I may eat first and then it (the potato) will be free.” Namakaokapaoo paid no attention to these words of Pualii, who repeated them after an interval. And while Pualii was about to cut Namakaokapaoo with the axe, the latter just then delivered his death prayer against Pualii. The prayer follows:

> O how I long for the eyes of my little fishes (paoo’s),
> For which I am undecided, wavering,
> Whether to eat, or whether to leave,
> To leave for Kukuiaimakaokalani.
> That is Kukuiaimakaokalani,
> This is my little friend
> Namakaokaia, the great chief of Hawaii.
> Vanquished, yes, vanquished is the coward;
> The man with the spear,
> The spear and the drum,
> Shall be vanquished by Namakaokapaoo.

(Let us here make a few remarks relating to Namakaokalani and Namakaokaia. They were great chiefs of Hawaii. The former was the father, the latter the son, but they were mentioned in the prayer of Namakaokapaoo.)

At the time that Namakaokapaoo ended his prayer, Pualii struck at Namakaokapaoo with the axe, but the sharp edge of the axe turned on himself cutting off and throwing his head some distance, from whence it said: “Farewell to thee, Namakaokapaoo.”

Namakaokapaoo picked up Puaiii’s head and threw it towards Waipouli, a cave situated on the beach at Honouliuli (a distance of about five miles). [13] After Pualii's death Namakaokapaoo went back to his mother. He did not eat any food.

At that time Amau, a king of Oahu, was residing at Waikiki. A certain man of Honouliuli came to Waikiki, to where the king was stopping, and said to him: "Your majesty, there is a very strong little boy, who killed his stepfather and threw his (father's) head a very long distance, about five miles."

When Amau heard this he said: "He is indeed strong if he kills me; but if he does not kill me he is not strong." While he was talking at Waikiki, Namakaokapaoo heard all of this talk about himself. He then took and hid his mother in the cave at Waipouli, after which he came back to their house at Keahumoa. He went up on the roof of the house and parted the front and rear thatchings on the ridge and slept there.

Amau the king sent four companies of men, each company consisting of forty-eight men. When they arrived at Keahumoa they entered the house and found no person in it. And when they were preparing to leave Namakaokapaoo called to them from the ridge. When they heard the voice without seeing anybody, they asked: "Where are you talking from?" Namakaokapaoo answered: "I am up here." Eight men climbed up on the roof, four from the rear and four from the front, and found Namakaokapaoo. He asked them: "What do you want here?" And they said: "We have come to fight Namakaokapaoo, a small boy just like you, who is very strong and brave, and who killed his father Pualii." He answered and said: "I know; Namakaokapaoo is quite a big man. He has gone to Koolau. I am his namesake." And they said to him: "No, no, you are the one, so we heard; therefore we will kill you; you shall not live."

Namakaokapaoo then said: "Let us go down and fight it out then." As soon as they were on the ground Namakaokapaoo made a clean sweep, killing them all excepting one man, who ran and met Amau at Waikiki, and reported their total annihilation with the exception of himself.

THE DEATH OF AMAU.

When Amau heard this he prepared eighteen war canoes, and set sail for Ewa to fight

13 While the exact location of the cave named Waipōuli is not known in the present-day, the location being five miles makai and on the shore from the Keahumoa-Kīpapa vicinity would place Waipōuli near the Honouliuli-Hōʻaeʻae boundary, and likely near the shoreward ʻili of Līhuʻe (cf. oral history interview with Shad Kāne dated August 26, 2011).

> Namakaokapaoo. When Amau and his men arrived at Ewa, they were suddenly exterminated by Namakaokapaoo, not a single man escaping. And thus Amau died. Oahu being completely conquered, Namakaokapaoo went and brought his mother and placed her as ruler over the land of Oahu. (pp. 274-278)

3.2.14 Kaʻuluakāhaʻi (The Breadfruit Tree of Kāhaʻi) at Kūalakaʻi

As cited in the tradition of Nāmakaokapāoʻo, Kaʻuluakāhaʻi was the true father of Nāmakaokapāoʻo. Following his victory over the king of Oʻahu, Nāmakaokapāoʻo traveled to Kūalakaʻi where a supernatural breadfruit tree grew in a sink hole-cave, in which had been hidden the royal gifts left to him by his father. According to Fornander's (1918) account, after retrieving the items from Kūalakaʻi, Nāmakaokapāoʻo then traveled to Hawaiʻi:

> After the complete possession of Oahu by Namakaokapaoo, he was desirous of visiting Hawaii for observation. He then went and got a small gourd wherein to place his garments which his father had left him. This gourd was deposited at Kualakai, where a breadfruit tree is standing to this day. This is the breadfruit impersonation of his father, Kahaiulu. When the real person went home the breadfruit tree remained, being in the supernatural state.
>
> Inside of the gourd was a garment, a girdle and a royal cloak (feather cloak). After he had obtained the gourd he journeyed on till he reached Hanauma, in Maunalua. There he found a canoe which was preparing to sail for Hawaii… (p. 278)

3.2.15 He Wānana — A Prophecy and the Death of Kahanana

In January 1862, J.H. Kānepuʻu, a frequent contributor of island history to native newspapers, penned one of the earliest native accounts of a plot involving Kahekili, king of the Maui group of islands, and his nephew Kahahana, king of Oʻahu. As a part of his plan to take control of Oʻahu, Kahekili tricked Kahahana into killing his high priest, Kaʻōpulupulu. Kahekili had raised Kahahana and he desired to make Oʻahu a part of his kingdom. It was the priest Kaʻōpulupulu who instructed Kahahana and warned him against certain actions proposed by Kahekili. The following account by Kānepuʻu (1862) – translated by K. Maly – from the Hawaiian language newspaper *Ka Hoku o ka Pakipika* pertains to the death of Kaʻōpulupulu and his son Kahulupuʻe and the prophecy uttered at their deaths:

> ***Ka Hoku o ka Pakipika***
> **E kapu ke puhi Rama!**

Ianuari 23, 1862 (aoao 2)	**January 23, 1862 (page 2)**
…ua hooko mai ke Akua ia wanana ma o Kaopulupulu la, kekahi kaula mana Oahu nei, e haawi mua ana no i ka aina no na mamo a Sapeta, penei kana olelo i kana keiki, i nui ke aho a make i ke kai, no ke kai ka hoi ua aina, aia la, lilo ka aina ia kai. Mai kai mai no o Kahekili maluna mai o ka waa, a pae ana i Oahu nei, kaua me Kahahana, a holo o Kahahana i ka nahelehele, lilo ka aina ia kai. Mai kai mai no o Kamehameha, a kaua me Kalanikupule ma Nuuanu nei, a hee o Kalanikupule, lilo ka aina ia kai. Mai kai mai nei no ka haole maluna mai nei o ka moku a noho ana i uka nei, he oluolu wale no ka lakou la hana ana mai i na'lii o kakou, aohe i eha ka ili, lilo no ia lakou la na hooponopono aupuni, na aina, na kuleana ma ka hoolimalima, ma ke kuai, ma ka hoaie i kahi awelu lole, i ka rama, ia mea ae ia mea ae, ua lilo ia lakou la, o kau no ia o ka hoaa aku ma ka palekai.	God has fulfilled the prophecy of Kaʻōpulupulu, one of the powerful prophets of Oʻahu—giving the land to the descendants of Japheth [cf. Genesis 9:27]—who spoke thus to his son, "Strive to die in the sea, for those of another land shall come from across sea, and the land shall belong to them from across the ocean." Kahekili came from across the sea on a canoe and landed on Oʻahu. He then engaged in war with Kahahana, who fled to the forests. Thus the land was taken by the sea. Kamehameha then came from across the sea and engaged in war with Kalanikūpule at Nuʻuanu. Kalanikūpule was defeated, and the land was taken by the sea. Then the foreigners came from the across the sea on ships and now reside on the land. Their deeds for our chiefs were kindly, and they took on the work of setting the nations right, the land, the properties and leasing, selling, creating debt for new clothing, rum, this thing and that, it is all theirs now. And built up on a breakwater…

S.M. Kamakau (1867) elaborated that about eight years into Kahahana's reign as king of Oʻahu, Kahekili succeeded in tricking Kahahana into killing Kaʻōpulupulu (March 23, p. 1). Kahahana ordered that Kaʻōpulupulu and his son, Kahulupuʻe, be brought before him at Waiʻanae. The call was made from Puʻukāhea (Hill of calling). Upon the summons, Kaʻōpulupulu prayed to his gods and discerned that he and his son would be killed once in the presence of the chief. Arriving at the place now called Nānākuli, Kaʻōpulupulu called out to Kahahana who looked at him, but made as if he did not hear the call (nānā kuli). [14] Kaʻopulupulu then knew for certain that he and his son

[14] Nānākuli translates to "look at knee," said to be named "in honor of the tattooed knee of Kaʻōpulupulu, whose chief, Kahahana, turned a deaf (kuli) ear to his advice, and, when asked about his knee, told of his relationship to the chief, thus rebuking him" (Pukui et al., 1976, p. 162).

were to be killed, and he told Kahulupuʻe:

> "I nui ke aho a moe i ke kai! No ke kai ka hoi ua aina!"
> Strive to lie down in the ocean! For our revenge will come from other lands across the sea. (Kamakau, 1867, March 23, p. 1)

Kahulupuʻe ran into the water near Puʻuohulu where he was killed. Kaʻōpulupulu continued his flight across the Honouliuli plain to the shore of Puʻuloa, where he was then killed (Kamakau, 1867, March 23, p. 1). Kamakau (1992) also wrote about the last years of Kahahana's life and his death at the command of Kahekili, placed by some native writers at Hōʻaeʻae:

> For two years and six months Ka-hahana and his wife and Ka- hahana's friend, Alapaʻi, hid in the mountains and were fed and clothed by the commoners, who had compassion upon them. Thus, were the misdeeds of Ka-hahana justly repaid. They were finally betrayed by Ke-ku-manoha', father of Ka-lani-moku and half brother of Ke-kua-poʻi, Haʻaloʻu being the mother of both. Their last place of hiding was near Wailele at Waikele in ʻEwa. Alapaʻi said to Ka-hahana, "Let us kill our wife and then we shall be able to escape." Ka-hahana was more merciful, perhaps because he could not endure to lose Ke-kua-poʻi, who was an incomparable beauty. He said, "Why kill our wife who has been so faithful a companion to us while we have dodged death in cold and wet, wandering here in the mountains, in the thickets of Wahiawa, in this ocean of Kaʻieʻiea? Perhaps she can persuade her kinsmen to help us some day." Learning that Ke-ku-manohaʻ was at Waikele and Ka-lani-ku-pule and Koa-lau-kani at Kapapapuhi, Ke-kua-poʻi made herself known to her brother, hoping that he would save them all three for her sake. "Where are Ka-hahana and his friend?" asked her brother. "Will you spare us three?" asked the woman. "Why should you die? are we not all chiefs?" he answered; but his words were false; he intended to give up his brother-in-law to Ka-hekili. Alapaʻi urged, "O heavenly one! let us flee. We shall die if we stay here; only Ke-kua-poʻi will be saved." "If Kekua-poʻi is saved, we shall be also." "You will not be saved; you are a chief, a ruler by descent." Then Ke-ku-manohaʻ sent men to Ka-hekili at Waikiki to tell him that Ka-hahana was at Waikele. Ka-hekili ordered him to be killed and brought to Waikiki and he sent double canoes to Halaulani at Waipiʻo in ʻEwa. Ke-ku-manohaʻ killed Ka-hahana and his friend Alapaʻi, wrapped them in coconut leaves, placed them on the platform of the canoes, and took them to Kahekili at Waikiki… (pp. 136-137)

The words of Kaʻōpulupulu's prophecy remained fresh in the minds of elder kamaʻāina through time and was often the subject of writings. As noted above in the account of Kānepuʻu (1862), many considered that the priest's words were fulfilled a short time later with the arrival of

Kahekili and his forces on the shores of Oʻahu. This was followed by the arrival of foreigners, Hawaiians' loss of their land and kingdom, and military control over a large area of ʻEwa moku.

In 1900, the native leadership of the Independent Hawaiian party conducted a tour of Oʻahu to advocate for restoration of Queen Liliʻuokalani to the throne. David Kaluokalani, president of Hui Kalaiʻāina, spoke to district residents while in Waiʻanae, recalling the power of the prophecy. His talk was described in *The Pacific Commercial Advertiser* of June 25, 1900, and while some facts differ from the earlier account, the connection between events is significant:

> Kalauokalani waxes reminiscent in his speech at Waianae and referred to an incident of the early days of Oahu which he said was applicable to the present situation of affairs as far as the natives were concerned with relation to their political status. He referred to the time when Kahanana was chief of the island of Oahu. There was then living in Waianae a famous kahuna named Keopulupulu [sic] whose son Kahulupue had committed a crime for which he fled the district. When he was being closely pursued the old kahuna called after his son, saying: "My child, bear up until you reach the water, for when you touch the water, then the land shall belong to those who come over the sea."
>
> The speaker said this prophecy had been fulfilled, and had culminated in the overthrow of the monarchy. He appealed to the people to rectify the evil which the old kahuna had brought upon them. (p. 5)

3.3 Historic Period – Historical Accounts of the Changing Landscape of ʻEwa Moku

There are thousands of historical accounts in both the Hawaiian and English languages that describe Honouliuli ahupuaʻa. The narratives in this section were penned by native Hawaiians, foreign visitors, and residents, and include some of the earliest accounts describing the Honouliuli vicinity following Western contact. The narratives provide an overview of: (1) changes in the landscape; (2) the decreasing Hawaiian presence; (3) loss of wahi pana and noted places; (4) development of ranching and plantation business interests in the region; (5) concerns about United States (U.S.) control over Pearl Harbor and "Reciprocity;" (6) the changing make-up of the communities; and (7) travel on the land. The narratives are generally cited chronologically, by period or activities being described.

3.3.1 Kamaʻāina and Visitors Descriptions

The historical record shares a wide range of descriptions of the Honouliuli landscape, life of the people, and expressions of aloha for place—the cultural attachment—shared by Hawaiians in their living environment. The narratives below were found in Hawaiian and English language sources and reflect both native and foreign experiences and observations on the land. The texts include some of the earliest descriptions of the native communities shortly after Western contact, provide descriptions of travel across ʻEwa (as well as the evolving trail and road systems), include mele describing the cultural landscape, and cite first-hand accounts of the challenges faced by native residents and loss of access and title to the land. The excerpts of articles detail how quickly change came to the land and lifeways of the people. The important inoa ʻāina of Honouliuli – as identified in Table 1 – are underlined in the following passages and excerpts.

3.3.1.1 Sites and Trails of ʻEwa (1800-1811)

John Papa ʻĪʻī, one of the preeminent native Hawaiian historians, was born at Kūmelewai, Waipiʻo in ʻEwa in 1800. Raised as an attendant to the Kamehameha heirs, he was privy to many facets of early history, practices and events during his life. In the 1860s, ʻĪʻī published "Na Hunahuna o ka Moolelo Hawaii," which was later translated by M.K. Pukui in 1959 under the title "Fragments of Hawaiian History" (1959). Based on the translations, Paul Rockwood produced a map of the trail routes and several locations identified by ʻĪʻī in his narratives (Figure 10).

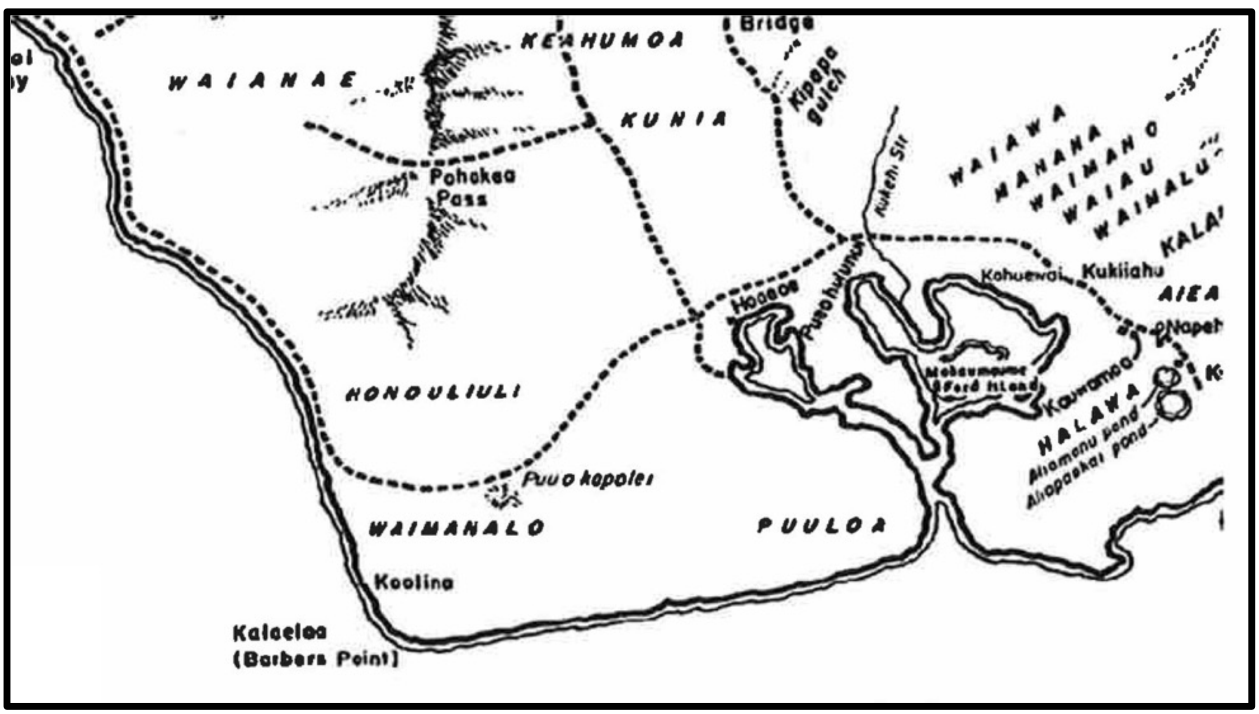


Figure 9. Trails of Leeward Oʻahu (portion of map by Paul Rockwood, based on narrative description by ʻĪʻī, 1959, p. 96).

Trails from Honolulu to ʻEwa

…Let us turn to look at the trail going to Ewa from Kikihale, up to Leleo, to Koiuiu and on to Keoneula. There were no houses there, only a plain. It was there that the boy Ii and his attendants, coming from Ewa, met with the god Kaili and its attendants who were going to Hoaeae…

The trail went down to the stream and up again, then went above the taro patches of Waiau, up to a maika field, to Waimano, to Manana, and to Waiawa; then to the stream of Kukehi and up to two other maika fields, Pueohulunui and Haupuu. At Pueohulunui was the place where a trail branched off to go to Waialua and down to Honouliuli and on to Waianae. As mentioned before, there were three trails to Waianae, one by way of Puu o Kapolei, another by way of Pohakea, and the third by way of Kolekole.

From Kunia the trail went to the plain of Keahumoa, on to Maunauna, and along Paupauwela, which met with the trails from Wahiawa and Waialua. The trail continued to the west of Mahu, to Malamanui, and up to Kolekole, from where one can look down to Pokai and Waianaeuka. There was a long cliff trail called Elou from Kalena and Haleauau on the east side of Kaala coming down to Waianae. There was also a trail called Kumaipo which went up and then down Makahauka…

Entering the ʻEwa District from Waiʻanae uka

There the trail met with the one from Kolekole and continued on to the stream of Waikakalaua, Piliamoo, the plain of Punaluu, to a rise, then down to Kipapa and to Kekualele [Kekuaolelo]. A trail ran from this main trail to Kalakoa, Oahunui, and other places much visited, such as Kukaniloko. From there it extended to the digging place of Kahalo, then went below to Paupalai, thence to Lelepua, and to Kahalepoai, where the legendary characters Kalelealuaka and Keinohoomanawanui lived. Then it reached Kekuaolelo, the stone in which the niho palaoa was hidden, then went on to Puunahawele and Pueohulunui, where it met with the Waialua trail.

All of these places mentioned had large populations. The land was rich, and there were many trees in olden times. Who has "closed" these places today? We do not know enough to say, "It was so-and-so." But there would be commercial wealth in the trees of these mountains if they were fenced off from animals. So it is with the planting places of every poor person. The person who manages these mountains and valleys could become prosperous. (ʻĪʻī, 1959, pp. 95-99)

3.3.1.2 Honouliuli Trails Cited on Malden's Map of 1825 (Visit of 1794)

As a part of the Vancouver expedition, cartographer, Lt. C.R. Malden, prepared a map of a portion of Oʻahu, which also covered the Honouliuli – Puʻuloa region (Figure 11). Malden's map was published in 1825 (Registered Map No’s 437 & 640) and provides the earliest cartographic record of the Honouliuli region. The map depicts several clusters of houses, fish weirs, and fishponds in the Honouliuli/Puʻuloa area. Being recorded during the early period of Western contact, the map is believed to represent the basic pre-contact coastal settlement pattern of Honouliuli and its vicinity. Even though the map and visit are of an early date, given the rapid decline of the native population just after Western contact, it is likely that the pre-contact population would have been higher and settlement denser than indicated by Malden.

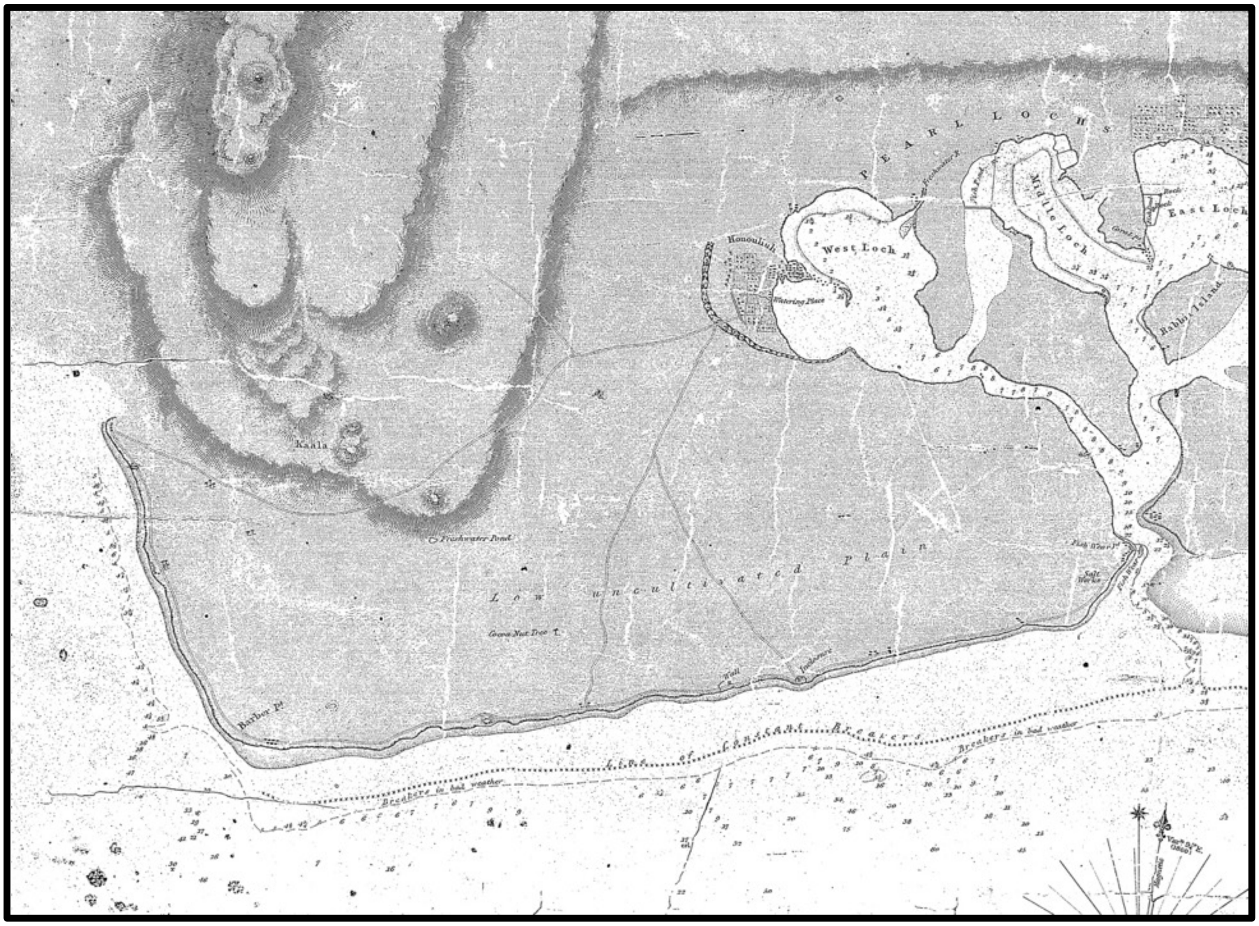


Figure 10. Portion of Map of South Coast of Woahoo [sic] and Honoruru [sic] Harbour (Registered Map No. 437, Lt. C.R. Malden, 1825)

3.3.1.3 Tours Made around Oʻahu in 1826 and 1828

In 1820, the first contingent of Protestant missionaries associated with the American Board of Christian Foreign Missions (A.B.C.F.M.) arrived in the Hawaiian Islands. The Honolulu station became the focal point of the missionary’s operations, with sub-stations on the major islands in the largest population centers. Periodically, the Honolulu station managers travelled around Oʻahu to inspect the work progress in the outlying stations, including church work, educational endeavors, and facilities to support the foreign missionaries’ living situation. Levi Chamberlain toured Oʻahu in 1826 and 1828, writing fairly detailed descriptions of the districts he visited, including lands of the Honouliuli-Moanalua region. Excerpts of Chamberlain's (1828) original handwritten notes are provided below (digitized from the A.B.C.F.M. archives at Harvard by Kumu Pono Associates LLC in 2004):

> **September 12, 1828**
> **Levi Chamberlain to Rufus Anderson**
> **A description of two trips made around the island of Oʻahu, one in 1826, the other in early 1828 to examine the schools on Oʻahu, and determine progress in education of the natives.**
> (Typed from a copy of the original handwritten letter in the collection of the A.B.C.F.M., Houghton Library, Harvard – Reel 794)
>
> About two years ago I performed a tour around this island, and I have recently made another. It was my intention to give you a brief account of my first tour, but I could not find time to do it while the scenes that passed under my observation and the events that transpired were fresh to my mind & retained their hold upon my feelings.
>
> I propose now to give you a history of my last tour, and in doing it I may refer to my minutes of the former tour… (p. 1)

Departing from the Waiʻanae District, Chamberlain (1828) went on to write:

> …The food by which the inhabitants are supplied, is cultivated in the vallies, which open among the mountains two or three miles from the shore.
>
> It was quite dark when were reached Waimanalo, and our arriving at the school house in which we expected to put up, we were disappointed to find it deserted; and it was infested with fleas that we feared we could not make ourselves comfortable in it. Some of the people of the place gathered around us, & we besought them to afford us accommodations in some of their houses. One man whose house stood nearest us and who was, I believe, the head man of the place, readily offered us his, and immediately began to put things in order for our accommodations; he did what he could to make us comfortable, and, as the house was small, vacated it entirely for our use.
>
> Saturday Feb. 9th. I enjoyed comfortable repose during the night and awaked refreshed. I arose and united with my attendants in singing a hymn, and offering a tribute of thanksgiving to God for his care & unfailing kindness. After breakfast a few scholars

assembled in front of the house. I examined them and to one of them I gave a catechism and a Sermon on the mount.

Their teacher was absent, and I exhorted them not, on that account, to neglect instructions, but to give more attention to it, to assemble on the Sabbath, and learn the catechism, and repeat passages from the word of God. At 10 minutes before 8 o'clock, after thanking our kind host for his attention to us, we set out for the next district. In consequence of the recent heavy rains the roads were very muddy, & the travelling very bad. We had met with nothing like it in any part of our previous journey travelling. After walking three hours & most of the time in mud, we reached Honouliuli in the district of Ewa. A school of 22 scholars had assembled which I examined. The head man, Kawaa, very kindly entertained me, caused a fowl to be cooked and some kalo to be nicely prepared, and furnished the native with a liberal supply of fish and poi. He invited me to stop and spend the Sabbath with him; but as his house was small, and our company had now become large by the accession of the teachers & their attendants who separated from us at Waialua and had crossed the inland and had put up at this place, I thought it best to decline his offer. But feeling desirous that religious worship should be conducted here on the morrow, I recommended that the party who had crossed the island should spend the Sabbath here, while we who had travelled round the shore, should proceed to the next considerable settlement, and make arrangements for spending the Sabbath.

Having expressed to Kawaa my thanks for his kindness, I set forwards with my attendants, and between the hours for three & four o'ck P.M. arrived at Waikele. Towards evening I attended to the examination of two schools, which met in front of the house where I had put up, At the close of the examination I gave information that religious worship would be conducted in the same place on the morrow & requested that all the people of the place should be informed & invited to attend. (pp. 28-30)

3.3.2 Relevant Business Ventures in Honouliuli

3.3.2.1 Paʻakai – Salt Making

The making of paʻakai (sea salt) was one of the significant traditional practices associated with the coastal lands of Honouliuli. There are a number of Māhele ʻĀina claims by native tenants of the larger Puʻuloa land division for salt making sites. The formation of a salt works business at Puʻuloa led to continuing residency along the Pākule, Keahi and Kupaka shoreline leading towards Oneʻula. The Puʻuloa Salt Works was in operation from the 1840s to the early 1900s (Figure 15). The narratives below provide an overview of the modern business venture.

Daily Alta California
Puuloa Salt Works Advertisement

July 1, 1852 (page 4)

Puuloa Salt Works—Sandwich Islands. These extensive works are situated at the mouth of Pearl river, Island of Oahu, within ten miles of Honolulu, and has the largest and safest harbor on the entire group of Islands. The entrance is half a mile wide, easily distinguished, with 12 feet of water over the bar at low tide. These works are capable of supplying the entire Pacific Ocean with the article of salt.

Shippers and masters of vessels may procure entire cargoes or smaller quantities of the above article, in bulk, matt bags or barrels at the works, or delivered on board their vessels in the harbor of Honolulu, by applying to:

C.W. Vincent, Honolulu,
Corner of Mauna Kea and King Streets.

Figure 11. Puʻuloa Salt Works, 1999 (USGS – Mendendall Collection, No. mwc00802).

In 1860, the following advertisement was published announcing the availability of ocean salt made at Puʻuloa:

Ka Hae Hawaii

Ka Paakai o Puuloa

Iulai 25, 1860 (aoao 70)

Mai ka wa kahiko mai ua ike na kanaka maoli i ka hana ana o ka paakai; he mea ia e mikomiko ai ka ai; he mea kalepa no hoi; aole nae maikai loa ka paakai o Hawaii nei, aole pono loa ka bipi a me ka puaa I kopiia i keia paakai; ina e waiho liuliu, pilau no. I keia manawa nae, ua hanaia ka paakai ma Puuloa a maikai loa, kaawale na mea awaawa oloko; a ua loaa hoi ka wili e wali ai e like me ka palaoa, a e like hoi me ka paakai no na aina e mai; nolaila, ua makemake loa ia ka paakai o Puuloa i keia wa; he mea lawe i ka aina e, a he mea no hoi e waiwai ka aina.

The Salt of Puʻuloa

July 25, 1860 (page 70)

From ancient time, the natives have known about and made salt; it is that with which food is seasoned, and is also an item of trade; but the salt of Hawaiʻi is not very good, it is not the best for salting beef and salting pork. If it is left for long, it spoils.

But at this time, salt is made at Puʻuloa, and it is very good. The bitterness has been removed from within; a mill has been gotten and the salt mixed like flour, and like the salt of other lands; therefore, at this time, the salt of Puʻuloa is greatly desired. It is taken to other lands and it is a thing that brings prosperity to the land

By 1922, the Puʻuloa Salt Works expanded into making table salt in addition to traditional sea salt as demand increased. The following newspaper article explains the changes to the salt works' machinery and output:

Honolulu Star Bulletin

Salt Works on Oahu to Branch Out Into Shaker Salt Field

March 11, 1922 (page 11)

Following a policy of doing its share towards making the Hawaiian islands self-supporting—productive of all necessities of life possible—an industry few know exists on Oahu is being brought rapidly to a standard equal to the highest achieved by mainland plants.

By a limpid lagoon, just beyond Pearl Harbor where crystal waters are not contaminated by infusion of foreign substances, the Honouliuli salt works has been developing under the eyes of Honolulu yet few have seen.

Machinery is being installed now to take the industry out of its swaddling clothes—to graduate it from its infant drudgery of feeding ice-cream freezers and supplying demand for crystal and rock salt, into what is known in the trade as the shaker salt field.

Now the word shaker means, in the parlance of salt, something which will shake out of a shaker. So it is a step forward from ice cream freezers to the table.

The plant, producing crude salt is turning out some 55 tons weekly eight months of the year. The other four month overcast skies and rains minimize production. The product is largely due to the care taken in filling the tanks, which are washed, scrubbed and drained before pure sea waters are pumped in. The tanks are of cement. The element of dust and dirt eliminated by the scrubbing makes the product marketable for cruder uses immediately. A fleet of motor trucks is supplying island consumers.

The new machinery will convert part of this crude output into salt for table and kitchen uses, shaker and bag salt. The demand for coarser salt will not be slighted in expanding to enter the shaker salt filed. It is the intention of the men who have brought the industry into being, to increase its capacity as the consumption increases.

The new machinery is designed to shatter the crystals and process the salt so that, in the moist climate of the island coasts, it will not cake—in fact it is the intention of the company to produce a Hawaiian product that will compare on all points with the imported article, with the added feature of ocean freight eliminated.

Expert supply surveys have been conducted in the island from time to time to determine just what imports are necessary to make up the difference between local production of any food article and demands of consumers. It is estimated that the salt works, when under full swing, would be able to eliminate this item from freight lists. The plant is on a branch of the railway. The new unit of the plant will be in operation before summer.

3.3.2.2 Honouliuli-Puʻuloa Fisheries

The fisheries—those along the shore of the open ocean and in Keawalau o Puʻuloa (now Pearl Harbor) and along the shoreline—were among the highly valued resources of Honouliuli. With the transition in land tenure and land use that occurred following 1848, native residents of Honouliuli were steadily denied access to the traditional fisheries. Conflicts arose between Hawaiians seeking to maintain customary practices and the restricted access imposed by new landowners.

Mose, a native of Honouliuli, presented a public account in the Hawaiian language newspaper *Ka Hae Hawaii* of the distress that he and his companions, Isaaka and Makahanohano, endured in being denied access to the shore along Ke Awalau o Puʻuloa by a foreign tenant of the land, and ask the King if this action was authorized by him:

Ka Hae Hawaii

Poino.

Nowemapa 25, 1857 (aoao 139)

Eia ua wahi mea la. Ia makou i hoomaka ai e holo maluna o ka waapa mai Honouliuli aku a hiki i kahi i kapaia o Keawalau o Puuloa, pa mai la kahi makani ma kai mai, he maunuunu ko ke kaha, he olauniu ko Waikiki, he kukalahale ko Honolulu, hoohuli pono ae la makou i ka ihu o ka waapa me ka manao e holo aku i Honolulu i ke kuai ia, loaa iho la makou i ka poino. Eia no ia, ninau mai la kekahi haole ia makou, o Aigate kona inoa, Owai keia waapa? Hai aku la makou, O makou no. Ninau hou kela ia makou, Owai ka inoa? Hai hou aku la makou, O Mose, Isaaka, Makahanohano. Pane hou mai kela ia makou, Go way; be off kanaka. O ke kani koke mai la no ia o ka pu, a pee iho la makou i ka waha o ka waapa, helelei iho la ka lu iluna o makou, kani hou mai la ka pu, helelei hou iho la ka lu. Kena aku la au i koʻu mau hoa e hoe aku i ka waapa, aka, aole e hiki; no ka mea, ua loaa makou i ka pilikia; aka, no ka ikaika ana mai o ka makani ma kai mai, huki pono mai la makou i ke kaula, pei mai la i ka pei, poho aku la ka pea i ka makani, o ka holo aku la no ia o makou, a pakele makou i keia pilikia.

E! nani ke aloha o ko kakou Haku i ka lani,

Distress.

November 25, 1857 (page 139)

We departed from Honouliuli in our boat and arrived at the place called Keawalau o Puʻuloa, when a wind arose from the shore. It was the māunuunu of the coastal region — the ʻōlauniu is of Waikīkī, and the kūkalahale is of Honolulu. We turned the bow of our boat, intending to go to Honolulu to sell our fish, that is when we ran into trouble. A foreigner came up to us and asked whose boat is this, his name was Isaac. We told him it was ours. He then asked our names and we told him, Mose, Isaaka and Makahanohano. He then told us, "Go away, be off, Hawaiians. He then shot at us, and we quickly tried to hide in the bow of our boat. We tried to push off, but because of the wind from the sea, we had a difficult time. We finally got the sail up and we were able to get away from the trouble.

ka mea kokua i ka poe poino, nana no i hoopakele mai ia makou mai loko mai o keia popilikia.

Say, the love of our Lord is beautiful, the one who helps those in need, and who rescues us from our troubles.

Ninau.
Ina ua ae ia e ka Moi a me kona lalo iho, a i ole ia, e na makaainana paha e noho ana malalo iho o ka Moi, kona ki wale ana aku i kela kanaka keia kanaka, alaila ua pono; aka, ina aole, e hiki no iaʻu ke hoopii e like me ke kanawai o ka aina.

Mose.
Honouliuli, Ewa, 18 Nov., 1857

Question.
Did the King agree to this being done by those below him, or not. The commoners live below the King, and it is he who determines what is right for each man. I will seek to prosecute this pursuant to the law of the land.

Mose.
Honouliuli, ʻEwa. Nov. 18, 1857

3.3.2.3 Sisal Cultivation

Sugar was not the only crop on the Honouliuli landscape. The fiber plant, sisal (*Agave sisalana*), was also planted in the ahupuaʻa, with a large track around Puʻuokapolei down to the Kalaeloa vicinity. In February 1899, *The Hawaiian Gazette* reported that 75 acres had been planted, with intentions of planting 3,000 acres on land that had been leased from James Campbell.

The Hawaiian Gazette
On a Sisal Farm
New Enterprise on Land Near Ewa Plantation.
The Production of Hemp.
Progress Made by the Hawaiian Fibre Company – Outlook for First Crop is Good.

February 21, 1899 (page 2)

Twenty miles west of Honolulu there is today an infant industry, comparatively unknown, which at no very distant date will probably take a leading rank in the industries of the Islands.

Last April a company was formed, with Cecil Brown, president; Mark Robinson, vice president; W. C. Weedon, secretary and treasurer; A.H. Turner, manager. The object of the Hawaiian Fibre Co., as it was termed, was the cultivation and manufacture of all fibres. Sisal was the class of fibre principally thought of.

Now possibly everybody does not know what sisal is. Sisal is a fibre of the Agave family and flourishes chiefly in Yucatan and the Bahama Islands.

The Hawaiian Fibre Co., upon its organization, leased from Jas. Campbell 3000 acres of land for the purpose of the cultivation of sisal. This tract of land is twenty miles west of Honolulu, being two miles beyond Ewa mill and ten miles from Pearl city. It extends some distance mauka of the railroad track and on the other side clear to the sea.

It has not been many years since the first sisal plant was imported here with a view of another possible industry. Joseph Marsden imported a number form the Bahamas about five years ago and they were planted on a small piece of land this side [east] of Pearl City, where is a pond for one-half the year and dried mud during the other half. They did not thrive, and it was thought they needed more water, as much as sugar cane. Some were taken up and planted on one edge of Ewa plantation, near the railroad track, by Mr. Lowrie. This lot forms the nursery for the present company.

Sisal is a peculiar plant. It will thrive and flourish where nothing else will live; where even a mountain goat could not live, sisal will grow like a green bay tree; when it gets into soil that is rich and has depth, and where something else might possibly grow, it immediately declines and loses strength. It does not depend on the soil for nourishment. Given plenty of heat and sunlight a little moisture now and then, a stretch of rocky land and you have your model site for the cultivation of sisal.

The tract selected by the Hawaiian Fibre Co. is admirably suited for the purposes desired. It is rough, rocky and about as useless looking a piece of [ground] as one could find. It is not to be thought of in connection with sugar.

Today about seventy-five acres of land are under sisal cultivation. The plant on an average is about three feet in circumference, that is the bulb itself, and has no roots to speak of. The branches or fronds from which the hemp is extracted, grow to a height of from three and a half to five and a half feet, tapering off to a small needle like barb, and in all direction and angles.

The perpendicular fronds are never taken. They are not ripe. As they ripen they fall toward the ground and then they are ready to be cut and turned into hemp.

While the plant has no roots to speak of, it throws out numerous suckers, or feeders, in all directions, which turn into small plants. These take the life of the mother plant and are cut off. The small plants are used as nursery stock. It take about three years for a plant to mature. From thirty-five to forty fronds can be cut from one plant twice a year, with an average weight of one and a half pounds to the green frond. Take five percent of this amount and you have the amount of pure fibre obtained from one plant in a year.

The company has cleared and planted about seventy-five acres of land. A comfortable home for the manager has been built. Everything is well conducted and prosperous looking.

The main difficulty is to obtain the fibre from the plant. Extensive machinery is necessary, but the management intends to put up the machinery in time to reduce the first crop, which they expect to take off in about two years.

This is one of the new businesses of the Islands. The hemp industry is confined to a few places. It now seems that it will not be long before these Islands will take a leading, if not the leading place in the hemp industry.

Specimens of hemp which have been worked out by hand can be seen at this office.

In 1900, it was reported that 1,000 acres of Honouliuli were currently under cultivation. The goal was to make locally sourced sugar bags and other fiber products. *The Honolulu Republican* reported:

The Honolulu Republican
Sisal Fiber Plant Successfully Grown.
Three Thousand Acre Farm Near Pearl City.
Talk of a Factory Plant.
Annual Cost of Sugar Bags an Incentive to Manufacturing.
Rumor That the Great Oakland, California, Jute Machinery May be Moved Over Here.

July 28, 1900 (page 5)

Hawaii now expends nearly half a million dollars annually for jute bags, all of which ought to be manufactured here. The Republican is pleased to be able to say that the foundation has been laid for the establishment of works for the manufacture of sugar sacks, cordage and other products from fiber. The firm to carry out this work is the Hawaiian Fiber Company, Limited, which has a 3000-acre farm two miles west of the Ewa plantation, near Pearl City. The officers of this company are: Cecil Brown, president; M.P. Robinson, vice-president; W.C. Weedon, secretary and treasurer; and W. G. Ashley auditor. B.F. Dillingham and other prominent business men, as well as the Ewa plantation, are largely interested in the company, which is experimenting with sisal, a fibrous plant well adapted to this climate and barren and unproductive lands of the Islands.

The Hawaiian Fiber Company platted 1000 of its 3000 acres which it secured from the railroad company. Six hundred acres are fenced in with a stone wall built from stone taken from the land. Three hundred and two acres are cleared; 80,000 plants, or 215 acres, have been planted, and a manager's house and comfortable quarters for the laborers have been built. A well has been sunk and a good supply of water has been obtained. The work of clearing ground, laying out walks and erecting permanent stone fences is being pushed. The farm, or plantation, is called "Sisal Farm," after the name of the plant.

Sisal belongs to the aloes family. It is a desert plant and can be raised profitably on rough, rocky, coral flats, where a plow cannot be used—land unsuited and worthless for sugar growing or anything else. It can be grown without irrigation, although the fronds of the plant, from which the cordage is made, might be larger and plumper if the plants were irrigated. During the late dry and hot weather the 215 acres set to the plants have grown surprisingly well. Scarcely a plant was lost. It takes from two and a half to three years for the plants to mature from the suckers. From plants two and a half years old sisal fiber four feet in length has been obtained. The fiber was made by hand, and specimens of it were sent to experts on the mainland, who pronounced it unexcelled in quality by any sisal fiber grown elsewhere.

Sisal is different from Manila hemp. It is superior to hemp for marine or naval cordage. Two years ago prepared fiber brought in the market from 3 to 3 ¼ cents; now it fetches from 6 ¾ to 8 ½ cents a pound. The cutting of plants after they reach their growth occurs twice a year. When the lower fronds obtain a horizontal position they are ready for cutting. From sixteen to thirty fronds are taken from each plant. The process of poling continues for five to seven years. Each frond makes a separate fiber. After the fronds are cut the pulp is extracted and the fiber is washed and baled for the market. Here plants are set from nine to eleven feet apart. In Bermuda they are set much closer. The fronds of the plants must not touch each other. There is a hard, horn spike, sharp as a needle, on the end of each frond, and if they come in contact they scar and bruise and materially and injuriously affect the fiber. The company believes that this industry will become one of the most profitable industries of the Islands. Land valueless for any purpose can be utilized in growing sisal; the cost of production is nominal and no irrigation is necessary in its cultivation. There are many thousands of acres of land in the group that will grow sisal and nothing else.

The Hawaiian Fiber Company has now, reached a better than the experimental stage. The ability to grow sisal has been fully demonstrated, and the company is now considering the advisability of erecting a plant for the manufacture of the fiber. Persons who have given the subject study predict great things from this industry…

[Wray Taylor, Commissioner of Agriculture and Forestry, stated:] "Sisal comes from the Bahamas and will grow here on any old worthless lands."…

The importance of this industry is shown by the fact that the sugar industry alone consumes 4,800,000 bags at a cost of not less than $384,000. It is estimated that the crop for this year will reach 300,000 tons, requiring sixteen bags to a ton, at a cost of 8 cents a bag.

In 1903, *The Sunday Advertiser* published an article providing more details on the sisal plantation in Honouliui, identifying the OR&L station situated near the mill site by the name "Sisal." The article also included two photographs of the Honouliuli sisal mill and a plantation field (Figure 16).

The Sunday Advertiser
Sisal One of Coming Island Industries.
The Work of Building Up the New Idea.

January 25, 1903 (page 3)

"Bermuda sisal" they call it, although the best authorities assert that it is native to the Everglades of Florida, and it contains within its sword-shaped leaves something of the future of Greater Hawaii.

B.F. Dillingham, president of the Oahu Railway, took a party in his special car down over the road yesterday to Sisal station, just on the far side of the Ewa plantation, to see the beginning of the sisal industry in the Islands. It is but a beginning, although a most promising one. The special, leaving the city station at half past one in the afternoon, ran down fast through a rarely beautiful country—all the country hereabouts is beautiful—until the station for Oahu sugar plantation was reached, the station under the picturesque cocoanut trees that has been made famous because no amateur with a kodak has ever been known to pass it by without a shot.

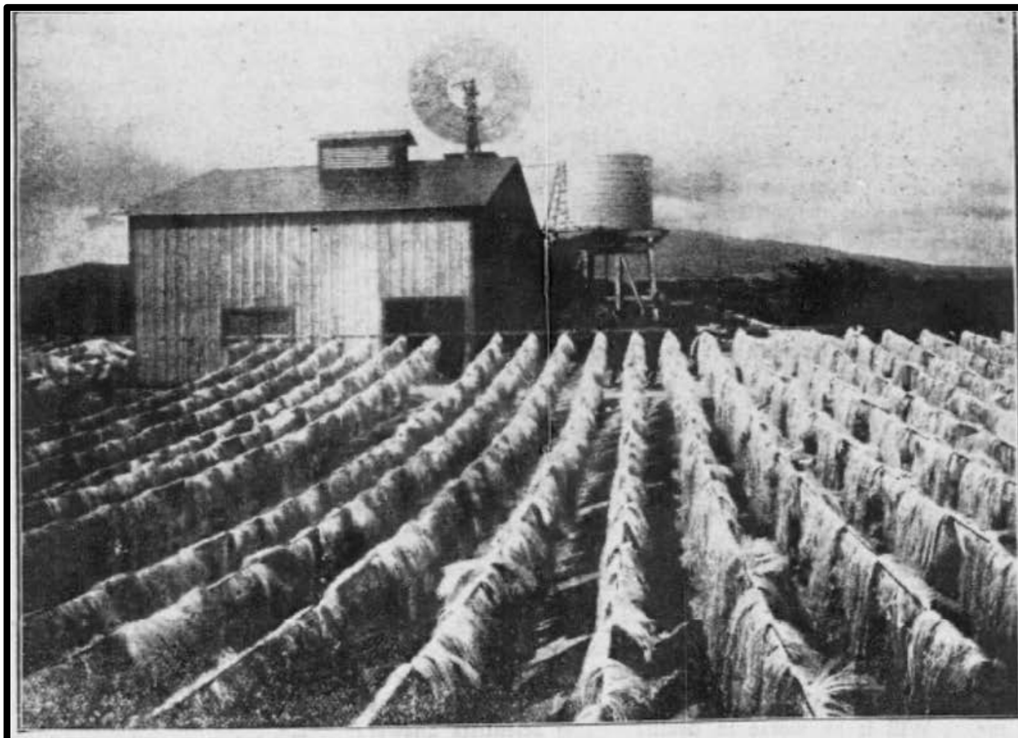
The party was shown over the Oahu sugar mill first, and, although most of them were old residents of the Islands, some were there who had never seen the golden wealth of the land turned out as it is turned out there. Then a busy little plantation locomotive came along, puffing, and took the special car out over the plantation roads to one of the big pumping plants, where from 15,000,000 to 18,000,000 gallons of water are raised every day to the top of a bluff over 400 feet high, and to another station where the big steam pump has been sunk into the earth to meet the rising artesian water–and that was a thing many of the party had not seen before.

The plantation locomotive went off about its regular business after that, and the special went whirling across the level land skirting Pearl Harbor, past the little Chinese rice fields and the great broad fields of waving cane, like oceans rustling with life, to Sisal. Presently the road led into a region of what seemed to be century plants, thousands and thousands of them standing stark upright in their thorny dignity, set out in straight rows and topping the weeds that they seemed to set themselves above as something exclusive and apart in the line of vegetation. And that was the sisal. Those spiny leaves, crushed for the fiber in them and dried, are worth just 8 ½ cents a pound in the market of San Francisco, and there is demand for all that can be produced. That is why the sisal holds in its heart a part of the future of Greater Hawaii, and probably a large part.

The sisal plantation and the small mill upon it are in charge of Superintendent A. B. Turner, and he is a man who knows his business and talks intelligently upon it. The little mill, the first of many large ones of the future, perhaps, was crushing the cut leaves of the plant, which were delivered at the door in carefully tied bundles of fifty by Japanese laborers. Each leaf went into the jaws of the crusher just as it came from the field. It came out in the form of bundles of glossy greenish fiber, which went out to hang on lines with thousands of its fellow, until the sun had bleached it white, when it would be spread on the ground for further bleaching, to be finally gathered and baled, as hay is baled, in which form it will go to the ends of the earth to be made into ropes and cordage and binding twine and all the things for which tough fiber is used in the hurry of modern life. For the sisal fiber is one of the toughest that is known, and ropes made from it might well be used to hold a weight for a man’s life.

“The sisal matures to the cutting stage in from three and a half to four years,” said Superintendent Turner, explaining the plant and the process to Mr. Dillingham’s guests yesterday. “The plant grows for from six to fifteen years before it flowers, as the century plant does. It is one of the aloes. After it flowers it dies, but it gives birth to many bulbs in flowering, and has produced much fiber before it reaches the stage of uselessness. We begin cutting it at the age of from three and a half to four years. Then, once we begin, the plant yields constantly. All the leaves are not taken at once, you understand. We take only those leaves from each plant that have reached the proper length, and then the remaining leaves on that plant take a straighter form until the time comes to cut that plant again. Thus, when a plant begins to yield fibre it keeps on producing until it dies. There is a constant succession of crops from it, and no cessation in the yield, because there are always plants in the cutting stage. A producing plantation produces all the time, and the men go about from plant to plant, always bringing on a crop.

“The sisal has the further recommendation that it grows on land too poor to produce sugar. In fact, sisal does not do best on land that is too rich. The fiber is too coarse, the growth being rank. We have 600 acres in this plantation, the plants being set out about 580 to the acre. I figure that we have about 300,000 mother plants, and about one million coming on from bulbs and sprouts. So that we can replace all our plants that dies as fast as they succumb to age. Also, we will eventually have lots of plants to sell. We are getting, as the plants stand now, about 1,000 pounds of fiber to the acre, which is good for a second crop. We will produce, this year, 100 tons of fiber, and will double that next. At the present price of fiber, the income should come not far from $18,000. Our mill has a capacity of 2,000 pounds daily, but is now handling only between 1,200 and 1,500 pounds per day.



DRYING YARD AT THE SISAL COMPANY'S MILL. (Photo by Williams.)

(Photo by Williams.)
CUTTING PLANTS ON SISAL PLANTATION AT SISAL, OAHU, NEAR HONOLULU.

Figure 12. The Sisal Plantation Drying Yard and Laborers Cutting Plants

> "And we have solved the labor problem, incidentally, in this industry. At least, we have scored a point that will aid in its solution so far as we are concerned. The sisal fiber can be cut and left lying in the field for six months, and it makes as good, clean fiber at the end of that time as when first cut. It is a pretty strong strike that would outlast that. Also, a peculiarity of the sisal is that when the mother plant flowers, all the suckers from it send up flower stalks, no matter what their age. So these must be taken up if they are to be saved."
>
> In the party taken out by Mr. Dillingham yesterday were A. B. Wood, W. W. Hall, W. G. Cooper, E. E. Paxton, John F. Bowler, J. O. Carter, M.P. Robinson, Isaac Dillingham, Dan Logan, Albert Raas, and T. C. Miller and ex-Governor John E. Osborne of Wyoming.

In 1904, *The Pacific Commercial Advertiser* reported:

> Five years ago the land near Barber's Point was so dry and 'waste' that it was good for nothing but 'bee pasture' during the few rainy months of the year. Last year it yielded a crop of sisal that paid a profit of twenty-five per cent or more. ("Proposed land exchange", 1904, p. 4)

While there was great interest in the sisal industry, by the 1920s, new manmade fibers were replacing locally grown sisal, which required large amounts of water for processing. This, added with the military condemnation of lands in around Pearl Harbor, led to the demise of the business.

3.3.3 Condemnation and Military Base Development by the United States

Throughout the early and mid-19th century, Hawaiʻi's sovereignty was threatened by the United States, which was interested in the booming sugar industry due to increased sugar pricing following the American Civil War. Businessmen and sugar growers in Hawaiʻi also sought a way to compete with the southern sugar growers of the U.S. As a result of this mutual desire, the Reciprocity Treaty of 1875 was established. This treaty was a "free-trade agreement between the U.S. and the Hawaiian kingdom that guaranteed a duty-free market for Hawaiian sugar in exchange for special economic privileges for the U.S. that were denied to other countries" (Britannica, 2023). While described as a "free-trade agreement," King Kalākaua was pushed into the agreement by the businessmen of Hawaiʻi, many of whom were children of missionaries and other foreigners who had taken up residency in the Hawaiian Kingdom.

The treaty was officially enforced on September 9, 1876 and granted the U.S. Navy the exclusive right to develop Pearl Harbor (Kuykendall, 1967). In the following article excerpt, Hawaiian historian Samuel M. Kamakau – translated by Mary Kawena Pukui – questioned the move towards the Kingdom relinquishing control of Puʻuloa (Pearl Harbor) to the U.S.:

Ko Hawaii Ponoi

Huikau, Pohihihi ke Kuikahi Panai Like me ka uku Kaulele o Puuloa.	**The haphazard, entagling Treaty of Reciprocity and the payment added of Puʻuloa.**
ʻAukake 20, 1873 (aoao 3)	**August 20, 1873 (page 3)**
No Ewa. He kaiwaenahonua o Ewa a me kona mau manamana muliwai halana, i hoopuniia e ka nina ma ko lakou mau mau aoao, a o ka nuku o na awalau, o Puuloa no la. O kona wahi haiki, aia mawaena o Kapuaikaula me Kapakule, he setadia paha a oi aku e emi mai. O ke ahua owaho o ka nuku, oia o Keaalii, aia malaila kahi papau, mai ka 9 kapuai a hiki aku i ka 10 ka hoohonu.	About ʻEwa. ʻEwa and its many bays are surrounded by land on most sides. The entrance to the Harbor is at Puʻuloa. Its narrowest point is between Kapuaikaula and Kapākule. It is perhaps a little more or less that a furlong across. The rise (submerged hillock) outside of the entrance is Keaʻaliʻi. There is a shallow place there, approximately 9 to 10 feet deep.
Eia kekahi hoakaka: Mai Keaalii i ke ahua o ka nuku o ke awa o Puuloa, e moe ana i ke kali awa komohana, a pili i Kapakule, a mai Kapakule a hiki i Kepookala, a mai Kepookala huli i ka mana muliwai o Kaihuopalaai, a o Kapapapuhi ma ka aoao komohana, a o ka mana muliwai ia o Honouliuli. O Amoe Haalelea ke konohiki nui o keia mana muliwai a me na konohiki liilii kaimoku papai.	Here is a description: From Keaʻaliʻi to the mound at the entrance of Puʻuloa harbor, there is a channel on the west, near Kapākule. Then [it runs] from Kapākule to Kepoʻokala. From Kepoʻokala one turns towards the estuary of Kaihuopalaʻai, and Kapapapuhi is on the west side. That is the branch of the estuary of Honouliuli. Amoe Haʻalelea is the chiefess, landlord of this section of the estuary, and the lesser landlords, who control the fishing boats.
Mai Kealii a kali awa o Kapakule a hiki i Kepookala a huli I ka aoao hikina a pili i ka welau hema o Mokuumeume e komo ana i ka mana muliwai o Komoawa, ua kapaia keia mana	From Keaʻaliʻi and the channel to Kapākule, and to the east, to the tip of Mokuʻumeʻume, is the estuary channel of Komoawa. This branch of the estuary is now called the Hālawa Branch. There are two titled landlords here, their highnesses Queen Emma and Ruth Keʻelikōlani.

muliwai, o ka mana o Halawa. Eluu konohiki, o na Mea Kiekie ka Moiwahine Emma, a o Ruta Keelikolani. Mai Kepookala a pili i ka lula komohana o Mokuumeume e pili ana i ka mana o Halawa, a pili I ka lae o Paauau a hiki i Kalaehopu, Kupahu, a me Halaulani; ua kapaia keia mana muliwai, o Waipio me Waiawa.	From Kepoʻokala, along the sheltered western side of Mokuʻumeʻume, along the Hālawa branch, and along the point of Pāʻauʻau to Kalaehopu, Kūpahu, and Hālaulani; this branch of the estuary is called Waipiʻo and Waiawa.
O na koaohiki nui alodio o keia mana muliwai, o Malaea li me ka pili no ia Ruta Keelikolani ke kau wahi.	The titled land lords of this section of the estuary are Malaea Iʻi and the relatives of Ruth Keʻelikōlani.
O kahi akea loa e piha ole ai i ke tausaai moku a oi aku, mai ka lae o Pipiloa a hiki i Mokuumeume, a malaila aku a hiki i Halawa e huli ana I ka akau, a o na aina ma ka akua, e huli aho o na Manana, o Waimano, o Waiau, o Waimalu malo, a Kalauao, a me Aiea. O Waimalu i ka ahupuaa nona o Mokuumeume.	This is an expansive place, not filled with thousands of boats and more, from the point of Pipiloa to Mokuʻumeʻume, and from there to Hālawa. Turning north are the lands of along the sheltered bays of Mānana, Waimano, Waiau, Waimalu, Kalauao, and ʻAiea. Waimalu is the land division to which Mokuʻumeʻume belongs.
Heaha ke kuleana o ka aupuni […] aku ai ia Puuloa, a ka Ewa I […] ke Kuikahi Panai Like? Aole maopopo iaʻu ke kuleana o ke aupuni.	What right does the government have in giving Puʻuloa and ʻEwa as payment for the Reciprocity Treaty? I know of no right that the government has.…

Immediately following the enforcement of the treaty, the U.S took no significant action on the harbor development. In 1888, it was reported that there were efforts by the U.S. Government to purchase the Waipiʻo Peninsula from the ʻĪʻī Estate (“Over the Oahu railway line”, 1888, p. 5). Following the overthrow of the Hawaiian Monarchy and subsequent annexation of Hawaiʻi to the U.S. in 1898, the U.S. Navy started to take action toward development and construction of the Puʻuloa harbor. These actions were partly due to conditions in the Philippines where the Spanish-American War was underway. In 1899, Lieutenant Pond, Commander of the U.S. Navy ship *Iroquois*, conducted a survey of island harbors and had the following recommendations for

Puʻuloa:

The Evening Bulletin
Navy and Pearl Harbor Lands

October 4, 1899 (page 1)

"…Now then as to harbor matters in general and Pearl Harbor in particular.
"You know that Pearl Harbor was conceded to the United States some time ago. Now that the flag of the United States flies over the islands, the appropriation of $100,000 has been made for dredging.

"This appropriation still stands, but it is insufficient and the Navy Department has recommended that nothing be done until a situation on land is obtained.

"When Pearl Harbor was conceded, the concession was made without any land and that is just where the big pilikia [problem] comes in now.

"The land all along the water front is owned by private parties and, when it was sought by the United States Government to purchase some of this, the parties concerned held their possessions at such an exorbitant price that it was decided to allow the matter to drop for a while.

"However, something may be done in the near future. The Bureau of Equipment has recommended to the government that condemnation proceedings be instituted against some of the land already referred to.

"The law of Eminent Domain is very clear here and if the lands are condemned they will be valued according to the taxation of previous years. There will be rigid kicks and court proceedings of course. Nothing more is to be expected. That is all I have to say in regard to harbor matters.…

On April 20, 1900, a bill was introduced into the U.S. Senate to construct a naval station at Pearl Harbor ("Pearl harbor", 1900, p. 6). The following entry details the land acquisition plans of the U.S., including securing the land on the "west side of channel," meaning Puʻuloa.

The Pacific Commercial Advertiser
A Naval Station.
Report on Pearl Harbor's Advantages.

June 27, 1900 (pages 1 & 3)

The following is a report of the Board of Naval Officers convened last March for the purpose of examining into the best locations for a naval station at Pearl Harbor, as presented to the chairman of the committee of naval affairs of the House of Representatives by the Secretary of the Navy:

Navy Department,
Washington, March 31, 1900…
Pearl Harbor can be successfully defended, rendering its anchorages safe from outside attack, and that it possesses a comparatively large deep-water anchorage, capable of expansion, if needed. And it should also be borne in mind that it is the only defensible harbor within the entire Hawaiian group. The board has, with careful consideration, approached the subject of improvement and reached its conclusions, keeping ever in mind the present and prospective needs of our country in this part of the world. The great expansion of American interests in the waters of the Pacific, as a result of recent events, has caused each point considered to be weighed carefully from every standpoint.

8. The board proceeds to answer the questions submitted by the Department's order, as follows:

(a) What land is it necessary and desirable to acquire in order to establish a naval station in Pearl Harbor, having in view the present and prospective needs of such a station.

The board recommends that for the purpose of establishing a naval station in Pearl Harbor, having in view the present and prospective needs of such a station, that the Government acquire the portion of the body of land shown on plan No. 1, accompanying, as Waipio peninsula, extending from the narrow neck marked with a blue line to the southernmost point of the peninsula, comprising to low-water mark, about 820 acres: also the body of land shown on plan No. 1, as Mokuumeume or Ford's Island, comprising to low-water mark about 370 acres, including the adjacent islets and the intervening shoal water.

9. The board is of opinion that under the general term naval station must be included the following: Dry docks, work and repair shops, a coaling station of large capacity with sheds, coal pockets, chutes, and sheltered anchorages or berthing space for tugs, lighters, etc.; extensive grounds for marine barracks, parade grounds, and a still larger area for drilling large bodies of sailors or marines, to which must be added ample camping ground for any

naval force that might be rendezvoused here in time of war. Considerable space will be needed for hospital accommodations with surrounding ground. Ample space, suitably selected, must be set apart for magazine purposes. All the above mentioned must be capable of expansion as our future naval needs may demand.

10. In selecting the two plots of ground above mentioned for naval purposes careful consideration has been given to the present commercial needs with possible great expansion, and there has been left free for commerce the entire main shore line within the entrance, several miles in extent, and situated where it is most likely to be of the greatest use. It may also be stated that of the two bodies of land decided upon as required for naval purposes, the Waipio peninsula was from personal observation chosen by Rear Admirals Irwin and Miller and Commanders Nichols and Merry in past years, but the present developments had not then been reached, and the board is of opinion that the area recommended by it is not in excess of Government needs, present and prospective. The Waipio peninsula lands recommended are from ten to thirty feet high and covered with algaroba trees. The thin alluvial soil is reported to be incapable of growing sugar cane except in certain spots “of small area, and then only by copious irrigation.”

To take this land would, therefore, cause little or no detriment to agricultural interests. For naval purposes this peninsula presents many advantages. Deep water channels surround it on nearly all sides, making it almost an island. It is, therefore, practically isolated from the mainland, and yet is connected with it by a narrow neck, assuring easy communication. The shores are clear of reefs, and bold water is found close to the shore line, thus minimizing the expense of probable wharf and dock construction and affording ample wharfage for a fleet of large and small vessels. The west loch and Walker Bay [Waipiʻo] would afford excellent shelter and anchorage for small vessels, while the middle channel and east loch would give good anchorage for the largest ships.

The prevailing winds in this locality are from northeast to east, making the eastern shore of the peninsula a weather shore. The winds are never so strong, however, but that fairly smooth water exists at all times. The “konas,” strong southerly and westerly gales, are said to occur at times in January and February, lasting from a few hours to two or three days, but never attaining a violence which would make anchorage in the harbor unsafe. The Oahu Railroad passes the head of the peninsula, and only a short spur would be required to reach the site of a dockyard over perfectly feasible ground. The neck of the peninsula, just above the sites recommended by Rear Admirals Irwin and Miller for a dry dock, is narrow enough to make it possible to locate repair shops and store houses near the probable dock site, convenient to vessels at the docks or anchorages on either side.

Ford's Island is chosen because of its proximity to deep-water anchorages of the greatest area for large ships, and being an island, it is peculiarly available for barracks for a strong force of marines and as sites for magazine, hospital and coaling docks. Its shores, like those of Waipio Peninsula, are for the most part easily accessible for large ships in going alongside wharves, which latter can be constructed at small expense. Its leeward or westward shore is particularly suitable for the location of coal storage houses and coaling wharves or piers. Good potable water in sufficient quantity for all the above purposes is reported to have been found on this island by sinking an artesian well, and from the fact that great quantities of fresh water have been found on the northern part of Waipio Peninsula and on the lands surrounding the harbor there is no reason to doubt that an all-sufficient amount can be obtained by the same means on the lower or main part of the peninsula. Water options are held, furthermore, by the present owners of the Waipio lands for the supply of water for irrigation purposes.

11. "(b.) What land is it necessary and desirable to acquire for defensive purposes of the harbor, channel and station?"

"(c) What land, if any, is it necessary and desirable to acquire from private parties to obtain the requisite facilities of ingress and egress?"

The board is of opinion that for clear explanation the queries under b and c can best be answered under one heading, and in so doing invites attention to plan No. 1, whereon is shown, below the Waipio Peninsula and at the entrance proper to the harbor, a certain body of land embraced on each side of the channel by a blue dotted line extending down the channel, thence eastward and westward, respectively, to a fixed point on the shore line. These two tracts of land the board recommends be selected for defensive purposes of the harbor, channel and station, and also for securing requisite facilities for ingress and egress.

12. The land lying along the line of the channel is selected in order to prevent any possibility of interference with the ultimate channel of navigation, which may in the future extend from shore to shore in this part of the narrow pathway. The wide areas nearer the shore line are intended for the emplacement of batteries to guard the entrance, to keep an enemy at a distance from the shipping within, for covering the mine fields, etc. The total area thus recommended to be acquired comprises about 690 acres. It may not be necessary that the acquisition of any of this area should in anyway interfere with or cause the removal of any existing private improved properties lying within the

boundaries; but the board desires to call attention to the very great importance of the Government acquiring an absolute title to the same and of holding it in fee simple forever. This done, permission may be granted for improvement, subject to war necessities as to their removal or destruction without damage to the Government, as is done within the reservation of Fortress Monroe.

13. For the purpose of securing easy and convenient access to all of the above land recommended to be purchased for Governmental use the board recommends that sufficient right of way, not less than 100 feet in width, should also be purchased for Government use, extending from the naval station to such public roads and railroad as may be considered most desirable.

14. "(d) What are the best methods for acquiring the above mentioned land?"
The board recommends that all of the above mentioned lands be acquired by condemnation under the law of eminent domain of the civil laws of the Hawaiian Islands, a copy of which is appended, marked "C." …

23. Regarding the value of the lands recommended to be acquired. —From the data placed before the board in the shape of reports, assessed values of land as given by the assessor in 1899, records of options offered, and taking into consideration the Hawaiian law of eminent domain, the board is of opinion that the following values should obtain:

Waipio Peninsula, about 820 acres, assessed at $25,000 in 1898, and adding 20 per cent	$30,000
Ford's Island, about 370 acres, assessed at $20,000 in 1898, and adding 20 per cent	24,000
Land on east side of channel [Hālawa], about 305 acres, at $20 per acre, plus 20 per cent	7,320
Land on west side of the channel [Puʻuloa], about 385 acres, at $50 per acre, plus 20 per cent	23,100
Total	$84,420

No accurate estimate can be made at this time of the amount of damages, if any, done to adjoining property through the condemnation of these lands, nor as to the value of fishing or riparian rights, or for the amount necessary to secure a right of way to highways and railroad, through lack of definite data bearing on these subjects. For these objects as well as to pay for improvements at present on some of the land recommended for purchase,

> it is thought that at least $150,000 should be made available for acquiring ownership and for all rights and damages.…

The early Navy activities centered around development of a coaling and repair station for naval ships. In 1901, Walter F. Dillingham's recently founded Hawaiian Dredging Construction Company was awarded the contract to dredge the channel. That same year, the U.S.S. *Iroquois* was the first naval ship to enter the harbor; it is for this naval vessel that the Puʻuloa point is now called "Iroquois Point." In 1908, additional funding was released by Congress to deepen the channel and construct a massive dry dock and various support facilities ("The measure passes", 1908, p. 2). On December 14, 1911, dredging was officially completed on the interior lochs, and the flagship U.S.S. *California* steamed into the harbor.

On February 17, 1913, disaster struck when Drydock No. 1 collapsed, and four years of work was lost. Native families of the ʻEwa moku attributed the disaster to the shark god Kahiʻukā (the smiting tail). Engineers attributed the collapse to unstable earth and adjusted their plans, reengaging in construction of the drydock, which was completed in 1919.

In the 1920s, the U.S. Navy leased 206 acres of land on the ʻEwa Plains from the Campbell Estate, and a Honolulu contractor was hired by the Navy to clear the land to build a Mooring Mast and Emergency Landing Field (ʻEwa Mooring Mast Field or ʻEwa Field) for dirigibles (Helber Hastert & Fee, 2008). This facility was used until the early 1930s and then was dismantled and became part of the ʻEwa Marine Corps Air Station at Barbers Point (MCAS ʻEwa) (Tuggle & Tomonari-Tuggle, 1997). The airfield formed a large "X" and was nearly finished in 1941, when it was bombed by Japanese invaders, triggering U.S. involvement in World War II.

On December 7, 1941, the MCAS ʻEwa was one of the first military targets that was bombed by the Japanese in Hawaiʻi (Frye & Resnick, 2013). Numerous aircraft were destroyed, but other facilities of MCAS ʻEwa were largely unharmed (BuDocks, 1947, cited in Helber Hastert & Fee, 2008). The Battle of the ʻEwa Plain included ʻEwa Field, ʻEwa Villages, and ʻEwa Beach. During and after the battle, military and civilians worked together closely to fight, defend, recover, and rebuild their community (Frye & Resnick, 2013).

Between 1921 and 1944, the U.S. Military acquired an additional 3,500 acres of land from the Campbell Estate and constructed the Barbers Point Military Reservation (Battery Barbers Point) as a training area, which consisted of multiple locations such as Camp Malakole Military Reservation (Honouliuli Military Reservation) and Gilbert Military Reservation. Fort Barrette (Kapolei Military Reservation and Battery Hatch) was built on top of Puʻuokapolei as a coastal defense station. Fire control stations were established on top of Puʻu Makakilo (Fire Control

Station A) and Puʻu Pālailai (Fire Control Station B), as well as Mooring Mast Field, which was an auxiliary airfield for the Marine Corps Air Station and the Naval Air Station at Barbers Point (NASBP) (Tuggle & Tomonari-Tuggle, 1997).

During World War II, the military also found use for the OR&L system; in 1944, the plantation manager reported: "We have continued to haul large quantities of ammunition over our railroad tracks and are continuing to supply the Armed Forces with buildings and electricity" (Conde & Best, 1973, p. 282). Following World War II, new heavy vehicles were being manufactured and use of the trains for hauling was becoming obsolete. In 1947, the plantation manager's report observed:

> For over fifty years we have depended upon the reliable and efficient service of the Oʻahu Railway & Land Co. to transport our sugar, molasses and supplies. We regret it has been necessary for them to terminate this service at the end of 1947 (Conde & Best, 1973, p. 315).

The last load of sugar cane came in by rail from the fields on November 14, 1950. The OSC manager noted that by the end of 1951, "transportation of the entire crop from field to factory was done for the first time, the railroad being eliminated" (Conde & Best, 1973, p. 316).

After World War II, during the Cold War building period, activities increased at NASBP and it became famous for its Navy patrol squadrons, including Rainbow Fleet and Pineapple Airlines (Helber Hastert & Fee, 2008). NASBP was used as the main Pacific Air Station responsible for all Pacific Naval air operations (Tuggle & Tomonari-Tuggle, 1997). In 1949, the MCAS ʻEwa was absorbed into the NASBP and all marine activities moved to Kāneʻohe.

In 1965, the formal U.S. Coast Guard Air Station Barbers Point was established. Several of the recreational facilities were erected to serve the base's diverse roles, including a larger airplane parking apron, residential communities, a golf course, and beach cabins along Nimitz Beach (Tuggle & Tomonari-Tuggle, 1997). The NASBP base played a role in both Operations Desert Shield and Desert Storm. NASBP reached a maximum size of 3,679 acres before it closed in 1999 (Helber Hastert & Fee, 2008). The base is now referred to as the traditional place name, Kalaeloa, and includes only 1,166 acres of land in five noncontiguous areas.

Since the deactivation of NASBP, the State Department of Defense, Department of Transportation, Department of Hawaiian Home Lands, and the University of Hawai'i acquired several acres of land in the area. The airfield was reopened in 1999 as a state regional airport and is now referred to as both Kalaeloa Airport and John Rodgers Field. The airport is used by the U.S.

Coast Guard (Air Station Barbers Point), Hawaii Community College Flight Program, Hawaiʻi National Guard, and the general aviation community. The airport also serves as the base for HC-130 “Hercules” long-range surveillance aircraft, HH-65 short-range recovery helicopter, search and rescue, and emergency response operations.

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4 Cultural Resources

The following research and analyses appropriately study the history and cultural resources of Honouliuli, focusing on the project area and the surrounding environment. Due to modifications made to large portions of the ʻEwa Plain for commercial agriculture, little is known of traditional land use in the project area. Based on archaeological evidence and historic accounts, it is believed that the traditional population was focused along the coastline and in the stream valleys and estuaries along the western side of Pearl Harbor.

4.1. Historic Properties and Cultural Sites

Based on a review of literature from SHPD, there are no known historic sites within the Project Area. The closest known cultural resources are three precontact sites approximately 700 yards north of the proposed action area on the coast: beach midden site (SIHP Number 50-80-12-02722) and two subsurface cultural deposits (SIHP Number 50-80-12-04526).

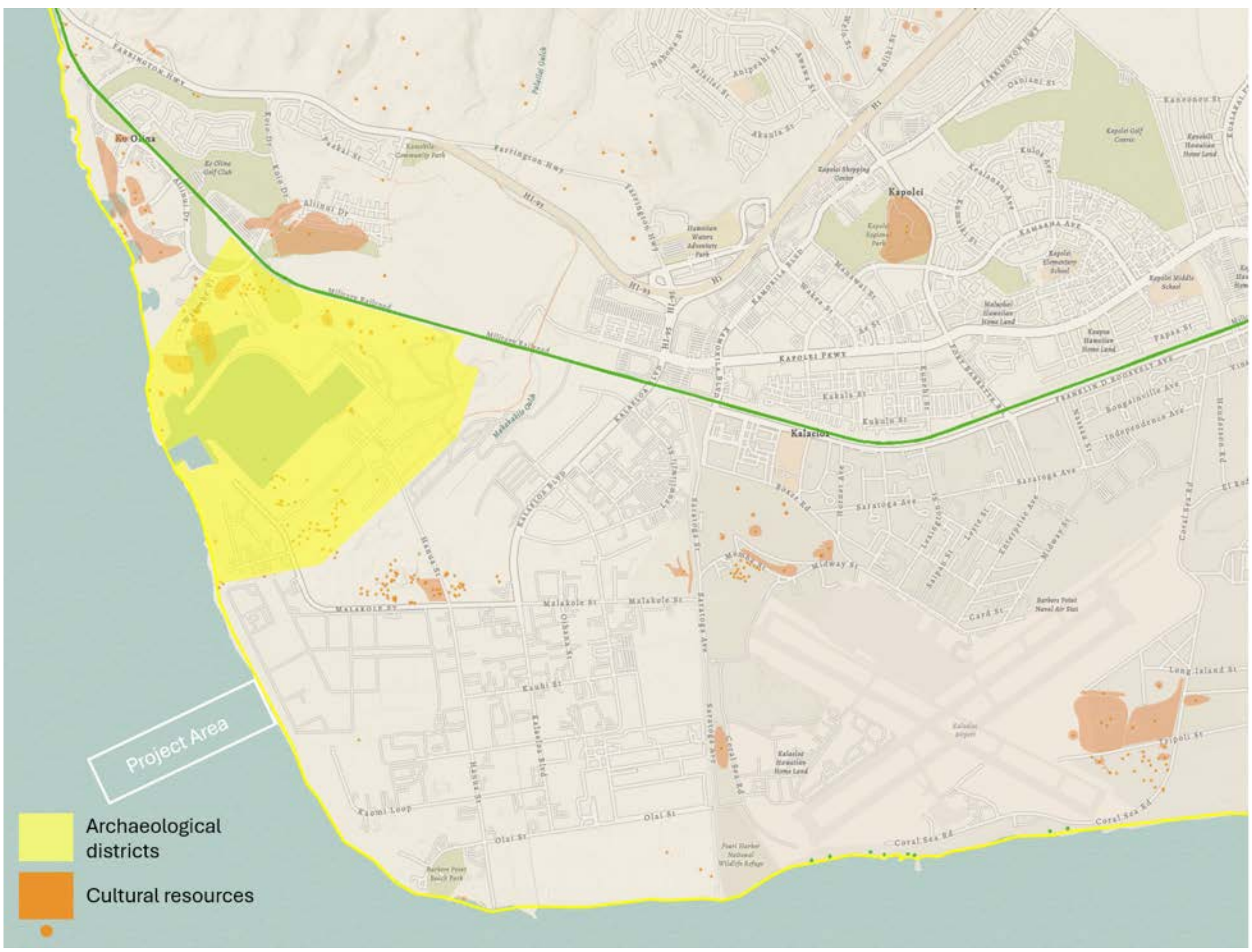

Figure 13. Archaeological districts in Honouliuli with project site overlaid (adapted from (Wahl 2021)).

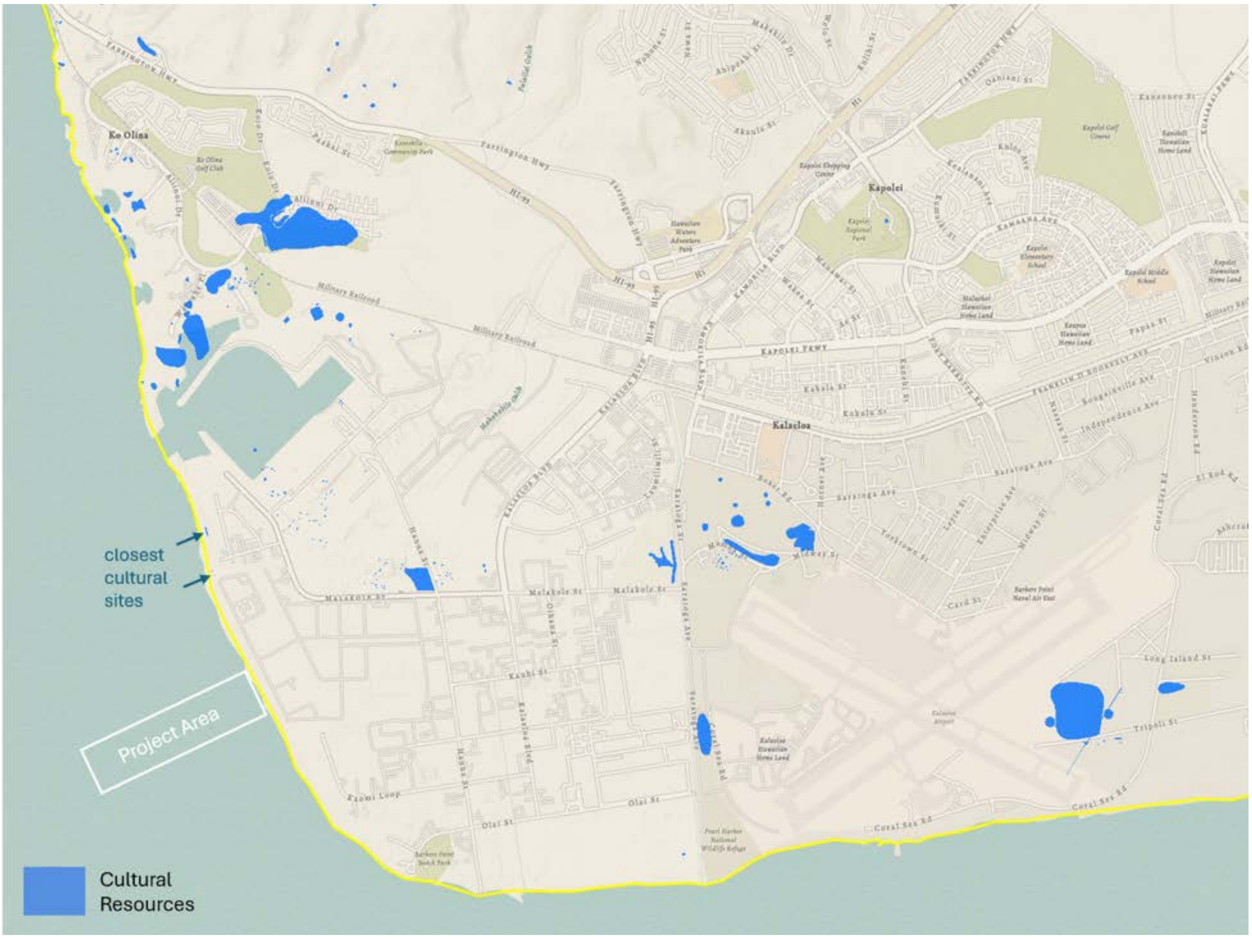

Figure 14. Traditional Hawaiian sites in Honouliuli with project site overlaid (adapted from (Wahl 2021)). Closest cultural resources denoted with arrows.

Puhilele has been newly identified from historic maps as a possible historic site within the Kalaeloa cultural landscape and is further evaluated in Section 5.7 of this assessment. The site lies 0.83 miles (1,334 meters) east of the eastern boundary of the Project Area. Puhilele may have been associated with kilo practices—observational activities carried out by cultural practitioners to monitor the environment, celestial patterns, and seasonal changes. In Hawaiian tradition, kilo were essential for determining the timing of fishing, planting, and ritual events, and particular coastal locations were favored for their broad views of the horizon and the sea.

Although limited archaeological data are currently available for Puhilele, its potential significance lies in this association with kilo. The area has been surveyed (Sinoto, 1978) and relevant association are discussed in Section 7.3 of this assessment. If confirmed, the site would represent a cultural node where intangible knowledge practices intersected with the physical landscape. The documentation in Section 5.7 explores the role of Puhilele in regional observation networks and its importance within Kalaeloa's broader cultural setting and an evaluation of the site is provided in Section 7.3.

The Project Area is also within the general proximity of Puʻukapolei, the state's first designated Traditional Cultural Property (TCP) and the ʻEwa Coral Plains. Neither are in close enough proximity of the site to be impacted by the project and other than the identification provided below, are not further analyzed.

4.1.1 Puʻuokapolei

Samuel M. Kamakau penned hundreds of articles as letters and in serial form, in which he documented Hawaiian history through traditions, personal experience, and in observations of the history unfolding around him. On February 10, 1870, Kamakau explained the history and reckoning of periods of time through the ancient Hawaiian year. In this account, he shares that Puʻuokapolei and Mahinaona on the kula lands of Honouliuli were the markers of the changing seasons. The original Hawaiian texts follow, with a new translation adapted from the translation of Mary Kawena Pukui (Kamakau, 1976, p. 14):

…O ka poe helu a hooponopono i na malama o ka makahiki, o ko Oahu poe kilohoku a me ko Kauai ka poe akamai loa i ka hooponopono ana, a me ka mahele pono ana i ke ano o ka la, o ka mahina a me na hoku, a me ka papa hulihouna o ka aina, a me na hoku, a ua kapa ia ia poe o ka poe kuhikuhi puuone, a me poe kilo hoku holo moana, a o ka poe helu e noho ona ma Waimea i Kauai.	…Of the people who kept administered the accounting of the seasons of the year, those observers of the heavens from Oʻahu and Kauai were extremely knowledgeable in reckoning, and the correct division of the character of the sun, the moon, and the stars, also in the study of the earth and stars. These people were known as the experts in discerning the nature of the land, the navigators and observers of the stars. They were the observers who went and resided at Waimea, Kauai.
I ke kupono ana o ka la ma ke alanui polohiwa a Kane, a nee ka la i ka akau a paupono ka la i Kaula, a nee ka la a kau i Kawaihoa, a no ke kau ana o ka la ma Kaula a kau i Kawaihoa, a nolaila i kapaia aku ai kekahi inoa o Makalii o ke Kau, a no Kaulana a Kane kekahi ikapaia aku ao o ke Kau, a no ke kau ana o ka la i Kaula a nee ka la i ka hema, a ua kapaia o ke Kau Hooilo, a pela ko Oahu poe helu, no ke kau ana o ka la i Puuokapolei, a kau ka [la] i ke kawaha o Mahinaona, ua kapa ia	When the sun reached the equator, and the sun traveled to the north and stopped right over the islet of Kaula, moving above Kawaihoa, it was then known by the names "Makaliʻi o ke Kau" or "Kaulana a Kāne," others called it "Kau," for the setting of the sun at Kaula. When it moved to the south, it was called Kau Hoʻoilo. When the observers of Oʻahu saw the sun above Puʻuokapolei, the sun set above the mouth of Mahinaona, it was called Kau. When the sun moved

> o ke Kau, a mai Puuokapolei a nee ka la i ka hema, a no ke kau o ka la i ka hema, a no ka hiki ana mai o ke anu, a no ka hoolio ana o ke kupu o na oliko o na mea ulu he oilo ia, ua kapaia ke kau o ka hooilo, a nolaila, elua no kau o ka makahiki. O ke Kau Makalii, a o ke kau Hooilo…
>
> south, and set in the south; when the cold arrived, and the sprouting of the shoots and reddening buds of growing things sprouted, it was called Kau o ka Hoʻoilo. Therefore there were two seasons in the year, the Makaliʻi (summer) season, and the Hoʻoilo (winter) season…

Several early writers undertook surveys of cultural sites and heiau on Oʻahu. In T.G. Thrum's *Hawaiian Annual and Almanac for 1907*, it was reported that a heiau had been located on or near Puʻuokapolei. Thrum (1906) observed a heiau on "Kapolei hill, Ewa – Size and class unknown. Its walls thrown down for fencing" (p. 46).

In the early 1930s, J.G. McAllister undertook an archaeological-ethnographic survey on the island of Oʻahu for the Bishop Museum. Regarding the heiau at Puʻuokapolei, McAllister (1933) reported:

> Site 138. Puu Kapolei heiau, on Puu Kapolei hill, Honouliuli.
> The stones from the heiau supplied the rock crusher which was located on the side of this elevation, which is about 100 feet away on the sea side. There was formerly a large rock shelter on the sea side where Kamapuaa is said to have lived with his grandmother. (p. 108)

Puʻuokapolei was later covered in World War II military features, but still retains cultural significance to Hawaiians as a traditional cultural property.

4.1.2 ʻEwa Coral Plains

The project area is located west of the old the ʻEwa Coral Plain. McAllister (1933) summarized how the coral plains of Honouliuli may have been used in historic times:

> Site 146. Ewa coral plains, throughout which are remains of many sites. The great extent of old stone walls, particularly near Puuloa Salt Works, belongs to the ranching period of about 75 years ago. It is probable that the holes and pits in the coral were formerly used by the Hawaiians. Frequently the soil on the floor of the larger pits was used for cultivation, and even today one comes upon bananas and Hawaiian sugar cane still growing in them. They afford shelter and protection, but I doubt if previous to the time of Cook there was ever a large population here. (p. 109)

4.2 Natural Resources with Cultural Significance

To employ the Hawaiian landscape perspective and emphasize the symbiosis of natural and cultural resources, Honua Consulting uses the term “biocultural” to refer to natural and cultural resources, with additional sub-classifications by attributes.

This section discusses the natural resources within the project area, specifically those natural resources that may have cultural significance or use. These natural resources were identified through the biological assessment prepared for the project and through primary research into historic resources.

Further, a brief discussion of environmental zones and traditional Hawaiian land management practices is necessary to understand the tangible and intangible aspects of the Hawaiian landscape. Additionally, it is important to specify again that in the Hawaiian landscape, all natural and cultural resources are interrelated and culturally significant. Natural unaltered landscape features such as rocky outcrops, cinder cones, intermittent streams, or an open plain can carry as much significance as a planted grove of wauke (*Broussonetia papyrifera*) or a boulder-lined ʻauwai (canal).

Maly (2001) presents a narrative of traditional Hawaiian land management strategies and the different environmental zones recorded in *Ka Hoku o Hawaii* (September 21, 1916):

> Hawaiian customs and practices demonstrate the belief that all portions of the land and environment are related, like members of an extended family, each environmental zone was named, and their individual attributes were known. Acknowledging the relationship of one environmental zone (wao) to another, is rooted in traditional land management practices and values. Just as place names tell us that areas are of cultural importance, the occurrence of a Hawaiian nomenclature for environmental zones also tells us that there was an intimate relationship between Hawaiians and their environment.
>
> The native tradition of Ka-Miki provides readers with a detailed account of Hawaiian land divisions and environmental zones. While competing in a riddling contest at the court of the chief, Palikū-a-Kīkoʻokoʻo, the hero, Ka-Miki sparred with Pīnaʻau, the foremost riddler of the district of Hilo Palikū (northern Hilo). The riddles covered topics describing regions from the mountain tips to the depths of the ocean, and descriptions of kalo (taro growth), the ala loa (trail systems), and nā mea lawaiʻa (fishing practices). As the contest unfolded, it was seen that each of the competitors were well matched. In one of the riddles, Ka-Miki described the various regions of the island of Hawaii, extending from the mountain to the sea. Ka-Miki then told his opponent, that if he could rise to the challenge

of answering the riddle, his knowledge could be compared to one who has ascended to the summit of the "mauna o Paliahu" (mountain of Poliʻahu, or Mauna Kea).

Through one of the riddles [the] reader learn[s] about the traditional wao or regions of land, districts, and land divisions of the administrators who kept peace upon the land. The environmental zones include:

1 – Ke kuahiwi; 2 – Ke kualono; 3 – Ke kaumauna; 4 – Ke ku(a)hea; 5 – Ke kaolo; 6 – Ka wao; 7 – Ka wau maʻu kele; 8 – Ka wao kele; 9 – Ka wao akua; 10 – Ka wao lāʻau; 11 – Ka wao kānaka; 12 – Ka ʻamaʻu; 13 – Ka ʻāpaʻa; 14 – Ka paheʻe; 15 – Ke kula; 16 – Ka ʻilima; 17 – Ka puʻeone; 18 – Ka poʻina nalu; 19 – Ke kai kohola; 20 – Ke kai ʻele; 21 – Ke kai uli; 22 – Ke kai pualena; 23 – Kai Pōpolohua-a-Kāne-i-Tahiti.

1 – The mountain; 2 – The region near the mountain top; 3 – The mountain top; 4 – The misty ridge; 5 – The trail ways; 6 – The inland regions; 7 and 8 – The rain belt regions; 9 – The distant area inhabited by gods; 10 – The forested region; 11 – The region of people below; 12 – The place of ʻamaʻu (fern upland agricultural zone); 13 – The arid plains; 14 – The place of wet land planting; 15 – The plain or open country; 16 – The place of ʻilima growth (a seaward, and generally arid section of the kula; 17 – The dunes; 18 – The place covered by waves (shoreline); 19 – The shallow sea (shoreline reef flats); 20 – The dark sea; 21 – The deep blue-green sea; 22 – The yellow (sun-reflecting sea on the horizon); and 23 – The deep purplish black sea of Kāne at Tahiti. (p. 3)

4.2.1 Flora

The project area offshore Kalaeloa encompasses a shallow nearshore reef environment characterized by native corals, seagrass, and marine algae, along with culturally significant limu species. Though coral cover in the action area has been described as low due to sedimentation, the deployment of reef-mimicking structures (RMS) and associated coral nursery activities are expected to enhance conditions for coral growth, limu propagation, and the return of other culturally important marine flora.

Corals are foundational to Hawaiian nearshore ecosystems and central to cultural identity. Surveys identified non-encrusting coral colonies within the proposed action area, primarily *Porites lobata* (lobe coral) and *Pocillopora meandrina* (cauliflower coral). These colonies will be salvaged and outplanted to the hybrid-reef structures following established protocols.

Culturally, corals are viewed as kinolau (physical manifestations) of deities and are integral to reef health, fish aggregation, and shoreline protection. Transplanting and propagating coral colonies maintains both ecological integrity and cultural continuity.

While no extensive seagrass beds were mapped in the immediate deployment footprint, the project area is within the depth profile (0–20 m) proposed for green sea turtle (honu) critical habitat, which relies on seagrass and algal resources. Native seagrasses, such as Halophila hawaiiana, are rare but ecologically valuable in Hawaiʻi and provide food for honu. Though sparse in this specific action area, monitoring will continue to ensure protection of any seagrass patches encountered. Marine algae are more prominent and include several species of native limu, which hold extraordinary cultural significance.

Native Hawaiian practitioners recognize limu as essential not only for diet but also for ceremony, medicine, and stewardship practices. Limu is used in lāʻau lapaʻau (traditional medicine), for seasoning food, and in customary celebrations such as hānai (feeding rituals). The project may incorporates active outplanting of native limu species, supported by the Division of Aquatic Resources' Anuenue Hatchery. This effort ensures the return of culturally valued species such as limu kala (*Sargassum echinocarpum*), used in hoʻoponopono (ceremonial reconciliation), and limu ʻeleʻele (*Enteromorpha spp.*), commonly eaten with fish.

Although the nearshore reef ecosystem does not directly support canoe plants, these species frame the cultural landscape inland of the project area and contribute to a holistic understanding of ecological connectivity. Niu (coconut), for example, lines the Kalaeloa shoreline and remains at risk from the coconut rhinoceros beetle. Coconuts provide fiber, food, water, and ceremonial resources. Inland, kalo (taro) and ʻuala (sweet potato) represent staple crops tied to ahupuaʻa management systems that once extended from upland Honouliuli to the reef. Their presence underscores the continuity between terrestrial planting traditions and the marine resources now under restoration.

4.2.2 Fauna

The nearshore environment of Kalaeloa and the greater ʻEwa coastline has historically supported a rich diversity of marine fauna. These resources were central to the lifeways of Native Hawaiians, shaping subsistence, ceremony, and kilo (observation, see Section 5.7) practices. The abundance of fish, invertebrates, marine mammals, and seabirds enabled thriving communities to sustain themselves along this leeward coast. Archaeological findings confirm that shellfish, fish, and other marine resources were staples, while oral traditions emphasize their cultural and spiritual resonance. Today, despite ecological degradation from military use, industrial activity, and shoreline alteration, the area continues to harbor species of cultural concern. This section identifies the major fauna associated with Kalaeloa, highlights their cultural and ecological importance, and considers conservation implications for the proposed project.

4.2.2.1 Fish Species

Fish species are of particular concern due to their importance with fishing traditions. Fish abundance data could not be fully collected due to limited visibility during the surveys. Observers noted low densities of fish within the project footprint, and the few individuals sighted were difficult to identify. Nevertheless, the coral species documented are known to provide critical habitat for juvenile reef fish, particularly *Pocillopora* species, which serve as shelter for recruits. The forthcoming fish survey data will provide greater clarity on species composition and abundance associated with the proposed structures. The following species are known to utilize the area as habitat and are therefore identified as possibly being in the Project Area.

ʻAmaʻama (Mugil cephalus, Striped Mullet)

The striped mullet, or ʻamaʻama, is one of the most culturally and economically important fish in Hawaiian history. ʻAmaʻama were prized as a staple food, eaten fresh, salted, or dried, and were essential in both daily diets and ceremonial feasts. Their migrations (*ʻanae holo*) along the leeward coast, including Kalaeloa, were seasonal events that guided communal fishing practices. Oral histories describe families gathering in large numbers to net mullet during runs, reinforcing the collective nature of lawaiʻa (fishing). Archaeological deposits in ʻEwa consistently contain mullet bones, underscoring its prominence in subsistence.

Culturally, ʻamaʻama carried deep meaning as a fish that moved between fresh and saltwater, embodying the interconnectedness of land and sea. Their migrations were used to track seasonal cycles and align planting and harvesting with marine abundance. Concerns raised during consultation highlight the enduring value of mullet, with fears that any disruption to migration or spawning would undermine subsistence and cultural continuity. Scientifically, studies suggest that mullet can navigate around obstacles such as breakwaters, but ongoing monitoring of ʻamaʻama behavior is essential. Protecting this species is central to maintaining community trust in the project.

ʻŌpelu (Decapterus spp., Mackerel Scad)

ʻŌpelu were traditionally caught using collective techniques, including the placement of koʻa (fishing shrines) to attract and school the fish. Fishermen often fed the schools with ʻakiʻaki algae to keep them near shore, demonstrating an intimate ecological knowledge and reciprocal relationship. ʻŌpelu were valued for both subsistence and ceremonial purposes, often served at important gatherings. The schooling behavior of ʻōpelu made them a communal fishery, reinforcing social bonds within fishing communities.

In modern times, ʻōpelu remains significant in certain regions of Hawaiʻi, though less abundant off ʻEwa. Their presence in Kalaeloa waters connects contemporary fishers to ancestral traditions. Conservation of reef habitats indirectly benefits ʻōpelu by supporting the planktonic ecosystems on which they rely. Including ʻōpelu in biodiversity monitoring acknowledges their enduring cultural role and the desire to revitalize practices tied to collective fishing.

ʻŌio (Albula spp., Bonefish)

The ʻōʻio, or bonefish, occupies shallow sandy habitats along the coast, making Kalaeloa's nearshore environment particularly suitable. ʻŌio were a valued subsistence fish, eaten raw or cooked, and feature in chants and stories as agile swimmers symbolic of vitality. They were often prepared into fish cakes, sustaining coastal communities during times of abundance.

Archaeological sites frequently yield ʻōʻio bones, demonstrating their role in prehistoric diets. For contemporary fishers, ʻōʻio has also become a prized catch in recreational fly fishing, though in Hawaiian tradition the emphasis remained on subsistence. The sandy patches at Kalaeloa, highlighted in community consultations, are especially important as habitat for ʻōʻio and related species. Protecting these areas safeguards both ecological function and cultural memory of ʻōʻio as a dependable resource.

Moi (Polydactylus sexfilis, Pacific Threadfin)

Moi was historically considered a chiefly fish, reserved for aliʻi as a symbol of status and abundance. This association with royalty made moi a highly regulated resource, tied to kapu that restricted access to commoners. Moi were raised in loko iʻa (fishponds) as part of advanced aquaculture systems, reflecting their high value and the ingenuity of Hawaiian resource management.

Culturally, moi symbolized chiefly power and stewardship, and they were often presented at ceremonies as tribute. Archaeological evidence of moi is less common than mullet or goatfish, but its symbolic resonance was profound. Today, moi is commercially farmed, but wild populations still hold significance for subsistence fishers. Ensuring habitat for moi near Kalaeloa acknowledges its dual role as a food source and cultural emblem of chiefly authority.

Akule (Selar crumenophthalmus, Bigeye Scad)

Akule were a staple of collective net fishing, often caught in large schools near shore. Communities coordinated torchlight fishing at night, using the fish's tendency to school in shallow bays to their advantage. Archaeological deposits at ʻEwa sites frequently contain akule bones, affirming their dietary importance.

Culturally, akule fisheries were communal, reinforcing reciprocity and cooperation. Large catches were shared among ʻohana, ensuring food security. Akule continue to be an important fish for subsistence and local markets, with seasonal runs eagerly anticipated by lawaiʻa. Monitoring their presence in the Kalaeloa project area ensures continuity of these traditions.

Weke (Mulloidichthys spp., Goatfish)

Goatfish, or weke, were another cornerstone of Hawaiian fisheries. Weke were prized for their taste and versatility, eaten fresh or preserved. Their spawning runs were well-known, and fishers carefully observed seasonal cycles to maximize harvests.

Culturally, weke carried ritual significance. In some traditions, red goatfish (weke ʻula) were used in ceremonies and offerings. Their prominence in moʻolelo underscores their symbolic and practical importance. Archaeological evidence supports their role as a major food source. Protecting nearshore habitats at Kalaeloa contributes to sustaining goatfish populations and maintaining continuity with these traditions.

4.2.6.1 Invertebrates

Kio Nahawele (Brachidontes cerebristriatus, Hawaiian Mussel)

The Hawaiian mussel, or kio nahawele, was a significant shellfish gathered from rocky intertidal zones. Archaeological sites across ʻEwa contain mussel shells, indicating their role in daily diets. Mussels provided a reliable source of protein and were often collected by women and children, reflecting the communal nature of gathering practices.

Culturally, kio nahawele reinforced the intimate relationship between people and shoreline resources. The act of gathering mussels linked families to place and perpetuated generational knowledge of tides, seasons, and safe harvest practices. Protecting rocky intertidal habitats ensures that mussels, as both ecological indicators and cultural resources, continue to thrive.

ʻŌpae (Shrimp)

Shrimp were another important invertebrate, gathered from streams, anchialine pools, and coastal waters. ʻŌpae were eaten directly and also used as bait for larger fish. Particularly significant was ʻŌpae ʻula, the tiny red shrimp of anchialine pools, which carried spiritual meaning and served as a food source in lean times.

In aquaculture, shrimp were raised in fishponds alongside mullet, demonstrating their role in sophisticated food systems. Culturally, they represent adaptability and resilience. Protecting groundwater flows and anchialine environments near Kalaeloa safeguards this resource and its associated practices.

Heʻe (Octopus cyanea, Octopus)

Heʻe, or octopus, remains one of the most culturally important invertebrates. Prized for its taste and as bait for ulua, octopus was a frequent target of nearshore fishers. Heʻe are also kinolau (manifestations) of Kanaloa, the god of the sea, carrying deep spiritual meaning.

Traditionally, octopus were caught using specialized stone lures (*luheʻe*), highlighting the ingenuity of Hawaiian fishing technology. Their role in diet, ritual, and moʻolelo makes them central to cultural continuity. Ensuring reef health supports octopus populations and sustains their place in Hawaiian lifeways.

4.2.6.2 Marine Mammals and Turtles

Honu (Chelonia mydas, Green Sea Turtle)

Honu are among the most iconic marine animals in Hawaiʻi, embodying both ecological and spiritual significance. As kinolau of Kū, honu are revered as guardians and symbols of longevity. Historically, honu were consumed under specific conditions, but today they are protected under the Endangered Species Act.

Ecologically, honu depend on seagrass and algal beds, which are present in patches offshore Kalaeloa. Their presence is a sign of ecosystem health. Culturally, honu are woven into moʻolelo as guides and companions. Protecting habitat for honu ensures both ecological integrity and the continuation of spiritual connections.

Honu ʻea (Eretmochelys imbricata, Hawksbill Turtle)

The hawksbill turtle, or honu ʻea, is rare in Hawaiʻi but of immense cultural importance. Its shell was historically used for ornamentation, though this practice has long ceased due to its endangered status. In moʻolelo, honu ʻea are associated with voyaging and the mysteries of the deep ocean.

Protecting honu ʻea habitat near Kalaeloa is critical given their endangered status. Even rare sightings reaffirm their cultural resonance as voyagers and symbols of resilience.

Naia (Stenella longirostris, Spinner Dolphin)

Naia, or spinner dolphins, are common in Hawaiian waters, often observed nearshore in daytime resting pods. They play an important role in Hawaiian voyaging moʻolelo, guiding canoes and representing joy and intelligence.

Culturally, naia were revered and often spared in fishing practices. Today, they remain beloved symbols of healthy oceans. Ensuring the reef project does not disrupt dolphin behavior is consistent with both ecological stewardship and cultural respect.

4.2.6.3 Avifauna

ʻUaʻu kani (Puffinus pacificus, Wedge-tailed Shearwater)

The wedge-tailed shearwater, or ʻuaʻu kani, nests in burrows along coastal dunes, including parts of Kalaeloa. Their seasonal presence was historically used by Hawaiians as a kilo indicator for fishing cycles.

Culturally, ʻuaʻu kani were a seasonal food source and also symbolized the connection between land and sea. Protecting nesting areas ensures this link remains intact and supports native biodiversity.

Manu o Kū (Gygis alba, White Tern)

The manu o Kū, or white tern, is a revered seabird associated with navigation. Polynesian voyagers relied on its flight patterns to locate land, as the birds typically remain within a day's flight of shore.

Culturally, manu o Kū symbolizes guidance, protection, and abundance. Observing their flight continues to connect modern practitioners with ancestral navigation techniques. Their presence near Kalaeloa is a sign of enduring ecological and cultural vitality.

4.2.6.4 Coral Communities

Six primary coral species were identified within the project area:

- **Montipora capitata (Rice Coral)** – A common reef-building coral in Hawaiʻi, noted for its branching to plate-like growth forms. It provides habitat complexity important for reef fish recruitment.
- **Porites compressa (Finger Coral)** – Characterized by upright, finger-like projections, this coral often dominates mid-depth reefs and supports diverse assemblages of reef fish and invertebrates.
- **Porites lobata (Lobe Coral)** – One of the most resilient Hawaiian corals, lobe coral is a massive reef-builder and a major contributor to reef framework.
- **Porites evermanni (Brown Lobe Coral)** – Less common but ecologically significant, this species resembles *Porites lobata* and contributes to reef structure in deeper or turbid waters.
- **Pocillopora grandis (Antler Coral)** – A branching coral with antler-like forms, providing structural habitat for small reef fish and invertebrates.
- **Pocillopora meandrina (Cauliflower Coral)** – A widespread coral with cauliflower-shaped branches, frequently used as shelter by juvenile fish.

Transect surveys recorded both **mounding** and **encrusting growth forms**, with size-class distributions ranging from small (0–10 cm) recruits to mature colonies taller than 10 cm. Within the proposed footprint of the hybrid-reef structures, an estimated **199 mounding corals** and **169 encrusting corals** may be affected. These colonies are proposed for translocation as part of the project's protective measures, ensuring they continue to contribute to reef structure and biodiversity.

Coral settlement domes deployed at the site further confirmed active recruitment of native corals, including *Montipora*, *Pocillopora*, *Porites*, and *Leptastrea*. This demonstrates that the area remains viable habitat for coral larval settlement and reef regeneration. The presence of recruits indicates ecological resilience despite relatively low live coral cover.

Although a full invertebrate species list was compiled, the survey emphasized corals as the primary faunal resources of cultural and ecological concern. The benthic community included sponges, worms, and small cryptic invertebrates, which collectively contribute to the productivity of the reef. In Hawaiian traditions, reef invertebrates such as crustaceans and mollusks were gathered for food and bait, linking these communities to subsistence practices.

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Table 2. Resource Table

Resource Type	Species (Hawaiian / Scientific)	Cultural Significance	Ecological Notes	Conservation Status
Fish	Naʻenaʻe(*Acanthurus olivaceus*)	Food fish, common in ʻEwa	Surgeonfish, important herbivore	Least Concern (IUCN)
	Pualu (*Acanthurus xanthopterus*)	Highly prized food fish	Large surgeonfish, abundant offshore	Least Concern (IUCN)
	Kala (*Naso unicornis*)	Food and cultural references	Unicornfish, reef grazer	Least Concern (IUCN)
	Moano (*Parupeneus multifasciatus*)	Food fish, valued for taste	Goatfish, sandy bottom forager	Least Concern (IUCN)
	Taʻape (*Lutjanus kasmira*)	Introduced snapper, eaten	Common in reef environments	Introduced species (non-native)
	ʻOmilu (*Caranx melampygus*)	Highly valued sport/subsistence fish	Apex predator in reef ecosystems	Least Concern (IUCN)
Limu	Limu kohu (*Asparagopsis taxiformis*)	Culinary delicacy, ritual use	Sensitive to water quality	Not Evaluated
	Limu ʻeleʻele (*Enteromorpha spp.*)	Staple in traditional diet	Found in tidepools	Not Evaluated

Resource Type	Species (Hawaiian / Scientific)	Cultural Significance	Ecological Notes	Conservation Status
	Limu ʻakiʻaki (*Ahnfeltia concinna*)	Consumed with fish	Reef-associated	Not Evaluated
Invertebrates	Pāpaʻi (crabs)	Subsistence food, rituals	Abundant in tidal flats	Multiple native species, generally Least Concern
	Mahamoe (bivalves)	Staple food	Found in sandy/muddy flats	Data Deficient (varies by species)
	ʻOpihi (*Cellana spp.*)	Food delicacy, cultural symbol	Found on rocky intertidal zones	Overharvested in some areas; Local Concern
	Wana (*Diadema setosum*)	Eaten, spines used in tools	Important grazer	Least Concern (IUCN)
	Loli (*Holothuria atra*)	Food and medicinal use	Sea cucumber, detritivore	Least Concern (IUCN)
Corals	Koʻa, Rice coral (*Montipora capitata*)	Kinolau of deities, foundation of reef life	Provides habitat and reef structure	Vulnerable (IUCN); ESA Species of Concern
	Koʻa, Finger coral (*Porites compressa*)	Symbol of resilience, reef health	Dominant reef-builder in mid-depths	Vulnerable (IUCN)
	Koʻa, Lobe coral (*Porites lobata*)	Long-lived, used as cultural markers	Major reef framework species, highly resilient	Near Threatened (IUCN)

Resource Type	Species (Hawaiian / Scientific)	Cultural Significance	Ecological Notes	Conservation Status
	Koʻa, Brown lobe coral (*Porites evermanni*)	Cultural association with reef abundance	Occurs in deeper/turbid environments	Near Threatened (IUCN)
	Koʻa, Antler coral (*Pocillopora grandis*)	Shelter for juvenile fish	Branching habitat-forming coral	Vulnerable (IUCN)
	Koʻa, Cauliflower coral (*Pocillopora meandrina*)	Important in moʻolelo of reef fertility	Common reef coral, supports high biodiversity	Vulnerable (IUCN)

Note:
Across Hawaiʻi, coral reef ecosystems face multiple stressors, including ocean warming, coral bleaching, sedimentation, nutrient runoff, invasive species, and physical disturbance. The species documented at Kalaeloa—particularly *Montipora capitata*, *Porites compressa*, and *Pocillopora meandrina*—are all considered vulnerable under the IUCN Red List and are indicators of reef health. These corals form the structural foundation of the ecosystem, supporting fish and invertebrates that hold cultural, subsistence, and ecological value. Their decline directly affects cultural practices such as fishing and gathering. The proposed restoration effort therefore has the potential not only to avoid adverse effects, but also to restore resilience, enhance biodiversity, and strengthen the cultural continuity of marine resource practices in the ʻEwa region.

Kalaeloa has long been a site of marine abundance and cultural practice. Fishing, limu gathering, diving, and surfing are not merely activities but practices that sustain cultural identity, ecological knowledge, and community resilience. Oral histories affirm that Kalaeloa was a place where “baskets of limu and nets of fish were always full,” while scientific studies confirm the persistence of diverse marine communities (Brock, 1994).

Despite industrialization and regulatory constraints, Kalaeloa remains central to subsistence and cultural life in ʻEwa. Protecting its marine environment is not only an ecological necessity but a cultural imperative, ensuring that future generations can continue to fish, gather, dive, and surf in the traditions of their ancestors.

4.2.7 Rain

Akana and Gonzalez (2015) explain the significance of the wind and rain in Native Hawaiian culture:

> In the mind…of our Hawaiian kūpuna [ancestors], every being and every thing in the universe was born. Our kūpuna respected nature because we, as kānaka, are related to all that surrounds us – to plants and creatures, to rocks and sea, to sky and earth, and to natural phenomena, including rain and wind. This worldview is evident in a birth chant for Queen Emma, “Hānau ke aliʻi, hānau ka ua me ka makani” (The chiefess was born, the rain and wind, too, were born). Our kūpuna had an intimate relationship with the elements. They were keen observers of their environment, with all of its life-giving and life-taking forces. They had a nuanced understanding of the rains of their home. They knew that one place could have several different rains, and that each rain was distinguishable from another. They knew when a particular rain would fall, its color, duration, intensity, the path it would take, the sound it made on the trees, the scent it carried, and the effect it had on people. (p. xv)

To the Native Hawaiians, no two rains are ever the same. Rain can be distinguished based on its intensity, the way it falls, and its duration, among other things. The following are a collection of rains that occur within and are associated with the ʻEwa moku. Moʻolelo, ʻōlelo noʻeau (traditional sayings), mele, oli, etc., associated with the rain name are also provided where available to give insight into the importance and cultural significance that the different types of rains have to the Native Hawaiian people.

Kuahina Rain

Kuahine or Tuahine is the rain primarily associated with Mānoa, Oʻahu. However, it is also found in other parts of Oʻahu, including ʻEwa.

Rain of Kahui, Central Oʻahu

He aha lā ka mea lena i uka o Kahui?	What is expanding in the uplands of Kahui?
He Kuahine lāua me ke Kiʻowao.	The Kuahine and the Kiʻowao.

From a mele inoa, or name chant, for chiefs (Akana & Gonzalez, 2015, p. 114).

The Kiʻowao is a cool mountain rain that also brings wind and fog with it. Kahui, the place name mentioned in the mele inoa above, is located in Kalauao, ʻEwa.

Nāulu Rain

Nāulu is a sudden shower that is associated with places throughout Hawaiʻi, including Kaupeʻa, ʻEwa. Nāulu is also the name of a shower cloud and a wind. In Hawaiian epistemology, sudden showers are associated with the akua Lono, whose domain is that of agriculture.

Rain of Kaupeʻa, Oʻahu

ʻAʻole au e hele i ke kaha o Kaupeʻa	I shall not tread Kaupeʻa's expanse
Kēlā kaha kūpā koili a ka lā i ke kula	That stretch where the sun beats down on the plain
Ua kūpono aʻela ka lā i ka piko o Wākea	The sun is right overhead, at the navel of Wākea
Ola i ke ahe a ka makani māunuunu	I am spared by the Māunuunu wind
I ka hapahapai mai a ka makani ʻAoʻaoa	By the uplifting ʻAoʻaoa breeze
Ke koi lā i ke ao o ka Nāulu e hanini i ka wai	Urging the Nāulu storm clouds to pour down their waters
Ola ihola nā kupa kamaʻāina i ka wai a ka ʻōpua	The natives here survive on water from the clouds
Ke halihali aʻela nā ʻōpua i ke awa lau	Which billowing clouds carry along to the branching lochs

From a mele by Hiʻiakaikapoliopele as she traveled over the hot stretch of land near Puʻuloa, Oʻahu (Akana & Gonzalez, 2015, p. 195).

Waʻahila Rain

Waʻahila rain is associated with Nuʻuanu, Oʻahu and is also found on other parts of Oʻahu, including ʻEwa. Waʻahila is also the name of a wind and ridge between Mānoa and Pālolo.

<u>Rain of Hālawa, Oʻahu</u>

No laila, ʻo mākou o ka Ahahui Hooikaika Kristiano holoʻokoʻa o ka ua Waʻahila o Hālawa, ʻEwa, ma o ko mākou kōmike lā, ke komo pū aku nei e kaʻana pū i nā ʻīnea o kēia mau lā ʻehaʻeha me nā mākua i hoʻonele ʻia i ka lei ʻole, ka ʻohana a me nā pilikana me ke kau nui aku i maluhia mai ko kākou puʻuhonua a me ka ikaika mai.	Therefore, we, on behalf of the entire Ahahui Hooikaika Kristiano of the Waʻahila rain of Hālawa, ʻEwa, through our committee, join in sharing the hardships of these tragic days with the parents, family, and relatives who have been deprived of their children, with hopes for peace and strength from our refuge.

From a message of condolence from members of the Christian Endeavor Society. Note: “Puʻuhonua” or “refuge” probably refers to Jesus Christ (Akana & Gonzalez, 2015, p. 272).

Nani Hālawa i ka ua Waʻahila Ke kīpū maila i luna o ʻAiea	Hālawa is beautiful in the Waʻahila rain Remaining above ʻAiea

From George M. K. Aekai o Kuloloia’s response to a name, or riddle, printed in the newspaper *Kuokoa Home Rula* (Akana & Gonzalez, 2015, p. 272).

4.2.8 Wind

Hawaiian wind names hold significant cultural and practical importance in the Hawaiian Islands. Wind names in Hawaiian culture are deeply rooted in the traditional belief system and connection to the natural environment. Hawaiians have a profound respect for nature and its elements, and wind names reflect their reverence for the forces of nature. These names are a part of the rich cultural heritage and oral tradition of the Hawaiian people. The importance of Hawaiian wind names lies in their cultural, practical, and spiritual significance, connecting the people to their environment, enabling navigation, predicting weather, and preserving their cultural heritage.

Wind names also were important resources for understanding the surrounding environment. Hawaiian wind names are instrumental in navigation and wayfinding, particularly for voyaging canoes and seafaring traditions. Traditional Polynesian voyagers used their knowledge of the winds and stars to navigate across vast expanses of the Pacific Ocean. By knowing the characteristics and names of different winds, they could effectively chart their courses and find their way to distant islands.

Wind names are also crucial for predicting weather patterns in Hawaiʻi. Hawaiians developed a deep understanding of the winds' behavior and associated weather conditions based on their observations over generations. By identifying and naming different winds, they could anticipate changes in weather, ocean currents, and other natural phenomena, which was essential for agriculture, fishing, and daily activities.

The wind names reflect a close connection between the people and the environment. By acknowledging and naming specific winds, Hawaiians recognized the unique characteristics and qualities of each wind. This awareness promoted a harmonious relationship with nature and fostered a sense of responsibility for its preservation and sustainable use.

Today, some of the most important use and preservation of Hawaiian wind names contribute to the retention and revitalization of the Hawaiian language, culture, and traditions. In a modern context, these names help to maintain and celebrate the unique cultural identity of the Hawaiian people, strengthening their sense of belonging and heritage.

The most famed of Hawaiian moʻolelo about winds is by Moses Kuaea Nakuina, *Moolelo Hawaii o Pakaa a me Ku-a-Pakaa, na Kahu Iwikuamoo o Keawenuiaumi, ke Alii o Hawaii, a o na Moopuna hoi a Laamaomao* (The Hawaiian Story of Pakaʻa and Kuapakaʻa, the Personal Attendants of Keawenuiaʻumi, the Chief of Hawaiʻi, and the Descendants of Laʻamaomao), published in Hawaiian in 1901. Many have written about the gourd's mythical properties, which is believed to contain all the winds of Hawaiʻi. More than myth, the gourd itself exists in physical form and was last owned by King David Kalākaua. Today, it is held in the collection of the Bishop Museum.

According to this moʻolelo, the descendants of Laʻamaomao, the wind god, used the wind gourd, Ka Ipu Makani o Laʻamaomao, to control the winds and cause the demise of their enemies. Pākaʻa and his son Kūapākaʻa, Laʻamaomao's descendants, control the winds by chanting the wind name, which recalls that particular wind from the gourd. Each wind name is associated with a specific ahupuaʻa or ʻāina. Pākaʻa passed on his knowledge of the wind names and the gourd to Kūapākaʻa, who called on all of the winds to destroy the canoe fleet of Pākaʻa's enemies in the Kaiwi Channel separating Oʻahu and Molokaʻi.

The following is an excerpt from the chant naming the winds of Oʻahu, focusing particularly on the wind names of ʻEwa:

Moaʻe-ku is of ʻEwaloa,
Kēhau is of Waiʻōpua,
Waikōloa is of Līhuʻe,
Kona is of Puʻuokapolei,
Māunuunu is of Puʻuloa… (Nakuina, 1901)

According to this account, Moaʻe kū, Kona, and Māunuunu are the winds typically found in the ʻEwa moku, particularly Honouliuli. Moaʻe kū is considered to be a foreign wind that blows from another land (He makani mai Kahiki mai). Moaʻe are trade winds and the Moaʻe kū is considered to be a very strong trade wind. Kona is the name of the wind associated with Puʻuokapolei and this a famous leeward wind. Māunuunu is the name of a strong, blustering wind typically associated with Waiʻalae and Puʻuloa.

4.3 Intangible Cultural Resources

It is important to note that Honua Consulting's unique methodology divides cultural resources into two categories: biocultural resources and built environment resources. We define biocultural resources as elements that exist naturally in Hawaiʻi without human contact. These resources and their significance can be shown, proven, and observed through oral histories and literature. We define built environment resources as elements that exist through human interaction with biocultural resources whose existence and history can be defined, examined, and proven through anthropological and archaeological observation. Utilizing this methodology is critical in the preparation of a CIA as many resources, such as those related to akua (Hawaiian gods), do not necessarily result in material evidence, but nonetheless are significant to members of the Native Hawaiian community.

4.3.6 ʻŌlelo Noʻeau

ʻŌlelo noʻeau are another source of cultural information about the area. ʻŌlelo noʻeau literally means "wise saying," and they encompass a wide variety of literary techniques and multiple layers of meaning common in the Hawaiian language. Considered to be the highest form of cultural expression in old Hawaiʻi, ʻōlelo noʻeau bring us closer to understanding the everyday thoughts, customs, and lives of those that created them.

The ʻōlelo noʻeau presented here relate to Puʻuloa, Honouliuli, and the larger ʻEwa moku. These ʻōlelo noʻeau are found in Pukui's *ʻŌlelo Noʻeau: Hawaiian Proverbs & Poetical Sayings* (1983). The number preceding each saying is provided.

80 ʻĀina koi ʻula i ka lepo.
Land reddened by the rising dust.
Said of ʻEwa, Oʻahu.

105 Alahula Puʻuloa, he alahele na Kaʻahupāhau.
Everywhere in Puʻuloa is the trail of Kaʻahupāhau.
Said of a person who goes everywhere, looking, peering, seeing all, or of a person familiar with every nook and corner of a place. Kaʻahupāhau is the shark goddess of Puʻuloa (Pearl Harbor) who guarded the people from being molested by sharks. She moved about, constantly watching.

123 Anu o ʻEwa i ka iʻa hāmau leo e. E hāmau!
ʻEwa is made cold by the fish that silences the voice. Hush!
A warning to keep still. First uttered by Hiʻiaka to her friend Wahineʻomaʻo to warn her not to speak to Lohiʻau while they were in a canoe near ʻEwa.

274 E hāmau o makani mai auaneʻi.
Hush, lest the wind arise.
Hold your silence or trouble will come to us. When the people went to gather pearl oysters at Puʻuloa, they did so in silence, for they believed that if they spoke, a gust of wind would ripple the water and the pysters would vanish.

493 Haunāele ʻEwa i ka Moaʻe.
ʻEwa is disturbed by the Moaʻe wind.
Used about something disturbing, like a violent argument. When the people of ʻEwa went to gather *pipi* (pearl oyster), they did so in silence, for if the spoke, the Moaʻe breeze would suddenly blow across the water, rippling it, and the oysters would disappear.

1014 Hoʻahewa na niuhi ia Kaʻahupāhau.
The man-eating sharks blamed Kaʻahupāhau.
Evil-doers blame the person who safeguards the rights of others. Kaʻahupāhau was the guardian shark goddess of Puʻuloa (Pearl Harbor) who drove out or destroyed all the man-eating sharks.

1023 Hoʻi aku la ka ʻōpua i ke awa lau o Puʻuloa.
The horizon cloud has gone back to the lochs of Puʻuloa.
He has gone home to stay, like the horizon clouds that settle in their customary places.

1126 Huhui na ʻōpua i Awalau.
The clouds met at Pearl Harbor.
Said of the mating of two people.

1330 Ka iʻa hali a ka makani.
The fish fetched by the wind.
The *ʻanaeholo*, a fish that travels from Honouliuli, where it breeds, to Kaipāpaʻu on the windward side of Oʻahu. It then turns about and returns to its original home. It is driven closer to shore when the wind is strong.

1331 Ka iʻa hāmau leo o ʻEwa.
The fish of ʻEwa that silences the voice.
The pearl oyster, which has to be gathered in silence.

1686 Ke awa lau o Puʻuloa.
The many-harbored sea of Puʻuloa.
Puʻuloa is an early name for Pearl Harbor.

1698 Ke hoʻi aʻe la ka ʻōpua i Awalau.
The rain clouds are returning to Awalau.
Said of a return to the source.

1721 Ke kai heʻe nehu o ʻEwa.
The sea where the nehu *come in schools to ʻEwa.*
Nehu (anchovy) come by the millions into Pearl Harbor. They are used as bait for fishing, or eaten dried or fresh.

2152 Mehameha wale no o Puʻuloa, i ka hele a Kaʻahupāhau.
Puʻuloa became lonely when Kaʻahupāhau went away.
The home is lonely when a loved one has gone. Kaʻahupāhau, guardian shark of Puʻuloa (Pearl Harbor), was dearly loved by the people.

4.3.7 Mele

Honua Consulting completed searches of mele written about the ahupuaʻa of Honouliuli.[15] Maui historian Inez Ashdown (1976) wrote about the importance of mele:

> The natives of Hawaiʻi Neʻi saw the Creator in everything and the Haku Mele or Music Masters delighted in presenting the chants and songs, mele and oli, to inspire the people. Such mele tell of God's assistant spirits which, to the imaginative natives, represented the winds, rains, and so on. Each spirit of creation was depicted as male or female and was given a personality and a name indicative of purpose. Hence the name of the volcanic action creating and cleansing the earth. She is beautiful, alluring, desirable. She also is unpredictable because she is temperamental and usually full of fiery emotions. She is an old woman asking help when she lies to test mortals, and woe betide anyone who is rude or inconsiderate of this form of an older person to whom respect and Aloha must be given. (p. 3)

There are numerous mele written about Honouliuli and ʻEwa moku. The area also enjoys having talented haku mele (composers) who continue to live in, and write about, the area. The following mele celebrate the Honouliuli area.

Pūpū A O ʻEwa (Shells of ʻEwa)

Hui:
Pūpū (aʻo ʻEwa) i ka nuʻa (nā kānaka)
E naue mai (a e ʻike)
I ka mea hou (o ka ʻāina)
Ahe ʻāina (ua kaulana)
Mai nā kūpuna mai
Alahula Puʻuloa he ala hele nō
Kaʻahupāhau, (Kaʻahupāhau)
Alahula Puʻuloa he ala hele nō
Kaʻahupāhau, Kaʻahupāhau

Nani Kaʻala hemolele i ka mālie
Kuahiwi kaulana aʻo ʻEwa
E kiʻi ana i ka makani o ka ʻāina

Chorus:
Shells of ʻEwa throngs of people
Coming to learn
The news of the land
A land famous
From the ancient times
All of Puʻuloa, the path trod upon by
Kaʻahupāhau
All of Puʻuloa, the path trod upon by
Kaʻahupāhau

15 It should be noted that there are numerous mele about the larger ʻEwa area that have not been included in this assessment as they did not yield information closely associated with the project area.

Hea ka Moaʻe eia au e ke aloha

Kilakila ʻo Polea noho i ka ʻolu
Ia home hoʻohihi a ka malihini
E walea ana i ka ʻolu o ke kiawe
I ka pā kolonahe a ke Kiu

Beautiful Kaʻala, sublime in the calm
Famous mountain of ʻEwa
That fetches the wind of the land
The tradewind calls, "here I am, beloved"

Majestic Polea in the coolness
Home delightful to visitors
Relaxing in the coolness of the kiawe
And the soft blowing of the Kiu wind

"The news of the land" was the discovery of pearl oysters at Puʻuloa, which was protected by Kaʻahupāhau, the shark goddess. Kaʻala is the highest mountain on Oʻahu and Polea is in ʻEwa. Nuʻa and naue in the chorus is often interchanged with nuku (mouth) and lawe (bring). Moaʻe is the name of a tradewind. In 1909, the Navy issued a $1.7 million contract for construction of the first Pearl Harbor dry dock. Kapuna Kanakeawe, a Hawaiian fisherman, told the contractor to build it in another location as the spot they selected was the home of Kaʻahupāhau. Work stopped after 3 months as things kept going wrong. Cement would not pour, and the contractor could not pump water out of the dry dock. February 17, 1913, 2 years behind schedule, opening ceremonies were held. Then it exploded. One man was killed, $4,000,000 lost and 4 years of work demolished. Another contract was issued in November 1914. As work progressed, the early warning given by Kanakeawe was remembered. Mrs. Puahi, a kahuna, was called, and instructed the foreman, David Richards, in the necessary rituals to appease Kaʻahupāhau and safeguard the project. After sacrifices were made, prayers chanted and rituals performed, the project was declared safe. When the bottom was pumped out, the skeleton of a 14-foot shark was discovered. Pearl Harbor was also the site of ancient Hawaiian fishponds (Huapala, n.d.).

The following mele names significant inoa ʻāina of Honouliuli, such as Pālehua, Kapapaʻapuhi and Puʻuokapolei (indirectly).

Mele Honouliuli by Puʻu Zablan

Eō Pālehua i ke kuahiwi la
Ke kuahiwi i noho i ka lani

Hear my call Pālehua, glorious mountain
The mountain that dwells in the heavens

ʻO Kapolei ka puʻu la
Ka puʻu i noho i ka ʻāina

Kapolei is our beloved hill
The hill that sits on the land

ʻO Kapapaʻapuhi ka loko la	Kapapaʻapuhi is our pond
Ka loko i noho i kai	The pond that resides at the sea
ʻO Honouliuli la	There is Honouliuli
He ʻāina aloha o ʻEwa	Our beloved land in ʻEwa
Aloha mai e nā pua la	Greetings to all of the descendants/people
Nā pua haʻaheo o ka ʻāina	The proud people of this land

5 Traditional or Customary Practices Historically in the Project Area and Surrounding Area

In traditional (pre-Western contact) culture, named localities served a variety of functions, informing people about: (1) places where the gods walked the earth and changed the lives of people for good or worse; (2) heiau or other features of ceremonial importance; (3) triangulation points such as koʻa for fishing grounds and fishing sites (4) residences and burial sites; (5) areas of planting; (6) water sources; (7) trails and trail side resting places (oʻioʻina), such as a rock shelter or tree shaded spot; (8) the sources of particular natural resources/resource collections areas, or any number of other features; or (9) notable events which occurred at a given area. Through place names knowledge of the past and places of significance was handed down across countless generations. There is an extensive collection of native place names recorded in the moʻolelo published in Hawaiian newspapers.

This is not intended to be a comprehensive list of all the practices that historically or contemporaneously occur in Honouliuli. Rather, this is meant to show the range of traditional or customary practices that took place in the larger geographic extent. As the project area is entirely submerged, the identification of practices focuses heavily on marine and coastal practices.

5.2 Moʻolelo

Moʻolelo is the practice of storytelling and developing oral histories for the purpose of transmitting knowledge information and values intergenerationally. Moʻolelo are particularly critical in protecting and preserving traditional culture in that they are the primary form through which information was transmitted over many generations in the Hawaiian Islands and particularly in the Native Hawaiian community.

Storytelling, oral histories, and oration are widely practiced throughout Polynesia and important in compiling the ethnohistory of the area. The Native Hawaiian newspapers were particularly valued for their regular publication of different moʻolelo about native Hawaiian history. Were it not for the newspapers having the foresight to allow for the printing and publication of moʻolelo, far less information about the cultural history of the Hawaiian people would be available today.

There are numerous moʻolelo about Honoululi and the geographic extent. These moʻolelo are provided in **Sections 3.2 (Traditional Period)** and in **Section 4.0 (Cultural Resources)**.

5.3 Fishing

Fishing was central to Native Hawaiian use of the Kalaeloa coastline. Archaeological evidence, including coral abraders, basalt flakes, and a human bone fishhook fragment, demonstrates that the area supported both nearshore and offshore fishing activities. Middens rich in *Brachidontes cerebristriatus* (*kio nahawele*, Hawaiian mussel) confirm systematic gathering of intertidal shellfish, while the presence of fishing gear indicates expeditions targeting pelagic species such as *aku* (bonito) and *heʻe* (octopus). The reef flats, sinkholes, and sheltered coastal areas provided natural camps where fishers could rest, process catches, and repair tools.

Fishing also carried cultural meaning beyond subsistence. It tied families and communities to seasonal cycles, reinforced kilo practices of observing the sea, and contributed to the transmission of generational knowledge. Today, fishing continues to hold importance for cultural practitioners in ʻEwa, linking modern use to ancestral traditions and underscoring the enduring significance of Kalaeloa's marine resources.

5.3.6 Nearshore Fisheries

The nearshore waters of ʻEwa were historically abundant with resources that sustained local communities. Women collected *pāpaʻi* (crabs), *mahamoe* (edible bivalves), and various types of limu in shallow reef flats. These practices reflected a gendered division of labor and reinforced intergenerational ecological knowledge (Emerson, 1915). Gathering was often accompanied by chants and protocols, affirming the reciprocal relationship between people and the sea.

Fishing in shallow waters also targeted species such as *ʻāholehole* (Hawaiian flagtail), *amaʻama* (mullet), and *ʻawa* (milkfish). Cast nets (*ʻupena*) and throw nets were commonly employed, with knowledge of tidal and lunar cycles critical to success. Traditional fisheries management operated through the *kapu* system, which restricted harvests during spawning seasons to ensure resource sustainability (Sterling, 1978).

5.3.7 Offshore Fisheries

Beyond the reef, offshore fishing at Kalaeloa focused on pelagic species. Fishermen pursued *aku* (skipjack tuna), *ʻahi* (yellowfin tuna), *ʻōpelu* (mackerel scad), and *aku ʻula* (bonito) using trolling lures, bone hooks, and stone sinkers (*poʻo lawaiʻa*). The cape's location made it an important starting point for interisland voyages to Maui and Kauaʻi, further intertwining fishing with navigation and voyaging traditions (Sterling, 1978).

Oral accounts and community narratives emphasize the abundance of offshore fisheries. In *Neva Eva Go ʻEwa*, families recall fishing as the foundation of community identity, with canoe fishing expeditions yielding plentiful catches of *akule* and *ulua*, sustaining both households and neighborhood exchange networks (Inter-Island Journal, n.d.).

Scientific surveys near the Barbers Point deep ocean outfall confirm the richness of Kalaeloa's marine environment. Fish communities documented in the early 1990s included surgeonfishes (*Acanthuridae*), goatfishes (*Mullidae*), snappers (*Lutjanidae*), damselfishes (*Pomacentridae*), wrasses (*Labridae*), and jacks (*Carangidae*). Dominant species included:

- *Naʻenaʻe* (*Acanthurus olivaceus*)
- *Pualu* (*Acanthurus xanthopterus*)
- *Kala* (*Naso unicornis*)
- *Moano* (*Parupeneus multifasciatus*)
- *Taʻape* (*Lutjanus kasmira*)
- *ʻOmilu* (*Caranx melampygus*) (Brock, 1994)

Macroinvertebrates were also abundant, with surveys noting *wana* (long-spined sea urchin, *Diadema setosum*), *loli* (black sea cucumber, *Holothuria atra*), and *pepeʻekeʻa* (cushion starfish, *Culcita novaeguineae*) (Brock, 1994). These findings resonate with oral traditions describing Kalaeloa as a place where marine life flourished and women's baskets overflowed with seafood and limu.

Today, fishing in the Kalaeloa region is subject to regulations under the Division of Aquatic Resources (DLNR-DAR). Oʻahu's regulated fishing areas include Pearl Harbor restricted zones and special provisions for net use, size limits, and seasonal closures (DLNR, 2024). These regulations reflect the ongoing need to balance cultural practices with ecological conservation.

Scientific studies of the Barbers Point diffuser show fish communities remain diverse, though smaller reef species dominate, suggesting resilience but also vulnerability to overfishing and habitat change (Brock, 1994).

5.4 Limu and Other Marine Resource Gathering

Limu played a central role in traditional diets and cultural practice. Kalaeloa's tidal flats provided species such as:

- *Limu kohu* (*Asparagopsis taxiformis*)
- *Limu ʻeleʻele* (*Enteromorpha* spp.)
- *Limu ʻakiʻaki* (*Ahnfeltia concinna*)

These were eaten with fish, incorporated into ceremonies, and used in medicinal preparations. The act of gathering limu was communal and intergenerational, with kūpuna teaching younger generations proper techniques and sustainable harvest practices. Oral histories describe ʻEwa women bending over tidepools to collect limu, highlighting both its abundance and cultural significance (Emerson, 1915; Inter-Island Journal, n.d.).

Crustaceans, such as *pāpaʻi,* and mollusks, like *ʻopihi,* were also collected, reinforcing the diversity of nearshore practices.

Registered Map 896 (Figure 15), prepared by surveyor M.D. Monsarrat in December 1881, provides one of the earliest detailed cartographic records of the Honouliuli coastline, which encompasses the Kalaeloa project area. The survey captures the physical character of the shoreline as it appeared in the late nineteenth century: an alternating pattern of **rocky coastlines and sandy beaches** that defined the ʻEwa shoreline. These features are significant because they confirm the environmental integrity of the landscape described in oral histories and visible in archaeological evidence.

The rocky outcrops shown on the map align with areas where Hawaiians gathered shellfish, particularly *Brachidontes cerebristriatus* (*kio nahawele*), and harvested limu in the intertidal zone. The sandy stretches provided natural landing places for canoes, critical for fishing expeditions and offshore travel. Together, these features formed a mosaic of subsistence zones that supported a dynamic coastal economy. Archaeological findings of fishhook fragments, coral abraders, and midden deposits rich in marine shell correspond directly to the shoreline conditions illustrated on Monsarrat's map.

The map thus offers more than a land survey; it provides documentary evidence of a **coastal environment that sustained cultural practices.** It corroborates traditional knowledge of ʻEwa as a place abundant in marine resources, while also underscoring the importance of place-based kilo (observation) practices. By visually situating the project area within this historic environmental context, Registered Map 896 highlights the continuity between the physical landscape of the late nineteenth century and the fishing, gathering, and voyaging traditions that shaped Kalaeloa's cultural identity.

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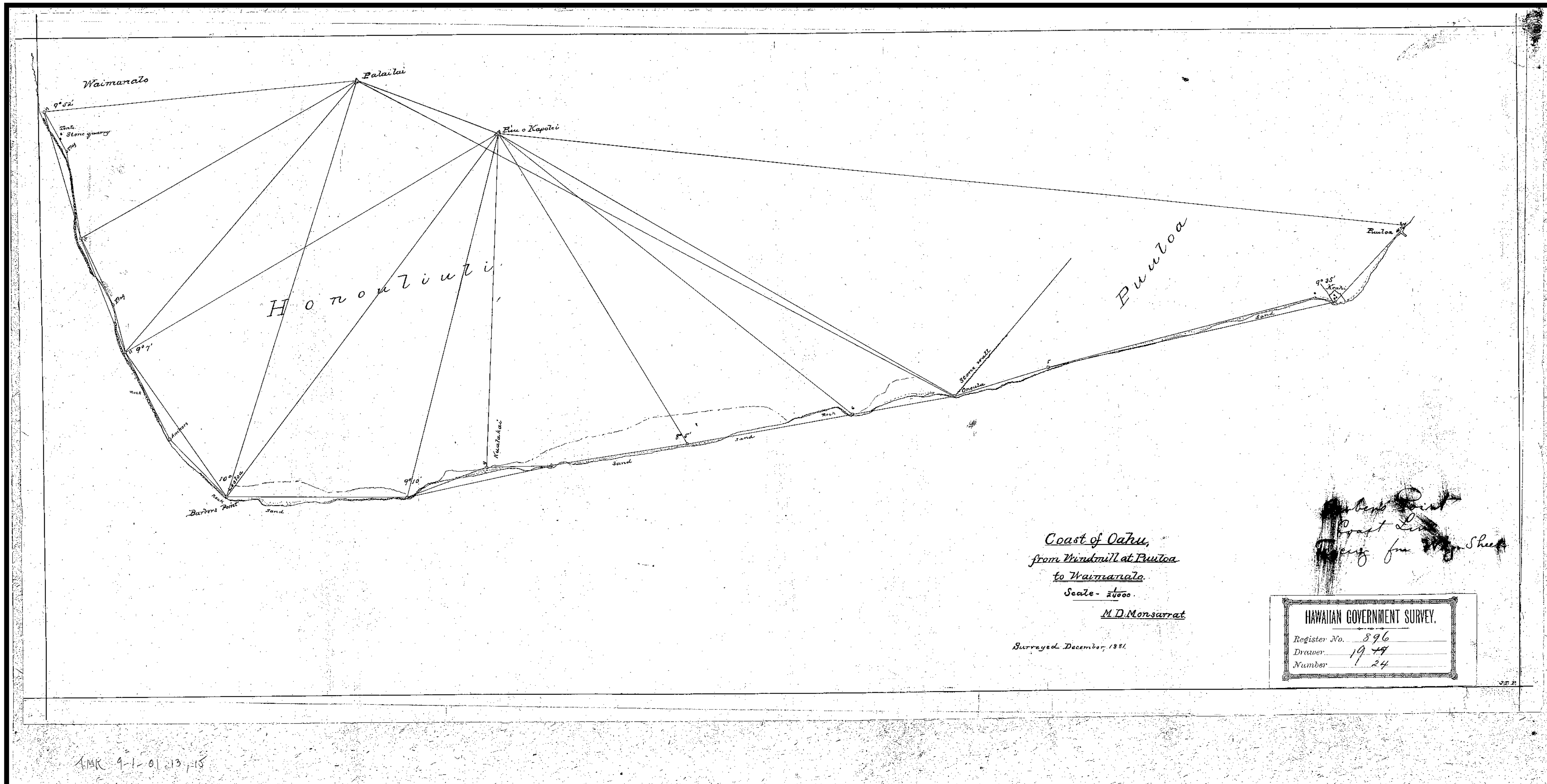

Figure 15. Registered Map No. 896 from 1881 shows the shoreline near the Project Area. From this figure the changes between a rocky and sandy shoreline as shown, which would have contributed to the type of species available for subsistence in each area.

5.5 Diving

Traditional divers (*luʻu*) harvested octopus (*heʻe*), sea cucumbers, and shellfish, relying on deep knowledge of lunar phases and currents. Diving was a skilled practice requiring stamina, breath control, and intimate familiarity with reef topography.

Today, freedivers and SCUBA divers continue these traditions. Spearfishing is particularly common, targeting species such as *ulua*, *kala*, and goatfish. Ecological monitoring shows that while smaller reef species dominate the diffuser area, larger species such as *ʻomilu* and *kala holo* (*Naso hexacanthus*) persist (Brock, 1994). These practices echo ancestral subsistence methods while adapting to modern gear.

Spearfishing has been an integral part of Hawaiian culture for centuries. It was not only a means of sustenance but also a way to connect with the ocean and maintain a balanced relationship with nature. Hawaiian ancestors relied on their skills as fishermen and practiced sustainable fishing techniques. Traditional Hawaiian spearfishing primarily utilizes two main tools: the koʻa (spear) and the Hawaiian sling. The koʻa is a wooden pole with a pointed tip, often made from the wood of the hau or koa tree. It was used for larger fish species or when deeper dives were required. The Hawaiian sling is a handheld device consisting of a short wooden or fiberglass rod with a looped rubber sling attached. The sling propels the spear with accuracy and force.

Traditional Hawaiian spearfishers developed sophisticated techniques to enhance their chances of success. These techniques involved free diving and breath-hold diving skills, using natural camouflage, and observing fish behavior to approach them stealthily. Patience and precision were key elements, as spearfishers needed to wait for the perfect moment to strike and accurately aim for the target. Spearfishing in Hawaiian culture was guided by cultural protocols and practices. Respect for the ocean and its resources was paramount, with a strong emphasis on sustainability and not taking more than needed. Traditional knowledge was passed down through generations, and elders played a significant role in teaching younger community members about proper fishing practices and the spiritual connection to the ocean.

In recent years, there has been a resurgence of interest in traditional Hawaiian practices, including spearfishing. Efforts have been made to preserve and revive traditional techniques, share knowledge, and promote sustainable fishing practices. Local communities, cultural organizations, and educational programs play an important role in preserving this cultural heritage. When engaging in spearfishing as a traditional Hawaiian practice, it is essential to approach it with cultural sensitivity, respect, and a deep appreciation for the ocean and its resources. Learning from experienced practitioners or participating in cultural programs can provide valuable insights into the rich traditions and practices associated with spearfishing in Hawaiʻi.

5.6 Surfing

Surfing (*he'e nalu*) has also been practiced along the ʻEwa coast for generations. Traditional boards (*papa he'e nalu*) carved from *wiliwili* or *ʻulu* wood were used by aliʻi and makaʻāinana alike. Surfing was both recreational and ceremonial, connected to ocean deities and seasonal cycles.

In contemporary times, surfing at Kalaeloa continues, with surf breaks offshore providing recreation for local communities. Oral histories describe how children in ʻEwa grew up "fishing by day and surfing at dusk," integrating ocean practices into everyday life (YouTube, 2020).

5.7 Lāʻau Lapaʻau

Lāʻau lapaʻau is the practice of traditional Hawaiian medicine. For centuries, Native Hawaiians have relied on their environment to provide medicinal resources. It is still actively taught and practiced today. Healers or medicinal experts possess deep knowledge of plants and other ingredients used to treat ailments, illnesses, and sicknesses. Traditional medicine is practiced by indigenous peoples and local communities worldwide. Likewise, over many generations, Native Hawaiians have learned how to properly care for, use, and prepare plants to support their community's health.

In addition to plant access, it was also important to ensure that these plants were healthy and in good condition. These cultural resources are critical to the ongoing practice of traditional medicine and healing within the Native Hawaiian community. There are still many traditional medicine practitioners in the Hawaiian community and throughout the Hawaiian Islands today. This practice continues to be taught to the younger generation and is honored and utilized in many Hawaiian households throughout the state.

It was important to have medicinal plants throughout the Hawaiian Islands so that when people traveled to different areas, they could always access the medicine they needed. In some cases, certain plants were extremely rare, and it was especially important to ensure those populations were well protected and cared for. An identification of plants with cultural value within the project area was conducted and is included in **Section 4.2.1 (Flora)**.

There were numerous gods associated with health, healing, and medicine: Hiʻiakaikapoliopele, Hiʻiakaikapuaʻenaʻena, Hauwahine, Hina, Hinaʻea, Hinalaulimukala, Kamakanuiʻahuʻilono, Kanaloa, Kū, Kūkeoloʻewa, Lonopūhā, Maʻiola, Mauliola, and ʻŌpeluhuikauhaʻailo.

Lāʻau lapaʻau is closely tied to farming. Plants, like kalo, still serve as a food source but it can and often also serves as medicine. Honouliuli has an active community of healing practitioners. These practitioners actively practice in the ahupuaʻa, although there is no indicator that the immediate project area is currently used for any of these practices.

5.8 Kilo

Kilo "references a Hawaiian observation approach which includes watching or observing [the] environment and resources by listening to the subtleties of place to help guide decisions for management and pono practices" (ʻAuamo, 2016). The practice of kilo is seeing a resurgence on Hawaiʻi Island and in the Hawaiian Islands.

Kilo hōkū are traditional astronomers, or those who study the stars. Hale kilo or hale kilo hōkū are observatories or star observatories, respectfully. Kilo makani are those who traditionally observe the winds. Kilo moana were traditionally oceanographers. Kilo ʻuhane were those who observed and communicated with spirits.

Traditionally, the practice of kilo was critical to the management of Hawaiian landscapes. This practice is very closely tied to traditional or customary access as observers would require access to specific vistas, viewsheds, or areas in order to observe environmental phenomenon.

As illustrated in the proceeding section, Native Hawaiians created a wide range of terms for the environment and understanding the ecosystems around them. These terms were often quite specific, and many were tied closely to a specific geographic area. This level of specificity illustrated the close kinship Hawaiians shared to their surrounding environment. The ability to observe and understand all elements of their ecosystem was essential to both the successful care of natural resources and the survival of the Hawaiian people.

The ability to effectively and accurately read weather phenomena was essential to the ability of Hawaiian people who farm, fish, navigate, and conduct any number of practices in a sustainable and successful manner. The knowledge Hawaiians acquired about their environment around them, including weather phenomena, was the result of multi-generational observations that comprised an extensive body of information passed down through oral traditions. The following Hawaiians names and their descriptions of weather phenomena include words for clouds, rains, and winds that are utilized by kilo to help guide activities and practices:

- Ānuenue – rainbow, a favorable omen.
- Ao akua – godly cloud, figurative representative of a rainbow.
- Ao loa – long cloud or high, distant cloud. Status cloud along the horizon.
- Ao ʻōnohi – cloud with rainbow, ʻōnohi, colors contained within it.

- Ao pehupehu – continually growing cumulus typical of summer. Drifting with the tradewinds, these clouds pick up moisture and darken at their base, finally releasing their rain on the windward mountain cliffs.
- Ao puaʻa – cumulus clouds of various sizes piled together, like a mother pig with piglets clustered around her. The Kona coast is famous for ao puaʻa, a sign of good weather and no impending storms.
- Hoʻomalumalu – sheltering cloud.
- Hoʻoweliweli – threatening cloud.
- Ua loa – extended rainstorm.
- Ua poko – short rain spell.

5.8.6 The Significance of Puhilele as a Viewpoint and View Plane in Kalaeloa

Puhilele, literally "leaping eel," is the traditional name for the navigational light site at Kalaeloa, Oʻahu. Today, it is the location of the Barbers Point Lighthouse, one of Hawaiʻi's most important maritime safety structures. Yet long before the installation of the lighthouse, Puhilele served as a natural beacon and cultural landmark. Its prominence as a coastal promontory made it a fixed point in Hawaiian wayfinding traditions, and its commanding views offered both physical orientation and symbolic meaning. The layered significance of Puhilele—as a cultural site, a view plane, and a modern navigational landmark—illustrates the continuity of Hawaiian landscape knowledge even amidst colonial and industrial transformations.

5.8.6.1 Puhilele as a Traditional Landmark

Located on the southwestern edge of Oʻahu, Puhilele juts into the sea at Kalaeloa, formerly known as Barber's Point. In Hawaiian tradition, such headlands were vital for navigation. They provided reference points for canoe voyagers who traveled interisland or along the coasts. A cape like Puhilele would have been visible for many miles, allowing navigators to confirm their position relative to the larger features of Oʻahu.

The name *puhilele* ("leaping eel") itself is suggestive. In Hawaiian thought, the eel (*puhi*) symbolized liminality, dwelling in brackish estuaries where freshwater and saltwater mingled. The imagery of leaping conveys motion, vitality, and the crossing of thresholds. As a place name, Puhilele embodies the idea of a boundary between land and sea, a site of transition where voyagers literally "leapt" from the safety of the shore into the vastness of the kai. In this way, the name holds cultural depth that corresponds to the physical reality of the site: a point that leaps into the ocean, bridging domains.

The significance of Puhilele also derives from the expansive views it commands. From the promontory, one sees eastward across the ʻEwa plain toward Diamond Head, northward along the Waiʻanae coast, and westward into the open Kai of Nā Kai ʻEwalu, the seas linking Oʻahu with

Maui and Molokaʻi. Inland, the flatlands of Honouliuli spread out, once covered in fishponds, loʻi, and limu gathering areas.

As a **view plane**, Puhilele embodies the Hawaiian practice of orientation by landscape and seascape. The site connects the mauka–makai continuum of the ahupuaʻa system, reminding observers that land and sea are parts of a unified whole. From this vantage, one could watch for approaching canoes, monitor the weather, or simply contemplate the abundance of ʻEwa's kai. In Native Hawaiian worldviews, such outlooks were not merely scenic—they were imbued with knowledge, responsibility, and memory.

5.8.6.2 Barbers Point Lighthouse

In the late 19th and early 20th centuries, the increasing presence of Western shipping in Hawaiian waters led to demands for formal navigational aids. Barbers Point, notorious for its reefs and strong currents, was especially dangerous for vessels arriving from Asia or the Americas. Numerous shipwrecks occurred off Kalaeloa, reinforcing the need for a lighthouse.

The first Barbers Point Lighthouse was constructed in 1888, a wooden tower that stood 50 feet high. It served as a critical marker for mariners navigating Oʻahu's southwestern approach. By 1933, however, a more durable concrete lighthouse was built to replace the earlier structure. Rising 72 feet, this modern tower remains in operation today, fitted with powerful rotating lights that can be seen up to 24 nautical miles offshore.

The installation of the lighthouse formalized Puhilele's long-standing role as a navigational landmark. What Hawaiian navigators had relied on for centuries was now translated into Western maritime infrastructure. In this way, the Barbers Point Lighthouse can be seen as a continuation—albeit through a colonial lens—of the Hawaiian recognition that Puhilele was a natural beacon.

5.8.6.3 Puhilele Cultural Landscape

The lighthouse at Puhilele symbolizes a point of convergence between Hawaiian cultural practice and global maritime systems. For Hawaiians, the cape had always been a wahi pana, a storied place central to fishing, voyaging, and orientation. For Western mariners, the lighthouse became essential for preventing loss of life and cargo. Both perspectives recognized the same physical truth: Puhilele is a point of guidance.

Oral histories collected in ʻEwa often recall how the lighthouse became a fixture in community memory. Children grew up seeing its beam sweep across the night sky, while fishermen used it as a reference point when heading offshore. In this way, even as industrialization transformed Kalaeloa, Puhilele remained culturally relevant.

The story of Puhilele illustrates how Hawaiian place-based knowledge persists even through changes in land use and governance. The name "leaping eel" connects the site to older traditions of liminality, vitality, and boundary-crossing. The commanding views reinforce Hawaiian concepts of observation and stewardship. The lighthouse itself represents continuity in a new form: a structure that, while foreign in origin, affirms the enduring role of Puhilele as a guidepost.

In cultural impact assessments and preservation planning, it is important to consider not only the physical lighthouse but also the integrity of the view planes from and toward Puhilele. Protecting these sightlines ensures that the place continues to serve its cultural function, linking the land and sea visually and spiritually.

Figure 16. Image of Barbers Point Light, location of Puhilele, from deck of Hōkūleʻa (March 2006, photo by author).

Puhilele is more than the site of the Barbers Point Lighthouse. It is a cultural vantage, a view plane that has long provided guidance to navigators, fishers, and community members. The image above is Puhilele from the deck of the Hōkūleʻa in 2006. Its name conveys the dynamism of the sea and the liminality of coastal thresholds. Its views unite the horizons of land and ocean, reminding us of ʻEwa's abundance and interconnectedness. In this regard, it is very possibly a historic site and as a view plane and cultural landscape, it should be evaluated under both Section 106 of the National Historic Preservation Act and Hawaii Revised Statutes, Chapter 6E. While the project is unlikely to have an effect on this landscape, it is nonetheless the responsibility of the project proponent under Chapter 343 to identify historic sites and cultural resources to the extent possible.

The lighthouse, though Western in origin, is a testament to the natural prominence of Puhilele as a beacon. Together, the cultural and maritime histories of this site affirm its enduring role as a place of guidance. Protecting Puhilele—its landscape, seascape, and name—ensures that future generations will continue to recognize the leaping eel as both a light in the night and a storied horizon of meaning.

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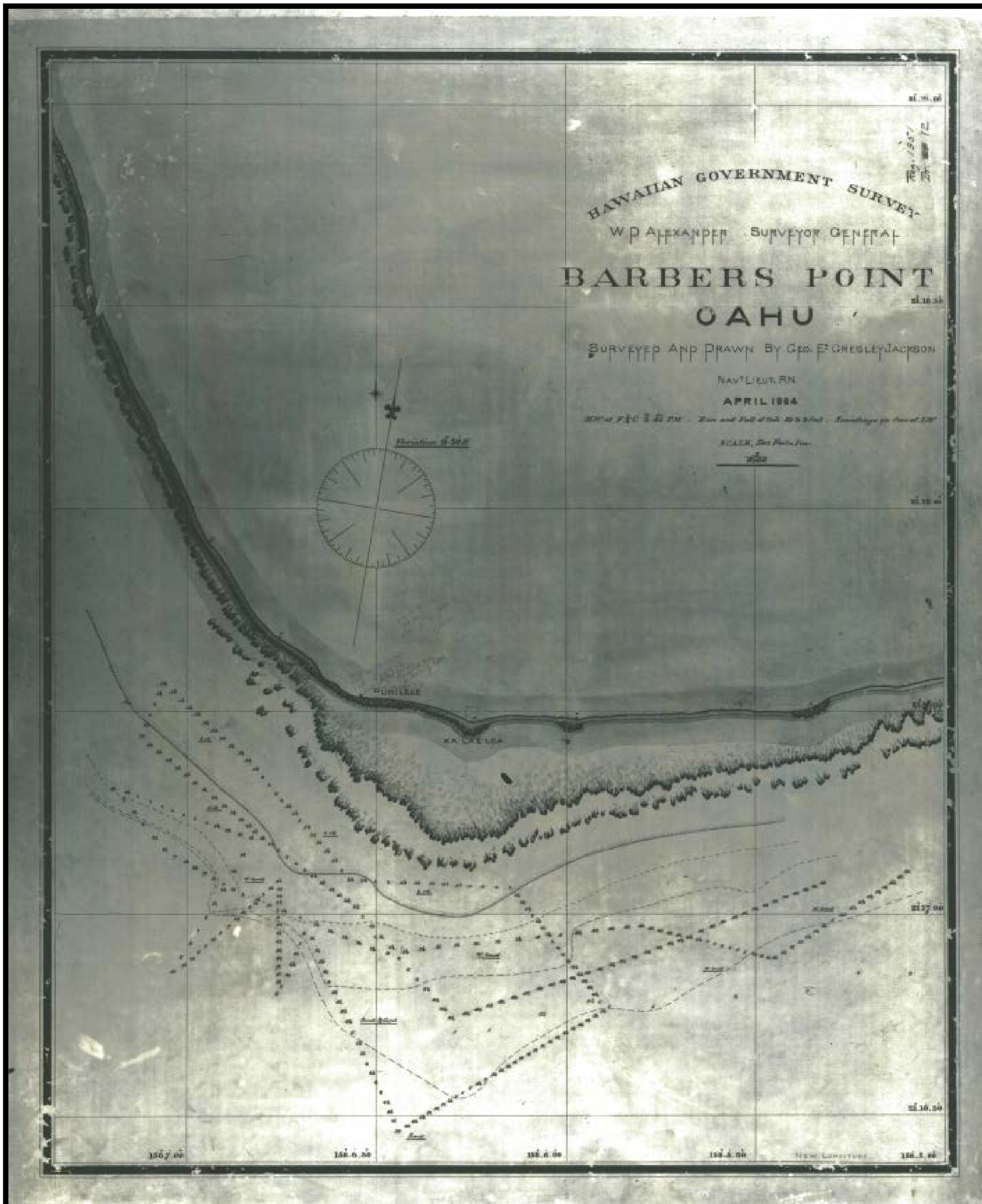

Figure 17. Registered map showing Puhilele.

5.9 Ceremonial Practices

The ceremonial practices of traditional Hawaiians are extensive. Throughout the course of Hawaiʻi's history, traditional Hawaiians have integrated religious, spiritual, and ceremonial practices in their daily lifestyle. Traditional or customary practices are then not distinct ceremonial practices but rather a part of the Hawaiian way of life. Therefore, it is challenging to explicitly define ceremonial practices associated with traditional Hawaiian customs. For the purpose of this section, the ceremonial practices discussed here focus primarily on customs carried out by general populations of Hawaiians, as opposed to activities or rituals carried out by trained and recognized specialists, kahuna.

Ceremonial practices are incorporated throughout numerous, if not all, of the activities identified in this section. For example, there is a great level of ceremonial practice and ritual associated with the care of the dead, burial remains, and funerary objects. Native Hawaiians, as with most Indigenous peoples, integrated ceremony into most of their practices especially those that occurred in the natural landscape or related to their way of life. There was no specific site or materials required for ceremony *per se*.

Nonetheless, shrines were sometimes associated with ceremonial practices. Shrines for the purpose of this assessment are distinct from heiau, which were places of worship. The distinction is the natural contexts in which these features or sites were created. Heiau required the advice and guidance of a kahuna, who would help aliʻi determine the best location in which to erect a heiau. Conversely, shrines were erected by makaʻāinana (working class) as part of their daily or occupational functions.

Makahiki is one example of a practice that has taken place prior to contact and continues post-contact and involves ceremonial elements. One of these elements is the akua loa, described by Malo as "the image of the Makahiki god, Lono-makua … This work was called ku-i-ke-pa-a" (Malo, 1951, p. 143). Further described by Malo (1951):

> 22. This Makahiki idol was a stick of wood having a circumference of about ten inches and a length of about two fathoms. In form, it was straight and staff-like, with joints carved at intervals and resembling a horse's leg; and it had a figure carved at its upper end.
>
> 23. A cross piece was tied to the neck of this figure, and to this cross piece, kea, were bound pieces of the edible pala[16] fern. From each end of this cross piece were hung

[16] Native fern (*Marattia douglasii)* used for medicinal purposes as well as in ceremony.

> feather lei that fluttered about, also feather imitations of the kaupu bird[17], from which all the flesh and solid parts had been removed.
>
> 24. The image was also decorated with a white tapa cloth made from wauke[18] kakahi[19], such as was grown at Kuloli[20]. … One end of this tapa was basted to the cross piece, from which it hung down in one piece to a length greater than that of the pole. The width of this tapa was the same as the length of the cross piece, about sixteen feet.
>
> 25. The work of fabricating this image, I say, was called kuikepaa. The following night the chiefs and people bore the image in grand procession, and anointed it with cocoanut (sic) oil. Such was the making of the Makahiki god. It was called Lono-makua (father Lono), also the akua loa. This name was given it because it made the circuit of the land. (pp. 144-145)

The akua loa was taken to each ahupuaʻa. This custom was important to the care, stewardship, and worship of the gods. These practices were intimately tied to the proper care and sustainable stewardship of all cultural and natural resources. Ethnographic data conducted for this study indicates that such practices take place within the project area.

As with many concepts of traditional Hawaiian living and practices, the contemporaneous concept of the kahuna has been largely influenced by Western thought. The roles and responsibilities of the kahuna are well explained by Professor Terry Kanalu Young (1998):

> As recipients of hana lawelawe[21], the Aliʻi Nui were themselves servers of a sort. They were responsible for maintaining a positive spiritual relationship with the Akua through pono conduct. Pono was defined for individuals of that era within the context of a particular task specialty. Kahuna who functioned as experts in specific skill areas like medicinal healing, canoe building, or spiritual advising were consulted by leaders. The experts were looked to as responses for what was considered pono in their respective realms of knowledge. (p. 74)

17 Laysan albatross (*Diomedea immutabilis*), written with diacritical markings as kaʻupu.
18 Paper mulberry (*Broussonetia papyrifera*)
19 Meaning outstanding or of high quality, as in reference to the white kapa (tapa) made from these fibers.
20 Likely a reference to the place in Pelekunu Valley at Kamalō, Molokaʻi, located between the peaks of Kaunuohua and Pēpēʻōpae.
21 Hana lawelawe are defined by Young (1998) as "service tasks" by which kaukau aliʻi (lower ranked chiefs) served the Aliʻi Nui (high chiefs). These hana lawelawe were critical to the ability of the Aliʻi Nui to effective govern.

Kahuna were critical to traditional Hawaiian lifeways as their extensive expertise helped to provide sound and strategic advice to aliʻi and other leaders on proper spiritual, cultural, and ecological management. There are numerous types of kahuna in Hawaiian traditions. including, but not limited to:

- kahuna ʻanāʻanā – sorcerer who practices black magic and counter sorcery.
- kahuna aʻo – teaching preacher, minister, sorcerer.
- kahuna hāhā – an expert who diagnoses, as sickness or pain, by feeling the body.
- kahuna haʻiʻōlelo – preacher, especially an itinerant preacher.
- kahuna hoʻohāpai keiki – medical expert who induced pregnancy.
- kahuna hoʻopiʻopiʻo – malevolent sorcerer, as one who inflicts illness by gesture.
- kahuna hoʻoulu ʻai – agricultural expert.
- kahuna hoʻoulu lāhui – priest who increased population by praying for pregnancy.
- kahuna hui – a priest who functioned in ceremonies for the deification of a king.
- kahuna kālai – carving expert, sculptor.
- kahuna kālai waʻa – canoe builder.
- kahuna kiʻi – caretaker of images, who wrapped, oiled, and stored them, and carried them into battle ahead of the chief.
- kahuna kilokilo – priest or expert who observed the skies for omens.
- kahuna lapaʻau – medical doctor, medical practitioner, healer. *Lit.*, curing expert.
- kahuna makani – a priest who induced spirits to possess a patient so that he might then drive the spirits out.
- kahuna nui – high priest and councilor to a high chief; office of councilor.
- kahuna poʻo – high priest.
- kahuna pule – preacher, pastor, minister, parson, priest, clergyman. *Lit*., prayer expert.
- kahuna pule kaʻahele – preacher.
- kahuna pule wahine – priestess.

Most ceremonial practices in this area would have been associated with kilo practices in Honouliuli, and their connection to the ocean, specifically observing ocean conditions before going to fish or dive. There is an active community of practitioners who cultivate and gather limu in the ahupuaʻa.

5.10 Haku Mele, Haku Oli, and Hula

This practice involves the creation of songs and chants. It has been part of Hawaiian culture for many centuries. Since Hawaiians mainly relied on oral tradition to pass down knowledge and information, the ability to craft songs and chants was crucial for transmitting information across generations. Hawaiians had hundreds of terms related to this practice.

Songs and chants are primarily influenced by their environment. As an educator, it was crucial—if not essential—that these songs or chants effectively reflect data from the surrounding environment of the composer and transmit this information for others to use in managing natural resources. In a literal sense, the land and natural resources serve as a muse for composers. The category of songs that provide information about, or speak to, natural resources are called mele ʻāina (songs of the land).

Much like mele and oli, hula serves as a way of both honoring place and telling the story of place. Many hula, especially those based on mele ʻāina, require intimate understanding of the place where the mele was composed, including the natural elements of that ʻāina. Hula hālau will regularly take huakaʻi (journeys) to visit and honor the place of which a particular mele speaks. The ability to visit the place and learn about it is important to the practice of hula.

Hula, as well as mele or oli, are also offered as gifts to kupuna and gods. This practice requires access to traditional sites. Associated with hula are the practices of lei making and the use of plants to dye clothing, both of which were identified in the project area through the ethnographic data collection.

Various celebrations occur in the Kapolei area, including the Annual Prince Kūhiō Parade and hula celebrations at Puʻuokapolei.

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6 Ethnographic Data

The following section provides ethnographic data in the form of interviews conducted by Honua Consulting. Ethnographic data is utilized to supplement the other research methods utilized. It is one in a range of research tools employed to gather information about the project area.

6.2 Previous Oral Histories

Ethnographic data, often gathered through oral interviews, plays a critical role in supplementing archival research, archaeological surveys, and other lines of inquiry in cultural impact assessments. The following synthesis is drawn from interviews conducted in previous CIAs within the ʻEwa and Kapolei region. While they provide valuable context for understanding cultural resources, perceptions, and community concerns, it is important to note that these are not the oral histories conducted specifically for this reef project. For the present study, Honua Consulting has carried out new oral histories with additional practitioners and residents directly connected to the Kalaeloa reef project area.

The earlier interviews nonetheless provide an important baseline for understanding cultural perspectives in Honouliuli and Kalaeloa. They highlight long-term residents' knowledge of the landscape, changes over time, and the enduring cultural significance of this part of ʻEwa. Taken together, they reveal both the disruption caused by plantation agriculture and modern urbanization, and the resilience of cultural memory and practice.

One voice represented in these earlier studies is that of Kumu Hula Iwalani Tseu, a Native Hawaiian cultural practitioner and hula teacher who was born and raised in Honouliuli. For her, the area is not simply a backdrop for modern development but a living cultural landscape, layered with spiritual presence and memory. She recalled that the plains once supported large numbers of *pueo* (Hawaiian short-eared owls), though their numbers have dwindled due to habitat destruction. She also spoke of Honouliuli's artesian wells, once renowned as sources of freshwater, but now heavily depleted by the pressures of development. Tseu emphasized that iwi are known to exist in the region despite sugarcane cultivation and subsequent construction. Her concerns centered on the ongoing commercialization of ʻEwa and the gradual erosion of cultural integrity. She stressed that any project in the area should engage Native Hawaiian practitioners to conduct blessings, consult with cultural experts, plant native and culturally significant trees, and follow proper reinterment protocols if iwi are encountered.

Another voice was that of Shad Kane, a long-time cultural consultant, community leader, and caretaker of Kalaeloa Heritage Park. Kane situated the project area in the historic landscape once known as Kaupeʻa, or "the bat's perch," a place rich with layered meaning. The name refers not only to the southern cross constellation, which guided navigators, but also to the spirits said to wander across the ʻEwa plains. Kane offered a detailed account of how ʻEwa's cultural and natural landscape was transformed in the late 1700s and 1800s with the rise of ranching, whaling, and sugarcane agriculture. American landowners recognized the fertility of the plains, and vast tracts were converted to monocrop plantations, permanently altering the cultural landscape. Kane observed that much of the area's archaeological and cultural record was destroyed in this process. As a result, he was unable to recall existing cultural resources within the project area. He acknowledged the possibility of iwi but was uncertain whether they had survived intact. Interestingly, Kane did not oppose further development, noting that Kapolei remains one of the few places left on Oʻahu where new housing can be built. His primary concern was not cultural impact but the strain on limited water resources.

Kumu Hula Mikiʻala Lidstone provided yet another perspective. Raised in Kailua but now residing in Kapolei, she is deeply familiar with the ʻEwa plains and passes the project site regularly. Her testimony emphasized the ecological and cultural significance of the region as habitat and pathway for the *pueo*. Like Tseu, she considered it very likely that iwi remain in the soil, especially given that much of the area is underlain by sinkhole environments that can preserve cultural materials. She also described the ʻEwa plains as a landscape of spirits, where wiliwili trees were traditionally planted to feed wandering souls. Lidstone stressed the potential impacts of new development on *pueo* breeding grounds and iwi kupuna. She recommended continuous archaeological monitoring during excavation, protection of the *pueo* during construction, and the use of native plants—wiliwili, kou, maʻo, and other culturally significant species—for landscaping. For her, mitigation was not simply about compliance but about honoring the spirit of the land and reintroducing cultural integrity through planting and stewardship.

Finally, Kumu Hula Hinaleimoana Wong-Kalu (Kumu Hina), a respected cultural leader and former chair of the Oʻahu Island Burial Council, placed the project area within a broader narrative of land and resource loss. She described how the ʻEwa moku was once lush and green before the sugar plantations diverted and consumed water, reshaping the landscape of Kapolei. She explained that burials are more commonly found closer to the shoreline, marked by coral rock pile formations, and that cavern systems run through the region. Although she did not believe the likelihood of finding prominent burials within the project site itself was high—given the constant disturbance from sugarcane cultivation—she emphasized that the project must be prepared to handle burials appropriately if discovered. Wong-Kalu was clear that any such discoveries require adherence to established archaeological and cultural protocols, and she supported the use of locally based and respected firms for cultural monitoring. Beyond burials, she expressed concern about the cumulative effects of development, noting that even if one project has limited direct impact, each new development contributes to broader pressures on agriculture, open space, and cultural practices.

Taken together, these previous interviews highlight recurring themes. First is the recognition that iwi kupuna remain in the ʻEwa landscape, even if their precise locations are obscured by centuries of plantation agriculture and construction. Second is the acknowledgement of ecological-cultural connections, particularly the decline of *pueo* and the loss of artesian water sources, both of which are tied to Hawaiian cultural identity. Third is the sense that the cultural integrity of ʻEwa is slowly being eroded, with each new development further distancing the land from its ancestral and ecological functions. Finally, the interviews reveal a divergence in perspectives: some practitioners, like Tseu, Lidstone, and Wong-Kalu, emphasize caution, cultural protocols, and ecological stewardship, while others, like Kane, view development as an unavoidable necessity so long as basic issues like water supply are addressed.

These testimonies illustrate that while the physical project area may appear to lack visible cultural practices today, it remains embedded in a broader cultural landscape filled with memory, ancestral presence, and symbolic meaning. Honouliuli, Kapolei, and Kalaeloa are not simply vacant plains awaiting development—they are storied places shaped by centuries of cultural practice, disrupted by plantation agriculture, and remembered through oral tradition.

It must be emphasized again that these interviews were conducted as part of previous CIAs and do not represent the new oral histories undertaken for the reef project. For the present study, Honua Consulting has engaged directly with additional practitioners and residents who hold knowledge specific to the Kalaeloa reef area. These new oral histories expand the record and provide more immediate perspectives on the cultural resources and practices connected to the reef itself. Nonetheless, the earlier interviews summarized here remain invaluable for situating the reef project within the wider historical and cultural context of ʻEwa, reminding us of the deep and enduring connections between land, water, spirits, and people in this storied moku.

6.3 Community Consultation (led by the University of Hawaiʻi)

Community consultation for the Kalaeloa Reef Project has been led by the **University of Hawaiʻi, Hawaiʻi Institute of Marine Biology (HIMB)** in collaboration with project partners. The consultation process was structured to engage Native Hawaiian organizations, cultural practitioners, community groups, and regulatory agencies to ensure that cultural knowledge, concerns, and recommendations were incorporated into project planning and assessment. Engagement included **formal presentations, neighborhood board meetings, civic club and hui discussions, emails, phone calls, and in-person meetings.**

Between 2021 and 2025, the project team conducted multiple consultations across Oʻahu, with an emphasis on communities most directly connected to the ʻEwa, Kapolei, Kalaeloa, and Honouliuli region. In **August 2025,** the Makakilo–Kapolei–Honokai Hale Neighborhood Board No. 34 received a project briefing and voted unanimously in support. That same month, presentations were provided to the **Kapolei Hawaiian Civic Club** and the Kuaʻāina Ulu ʻAuamo (**KUA) Limu Hui,** preceded by consultation with the **Kalaeloa Heritage and Legacy Foundation** in July 2025, which resulted in a letter of support. Earlier, in June 2025, the project team was invited to present to the **Kalaeloa Heritage Park Foundation Board,** where discussions began around the site's cultural and ecological significance.

Broader island-wide outreach was also conducted. In **December 2024,** the project was presented to the **DLNR Fishers Working Group,** preceded by neighborhood board meetings in **Kāneʻohe (June 2024)** and **Kailua (March 2024).** Additional engagements included presentations to **Hui o Koʻolaupoko (March 2024), Ke Kula Nui o Waimānalo/Waimānalo Pono Research (January 2024),** and repeated consultation with the **Koʻolaupoko Hawaiian Civic Club (2021–2024),** which also issued a formal letter of support.

Consultations revealed a wide range of perspectives, with recurring themes reflecting both longstanding regional issues and site-specific questions about the hybrid reef. Community members often tied their feedback to broader challenges in ʻEwa and Oʻahu, such as rapid development, water diversions, loss of limu, pressures on cultural sites, and distrust of projects perceived to prioritize outside interests. While many expressed support for the project's concept, skepticism remained about whether it would provide meaningful benefits or simply add to the cumulative burden of development. Key questions centered on how success would be measured, who in the community would decide if it was beneficial, and under what conditions the structure might be removed if it did not serve community interests.

Concerns were raised about whether the Kalaeloa shoreline truly required protection, and why the prototype was being tested here rather than in higher-energy locations such as the North Shore. The project team explained that the design was not intended for such conditions and must first be tested in a smaller wave-energy environment, with potential applications elsewhere in Hawaiʻi if successful. Similarly, some community members argued that the coastline looked unchanged in their lifetime and questioned whether there had ever been a reef to restore. Archival maps, early explorer accounts, and historic photographs were used to demonstrate that Kalaeloa once supported more extensive reef habitat and nearshore limu beds, suggesting a long-term decline in ecological productivity.

The most significant cultural concern centered on *ʻamaʻama* (mullet). Community members emphasized that the sandy habitats offshore Kalaeloa have been culturally important for mullet spawning and migration, and that any interference would be unacceptable. While ecological studies suggest mullet are able to move around natural and artificial obstacles, assurances were requested that biodiversity monitoring will track mullet specifically, and that mitigation—including possible removal—would be considered if adverse impacts occurred. Limu was also identified as a critical resource, with mixed opinions on whether it should be actively outplanted or allowed to regenerate naturally. Lawaiʻa voiced concern about predator-prey dynamics and whether the reef might attract predatory fish to the detriment of subsistence species.

Community members also questioned the footprint of the prototype, arguing that it seemed unnecessarily large for a test. The project team explained that the design reflects the minimum size needed to measure wave attenuation and that performance will be independently assessed by the U.S. Army Corps of Engineers and U.S. Geological Survey. Finally, participants asked how the community would be directly involved and compensated for their time and expertise. In response, the project team committed to forming a kūpuna council of lineal descendants, working with community partners, and creating pathways for community participation in monitoring and evaluation.

Overall, consultation showed cautious support tempered by concerns about cumulative development, impacts to *ʻamaʻama* and limu, and trust in long-term project stewardship. Success will depend on continued transparency, rigorous monitoring of culturally important species, and ensuring meaningful pathways for community involvement in decision-making.

6.4 Oral Interviews

As part of the ethnographic research for this CRA, oral interviews were conducted to gather community perspectives and cultural knowledge related to the Kalaeloa Reef Project area. Previous interviews with long-time ʻEwa residents have already been incorporated into this assessment, providing foundational insights into traditional and customary practices such as fishing, limu gathering, and kilo (environmental observation). To build upon this foundation, the most recent round of interviews focused specifically on residents of **Hawaiian Homestead communities**, which represent the geographically closest residential Native Hawaiian communities to the project site.

These interviews with community leaders and residents of Kanehili and Kaupeʻa Homesteads captured both personal experiences and generational knowledge tied to the ʻEwa and Kalaeloa coastline. Participants described childhood memories of fishing, canoe paddling, surfing, camping, and gathering limu along the shoreline, practices that formed an essential part of family and community life. They also spoke candidly about the environmental decline they have witnessed over time, including the loss of reef structure, diminishing coral, and reductions in limu and fish populations.

The interviews further emphasized the significance of cultural heritage in the Kalaeloa area, including oral traditions identifying sacred sites such as heiau and accounts of restricted access due to military control. Community members expressed both pride in their cultural connections and concern for the future of marine resources. Collectively, these oral histories provide valuable, place-based perspectives that ground the project in the lived experiences of nearby Native Hawaiian homestead residents, ensuring their voices are included in cultural impact evaluation and planning.

6.4.6 Jodi Akau

Ms. Jodi Akau is a resident of the Kanehili Community (Hawaiian Home Lands) and an active participant in her neighborhood's security watch program. Ms. Akau has long-standing familial and community ties to the ʻEwa region, having been born in Hawaiʻi and raised in ʻEwa Beach. Today, she continues to play a leadership role in her community by coordinating safety and security efforts. Through her involvement, she has helped close down five drug houses and one illegal gaming room, underscoring her commitment to protecting and improving the quality of life in her neighborhood.

In reflecting on her upbringing, Ms. Akau shared her deep memories of growing up in ʻEwa Beach surrounded by sugarcane fields and coastal ecosystems. The shoreline of Honouliuli and Kalaeloa was central to her childhood. She recalls a community environment filled with cultural and natural richness—paddling canoes, surfing, fishing, and gathering limu along the beaches of Puʻuloa. Birds such as the pueo (Hawaiian short-eared owl) were a common sight, further anchoring her sense of place in the ʻEwa landscape.

A central theme of Ms. Akau's recollections is the **coral reef and its decline**. As a child, she knew the reef that extended from ʻEwa to Kapolei as an abundant source of limu and fish. However, over time, she witnessed its slow degradation. She describes standing on the shoreline of Kalaeloa and watching as broken fragments of coral washed ashore with the waves, often collecting pieces that came to her feet. These weekly experiences left her saddened, as they symbolized the diminishing reef system and the concurrent loss of limu, fish, and other marine life. Her observations provide valuable first-hand testimony of ecological change in the region as seen through the eyes of a community member who has lived there for decades.

Ms. Akau has also engaged with efforts to learn about the heritage of the ʻEwa region. She has visited the Kalaeloa Heritage Center to learn about the cultural and historical significance of the area. While she was primarily aware of recreational sites such as the raceway parks in her younger years, her later experiences deepened her awareness of the broader heritage of Honouliuli. She expressed that the shoreline and its resources were "everything to the people in that area," emphasizing the centrality of coastal ecosystems to community life.

When asked about ongoing or recent projects in the Kalaeloa area, Ms. Akau stated she was not aware of any. However, she strongly emphasized the importance of raising awareness within Hawaiian communities about the ecological and cultural conditions of Honouliuli and Kalaeloa. She believes that **all Hawaiians have a shared responsibility** to care for these resources and that communication should be brought directly to surrounding communities. To that end, she suggested convening townhall meetings led by Honouliuli community leaders and strongly encouraged involvement by state representatives to ensure that Hawaiian voices are recognized and integrated into decision-making processes.

Ms. Akau's testimony highlights several key cultural themes: the deep connection between community identity and the coastal environment, the observed decline of coral reefs and limu resources, and the importance of collective stewardship. Her personal story reflects the lived experience of many ʻEwa residents, where the erosion of ecological health has been witnessed over a lifetime. Her recommendations emphasize community engagement, cultural awareness, and political advocacy as essential elements in protecting the resources of Honouliuli and Kalaeloa for future generations.

6.4.7 Iwalani Laybon-McBrayer

This oral history interview was conducted with **Ms. Iwalani Laybon-McBrayer**, a lifelong Hawaiʻi resident who was born and raised in Honolulu and now resides in the Kapolei Kaupeʻa Homestead. Professionally, Ms. Laybon-McBrayer serves as a Community Coordinator Consultant with Ikenakea Development and Kalanianaʻole Development, supporting housing and commercial projects both on Hawaiian Home Lands and beyond. Her dual role as a community member and consultant provides her with a perspective rooted in both cultural connection and contemporary land-use issues.

Although Ms. Laybon-McBrayer has not personally visited the Kanehili Heritage Center in Kalaeloa, she is aware of its importance within the Barber's Point region. Her familiarity with the area derives from both her professional work and her upbringing, particularly her family's practices along the ʻEwa shoreline. She recalls that after attending services at the Church of the Nazarene in ʻEwa Beach, her family would often go to Puʻuloa Beach, where they gathered limu with their grandmother. Labor Day weekends were marked by camping and fishing trips with her ʻohana, practices that reinforced cultural connections to place and resources along the ʻEwa coast. These memories emphasize the continuing importance of subsistence, family gatherings, and resource use in shaping community identity.

In discussing the historical and cultural significance of Kalaeloa and Honouliuli, Ms. Laybon-McBrayer shared the knowledge passed down from her kūpuna. She recounted that oral traditions spoke of the area as a site of human sacrifice and of the presence of heiau. While she did not provide specific site identifications, her testimony underscores the recognition within Hawaiian families that Kalaeloa is a landscape of profound spiritual and cultural importance.

Ms. Laybon-McBrayer also noted the impact of restricted access in the area, particularly during the years when the land was under exclusive military control. She recalled that much of the coastline had been closed to the public, limiting the ability of local families to continue cultural practices there. Although she is not aware of specific resources that might be directly impacted by proposed development projects in Kaloa, she emphasized the broader concerns of the lāhui regarding access to coastal areas and cultural sites. She stressed that any future projects should incorporate education about cultural places, resources, and best practices to ensure that development does not further alienate communities from their ancestral lands.

Looking forward, Ms. Laybon-McBrayer recommended that consultation extend beyond individual voices to include the broader ʻEwa and Kapolei communities, as well as elected city and state officials. She did not request omission of any of her statements from the record and expressed appreciation for the opportunity to share her experiences and perspectives.

Her testimony highlights several key themes: the continuity of limu gathering and fishing as cultural practices, the significance of oral traditions in identifying sacred places such as heiau, the disruptions caused by military restrictions, and the importance of inclusive consultation processes. Together, these reflections provide valuable insight into how residents of ʻEwa and Kapolei view the cultural landscape of Kalaeloa and Honouliuli, emphasizing the need to balance development with cultural stewardship and community trust.

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7 Impact Assessment

When the Hawaiʻi State Legislature passed Act 50 in 2000, the purposes of the Act were clear: "1) Require that environmental impact statements include the disclosure of the effects of a proposed action on the cultural practices of the community and State; and 2) Amend the definition of "significant effect" to include adverse effects on cultural practices" (Act 50, SLH 2000).

HRS 343-2, as amended per Act 50, defines an "Environmental impact statement" (EIS) as "an informational document prepared in compliance with the rules adopted under 343-6 and which discloses the environmental effects of a proposed action, effects of a proposed action, effects of a proposed action on the economic welfare, social welfare, and *cultural practices of the community and State*, effects of the economic activities arising out of the proposed action, measures proposed to minimize adverse effects, and alternatives to the action and their environmental effects" (emphasis added) (HRS Chapter 323-2).

Under the same part, "Significant effects" is defined under state law as "the sum of the effects on the quality of the environment, including actions that irrevocably commit a natural resource, curtail the range of beneficial uses of the environment, are contrary to the State's environmental policies or long-term environmental goals as established by law, or adversely affect the economic welfare, social welfare, or *cultural practices of the community and State*" (emphasis added) (HRS Chapter 323-2). Therefore, an adverse effect to cultural practices of the community or state constitutes a "significant effect" under Chapter 343.

The purpose of this Cultural Resource Assessment (CRA) is to identify and evaluate the range of cultural resources that may be present in the project area. These include archaeological resources, biological resources of cultural importance, intangible cultural resources, and ongoing cultural practices. The assessment then considers whether or not the proposed action may have an adverse impact on any of these resources.

This CRA identifies and evaluates tangible or physical impacts to historic sites, as well as impacts to flora and fauna, to the extent that such impacts affect cultural resources or cultural use. While the archaeological and biological sections of the Environmental Assessment (EA) provide more technical analysis of those respective areas, the CRA addresses them in relation to their cultural meaning and significance. In this way, the CRA provides a holistic view that integrates archaeological, biological, and intangible cultural dimensions, with a focus on how they relate to Native Hawaiian practices and values, as required under Hawaiʻi Revised Statutes Chapter 343.

The standard under which an Environmental Impact Statement (EIS) is considered sufficient is also well-established in Hawaiʻi case law. As the Hawaiʻi Supreme Court has held:

> …an EIS need not be exhaustive to the point of discussing all possible details bearing on the proposed action but will be upheld as adequate if it has been compiled in good faith and sets forth sufficient information to enable the decision-maker to consider fully the environmental factors involved and to make a reasoned decision after balancing the risks of harm to the environment against the benefits to be derived from the proposed action, as well as to make a reasoned choice between alternatives. *Price v. Obayashi Hawaii Corp.*, 81 Hawaiʻi 171, 182 (1996), upheld in *Kaleikini v. Yoshioka*, 283 P.3d 60, 74 (2012).

Consistent with this standard, the CRA does not attempt to provide exhaustive detail on every conceivable aspect of the project area. Rather, it seeks to provide a good-faith and sufficiently thorough evaluation of the cultural resources potentially affected, so that decision-makers and the public can fully consider environmental factors, balance risks and benefits, and make reasoned choices about the proposed action.

7.2 Impacts to Flora

Conservation measures developed in consultation with NMFS and DARPA specifically require avoidance of placing anchors or reef structures on existing seagrass or coral colonies. Outplanted corals, propagated limu, and culturally informed installations such as umu kai (traditional stone fish houses) will actively reestablish marine biodiversity and integrate Native Hawaiian stewardship practices into the project's ecological design. This explicit blending of cultural knowledge and ecological restoration demonstrates the recognition that protecting native and culturally significant flora is central to both community well-being and project success.

7.3 Impacts to Fauna

The Kalaeloa Reef Project intersects with species that are ecologically and culturally vital. Consultation with NMFS emphasized the need to protect ESA-listed turtles, coral-dependent fish, and limu-associated invertebrates. The project's biodiversity monitoring program includes species such as ʻamaʻama, ʻopelu, mullet, octopus, and limu, ensuring that cultural resources are explicitly considered in scientific assessments.

By integrating cultural knowledge with ecological science, the project has the potential not only to avoid adverse impacts but to foster restoration. Protecting and enhancing faunal populations strengthens subsistence practices, sustains kilo traditions, and reinforces cultural continuity in Kalaeloa.

The fauna of Kalaeloa embody the intimate ties between people and place. From mullet migrations to nesting seabirds, these species anchor traditional knowledge, subsistence practices, and ceremonial life. Archaeology, moʻolelo, and living traditions affirm their centrality. The proposed project must carefully monitor and protect these resources, acknowledging that cultural resilience is inseparable from ecological health. If successful, the reef restoration may provide a model for how science and cultural practice can work together to revitalize marine life and sustain Hawaiʻi's living heritage.

7.4 Impacts to Historic Sites

Impacts to historic sites with the project are unlikely. There is always the potential for the identification of human remains in coastal regions, but the likelihood of the project impacting burials is low.

7.4.6 Puhilele

The Puhilele site, despite being identified on historic maps, has gone largely undocumented in cultural resource reports. This section documents and evaluates the site within the context of the region as part of a potential cultural landscape. The ʻEwa Plain and the coastal lands of Kalaeloa (Barbers Point) form one of the most archaeologically significant landscapes on Oʻahu. For centuries, Native Hawaiians occupied and utilized this region, leaving behind a record of habitation, subsistence, and ritual features embedded in the coral limestone substrate. Salvage excavations conducted in 1977 ahead of harbor development revealed evidence of temporary shelters, sinkhole use, and specialized fishing technology (Sinoto, 1978). More recently, surveys and preservation planning associated with the closure of the Naval Air Station at Barbers Point led to the creation of Kalaeloa Heritage Park, which protects over 177 relatively undisturbed archaeological features including habitation sites, agricultural complexes, and religious structures such as a heiau. Taken together, these findings and preservation efforts demonstrate that Kalaeloa was not marginal but central to coastal lifeways, particularly fishing and gathering, and remains critical to cultural identity and education.

7.4.6.1 Salvage Archaeology and Coastal Adaptation

The 1977 salvage project focused on a sample of the coastal plain, documenting roughly twelve percent of the planned development area. The karstic environment of the ʻEwa Plain is riddled with sinkholes, and these features became focal points for both paleontological and archaeological evidence. While many contained only fossilized bird remains deposited naturally, several clearly showed cultural use: ash deposits, midden, and artifacts were recovered that point to short-term habitation and subsistence activity.

At Site B6-70, archaeologists uncovered a U-shaped stone structure built to shield occupants from the trade winds, located beside a sinkhole filled with midden. The midden included bird bone, ash, and abundant marine shell, notably *Brachidontes cerebristriatus*, the Hawaiian mussel known as *kio nahawele*. This species thrives in intertidal environments, and its presence indicates systematic shellfish gathering. The site also produced basaltic glass flakes, a hematite chip, and a drilled bird bone fragment—possibly crafted from an extinct seabird species. This combination of artifacts and ecofacts suggested that B6-70 functioned as a temporary shelter for coastal foragers and fishers, who consumed shellfish and disposed of waste in the sinkhole.

Site B6-78 contained dense avifaunal remains but few cultural indicators, while Site B6-100 yielded more robust evidence of human use. Here, midden deposits contained fire-cracked basalt, ash, and thirteen artifacts, including basaltic flakes, an adze fragment, and a coral abrader. The basalt, not native to the ʻEwa limestone plain, must have been imported by canoe from volcanic uplands, demonstrating integration of inland and coastal zones. Coral files were likely used for finishing bone fishhooks, directly connecting the site to fishing technology. Fireplaces and cooking debris suggested habitation during short-term fishing trips, with on-site tool maintenance.

Site B6-119 consisted of a rectangular enclosure with limited cultural material, while Site B6-138 provided some of the strongest evidence of fishing. Ash and midden deposits there were associated with coral abraders and a fishhook fragment made from human bone. This fragment was part of a composite hook used to catch pelagic species such as *aku* (bonito) or octopus (*heʻe*). The presence of this artifact, alongside coral tools for hook production, indicated that B6-138 was a fisherman's shelter where catches were processed and gear repaired before returning to inland settlements.

Across these sites, midden contents consistently reflected reliance on coastal resources. Shellfish, especially *kio nahawele*, were abundant, showing that intertidal harvesting was routine. Bird bone, including extinct species, highlighted the ecological richness of the plain, while ash deposits marked food preparation. Imported volcanic rock showed broader transport and exchange networks, with canoe travel bringing tools and resources to the limestone coast.

7.4.6.2 Broader Archaeological Landscape

While the salvage excavations provided detailed snapshots of coastal lifeways, later surveys expanded the picture of Kalaeloa's archaeological significance. The closure of Naval Air Station Barbers Point in 1999 triggered a Section 106 consultation process under the National Historic Preservation Act. This process required the Navy to identify historic properties, evaluate impacts, and consult with state and community stakeholders. As part of the redevelopment planning, more than 177 archaeological features were documented and preserved within what became the Kalaeloa Heritage Park.

These features included stacked coral dwellings, agricultural sites, religious structures such as a heiau, modified sinkholes, and traditional trails. The diversity of site types demonstrated that Kalaeloa supported not only temporary fishing shelters but also long-term habitation and ritual activity. Oral traditions had long placed early Polynesian migrants in the ʻEwa Plain, and the archaeological record now confirmed a complex pattern of use that included subsistence, ceremony, and settlement.

The establishment of Kalaeloa Heritage Park in partnership with the Kalaeloa Heritage and Legacy Foundation ensured that these resources would be preserved and interpreted for the public. The park highlights both pre-contact Hawaiian archaeology and later layers of land use, including plantation-era ranching and military occupation. This integrated history reflects the ongoing cultural presence of Native Hawaiians in the region and provides opportunities for education about subsistence practices, including fishing, gathering, and farming, which shaped the landscape for centuries.

7.4.6.3 Ecological and Cultural Integration

The archaeological data reveal a system of adaptation finely tuned to Kalaeloa's ecological zones. The reef and offshore waters provided pelagic species, exploited with composite fishhooks such as that found at Site B6-138. The intertidal zone supplied *kio nahawele* mussels and other shellfish, as seen in the midden of Site B6-70. Inland karst sinkholes served as shelters and refuse pits, where bird bone, ash, and artifacts accumulated. Together, these zones structured a subsistence strategy where temporary coastal camps were linked to inland agricultural bases, and canoe transport integrated resources from across Oʻahu.

The role of seabirds in this system is notable. Dense deposits of avifaunal bone at sites such as B6-78, though not always cultural in origin, illustrate the ecological abundance of the coast. Bird species may have supplemented diet or provided raw material for tools, as seen in the drilled bird bone artifact from B6-70. Their presence adds another layer to the picture of Kalaeloa as a productive environment that supported both terrestrial and marine harvesting.

7.4.6.4 Evaluation of Significance

The archaeological record of Kalaeloa demonstrates that the ʻEwa coastal plain was far from marginal. Although its arid, limestone terrain was not suited to intensive agriculture, the coast was a dynamic zone of subsistence and settlement. Short-term camps, shelters, and sinkhole middens preserve evidence of fishing, gathering, and tool production. Finds such as human bone fishhook fragments, coral abraders, and *kio nahawele* shells confirm the exploitation of reef and intertidal resources, while imported basalt indicates integration with inland and offshore transport systems. Later preservation efforts reinforced the significance of this record.

The Puhilele site itself has been destroyed by military activity and replaced with the Barbers Point Light, which itself is now a historic site on the National Register of Historic Places. While Puhilele no longer retains integrity as an individual property, it may continue to contribute to a larger cultural landscape. As Puhilele as an individual site no longer retains integrity, it is not eligible for the Hawaiʻi Register of Historic Places.

Through the Section 106 process for the closure of Naval Air Station Barbers Point, the establishment of Kalaeloa Heritage Park occurred, and as a result of this preservation effort, over 177 features, including heiau, habitation sites, and agricultural complexes, are now protected. This park ensures that the archaeological evidence of subsistence and cultural practice is not only preserved but shared with the community. The integration of salvage data, heritage preservation, and ecological context shows Kalaeloa as a key locus of Hawaiian adaptation, where fishing, gathering, and sailing formed the foundation of life along the ʻEwa coast. The park itself is not on the HRHP or NRHP, but individual sites located in the park have been determined eligible for the NRHP.

7.5 Impacts to Intangible Cultural Resources

The proposed project will have **no significant impact on intangible cultural resources.** Intangible cultural resources at Kalaeloa include the values, beliefs, and traditions tied to the coastal landscape, such as the oral histories of ʻEwa, the chants and sayings that reference its fisheries, and the sense of place associated with historic practices of gathering, fishing, and canoe travel. These resources are not solely dependent on the physical footprint of the project area, but rather on broader cultural identity, narratives, and community memory.

Because the project avoids direct disturbance to known archaeological sites and maintains the integrity of the surrounding heritage landscape, the intangible qualities associated with Kalaeloa are not anticipated to be diminished. The coastal viewsheds, sounds, and general character of the area will remain intact, preserving the setting in which moʻolelo, ʻōlelo noʻeau, and cultural memory are grounded. Continued access to cultural resources further ensures that the transmission of values and stories tied to the coast can continue uninterrupted.

Additionally, the project offers opportunities to showcase and interpret intangible cultural heritage through educational outreach and cultural signage. Such measures may strengthen public awareness of Kalaeloa's history and contribute positively to the perpetuation of cultural knowledge. On this basis, the project is determined to have **no adverse effect** on intangible cultural resources.

7.6 Impacts to Cultural Practices

Cultural practices at Kalaeloa have long centered on the **use of marine and coastal resources.** Archaeological evidence, including fishhook fragments, coral abraders, and midden rich in *kio nahawele*, demonstrates the historical importance of fishing and shellfish gathering. Oral traditions and historic accounts further document surfing at noted breaks, canoe launching, and limu collection along this coast. Today, cultural practitioners continue to value Kalaeloa for subsistence fishing, education, and ceremonies that reinforce ancestral connections to the sea.

The proposed project has the potential to temporarily **disrupt these practices.** Construction may temporarily limit access to shoreline areas used for fishing and gathering. Increased activity or modification of reef structures could alter nearshore habitats, potentially reducing the abundance of marine species relied upon by practitioners. The introduction of modern infrastructure also risks diminishing the cultural atmosphere that supports practices like fishing or ceremonial observances, where a sense of continuity with ancestors is essential.

However, with careful planning, impacts can be minimized. Access routes to the shoreline can be maintained or enhanced, ensuring that cultural practitioners retain entry to fishing grounds and gathering areas. Consultation with lineal descendants and community organizations can identify periods of sensitivity, such as seasonal fishing runs or ceremonial events, during which activities should be restricted. Restoration efforts—such as limu planting or water quality improvements—can also offset some project effects, directly supporting cultural use of the area.

In sum, while development has the potential to adversely affect cultural practices, proactive mitigation and partnership with the community can not only protect but also revitalize traditional uses. This ensures that fishing, gathering, and ceremonial connections to Kalaeloa remain vibrant elements of Native Hawaiian life.

7.7 Cumulative and Indirect Impacts

Adverse cumulative and indirect impacts to cultural resources are often overlooked in CIAs, as they are difficult to assess. Cumulative impacts are cultural impacts that result from the incremental impacts of an activity when added to past, present, and reasonably foreseeable future actions and activities. Indirect impacts are impacts on cultural resources which are not a direct result of the project, but a secondary or tertiary result of the project. DLNR intends to develop the project area, and this development is unlikely to result in any adverse cumulative and indirect impacts given the extensive agricultural development previous conducted on the project area. Therefore, there are no anticipated cumulative or indirect cultural impacts to the area.

7.8 Mitigation and Best Management Practices

Per the recommendations of Shad Kane, it is advised that the project incorporate and include traditional place names whenever possible, be it the naming of certain halls, or generally included in planning and development. As noted in his interview, it is important to Mr. Kane to see the place names of ʻEwa included in future projects so that the cultural integrity of the place is not lost. An option for this would be to pursue obtaining an State Inventory of Historic Places number for Puhilele, which is not otherwise recognized in existing archaeological surveys, including any of the NRHP documents for the area. This would be keeping in line with Mr. Kane's request.

Should burials be identified on the property, this adverse effect would need to be resolved in consultation with SHPD. It is recommended by local practitioners that the project include cultural monitoring throughout the construction phase.

Should a community advisory council be formed, it should include members of nearby cultural organizations, like Kalaeloa Heritage Park, Ulu Aʻe, or the Hoakalei Cultural Foundation. Community members from the nearby homestead communities should also be invited to participate, as they are the closest Hawaiian communities residing near the Project Area. Reporting to these communities on the results of the efforts is also recommended. Community engagement on monitoring efforts, if implemented, should also include these groups.

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8 *Ka Paʻakai* Analysis

It has long been the law of the land that the State of Hawaiʻi has an "obligation to protect the reasonable exercise of customary and traditionally exercised rights of Hawaiians to the extent feasible" *Public Access Shoreline Hawaiʻi v. Hawaiʻi County Planning Commission ("PASH")* 79 Hawaiʻi 425, 450 n. 43, 903 P.2d 1246, 1271 n. 43 (1995). In 2000, in the *Ka Paʻakai* decision, the Court established a framework "to help ensure the enforcement of traditional and customary Native Hawaiian rights while reasonably accommodating competition private development interests." 94 Hawaiʻi 31, 35, 7 P.3d 1068, 1972 (2000). This analysis is used here to fulfill the goal of this CIA (**Section 1.4**). It is also used as guidance to state agencies in fulfulling their obligations under *Ka Paʻakai*.

It is also imperative to emphasize that the State may not delegate their obligations under the *Ka Paʻakai* decision to another party, including but not limited to the federal government. While the *Ka Paʻakai* decision was specific to a private developer, the facts of that case would be applicable to the situation at hand because the Court's reasoning for this decision and applicable precedent apply – the issue being that another entity would not have the same public accountability as the State. That is the case herein, the public accountability of the federal government is not equal to that of the State of Hawaiʻi. More specifically, the federal government is not bound to the obligations of the State as set forth under the Hawaiʻi State Constitution, which is the document from which the rights protected under *Ka Paʻakai* emanate.

Based on the guidelines set forth in *Ka Paʻakai*, the Hawaiʻi Supreme Court provided government agencies an analytical framework to ensure the protection and preservation of traditional and customary Native Hawaiian rights while reasonably accommodating competing private development, or other, interests. The Court has stated: "that in order to fulfill its duty to preserve and protect customary and traditional Native Hawaiian rights to the extent feasible, as required by Article XII, Section 7 of the Hawaiʻi Constitution, an administrative agency must, at minimum, make specific findings of fact and conclusions of law as to the following:

1) The identification 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 to reasonably protect Native Hawaiian rights if they are found to exist. *Ka Paʻakai*, 94, Hawaii at 47, 7 P.3d at 1084. Cited in *Matter of Contested Case Hearing Re Conservation District Use Application (CDUA) HA-3568 for the Thirty Meter Telescope at the Mauna Kea Science Reserve, Kaʻohe Mauka, Hāmākua, Hawaiʻi*, 143 Hawaiʻi 379, 431 P.3d 752 (2018) ("*Mauna Kea II*").

To complete a thorough CIA that complies with statutory and case law, it is necessary to fully consider information available from, and provided by, Native Hawaiian cultural practitioners and cultural descendants from the project area. From thorough research, data was extrapolated that provides a comprehensive look at the cultural resources in this ʻāina. Through this research, the factors from *State v Hanapi* are met. These factors are: "to establish that his or her conduct is constitutionally protected as a native Hawaiian right, he or she must show, at minimum, the following three factors. First, he or she must qualify as a "native Hawaiian" within the guidelines set out in PASH . . . [as] "those persons who are ʻdescendants of native Hawaiians who inhabited the islands prior to 1778,ʼ … regardless of their blood quantum." Second, once a defendant qualifies as a native Hawaiian, he or she must then establish that his or her claimed right is constitutionally protected as a customary or traditional native Hawaiian practice…. Finally, a defendant claiming his or her conduct is constitutionally protected must also prove that the exercise of the right occurred on undeveloped or "less than fully developed property." 89 Hawaiʻi 177, 185-86, 970 P.2d. 485, 493-94 (1998).

The *Ka Paʻakai* analysis is largely a legal analysis, as the applicable tests are legal standards. Therefore, a strong analysis is one conducted by someone with sufficient legal training. Additionally, at the core of a thoughtful *Ka Paʻakai* analysis is a comprehensive understanding of traditional and customary practices. In breaking down the Court's tests, it is important to the different elements that contribute to each test.

The first test – "The identification 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" – consists of two separate elements. First, the simple identification and existence of valued cultural, historical, or natural resources. These resources are tangible in nature. They can include sacred places, culturally valuable plants, or a religious or historic site. This survey sought to exhaustively identify the great multitude of resources that may exist in the project area or adjacent areas.

As to this test, this survey shows there are potentially resources within the project area (e.g. indigenous flora currently used in lei making and potential iwi that could be uncovered with construction), but it is likely they have already been extensively disturbed. Interviews indicate there are otherwise no current traditional cultural resources in the area that are used for traditional or customary practices, but as noted in Section 5, there are practices occurring in the surrounding and adjacent areas that could potentially be expanded to the project area.

The second element of this first test is access. Access requires two things to occur. One is the existence of a resource. Whether a plant, an animal, a place, or site, the resource must exist in order a practitioner to access it. The second thing is physical access. This includes, but it is not limited to, the ability to physically access a plant, animal, site, or location associated with a particular practice. This can also include the traditional and customary route or path taken to access the resource. This can also include cultural protocols that existed in accessing a resource. These are often temporal, in that access protocols can be at a certain time of day or year. Makahiki would be a good example of a traditional custom that has specific cultural protocols associated with access. In the case of Makahiki, the custom takes place at a certain time of year.

Therefore, the first test under *Ka Paʻakai* should include not only a listing of resources, but the identification of ways in which those resources are accessed and utilized in association with a traditional and customary practice.

As noted in the previous sections, there are unlikely to be resources in the area and there is no indicator that practitioners use the area for access.

Therefore, the second test – "The extent to which those resources—including traditional and customary Native Hawaiian rights—will be affected or impaired by the proposed action" – also looks at two separate elements. The first, does the proposed action and its alternatives have an adverse impact on the existence of resources? This would include the alteration, destruction, modification, or harm of sites, including biological resources, sacred places, burial sites, etc. It also includes a loss of species. Any adverse impact or harm to resources is alone an affect or impairment caused by the proposed action.

Under this element, adverse impacts to historic sites or culturally utilized plants would all be identified adverse impacts. Under this same element, any indirect or cumulative effects would create an adverse impact under *Ka Paʻakai* if those actions harmed resources. It is not currently anticipated that any of these impacts would occur on this project.

In addition to this, any action that impacts traditional and customary access to resources, even if there is not direct adverse impact to the resource itself, would result in an affect or impairment resulting from the proposed action. Therefore, the limitations on access that could result from development or use of the project area could create an adverse impact under *Ka Paʻakai.* Again, it is not anticipated any impacts to cultural access would result from this project.

The third part of the *Ka Paʻakai* framework aims to identify "[t]he feasible action, if any, to be taken to reasonably protect Native Hawaiian rights if they are found to exist." Determining whether or not action has been suitably "feasible" is a matter for the State. These feasible actions could include continued access to the project as needed to conduct cultural practices. The potential adverse effects can be avoided through the implementation of best management practices, which are identified in Section 7.0.

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9 Public Trust Resource Analysis

Hawaiʻi's public trust doctrine establishes that all natural resources—including land, water, air, and ceded lands—are held by the State in trust for the benefit of the people. This fiduciary duty is rooted in Article XI, Section 1 (Natural Resources Trust) and Article XII, Section 4 (Ceded Lands Trust) of the Hawaiʻi Constitution. The Hawaiʻi Supreme Court has made clear in cases such as *In re Waiāhole Ditch* (94 Hawaiʻi 97, 9 P.3d 409, 2000) that when an agency authorizes private activity affecting these resources, it must 1) begin with a presumption in favor of public use, 2) consider practicable alternatives, and 3) articulate its decision with clarity. Subsequent cases—including *Superferry* (2007), *Kauaʻi Springs* (2014), *Mauna Kea II* (2018), *Ching* (2019), *MECO* (2022), *Carmichael* (2022), and *Kauaʻi Department of Water* (2022)—have reaffirmed these obligations. Most recently, the Intermediate Court of Appeals in *Frankel v. BLNR* (564 P.3d 1157, Haw. App. 2025) vacated BLNR's permit renewal for Lot 41 at the Kahala Hilton precisely because the agency failed to conduct and clearly articulate this three-part analysis.

The *Frankel* decision emphasizes that the burden is on State agencies, such as DLNR and BLNR, to complete this analysis and build a defensible record. The CRA does not itself substitute for the agency's findings, but it plays a critical role in supporting the three-part test by compiling information, documenting cultural practices, and organizing community input in a way that enables the agency to meet its fiduciary duty.

The Kalaeloa Reef Project directly engages several public trust resources that are constitutionally protected under Article XI, Section 1 of the Hawaiʻi Constitution and interpreted through decades of case law. The most immediate resource is the coastal shoreline**,** which serves as a place of access, recreation, and gathering for the community. This shoreline is part of the commons and must be preserved for the benefit of present and future generations. Equally significant is the marine environment, including the reef ecosystem, fisheries, and limu beds that provide subsistence resources and sustain cultural practices. Fishing grounds and gathering areas are not only ecological assets but also integral to Native Hawaiian traditions, supporting kilo (observation practices), communal sharing, and intergenerational knowledge transfer.

Because this project area also encompasses ceded lands, these resources carry an additional fiduciary duty: they are held in trust for Native Hawaiians as well as the general public. This dual obligation heightens the level of scrutiny required under the public trust doctrine. Collectively, the shoreline, reef, fisheries, and ceded lands are all trust resources that cannot be treated as ordinary property but must be managed with vigilance, transparency, and respect for cultural and subsistence practices.

First, with respect to the presumption in favor of public use, the CRA provides the factual background that establishes the priority of cultural and subsistence practices in the project area. Section 3.0 (Traditional Background) and Section 4.0 (Cultural Resources) document fishing, gathering, kilo observation, surfing, canoe launching, and ceremonial activities tied to the Kalaeloa coast. These sections ensure that the State has a clear record of the public and cultural uses that must be prioritized when weighing project impacts, consistent with *Waiāhole* and *Frankel*.

Second, with respect to practicable alternatives, the CRA identifies possible measures that can reduce or avoid encroachment. Section 7.0 (Impact Assessment) discusses how shoreline access, seasonal fishing, and ceremonial observances could be affected by project activities and notes options such as maintaining shoreline pathways, scheduling activities to avoid sensitive times, and implementing restoration activities like limu planting. Section 7.7 (Mitigation and Best Management Practices) further records community suggestions, such as integrating traditional place names, that help minimize cultural disruption. While the CRA does not itself determine whether alternatives are practicable, it provides the agency with a substantive record to evaluate alternatives in compliance with *Kauaʻi Springs*.

Third, with respect to clarity, the CRA enhances the agency's ability to articulate its reasoning by compiling the consultation process and ethnographic evidence in a transparent way. Section 2.0 (Methodology) and Section 2.6 (Ethnographic Methodology) describe how interviews, archival research, and oral histories were conducted. Section 6.0 (Ethnographic Data) presents community voices and biographical context for those consulted, while Appendices A–C (Consultation Record) compile communications and testimony from descendants and cultural practitioners. Finally, Section 10.0 (Conclusion) synthesizes these findings and links them to State's trust responsibilities. By consolidating this material, the CRA makes it easier for the State to set forth findings with the clarity required in *Kauaʻi Springs* and *Frankel*.

In this way, the CRA functions as a supporting document that provides the necessary cultural, historical, and community evidence for the State to apply the *Frankel* test. It does not replace the agency's obligation to make findings, but it ensures that the record contains the information needed to begin with the presumption in favor of public use, to meaningfully consider alternatives, and to articulate decisions with clarity. By integrating these elements, the CRA equips the agency with the evidentiary base to meet its constitutional obligations, reduces the risk of vacatur, and helps ensure that the project proceeds in a manner consistent with Hawaiʻi's public trust doctrine.

10 Conclusion

This CRA investigated potential traditional or customary practices that occur within the proposed project area. This survey found that while the project area may have been used for traditional habitation, farming, and gathering, much of those activities stopped as land ownership changed in the area and the project area was utilized for modern agricultural activities.

Previous archaeological studies have identified numerous significant historic properties and cultural resources in the surrounding area. It is likely that the area was traditionally inhabited and actively used for traditional and customary practices.

Based on the information gathered and the ethnographic data, the proposed project has minimal potential to adversely impact cultural resources and traditional or customary practices in the area.

Nonetheless, it would be essential for the project to implement best management practices recommended by the biological resources survey and archaeological and/or cultural monitoring during the project's construction. It is also advisable to continue working closely with the community to ensure that there are no unintended adverse effects and that practitioners have a means of quickly contacting the project applicant with questions or concerns should any arise.

Additionally, the Office of Environmental Quality Control (OEQC), now the Environmental Review Program (ERP), offers specific guidelines for what elements and issues a CIA should address. Table 2 outlines these specific guidelines and the corresponding sections of this report, which address that element.

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Table 3. OEQC compliance requirements and their corresponding sections in this CIA

OEQC notes that in addition to the content requirements for the EIS, which are set out in HAR §11-200.1 et seq., the assessment concerning cultural impacts should address, but not necessarily be limited to, the following matters:	
A. A discussion of the methods applied and results of consultation with individuals and organizations identified by the preparer as being familiar with cultural practices and features associated with the project area, including any constraints or limitations which might have affected the quality of the information obtained.	A detailed methodology section is provided in **Section 2.0 (Methodology)**.
B. A description of methods adopted by the preparer to identify, locate, and select the persons interviewed, including a discussion of the level of effort undertaken.	A discussion of the effort to gather information from persons familiar with the area or other stakeholders is provided in **Section 2.6 (Ethnographic Methodology)**.
C. Ethnographic and oral history interview procedures, including the circumstances under which the interviews were conducted, and any constraints or limitations which might have affected the quality of the information obtained.	A discussion of procedures, including constraints or limitations, is provided in **Section 2.6 (Ethnographic Methodology)**.
D. Biographical information concerning the individuals and organizations consulted, their expertise, and their historical and genealogical relationship to the project area, as well as information concerning the persons submitting information or interviewed, their particular knowledge and cultural expertise, if any, and their historical and genealogical relationship to the project area.	Biographical information was provided in and through the interviews, which are included with the individual interview summaries in **Section 6.0 (Ethnographic Data)**.

E. A discussion concerning historical and cultural source materials consulted, the institutions and repositories searched and the level of effort undertaken. This discussion should include, if appropriate, the perspective of the authors, any opposing views, and any other relevant constraints, limitations or biases.	A discussion of the materials consulted is provided in **Section 2.0 (Methodology)**. An extensive cultural and historical overview, which uses both Hawaiian and English language resources is also provided in **Section 2.0 (Methodology)**.
F. A discussion concerning the cultural resources, practices and beliefs identified, and, for resources and practices, their location within the broad geographical area in which the proposed action is located, as well as their direct or indirect significance or connection to the project site.	In addition to the cultural and historical overview, an extensive discussion concerning cultural resources, practice and beliefs are provided throughout the document by subfield, specifically in **Section 3.0 (Traditional Background)** and **Section 4.0 (Cultural Resources)**.
G. A discussion concerning the nature of the cultural practices and beliefs, and the significance of the cultural resources within the project area affected directly or indirectly by the proposed project.	A thorough discussion concerning the nature of traditional or customary practices and the significance of the cultural resources affected directly or indirectly by the proposed alternatives are provided in **Section 7.0 (Impact Assessment)**.
H. An explanation of confidential information that has been withheld from public disclosure in the assessment.	There was no confidential information withheld from public disclosure, except for personal emails, addresses, or phone numbers.
I. A discussion concerning any conflicting information regarding identified cultural resources, practices and beliefs.	There was no conflicting information regarding cultural resources, practices, or beliefs.
J. An analysis of the potential effect of any proposed physical alteration on cultural resources, practices or beliefs; the potential of the proposed action to isolate cultural resources, practices or beliefs from their	A thorough analysis is provided in **Section 7.0 (Impact Assessment)**.

setting; and the potential of the proposed action to introduce elements which may alter the setting in which cultural practices take place.	
K. A bibliography of references and attached records of interviews which were allowed to be disclosed.	References are included in the following section (**11.0 References**). Interview summaries are provided in **Section 6.0 (Ethnographic Data)**.

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Reference Maps

1825	Map of South Coast of Woahoo and Honoruru Harbour. Registered Map No. 437. Lt. C.R. Malden.
1873	Map of Honouliuli, Oahu. Registered Map No. 405. W.D. Alexander.
1873	Map of Honouliuli, Oahu. Registered Map No. 618. W.D. Alexander.
1873	Map of West Loch and the Peninsula of Pearl River. Registered Map No. 322. J. Lidgate.
1902	Map of Oahu, Hawaiian Islands. W.E. Wall and J.M. Donn.
1913	Map of Oahu. U.S. Army, Cos. A.G. and I. Engineers.

12 Appendix I: Glossary of Hawaiian Terms

The following list of terms were used frequently throughout this report. All definitions were compiled using Pukui and Elbert's *Hawaiian Dictionary* (1986).

Ahupuaʻa	Land division usually extending from the uplands to the sea, so called because the boundary was marked by a heap (ahu) of stones surmounted by an image of a pig (puaʻa), or because a pig or other tribute was laid on the altar as tax to the chief.
ʻĀina	Land, earth.
Akua	1. God, goddess, spirit, ghost. 2. Divine, supernatural, godly.
Ala	Path, road, trail.
Aliʻi	1. Chief, chiefess, ruler, monarch. 2. Royal, regal. 3. To act as chief, reign.
ʻAnae	Full-sized ʻamaʻama mullet fish.
ʻAumakua	Family or personal gods, deified ancestors who might assume the shape of sharks, owls, hawks, dogs, plants, etc. A symbiotic relationship existed; mortals did not harm or eat them, and the ʻaumakua warned or reprimanded mortals in dreams, visions, and calls.
ʻAumākua	Plural of ʻaumakua.
ʻAuwai	Irrigation ditch, canal.
Haʻi Moʻolelo	Storytelling performances.
Haku mele	Poet, composer; to compose song or chant.
Hālau	1. Long house, as for canoes or hula instruction; meeting house. 2. Large, numerous; much.
Hale pili	House thatched with pili grass.
Heʻe nalu	To ride a surfboard; surfing; surf rider. *Lit.*, wave sliding.

Heiau	Pre-Christian place of worship, shrine. Some heiau were elaborately constructed stone platforms, other simple earth terraces.
Heiau luakini	Temple state worship at which human sacrifices were once offered.
Hoʻi	1. To leave, go or come back; to cause to come back. 2. To enter, as an institution or last resting place. 3. A parting chant to which hula dancers dance as they leave the audience. 4. Marriage of a chief with the daughter of a brother or sister; to do so (a means of increasing offspring).
Hoʻokupu	Tribute, tax, ceremonial gift-giving to a chief as a sign of honor and respect; to pay such tribute; church offering.
Huakaʻi	Trip, voyage, journey, mission.
Hula	A Polynesian dance form accompanied by chant or song.
ʻIli	Land section, next in importance to ahupuaʻa and usually a subdivision of an ahupuaʻa.
ʻIli kūpono	A nearly independent ʻili land division within an ahupuaʻa, paying tribute to the ruling chief and not to the chief of the ahupuaʻa. Transfer of the ahupuaʻa from one chief to another did not include the ʻili kūpono located within its boundaries.
Inoa ʻĀina	Place names.
ʻIole	Hawaiian rat, introduced rat, mouse.
Iwi	Bone, carcass. The bones of the dead, considered the most cherished possession, were hidden, and hence there are many figurative expressions with iwi meaning life, old age.
Kahuna	Priest, sorcerer, magician, wizard, minister, expert in any profession.
Kalo	Taro (*Colocasia esculenta*), a kind of aroid cultivated since ancient times for food, spreading wildly from the tropics of the Old World. In Hawaiʻi, taro has been the staple from earliest times to the present, and here its culture developed greatly, including more than 300 forms. All parts of the plant are eaten, its starchy root principally as poi, and its leaves as lūʻau.

Kamaʻāina	1. Native-born, one born in a place, host. 2. Native plant. 3. Acquainted, familiar.
Kanaka	Human being, man, person, individual, party, mankind, population.
Kānaka	Plural of kanaka.
Kānāwai	Law, code, rule, statute, act, regulation, ordinance, decree, edict.
Kāne	Male, husband, male sweetheart, man; brother-in-law of a woman.
Kanikau	1. Dirge, lamentation, chant of mourning, lament. 2. To chant, wail, mourn.
Kapu	1. Taboo, prohibition. 2. Special privilege or exemption from ordinary taboo. 3. Sacredness, prohibited, forbidden, sacred, holy, consecrated. 4. No trespassing, keep out.
Kino lau	Many forms taken by a supernatural body, as Pele, who could at will become a flame of fire, a young girl, or an old hag.
Koʻa	1. Fishing grounds, usually identified by lining up with marks on shore. 2. Shrine, often consisting of circular piles of coral or stone, built along the shore or by ponds or streams, used in ceremonies as to make fish multiply; also built on bird islands, and used in ceremonies to make birds multiply.
Koʻi	Axe, adze; adzelike, sharp, projecting, as a forehead
Kōnane	Ancient game resembling checkers, played with pebbles placed in even lines on a stone or wood board called papa kōnane.
Kula	Plain, field, open country, pasture.
Kuleana	Right, privilege, concern, responsibility, title, business, property, estate, portion, jurisdiction, authority, liability, interest, claim, ownership, tenure, affair, province.
Kupuna	Grandparent, ancestor, relative or close friend of the grandparent's generation, grandaunt, granduncle.
Kūpuna	Plural of kupuna.
Lāʻau lapaʻau	Medicine. *Lit*. curing medicine.

Lei	Garland, wreath, necklace of flowers, leaves, shells, ivory, feathers, or paper, given as a symbol of affection.
Limu	A general name for all kinds of plants living under water, both fresh and salt, also algae growing in any damp place in the air, as on the ground, on rocks, and on other plants; also mosses, liverworts, lichens.
Loʻi	Irrigated terrace, especially for taro, but also for rice and paddy.
Loko	Pond, lake, pool.
Loko iʻa	Traditional Hawaiian fishpond.
Luakini	Temple, church, cathedral, tabernacle; large heiau where ruling chiefs prayed and human sacrifices were offered; to perform temple work.
Luna	1. High, upper, above, over, up. 2. Foreman, boss, leader, overseer, supervisor, headman, officer of any sort.
Māhele ʻĀina	Land Division.
Mahi ʻai	Farmer, planter; to farm, cultivate; agricultural.
Makai	On the seaside, toward the sea, in the direction of the sea.
Mālama	To take care of, tend, attend, care for, preserve, protect, beware, save, maintain.
Mana	Supernatural or divine power, mana, miraculous power; a powerful nation, authority; to give mana to, to make powerful; to have mana, power, authority; authorization, privilege; miraculous, divinely powerful, spiritual; possessed of mana, power.
Manō	Shark.
Manu	Bird, any winged creature.
Mauka	Inland, upland, towards the mountain.
Mele	1. Song, anthem, or chant of any kind. 2. Poem, poetry. 3. To sing, chant.
Mele ʻāina	Songs of the land.

Mele mākaʻikaʻi	Travel chant.
Mōʻī	King, sovereign, monarch, majesty, ruler, queen.
Moku	1. District, island, islet, section, forest, grove, clump, fragment. 2. To be cut, severed, amputated, broken in two.
Momi	Pearl.
Moʻo	Lizard, reptile of any kind, dragon, serpent.
Moʻolelo	Story, tale, myth, history, tradition, literature, legend, journal, log, yard, fable, essay, chronicle, record, article.
Moʻowahine	Female lizard deity.
Nīʻau-piʻo	Offspring of the marriage of a high-born brother and sister, or half-brother and half-sister.
Noni	The Indian mulberry (*Morinda citrifolia*), a small tree or shrub in the coffee family, a native of Asia, Australia, and islands of the Pacific. Leaves are large, shiny, deep-veined. Many small flowers are borne on round heads, which become pale-yellow unpleasant-tasting fruits. Formerly Hawaiians obtained dyes and medicine from many parts of the tree.
ʻOhana	Family, relative, kin group; related.
ʻŌlelo noʻeau	Proverb, wise saying, traditional saying.
Oli	Chant that was not danced to, especially with prolonged phrases chanted in one breath, often with a trill at the end of each phrase; to chant thus.
Pae ʻāina	Group of islands, archipelago.
Pana pua	To shoot with bow and arrow; archer; archery.
Pilikia	Trouble of any kind, great or small; problem, nuisance, bother, distress.
Piʻo	Marriage of full brother and sister of nīʻaupiʻo rank, presumably the highest possible rank. Their offspring had the rank of naha, which is less than piʻo but probably more than nīʻaupiʻo. Later piʻo included marriage with half-sibling.

Pipi	Hawaiian pearl oyster (*Pinctada radiata*); in songs this is known as the iʻa hāmau leo o ʻEwa, ʻEwa's silent sea creature [it was believed that talking would cause a breeze to ripple the water and frighten the pipi].
Pueo	Hawaiian short-eared owl (*Asio flammeus sandwichensis*), regarded often as a benevolent ʻaumakua.
Puʻu	Any kind of a protuberance from a pimple to a hill: hill, peak, cone, hump, mound, bulge, heap, pile
Waʻa	Canoe, rough-hewn canoe, canoemen, paddlers; a chant in praise of a chief's canoe.
Wahi pana	A sacred and celebrated/legendary place.
Wahine	Woman, lady, wife; sister-in-law, female cousin-in-law of a man.
Wai	Water, liquid or liquor of any kind other than sea water.
Wao	1. Realm. 2. A general term for inland region usually forested but not precipitous and often uninhabited.
Wauke	The paper mulberry (*Broussonetia papyrifera*), a small tree or shrub, from eastern Asia, known throughout the Pacific for its usefulness. It belongs to the fig or mulberry family. The bark was made into tough tapa used for clothing, bed clothes; it lasted longer than māmaki tapa.

13 Appendix II: Boundary Commission Records, Honouliuli Ahupuaa, District of Ewa, Island of Oahu

Boundary Commission Volume 1 pps. 131-133 [Figure 1]

Boundaries of the Ahupuaa of Honouliuli Oahu
Filed June 23rd 1873

Application of Mrs. A.A. Haaelea

To the Honorable W.P. Kamakau
Commissioner Boundaries for the Island
of Oahu, one of the Hawaiian Islands.

The undersigned applicant represents

that she is the owner of the Ahupuaa called Honouliuli, situated in the District of Ewa, Island of Oahu aforesaid; that the same was awarded by name to Mikahela Kekauonohi, dec'd. by Land Commission Award No. 11216; – that the same has not been awarded by the Land Commission, patented or conveyed by Deed from the King by boundaries described in such award, patent or Deed; and therefore she respectfully requests that the boundaries of said Ahupuaa may be settled by Your Honorable Commission, and to that end makes this application to have the boundaries of said land decided and certified by you as Commissioner of Boundaries as aforesaid.

Pursuant to the statute, the Undersigned applicant represents that the name of the land is Honouliuli, in the District of Ewa, Island of Oahu, one of the Hawaiian Islands; that the following are the names of the adjoining lands, and the names of the owners of the same, so far as known to the undersigned applicant, to wit. "Waianae" – Crown Land; "Nanakuli" – Crown Land; "Pouhala," owned by J. Robinson; "Waikakalaua" – Crown Land in possession of J. Robinson; "Hoaeae," owned by J. Robinson; "Waikele," owned by K. Komoikehuehu; "Waipio," owned by Estate John Ii, deceased; "Halawa," owned by Dowager Queen Emma.

That the undersigned applicant is unable to give a general
description of the boundaries claimed, other than as to lands
bordering on the Ahupuaa of Honouliuli, but intends to have
filed with the Honorable Commission a full survey and plot
of the said land upon which she intends to adduce proof
as to the Boundaries of said land.

Very Respectfully
A.A. Haalelea
By her Attorney at Law, R.H. Stanley
Honolulu, June 23, 1873 [page 131]

Ahupuaa of Honouliuli
Supplement to Application
Filed June 24th 1873

Honolulu, June 24th 1873
Hon. W.P. Kamakau
Commissioner of Boundaries for the Island of Oahu,
Hawaiian Islands,

Sir,
Herewith please find under cover
"Memoranda on the Boundaries of Honouliuli" as furnished
by Mr. Alexander, Government Surveyor; which please annex
as part and parcel of application delivered you yesterday.

So soon as the Survey now in progress is completed, full
field notes together with a plot or map of the Bounda-
ries of Honouliuli, as claimed, will be furnished.

I am, Very Respectfully
Your Obdt Svt.
R.H. Stanley
Attorney for Mrs. A.A. Haalelea
owner of the Ahupuaa of Honouliuli.

Filed with above June 24th.

Memoranda on the Boundary of Honouliuli.

1. The boundary between this land and Hoaeae was first surveyed by J. Metcalf May 29, 1848, and the “Kula” of Hoaeae was awarded to L. Rees by this survey.

See Award 193, Volume 1, p. 536.

Starting from a stake at makai S.W. corner of Hoaeae at Kaulu, Metcalf’s survey runs as follows: I. – North 45° 30’ W. 54 chains – 54.20 in orig. field book – 13 3/12 feet to a point in the old road on mauka side of gulch near mauka N.W. corner of Namauu’s land.

(from a long stone in the wall at mauka N.W. angle of Namauu’s land, it is N. 72 1/2° W. 7.30 ch. to the above mentioned point in the old road)

II. Thence N. 47° 15’ W. 42.90 ch. to a rock by the road called **Pohaku Palahalala**. III. Thence N. 29° 45’ W. 29.30 ch. to a stone marked X by the road. IV. Thence N. 31° 15’ W. 71 ch. to rock marked + by by the road; V. Thence N. 33° 15’ W. 97.30 ch. to a large wiliwili tree; VI. Thence N. 44° 45’ W. 57.40 ch. to old Kukui tree; VII. Thence N. 29° 30’ W. 64.20 ch. to a pile of stones on North upper bank of **Ekahanui gulch**; VIII. Thence N. 32° 15’ E. 45.30 ch. along **Lihue** to a Kukui tree marked A in clump of Kukui trees; IX. Thence N. 36° 15’ E. 55.30 chains along Lihue to a large Kukui tree, marked B, at bottom ledge of Waikele gulch (**Manawaielelu** in field book) at mauka N.W. corner of Hoaeae.

2. The boundary of Honouliuli next follows the line between it and the Ili of **Pouhala** in the Ahupuaa of Waikele or more particularly, that part of Pouhala which belonged to the heirs of Luluhiwalani, and now belongs to J. Robinson. This part of Pouhala was conveyed to them by Royal Patent 4486, by a survey made by J.H. Sleeper in March 1859. His survey was made independently of Metcalf’s survey of the

adjoining land of Hoaeae, and I have not ascertained
how well they agree. As near as I can ascertain the boundary
between Pouhala and Lihue according to Sleeper's survey
would be as follows: – (X. – N. 26 1/4° W. 4.07 ch.
XI. N. 24 1/4° W. 31.17 ch.
XII.) N. 25 1/4° W. 15.61 ch. to rock
at the western corner of this Pouhala.

3. Honouliuli next borders on a portion of Pouhala
which belongs to his Majesty, being a Crown land.
I know of no survey of it.

4. The next land bordering on Honouliuli is
Waikakalaua, a Crown Land. By an old survey
made in 1846, the boundary between Waikakalaua
and Lihue runs as follows, beginning at the corner
of Pouhala: N. 30° W. 37 chains;
N. 23° W. 24.35 ch.;
N. 23 1/2° W. 27.87 ch. to corner of Waianae
and Waikakalaua.

5. The boundary of Waianae has been described by
natural landmarks in a decision made by the
Boundary Commissioner, W.P. Kamakau, Sept. 4, 1869.

6. A survey was made of the land of Nanakuli
which is a subdivision of Waianae bordering
on Honouliuli by William Webster. Mr. Coney has a
copy of his map.

To Folio 218. [page 133]

Ahupuaa of Honouliuli
District of Ewa, Island of Oahu
Boundary Commission Volume 1 pp. 218

From fol. 133

Kaulu or Coneyville, Sept. 11th 1873

This day in company with Professor Alexander, who is sur-
veying the land went about the boundary in part
tracing it, in part looking at natural boundaries. Mr.
Coney also in company. Adjacent owners not summoned,
this being preliminary.

Sept. 12th Kaulu

The proper name of the locality of the premises on the
tract, now occupied by Mr. Coney & family is Kaulu.

Beginning at this the boundary along Hoaeae, already sur-
veyed and awarded accordingly will be easily ascertained.

Honouliuli cuts off Hoaeae at top; then runs along
Pouhala which is a part of Waikele. The lower part of
a crown land, unsettled, for which application is
made, and which is to be surveyed by Alexander. It is
now understood by surveyor & the petitioner that Waika-
kalaua, which was claimed as the 4th portion of boun-
dary does not come to Honouliuli but that Pouhala.
Honouliuli and Waianae come together in the gulch
called by us "Waieli" from the pool or bathing place
dug for __________ [blank]. Thence the boundary of this land is along
Nanakuli of Waianae, the boundary of which has been
settled by the B.C.

Court House, Honolulu,
Dec. 30th 1873, 11 A.M.

Hearing assigned for this date and notices issued to
Govr. Dominis for Crown Lands; Jas. Robinson for Hoaeae;
J. Komoikehuehu for Waipio; A.F. Judd for John Ii Estate;
H.A. Widemann for Halawa, of Queen Emma; J.H. Coney, agent
for the petitioner; R.H. Stanley, attry. for petitioner; Chas. R. Bishop,
agent for Kapepa, heir of Nakuepa; A.W. Pierce for Puuloa.

Present: J.H. Coney; Komoikehuehu; Kapepa heir of Nakuepa for
land & sea of **Hanohano**; Chas. R. Bishop, R.H. Stanley, Miss Robinson;

H.A. Widemann; A.F. Judd.

The petitioner submits as the basis of description of this land and its adjacent kai, a new survey and map executed by Professor Alexander.

To Folio 243 [page 218]

Ahupuaa of Honouliuli
District of Ewa, Island of Oahu
Boundary Commission Volume 1 pp. 243-251

From folio 218

H.A. Widemann for Halawa, assents to the line of the Halawa fishery as laid down on the Alexander map. Running through the middle of the channel at the entrance of Pearl River.

C.R. Bishop for Waipio claims a shore fishery not laid off on the Alexander map. Will have it surveyed by Mr. Alexander.

A.F. Judd, for Estate of John Ii, says that the Estate does not appear to border on Honouliuli; that Auwaiole belongs by devise to Komoikehuehu

<u>W.D. Alexander, sworn,</u>
Is Govt.. Surveyor, made the survey of Honouliuli for Mrs. Haalelea, Coney agent. This is the plot of the survey. In making it the principal kamaaina was <u>Kaopala</u>, brother of the former Luna of H. [Honouliuli] under Haalelea on boundary between H. and Waianae. I had the widow of <u>Kuahele</u>. Kamaaina of **Popouwela**, whose testimony agreed with Kaopala, also <u>Kihei</u> K. who went with me, particularly on the b. [border] of Hoaeae. On Pouhala I had the present Konohiki, Kulukulu, now resident there. Also <u>Kanehalau</u>, a kamaaina of Pouhala. Also Thos. Meek.

In regard to Hoaeae I followed the original survey made by Metcalf, which is incorporated in the Award of Hoaeae. I have made this survey and map to accord with the Hoaeae line. I had Metcalf's original field book, March 29th 1848.

Followed the land in the same order. The point of commencement is

Pohaku palahalaha, a well-known rock, now marked by
an arrow and the name "Honouliuli" on one side and Hoaeae
on the other, which I have made the initial point of this survey.
I verified this by several courses & measurements.

Thence laid the line accordingly along Hoaeae to Pouhala.

Mr. Robinson says he is satisfied this conforms to their line.
Note: Lower Pouhala is controlled by survey in R.P. No. 4486
made by J.H. Sleeper. I could not find the marks referred to in the
survey. The stone was said to have been marked only with a
man's spur, marks on kukui trees have perished. The R.P.
for Pouhala & the award for Hoaeae overlap each other seri-
ously, but that is not material to this survey.

My survey substantially agrees with that in R.P. 4486,
and the two maps mine & that made by Sleeper show it.
The kamaainas took me to the corner of Pouhala, Hoaeae
and Honouliuli; there is an ancient holua or sliding place
near this, which is agreed to be the ancient corner.

To fol. 244 [page 243]

Honouliuli
From fol. 243.

I marked a flat rock at that point.

From Lower Pouhala the line runs along upper Pouhala, the
property of Crown Lands, to Waianae. In this I consulted all
the kamaainas. I also surveyed Pouhala for the Crown Com-
missioners and made the map of Pouhala for them. I was
authorized by the Comm. to represent the crown in fixing this
line, and now appear for Pouhala.

The line runs nearly straight, following for the most part
the ancient road; where it crosses the Waieli gulch is
a remarkable looking rock marked by me. This line
is settled as here surveyed. A post, granite, is at the corner
of Pouhala, Waianae & Honouliuli.

Thence along Waianae, determined by W.P. Kamakau, the Boun-
dary Commissioner. I had a copy of his award, and followed
it as near as his description permitted. It takes along the

far side of the Waieli gulch to the "houses of Kuhau ma"
where it crosses the gulch. It follows an ancient path,
thence up spur to Hapapa peak. Thence along the mountain
range, an unmistakable line, conforming with Kamakau's
award, to three round hills, Manawahua on boundary of
Nanakuli, I had here a survey of William Webster of Nanakuli,
the award conforms to this survey, and my survey to both
of them; The line is defined along Nanakuli; nearly
to the sea by ridge of mountains and from its termination
to a point on the sea coast, at end of old stone wall.

Mr. Robinson, as lessee of Nanakuli & Mr. Alexander on the
part of Crown, agree on this part of the line. The point is called
Kalanimua, in the award of Waianae.

Thence the line of Honouliuli follows the coast, to the mouth
of **Pearl River**; thence up the line of the loch to where the pali
comes up to the sea just South of the Kuleana of Koulua, which
is the site of the residence of Coney, formerly Monsarratt's, from
thence up to the point of commencement, agreeing with the
Metcalf survey.

Fishery of Hoaeae. The testimony of the kamaainas is that the
fishery extends to the depth of a man's chin, opposite this land.
Mr. Robinson & Mr. Coney agree to this and that outside of that
the fishery belongs to Honouliuli. The award of Hoaeae does
not include the Kai. The makai, cultivated part of
Hoaeae and the Kai or fishery were granted to Namauu
by R.P. 4490 for M. Kekuanaoa. The survey by A. Bishop
is not copied into the R. Patent; the Patent being without metes
& bounds.

To Folio 245 [page 244]

Honouliuli
From Fol. 244

The red line indicating the fishery of Hoaeae, conforms to
Mr. Bishop's survey, and is agreed to by Mr. Robinson as re-
presenting their rights of fishing.

Next is the Kai of **Apokaa** which is a lele of **Hanohano**.

The petitioner claims to within neck deep of the shore, along
this, as far as to point marked “Miki” on the map, but
the line of this “neck deep” water has not yet been de-
fined by survey.

Wit. From “**Laeokane**” a point in **Miki**, this survey follows &
conforms to the boundary laid down in R.P. No. 4524 to Nama-
hana, of **Auiole**, an Ili of Waikele. This patent describes as
going to “Kahakai” and the plot on the patent bounds it by the
“Kai of Honouliuli”. This patent terminates at boundary of Waipio
& Auwiole [sic]; From thence I followed the authority of a map
of Waipio & notes of Bishop. (Waipio has been awarded by
survey, following on the coast Pookela Point, the terminus
of peninsula, not giving on the map any Kai to the peninsula,
“Anemoku” of Waipio, as I found none designated in the notes.
From thence the line is midway of channel between this and
Halawa (consented to above).

My accompanying notes of survey correspond with this
plot and my testimony as given; though I have not
described the fishery. My notes and survey follow the line of the
shore.

<u>Kukahiko, K. Sworn</u>
I was born at Honouliuli, an ahu-
puaa on Oahu; born in 1810. Know boundaries; am
kamaaina of the land and sea. I know **Papapuhi**. I belong
there. It is a cape, the division of Hoaeae & Honouliuli.
(Wit. points it out). The fishery opposite Hoaeae where a man
can stand belongs to Hoaeae, and outside is deep water is
Honouliuli, and so on, the shore water belongs to the land & the
deep water of Honouliuli, till you come to **Kalaeokane**,
a village Kupalii, which is a point of division between Hono-
uliuli & Waikele, in assessing the ancient tax, putting houses
on the line so as to evade both. Thence the line ran on the edge
of the shore, giving no water to Auiole. The line of Honouliuli
cutting across the land to Panau. There the people would cross
from side to side to escape tax of either land. There the whole

Kai, of **Homaikaia** belonged to Waipio.

Along the coast to Pili o Kahi [**Pili o Kahe**] joining Nanakuli is all Honouliuli.

To Fol. 246 [page 245]
Honouliuli
From Fol. 245

X [cross examined] Kimo. There is a Kai to **Kapuna**, which is a portion of Honouliuli, and not of Auiole. In ancient times not a division of the fish caught by the Kolo, but latterly John Ii secured a division. I belonged at Honouliuli, not at Kapuna. The Kai mauka of Kaulu belongs to Waipio. The Kai below, the Moana belonged to Honouliuli. Heard that in shallow places it belonged to Waipio.

<u>Hanama sworn - for petitioner</u>
Was born at Hilo, know land of Honouliuli. Have lived on it now and then a year & some months, with Haalelea. I am 37 years old. I know the boundaries from <u>Kauhi</u>, a kamaaina, who died three months ago. Kauhi was a makua of Haalelea's, was of age of last witness. I, <u>Kalaauala, Kamakani & Haalelea</u> went around boundary with Kauhi, beginning at **Pili o Kahi**, which he pointed out as the division of Nanakuli & Honouliuli. We stopped there three days; thence we came to **Waimanalo**, a river on coast & stayed one day; thence to **Koolina**, thence to **Kualakai**, thence to **Kauela**, stayed there a week, thence to **Keahi**; thence to **Puuloa**. There then was a conversation with Haalelea. Kauhi told Haalelea that ½ the moana was Honouliuli & ½ Halawa. Haalelea inquired why ½ was lele to Halawa.

Kauhi said that Halawa & Honouliuli were lands joining at their heads at the sea, that the lae of Halakahi belonged to Honouliuli & not to Halawa. **X** [cross examined] This progress was made in 1856, coming to **Pookala**. Kauhi said that Waipio took the shallow water & Honouliuli the deep, to **Kaulu**, that on the West side the Kai belonged to Honouliuli, and on the East side to other lands, coming to **Panau**. The Kai of those places belonged to Honouliuli, thence to **Kapuna**. Honouliuli anciently took the cape & thence turned. **XX** That from there to **Miki** was all Honouliuli, not mentioning any kai for that shore.

X by Kimo: The same people went all round. They are all dead but me.

We went to Kapuna, Kauhi said it was Honouliuli.

At 5 p.m. adjourned — to 31st 1873

Dec. 31st. Present: Coney, Stanley, Judd, Kimo.
Mr. Judd submits that it is not within the jurisdiction of the Commissioner to award as territory, the sea or inland waters, defining only the land, and leaving fishing rights as appurtenances to be regulated by law.

Mr. Stanley contra. The point is reserved for argument and consideration.

To Fol. 247 [page 246]

Honouliuli
From fol. 246

Prof. Alexander gives a mem. from Vol. 10 p. 59 of L. Com Awards, from the award of Keahua, where the part of the survey including the fishery was expressly excluded by the Commissioners, and the party was referred to his right at law.

Considerations respecting Award of Fishery.
The petitioner for settlement of boundaries of Honouliuli asks that the fishing rights in "**Pearl River**" be determined and certified.

The Attorney General advised the Commissioner not to include such rights in the certificate, confining the award to the shore line and leaving fishing rights to the provisions of the Statute.

As the duty of the Commissioner is supplementary to the work of the "Board of Com's to Quiet Land titles," determining the boundaries of what they awarded by name only, the principles and rules adopted by them, and powers granted to them, and their practice together with subsequent statutes or decisions of the Supreme

Court will in respect to boundaries form a rule for the Comr.
of Boundaries.

The Board cite among certain questions to be decided "Water privileges and rights of piscary" page 90, Vol. II of Stat. Laws, and page 109 Vol. I, on the same clause they speak of rights of primogeniture, rights of adoption &c. It is obvious that the Board could have entertained such matters only in a collateral and incidental way, and only in making the award, not in the boundary of what was awarded, and therefore little or no authority can be derived thence to the B. Cr.

There is no question that the treatment of rights to fish ponds and such enclosed spaces of the edge of the sea bays &c was as land to be surveyed and awarded as dry land. There is as to such tracts covered with water, not a mere right of fishing but a sole and exclusive ownership. Sec. 384 Civil Code.

As to the general sea coast both near the shore and beyond the reef there may be rights of piscary but there are statutes which regulate them. In Oni v. Meek and in Haalelea vs. Montgomery this is expressly held, and parties are remitted to their rights under them.

The present case is a claim of right of piscary over a navigable bay or loch perhaps unlike any other in the Kingdom, and is a claim of exclusive fishing right as to the whole of a certain branch of this loch of the part lying outside of a line "chin deep" opposite the other lands situate on this branch. It is distinguishable from the right claimed and by statute given to Konohikis with certain [page 247]

Honouliuli

<u>From fol. 247</u> prescribed reservations. Civ. Code Sec. 387-92 being a claim as a private and exclusive fishery as completely as that within the "chin deep" line, is claimed for the lands adjacent.

I find in repeated instances that the Board declined to award and define piscary rights, leaving parties to their rights under general statutes, e.g. in the award to Keahua, Vol. 10, p. 59, where the fishing right was surveyed and included in the land asked for, the Board expressly refused to award this portion of the survey, remitting the claimant to the law, endorsing this refusal both on the notes of survey in the award and on the accompanying plot, and no instances of a customary practice are shown to me.

Upon due consideration of the premise, I decline to award the fishery of Honouliuli as a right or as territory, but deeming it of importance that all rights depending on kamaaina testimony be now settled as far as may be, and knowing of no better place than the records of the Boundary Commissioner for the preservation of such claims, I take the testimony offered on the subject and make such a supplementary finding as such testimony warrants.

Award No. 4

Office of the Commissioner
of Boundaries of Oahu

In the Matter of the application
of Mrs. A. Haalelea for settlement
of the boundaries of the
Ahupuaa of Honouliuli, Ewa.

Proper application having been made, as above, and notice having been given to all parties concerned the matter came on to be heard at the Court House in Honolulu on the 30th day of December A.D. 1873, and from the proofs taken I find the boundaries of the said Ahupuaa of Honouliuli as follows, to wit:

Beginning at a large flat rock known as Pohaku Pa-

lahalaha, a well-known rock now marked by an arrow
and the name “Honouliuli” on one side and Hoaeae on
the other, from which the Govt. Survey Trig. station near
Kaulu bears S. 38° 48’ E. the boundary runs
1. S. 38° 16’ E. 2875 feet along Hoaeae, to a red wood post [page 248]

Honouliuli
From Fol 248

375 feet beyond the Govt. road near the brink of a gulch;
2. S. 36° 06' east 3703 feet to a point adjoining the west corner of Royal Patent 778 in Kaulu;
3. Along the brink of the Pali to a point opposite a red wood post which bears S. 54° 28' E. 895 feet from the last corner where land Hoaeae begins:
4. Beginning again at Pohaku Palahalaha N. 21° 21' W. 2035 ft. to a pile of stones; along
5. Hoaeae, thence N. 22° 3' W. 4686 ft. along do. to a red wood post, and thence
6. N. 23° 46' W. 6422 ft. to red wood post, and
7. N. 35° 32' W. 4410 ft. to red wood post by an old Kukui tree adjoining Hoaeae;
8. N. 20° 33' W. 4237 ft. across **Ekahanui Gulch** to a granite post at the N.W. corner of Hoaeae; thence
9. N. 41° 18' E. 2990 ft. to a red wood post, still along Hoaeae;
10. N. 43° 36 ½ ft. to a marked rock at the head of an ancient "holua" near the junction of the Poliwai with the **Manawaielelu gulch** on the boundary between Hoaeae & Pouhala, thence;
11. N. 16° 49' W. 265 ft. along Lower Pouhala as per Royal Patent No. 4486, to a marked stone post; thence
12. N. 14° 24' W. 2057 ft. along Pouhala to a marked stone &
13. N. 31° 36' W. 1090 ft. to a large flat rock at the N.W. corner of R. Pat. 4486;
14. N. 26° 43' W. 4587 ft. along upper Pouhala to a marked stone, and thence –
15. N. 15° 44' W. 2467 ft. to brink of the **Kawaieli** gulch by the road – thence –
16. North 11° 52' W. 1363 ft. across the Kawaieli gulch to a granite post which is the corner of Honouliuli, Pouhala & Waianae uka – thence –
17. N. 67° 44' W. 4406 ft. to a red wood post along Waianae and thence –

18. N. 86° 58′ W. 3339 feet (along an old path called Mookapu)
adjoining Waianae uka to a red wood post and thence
19. S. 60° 49′ W. 1677 ft. along Waianae uka to a post & thence
20. S. 27° 07′ W. 762 ft. across the Kawaieli gulch to a marked
stone where Kuhau's house formerly stood – thence –
21. S. 47° 14′ W. 8660 ft. up a ridge to the summit of **Kahapapa**
thence along the summits of the mountain range which
separates this land from Waianae;
22. S. 30° 36′ E. 5709 ft.
23. S. 12° 37′ W. 5190 ft. to **Puu Kuua** – thence
24. S. 3° 4′ W. 9367 ft. along the ridge

Fol. 250 [page 249]
Honouliuli
From Fol. 249

25. S. 9° 35′ E. 4505 ft. to Mauna Kapu, thence –
26. S. 22° 31′ W. 6219 ft. to a red wood post on **Manawahua**,
which bears N. 77° 44′ W. from the Honouliuli Trig. Station
near Kaulu, and
27. S. 63° 16 ½′ W. 9115 feet along Nanakuli to a pile of stones
on the ridge and thence –
28. S. 44° 47′ W. 3200 ft. along Nanakuli to the **Pili o Kahe**,
to a marked rock at the end of a stone wall by the
road on the shore – thence
29. S. 20° 53′ E. 28,175 feet along the sea to **Laeloa** or Barber's
Point and thence
30. N. 82° 56′ E. 28,641 feet along the sea to a large pile of stones
in Oneula – thence –

[side note] Amended by new course [illegible]

31. N. 41° 97′ E. 20,920 feet along the land of **Puuloa** con-
veyed to Isaac Montgomery by Kekauonohi, September 7th
1849 to a large pile of stones at the Lae o Kahuka
32. Thence the boundary follows the shore to the point men-
tioned above where the land of Hoaeae begins, include-
ing an Area of Forty Thousand, Six hundred and
forty (40,640) acres more or less.

43,250 acres including Puuloa

The bearings given in above survey are the true bearings,
the mean declination of the magnetic needle being 9 ¼° East.

Appendix E HDOT Early Consultation Letters

JOSH GREEN, M.D.
GOVERNOR
KE KIA'ĀINA

EDWIN H. SNIFFEN
DIRECTOR
KA LUNA HO'OKELE

Deputy Directors
Nā Hope Luna Ho'okele
DREANALEE K. KALILI
TAMMY L. LEE
CURT T. OTAGURO
ROBIN K. SHISHIDO

STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF TRANSPORTATION | KA 'OIHANA ALAKAU
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:

ESCO-2025-001

July 31, 2025

Mr. Ian Hirokawa
Land Division
Department of Land and Natural Resources
1151 Punchbowl St., Room 220
Honolulu, HI 96813
Via Email: ian.c.hirokawa@hawaii.gov

Dear Mr. Hirokawa:

Subject: Kalaeloa Reef Laboratory Project

The State of Hawai'i Department of Transportation (HDOT) in collaboration with the University of Hawai'i, the Defense Advanced Research Projects Agency (DARPA), and other partners, is planning a project in the waters of Kalaeloa, O'ahu to test and develop a living, self-healing hybrid reef to protect infrastructure and communities by mitigating damage related to coastal flooding, erosion, and storm surge. The purpose of the Kalaeloa Reef Laboratory is to further research and gain knowledge of reef-mimicking structures that may attenuate wave energy more effectively than traditional hardscaping solutions to coastal erosion, with added benefits to the marine environment and local communities. If the pilot structures in the Kalaeloa Reef Laboratory Project function as expected to dissipate wave energy and therefore protect the shoreline, the nature-based technology may be tailored to provide nature-based alternatives and increase resilience of threatened shorelines across Hawai'i.

HDOT anticipates preparing an Environmental Assessment (EA) in compliance with Chapter 343 of the Hawai'i Revised Statutes, Hawai'i's environmental review law, to evaluate and disclose the project's potential environmental impacts and identify permitting requirements. In addition to preparing an Environmental Assessment, HDOT will also be submitting a Conservation District Use Application pursuant to HAR 13-5-31. HDOT will also be requesting a Right of Entry and Set Aside from Land Division.

Prior to the HRS 343 EA which formally notes the start of the environmental review process, we are gathering information from stakeholders and agencies who may have knowledge of the project area. At this time, we are seeking input on the proposed project as well as information related to any environmental, cultural/historic, social, or economic concerns related to the project or project area. Two location maps showing the general project area are attached, as well as a graphic of the different components of the proposed artificial reef structures and attached components.

DARPA is currently preparing an Environmental Assessment (EA) and forthcoming Finding of No Significant Impact (FONSI), in accordance with the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] §§ 4321 et seq.). As DARPA does not have their own NEPA implementing regulations, and in reliance on CEQ guidance, DARPA has elected to voluntarily rely on CEQ's NEPA regulations in completing ongoing NEPA reviews. Therefore, DARPA's proposed Kalaeloa Reef Laboratory intends to follow CEQ's NEPA regulations.

Overview of Proposed Project

The Kalaeloa Reef Laboratory Project would deploy bio-hybrid Reef-Mimicking Structures (RMSs) offshore at Kalaeloa, in the ahupua'a of Hono'uli'uli, in the moku of 'Ewa, on the island of O'ahu. The land fronting the proposed area is used for industrial uses, and the project site is offshore of PAR Hawaii Refining. The proposed area is characterized by wave scoured hard bottom seabed with intermittent patches of coral and sand. It is a degraded reef site that is subject to high wave action. The depth range within the proposed action area is approximately 0–50 ft (0–15 m). The location for the Kalaeloa Reef Laboratory was chosen as it fits several preliminary criteria including water depths, wave climate, and the presence of both a degraded reef and coastal infrastructure which could both benefit from a living breakwater.

The structures in the Kalaeloa Reef Laboratory Project are designed to mimic the function of a fringing reef, and consists of two types of base structures that form arrays inspired by different sections of a natural fringing reef: the reef crest (highest point of the reef) and the back reef or reef flat (shallow, shoreside). The RMS are made of concrete and epoxy which would be submerged in seawater. However, the concrete structures would contain no hazardous materials. Although trace amounts of concrete components could be released as the materials degrade over long periods of time, the ocean chemistry would not be affected. The use of epoxy would be in such small quantities that it would not affect ocean chemistry.

The project need is to find cost-effective and novel solutions for protecting shorelines, including alternatives to shoreline hardening, as the impacts of storm surges and sea level rise increase. The purpose of the Kalaeloa Reef Laboratory Project is to develop and test reef-mimicking structures that can attenuate wave energy more effectively than traditional hardscape solutions to protect infrastructure and people by mitigating damage related to coastal flooding, erosion, and storm surge. It is also intended to enhance the presence of marine organisms by establishing a healthy coral reef on the structures.

Request for Input

HDOT welcomes any comments and input you may have on the Right of Entry and Set Aside from Land Division, the purpose and need for this project, possible alternatives, or any information related to any environmental, cultural/historic, social, or economic concerns related to the project or project area.

HDOT would appreciate a written response within 30 days from date of receipt to Genevieve Sullivan, HDOT Project Manager, via email at mail to: genevieve.h.sullivan@hawaii.gov, or by U.S. Postal Service to Hawaii Department of Transportation, 869 Punchbowl Street, Room 513, Honolulu, Hawaii, 96813. Please include the letter reference number noted above. Should you have any questions regarding this request, you may also contact Genevieve Sullivan via email or at 808-587-2169.

Aloha ʻĀina,

LAURA H.E. KAAKUA
Energy Security & Community Outreach Manager
Office of Energy Security & Community Outreach
Hawaiʻi Department of Transportation

Enclosure

Figure Error! No text of specified style in document.. **Overview of Project Location with Example Hybrid-Reef Layout**

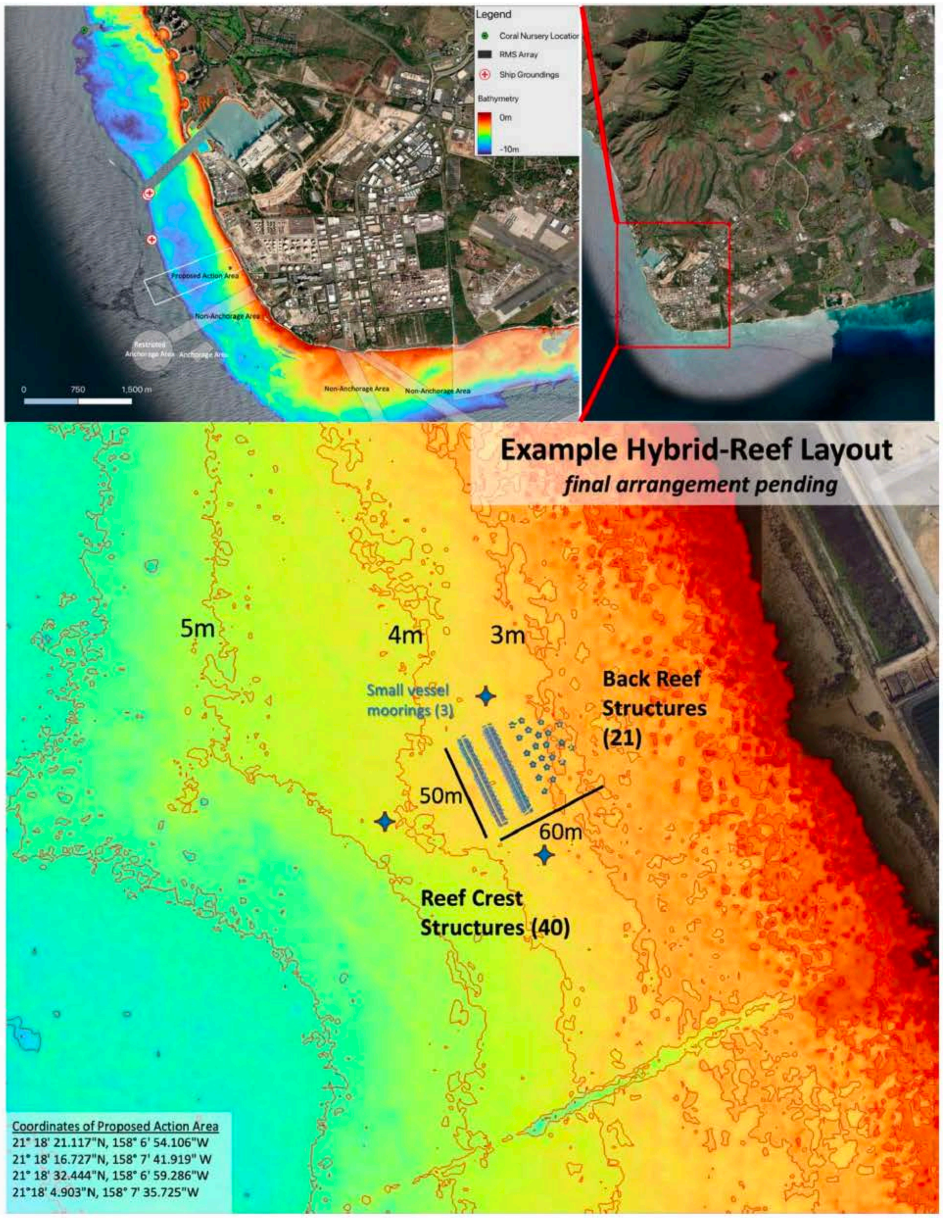


Figure Error! No text of specified style in document.. **Artist Rendering of Original Reefense Design**

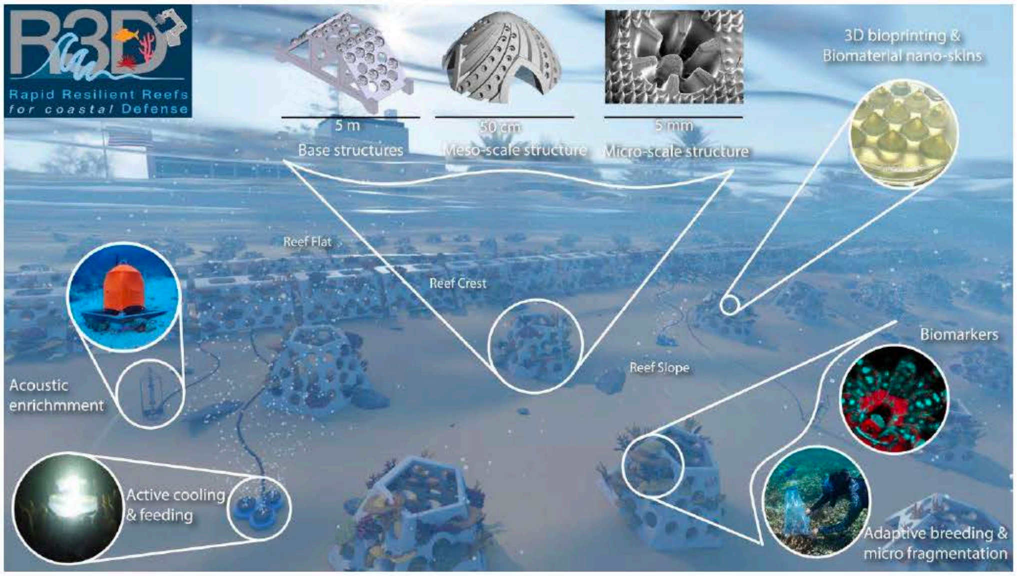
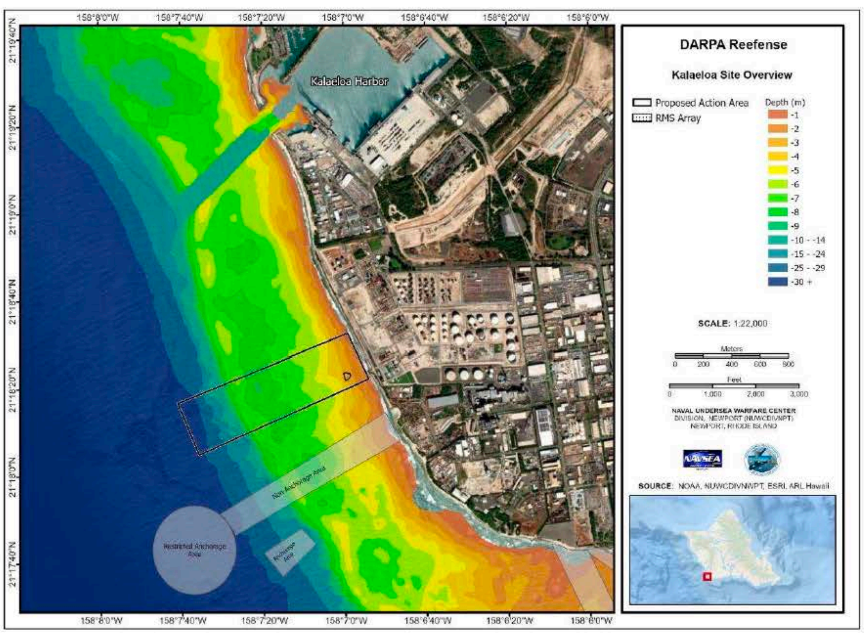


Figure 3. Kalaeloa Site Overview



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STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF TRANSPORTATION | KA ʻOIHANA ALAKAU
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:

ESCO-2025-003

June 18, 2025

Mr. Michael Cain, Administrator
Office of Conservation & Coastal Lands
Department of Land and Natural Resources
Via Email: michael.cain@hawaii.gov

Dear Mr. Cain:

Subject: Kalaeloa Reef Laboratory Project

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HDOT anticipates preparing an Environmental Assessment (EA) in compliance with Chapter 343 of the Hawaiʻi Revised Statutes, Hawaiʻi's environmental review law, to evaluate and disclose the project's potential environmental impacts and identify permitting requirements. In addition to preparing an Environmental Assessment, HDOT will also be submitting a Conservation District Use Application pursuant to HAR 13-5-31.

Prior to the HRS 343 EA which formally notes the start of the environmental review process, we are gathering information from stakeholders and agencies who may have knowledge of the project area. At this time, we are seeking input on the proposed project as well as information related to any environmental, cultural/historic, social, or economic concerns related to the project or project area. Two location maps showing the general project area are attached, as well as a graphic of the different components of the proposed artificial reef structures and attached components.

DARPA is currently preparing an Environmental Assessment (EA) and forthcoming Finding of No Significant Impact (FONSI), in accordance with the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] §§ 4321 et seq.). As DARPA does not have their own NEPA implementing regulations, and in reliance on CEQ guidance, DARPA has elected to voluntarily rely on CEQ's NEPA regulations in completing ongoing NEPA reviews. Therefore, DARPA's proposed Kalaeloa Reef Laboratory intends to follow CEQ's NEPA regulations.

Overview of Proposed Project

The Kalaeloa Reef Laboratory Project would deploy bio-hybrid Reef-Mimicking Structures (RMSs) offshore at Kalaeloa, in the ahupuaʻa of Honoʻuliʻuli, in the moku of ʻEwa, on the island of Oʻahu. The land fronting the proposed area is used for industrial uses, and the project site is offshore of PAR Hawaii Refining. The proposed area is characterized by wave scoured hard bottom seabed with intermittent patches of coral and sand. It is a degraded reef site that is subject to high wave action. The depth range within the proposed action area is approximately 0–50 ft (0–15 m). The location for the Kalaeloa Reef Laboratory was chosen as it fits several preliminary criteria including water depths, wave climate, and the presence of both a degraded reef and coastal infrastructure which could both benefit from a living breakwater.

The structures in the Kalaeloa Reef Laboratory Project are designed to mimic the function of a fringing reef, and consists of two types of base structures that form arrays inspired by different sections of a natural fringing reef: the reef crest (highest point of the reef) and the back reef or reef flat (shallow, shoreside). The RMS are made of concrete and epoxy which would be submerged in seawater. However, the concrete structures would contain no hazardous materials. Although trace amounts of concrete components could be released as the materials degrade over long periods of time, the ocean chemistry would not be affected. The use of epoxy would be in such small quantities that it would not affect ocean chemistry.

The project need is to find cost-effective and novel solutions for protecting shorelines, including alternatives to shoreline hardening, as the impacts of storm surges and sea level rise increase. The purpose of the Kalaeloa Reef Laboratory Project is to develop and test reef-mimicking structures that can attenuate wave energy more effectively than traditional hardscape solutions to protect infrastructure and people by mitigating damage related to coastal flooding, erosion, and storm surge. It is also intended to enhance the presence of marine organisms by establishing a healthy coral reef on the structures.

Request for Input

HDOT welcomes any comments and input you may have on the purpose and need for this project, possible alternatives, or any information related to any environmental, cultural/historic, social, or economic concerns related to the project or project area.

HDOT would appreciate a written response within 30 days from date of receipt to Genevieve Sullivan, HDOT Project Manager, via email at mail to: genevieve.h.sullivan@hawaii.gov, or by U.S. Postal Service to Hawaii Department of Transportation, 869 Punchbowl Street, Room 513, Honolulu, Hawaii, 96813. Please include the letter reference number noted above. Should you have any questions regarding this request, you may also contact Genevieve Sullivan via email or at 808-587-2169.

Aloha ʻĀina,

LAURA H.E. KAAKUA
Energy Security & Community Outreach Manager
Office of Energy Security & Community Outreach
Hawaiʻi Department of Transportation

Cc: K. Tiger Mills, kimberly.mills@hawaii.gov

Enclosure: 3 pages (2 maps and 1 graphic)

JOSH GREEN, M.D.
GOVERNOR
KE KIA'ĀINA

EDWIN H. SNIFFEN
DIRECTOR
KA LUNA HO'OKELE

Deputy Directors
Nā Hope Luna Ho'okele
DREANALEE K. KALILI
TAMMY L. LEE
CURT T. OTAGURO
ROBIN K. SHISHIDO

STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF TRANSPORTATION | KA 'OIHANA ALAKAU
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:

ESCO-2025-002

July 23, 2025

Mr. Brian Neilson
Division of Aquatic Resources
Department of Land and Natural Resources
Via Email: brian.j.neilson@hawaii.gov

Dear Mr. Brian Neilson:

Subject: Kalaeloa Reef Laboratory Project

The State of Hawai'i Department of Transportation (HDOT) in collaboration with the University of Hawai'i, the Defense Advanced Research Projects Agency (DARPA), and other partners, is planning a project in the waters of Kalaeloa, O'ahu to test and develop a living, self-healing hybrid reef to protect infrastructure and communities by mitigating damage related to coastal flooding, erosion, and storm surge. The purpose of the Kalaeloa Reef Laboratory is to further research and gain knowledge of reef-mimicking structures that may attenuate wave energy more effectively than traditional hardscaping solutions to coastal erosion, with added benefits to the marine environment and local communities. If the pilot structures in the Kalaeloa Reef Laboratory Project function as expected to dissipate wave energy and therefore protect the shoreline, the nature-based technology may be tailored to provide nature-based alternatives and increase resilience of threatened shorelines across Hawai'i.

HDOT anticipates preparing an Environmental Assessment (EA) in compliance with Chapter 343 of the Hawai'i Revised Statutes, Hawai'i's environmental review law, to evaluate and disclose the project's potential environmental impacts and identify permitting requirements.

Prior to the HRS 343 EA which formally notes the start of the environmental review process, we are gathering information from stakeholders and agencies who may have knowledge of the project area. At this time, we are seeking input on the proposed project as well as information related to any environmental, cultural/historic, social, or economic concerns related to the project or project area. A location map showing the general project area is attached.

HDOT is not applying for any Special Activity Permit (SAP) or other permit from the Division of Aquatic Resources. However, a partner in the proposed Kalaeloa Reef Laboratory project has submitted a request to amend an already existing Kuleana Coral Restoration (KCR) SAP under number 2026-26. This permit request is for the removal of intact coral colonies as well as coral of opportunity from the project site in support of the deployment. This effort will support the permitting plan to remove all colonies greater than 10 cm (4 in) in height from the locations where structures will be deployed. Additionally, the request will include increasing the number of permitted corals that can be removed and cached at KCR's coral nursery near Ko Olina.

A second SAP will be submitted to the Division of Aquatic Resources by the University of Hawai'i. This permit will be for the use of coatings of natural materials encouraging the settlement and supporting post-settlement survival of coral larvae on the Kalaeloa reef structures. These materials include components isolated directly from coral and local crustose coralline algae (e.g., molecules, biofilms). This SAP will be submitted in the coming weeks.

DARPA is currently preparing an Environmental Assessment (EA) and the forthcoming Finding of No Significant Impact (FONSI), in accordance with the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] §§ 4321 et seq.). As DARPA does not have their own NEPA implementing regulations, and in reliance on CEQ guidance, DARPA has elected to voluntarily rely on CEQ's NEPA regulations in completing ongoing NEPA reviews. Therefore, DARPA's proposed Kalaeloa Reef Laboratory intends to follow CEQ's NEPA regulations.

Overview of Proposed Project

The Kalaeloa Reef Laboratory project would deploy bio-hybrid Reef-Mimicking Structures (RMSs) offshore at Kalaeloa, in the ahupua'a of Hono'uli'uli, in the moku of 'Ewa, on the island of O'ahu. The land fronting the proposed area is used for industrial uses, and the project site is offshore of PAR Hawaii Refining. The proposed area is characterized by wave scoured hard bottom seabed with intermittent patches of coral and sand. It is a degraded reef site that is subject to high wave action. The depth range within the proposed action area is approximately 0–50 ft (0–15 m). The location for the Kalaeloa Reef Laboratory was chosen as it fits several preliminary criteria including water depths, wave climate, and the presence of both a degraded reef and coastal infrastructure which could both benefit from a living breakwater.

The structures in the Kalaeloa Reef Laboratory Project are designed to mimic the function of a fringing reef, and consists of two types of base structures that form arrays inspired by different sections of a natural fringing reef: the reef crest (highest point of the reef) and the back reef or reef flat (shallow, shoreside). The RMS are made of concrete and epoxy which would be submerged in seawater. However, the concrete structures would contain no hazardous materials. Although trace amounts of concrete components could be released as the materials degrade over long periods of time, the ocean chemistry would not be affected. The use of epoxy would be in such small quantities that it would not affect ocean chemistry.

The project need is to find cost-effective and novel solutions for protecting shorelines, including alternatives to shoreline hardening, as the impacts of storm surges and sea level rise increase. The purpose of the Kalaeloa Reef Laboratory is to develop and test reef-mimicking structures that can attenuate wave energy more effectively than traditional hardscape solutions to protect infrastructure and people by mitigating damage related to coastal flooding, erosion, and storm surge. It is also intended to enhance the presence of marine organisms by establishing a healthy coral reef on the structures.

Request for Input

HDOT welcomes any comments and input you may have on the purpose and need for this project, permit requirements, or any information related to any environmental, social, or economic concerns related to the project or project area.

HDOT would appreciate a written response within 30 days from date of receipt to Genevieve Sullivan, HDOT Project Manager, via email at mail to: genevieve.h.sullivan@hawaii.gov, or by U.S. Postal Service to Hawaii Department of Transportation, Highways Division, 869 Punchbowl Street, Room 513, Honolulu, Hawaii, 96813. Please include the letter reference number noted above. Should you have any questions regarding this request, you may also contact Genevieve Sullivan via email or at 808-587-2169.

Aloha ʻĀina,

LAURA H.E. KAAKUA
Energy Security & Community Outreach Manager
Office of Energy Security & Community Outreach
Hawaiʻi Department of Transportation

Enclosure

DAVID Y. IGE
GOVERNOR

JADE T. BUTAY
DIRECTOR

Deputy Directors
ROSS M. HIGASHI
EDUARDO P. MANGLALLAN
PATRICK H. MCCAIN
EDWIN H. SNIFFEN

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
ESCO 2025-005

Submitted in digital copy via HICRIS (https://shpd.hawaii.gov/hicris) and via email to jessica.puff@hawaii.gov

JULY 23, 2025

TO:	MS. DAWN CHANG, STATE HISTORICPRESERVATION OFFICER STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES
ATTN:	JESSICA PUFF, ADMINISTRATOR AND DEPUTY STATE HISTORIC PRESERVATION OFFICER, STATE HISTORIC PRESERVATION DIVISION
FROM:	GENEVIEVE SULLIVAN, RESILIENCE COORDINATOR, ADMINISTRATIVE DIVISION, HAWAI'I DEPARTMENT OF TRANSPORTATION
SUBJECT:	HAWAII REVISED STATUTES (HRS) CHAPTER 6E-8 REVIEW; KALAELOA REFF PROJECT, OFFSHORE KALAELOA, AHUPUA'A OF HONOULIULI, MOKU OF 'EWA, ISLAND OF O'AHU

In accordance with Hawaii Revised Statutes (HRS) Chapter 6E-8 and Hawaii Administrative Rules (HAR) 13-275, the State of Hawaii Department of Transportation (HDOT) is initiating State Historic Preservation Division (SHPD) review of the proposed Kalaeloa reef project. HDOT has jurisdiction over determining the project's effects under HRS Chapter 6E-8 (HAR 13-275). An Environmental Assessment (EA) for this project is being prepared in compliance with Chapter 343 of Hawaii Revised Statutes (HRS), also known as the Hawaii Environmental Policy Act (HEPA).

Overview of the Undertaking

he Defense Advanced Research Projects Agency (DARPA) Reefense Program aims to develop and demonstrate a new class of hybrid, engineered reef technology for coastal resiliency and defense applications. The Kalaeloa reef project is investigating the use of bio-rock (electro-mineral accretion) and natural reef recruitment to enhance the growth of coral and calcareous organisms on purpose-built structures to create self-repairing, adaptive, living coastal infrastructure (LCI).

The proposed Kalaeloa reef project involves the deployment of test structures (modules) offshore of Kalaeloa, O'ahu, Hawai'i. The test structures would be deployed to a maximum depth of approximately 10 meters (33 feet) relative to mean lower low water (MLLW) in a sandy-bottom environment that has been previously disturbed by the effects of military activity. The test modules would not be placed on existing live reef structures or within any coral habitat. The RHP would monitor the growth and stability of the test modules and their ability to recruit and maintain natural reef structures, with the goal of developing a technology that could be used as a self-repairing, adaptive LCI.

The project is located within the Ahupuaʻa of Honouliuli, Moku of ʻEwa, on the Island of Oʻahu, offshore of Kalaeloa. The approximate coordinates of the project area are:

* 21° 18' 21.117"N, 158° 6' 54.106"W

* 21° 18' 16.727"N, 158° 7' 41.919"W

* 21° 18' 32.444"N, 158° 6' 59.286"W

* 21° 18' 4.903"N, 158° 7' 35.725"W

Consultation

In accordance with HRS Chapter 6E-8, HDOT is conducting early consultation with the State Historic Preservation Division. We also seek to engage Native Hawaiian organizations and other interested parties with ancestral, lineal, or cultural ties to, or concerns for, historic or cultural properties in the project area. We welcome your input on appropriate parties for consultation under HRS Chapter 6E.

Project Area for HRS 6E-8 Review

The project area for HRS 6E-8 review is the offshore marine environment where the test modules will be deployed, as described above and shown in the enclosed Project Location Map. This area is offshore of Kalaeloa, Oʻahu.

Historic and Cultural Context of Honouliuli, ʻEwa

The ahupuaʻa of Honouliuli, located in the moku of ʻEwa on the island of Oʻahu, is a wahi pana (storied place) with deep historic and cultural significance. Its extensive history is documented in various records, including royal land awards. Royal Patent No. 6971, issued upon confirmation by the Land Commission, granted an estate of freehold to M. Kekauonohi in Honouliuli, ʻEwa, Oʻahu. This patent specifically references Pohaku Palahalaha (a large flat rock) as a key landmark in its boundary description, demonstrating the traditional role of natural features in defining land divisions. This land award is further identified as Land Commission Award Helu: 11216:8 to Kekauonohi.

The broader Honouliuli and ʻEwa region encompass a wide range of significant cultural sites, demonstrating the extensive history and cultural practices of the area. These sites vary in type and era, including:

1. Puʻu Kapolei Heiau (Site 50-80-12-00138): A prominent pre-contact religious structure, indicative of early Hawaiian spiritual and community practices.
2. Pohaku Palahalaha: A natural landmark with historical significance, as evidenced by its use in traditional land boundaries like those described in Royal Patent No. 6971.
3. Puʻuloa Salt Works (historical): A significant historic-era site reflecting traditional economic and cultural practices associated with salt production.

Despite the rich cultural landscape of the surrounding area, the proposed project activity is located exclusively within the marine environment. While significant cultural sites like Kalaeloa Heritage Park are located within the broader Kalaeloa region, they are situated a considerable distance inland from the project's offshore area. Based on the Cultural Resources Literature Review and Survey conducted for the project, no historic properties, or historic sites, are known to exist within the specific project area (the nearshore marine environment offshore of Kalaeloa).

Summary

We request your input on potential Native Hawaiian organizations and other consulting parties for this project under HRS Chapter 6E. In addition, we welcome your comments on the proposed project area.

HDOT would appreciate a written response within 30 days from date of receipt to Genevieve Sullivan, HDOT Project Manager, via email at [genevieve.h.sullivan@hawaii.gov, or by U.S. Postal Service to Hawaii Department of Transportation, Office of Energy Security and Waste Reduction, 869 Punchbowl Street, Room 513, Honolulu, Hawai'i, 96813. Please include the letter reference number noted above. Should you have any questions regarding this request, you may also contact Genevieve Sullivan via email or at 808-587-1834.

Aloha ʻĀina,

LAURA H.E. KAAKUA
Energy Security & Community Outreach Manager
Office of Energy Security & Community Outreach
Hawaiʻi Department of Transportation

Enclosure

Appendix F Responses to HDOT's Draft EA Early Consultation Letters

STATE OF HAWAIʻI
OFFICE OF PLANNING
& SUSTAINABLE DEVELOPMENT

JOSH GREEN, M.D.
GOVERNOR

SYLVIA LUKE
LT. GOVERNOR

MARY ALICE EVANS
DIRECTOR

235 South Beretania Street, 6th Floor, Honolulu, Hawaiʻi 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaiʻi 96804

Telephone: (808) 587-2846
Fax: (808) 587-2824
Web: https://planning.hawaii.gov/

Coastal Zone Management Program

Environmental Review Program

Land Use Commission

Land Use Division

Special Plans Branch

State Transit-Oriented Development

Statewide Geographic Information System

Statewide Sustainability Branch

DTS 202508181326ME

August 25, 2025

TO: Edwin H. Sniffen, Director
Department of Transportation

THROUGH: Laura H.E. Kaakua, Manager
Office of Energy Security & Community Outreach

FROM: Mary Alice Evans, Director Mary Alice Evans
Office of Planning and Sustainable Development

SUBJECT: Early Consultation on Environmental Assessment for the Kalaeloa Reef Laboratory Project

The Office of Planning and Sustainable Development (OPSD) is in receipt of your review request dated July 31, 2025, on the preparation of an Environmental Assessment (EA) for the Kalaeloa Reef Laboratory Project.

According to the pre-EA information provided, the purpose of the Kalaeloa Reef Laboratory project is to develop and test reef-mimicking structures that can attenuate wave energy more effectively than traditional hardscape solutions to protect infrastructure by mitigating damage risk from coastal flooding, erosion, and storm surge. The project will deploy two types of bio-hybrid reef-mimicking structures offshore at Kalaeola, in the ahupuaʻa of Honoʻuliʻuli, in the moku of ʻEwa, on the island of Oʻahu. The structures will be made of concrete and epoxy which will be submerged in seawater. The depth range within the proposed action area is approximately 0-50 feet.

The OPSD has reviewed the pre-EA information and offers the following comments:

1. <u>List of Permits and Agency Approvals Maps & Diagrams</u>
   The EA shall discuss the triggers for the preparation of an EA set forth in Hawaiʻi Revised Statutes (HRS) Chapter 343, and list all required permits and approvals. Furthermore, the EA should contain the project location maps, including the regional location on the island of Oʻahu, and provide schematic plans or drawing indicating the scope of project.

2. <u>Coastal Zone Management Act (CZMA) federal consistency</u>
   The national Coastal Zone Management Act (CZMA) requires that federal actions be consistent with approved state coastal program enforceable

policies. Federal actions include activities performed by a federal agency; activities that require federal permits or approvals; or state and local government projects that receive federal financial assistance. If federal permits are required, then this project may be subject to CZMA federal consistency.

OPSD is the lead state agency with the authority to conduct CZMA federal consistency determinations. Please contact OPSD on the applicable rules and regulations related to federal consistency reviews.

3. Hawai‘i Coastal Zone Management (CZM) Program
The CZM area is defined as "all lands of the State and the area extending seaward from the shoreline to the limit of the State's police power and management authority, including the U.S. territorial sea" under HRS § 205A-1.

Pursuant to HRS § 205A-4, in implementing the objectives of the CZM program, all agencies shall consider ecological, cultural, historic, esthetic, recreational, scenic, open space values, coastal hazards, and economic development. The subject EA should include an assessment with mitigation measures as to how the proposed project conforms to each of the CZM objectives and supporting policies set forth in HRS § 205A-2, as amended.

4. Special Management Area (SMA) Use and Shoreline Setbacks
The Department of Planning and Permitting, City and County of Honolulu, should be consulted to confirm the requirements of SMA use and shoreline setbacks. The EA should discuss how the proposed action, including any staging area, will comply with Revised Ordinances of Honolulu Chapter 25 and Chapter 26, respectively.

5. Water Quality and Impacts to the Nearshore Environment
Pursuant to the Hawaii administrative Rules § 11-200.1-18(d)(7) and (8), the EA should assess the positive and negative impacts of the proposed project on the nearshore marine ecosystem and discuss site-specific mitigation measures for protection of the nearshore ecosystem and the maintenance of water quality.

6. The Kalaeloa Reef Laboratory Project is designed to test reef-mimicking structures as one alternative to traditional hardscape solutions to protect infrastructure such as highways. The OPSD recommends that the EA discuss how the proposed project would be applicable to other sites across the state, including shoreline or beach erosion areas impacted by high-wave energy.

If you respond to this comment letter, please include DTS 202508181326ME in the subject line. For any questions regarding this letter, please contact Debra Mendes by email at Debra.L.Mendes@hawaii.gov.

re OA-26-17 MIC

JOSH GREEN, M.D.
GOVERNOR | KE KIA'ĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIA'ĀINA

RECEIVED
LAND DIVISION
2025 AUG 18 PM 2:47

DAWN N. S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RECEIVED
OFFICE OF CONSERVATION AND COASTAL LANDS
2025 AUG -8 A 9:11
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA 'OIHANA KUMUWAIWAI 'ĀINA
LAND DIVISION

P.O. BOX 621
HONOLULU, HAWAII 96809

August 7, 2025

MEMORANDUM

TO: **DLNR Agencies:**
X Div. of Aquatic Resources (kendall.l.tucker@hawaii.gov)
X Div. of Boating & Ocean Recreation (richard.t.howard@hawaii.gov)
X Engineering Division (DLNR.ENGR@hawaii.gov)
X Div. of Forestry & Wildlife (rubyrosa.t.terrago@hawaii.gov)
__Div. of State Parks
X Commission on Water Resource Management (DLNR.CWRM@hawaii.gov)
X Office of Conservation & Coastal Lands (sharleen.k.kuba@hawaii.gov)
X Land Division – O'ahu District (barry.w.cheung@hawaii.gov)
X Land Division – Ian C. Hirokawa (ian.c.hirokawa@hawaii.gov)
X Land Division – Rebecca L. Anderson (rebecca.l.anderson@hawaii.gov)
X Aha Moku Advisory Committee (leimana.k.damate@hawaii.gov)

FROM: Ian C. Hirokawa, Acting Land Administrator
SUBJECT: **Early Consultation of the Environmental Assessment for the Kalaeloa Reef Laboratory Project**
LOCATION: Kalaeloa, Island of O'ahu
APPLICANT: The State of Hawai'i Department of Transportation (HDOT)

Transmitted for your review and comment is information on the above-referenced subject matter. Please submit comments by **August 28, 2025.**

If no response is received by the above date, we will assume your agency has no comments. Should you have any questions about this request, please contact Dayna Vierra at dayna.k.vierra@hawaii.gov. Thank you.

BRIEF COMMENTS:

comments from OCCL were sent to applicant on Aug 7, 2025.

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

Signed:
Print Name: Mari Kurosawa
Division: office of conservation & coastal Lands
Date: 8/14/2025

Attachment(s)

JOSH GREEN, M.D.
GOVERNOR | KE KIA'ĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIA'ĀINA

STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA 'OIHANA KUMUWAIWAI 'ĀINA
Office of Conservation and Coastal Lands
P.O. BOX 621
HONOLULU, HAWAII 96809

DAWN N.S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RYAN K.P. KANAKA'OLE
FIRST DEPUTY

CIARA W.K. KAHAHANE
DEPUTY DIRECTOR - WATER

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

REF:OCCL:MK

COR OA 26-17
Aug 7, 2025

Genevieve Sullivan, HDOT Project Manager
Hawai'i State Department of Transportation
869 Punchbowl Street, Room 513
Honolulu, HI 96813

SUBJECT: Correspondence OA 26-17 Request for Comments Regarding Kalaeloa Artificial Reef Project, Located offshore of Honouliuli, 'Ewa, Island of O'ahu
Tax Map Key (TMK): Offshore of (1) 9-1-014

Dear Genevieve Sullivan:

The Office of Conservation and Coastal Lands is in receipt of your letter regarding the subject project. According to your letter, the Hawai'i State Department of Transportation (HDOT) is preparing an Environmental Assessment for an artificial reef project, in collaboration with the Defense Advanced Research Projects Agency (DARPA) and other partners. The project intends to develop a living, self-healing, hybrid reef to protect infrastructure and communities by mitigating damage related to coastal flooding, erosion, and storm surge. The project is located on State submerged land within the Resource Subzone of the State Land Use Conservation District.

The reef mimicking structures are designed to mimic the function of a fringing reef and consist of two types of base structures: the reef crest (highest point of the reef) and the back reef or reef flat (shallow, shoreside). According to your attachments, it appears the project proposes to install 40 reef crest structures and 21 back reef structures, within a 50-meter by 60-meter area (**Exhibit 1**). The depth range within the proposed action area is approximately 0-15 meters. The structures are made of concrete and epoxy, which will be submerged in seawater. Although trace amounts of concrete components could be released as the materials degrade over time, the applicant believes the ocean chemistry will not be affected. Additionally, the applicant believes the quantity of epoxy required for this project will not affect ocean chemistry.

The proposed use is an identified land use in the Resource subzone of the Conservation District, pursuant to the Hawaii Administrative Rules (HAR) §13-5-24, R-2 ARTIFICIAL REEFS (D-1*) Artificial reefs.* This requires the filing of a Conservation District Use Application (CDUA). To allow, modify, or deny the proposed land use would be at the discretion of the Board of Land and Natural Resources. The CDUA should be signed by the landowner and contain all required attachments, such as but not limited to the completed environmental assessment, and compliance with Hawai'i Revised Statutes (HRS) 6E. Applications can be found on our website at https://dlnr.hawaii.gov/occl/application-process/.

Please contact the Land Division to determine if a land disposition for the use of submerged State Lands is required, and to obtain landowner's signature for the application. Additionally, you may wish to consult with the Division of Aquatic Resources and the Division of Boating and Ocean Recreation for comments or permit requirements.

Regarding cultural/historic concerns related to the project or project area, you may wish to consult with the Aha Moku Advisory Committee and cultural practitioners within the area.

The OCCL has the following questions that should be answered, preferably in the EA, of not the CDUA application:

- Please provide construction plans/diagrams to understand what is being proposed, including the dimensions of the structures and how many of each type of structure will be deployed;
- How will the structures be installed? Will ground disturbance be required?;
- How many coral fragments will be adhered to each structure?;
- Are these coral fragments corals of opportunity? Will they be sourced from the same locality as the proposed project?;
- Are the structures intended to be permanent?;
- Does the project require staging areas? If so, where will they be located?; and
- Does the project involve acoustic enrichment and the active cooling and feeding shown in the attached graphic (**Exhibit 2**)?

Should you have any questions regarding this matter, please contact Mari Kurosawa of our Office at (808) 587-0381 or at mari.i.kurosawa@hawaii.gov.

Sincerely,

S Michael Cain

S. Michael Cain, Administrator
Office of Conservation and Coastal Lands

CC: Land Division
Division of Aquatic Resources
Division of Boating and Ocean Recreation
City & County of Honolulu- Department of Planning and Permitting

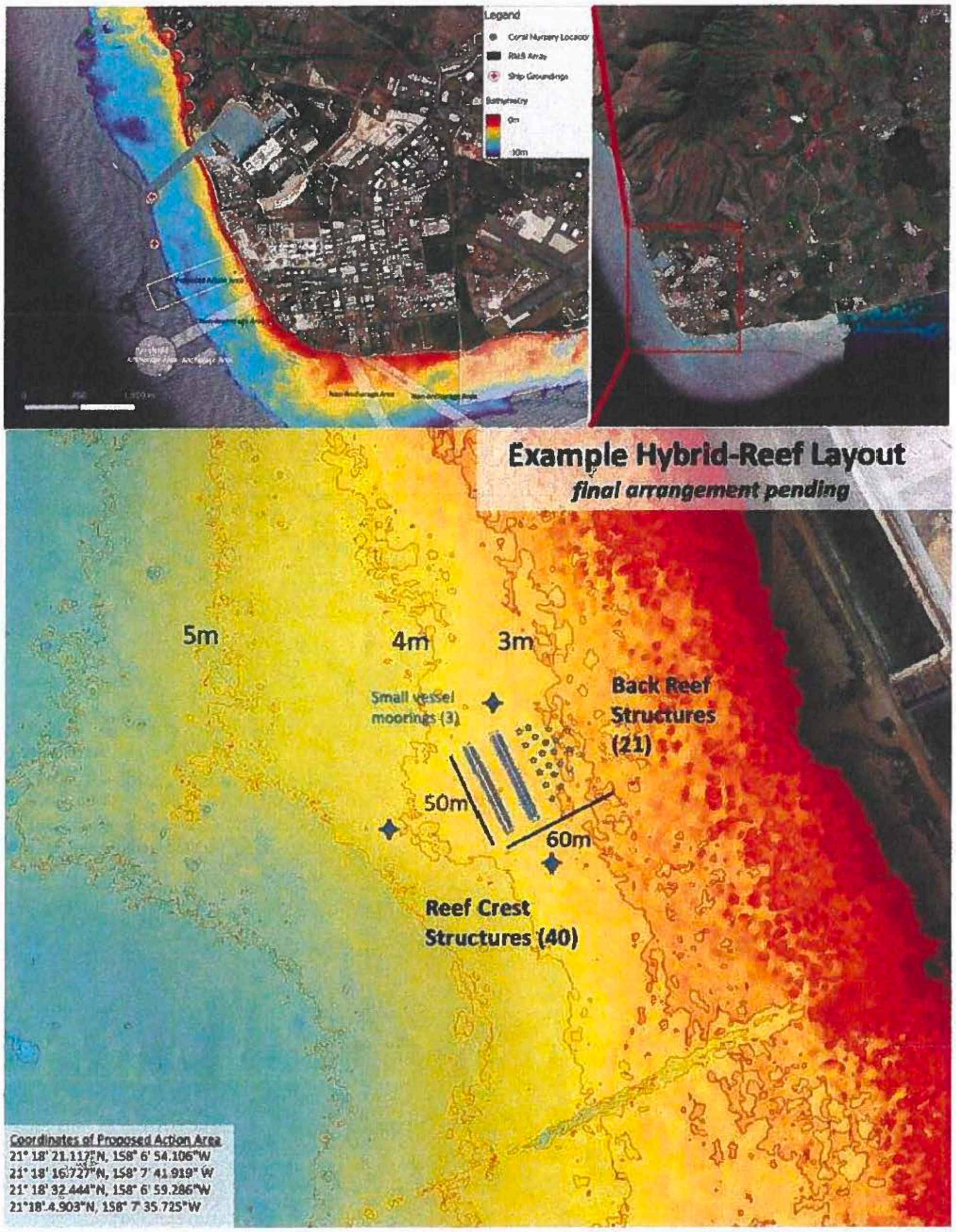
Legend
Bathymetry
0m
Example Hybrid-Reef Layout
final arrangement pending
5m
4m
3m
Small vessel moorings (3)
Back Reef Structures (21)
50m
60m
Reef Crest Structures (40)
Coordinates of Proposed Action Area
21° 18' 21.117"N, 158° 6' 54.106"W
21° 18' 16.727"N, 158° 7' 41.919" W
21° 18' 32.444"N, 158° 6' 59.286"W
21°18'.4.903"N, 158° 7' 35.725"W

Exhibit 1

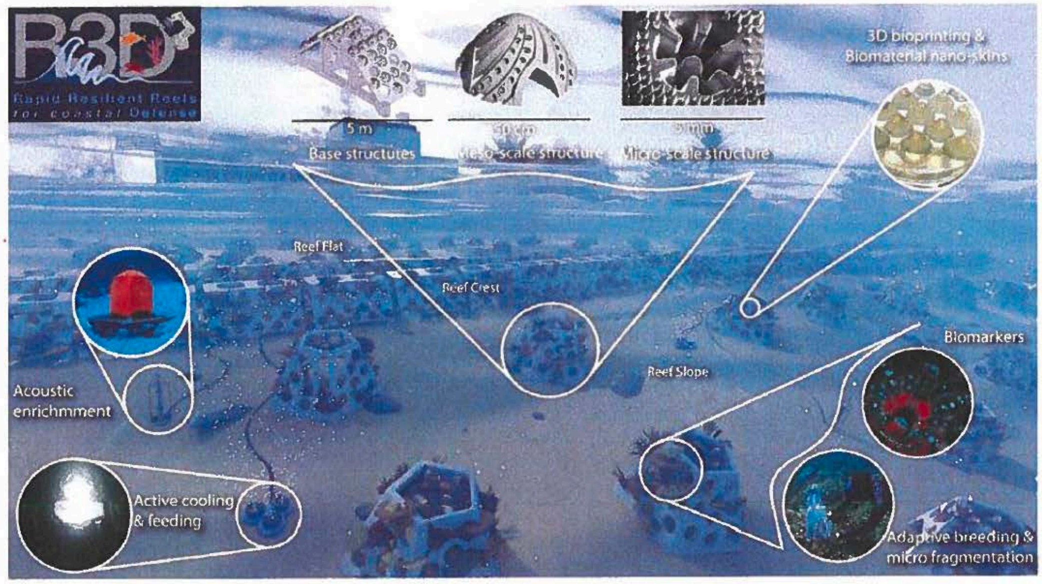
R3D
Rapid Resilient Reefs for Coastal Defense
5 m
Base structures
Meso-scale structure
Micro-scale structure
3D bioprinting &
Biomaterial nano-skins
Reef Flat
Reef Crest
Reef Slope
Biomarkers
Acoustic
enrichmment
Active cooling
& feeding
Adaptive breeding &
micro fragmentation

Exhibit 2

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES DIVISION OF AQUATIC RESOURCES
1151 PUNCHBOWL STREET, ROOM 330
HONOLULU, HAWAII 96813

Date: 8/27/2025
DAR # AR6847

MEMORANDUM

TO: Brian J. Neilson
DAR Administrator

FROM: Kendall Tucker, Aquatic Biologist

SUBJECT: Early Consultation Kalaeloa Reef Laboratory Project

Request Submitted by: HDOT

Location of Project: Kalaeloa Reef

Brief Description of Project:

The State of Hawai'i Department of Transportation (Hoon in collaboration with the University of
Hawai'i, the Defense Advanced Research Projects Agency (DARPA), and other partners, is planning a project in the waters of Kalaeloa, O'ahu to test and develop a living, self-healing hybrid reef to
protect infrastructure and communities by mitigating damage related to coastal flooding, erosion,
and storm surge. The purpose of the Kalaeloa Reef Laboratory is to further research and gain
knowledge of reef-mimicking structures that may attenuate wave energy more effectively

Comments:

☐ No Comments ☑ Comments Attached

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

Comments Approved: ______________________ Date: 08/28/2025
Brian J. Neilson
DAR Administrator

DAR# AR6847

Brief Description of Project

If the pilot structures in the Kalaeloa Reef Laboratory Project function as expected to dissipate wave energy and therefore protect the shoreline, the nature-based technology may be tailored to provide nature-based alternatives and increase resilience of threatened shorelines across Hawai'i.

The Kalaeloa Reef Laboratory project would deploy bio-hybrid Reef-Mimicking Structures (RMSs) offshore at Kalaeloa, in the ahupua'a of Hono'uli'uli, in the moku of 'Ewa, on the island of O'ahu. The land fronting the proposed area is used for industrial uses, and the project site is offshore of PAR Hawaii Refining. The proposed area is characterized by wave scoured hard bottom seabed with intermittent patches of coral and sand. It is a degraded reef site that is subject to high wave action. The depth range within the proposed action area is approximately 0-50 ft
(0--15 m). The location for the Kalaeloa Reef Laboratory was chosen as it fits several preliminary criteria including water depths, wave climate, and the presence of both a degraded reef and coastal infrastructure which could both benefit from a living breakwater.

The structures in the Kalaeloa Reef Laboratory Project are designed to mimic the function of a
fringing reef, and consists of two types of base structures that form arrays inspired by different
sections of a natural fringing reef: the reef crest (highest point of the reef) and the back reef
or reef flat (shallow, shoreside). The RMS are made of concrete and epoxy which would be submerged in seawater. However, the concrete structures would contain no hazardous materials. Although trace amounts of concrete components could be released as the materials degrade over long periods of time, the ocean chemistry would not be affected. The use of epoxy would be in such small quantities that it would not affect ocean chemistry.

DAR# AR6847

Comments

Thank you for the opportunity to provide comments on the early consultation for the Kalaeloa Reef Laboratory Project. The Division of Aquatic Resources (DAR) has been engaged in ongoing consultation with DARPA through various stages of this project and remains supportive of the innovative work being proposed.

As preparations move forward for deployment, DAR requests that all contractors and consultants implement a comprehensive in-water monitoring plan for storms and/or large swell events. This plan should be designed to ensure the stability of structures following storm events or significant swell activity and that nothing is negatively impacting the surrounding environment.

DAR strongly recommends that the Department of Transportation (DOT) adhere to the DAR Special Activity Permit Coral Framework guidelines for coral monitoring, as part of this project will impact coral resources. The full Coral Framework Tool and Guidelines can be accessed here:
https://dlnr.hawaii.gov/dar/files/2025/05/SAP_Coral_Restoration_Application_Guidelines.pdf

The following monitoring schedule is required under DAR's coral restoration permits. While DAR encourages monitoring as frequently as logistically feasible, the minimum required time points for monitoring coral outplants are:

- At the time of outplant
- 1 week after outplant (particularly for pilot projects or those using novel methods)
- 1 month after outplant
- 3 months after outplant
- 1 year after outplant
- 3 years after outplant

Given that this is a pilot project, DAR recommends incorporating additional monitoring methods to better evaluate project success. Suggested supplemental monitoring efforts include:

- High-resolution topography/bathymetry: Typically collected via topo-bathy LiDAR, this data can assess long-term structural stability and scour.
- Coastal photogrammetry: Airborne surveys can detect changes in sediment transport and beach morphology.
- Environmental DNA (eDNA): Provides insight into site biodiversity.
- Passive acoustic monitoring: Complements eDNA by offering continuous, long-term data on reef health and biodiversity.
- Underwater photogrammetry: Enables assessment of coral growth rates, health, mortality, and site biodiversity.

DAR# AR6847

Comments

• Coral settlement surveys: Conducted by divers using blue lights and filtered lenses to detect coral recruits.
• Wave attenuation measurements: Measure wave height before, within, and after the hybrid reef
• Kilo surveys: Track algal growth, migration, or reduction along the project shoreline.

Lastly, if there are any changes to the scope or design of the project, DAR requests the opportunity to review and provide additional comments.

We appreciate your commitment to incorporating ecological safeguards into the development of this project and look forward to continued collaboration

Appendix G Federal Agencies Permit Letters

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, HONOLULU DISTRICT
230 OTAKE STREET, CEPOH-RO
FORT SHAFTER, HAWAII 96858-5440

November 7, 2025

SUBJECT: Nationwide Permit Verification for DARPA, Rapid Resilient Reefs for coastal Defense (R3D) Hybrid Reef Prototype, Pacific Ocean, Island of Oahu, HI Department of the Army File No. POH-2025-00157

Catherine E. Campbell
Program Manager, Biological Technologies Office
Defense Advanced Research Projects Agency (DARPA)
675 North Randolph Street
Arlington, VA 22203

Dear Ms. Campbell:

The Honolulu District, U.S. Army Corps of Engineers (Corps), Regulatory Branch has completed review of your Pre-Construction Notification dated July 29, 2025, requesting authorization for the proposed reef mimicking structures, marker poles, moorings, and various scientific instruments located in the Pacific Ocean centered at 21.306076, -158.115986 off the west coast of Barbers Point, Island of Oahu, Hawaii. Please reference Department of the Army (DA) file number POH-2025-00157 in any future correspondence related to this permit.

This Nationwide Permit (NWP) verification letter is being issued pursuant to Section 404 of the Clean Water Act for the discharge of dredged and/or fill material into waters of the U.S. and Section 10 of the Rivers and Harbors Act of 1899 for work or structures in, over, under or affecting navigable waters of the U.S. You are authorized to conduct the following activities:

a) To permanently install 61 reef mimicking structures (RMSs) within a 0.21-acre site in the Pacific Ocean, a navigable water of the U.S., for the purpose of increasing coral reproduction. A total of 40 structures will be “reef crests” that are 20.0 feet long by 7.9 feet wide by 7.9 feet tall. The other 21 structures will be “back reefs” that are 8.2 feet long by 13.8 feet wide by 5.2 feet tall. A total of 10 marker poles will be attached to outer structures to indicate the boundary of the site.

b) RMSs will be installed using 200-foot-long dynamic positioning vessels supported by lift bags. A 90-foot-long vessel will support maneuvering each RMS into place. If this method proves unsuccessful, a customized catamaran will deploy from land with the RMS and lower them into place. Divers will assist in anchoring the RMS into place. Drilled anchor bars or ballasts in the form of steel blocks or chain clumps will be used to secure the structures into place. Anchor bars will be epoxied into holes drilled into the seafloor by divers.

c) A total of five subsurface mooring will be deployed at the site. Moorings will be anchored in by mooring plates held by anchor bars. Up to 2 mooring plates (24 inches wide by 64 inches long each) per subsurface float may be placed on the seabed (up to 10 mooring plates total). Each plate is held down by up to three anchor bars, with a welded padeye and shackles that will connect to a stainless steel chain or nylon line and a subsurface float.

d) A total of two ten-foot-long by ten-foot-wide by five-foot-tall coral nursery tables will be installed at a site 2.5 miles to the north of the reef mimicking structures. Tables will consist of a steel frame and a fiberglass grated tabletop. The tables will be installed prefabricated by a vessel mounted crane. Divers will assist in the installation. The tables will be installed for the entirety of the project lifespan.

e) Up to 1,246 coral settlement modules (CSMs) will be attached to the RMSs with stainless steel bolts or reef-safe epoxy prior to RMS deployment or post-deployment with SCUBA divers and small vessel(s). CSMs are 19.7-inch-diameter by 9.8-inch-high concrete structures. CSMs may have one-inch-diameter PVC pipes inserted across the structure to provide habitat for fish larvae recruited to the reef.

f) Portions of the RMSs and CSMs (either before or by divers after deployment) will be coated with <5.3 gallons of locally sourced materials such as alginate from seaweed and naturally occurring components. Additional biodegradable and non-toxic molecules may be included (<5.3 gallons total) to concentrate the solution for the experiment.

g) Up to 305 coral growth modules will be attached to the RMSs consisting of coral stock from loose corals not attached to an intact reef or preemptively removed. The coral fragments will be attached to CGMs via marine epoxy or similar material. CGMs will be attached to the RMSs on land, prior to deployment, using stainless steel threaded rods capped with a nut and washer, and reef-safe epoxy or similar method. CGMs may be attached to the tops and sides of the RMSs, and possibly also over footings with anchor bars.

h) Up to 56 “mini-ARMS” consisting of up to 10 layers of plastic sheets (7.9 inches x 7.9 inches x 7.9 inches total) will be attached to 28 of the reef crest structures (2 CGMs per reef crest structure). Researchers will attach mini-ARMS using threaded bolts that have been glued to the top of the CGMs.

i) Up to 10 of the CGMs or CSMs will have battery-powered coral feeding units, referred to as Underwater Zooplankton Enhancing Light Array (UZELA).

j) Up to 5,000 native collector urchins (*Tripneustes gratilla*) bred off-site will be released on and around the RMSs.

k) Up to 34 scientific instruments no greater than 2.1 feet long by 0.7 feet wide by 0.7 feet tall will be either attached to the RMSs prior deployment or post deployment by divers.

l) Up to four different scientific instrument sets with a footprint less than 11 square feet each will be deployed by barge or divers working from two 26-foot-long vessels. Instruments will be deployed adjacent to RMS units.

m) Up to three cylindrical pressure cases filled with nickel-metal hydride batteries will be mounted directly onto or outside an RMS unit using tie wraps, hose clamps or similar equipment. Each case will be 3.3 feet long by 10 inches in diameter. An underwater speaker (1.0-foot x 1.0-foot x 0.5-foot) will be mounted on or between an RMS structure.

n) Up to 60 autonomous “Kilocam” cameras mounted in 9.1 inches long and 2.0-inch diameter PVC housings will be attached to RMSs using tie wraps and hose clamps. Each camera will be accompanied by an underwater light inside PVC housings that are 13.8-inch long and 2.0-inch diameter. Both the cameras and the lights will be attached to RMSs using tie wraps and hose clamps.

o) Up to 9 passive acoustic “SoundTrap” recorders (4.7 inches long by 1.6 inches diameter) will be mounted on a sand anchor directly to the ocean floor, attached to another seafloor-mounted instrument, or mounted on the end of a two-foot rod, with the other end mounted to an RMS unit.

p) Up to six "Wilcoxon" vector sensor modules (VSMs) will be deployed, evenly spaced along the structure, using sand anchors attached directly to the ocean floor, or mounted on another seafloor-mounted instrument. The dimensions of the pressure cases for these items are 14.2 inches long and 5.1 inches diameter. An additional two "DASARs" will be deployed for specialized detection of low-frequency fish sounds for two months a year during the summer. A DASAR has 2.0 feet by 2.0 feet footprint on the ocean bottom, using sand anchors or stakes attached directly to the ocean floor. The DASAR height is about 2.0 feet.

q) Up to 290 cubic yards of rock will be placed into 1,952 square feet of the Pacific Ocean, a navigable water of the U.S. for construction of reef houses.

r) Removal, if necessary, will occur in reverse of the process used for installation. All materials and instruments will be removed from below the MHW except for the portion of the anchor bolts/bars embedded in the seafloor.

Based upon the information and plans you provided, we hereby verify that the work described above, which would be performed in accordance with the enclosed plan (Enclosure 1), dated July 29, 2025, complies with the terms and conditions of and is authorized by NWP 1, (Aids to Navigation) NWP 5 (Scientific Measurement Devices), NWP 10 (Mooring Buoys), and NWP 27, (Aquatic Habitat Restoration, Enhancement, and Establishment Activities) issued on February 25, 2022. The full text of NWP 1, 5, 10, and 27 and their associated Regional and General Conditions, can be accessed at: https://www.poh.usace.army.mil/Missions/Regulatory/Permits/Nationwide-Permits. You must comply with all terms and conditions associated with NWP 1, 5, 10, and 27.

Verification of your project under these NWPs is valid until **March 14, 2026,** unless these NWPs are modified, reissued, or revoked prior to that date. If you commence or are under contract to commence this activity before the date that the NWPs are modified or revoked, you will have twelve (12) months from the date of the modification or revocation of the NWPs to complete the activity under the present terms and conditions. It is incumbent upon you to remain informed of changes to the NWPs. If the Corps modifies, reissues, or revokes any NWP at an earlier date, we will issue a public notice announcing the changes. Failure to comply with all terms and conditions of this NWP verification invalidates this authorization and could result in a violation of the Clean Water Act and/or Rivers and Harbors Act and subsequent enforcement action.

This authorization does not relieve you of the responsibility to obtain any other federal, state, and/or local authorizations required by law.

Your project complies with the requirements of the Clean Water Act, Section 401 Blanket Water Quality Certification (WQC) WQC1092 issued for this Nationwide Permit by the State of Hawaii Department of Health, Clean Water Branch. You are responsible for complying with the attached General Conditions of this WQC (Enclosure 2).

Your project complies with the requirements of the Coastal Zone Management Consistency Concurrence for this NWP issued by the State of Hawaii Department of Business, Economic Development and Tourism, Office of Planning during the NWP reissuance process in 2021.

Finally, General Condition 30 requires a signed certification be submitted to this office upon completion of work. Therefore, please sign, date and return the enclosed *Compliance Certification* form (Enclosure 3) within 30 days of completion of work to the email address specified below or to the mailing address indicated on the letterhead above.

Thank you for your cooperation with the Honolulu District Regulatory Program. Should you have any questions related to this authorization, please contact David Rojek at 808-459-0179 or via e-mail at david.j.rojek@usace.army.mil and CEPOH-RO@usace.army.mil, referencing the project number POH-2025-00157 in the email subject. Please see our website for more information, located at https://www.poh.usace.army.mil/Missions/Regulatory/.

Sincerely,

Jen Martin

Jen Martin
Chief, Regulatory Branch

Enclosures

Electronic cc:
State of Hawaii Department of Health, Clean Water Branch
Darryl C Lum darryl.lum@doh.hawaii.gov
CleanWaterBranch@doh.hawaii.gov
State of Hawaii Office of Planning, Coastal Zone Management Program
Debra.L.Mendes@hawaii.gov
Joshua Levy (University of Hawai'i Applied Research Laboratory),
levyjosh@arl.hawaii.edu
U.S. Coast Guard, SecHonoWaterWays@uscg.mil
USCG District 14 Waterways Management, d14-dg-pj-dpw@uscg.mil
NOAA's National Ocean Service, N/MB6, SSMC4, ocs.ndb@noaa.gov

Enclosure 2

DAVID Y. IGE
GOVERNOR OF HAWAII

ELIZABETH A. CHAR, M.D.
DIRECTOR OF HEALTH

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

In reply, please refer to:
File:

WQC1092.FNL.22

April 28, 2022

David S. Hobbie
Regional Regulatory Chief
Honolulu District
Department of the Army
U.S. Army Engineer District, Honolulu
Fort Shafter, Hawaii 96858-5440

Dear Mr. Hobbie:

Subject: **Blanket Section 401 Water Quality Certification (WQC) for Certain 2021 Department of the Army (DA) Nationwide Permits (NWP) and Activities File No. WQC1092**

Purpose. This letter is a blanket Section 401 WQC (Blanket Certification) and sets forth applicable qualifications and activity-specific conditions to certain NWPs and activities, as described below. This Blanket Certification may be utilized by any applicant that is seeking authorization and/or verification from the U.S. Army Corps of Engineers (USACE), Honolulu District of the Pacific Ocean Division (POH) for work in Waters of the United States.

This Blanket Certification supersedes and replaces previous WQC0901.FNL.20 issued in May and November of 2020 (WQC0901). The following shall apply:

1. Requirements and conditions set forth in WQC0901 which are not set forth in this Blanket Certification shall no longer be applicable;
2. Activities covered under WQC0901 shall be subject to this Blanket Certification, including requirements and conditions different from or in addition to WQC0901;
3. Pending applications, including those currently under review by USACE or the Department of Health (DOH), shall be subject to this Blanket Certification.

Note: A previous version of this Blanket Certification was public noticed on September 23 and 24, 2020, for the proposed 2020 NWPs. Since the aforementioned public notices, the NWPs were reissued and modified in 2021, the federal Section 401 WQC regulations were revised, and the State Section 401 WQC rules were revised. This Blanket Certification incorporates these revisions.

Overview. The DA has published a list of NWPs and applicable general conditions that attach to those NWPs.[1] Certain NWPs may require a Section 401 WQC from the State of Hawaii. The DOH has the authority to issue a Blanket Certification and may qualify or condition the Blanket Certification. The conditions in this Blanket Certification become additional conditions to the NWPs. The qualifications would set forth the applicability of the Blanket Certification to a NWP or other described activity.

The DOH reviewed the NWP and General Conditions published in the Federal Register: Final Rules and the additional comments submitted by USACE POH. DOH believes that when all requirements and conditions contained in this Blanket Certification are fully complied with, there is a reasonable assurance that the activities will be conducted in a manner which will not violate the applicable State water quality standards and will comply with the applicable provisions of the CWA, Sections 301, 302, 303, 306, and 307.

The NWPs and activities in Item 2.a below do not require a Section 401 WQC. The NWPs and activities in Item 2.b below are covered under this Blanket Certification. The DOH has determined that projects authorized by the USACE POH for the NWPs and activities in Item 2.b below, subject to the requirements of the General Conditions in Item 3 below, will not cause adverse environmental impacts or effects; are in the public interest; and represent the optimum balance between economic development and environmental quality.

1. Term of this Blanket Certification

    a. This Blanket Certification becomes effective with respect to a specific project on **April 28, 2022.**

    b. This Blanket Certification will expire at midnight, **March 14, 2026**.

    c. This Blanket Certification's coverage is administratively extended to a certain project beyond midnight, March 14, 2026, when the USACE POH extends the project authorization/verification.

2. Coverage of this Blanket Certification

    a. The NWPs and activities listed below do not require a Section 401 WQC.

        - NWP 1 – Aids to Navigation
        - NWP 8 – Oil and Gas Structures on the Outer Continental Shelf

[1] The DA NWP authorizes activities under 1) Section 404 of the Clean Water Act (CWA), 2) Section 10 of the Rivers and Harbors Act of 1899 (RHA), and/or 3) a Letter of Permission. The NWPs were published on September 15, 2020, in the Federal Register, Volume 85, Number 179 and December 27. 2021, Volume 86, Number 245 (Federal Register).

- Projects in response to a public emergency proclaimed by the President of the United States or Governor of Hawaii where HRS Chapter 342D has been suspended
- Any emergency project as determined by the Director of Health
- Projects granted an exemption under Act 048 of 2017 (temporary exemption of certain bridge rehabilitation projects)
- Activities exempt under CWA, Section 404(f)(1)
- Directional drilling under a waterbody where entry and exit pits are located on land and all slurry/spoils/runoff is contained on land
- Structures over a waterbody where debris and other pollutants associated with the installation, construction, and operation do not enter the waterbody
- Installation of temporary Best Management Practices (BMPs) with inert material in State waters, excluding material used to divert or dam stream flow
- Comprehensive Environmental Response, Compensation, and Liability Act actions with oversight from DOH Hazard Evaluation and Emergency Response (HEER) Office and/or EPA
- DOH HEER response actions
- Bridge inspections
- Improvements or modifications to Department of Land and Natural Resources, Division of Boating and Ocean Recreation permitted existing offshore moorings installed prior to October 4, 2017
- Coral transplant with National Oceanic and Atmospheric Administration oversight
- Fireworks where visible debris is collected after event
- Lanterns and rubber duckies collected after event
- Ashes from funeral ceremonies 3 miles away from shore
- After-The-Fact applications for USACE POH enforcement actions[2]

b. The NWPs and activities listed below are hereby granted coverage under this Blanket Certification in the State of Hawaii if the applicant of the activity/discharge complies with the General Conditions (Item No. 3) and USACE POH provides notification (Item No. 4). Any person, including any public body, conducting activities authorized by these NWPs and activities that cannot or will not comply with this Blanket Certification must apply for and obtain an individual Section 401 WQC from DOH Clean Water Branch (CWB).

- NWP 2 – Structures in Artificial Canals
- NWP 3 – Maintenance

[2] DOH has decided not to process After-The-Fact applications so the USACE POH can proceed with their enforcement action.

- NWP 4 – Fish and Wildlife Harvesting, Enhancement, and Attraction Devices and Activities
- NWP 5 – Scientific Measurement Devices
- NWP 6 – Survey Activities
- NWP 7 – Outfall Structures and Associated Intake Structures
- NWP 9 – Structures in Fleeting and Anchorage Areas
- NWP 10 – Mooring Buoys
- NWP 11 – Temporary Recreational Structures
- NWP 12 – Oil or Natural Gas Pipeline Activities
- NWP 13 – Bank Stabilization
- NWP 14 – Linear Transportation Projects
- NWP 15 – U.S. Coast Guard Approved Bridges
- NWP 16 – Return Water from Upland Contained Disposal Areas
- NWP 17 – Hydropower Projects
- NWP 18 – Minor Discharge
- NWP 19 – Minor Dredging
- NWP 20 – Response Operations for Oil or Hazardous Substances
- NWP 22 – Removal of Vessels
- NWP 23 – Approved Categorical Exclusions
- NWP 25 – Structural Discharges
- NWP 27 – Aquatic Habitat Restoration, Establishment, and Enhancement Activities
- NWP 28 – Modifications of Existing Marinas
- NWP 29 – Residential Developments
- NWP 31 – Maintenance of Existing Flood Control Facilities
- NWP 32 – Completed Enforcement Actions
- NWP 33 – Temporary Construction, Access and Dewatering
- NWP 35 – Maintenance Dredging of Existing Basins
- NWP 36 – Boat Ramps
- NWP 37 – Emergency Watershed Protection and Rehabilitation
- NWP 38 – Cleanup of Hazardous and Toxic Waste
- NWP 39 – Commercial and Institutional Developments
- NWP 40 – Agricultural Activities
- NWP 41 – Reshaping Existing Drainage Ditches
- NWP 42 – Recreational Facilities
- NWP 43 – Stormwater Management Facilities
- NWP 45 – Repair of Uplands Damaged By Discrete Events
- NWP 46 – Discharges in Ditches
- NWP 48 – Commercial Shellfish Mariculture Activities
- NWP 51 – Land-Based Renewable Energy Generation Facilities
- NWP 53 – Removal of Low-Head Dams
- NWP 54 – Living Shorelines

- NWP 55 – Seaweed Mariculture Activities
- NWP 56 – Finfish Mariculture Activities
- NWP 57 – Electric Utility Line and Telecommunications Activities
- NWP 58 – Utility Line Activities to Water and Other Substances
- NWP 59 – Water Reclamation and Reuse Facilities
- Letters of Permission – Section 10 only activities with no discharge of fill material
- Any activity conducted in compliance with DOH pre-approved Standard Operating Procedures

c. Limitations on Coverage

This Blanket Certification shall not cover:

(1) Discharge(s) regulated under CWA, Section 402.
(2) Any project that may result in downstream/downdrift post construction impacts to the physical, chemical, and/or biological environment.
(3) Concrete lining any section of natural streambed or bank.[3]
(4) Projects involving the removal of dams, impoundments, structures, or sand bars that will result in the downstream/downdrift mobilization of material, sediment, and/or water pollutants.
(5) Waste Discharges to natural lakes and anchialine pools as specified in HAR 11-54 or any State waters.

“Waste” means sewage, industrial and agricultural matter, and all other liquid, gaseous, or solid substance, including radioactive substance, whether treated or not, which may pollute or tend to pollute the waters of this State. Hawaii Revised Statutes (HRS) §342D-1.

Non-contaminated and suitable dredge and fill material authorized under a 2021 NWP is not considered waste.
(6) New sewage discharges and new industrial discharges to estuaries as specified in HAR 11-54. New industrial discharges do not include the repair and/or replacement within the footprint of an existing structure.
(7) New sewage and industrial discharges to Embayments: Class AA and Class A as identified in HAR 11-54. New industrial discharges do not include the repair and/or replacement within the footprint of an existing structure.

[3] This type of activity is prohibited as it will result in adverse post construction impacts by eliminating ground water recharge, raising pH, and lowering dissolved oxygen or causing downstream bank erosion.

3. General Conditions

The applicant of the activity/discharge shall:

a. Report any non-compliance with the conditions of this Blanket Certification to the USACE POH. Do not report or submit compliance related information to DOH. This Blanket Certification is a condition of the USACE POH permit.[4]

b. Maintain records at the project site or in the nearby field office demonstrating that all Blanket Certification requirements have been fully complied with.

c. Ensure that all activities are conducted in a manner that will comply with the "Basic Water Quality Criteria Applicable to All Waters" as specified in HAR 11-54.

d. Ensure that all material(s) placed or to be placed in State waters are free of waste metal products, organic materials, debris, and any pollutants at toxic or potentially hazardous concentrations to aquatic life as specified in HAR 11-54.

e. Ensure that the activities will not permanently interfere with or become injurious to any designated uses and/or existing uses of the receiving State water. Any permanent adverse impacts to the designated uses and/or existing uses of the receiving State water is a violation of HAR Chapter 11-54.

f. Ensure that pollution control measures and BMPs are utilized that prevent water pollutants from leaving the in-water work area authorized by the USACE POH permit.[5] Any visual plume emanating from the authorized in-water work area is a violation of HAR Chapter 11-54.

g. Ensure that all construction debris from any portion of the activities (including but not limited to debris caused by hydraulic saws, water jets, or drilling equipment) are contained and prevented from entering or re-entering State waters. All construction debris and sidecast material shall be properly removed from the aquatic environment and disposed of at an upland State and county approved site. Before the start of the activities, a Solid Waste Disclosure Form for Construction Sites shall be completed and returned to the DOH's Solid and Hazardous Waste Branch,

[4] With respect to USACE projects granted coverage under Item 2.c above, non-compliance reports from USACE POH should be submitted to DOH CWB.

[5] With respect to USACE projects granted coverage under Item 2.c above, the relevant in-water work area is identified in the USACE project.

Office of Solid Waste Management. No construction material or construction related materials shall be stockpiled in the aquatic environment or stored or placed in ways that will disturb the aquatic environment. The Solid Waste Disclosure Form for Construction Sites is available online at:
https://health.hawaii.gov/shwb/files/2018/04/swdiscformapr2018.pdf.

h. Utilize only BMPs that are inert and not sources of pollution themselves. Examples of inappropriate in-water porous material BMPs include but are not limited to: compost biosocks since they are a source of nutrients; and a soil berm since the soil particles will erode.

i. Collect activity/discharge related water pollutants utilizing appropriate catchment/detention devices (e.g. construction debris, airborne particulates, dust, concrete slurry, concrete chips, concrete surface preparation washing effluent, excess water and overflow from boring related activity, horizontal directional drilling slurry, etc.) from localized work areas and minimize or prevent the release of these water pollutants into State waters, including the in-water work area.

j. Utilize BMPs for all upland project activity to minimize the discharge of water pollutants into State waters, including the designated in-water work area.

k. For a stream, ditch, or gulch: Allow unimpeded flow around the in-water work area to allow for aquatic animal migration and/or to prevent work site and downstream flooding situations. The unimpeded flow shall be equivalent to a 2-year, 24-hour duration storm event and/or the existing flow capacity of the stream, ditch, or gulch. Pumped diversions may be utilized if the stream, ditch, or gulch is dry or there is only standing/ponded water without the existence of living aquatic animals.

l. Not discharge any type of wash water and/or effluent into State waters without first obtaining from DOH a National Pollutant Discharge Elimination System (NPDES) permit authorizing such type of water pollutant discharge to State waters.

m. Not allow any concrete truck wash water to be disposed by percolation into the ground.

n. Ensure that all areas temporarily impacted, either directly or indirectly, by the project construction activities are fully restored to its pre-construction conditions. For example: Incidental construction debris is cleaned up prior to removal of BMPs; remove all scientific measurement devices and any other structures or fills associated with installation and use of these devices (e.g., foundations, anchors, buoys, lines, etc.) when no longer in use; etc.

o. When projects involve dredging/excavation activities:

(1) Be required to check the DOH, HEER Office Sites, Incidents and Records through the "Viewer" in iHEER at: https://eha-cloud.doh.hawaii.gov/iheer.[6]

(2) Be required to contact the HEER Office at (808) 586-4249 and through e-permitting Form "Notification of Construction Activities" at Form Finder https://eha-cloud.doh.hawaii.gov/epermit/finder if contaminated soil, sediment, vapor, or groundwater is known to be present at your project site. The applicant shall notify the HEER Office at least 90 days prior to surface and subsurface disturbing activities that may disturb the ground surface at HEER sites. If the 90-days prior notification is missed, the applicant shall notify the HEER Office as soon as possible to avoid any potential delays regarding the covered project.

(3) Contain return flow or runoff from upland dredged spoils dewatering site(s)/disposal site(s), including the confined disposal facility (CDF), which shall be contained on land and not allowed to discharge and/or re-enter any State waters without first obtaining the required discharge permit from USACE POH or CWB. Unless authorized by a USACE POH or NPDES permit, the applicant shall not allow any runoff, return flow, or airborne particulate pollutants from the excavated or dredged material dewatering or stockpiling site, including the CDF, to enter or re-enter State waters.

(4) Properly deploy warning signs, which shall be maintained until the portion of the in-water work is completed and the affected area water quality has returned to its preconstruction condition and turbidity control devices have been removed from the waterway.

p. When projects involve moorings:

(1) Avoid locating moorings (including anchors and floats) in sensitive aquatic habitats such as coral reefs, fish spawning areas, and submerged aquatic vegetation (unless location is acceptable to the Department of Land and Natural Resources, Division of Aquatic Resources or the National Oceanic Atmospheric Administration);

(2) Ensure moorings (including anchors and floats) are made of clean, inert material. Treated lumber shall not be used as it may contain

[6] The HEER Office is currently updating site information for sites. Most, but not all, sites may be displayed on the viewer map. Site Document data upload is ongoing and not all documents may be currently available via this website. To get the complete record for the site, a record request form can be filled and submitted it to the HEER Office. Users will then be notified when they are able to download all information via the iHEER system website.

compounds that can be released into the water and become toxic to the aquatic environment;

(3) Pre-cast and cure concrete anchors, if required, away from State waters prior to use to prevent seepage of potentially toxic substances into the waterbody;

(4) Locate moorings in depths that allow structures and vessels to remain afloat at the lowest possible water levels and that prevent propellers from disturbing bottom sediments;

(5) Select mooring anchors of an adequate size to secure vessels or structures and prevent the anchor from shifting or dragging along the bottom of the State water;

(6) Size the length of mooring lines, chains, or cables to avoid excess line, chain, or cable accumulation on the bed of the State water;

(7) Ensure native beach material such as logs, sand, gravel, and boulders that are important components of fish habitat are not used as mooring structures and are left in place on the foreshore;

(8) Properly dispose of derelict or unused floats, lines, chains, or cables in accordance with appropriate laws and rules; and

(9) Ensure moorings are kept in good repair by regularly inspecting and maintaining the structure. Mooring maintenance must be performed into perpetuity (or until it is properly disposed of) or it will itself become a pollution source.

4. USACE POH shall e-mail to CWB (cleanwaterbranch@doh.hawaii.gov and darryl.lum@doh.hawaii.gov) a pdf copy of all issued final verifications. This Blanket Certification coverage shall become valid with respect to an activity only when USACE POH notifies CWB via email of a project authorization/verification and conditions of this Blanket Certification have been incorporated as part of the USCE POH final verification; provided, that this email notification requirement shall not apply to activities that do not require a pre-construction notification, and this Blanket Certification shall automatically become valid with respect to such activities.

If you agree with the terms and conditions of this Blanket Certification, please sign and date below; make a copy for your administrative record; and submit this entire letter with your original signature to CWB within 14 calendar days from your signature date.

If you have any questions, please contact Mr. Darryl Lum of the Engineering Section, CWB, at (808) 586-4309.

Sincerely,

Joanna L Seto

for ELIZABETH A. CHAR, M.D.
Director of Health

c: Regulatory Office, POH, COE [via e-mails linda.speerstra@usace.army.mil only]
Ms. Debra Mendes, CZM Program, Office of Planning, DBEDT
[via e-mail debra.l.mendes@hawaii.gov only]
U.S. Fish and Wildlife Service [via e-mail pifwo_admin@fws.gov only]
U.S. National Marine Fisheries Service [via e-mail pirohonolulu@noaa.gov only]
Division of Aquatic Resources, DLNR [via e-mail dlnr.aquatics@hawaii.gov only]
CWRM, DLNR [via e-mail dlnr.cwrm@hawaii.gov only]
OCCL, DLNR [via e-mail dlnr.occl@hawaii.gov only]
DHO (Hawaii, Maui, Kauai) and EHS, Molokai/Lanai [via e-mail only]

I AGREE WITH THE TERMS AND CONDITIONS OF THIS LETTER:

David S. Hobbie — DATE
Regional Regulatory Chief
Honolulu District

Enclosure 3

US Army Corps of Engineers
Honolulu District
BUILDING STRONG®

DEPARTMENT OF THE ARMY PERMIT
COMPLIANCE CERTIFICATION

File Number: POH-2025-00157
Project Title: DARPA, Rapid Resilient Reefs for coastal Defense (R3D) Hybrid Reef Prototype, Pacific Ocean, Island of Oahu, HI

PERMIT TYPE: Nationwide Permit 1, 5, 10, and 27

NAME OF PERMITTEE: Catherine Campbell (DARPA)

DATE OF ISSUANCE: November 7, 2025

DATE OF EXPIRATION: March 14, 2026

The permittee must, upon completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address or via email within thirty (30) days of completion of work:

U.S. Army Corps of Engineers, Honolulu District
Regulatory Office
Building 230, CEPOH-RO
Fort Shafter, HI 96858-5440
Email: CEPOH-RO@usace.army.mil

Please note that your permitted activity is subject to a compliance inspection by a U.S. Army Corps of Engineers representative. If you fail to comply with the terms and conditions of this permit, you are subject to permit suspension, modification or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation was completed in accordance with the permit conditions.

________________________________ ________________
Signature of Permittee Date

EFH Consultation:

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
1845 Wasp Blvd., Bldg 176
Honolulu, Hawaii 96818
(808) 725-5000 · Fax: (808) 725-5215

August 7, 2025

Catherine Campbell, Ph. D.
Program Manager
Biological Technologies Office
Defense Advanced Research Projects Agency
675 North Randolph Street
Arlington, VA 22203

Dr. Campbell,

The National Marine Fisheries Service, Pacific Islands Regional Office (NMFS), received the updated EFH Assessment (EFHA) and request to reinitiate EFH consultation from the Defense Advanced Research Projects Agency (DARPA) for the Reefense program at Kalaeloa, O‘ahu, Hawai‘i on July 15, 2025. In the updated EFHA you have outlined best management practices (BMPs) that, when adhered to and implemented, will avoid and minimize most adverse effects to EFH. NMFS provided conservation recommendations pursuant to the EFH provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA; Section 305(b)(2) as described by 50 CFR 600.920) on June 4, 2024. These relevant CRs were incorporated into the updated project. We are providing additional conservation recommendations on the updated project pursuant to the EFH provision within Section 305(b)(4)(A) of the MSA. Adherence to the conservation recommendations along with the BMPs and CRs from the initial consultation will help further avoid, minimize, and otherwise offset adverse effects from the action on EFH.

Consultation History

There was a significant amount of early coordination between NMFS and DARPA during the planning phase of the Reefense program in Hawai‘i. Early coordination included briefing meetings on April 20, June 15, July 24, September 1, and September 22, 2023 to discuss the plans for this Proposed Action. A field site visit of the Fort Hase location was conducted with the NMFS EFH Team on July 28, 2023. An EFH consultation on Temporary Testing of Oceanographic and Biological Equipment in Support of the Reefense Program, at Test Sites on O‘ahu, Hawai‘i was completed on November 7, 2023. An EFHA for the deployment of the actual Reefense array was submitted on March 11, 2024, but important information including details about the resources in the area were missing. The EFHA was revised and resubmitted with the needed information on May 6, 2024. NMFS responded with EFH CRs on June 4, 2024.

DARPA confirmed that they accepted the CRs on June 20, 2024. DARPA notified NMFS that the location had changed for the Reefense project by email on June 4, 2025. An updated EFH Assessment with a new location and updated project description was submitted on July 15, 2025.

Project Description

Overview/purpose

The purpose of the Reefense project is to test an engineered artificial reef (herein referred to as "Reefense array") made up of reef-mimicking structures (RMS) to mitigate damage related to coastal flooding, erosion, and storm surge due to sea-level rise and climate change. The Reefense array is designed to be a functional, self-sustaining, living breakwater within five years after deployment. The engineered-reef design consists of individual base structures (RMS) that make up sections of a fringing reef: the reef crest (highest point of the reef) and the back reef or reef flat (shallow, shoreside). The proposed action includes deployment of structures, installation of anchor bars to secure structures, attachment of additional sensors and reef enrichment equipment, and monitoring. After deployment, the hybrid reef system and maintenance requirements would be transferred to the Hawaiʻi Department of Transportation (HDOT). Installation is set to begin in the Fall of 2025. The structures will be monitored for stability and durability by DARPA through Spring 2026. The University of Hawaiʻi will seek further funding for continued long-term monitoring and surveys.

Design

The Reefense array is designed to mimic a fringing reef, including a reef crest and back reef made up of 61 total structures. The reef crest section will be made up of 40 structures each with a height of 7.9 feet (ft) (2.4 meters [m]) and width of 7.9 ft (2.4 m). The back reef will consist of 21 structures with a height of 5.3 ft (1.6 m) and width 13.8 ft (4.2 m). Each RMS would be designed with perforated holes (diameter of 0.9 ft to 2.7 ft (30 centimeters [cm] - 82 cm) to allow for egress of mobile marine species. All structures would be deployed in 6.5 to 13 ft (2 to 4 m) water depth. The whole Reefense array will be 164 ft long with an approximate total footprint of 8,945 ft^2 (820 m^2). All base structures will be constructed from concrete reinforced with glass fiber or steel/basalt rebar.

Three dimensional habitat structures will be mounted to the base RMS to add geometric complexity and enhance settlement of corals, other sessile invertebrates, and fish. A biofilm solution will be used on parts of the RMS to enhance coral recruitment and reduce algal overgrowth. Standard oceanographic equipment will be attached directly to RMS as well as placed adjacent to the structures on the seafloor. Equipment on the seafloor would be weighted but not anchored; ballasted grid frames would be deployed with equipment to keep it in place. The equipment would monitor structural integrity, flow patterns, and environmental conditions.

Coral growth modules would also be attached to the RMS to stimulate rapid coral growth and provide additional fish habitat, wave attenuation, and structural support. Up to 1000 colonies of local reef building coral species including *Montipora capitata*, *M. flabellata*, Po*cillopora grandis*, *P. meandrina*, *Porites compressa*, and *P. lobata* will be attached to the structures. The corals used will be corals of opportunity (COOs) collected from the Kalaeloa proposed action area. The corals would likely be attached to coral growth modules or aragonite plugs via cyanoacrylate glue, marine epoxy, or LOCTITE HY 4090.

Coral Nursery

Coral from the action area and other COOs will be collected and taken to a coral nursery located 2.2 nautical miles to the north of the deployment site in a sand channel. The corals will be stored at the nursery until they are attached to the RMS. The site is 40 ft deep, located 200 ft (61 m) from hard substrate, corals, or seagrass, and protected from wave energy by steeply sloping walls. Two 10 ft by 10 ft coral nursery tables will be installed at the nursery site at a depth of 40 ft, 20 ft apart from each other, to cache several hundred coral colonies and corals of opportunity to be outplanted to the Reefense array. The tables will weigh 4,800 lbs each, constructed from a steel frame with a fiberglass grating tabletop. These tables will have reinforced-steel struts on the legs as well as longitudinal bracing across the table to allow the tables to withstand loading from larger wave events. A flat bar (0.25 in by 3 in [0.64 cm by 7.6 cm]) creates a 2 in (5 cm) lip on the sides of the table which will help prevent corals from falling off the sides. A fiberglass grating covers the table, allowing corals to be zip tied or secured by other means as needed. The tables' frames will be 4 ft (1.2 m) tall with no closed walls, allowing water to flow naturally in the channel. The tables at their highest points would be approximately 35 ft (10.7 m) below sea level.

The tables would be deployed via a vessel-mounted crane which would be used to lower the structures to the seabed. Divers may be required to secure the legs of the structures to the seabed using an anchoring system appropriate for the substrate (hard substrate or sand). The nursery site will be monitored by Kuleana Corals Restoration. The nonprofit will monitor and maintain the tables for the foreseeable future.

Deployment of Reefense Array

<u>Location</u>

The Reefense array will be installed off of the Kalaeloa coastline on the west side of O'ahu, Hawai'i. The area is characterized by ancient emergent reef pocketed by countless depressions and occasional deep sinkholes. Some narrow sandy beaches exist between the exposed reef and coastal vegetation. The proposed action area is subject to high wave action and is characterized as wave scoured hard bottom seabed with intermittent patches of coral and sand (Fletcher et al. 2002). The hybrid-reef would be deployed within a depth range of approximately 6.56 – 13 ft (2-4 m).

Coral cover in the proposed action is less than 5% (Franklin et al. 2013; Franklin et al. 2014) and distributed intermittently across the seafloor. Divers will survey the exact location of the installation areas prior to deployment of the structures, and remove branching corals over 10 cm in diameter as COOs. The COOs will be moved to coral nursey tables or cache sites and eventually may be attached to one of the RMS. After deployment of all the hybrid reefs, an additional survey would be conducted to map the final locations of each individual RMS. Deployment of the reef crest section would likely precede the back reef sections. All structures would be deployed in 6.5 to 13 ft (2 to 4 m) water depth.

Vessels
Deployment and installation will take place over the course of up to a few months, weather dependent. The specific vessels and plan are to be determined closer to installation and are subject to availability, final design, and the development of a safe installation methodology. Deployment of the RMS would likely occur using a dynamically positioned vessel approximately 181 ft (55 m) long by 34 ft (10 m) wide with a 12 ft (3.7 m) draft. RMS would be transported with temporary buoyancy systems to their shallow water deployment locations. A workboat with twin engines, approximately 84 ft (25.5 m) in length, and a small, rigid inflatable or whaler-type boat less than 26 ft (8 m), also referred to as a daughter craft, would assist the final stages of deployment and operate at 5 knots or less in the proposed action area. The supporting vessels would transit from Kalaeloa Harbor during the installation period to reload RMS units and avoid unfavorable weather conditions.

Two deployment options are being considered:

1. Lower the RMS into the water alongside a deep-water-positioned dynamic positioning vessel, supported by temporary buoyancy. Smaller vessel(s) such as a rigid inflatable boat would maneuver the RMS unit into the shallow water deployment site, where buoyancy would be reduced and the RMS unit placed slowly onto the seabed.
2. Use a custom built deployment catamaran vessel to buoyancy support up to four RMS units for a tow using a small support vessel from the staging/launching site to the deployment site.

Anchoring
To ease operations and limit impacts to the site, three subsurface moorings would be deployed within the proposed action area. One subsurface mooring would be deployed along each side (or at the corners) of the Reefense array. Up to two mooring plates (24 in by 64 in each) per subsurface float may be placed on the seabed (up to 8 mooring plates total). Each plate will be held down by up to three anchor bars (described below), with a welded padeye and shackles that would connect to a stainless steel chain or nylon line and a subsurface float (diameter of approximately 18 in). This anchoring arrangement is rated for 90,000 lbs., which aligns with the proposed vessels and activities for this project.

Anchor Bars
Anchoring and supplementary ballast would be required to ensure the RMS stay in place on the seafloor. Anchors would consist of a steel bar in a drilled rock socket with a maximum of 10 ft (3 m) embedment in the seafloor, held in place with a two-part mortar epoxy (i.e, HIT-RE 500 V3). The drilled hole would be less than 6 in (15 cm) in diameter and the bar less than 3 in (8 cm) in diameter. The anchor bars would either be installed by divers with a handheld drill or with a remotely operated vehicle drilling rig that would be temporarily lowered to the seafloor and tended from a surface vessel. Four to five anchor bars would be required per RMS, and each anchor would take approximately one hour to install. The drilled anchors may be installed after the RMS have been deployed, or the drilled anchorages may be pre-installed using a seabed template for alignment before the RMS are installed. The anchors would be drilled through holes at the base of each RMS, or the drilled anchors would be set into the seabed in close proximity

(less than 1 ft [0.3 m]) to the RMS and connected via a steel plate, tendon, chain, or turnbuckle. This mechanical connection between the anchor and the RMS would be made by divers immediately after each RMS is deployed.

Additional Structural and Biological Components

Once the RMS are deployed, structural and biological components and scientific monitoring equipment would be deployed onto and adjacent to the Reefense array (Tables 1 and 2).

Reef Enrichment Devices

Acoustic enrichment devices will be used to play back healthy reef sounds recorded on a productive, adjacent reef to attract and recruit reef fish larvae and juvenile fish to the site. Acoustic enrichment devices would be located near the center of the Reefense array or in the center of the back reef RMS. The speakers that playback healthy reef sounds at close to ambient volume would be mounted directly onto or outside a RMS, most likely using tie wraps and/or hose clamps. The speakers may play continuously for up to 12 hours, primarily during evening hours. The sound will be detectable up to 66 ft from the source. In addition to acoustic enrichment, plankton-attracting lights may be added to the proposed action area to enhance feeding to support the survivorship and growth of coral. Up to 350 coral feeding units with plankton attracting lights will be attached to the structures. Lights would be programmed to turn on for one hour each night to encourage nighttime feeding. Additionally, up to 5,000 native collector urchins (*Tripneustes gratilla*) may be released in the proposed action area to reduce the overgrowth of invasive algae that competes with coral.

Up to 40 Umu Kai will be deployed adjacent to the Reefense array. Umu Kai are artificial reefs (or fish houses) that function similarly to a coral reef by providing habitat for fish to congregate and reproduce. These umu (heap of rocks) can be up to 4 ft by 8 ft (1.2 m by 2.4 m) and are constructed with loosely stacked rocks or coral with an opening at either end to let the current run through. While some live rock from the site would be opportunistically collected, community members have suggested also bringing rocks in from the shore.

Monitoring

UH will conduct an initial survey post-deployment and two months post-deployment. Additionally, UH divers will survey the structures every five years to asses structural integrity. Once funding is secured, UH will conduct regular surveys of the structures. These surveys would monitor coral survivorship and growth, as well as remove any marine debris from the Reefense array that could compromise its integrity or create a hazard to mariners or marine life. Environmental DNA sampling may also occur post-deployment to measure the changes in quantity and relative abundance of the corals between a control site and the proposed action area. Bathymetric LIDAR surveys to monitor structure stability and scour will take place annually. Quarterly coastal photogrammetry surveys will be conducted to monitor any shoreline changes.

Up to 30 autonomous cameras (Kilocams) would be mounted in PVC housings (9 in [23 cm] long; 2 in [5 cm] diameter; submerged weight 1.1 lb.) to RMS using zip ties and hose clamps. Each camera would be accompanied by an underwater light inside PVC housings (13.8 in [35 cm] long; 2 in [5 cm] diameter). The lights would be directly attached to RMS using zip ties and hose clamps. The lights would emit white light with a daylight spectrum for five seconds every five minutes with the intention of allowing cameras to take pictures of nighttime activity of fish settlement. All sensors will be retrieved from the site if there is a lapse in funding for monitoring efforts.

Table 1. Monitoring instruments attached directly to the Reefense Array

Instrument Name	***Count***	***Function***	***Area (m^2)***	***Length (m)***	***Width (m)***	***Height (m)***
Acoustic Doppler Velocimeter (ADV)	12	Measures instantaneous velocity at a point	0.04	0.23	0.16	0.18
Strain Gauge	12	Measures strain on the RMS	0.009	0.17	0.05	0.05
SeaBass system main bottle with a 3-10m cable	1	Helps resolve sediment dynamics near the toe of the reef structure	0.14	0.63	0.22	0.22
SeaBASS system Blueview M900-2250 sonar	1	Helps resolve sediment dynamics near the toe of the Reefense array	0.03	0.21	0.13	0.13
RBR Solo-DWave16 data logger	5	Pressure sensors which provides high resolution wave data	0.03	0.4	0.07	0.07
Odyssey PAR logger + Wiper	3	Measure photosynthetic active radiation near coral	0.02	0.16	0.09	0.09
Nortek Acoustic Wave & Current Profiler (AWAC)	1	Acoustic surface tracking to measure wave height, direction, and current profile	6-8	0.57	0.61	0.92
Battery Canisters	2					

Up to nine passive acoustic "SoundTrap" recorders would be deployed to record the activity of fish and other biota and assess the impacts of the acoustic enrichment underwater speakers across a gradient. They would be mounted on a sand anchor that is attached to the seafloor, attached to another seafloor-mounted instrument, or mounted on the end of a two-foot rod, with the other end mounted to a RMS. Vector sensor modules (VSMs) would be deployed to record directionality of fish and crustacean activity within 65.6 (20 m) of each recorder. Up to six "Wilcoxon" VSMs would be evenly-spaced along the Reefense array using sand anchors attached directly to the seafloor, or mounted on another seafloor-mounted instrument. The dimensions of the pressure cases for the VSMs are 14 in (36 cm) long with a diameter of 5.1 in (13 cm). Submerged weights would be 2.2 lb. (1 kg) each. An additional two "DASARs" would be deployed for specialized detection of low-frequency fish sounds for two months a year during the summer. A DASAR has a 2 ft (60 cm) by 2 ft (60 cm) footprint on the ocean bottom, using sand anchors or stakes attached directly to the ocean floor. The DASAR height is about 2 ft (60 cm).

Table 2. Monitoring instruments that will be adjacent to the Reefense Array

Instrument	***#***	***Function***	***Depth (m)***	***Area (m^2)***	***Length (m)***	***Width (m)***	***Height (m)***	***Weight (lb)***
Nortek Acoustic Wave & Current Profiler (AWAC)	1	Acoustic surface tracking to measure wave height, direction, and current profile	6 to 8	0.57	0.61	0.92	0.61	150-200 (frames)
Battery Canisters	2							
Nortek Signature 1000	3	Releases sound waves to measure the speed & direction of currents	4 to 6	0.32	0.61	0.61	0.51	150-200 (frames)
RBR Virtuoso Dwave Logger	1	Pressure logger						
Seabird MicroCAT	1	Conductivity & temp. recorder						
RBR Tu with ZebraTech Hydro Wiper	1	Turbidity logger						
HOBO Water Level Data Logger	10	Measures water level	2 to 10	0.007	0.16	0.04	0.04	0.4
Surface floater	10	Locates the HOBO sensors	2 to 10	0.13	0.31	0.36	0.36	5
Lead weight	20	Secures the floaters	2 to 10	N/A	0.18	0.11	0.06	up to 20
Rope	10	Connects the floater to the lead weights	2 to 10	0.052 -0.26	4-20m	0.013	0.013	2.5

Instrument	*#*	*Function*	*Depth (m)*	*Area (m^2)*	*Length (m)*	*Width (m)*	*Height (m)*	*Weight (lb)*
Nortek Signature 1000	1	Sound waves to measure the speed & direction of currents	4 to 6	0.38	0.61	0.61	0.51	150-200 (frames)
RBR Virtuoso Dwave Logger	1	Pressure logger						
RBR Virtuoso Dwave Logger	6	Pressure logger	1 to 6	0.38	0.61	0.61	0.51	100 (frames)

Essential Fish Habitat

The marine water column from the surface to a depth of 3,281 ft from the shoreline to the outer boundary of the EEZ (200 nautical miles), and the seafloor from the shoreline out to a depth of 2,296 ft around each of the Hawaiian Islands, have been designated as EFH. As such, the water column and bottom of the Pacific Ocean around O'ahu are designated as EFH, and support various life stages for the management unit species (MUS) identified under the Western Pacific Fishery Management Council's Pelagic and Hawai'i Archipelago Fishery Ecosystem Plans. The MUS and life stages found in these waters include eggs, larvae, juveniles, and adults of Bottomfish, Crustacean, and Pelagic MUS. Specific types of habitat considered as EFH include coral reef, patch reefs, hard substrate, artificial substrate, seagrass beds, soft substrate, lagoon, estuarine, surge zone, deep-slope terraces and pelagic/open ocean.

Baseline Condition

The proposed action area is located off the coast of Kalaeloa on the west side of O'ahu. The proposed site receives high wave action. The seafloor is characterized as weathered hard-bottom seabed with intermittent patches of sand and sparse coral. The exact deployment location of each RMS will be determined based on detailed photogrammetry surveys. Coral cover at the site is less than 5% (Franklin et al 2013, 2014). Any non-encrusting corals greater than 4 in (10 cm) in height that could be damaged during deployment actions will be collected and brought to the coral nursery site nearby for fragmentation before being attached to the RMS.

Adverse Effects

The proposed activities could result in adverse effects to EFH from physical damage, sedimentation, turbidity, introduction of chemical contaminants (e.g., petroleum and adhesives), acoustic stress, and spread of invasive species. Physical damage will result from placement of structures on existing coral or seagrass. Sedimentation and turbidity may increase due to in-water work, reducing water quality and potentially smothering nearby habitat forming EFH, including corals and seagrass. Introduction of chemical contaminants may result from accidental spills or leaching from epoxy, resulting in reduced water quality, leading to decreased coral health. In-water drilling will temporarily increase acoustic stress in the area. Use of in-water equipment that has been used elsewhere.

Physical Damage/Removal (physical stressor): There is the risk of physical damage to benthic organisms from in-water activities including anchoring of vessels, deployment of equipment, and in-water surveys. The Reefense Array has many components that could become dislodged, if not properly secured, and act as marine debris. An estimated 226 corals will be crushed and permanently lost due to equipment deployment. However, the structures will provide 3D habitat to replace the crushed corals. Physical damage to principle nearby benthic organisms may result in breakage or dislocation (i.e., mortality), but can also result in sub-lethal tissue abrasion. Corals, which are primarily responsible for the structural complexity of coral reefs, are particularly vulnerable to physical damage because their slow-growing carbonate skeleton is relatively brittle and their polyps are easily damaged. In general, lobate, encrusting, and other massive colony morphologies tend to withstand breakage better than foliose, table, plating, and branching morphologies; forms that are more fragile tend to have higher growth rates (Rützler 2001). Reduction of topographic complexity in the habitats of the coral reef ecosystem reduces biodiversity and productivity (Alvarez-Filip et al. 2009).

Sedimentation (pollution stressor): Suspended sediment from deployment of equipment and drilling can elicit short- and long-term responses from aquatic organisms depending on the quantity, quality, and duration of suspended sediment exposure (Kjelland et al. 2015). Movement of vessels, diver activity, and placement of structures may increase turbidity in the action area. Coral reef organisms are easily smothered by sediment and can experience both physiological and lethal responses to concentrations below 10 milligrams (mg)/cm^2/day and 10 mg/Liter (L) (Tuttle and Donahue 2022). Adverse effects from deposited sediment can occur as low as 1 mg/cm^2/day for larvae and 4.9 mg/cm^2 /day for adult tissue (Tuttle and Donahue 2022). Suspended sediment levels of 10 mg/L can lead to reduced growth rates and levels of 3.2 mg/L can cause bleaching and tissue mortality (Tuttle and Donahue 2022), although corals show considerable interspecific variability. Increased turbidity can cause changes in fish behavior, including altered predator-prey relationships (Higham et al. 2015).

Chemical Contamination (pollution stressor): Chemical pollutants may enter the environment through accidental spills or leaching from materials, including the epoxy that will be used. Contaminants can have a variety of lethal and sublethal effects on habitat-forming marine organisms, including alteration of growth, interference with reproduction, disruption of metabolic processes, and changes in behavior. These adverse effects can cascade through ecosystems, altering species composition and ecosystem functions and services. Some pollutants are environmentally persistent and can take years or even decades to biodegrade, and others can bioaccumulate or biomagnify through the food chain, eventually posing a direct threat to human health. Contaminant concentrations in fishes are linked to locations with increased urbanization and military history (Nalley et al. 2021; 2023).

Noise (environmental stressor): Drilling into the substrate for anchor bar installation will expose individual habitat-forming marine organisms to sound and vibratory stressors. Behavioral changes can occur as a response to noise, resulting in animals leaving feeding or reproduction grounds (Slabbekoorn et al. 2012) or becoming more susceptible to mortality through decreased predator-avoidance responses (Simpson et al. 2016). Less intense but chronic noise, such as that produced by continuous boating, can cause a general increase in background noise over a large area. Although not likely to kill organisms, chronic noise can mask biologically important sounds and alter the natural soundscape, cause hearing loss, and/or have an adverse effect on an organism's stress levels and immune system. Acoustic enrichment devices will play sounds of healthy reefs. NMFS does not think the speaker system will cause a significant amount of acoustic stress on managed fish species or ecosystem component species due to the frequency of the playback recordings and the similarity of the playback sounds to the soundscape expected in a healthy coral reef environment. However, the acoustic enrichment may change the community structure that currently exists in the area.

Invasive Species (biological stressor): Movement of vessels, gear, coral, and divers from one area to another has an increased risk of spreading invasive species. The vessel may carry invasive species from other parts of the island to the project site. Introduced species are organisms that have been moved, intentionally or unintentionally, into areas where they do not naturally occur. Invasive species rapidly increase in abundance to the point that they come to dominate their new environment, adversely affecting other species of the ecosystem and the functions and services they may provide (Goldberg and Wilkinson 2004). Nearly 500 introduced species have been identified in Hawaiʻi (Randall 1987; Coles and Eldredge 2002; Carlton and Eldredge 2014). Invasive species can decrease species diversity, change trophic structure, and diminish physical structure, but adverse effects are highly variable and species-specific.

Loss of Habitat

Deployment of the Reefense Array will result in a loss of approximately 57 small (< 10 cm) mounding corals, 144 small encrusting corals, and 25 encrusting corals larger than 10 cm, if the structures are deployed in the notionally chosen location that has been surveyed. The EFHA states that as soon as the RMS are deployed, they would immediately attenuate coastal wave energy. As the structures facilitate coral growth, they would provide a biological benefit (e.g., habitat for mobile reef species) in just a few months or years that would be equivalent to decades of growth for a similarly-sized naturally-occurring reef.

Translocation of corals to the RMS will create an artificial reef with 3D structure. The structures themselves will provide coral and reef fish habitat that is more structurally complex than the current condition. The potential benefits of the Reefense array include increased habitat complexity, enhanced recruitment, and shoreline protection will offset the loss of approximately 226 corals that are <10 cm and/or encrusting.

NMFS Concerns

The Reefense project incorporates cutting-edge science and tools using latest research techniques with promising results that may aid in shoreline protection and habitat enhancement. If the structures are successfully installed, they will provide increased structural complexity and habitat in the area while protecting the shoreline. There are many components to the project, including the back reef and fore reef structures, sensors, and experimental devices. Improperly secured equipment may act as marine debris after a large storm event, damaging nearby reefs. Increased boat traffic to the area for deployment and monitoring come with increased risk of physical damage from anchors, introduction of invasive species, and pollution. The site will be monitored immediately post-deployment, two-months post-deployment, but otherwise may not be monitored if funding is not secured. Monitoring is essential to ensure structures are properly attached and to determine if the project is a success. Dislodged structures or devices may not be secured promptly without regular maintenance and monitoring.

DARPA-proposed BMPs
In the package submitted for the consultation, DARPA provided a list of Standard Operating Procedures outlining BMPs that will be incorporated into the overall design, deployment, and monitoring methods for the proposed action to minimize and reduce most adverse impacts to EFH. Application of these BMPs is required throughout the entirety of the installation and monitoring activities. HDOT will take over ownership of the project in Spring 2026. Post- severe storm event, HDOT will perform a preliminary site assessment from shore to determine if structures have significantly shifted from their original positions to potentially damage the seabed and/or shoreline.

NMFS previous CRs
DARPA had accepted all 10 of the CRs NMFS originally provided. The following eight CRs are still applicable and will be implemented as part of the updated project action.

CR 1: Ensure all gear, diving equipment, coral transplants, rocks used for Umu Kai, and tools are free of invasive species prior to in-water work to prevent spread of invasive species between the sites.

CR 2: Use locally sourced vessels and equipment when possible to avoid introduction of invasive species from outside Hawai‘i. Ensure vessels are free of organic material and invasive species prior to installation or removal activities to avoid spreading invasive species.

CR 3: Avoid placing anchors and structures on seagrass or corals of any size, whenever possible.

CR 4: Ensure all components (e.g. speakers, coral transplants, sensors) are properly secure and weighted so that they do not become detached and damage nearby resources. Check each component during quarterly surveys and after storms and remove or re-secure loose equipment.

Ensure all components, including mechanical connections, are properly maintained. If the placement of any structures, equipment, rocks, or other components end up moving and causing damage elsewhere (e.g. nearby reef, shoreline), provide NMFS with an assessment of the damage and a restoration mitigation plan, if needed.

CR 5: Survey the structures more frequently after deployment, such as 1 week and 1 month after, to ensure all components are adequately secured.

CR 6: Make efforts to track the number of corals unavoidably lost due to structure installation, anchoring, transplanted from the site to the structures, and transplanted to or recruited to the Reefense structures.

CR 7: Share reports with data from monitoring equipment, in-water surveys, and findings with NMFS.

CR 8: Ensure all Best Management Practices described in the Standard Operating Procedures are applied

Conservation Recommendations

Pursuant to Section 305(b)(2) (as described by 50 CFR 600.920 and 600.925(b)) of the MSA NMFS is providing the following additional conservation recommendations, that when implemented, will ensure that potential adverse effects to EFH at the proposed action areas are avoided, minimized, and offset.

Conservation Recommendation 1: Check on the coral nursery tables and the Reefense array before and after large storms, as practical, to ensure all structures and corals are secure.

Conservation Recommendation 2: Ensure all components, coral fragments, and scientific measuring devices are properly secured or otherwise removed if the structures will not be checked or monitored for an extended period of time.

Conclusion

NMFS greatly appreciates the efforts of DARPA to comply with the EFH provision of the MSA and recognizes that DARPA proposed BMPs and mitigation strategies, when adhered to and implemented, may avoid and minimize most adverse effects to EFH. Due to the proposed project activities, potential long-term or permanent impacts to EFH may result in adverse effects to nearshore EFH from physical damage and associated spatial and temporal losses of function and service. We have determined that the proposed project may adversely affect EFH and provided explanations of our concerns and conservation recommendations for implementation to avoid and minimize them.

Please be advised that regulations (Section 305(b)(4)(B) of the MSA) to implement the EFH provisions of the MSA require that Federal action agencies provide a written response to this letter within 30 days of its receipt and at least 10 days prior to final approval of the action. A preliminary response is acceptable if final action cannot be completed within 30 days. The final response must include a description of measures to be required to avoid, mitigate, or offset the adverse impacts of the activity. If the response is inconsistent with our EFH Conservation Recommendations, an explanation of the reason for not implementing them must be provided at least 10 days prior to final approval of activities. Finally, re-initiation of the consultation with NMFS will be required if a net loss of coral occurs, such as from a natural disaster that compromises the Reefense array or unsuccessful installation operations, to discuss potential offset options for lost resources.

Thank you for consulting on this proposed project. We appreciate the extensive effort you have invested in pre-consultation and information sharing regarding the DARPA Reefense project. Feel free to contact Alexandria Barkman by phone (808-725-5150) or at alexandria.barkman@noaa.gov with any questions or comments.

Sincerely,

GOLDEN.DAWN.KIMBERLY.1365826150 Digitally signed by GOLDEN.DAWN.KIMBERLY.1365826150 Date: 2025.08.07 14:45:20 -10'00'

Dawn Golden
Assistant Regional Administrator
Protected Resources Division

Cc by email:
Catherine Campbell, DARPA
Jacob Goodwin, DARPA
Jocelyn Borcuk, DARPA
Benjamin Jones, University of Hawai‘i
Josh Levy, University of Hawai‘i

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ESA Informal Consultation:

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NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
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Honolulu, Hawaii 96818
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September 10, 2025

Erica Felins
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Biological Technologies Office
675 North Randolph Street
Arlington, Virginia 22203

RE: Request for reinitiation of Informal ESA Consultation and Conference on the Defense Advanced Research Projects Agency's Reefense Program: Rapid Resilient Reefs for Coastal Defense Project (PIRO-2025-02108, I-PI-25-2534-DG, INQ-2025-00193).

Dear Ms. Felins:

On July 21, 2025, NOAA's National Marine Fisheries Service (NMFS) received your written request for informal consultation on the Defense Advanced Research Projects Agency's (DARPA) proposed action to develop and test a living, self-healing hybrid reef that can attenuate wave energy more effectively than traditional hardscape solutions to protect infrastructure and communities by mitigating damage related to coastal flooding, erosion, and storm surge. The proposed action may affect the endangered or threatened species and/or designated critical habitat under our jurisdiction, as identified below in Table 1. Informal consultation on this proposed action originally concluded on July 11, 2024 (I-PI-24-2323-DG, PIRO-2024-01249). However, on June 4, 2025, DARPA informed NMFS that significant modifications were required for the proposed project including the deployment location, additional structures to be installed, modified logistical requirements, and changes in the potential effects to endangered species act (ESA) listed species. A technical assistance record was opened on that date INQ-2025-00193) and continued through July 20, 2025. On July 21, 2025, we received all the necessary information to evaluate the proposed action and initiated section 7 consultation.

We prepared this response to your request pursuant to section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. §1531 *et seq*.), implementing regulations at 50 CFR 402, and agency guidance for the preparation of letters of concurrence. This letter also underwent pre-dissemination review using standards for utility, integrity, and objectivity in accordance with applicable guidelines issued under the Information Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). A complete record of this consultation is on file at the Pacific Island Regional Office, Honolulu, Hawaii.

The ESA requires federal action agencies to consult with National Marine Fisheries Service (NMFS) when the action may affect a listed species or its designated critical habitat under our jurisdiction (50 CFR 402.14(a)).

Under section 7(a)(4) of the ESA, each Federal agency shall confer with the Secretary on any agency action that is likely to jeopardize the continued existence of any species proposed to be listed or result in the destruction or adverse modification of critical habitat proposed to be designated for such species. While consultations are required when the proposed action may affect listed species, a conference is required only when the proposed action is likely to jeopardize the continued existence of a proposed species or destroy or adversely modify the proposed critical habitat. However, Federal action agencies may request a conference on any proposed action that may affect proposed species or proposed critical habitat (USFWS and NMFS 1998).

Proposed Action

The DARPA Reefense Program, which operates within the DoD and under the statutory authority of the Secretary of Defense, proposes to deploy custom reef mimicking structures (RMS) that work as wave attenuators and promote coral settlement and growth. The RMS will mitigate damage related to coastal flooding, and erosion, and grow into a functional, self-sustaining, living breakwater within five years. DARPA would fund the deployment of the hybrid reef, which would start as early as fall 2025. After deployment, the hybrid-reef system and maintenance requirements would be transferred to the Hawaii Department of Transportation. DARPA would continue to monitor until spring of 2026.

The action includes the following activities:

1. Site selection, surveys, and coral transplanting
2. RMS deployment and installation
3. Mooring installations
4. Oceanographic equipment installation
5. Reef enrichment/ lighting installation
6. Additional site monitoring efforts
7. Urchin and algae installation
8. Umu kai installation

Site selection, surveys, and coral transplanting

The original consultation considered a deployment location at Marine Corps Base Hawaii; however, the new location at Kalaeloa (i.e., West Oahu near Barber's Point) was based on a 1-m resolution aerial light detected and ranging (LiDAR) survey conducted in 2013. The exact location of the deployment within the proposed action area may change based on detailed photogrammetry surveys, oceanographic monitoring, and structural testing. After deployment of the hybrid reef, an additional survey would be conducted to map the final locations of each individual RMS. Divers would conduct a survey close to deployment to identify coral colony locations. Any non-encrusting corals greater than 4 inches (in) (10 centimeters (cm)) in height that could potentially be disturbed during the deployment of the RMSs or associated instruments and components would be collected and cached at deeper, established coral nursery site nearby, per procedures developed by Kuleana Coral Restoration (Kuball et al. 2024). These corals would be fragmented and attached to the RMSs after installation. Additionally, corals of opportunity, sourced from the proposed action area may also be outplanted to the hybrid reef after being cached at the coral nursery.

RMS deployment and installation
The Reefense array will consist of 61 RMS structures, including 40 reef crest structures and 21 back reef structures (Figure 1). Each Reefense structure would be designed with perforated holes (diameter of 0.9 feet (ft.) to 2.7 ft. [30 cm - 82 cm]) that attenuate wave energy through generation of turbulence and allow for egress of mobile marine species. Deployment of the reef crest section would likely precede the back reef sections. All structures would be deployed in 6.5 to 13 ft. (2 to 4 meters(m)) water depth. All RMS are constructed from concrete reinforced with glass fiber or steel/basalt rebar.

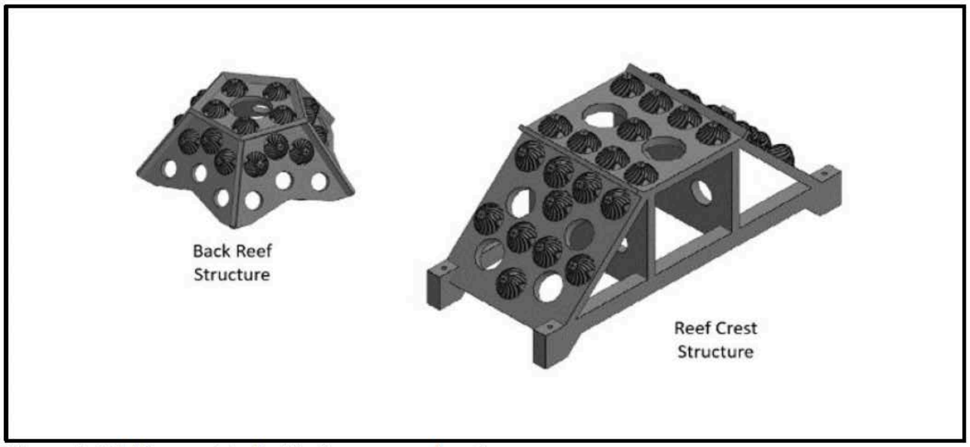

Figure 1: RMS associated with the proposed action.

The notional installation plan consists of two rows of reef crest structures measuring approximately 50 m in length with a distance of at least 6.1 m between the two rows and between the reef crest structures and the back reef structures (Figure 2). The approximate total footprint for all structures is 831 m^2. At the shallowest point in the array, the reef crest structures would be fully submerged, at an estimated 1.41 ft (0.43 m) depth below the water surface at Mean Lower Low Water (MLLW) and 0.59 ft (0.18) below water at the Lowest Astronomical Tide (LAT). The back reef structures with additional components are estimated to be 0.75 ft (0.23 m) below the surface at MLLW and 0.07 ft (0.02 m) above the surface at LAT.

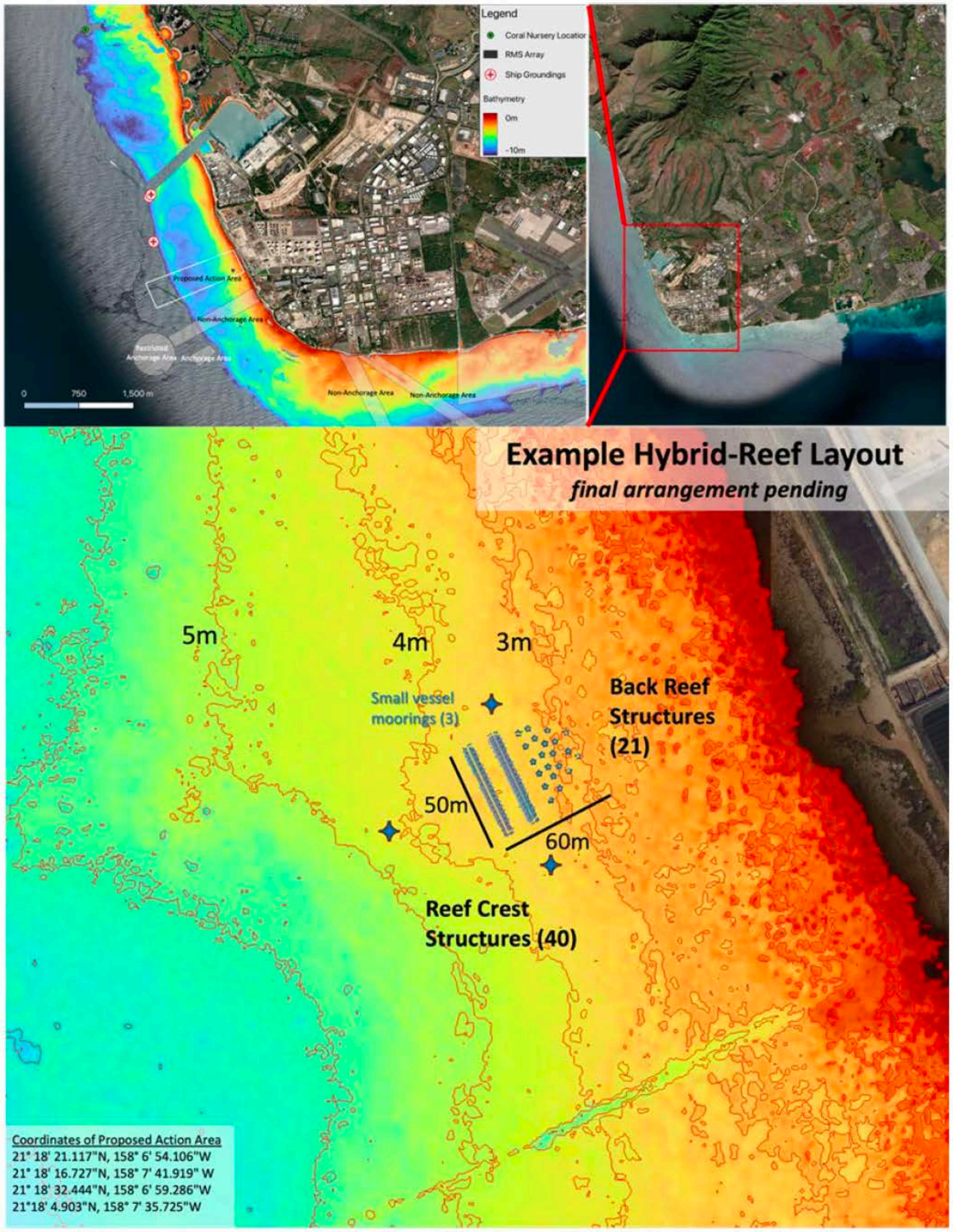

Figure 2: Proposed arrangement of Reefense Structures within the Proposed Action Area.

Deployment of the RMSs would likely occur using a dynamically positioned vessel approximately 181 ft (55 m) long by 34 ft (10 m) wide with a 12 ft (3.7 m) draft. RMSs would be transported with temporary buoyancy systems to their shallow water deployment locations. A workboat with twin engines, approximately 84 ft (25.5 m) in length, and a small, rigid inflatable or whaler-type boat less than 26 ft (8 m), also referred to as a daughter craft, would assist the final stages of deployment and operate at 5 knots or less in the proposed action area.

A second option to deploy the units is to use a custom-built deployment catamaran vessel for buoyancy support. Engineering mock-ups suggest up to four RMS could be deployed at a time per tow using a small support vessel from the staging/launching site to the deployment site. Once in position at the deployment location within the proposed action area one of the following methods would occur to deploy the RMS': (1) the RMSs would be lowered in a controlled manner from the floating catamaran vessel or (2) the catamaran vessel itself, including RMS', would be submerged in a controlled manner, by flooding the sponsons. Once the RMSs are on the seabed in position, the RMSs are disconnected from the catamaran frame by divers and (if needed) the sponsons are refilled with air using a compressor on a small surface vessel to allow the catamaran vessel to refloat to the surface. In most cases, divers would be expected to assist the anchoring and placement of RMS, if it is safe to do so, to avoid placement on non-encrusting corals. RMS installation would likely take several months overall using this method. The supporting vessels would transit from Kalaeloa harbor during the installation period to reload RMS and avoid unfavorable weather conditions.

Anchoring and supplementary ballast would be required to ensure the RMS stay in place on the seafloor. Anchors would consist of a steel bar in a drilled rock socket with a maximum of 10 ft (3 m) embedment, held in place with a two-part mortar epoxy (i.e., HIT-RE 500 V3). When injecting epoxy, the gap at the seabed surface around the anchor bar is expected to be small, and the process would be monitored with sensors and cameras. During the injection process, significant loss of epoxy is not anticipated. Once the gaps are filled a permanent cap would be placed over the pile that would have the effect of preventing loss of epoxy while it cures. The drilled hole would be less than 6 in (15 cm) in diameter and the bar less than 3 in (8 cm) in diameter. The anchor bars would either be installed by divers with a handheld drill or with a remotely operated vehicle (ROV) drilling rig that would be temporarily lowered to the seafloor and tended from a surface vessel. Provided it is safe to do so, divers would be present in the water when the ROV is in operation to ensure impacts to corals are avoided.

One to four anchor bars would be required per RMS (no more than 124 anchor bars total), and each anchor would take approximately one hour to install. Anchor bars would be installed by a single team operating one drilling spread. The drilled anchors may be installed after the Reefense structures have been deployed. Alternatively, the drilled anchorages may be pre-installed using a seabed template for alignment, and the Reefense structures would be installed subsequently. The anchors would be drilled through holes at the base of each Reefense structure, or the drilled anchors would be set into the seabed in close proximity ((up to 10 ft [3 m]) to the Reefense structures and connected via a steel plate, tendon, chain, or turnbuckle. This mechanical connection between the anchor and the Reefense structure would be made by divers immediately after each Reefense structure is deployed.

According to DARPA (2025), the frequency range of hydraulic drills similar to those that would likely be used in the proposed action have been measured 159-161 dB re 1 μPa at 1 m from the source (Nedwell et al. 2004; Anthony et al. 2009). Based on these findings, DARPA assumes an approximate level of 161 dB re 1 μPa at the source for the hand drills.

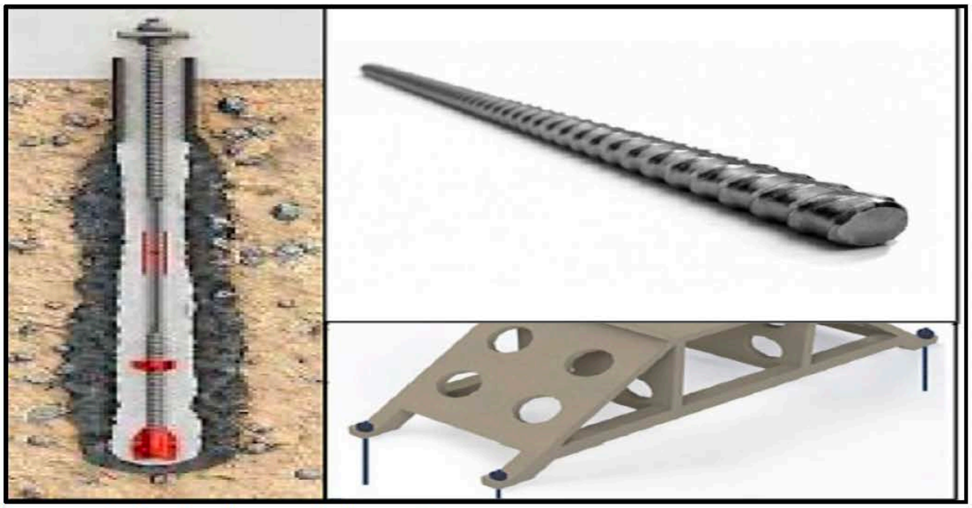

Figure 3: Anchor bar design and placement.

The RMS will support additional components, including up to 1,300 coral settlement modules (CSMs) to add a three-dimensional habitat, some of which are coated with a solution to enhance coral recruitment and reduce algae growth. They are made of concrete with a diameter of 50 cm, a height of 25 cm, and a weight of no more than 50 lbs. and are attached to the perforations in the RMS by underwater drilling (Figure 4). This is an increase of 100 CSM from that which was previously considered.

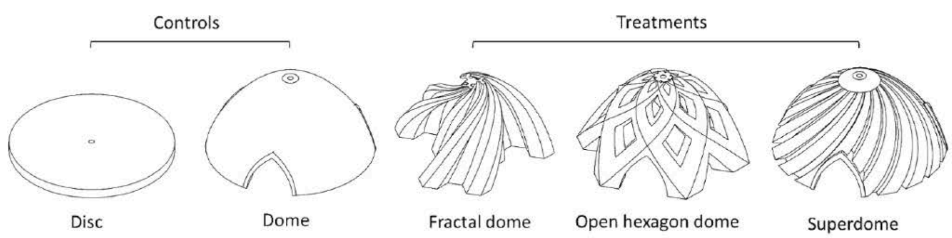

Figure 4: CSMs in a variety of shapes.

The RMS will also contain up to 500 coral growth modules (CGMs) installed with steel bolts and reef-safe epoxy. CGMs will weigh up to 50 lbs. and contain attached live corals (Figure 5).

Figure 5: CGM (left) with holes to fit aragonite plugs that hold juvenile corals.

Mooring installations

Three subsurface moorings, rated for 90,000 lbs., will be deployed within the proposed action area near the RMS. Up to two mooring plates per subsurface float are anchored on the seabed, with each plate held down by up to three anchor bars containing a welded pad eye and shackles that will connect to a stainless-steel chain or nylon line and an 18 in. subsurface float (Figure 6).

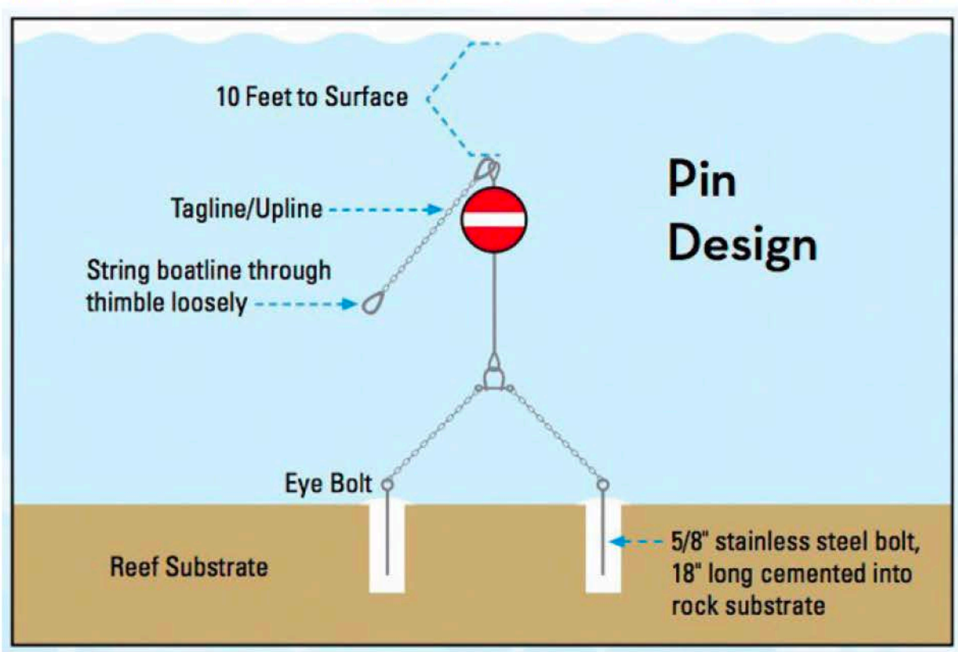

Figure 6: Buoy design and installation.

Oceanographic equipment installation
The RMS will contain oceanographic equipment attached to its structure and additional equipment placed adjacent to the RMS on the seafloor. Equipment placed directly on the RMS by divers (via bolts, zip ties, or similar method) will include twelve acoustic Doppler velocimeters (ADVs) that record water velocity, twelve strain gauges that measure strain on the RMS, a SeaBASS system Blueview M900-2250 sonar to resolve sediment dynamics, five RBR Solo-DWave16 data loggers to provide high-resolution wave data, and three Odyssey PAR loggers to measure photosynthetic active radiation. Additional equipment mounted to the RMS will include thirty-two autonomous Kilocam cameras in PVC housings, which are accompanied by an underwater light, to monitor fish settlement.

Equipment on the seafloor adjacent to the RMS will be weighted with ballasted grid frames and installed by divers. This equipment includes a Nortek acoustic wave and current profiler (AWAC) to measure wave height, direction, and current, four Nortek Signature 1000 current profilers, eight RBR Virtuoso Dwave pressure loggers, a Seabird MicroCAT CTD, a RBR ZebraTech Hydrowiper turbidity logger, and ten HOBO water level data loggers and floats.

Up to nine passive acoustic "SoundTrap" recorders will record the activity of fish and other biota and assess the impacts of the underwater speakers. Each SoundTrap is the size of a soda can and is attached to the seafloor next to the RMS with a 5 kg submerged weight, placed every 6 m along the inside of the Reefense array. Up to six Vector sensor modules (VSMs) will be placed along the Reefense array using sand anchors attached to the seafloor. The dimensions of the pressure cases for the VSMs are 36 cm long by 13 cm wide with a 1 kg submerged weight. The deployment of two directional autonomous seafloor acoustic recorders (DASARs) for specialized detection of low-frequency fish sounds will occur for two months a year during the summer. A DASAR has a 60 cm by 60 cm footprint on the ocean bottom and uses sand anchors or stakes to attach directly to the ocean floor.

Reef enrichment/ lighting installation
Reef acoustic enrichment devices (AEDs), located near the center of the Reefense array or in the center of the back reef structures, will playback healthy reef sounds to recruit fish larvae and juvenile fish. Underwater speakers, consisting of three cylindrical pressure cases filled with nickel-metal hydride batteries and measuring 1 m by 25.6 cm with a submerged 22 kg weight, will be mounted on the RMS and play continuously for up to 12 hours, primarily during evening hours.

Up to 350 CGMs and CSMs may include battery-powered Underwater Zooplankton Enhancing Light Arrays (UZELA) to encourage nighttime feeding of newly recruited corals and adult coral colonies. These lights are programmed to turn on for one hour each night, starting 30 minutes after sunset. The UZELAs emit white light at a maximum of 700 lumens. However, light is restricted by the modules and is only visible from the above (Figure 7).

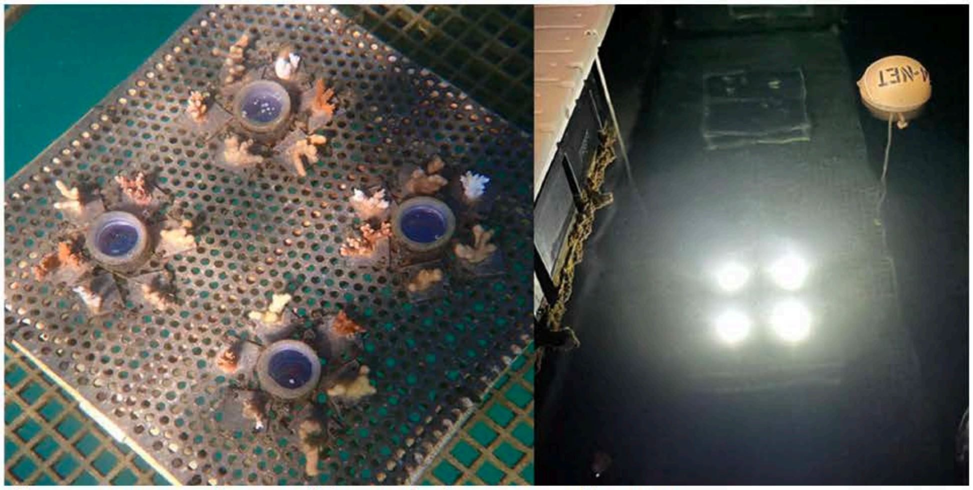

Figure 7: UZELA underwater lights attached to CGMs and/or CSMs.

Additional site monitoring efforts
Monitoring will occur post-deployment, 2 months post deployment, and every five years to assess the anchoring system. Post- severe storm events, HDOT will perform a preliminary site assessment from shore to determine if structures have significantly shifted from their original positions. At the time of this consultation, the University of Hawaii (UH) is seeking additional funding for long-term surveys to understand the effectiveness of the hybrid-reef system. Long-term surveys will include the following: quarterly underwater photogrammetry to assess coral health, recruitment and growth; continuous passive acoustic surveys with data being analyzed quarterly; and periodic environmental DNA sampling to measure the changes in quantity and relative abundance of the corals between a control site and the proposed action area. Any diver surveys would include identification and removal of any marine debris from the structures that may create a hazard to the hybrid-reef system or marine life in the area. We consider this additional monitoring activities in the description of the proposed action in the event funding is procured in order to properly assess the potential effects.

Urchin and algae installation
Up to 5,000 native collector urchins (*Tripneustes gratilla*) may be released in the proposed action area to reduce the overgrowth of invasive algae that competes with coral. The released urchins are bred at the Division of Aquatic Resources (DAR) Anuenue Sea Urchin Hatchery facility. Additionally, the Waimānalo Limu Hui may outplant native algae propagated at the DAR Anuenue facility on the RMS.

Umu/imu kai installation
This activity will deploy up to 40 umu/imu kai (heap of rocks) on the seafloor to attract fish to otherwise barren areas adjacent to and behind the RMS in open spaces. The umu/imu kai are up to 1.2 m by 2.4 m and constructed with loosely stacked rocks or coral with an opening at either end to let the current run through. The umu/imu kai will use opportunistically collected live rock

from the site and shore and match traditional designs that lack epoxy or other attachment methods.

Standard Operating Procedures, Protective Measures, and Mitigation Measures
We incorporate all Standard Operating Procedures, Protective Measures, and Mitigation Measures which are noted on pages 36 through 39, and include the Applicable Conservation Recommendations from the previous Reefense EFH consultation which was completed in June 2024 as described in the biological evaluation on page 40 (DARPA 2025).

Action Area
The action area is defined by regulation as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). The action area for the proposed activities encompasses the full extent of the action's modifications to land, water, and air. For this action, the full extent of direct and indirect effects is the potential disturbance from human activity. It encompasses the entire cell noted in Figure 8 and any transit routes to and from the site to the Kalaeloa Harbor to the North. While the hybrid-reef would be deployed within a depth range of approximately 2-4 m near the shore, support vessels will stage within the greater cell in deeper waters. We also consider the downward extent of any turbidity, sedimentation, or chemicals travelling from these activities if they were to occur.

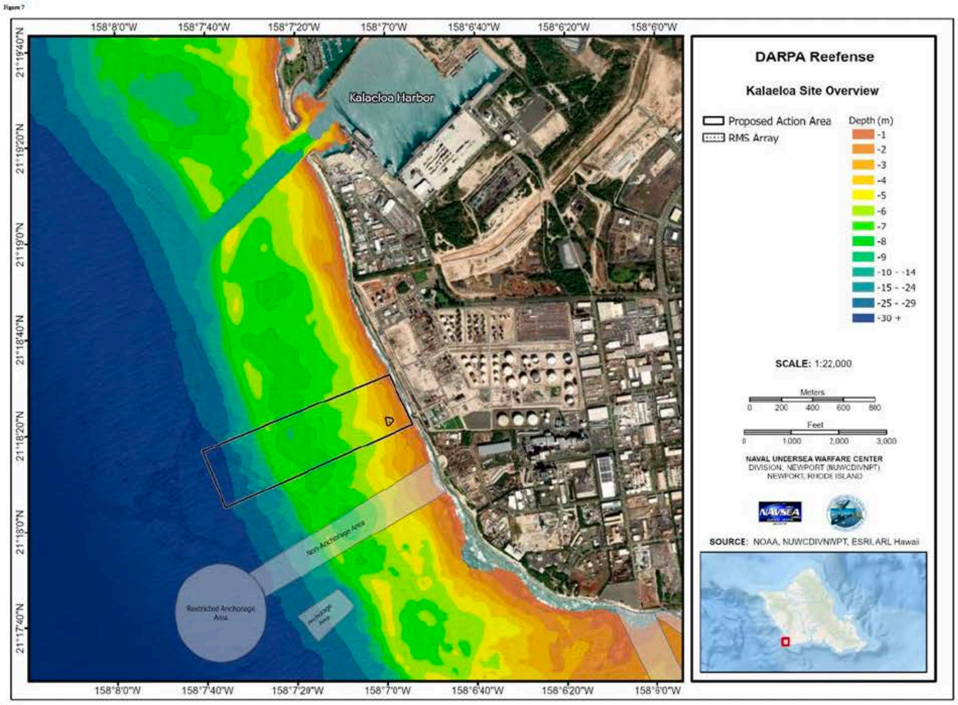

Figure 8: Proposed action area.

Listed Species in the Action Area

We are reasonably certain the ESA-listed species and designated critical habitat under our jurisdiction listed in Table 1 occur in the action area, and may be affected by the proposed activities. Detailed information about the biology, habitat, and conservation status of the animals listed in Table 1 is available in their status reviews, recovery plans, federal register notices, and other sources at https://www.fisheries.noaa.gov/species-directory/threatened-endangered.

Table 1. Common name, scientific name, ESA status, effective listing date, critical habitat designation, and recovery plans, with Federal Register reference for ESA-listed species considered in this consultation.

Species/ common name	ESA Status	Effective Listing Date/ FR Notice	Critical Habitat	Recovery Plan
Central North Pacific Green Sea Turtle	Threatened	05/06/2016 81 FR 20057	Proposed 07/19/2023 88 FR 46572	
Eretmochelys imbricata Hawksbill Sea Turtle	Endangered	06/03/1970 35 FR 8491		5/22/98 63 FR 28359
Neomonachus schauinslandi Hawaiian Monk Seal	Endangered	11/23/1976 41 FR 51612	9/21/2015 (revised) 80 FR 50925	8/22/07 72 FR 46966
Pseudorca crassidens False Killer Whale Main Hawaiian Island Insular[2]	Endangered	12/28/2012 77 FR 70915	8/23/2018 83 FR 35062	
Manta birostris Giant Manta Ray	Threatened	02/21/2018 83 FR 2916		

Critical Habitat in the Action Area

Hawaiian monk seal. In designated areas of the Main Hawaiian Islands (MHI), critical habitat for monk seals includes the marine environment with a seaward boundary that extends from the 200-meter depth contour line (relative to mean lower low water), including the seafloor and all subsurface waters and marine habitat within 10 meters of the seafloor, through the water's edge 5 meters into the terrestrial environment. Detailed information on Hawaiian monk seal critical habitat is available at https://www.fisheries.noaa.gov/action/critical-habitat-hawaiian-monk-seals.

The specific areas within the designation, with their physical and biological features are:

1. Terrestrial areas preferred by monk seals for pupping and nursing with adjacent shallow, sheltered aquatic areas
2. Marine areas from 0 to 200 meters in depth with water quality and sediment characteristics that support adequate prey quality and quantity for juvenile and adult monk seal foraging
3. Significant areas used by monk seals for hauling out, resting or molting

Central North Pacific Green Sea Turtle. In areas of the MHI, the proposed critical habitat for green sea turtles includes the marine environment from the mean high water line to 20 m depth.

The specific areas within the proposed designation, with their physical and biological features are:

1. From the mean high-water line to 20 m depth, sufficiently dark and unobstructed nearshore waters adjacent to nesting beaches are proposed as critical habitat by USFWS, to allow for the transit, mating, and internesting of reproductive individuals, and the transit of post-hatchlings.
2. From the mean high water line to 20 m depth, underwater refugia (*e.g.,* caves, reefs, protective outcroppings, submarine cliffs, and "potholes") and food resources (*i.e.,* seagrass, marine algae, or marine invertebrates) of sufficient condition, distribution, diversity, abundance, and density necessary to support survival, development, growth, or reproduction.

Detailed information on proposed green sea turtle critical habitat is available at:
https://www.fisheries.noaa.gov/action/proposed-rule-designate-critical-habitat-green-sea-turtles

Analysis of Effects
Under the ESA (50 CFR 402.02), "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

The applicable standard to find that a proposed action is "not likely to adversely affect" listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial (USFWS and NMFS 1998). Discountable effects are those extremely unlikely to occur. Insignificant effects relate to the size of the impact and should never reach the scale where take[1] occurs. Beneficial effects are contemporaneous positive effects without any adverse effects.

We incorporate the effects analysis from the original consultation (I-PI-24-2323-DG, PIRO-2024-01249) including the following stressor discussions:

- Vessel collisions,
- Direct physical impact,
- Disturbance from human activity,
- Increased turbidity,
- Exposure to waste and discharge,
- Exposure to elevated noise,
- Exposure to light sources,
- Exposure to contaminants, and
- Entanglement/entrapment.

[1] Under the ESA, the term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (16 U.S.C. §1532). We further define "harass" as to create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (Wieting 2016).

We therefore only discuss the project's stressors which were not previously considered. We consider the slight increase in the number of units to be deployed and the addition of the coral nursery tables to be applicable to the prior effects analysis and do not consider them further.

To assess the effects of proposed actions, we use an exposure-response assessment framework. Effects are discountable if exposure is extremely unlikely to occur. For this reason, we first determine the probability of stressors co-occurring with individuals from the listed species, or features of critical habitat. For stressors where exposure is not discountable, we discuss the significance of the species' response.

Recreational fishing effects

Artificial reefs may contribute to the attraction of ESA-listed species as they increase habitat complexity, aggregate food resources, and provide physical protection; thus, may potentially increase the risk of incidental hooking and entanglements. Considering the geographic location of the proposed action and the expected species at this depth profile, this stressor analysis focuses solely only on the Central North Pacific green sea turtle and their proposed critical habitat, the hawksbill sea turtle, and the Hawaiian monk seal and their designated critical habitat. We do not consider the Main Hawaiian Island insular false killer whale or giant manta ray further.

Additionally, we highlight that DARPA does not have the authority to manage or restrict fishing activities in the area and fishing is not expected to occur as part of the proposed action. However, the installation of these structures may increase the risk of these activities in the foreseeable future from recreational users once the site is discovered by the public.

Fishing poses hooking and entanglement risks to green, hawksbills, and Hawaiian monk seals as they may depredate bait or catch. Hooking can result in physical damage to the animal, increase the opportunity for a depredation event by a higher-level predator while the animal is on the line, interfere with reproduction, reduce foraging efficiency, require extra energy for movement, and in the case of sea turtles and marine mammals, may result in drowning. Spearfishing may result in puncture wounds, broken bones or carapaces, amputations, or death depending on where the spear contacts an animal.

Entanglements can also create physical damage to the animal by constriction of the line which can partially sever limbs or flippers, create penetrating injuries, increase the opportunity for necrosis or death of tissues to occur, and can potentially immobilize an animal (Andersen et al. 2008; Parga 2012). Entanglements also interfere with reproduction, reduce foraging efficiency, require extra energy for movement, and in the case of sea turtles and marine mammals, may also result in drowning. Ingestion of fishing line by sea turtles has also been shown to cause delayed mortality by blocking intestinal tracts leading to starvation as summarized by Parga (2012). Passive entanglement could also occur from fishing lines left on the structures.

Demersal line fishing occurs throughout Oahu and the Main Hawaiian Islands. At this time, we do not have data to suggest the amount or severity of fishing that might occur at the site currently although Hoiberg et al. (2025) predicted fishing line debris to be high in this area of Oahu given the number of sea turtle strandings which occur to the North near the Barber's Point Harbor and Malakole Harbor. The results of the in-water survey show the area has low coral cover, a heavy sedimentation load, and divers did not document any fishing line in the area presently. The shoreline is also a poor haul out site for Hawaiian monk seals and the two sea turtle species given the wide coastal rockbench and considering these species prefer sandy beaches.

Spearfishing would likely be the more prevalent harvest method as the artificial reef will be in fairly shallow water (only up to 12 ft.) and likely accessed from shore. However, it may also be difficult given the local environmental conditions as the swell builds on the corner of the island throughout the day into the afternoon creating potentially dangerous swimming conditions and it is roughly one mile from the nearest public parking lot. Furthermore, the three buoys that will be installed will be subsurface so as not to attract attention to the site and most vessels would be expected to avoid shallow waters for safety reasons to avoid grounding.

We would also expect target catch would likely be various goatfish, surgeonfish, squirrelfish, etc. which may also reduce the fishing effort which may occur at the site. Spearfisherman usually prefer to go further offshore to target more valuable species like uku (*Aprion virescens*) or mu (*Monotaxis grandoculis*) in much deeper waters.

Even with the lack of evidence of fishing in the area, based on the species' distribution, abundance, and expected food sources, along with established BMPs to monitor the success of the artificial reef including active restoration efforts and to remove fishing line when it is discovered, subsurface buoys to keep the location discrete, difficulty reaching the location from land, and the expectation that fishing is already occurring throughout Oahu; we believe it highly unlikely the installation of this structure would contribute substantially to fishing activities in the area that would result in a sea turtle or monk seal interaction and is therefore discountable. Hooking and other fishing related effects would not be expected to result in the destruction or adverse modification of proposed or designated critical habitats.

Conclusion

Considering the information and assessments presented in the consultation request and available reports and information, and in the best scientific information available about the biology and expected behaviors of the ESA-listed marine species considered in this consultation, all effects of the proposed action are either discountable or insignificant. Accordingly, we concur with your determination that the proposed action is not likely to adversely affect the following ESA-listed species and designated and proposed critical habitats: endangered Main Hawaiian Island insular false killer whales; endangered Hawaiian monk seals; threatened Central North Pacific green turtles; endangered hawksbill turtles; threatened giant manta rays; designated critical habitat for Hawaiian monk seals; and proposed critical habitat Central North Pacific green turtles.

This concludes informal consultation under section 7 of the ESA for species under our jurisdiction. Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect essential fish habitat (EFH). If necessary, it is your responsibility to request EFH consultation for this action with NMFS' Habitat Conservation Division.

Reinitiation Notice

The reinitiation of consultation is required and shall be requested by DARPA where discretionary Federal involvement or control over the action has been retained or is authorized by law and if:

a. Take occurs to an ESA-listed species;
b. New information reveals effects of the action that may affect ESA-listed species or designated critical habitat in a manner or to an extent not previously considered;

c. The identified action is subsequently modified in a manner that causes an effect to ESA-listed species or designated critical habitat that was not considered in this concurrence; or
d. A new species is listed or a critical habitat is designated that may be affected by the identified action.

If you have further questions, please contact Joshua Rudolph at (808) 725-5147 or Joshua.rudolph@noaa.gov. Thank you for working with us to protect our nation's living marine resources.

Sincerely,

Dawn Golden

Dawn Golden
Assistant Regional Administrator
Protected Resources Division

NMFS File No.: PIRO-2025-02108
PIRO Reference No.: I-PI-25-2534-DG

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Appendix H Benthic Survey Report by Kuleana Coral Restoration

Benthic Survey Report – Rapid Resilient Reefs (R3D) Footprint
Kuleana Coral Restoration
Date of Survey: November 24, 2025
Location: R3D Project Footprint, Oʻahu, Hawaiʻi - (21.3068N; 158.116031W)
Introduction:
This report summarizes the results of benthic and reef fish belt transect surveys conducted within the R3D project footprint. The objective of this assessment was to characterize benthic substrate condition, coral community structure, and associated invertebrate and fish assemblages to inform the R3D project planners, and at the request of community partners Hoʻōla Hanio. Hoʻōla Hanio requested a more in depth biological assessment of the area.
Methods
Survey Design
Three **25 m × 1 m benthic belt transects** and three **25 m x 5 m reef fish belt transects** were conducted during the survey effort. Transects were positioned to evenly span the R3D project footprint and were oriented along headings of:

- **T1:** 300°
- **T2:** 120°
- **T3:** 30°

These orientations ensured representative sampling across the footprint's spatial extent.
Data Collection
For each transect, divers recorded:

- Coral species present
- Live coral colonies >10 cm in height
- Benthic cover characteristics, including algal composition
- Presence and abundance of key invertebrate taxa (urchins, sea cucumbers)

Fish belt transects (25 m × 5 m) were conducted immediately prior to benthic assessments to contextualize habitat condition.

Results

Overall Benthic Condition
Across all three transects, the benthic community was characterized by:

- **Low live coral cover (visual estimates <5%)**
- Primarily consolidated pavement with **high turf algae cover** and scattered **encrusting coral morphologies** with visible partial mortality
- Macroalgae clusters (*Halimeda*, *Padina*, *Martensia*, *Neomeris*, *Dictyosphaeria*) present throughout the site

Coral Community Structure
Live coral abundance was low across all transects. The majority of colonies were small (<10 cm) and exhibited encrusting growth forms. Coral species present and coral colonies >4 inches (10 cm) in height are summarized below (from SAP summary table)

Common Name	**Scientific Name**	**T1 Abundance of Colonies > 10cm**	**T2 Abundance of Colonies > 10cm**	**T3 Abundance of Colonies > 10cm**
Rice Coral	*Montipora capitata*			
Sandpaper Coral	*Montipora patula*			
Lobe Coral	*Porites lobata*	5	9	4
Brown Lobe Coral	*Porites evermanni*	1		
Finger Coral	*Porites compressa*	1		
Brigham's Coral	*Porites brighami*			
Lichen Coral	*Porites lichen*			
Stellar Coral	*Psammacora stellata*			
Cauliflower Coral	*Pocillopora meandrina*	11	8	18
Lace Coral	*Pocillopora damicornis*			

Coral colonies measured were consistent with visual assessments of sparse, patchy coral distribution across the site.

Algae Observations
Macroalgae abundance was low across transects. Turf algae was the predominant cover of the benthic habitat with small clusters of macroalgae summarized below across all transects:

Common Name	**Scientific Name**
Cactus Alga	*Halimeda spp.*
Peacock's Tail	*Padina spp.*
Martensia	*Martensia spp.*
Finger Algae	*Neomeris spp.*
Green Bubble Weed	*Dictyosphaeria spp.*

Urchin and Invertebrate Observations
High densities of ***Echinometra mathaei*** (rock-boring urchin) were observed on all transects, with counts exceeding **100 individuals** per transect. Additional urchin species were present in lower numbers:

- ***Diadema spp.*:** 1–6 individuals
- ***Tripneustes gratilla*:** 1 individual (T1)
- ***Echinothrix spp.*:** 1 individual (T3)

Common Name	**Scientific Name**	**T1 Abundance**	**T2 Abundance**	**T3 Abundance**
Collector Urchin	*Tripnuestes gratilla*		1	

Rock-boring Urchin	*Echinometra mathaei*	100+	100+	100+
Long-spined Urchin	*Diadema spp.*	2	1	6
Banded Urchin	*Echinothrix spp.*			1

A single ***Actinopyga varians*** (white-spotted sea cucumber) was observed on T1.

Reef Fish Community

Fish observations were dominated by **juvenile fishes (0–10 cm)** across all transects. Notable exceptions included:

- **1 × Christmas wrasse (*Thalassoma trilobatum*) ~20 cm** at T1
- **1 × spotted queenfish (*Scomberoides lysan*) ~40 cm** at T3

Fish species encountered during the survey are summarized below with the corresponding abundance of juveniles (0-10cm) counted per transect:

Common Name	**Scientific Name**	**T1**	**T2**	**T3**
Saddle Wrasse	*Thallasoma duperrey*	3	5	6
Belted Wrasse	*Stethojulis balteata*	1		1
Convict Tang	*Acanthurus triostegus*	1		
Brown Surgeonfish	*Acanthurus nigrofuscus*		1	2
Bright-eye Damselfish	*Plectroglyphidodon imparipennis*	3	8	5
Reef Triggerfish	*Rhinecanthus rectangulus*	1	1	
Whitemouth Moray	*Gymnothorax meleagris*		1	

Juvenile wrasses, damselfishes, and surgeonfishes were the most frequently encountered, with the highest counts in T2 and T3. These size classes and species compositions are typical of low-relief, algae-dominated reef habitats.

Discussion

The benthic community within the R3D project footprint is characterized by low live coral cover, high turf algal dominance, and very high densities of rock-boring urchins (*Echinometra mathaei*). Coral colonies were sparse, generally small, and patchily distributed, with *Porites lobata* and *Pocillopora meandrina* comprising most colonies greater than 10 cm in height. These patterns are consistent with a low-relief reef flat where bioerosion and algal growth are prominent features of the habitat.

The fish assemblage was dominated by juvenile size classes (0–10 cm) of common wrasses, damselfishes, and surgeonfishes, with relatively few larger individuals or higher-trophic-level species observed. This size structure and species composition are typical of algae-dominated, low-complexity habitats that provide limited structural refuge.

Taken together, the observations indicate a benthic environment with limited live coral framework, high urchin abundance, and a fish community skewed toward small, omnivorous and herbivorous reef fishes associated with turf-algal and pavement-dominated substrates.

Appendix I Draft Environmental Assessment Comments and Responses

Thanks Gen!

Mahalo and have a blessed day!

Aloha,
Damon

On Thu, Feb 5, 2026 at 1:34 PM Sullivan, Genevieve <genevieve.h.sullivan@hawaii.gov> wrote:

Aloha Damon,

Hope all is well. This email is to confirm that your comments below on the Draft EA were received and incorporated into the Final EA. Thank you very much for your guidance, participation, and partnership in the Kalaeloa Hybrid Reef Project.

Kind Regards,
Genevieve

Genevieve Hilliard Sullivan | W: 808.587.2169 | C: 808.927.7568 | genevieve.h.sullivan@hawaii.gov
Resilience Coordinator and Project Manager | Office of Energy Security and Community Outreach
Hawai'i Department of Transportation | 869 Punchbowl St. Rm 513 | Honolulu, HI 96813

From: Sullivan, Genevieve <genevieve.h.sullivan@hawaii.gov>
Sent: Thursday, February 5, 2026 1:27 PM
To: Arevalo, Marvin J <marvin.j.arevalo@hawaii.gov>
Subject: Re: Kalaeloa Hybrid Reef Draft EA Comment

Hi Marvin,

Thanks for your help incorporating Damon Duhaylonsod's comments on the Draft EA into both the Executive Summary (page 6) and Chapter 3 Affected Environment - Cultural Resources Section (page 20) of the Final EA.

Kind Regards,
Genevieve

From: Sullivan, Genevieve <genevieve.h.sullivan@hawaii.gov>
Sent: Thursday, January 22, 2026 5:26 PM
To: Arevalo, Marvin J <marvin.j.arevalo@hawaii.gov>
Subject: FW: Kalaeloa Hybrid Reef Draft EA

DEA comment below

From: Ben Jones <benjones@arl.hawaii.edu>
Date: Friday, January 16, 2026 at 3:16 PM
To: Sullivan, Genevieve <genevieve.h.sullivan@hawaii.gov>
Cc: Joshua Levy <levyjosh@arl.hawaii.edu>
Subject: [EXTERNAL] FW: Kalaeloa Hybrid Reef Draft EA

Hey Gen,

See below. Think we can make this small change to the FEA from Damon?

Aloha,
Ben

From: Ben Jones
Sent: Friday, January 16, 2026 3:16 PM
To: 'Damon' <damon-duhaylonsod@hawaii.rr.com>
Subject: RE: Kalaeloa Hybrid Reef Draft EA

Hey Damon,

Yes, this is a great idea. As we get started on the actual monitoring we should have plenty of opportunities to credit important ideas and work in the various reports and any publications that come out of this. I can also ask Gen to see if she can add that into the final EA when it is published. Let me check, but that should be an easy change. I agree that crediting members of the community and the community groups that are going to be so critical to this project is important.

Have a great long weekend!

Aloha,
Ben

From: Damon <duhaylonsod@gmail.com> **On Behalf Of** Damon
Sent: Friday, January 16, 2026 3:12 PM
To: Ben Jones <benjones@arl.hawaii.edu>
Subject: Re: Kalaeloa Hybrid Reef Draft EA

Caution: This is an unsigned external email. Please take care when clicking links or opening attachments. When in doubt, contact your IT Department

Would it be possible to credit: Damon Duhaylonsod, Po‘o Lawai‘a of Ho‘ola Hani‘o or Community Member, Damon Duhaylonsod, for the observance of the ‘ama‘ama habits? This is something I grew up understanding and don‘t want to minimize my observations without being properly credited. No one new this but myself, which I shared with Kuleana Coral and other people asking cultural questions.
As stated in the draft, “The most significant cultural concern centered around ‘ama‘ama…” (in the Executive Summary and elsewhere).

This is truth and something my dad and Ohana would be very proud of.

Mahalo,
Damon

> On Jan 13, 2026, at 5:38 PM, Ben Jones <benjones@arl.hawaii.edu> wrote:
>
> Aloha everyone,
>
> Just a quick update here.. the draft environmental assessment is available for public review through the Environmental Review Program portal. This went live just before Christmas and will be posted until 01/22/26. Link is here:
>
> https://files.hawaii.gov/dbedt/erp/Doc_Library/2025-12-23-OA-DEA-Kalaeloa-Hybrid-Reef-Project.pdf
>
> Happy new year!
> Ben

Outlook

Miscellaneous comments on the DEA

From Sullivan, Genevieve <genevieve.h.sullivan@hawaii.gov>
Date Thu 2/5/2026 1:17 PM
To Douglas Meller <douglasmeller@gmail.com>

Aloha Mr. Meller,

Thank you very much for your comments on the Kalaeloa Hybrid Reef Project. The Hawaii Department of Transportation (HDOT) / University of Hawaii (UH) project team appreciates your suggestions regarding additional recreational features. The Kalaeloa Hybrid Reef Project is primarily designed to provide shoreline stabilization, habitat enhancement, and coastal resilience, and the reef geometry and elevation were not developed to create a recreational surf break. Modifying the design to optimize surf conditions would require substantial engineering changes and additional environmental review beyond the scope of the proposed action.

Proposed night-time lighting is limited in purpose and scale, primarily to support safety and monitoring needs. Expanding submerged illumination to attract manta rays or increase nighttime recreation is not proposed, as increased artificial lighting could introduce potential ecological effects and regulatory considerations. The project team acknowledges community interest in recreational opportunities; however, the current design reflects a balance between coastal protection objectives, environmental stewardship, and permitting constraints.

Thanks again for your comments on the Kalaeloa Hybrid Reef Project Draft Environmental Assessment published on December 23, 2025, in the Environmental Notice.

Kind Regards,

Genevieve

Genevieve Hilliard Sullivan | W: 808.587.2169 | C: 808.927.7568 | genevieve.h.sullivan@hawaii.gov
Resilience Coordinator and Project Manager | Office of Energy Security and Community Outreach
Hawai'i Department of Transportation | 869 Punchbowl St. Rm 513 | Honolulu, HI 96813

From: Douglas Meller <douglasmeller@gmail.com>
Sent: Tuesday, December 23, 2025 9:19 PM
To: Sullivan, Genevieve <genevieve.h.sullivan@hawaii.gov>
Subject: [EXTERNAL] miscellaneous comments on the DEA

I assume that the "project team" is not interested in modifying either the proposed hybrid reef design or proposed night-time reef lighting to maximize potential public benefits. Nonetheless, I will point out that:

1. The proposed structure will be large and shallow enough that it could have been designed to create an artificial recreational surf site. Lots of Oahu residents would appreciate another surf site.

2. If proposed night-time reef lights attract plankton, then the plankton may attract manta rays. Adding more submerged illumination would allow snorkelers and scuba divers to observe manta rays. Just like they do offshore Kona.

Sent from my iPhone