He‘eia National Estuarine Research Reserve

Draft Environmental Impact Statement

NOAA Office for Coastal Management

August 23, 2016

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LIST OF ACRONYMS AND ABBREVIATIONS

ACE – Ashepoo-Combahee-Edisto
ACS – American Community Survey
AICUZ – Air Installations Compatible Use Zones
BMP – Best Management Practice
C-CAP – Coastal Change Analysis Program
C&CH – City and County of Honolulu
CDD – Community Development District
CDUP – Conservation District Use Permit
CEQ – Council on Environmental Quality
CIA – Cultural Impact Assessment
CMP – Coastal Zone Management Program
CZMA – Coastal Zone Management Act
DAR – Division of Aquatic Resources
DBEDT – Department of Business, Economic Development, and Tourism
DEIS – Draft Environmental Impact Statement
DHHL – Department of Hawaiian Home Lands

DLNR – Department of Land and Natural Resources
DMP – Draft Management Plan
DNL – Day-Night Average Sound Level
DOBOR – Division of Boating and Ocean Recreation
DOC – Department of Commerce
DOFAW – Division of Forestry and Wildlife
DOH – Department of Health
EA – Environmental Assessment
EFH – Essential Fish Habitat
EIS – Environmental Impact Statement
ENOW – Economics: National Ocean Watch
ESA – Endangered Species Act
FEMA – Federal Emergency Management Agency
HAPC – Habitat Areas of Particular Concern
H.A.R. – Hawai'i Administrative Rules
HCDA – Hawai'i Community Development Authority
HIMB – Hawai'i Institute of Marine Biology
HRS – Hawai'i Revised Statute
IPaC – Information for Planning and Conservation
IPCC –Intergovernmental Panel on Climate Change
KEEP – K-12 Estuary Education Program
MCBH – Marine Corps Base Hawai'i
MMPA – Marine Mammal Protection Act
MOA – Memorandum of Agreement
MPA – Marine Protected Area
MSD – Marine Sanitation Device
MUS – Management Unit Species
NAAQS – National Ambient Air Quality Standards
NCCOS – National Centers for Coastal Ocean Science
NEPA – National Environmental Policy Act
NERR – National Estuarine Research Reserve
NERRS – National Estuarine Research Reserve System
NFIP – National Flood Insurance Program
NHPA – National Historic Preservation Act
NMFS – National Marine Fisheries Service
NMSA – National Marine Sanctuaries Act
NOAA – National Oceanic and Atmospheric Administration
NRCS – Natural Resources Conservation Service
OCM – Office for Coastal Management
OHA – Office of Hawaiian Affairs
OP – Office of Planning

PCB – Polychlorinated Biphenyls
RAB – Reserve Advisory Board
SCP – Sustainable Communities Plan
SHPD – State Historic Preservation Division
SMA – Special Management Area
SWMP – System-Wide Monitoring Program
TMDL – Total Maximum Daily Load
TN – Total Nitrogen
TOTE – Teachers on the Estuary
TRI – Toxic Release Inventory
USACE – United States Army Corps of Engineers
USDA – United States Department of Agriculture
USEPA – United States Environmental Protection Agency
USFWS – United States Fish and Wildlife Service
USMC – United States Marine Corps
ZCTA – Zip Code Tabulated Area

EXECUTIVE SUMMARY

The proposed federal action considered by the National Oceanic and Atmospheric Administration (NOAA) under this environmental review is the designation of the nation's 29th research reserve. This action would take the form of a formal designation by the NOAA Administrator and joint declaration by the NOAA Administrator and the Governor of Hawai'i.

On May 21, 2014, Hawai'i Governor Neil Abercrombie submitted a nomination to NOAA for the designation of a portion of the Kāne'ohe Bay estuary on the island of O'ahu as the He'eia National Estuarine Research Reserve (nominated site). The State of Hawai'i has proposed that the Hawai'i Institute of Marine Biology serve as the lead state agency for the proposed He'eia research reserve. As such, NOAA's proposed action would be consistent with the recommendation from the State of Hawai'i.

The National Estuarine Research Reserve System is a partnership program between NOAA and coastal states that protects more than 1.3 million acres of coastal and estuarine habitat. Established by the Coastal Zone Management Act (CZMA) in 1972, NOAA provides funding, national guidance, and technical assistance for the research reserves, while a state partner manages each site on a daily basis with input from local partners. The reserve system protects estuarine areas, provides educational opportunities, facilitates research and monitoring, and facilitates the transfer of relevant information to coastal communities.

Representing different estuarine types and biogeographic regions, there are currently 28 reserves in 22 states and one territory. The focus is on research and education. The goals as identified in the system's strategic plan are provided here:

- Estuaries and coastal watersheds are better protected and managed by implementing place-based approaches at reserves;
- National Estuarine Research Reserve System scientific investigations improve understanding and inform decisions affecting estuaries and coastal watersheds; and,
- National Estuarine Research Reserve System education and training increases participants' environmental literacy and ability to make science-based decisions related to estuaries and coastal watersheds.

An analysis of the nominated site and other alternatives has identified a preferred site alternative that represents an expansion of the nominated site boundary. This alternative is described below.

The He'eia estuary is located within the Kāne'ohe Bay region on the windward side of O'ahu and is the largest sheltered body of water within the main Hawaiian Islands. Unique within the reserve system, the proposed He'eia Reserve would represent the only reserve within the Hawaiian Islands and the insular biogeographic region. The native flora and fauna, rich cultural traditions and practices, historical attributes, diverse habitats, and existing and potential future

impacts of multiple coastal stressors come together to create a compelling addition to the National Estuarine Research Reserve System.

The proposed site encompasses 1,385 acres of coastal habitats including uplands (i.e., grasslands and shrublands), wetlands (i.e., streams, ponds, and freshwater and estuarine wetlands), and marine habitats (i.e., patch reefs, sandy bottoms, and seagrass beds). The four main components are profiled below:

- Upland areas (437 acres) fall within the Hawai‘i Community Development Authority parcel in He‘eia, as well as He‘eia State Park. The development authority parcel lands are a mix of wetlands and forested land. Proposed activities within this parcel would include demonstration lo‘i kalo (taro patches) cultivation and aquaponics. He‘eia State Park protects historic and cultural sites and provides public access and recreational opportunities.
- Marine areas (822 acres), the largest component of the proposed reserve, are managed by the State of Hawai‘i, Department of Land and Natural Resources, and are composed primarily of patch and fringing coral reefs and sand flats.
- He‘eia Fishpond (88 acres) is owned by the Kamehameha Schools and is a pre-existing use in the area being restored to promote food security and education through traditional aquaculture.
- Moku o Lo‘e (Coconut Island – 28 acres) is owned by the University of Hawai‘i Foundation and operated by the University of Hawai‘i as a research lab under the Hawai‘i Institute of Marine Biology. The Hawai‘i Marine Laboratory Refuge surrounds the island and is the most protected habitat within the proposed reserve.

The reserve would be administered by the Hawai‘i Institute of Marine Biology, designated the lead administrative agency by the State of Hawai‘i for the proposed reserve. The Institute would be supported by additional state, local, and Native Hawaiian Organizations, plus partners including the State of Hawai‘i Office of Planning, Hawai‘i Department of Land and Natural Resources, Kāko‘o ‘Ōiwi, Paepae o He‘eia, Ko‘olaupoko Hawaiian Civic Club, Kama’aina Kids, and Ko‘olau Foundation. (Additional information regarding administration and management of the proposed He‘eia Reserve can be found in the proposed He‘eia National Research Reserve Management Plan found in Appendix A. The plan includes information about goals and objectives; administration; boundaries and acquisition; facilities and construction; public access; resource protection, and restoration and manipulation; as well as an orientation to the reserve and its unique historical land tenure system.)

In addition to the proposed He‘eia research reserve, this document analyzes several alternatives within Kāne‘ohe Bay, including a “no action” alternative. Under the no action alternative, the lands within the proposed research reserve boundary would continue to be managed separately by the various landowners and their lessees where applicable; however, no additional Coastal Zone Management Act Section 315 federal funds, including grants, would be awarded to manage these lands and waters or to conduct research and education programs. Although these lands would continue to be protected and managed, they would be managed in

accordance with the different resources and priorities of the respective landowning entities and lessees.

The proposed designation action would provide a more coordinated approach to management that encourages reserve partners to create a management structure that fosters collaboration among the landholding entities and other interested parties to work toward common goals for research, education, and resource stewardship.

Designation of a He‘eia research reserve does not alter existing state or federal regulations and authorities of the resource agencies and landowners within the proposed He‘eia research reserve. However, as a reserve, certain activities that are inconsistent with the reserve program or applicable National Estuarine Research Reserve System regulations may not be implemented as part of the NOAA-approved management plan.

Native Hawaiian Organizations were involved throughout the reserve development and designation process, including scoping and management plan development. These entities would continue to be engaged through public review of the management plan. If a research reserve is designated here, these entities would be among the community members that benefit from the reserve.

As discussed throughout this document, the proposed designation of a He‘eia research reserve within the Kāne‘ohe Bay area of O‘ahu and the implementation of the proposed management plan would be expected to provide environmental, social, and economic benefits to the region. An improved understanding of Hawaiian Island estuaries and the traditional ahupua‘a system of resource management would be enhanced by linking research and educational efforts, natural and cultural resources, and people. It is expected that physical alterations and impacts would be restricted to limited areas and associated with the construction of facilities supporting research and education activities and public access sites associated with future growth and potential acquisition. Environmental reviews would be conducted for individual facilities development and land acquisition projects.

Overall, it is expected that the natural resources found within the proposed reserve would benefit from coordinated and integrated conservation and management, and the reserve would serve surrounding communities by improving public understanding of Hawaiian estuaries, their benefits, and needs for stewardship.

CHAPTER 1: NATIONAL CONTEXT

Estuaries provide a vast array of resources and services to people. An estuary is an ecosystem, comprising both the biological and physical environment, that has developed in a region where rivers meet the sea and fresh-flowing river water mingles with tidal salt water to become brackish, or partly salty. The transport of sediments and nutrients at the interface between the land and water supports a diverse array of habitats and species. Providing food, fresh water, habitat, flood regulation, nutrients, recreational opportunities, soils, aesthetics and other values, estuaries have long been a focal point of human activity. As a consequence, they have been heavily exploited throughout our history for natural resources, commerce, tourism and a host of other purposes. Within the Hawaiian Islands, the ahupua'a system[1] has traditionally been used to manage natural resources, using local knowledge and community-based efforts to make collective decisions for the benefit of individuals, society, and future generations (Blane et al. 2000).

Nationally, 52% of the U.S. population resides within coastal watershed counties (NOAA, 2016). Population and development pressures on our coasts and estuaries as well as economic activities have subjected these areas to continuous degradation. As compared to other regions of the United States, estuaries within the Hawaiian Islands are relatively small in size, but still ecologically significant components of the state's coastal resources, providing direct benefits to fisheries, tourism, and recreation. The United States Environmental Protection Agency (USEPA) National Coastal Conditions Report notes that changing land uses, such as reduction of land used for agriculture and increases in residential and commercial development, may be altering the magnitude and types of stressors impacting estuaries and coastal areas of Hawai'i (USEPA, 2012). Within the Hawaiian Islands, O'ahu has both the largest population and highest population density, which can influence the alteration of natural estuarine systems.

1.1 The Coastal Zone Management Act

In 1972, Congress passed the National Coastal Zone Management Act (P.L. 92-583, as amended, hereinafter the "act" or "CZMA"). Congress recognized the significance of coastal resources and the importance of these resources to the national, regional and local economies. The act further recognized the interrelationships between the land, water, and transitional areas between them. These relationships are reflected in the act's 1996 reauthorization, which referenced the increasing and competing demands upon the lands and waters of our coastal zone, which have resulted in the loss of living marine resources, wildlife, and nutrient-rich areas; permanent and adverse changes to ecological systems; decreased open space; and shoreline erosion (16 U.S.C. § 1451(c)). The reauthorization further notes that the habitat areas of the coastal zone, along with the fish, shellfish, other living marine resources, and wildlife therein, are ecologically fragile and consequently extremely vulnerable to destruction due to alternations by humans (16 U.S.C. § 1451(d)). In recognition of these issues, the act established a national policy to preserve, protect, develop, and, where possible, to restore and enhance the resources

[1] Refer to the Preamble to the He'eia NERR Management Plan, Appendix A

of the Nation's coastal zone for this and succeeding generations (16 U.S.C. § 1452(1)). The act supports coastal states, territories and local governments in developing tools and programs to improve their management capabilities in the rapidly developing coastal zone, to help protect, preserve, develop and restore fragile natural resources such as the bays and estuaries, beaches, dunes and wetlands, as well as the flora and fauna that are dependent on those habitats. Congress also recognized that scientific knowledge of our coastal zone was often limited. However, local decision-makers, developers and the public need to understand how the coastal ecosystems work and the consequences associated with development activities on these systems. To improve our understanding of these ecosystems and support coastal management, Congress provided an additional incentive in the act with the establishment of the National Estuarine Research Reserve System (hereafter "reserve system") (16 U.S.C. § 1461) as amended in the Coastal Zone Management Reauthorization Act of 1985. *See* Public Law 99-272, 100 STAT. 82. The reserve system provides states and territories (hereafter, states) opportunities to seek answers to important questions about our nation's estuaries through a network of protected areas.

1.1.1 The National Estuarine Research Reserve System

The mission of the National Estuarine Research Reserve System (NERRS) is stated in its implementing regulations (15 C.F.R. § 921.1) as the following: the establishment and management, through federal-state cooperation, of a national system of Estuarine Research Reserves representative of the various regions and estuarine types in the United States. Pursuant to these implementing regulations, habitats within healthy estuaries that typify different estuarine types within the U.S. can be designated as a system reserve. Reserves are operated for long-term research and monitoring, estuarine education, training, and interpretation. The national system provides a framework to conduct research; monitor estuarine health and conditions; model restoration techniques; and disseminate information for estuarine education, interpretation or decision-maker training.

1.1.2 National Estuarine Research Reserve System Administrative Framework

The NERRS is a partnership program between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states. NOAA provides funding, national guidance, and technical assistance through the Office for Coastal Management (OCM). OCM plays four important roles in operating the reserve system. First, it supports the NOAA Administrator's review and approval in the designation of individual reserves. Second, it disburses and oversees expenditures of federal funds for research, monitoring, education, land acquisition, facilities construction, and operation of reserves, as well as for the development of future reserves. Third, it coordinates and provides policy guidance for the system. Finally, as required by federal law, OCM periodically evaluates the operation of research reserves for compliance with applicable federal requirements and with a reserve's approved five-year management plan. OCM's Stewardship Division has day-to-day responsibility for the implementation of the system. Each research reserve is managed on a daily basis by a lead state agency or university, with input from local partners.

Through integrated research and education, the reserves help communities develop strategies to deal successfully with coastal resource issues. Reserves provide adult audiences with training on estuarine issues of concern in their local communities. They offer field experiences for K-12 students and support teachers through professional development programs that focus on the ecological, cultural, and historical aspects of the estuary. Reserves also provide long-term water quality and habitat monitoring, as well as opportunities for both scientists and graduate students to conduct research in a "living laboratory."

1.1.3 National Estuarine Research Reserve System Biogeographic Regions

In the more than 40 years since Section 315 of the Act established the NERRS, the system has grown into a national network of 28 protected estuaries that serve as reference sites for research, education and stewardship. Reserves represent different biogeographic regions of the United States. A biogeographic region is defined by a geographic area with similar dominant plants, animals and prevailing climate. Regions are classified by ecosystem type (e.g., maritime forest, coastal mangroves) and physical characteristics (i.e., geologic, chemical, or hydrographic). As depicted in Figure 1.1, there are 11 major biogeographic regions around the coast, with 29 subregions. The reserve system currently represents nine of the major biogeographic regions and 20 of those subregions and is designed to include sites representing all 29 biogeographic subregions (Table 1.1). In the near term, priority for federal designation of new NERRS sites is given to coastal states that are in unrepresented biogeographic regions.

1.2 A Potential He'eia National Estuarine Research Reserve as Part of a Network of Reserves

The State of Hawai'i proposed the He'eia National Estuarine Research Reserve (He'eia Research Reserve, or He'eia NERR) on May 21, 2014. The Hawai'i Institute of Marine Biology (HIMB) has been identified as the lead state agency[2] for the proposed reserve. Operating under a proposed five-year management plan (Attachment A), reserve staff would work with resource managers, Native Hawaiian groups, local communities and regional groups to address natural resource management issues, such as nonpoint source pollution, toxics contamination, habitat restoration, climate change, and invasive species.

Under the preferred alternative described below, the proposed He'eia Research Reserve would include 1,385 acres of wetlands, marine waters, and upland areas in the He'eia estuary, becoming the only National Estuarine Research Reserve within the insular biogeographic region and the 29th in the nation. The table below (Table 1.2) shows the other reserve sites along with their year of designation and area. In total, the system represents a wide diversity of coastal ecosystems and physical characteristics found within the United States. The proposed He'eia

[2] Per 15 C.F.R. 921.2(d), State agency means an instrumentality of a coastal state to whom the coastal state has delegated the authority and responsibility for the creation and/or management/operation of a National Estuarine Research Reserve. Factors indicative of this authority may include the power to receive and expend funds on behalf of the Reserve, acquire and sell or convey real and personal property interests, adopt rules for the protection of the Reserve, enforce rules applicable to the Reserve, or develop and implement research and education programs for the reserve. HIMB is part of the University of Hawai'i System, a public (state) institution of higher learning.

NERR site would represent a significant addition to the reserve system by increasing its biogeographic representation and adding new resources and capabilities to the national system.

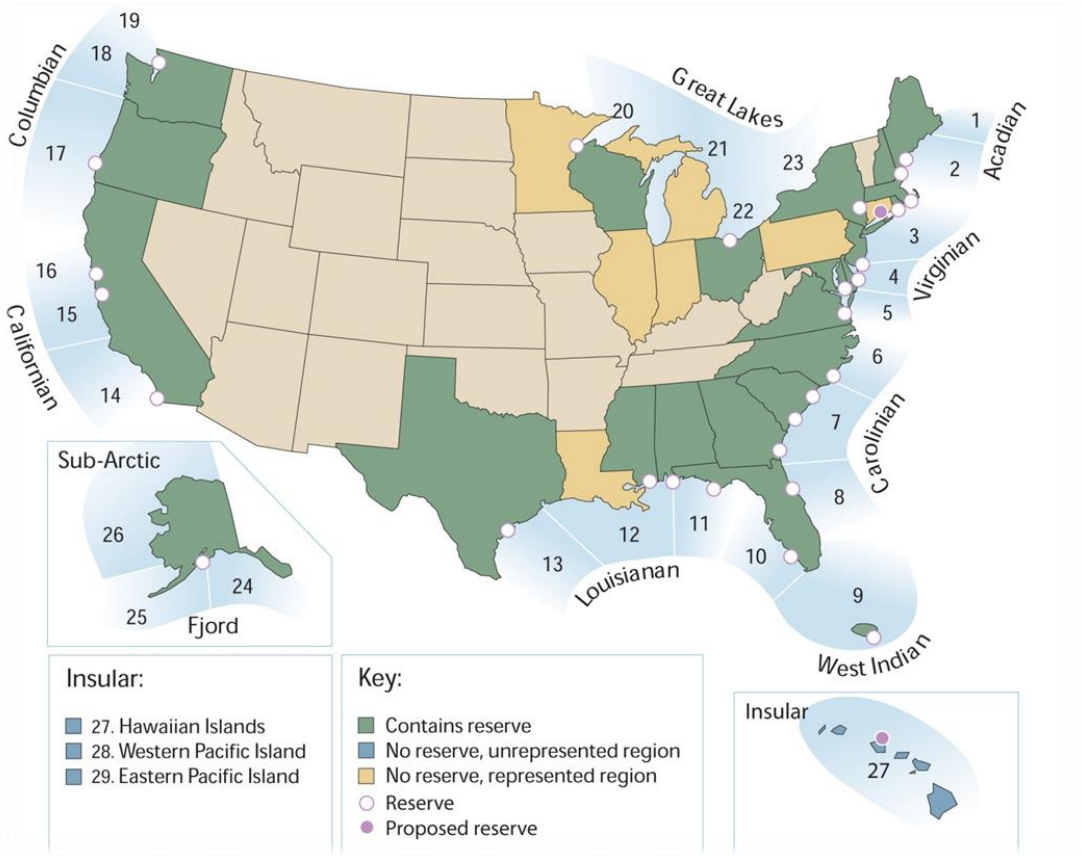


Figure 1.1 – Map of biogeographic regions of the United States and National Estuarine Research Reserves

Table 1.1 – Biogeographic regions and subregions of the National Estuarine Research Reserve System

1. Acadian – Northern Gulf of Maine*	16. Californian – San Francisco Bay
2. Acadian – Southern Gulf of Maine	17. Columbian – Middle Pacific
3. Virginian – Southern New England	18. Columbian – Washington Coast*
4. Virginian – Middle Atlantic	19. Columbian – Puget Sound
5.Virginian – Chesapeake Bay	20. Great Lakes – Lake Superior
6.Carolinian – North Carolina	21. Great Lakes – Lakes Michigan and Huron *
7.Carolinian – South Atlantic	22. Great Lakes – Lake Erie
8.Carolinian – East Florida	23. Great Lakes – Lake Ontario *

9.West Indian – Caribbean	24. Fjord – Southern Alaska *
10.West Indian – West Florida	25. Fjord – Aleutian Islands
11. Louisianan – Panhandle Coast	26. Sub-Arctic – Northern Alaska *
12. Louisianan – Mississippi Delta	27. Insular – Hawaiian Islands*[3]
13. Louisianan – Western Gulf	28. Insular – Western Pacific Island *
14. Californian – Southern California	29. Insular – Eastern Pacific Island *
15. Californian – Central California	

*No reserve

Note: biogeographic regions and subregions based on classification scheme described in Appendix I to 15 C.F.R. 921

Table 1.2 – Reserve designation dates (year), area, and biogeographic region

Reserve	Year	Acres	Square miles	Square kilometers	Region
South Slough, OR	1974	4,771	7.5	19.3	Columbian (17)
Sapelo Island, GA	1976	6,110	9.5	24.7	Carolinian (7)
Rookery Bay, FL	1978	110,000	171.9	445.2	West Indian (10)
Apalachicola Bay, FL	1979	234,715	366.7	949.9	Louisianian (11)
Elkhorn Slough, CA	1979	1,439	2.2	5.8	Californian (15)
Padilla Bay, WA	1980	12,100	18.9	49.0	Columbian (19)
Narragansett Bay, RI	1980	4,259	6.7	17.2	Virginian (3)
Old Woman Creek, OH	1980	573	0.9	2.3	Great Lakes (22)
Jobos Bay, PR	1981	2,883	4.5	11.7	West Indian (9)
Tijuana River, CA	1982	2,293	3.6	9.3	Californian (14)
Hudson River, NY (4	1982	4,838	7.6	19.6	Virginian (3)

[3] The Waimanu Valley on the windward coast of Hawai'i Island was designated as a National Estuarine Research Reserve in 1978 but the site was de-designated in 1993. Presently, there is no designated National Estuarine Research Reserve within the Insular biogeographic region.

components)					
North Carolina (4 components)	1985 1991	10,568	16.5	42.8	Carolinian (6)
Wells, ME	1986	2,250	3.5	9.1	Acadian (2)
Chesapeake Bay, MD (3 components)	1985 1990	6,249	9.8	25.3	Virginian (5)
Weeks Bay, AL	1986	6,525	10.2	26.4	Louisianian (11)
Waquoit Bay, MA	1988	2,804	4.4	11.3	Virginian (3)
Great Bay, NH	1989	10,235	16.0	41.4	Acadian (2)
Chesapeake Bay, VA (4 components)	1991	3,072	4.8	12.4	Virginian (5)
Ashepoo-Combahee-Edisto (ACE) Basin, SC	1992	99,308	155.2	401.9	Carolinian (7)
North Inlet Winyah Bay, SC	1992	18,916	29.6	76.6	Carolinian (7)
Delaware	1993	6,206	9.7	25.1	Virginian (4)
Jacques Cousteau, NJ	1998	114,873	179.5	464.9	Virginian (4)
Kachemak Bay, AK	1999	371,950	581.2	1,505.2	Fjord (25)
Grand Bay, MS	1999	18,049	28.2	73.0	Louisianian (12)
Guana Tolomato Matanzas (GTM), FL	1999	73,352	114.6	296.8	Carolinian (8)
San Francisco Bay, CA	2003	3,710	5.8	15.0	Californian (16)
Mission-Aransas, TX	2006	185,708	290.2	751.1	Louisianian (13)
Lake Superior, WI	2010	16,697	26.1	67.6	Great Lakes (20)
*He‘eia, HI	Proposed 2016	1,385	2.2	5.6	Insular (27)
*Connecticut, CT	TBD	TBD	TBD	TBD	Virginian (3)

Total		1,335,839	2,088	5,406	

* Proposed reserve

CHAPTER 2: PURPOSE OF AND NEED FOR ACTION

2.1 Purpose of Proposed Action

The purpose of the action is to designate a National Estuarine Research Reserve (hereafter "research reserve") in Hawai'i as the 29th reserve in the National Estuarine Research Reserve System (hereafter "reserve system") within portions of the He'eia estuary and adjacent Kāne'ohe Bay waters. As required by 15 C.F.R. § 921.20, the proposed action will also include the National Oceanic and Atmospheric Administration's (NOAA) approval of a management plan developed by the state, provided the plan meets the required elements described in the applicable reserve system regulations. If all requirements of the process are met and there is a designation of the proposed He'eia NERR, the state and NOAA will partner in the operation and management of the reserve in accordance with 15 C.F.R. § 921.32. Therefore, the purpose of the proposed action includes both the designation of the proposed reserve, including NOAA approval of the He'eia National Estuarine Resarch Reserve Draft Management Plan (DMP), and the subsequent implementation of plan management elements resulting from a NERR designation.

The proposed reserve will involve the cooperation and interaction of a unique combination of federal, state, local and private partners. In this instance federal-state and state-community partnerships have been developed to support the enhancement of representative natural habitats and to collaborate on operations and management plans that will increase our understanding, awareness and stewardship of the resources. These partnerships assure benefits that can be enjoyed by the people of Hawai'i and visitors to the area, including across environmental, economic, and social domains.

As part of the national system of estuarine research sites, each reserve is part of the reserve system long-term water quality, biotic, and land use and habitat change monitoring programs that represents an unprecedented effort to compare data across a network of sites. The ability to leverage the long-term data-sets of the national network would be especially relevant at a new research reserve estuarine representative of the Hawaiian Islands and the insular biogeographic region. Some additional benefits of a becoming a new research reserve include opportunities to:

- Establish baseline data for environmental conditions, species (both endemic and not), and archaeological resources at the site.

- Create a research program that examines how different ecosystem-based management strategies contribute to a healthy and sustainable estuarine ecosystem in the face of ongoing anthropogenic impacts, and human use demands.

- Integrate traditional cultural knowledge and practices with contemporary science and research to sustainably manage resources in the vicinity of the reserve site.

- Increase understanding of natural and anthropogenic processes, restoration efforts and their impacts to the estuary, and key ecosystem services.

- Inform resource management decisions enabling local communities to effectively address key coastal issues like climate change, habitat restoration, and water quality.

2.2 Need for Proposed Action

The need for the proposed action is to fill a currently unrepresented gap in the national system identified as the Insular biogeographic region and Hawaiian Islands sub-region. The Insular bioregion is comprised of three subregions: the Hawaiian Islands, the Western Pacific Islands, and the Eastern Pacific Islands. With the designation of a reserve in Hawai‘i, the system would have a tenth region (of eleven total regions) and a twenty-first sub-region (of 29 total subregions) represented. The proposed He‘eia Research Reserve would further the national goal to ensure that the system reflects the wide range of estuarine types within the United States. It would also represent a significant addition to the National Estuarine Research Reserve System (NERRS) because of its unique estuarine type that, since 1996, has not been represented in the system.

In evaluating potential designation of a new reserve in Hawai‘i, NOAA is also acting upon the nomination of a site by former Governor Neil Abercrombie of Hawai‘i for inclusion within the national system. Given the site nomination submitted by Hawai‘i, careful consideration of existing land uses and community support was integral to selecting alternatives that would enable the creation of a successful research reserve in this biogeographic region. For the national system, a successful site designation takes into account the area’s ecological characteristics; its value for long-term research and monitoring; how well natural resources and habitats are protected; suitability for education, training and outreach; and local management considerations.

A new research reserve would coordinate existing, and establish new, research, education, and management programs to address coastal management issues within the state. Its designation would also further the national goal to ensure that the system reflects the wide range of estuarine types within the United States. A new reserve would also use existing authorities to ensure a stable environment for long-term research and provide a coordination and oversight mechanism for achieving reserve goals.

Key considerations with respect to establishing a research reserve include its long- term viability, its ability to promote collaboration among entities conducting research in the area, and the availability of facilities (e.g., laboratories, dormitory space, monitoring infrastructure).

As described within the research and monitoring program within the DMP, the proposed He‘eia NERR presents an opportunity to contribute to an ongoing debate about ecosystem-based management best management practices through research activities which are expected to contribute to the coastal management needs of the state of Hawai‘i and other Pacific Island systems. The proposed He‘eia NERR seeks to provide a unique perspective on how different ecosystem-based management strategies influence a broad array of ecosystem services that contribute to a healthy and sustainable estuarine ecosystem in the face of ongoing anthropogenic impacts, and human use demands. The reserve plans to examine the ecosystem services provided by two management strategies:

(1) an approach based on contemporary ecological restoration techniques to increase native species biodiversity, ecological resilience, and ecosystem integrity; and
(2) an approach that embraces traditional Native Hawaiian management practices to return the ecosystem to a state that was realized within the traditional ahupuaʻa system.
Both strategies seek to integrate the concerns of the environment, society, economy, and human institutions, but focus on different aspects of each (Heʻeia NERR DMP, 2016).

Establishment of a Research Reserve in Hawaiʻi would allow for the development of interpretive and educational programs that would be attractive to local and state-wide school systems. Schools of all levels (K-12, colleges and universities) would be encouraged to use existing education facilities at the reserve site for educational programs (Heʻeia NERR DMP, 2016); participate in wetlands or marine field experiences; and help restore native habitats, species and traditional Hawaiian agricultural and fishing sites managed by local community partners.

In addition there is a strong potential for the development of water-based investigations (e.g., boat or canoe tours through the site) with a new Heʻeia NERR through which ocean literacy and traditional ecological knowledge could be incorporated with research. Local schools could be encouraged to use reserve facilities, habitats, and restoration landscapes as sites for long-term monitoring and ecological studies that can be coordinated with Heʻeia NERR educational programs. Schools could, for example, work with local partners and the reserve to assist with restoration efforts, and that students could revisit the site(s) throughout the academic year. Students could participate in making observations about the environment, collecting water quality data, learning about traditional knowledge, and applying their training to impact resource stewardship.

CHAPTER 3: STATE CONTEXT

3.1 He‘eia NERR Site Selection and Nomination Process and History

Based on former Hawai‘i Governor Neil Abercrombie’s site nomination and further recommendations from the Hawai‘i Institute of Marine Biology, acting as the lead state agency, the National Oceanic and Atmospheric Administration (NOAA) proposes that a National Estuarine Research Reserve (hereafter “research reserve” or “He‘eia NERR”) be established at the He‘eia estuary and include portions of Kāne‘ohe Bay on O‘ahu in the Hawaiian Islands. A nomination proposal for the establishment of this research reserve was submitted by the State of Hawai‘i and approved by NOAA in 2014. NOAA is following the procedures for nominating and designating a research reserve in accordance with the established regulations 15 CFR Part 921 – National Estuarine Research Reserve System Regulations.

At the outset, former Governor Abercrombie identified the State of Hawai‘i Office of Planning as the lead agency in the site selection phase, with University of Hawai‘i becoming the lead state agency to coordinate the management of He‘eia NERR upon designation. The Hawai‘i Coastal Zone Management Program, located within the Hawai‘i Office of Planning, created a three phased site selection approach (Figure 3.1), culminating with the development of a reserve management plan and support for NOAA’s environmental compliance review. Phase I involved developing site selection criteria; forming site selection and site evaluation committees; managing a public solicitation for proposed sites; examining and analyzing proposed sites; and forwarding a short list of potential sites to support Phase II. During Phase II, a preferred site was selected from the short list of proposed sites; public meetings in the vicinity of the preferred site were held to solicit public feedback and to educate local communities, stakeholders, and individuals about the reserve system and the site; and a proposed site was forwarded to the Governor for nomination. The final phase of the process involved working with site partners with input from the broader community to develop a site management plan and to support the environmental review required under National Environmental Policy Act (NEPA).

Beginning in February 2013, Hawai‘i Office of Planning (OP) initiated Phase I by developing selection criteria. The criteria were used to support an online solicitation seeking proposals for reserve sites from educational or research institutions, community organizations, and the public. Two calls for proposals took place between April and June 2013. Several inquiries from agencies and community groups were made via phone and email to the Hawai‘i Coastal Zone Management Program during the solicitation periods resulting in two formal proposal submissions. These were identified as the He‘eia estuary in Kāne‘ohe Bay on the island of O‘ahu and Hilo Bay on Hawai‘i Island.

Following the submission of the proposed sites, the Hawai‘i OP, with contractor support, coordinated two committees—the Site Evaluation Committee and the Site Selection Committee—and managed the process on behalf of the state.

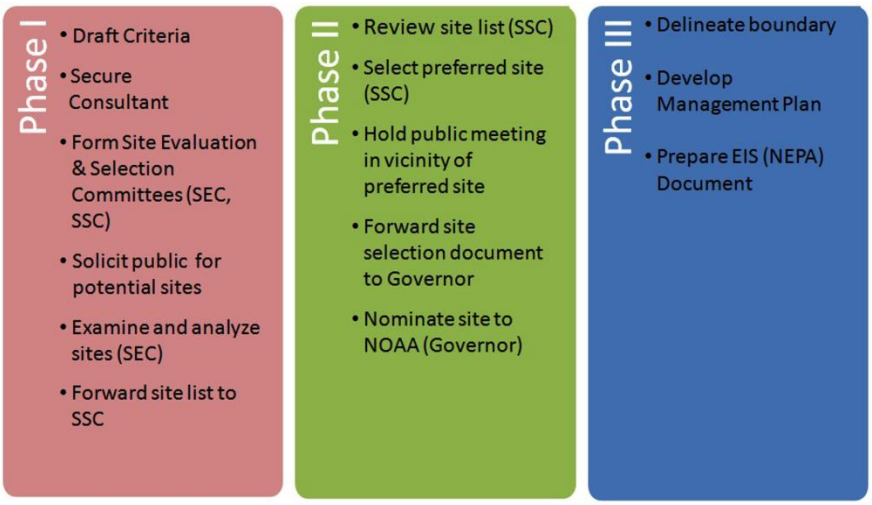


Figure 3.1. Hawai‘i National Estuarine Research Reserve site selection process (from Hawai‘i NERR Site Nomination Document May 2014)

Site Evaluation Committee

The Site Evaluation Committee consisted of representatives from nine agencies and organizations who were charged with evaluating submitted proposals against specific selection criteria approved by NOAA and the Site Selection Committee. The Site Evaluation Committee provided local expertise and advice on the technical aspects of the site selection process. Members reviewed the site selection criteria and evaluated the proposed estuary sites in Hawai‘i using the criteria. Each of the Site Evaluation Committee’s member organizations were invited based on their technical expertise and/or local knowledge of Hawaiian estuaries.

Site Evaluation Committee Representatives included:

- County of Kaua‘i
- County of Hawai‘i
- Marine and Coastal Zone Advisory Council
- National Oceanic and Atmospheric Administration
- Office of Hawaiian Affairs
- State of Hawai‘i Department of Health
- State of Hawai‘i Department of Natural Resources – Division of Aquatic Resources
- University of Hawai‘i Mānoa
- U.S. Fish and Wildlife Service

Site Selection Committee

The Site Selection Committee consisted of representatives from eight agencies and organizations who were charged with reviewing and approving the site selection criteria developed by a Hawai‘i Coastal Zone Management Program-led group of technical experts. Another role of the Site Selection Committee was to ensure that the National Estuarine Research Rerserve site selection process was consistent with regulatory requirements, and involved both the public and partner organizations. The Site Selection Committee was also responsible for selecting a preferred site for the Governor to consider for nomination to NOAA.

Site Selection Committee Representatives included:

- City and County of Honolulu
- County of Kaua‘i
- County of Hawai‘i
- County of Maui
- Marine and Coastal Zone Advisory Council
- National Oceanic and Atmospheric Administration
- State of Hawai‘i Department of Natural Resources – Division of Aquatic Resources
- University of Hawai‘i Mānoa

The Site Evaluation Committee evaluated both site proposals using the approved selection criteria and found both to be strong candidate sites. As a result, both site proposals were forwarded to the Site Selection Committee for consideration under Phase II. The final selection of the He‘eia estuary by the Site Selection Committee was based on the compiled site scores of the approved site selection criteria, updated site information and presentations by the proposal authors.

3.2 He‘eia: The Proposed Site

The proposed He‘eia NERR site as defined in this document consists of multiple habitat types generally categorized as upland, coastal and oceanic areas (Figure 3.2 and Table 3.1) found in Kāne‘ohe Bay, on the northeastern or windward shore of the island of O‘ahu (PBR 2014). In accordance with the National Estuarine Research Reserve System Habitat and Land Cover Classification Scheme (Kutcher 2008), these habitats are described as marine, estuarine, palustrine, upland, and cultural habitats. The site includes 822 acres of marine intertidal and subtidal habitats, including seagrass, sand, mud, patch and fringing reefs. Just outside the proposed boundary is the only barrier reef in US waters (PBR 2014). The barrier reef has a major influence on bay circulation, and the relatively large freshwater inputs from numerous streams have created diverse marine habitats.

A significant portion of the wetland and terrestrial areas within the proposed He‘eia NERR sire are identified as areas managed for traditional agricultural or fisheries uses. This includes one of the largest fishponds in the Hawaiian Archipelago (88 acres) at its estuarine border. A large taro cultivation site (~180 acres) and a native wetland restoration (~40 acres) upland of the fishpond

are currently being implemented or planned that are anticipated to support ecological functions of the watershed. The site's estuarine waters from the He'eia Stream are directly influenced by runoff from the surrounding watershed as well as by the exchange of seawater from the ocean (PBR 2014).

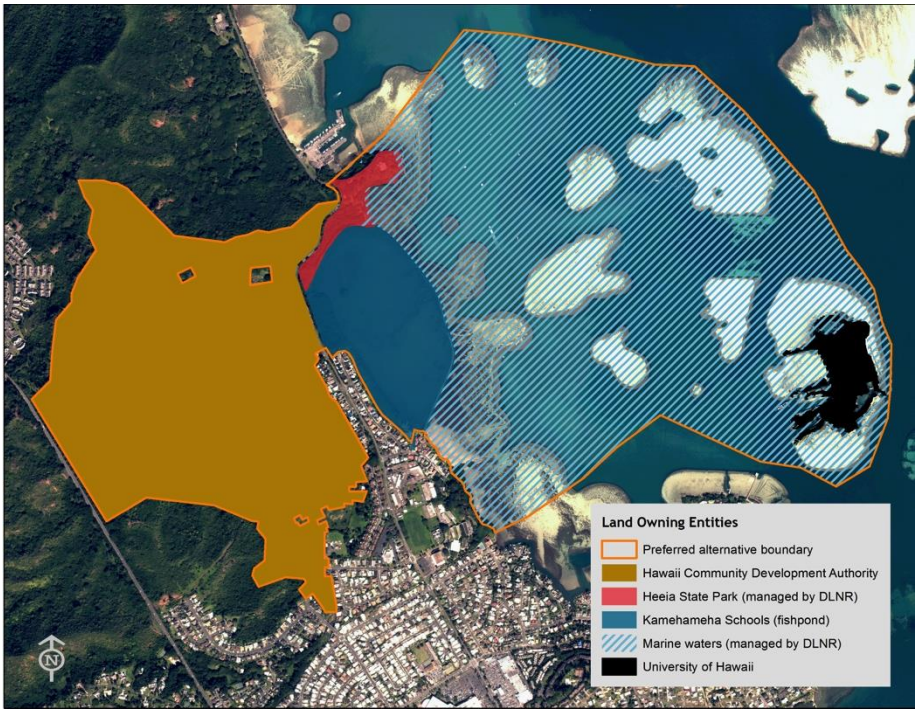


Figure 3.2. Land owning entities within the proposed preferred alternative for the He'eia National Estuarine Research Reserve

Table 3.1. He'eia National Estuarine Research Reserve preferred alternative
He'eia National Estuarine Research Reserve site acreage (from Hawai'i Office of Planning 2016).

Land Owning Entities	**Area (Acres)**
Hawai'i Community Development Authority	419
University of Hawai'i	28
Marine Water Areas*	822
He'eia State Park*	19
Kamehameha Schools	97
Total Area (acres)	1,385

***** State of Hawai'i owned, managed by the Hawai'i Department of Lands and Natural Resources

The proposed He'eia NERR components are a combination of state, private, and university owned properties that would allow for shared resources (e.g., personnel, technical assistance) among respective partners. Other governmental agencies, non-governmental organizations, Native Hawaiian Organizations, other organizations, industries, and citizens groups have

expressed interest in providing additional resources, such as labor and funds, to support a new reserve. To date, these groups have supported the designation process through their participation in the nomination and site selection efforts. NOAA intends to continue to engage these groups throughout the designation and the future operation of a reserve.

3.3 Scoping

This Draft Environmental Impact Statement (DEIS) has been developed to provide information to decision-makers and the interested public on the potential impacts associated with designation of the He‘eia NERR under federal authorities. The DMP in Appendix A describes an organizational framework for the proposed He‘eia NERR and articulates approaches that are intended to protect the ecological integrity of the proposed He‘eia Research Reserve while improving its value for research, monitoring, education, and stewardship purposes. The DMP will provide guidance on the development of the He‘eia Research Reserve, and will remain in effect until the DMP is revised and updated pursuant to the 5 year plan cycle.

In an effort to better understand what the concerns of interested parties might be with respect to the designation of the proposed He‘eia NERR, considerable effort was made to include broad and diverse public and private participation through the National Environmental Policy Act (NEPA) scoping process. Groups and individuals had the opportunity to provide input and support in the process from the beginning. This approach was designed to develop among the participatory groups a sense of “ownership” in the process and the future of the proposed He‘eia NERR.

Federal regulations (15 C.F.R. § 921.13(c)) require at least one public scoping meeting. Two scoping meetings were held to meet the requirements of this regulation: one in the vicinity of the proposed reserve site in He‘eia; and one in Honolulu, the state capital. The first scoping meeting was held on December 17, 2014, at 5 p.m. at the King Intermediate School in Kāne‘ohe. The second scoping meeting was held on December 19, 2014, at 5 p.m. at the NOAA Fisheries Honolulu Service Center in Honolulu. The public was provided notice of the meetings in the Federal Register and through an advertisement in a local newspaper. The Federal Register notice was posted on November 24, 2014 (79 Fed. Reg. 69838), 23 days in advance of the first scoping meeting. A newspaper advertisement was posted in the largest paper in the state, the Honolulu Star-Advertiser, on November 26, 2014, 21 days in advance of the first scoping meeting. The Honolulu Star-Advertiser serves the Honolulu-area as well as the entire state of Hawai‘i.

The scoping meetings were attended by a diverse set of stakeholders including interested citizens and representatives of local, state, federal, and non-governmental organizations. In total, more than 20 individuals from the public attended the two scoping meetings.

The participating public heard presentations about the reserve system from NOAA and about the proposed He‘eia NERR by Ku‘iwalu Consulting, on behalf of the Hawai‘i Office of Planning. Overall, participant comments were supportive of the proposed nomination, however, the

scoping meeting raised several issues addressed in the DEIS and the DMP. These are discussed in Table 3.2.

Consistently mentioned throughout scoping was the interest in incorporating traditional Hawaiian knowledge and ahupua‘a management into the development of a Research Reserve in Hawai‘i.

It was also noted that the proposed He‘eia NERR boundary discussed during the scoping meetings differed from an earlier tentative boundary presented at a public meeting hosted by Hawai‘i OP. The prospective boundary as presented by the State in a September 2013 meeting included several reefs which were not included in the state site nomination package. Inclusion of these reefs within the proposed He‘eia NERR is evaluated as part of alternative B within this environmental analysis (see Chapter 4).

In addition, members of the public also suggested that additional uplands, including He‘eia Stream tributaries, be considered for inclusion within the proposed reserve due to their cultural and natural resources and potential research value, as well as that additional public access points (including He‘eia Kea Small Boat Harbor) be included. Section 4.2 presents several boundary alternatives based, in part, on input from the public scoping process. Section 4.6 of this document further discusses proposed boundary considerations that were proposed but not further developed and the reason(s) why they were not fully developed into alternatives.

Section 106 of the National Historic Preservation Act (NHPA) requires that federal agencies identify historic properties that may be impacted by federal undertakings, and to seek to protect those properties that are listed, or eligible for listing, on the National Register of Historic Places. NHPA regulations at 36 CFR Part 800 identify a process to determine site eligibility, to evaluate potential impacts, and to identify impact avoidance or mitigation actions. Pursuant to NHPA, NOAA’s Office for Coastal Management (OCM) reached out to Native Hawaiian Organizations[4] in correspondences dated June 18, 2015 to gain assistance with identifying properties within the area of potential effect that may be eligible for the National Register listing and to provide information related to religious and cultural significance that these organizations attaches to the areas that would be affected by the proposed action. NOAA’s OCM also requested assistance identifying additional organizations to involve in the process. Two responses were received which identified a total of eight historic sites, all of which were already identified by NOAA for consideration within the impact analysis. These responses also identified nine organizations to engage, all of which have participated in some portion of the process to date (Appendix G).

Finally, multiple comments regarding concerns about new fishing and resource usage regulations were received. These concerns have been addressed within the reserve management plan.

[4] Notifications were distributed to all organizations on the Native Hawaiian Organization Notification List, maintained by the U.S. Department of Interior, Office of Native Hawaiian Relations and accessible via https://www.doi.gov/hawaiian/NHOL.

Table 3.2. Issues raised during scoping

Issue Mentioned by the Public in Scoping Process	Where Discussed: Draft Environmental Impact Statement (EIS) or Draft Management Plan
Public Access	EIS and Management Plan
Native Hawaiian traditional cultural heritage	EIS and Management Plan
Recreation/public use	EIS and Management Plan
Future land acquisition and boundary expansions	Management Plan
Public participation	EIS and Management Plan
Stewardship/Ecological restoration activities	EIS and Management Plan
Educational opportunities	EIS and Management Plan
Engagement with state agencies	Management Plan
Research opportunities throughout watershed	Management Plan
Community group coordination	Management Plan

3.4 Alternative Estuaries Considered During Site Selection

The preferred alternative of the proposed He‘eia Research Reserve resulted from a review of two proposals: He‘eia estuary, O‘ahu, and Hilo Bay, Hawai‘i Island. Additionally, exploratory review of sites in each of Hawai‘i’s four counties were considered[5] (Table 3.3).

Table 3.3. Inquiries and proposals resulting from request for solicitation

Possible Proponent	Conceptual Site	Proposal Submitted
Kona Community Cultural and Educational Foundation	Keauhou Bay, Hawai‘i	No
Mālama Maunalua	Maunalua Bay, O‘ahu	No

[5] Hawaiian counties participating in site consideration: Hawai‘i County, City and County of Honolulu, Kaua‘i County, and Maui County. Given the unique governing structure of Kalawao County, this county was not included in this listing of Hawai‘i counties.

Wailuku Community Management Makai Area	Wailuku, Maui	No
Hanalei Watershed Hui	Hanalei Bay, Kauaʻi	No
University of Hawaiʻi Hilo	Hilo Bay, Hawaiʻi	Yes
Kauaʻi Westside Watershed Council	Hanapepe estuary, Kauaʻi	No
Hawaiʻi Pacific University	Hawaiʻi Watershed, Oʻahu	No
Hawaiʻi Wetland Joint Venture	No specific site	No
Hawaiʻi Institute for Marine Biology/Kākoʻo ʻŌiwi	Heʻeia estuary, Oʻahu	YES

Two proposals were submitted during a public solicitation between April and June of 2013. The Site Evaluation Committee recommended both proposals for further consideration by the Site Selection Committee. The Heʻeia estuary was chosen by the Site Selection Committee and further developed into a site nomination. Hilo Bay was eliminated from further consideration after selection of Heʻeia estuary (see PBR 2014 for information on-site selection criteria and committee notes).

3.5 Documents that Influence the Scope of the DEIS

The scope of this DEIS is supported by a wide range of key documents. Some of these documents are either pre-existing or were created specifically in support of the proposed Heʻeia Research Reserve designation as part of the preliminary impact analysis. The most important ones include the Hawaiʻi NERR Site Nomination; Kāneʻohe Bay Master Plan; Kāneʻohe Bay, Heʻeia Estuary NERR Site Proposal; Natural, Cultural, and Socioeconomic Impact Analysis for the Proposed Heʻeia NERR; Gap Analysis for the Proposed Heʻeia NERR EIS; and the proposed Heʻeia NERR DMP 2016-2021.

3.6 Permits, Licenses, and Entitlements Associated with the Action

The proposed Heʻeia Research Reserve is located within various land use districts, including the State Land Use Conservation District, the Heʻeia Community Development District, and the City and County of Honolulu's special management area (SMA). Any future reserve facilities development, installation of long-term monitoring or research equipment, or the disturbance of important natural or cultural resources on either Moku o Loʻe, upland areas, and the Heʻeia Fishpond, would require a Conservation District Use Permit (CDUP) from Hawaiʻi Department of Land and Natural Resources (DLNR), a Use or Development Permit from the Hawaiʻi Community Development Authority (HCDA), and/or an SMA permit from the City and County of Honolulu's Department of Planning and Permitting. For the marine waters of the proposed Heʻeia Research Reserve (marine waters seaward of the certified shoreline), the installation of long-term monitoring or research equipment would require a CDUP from DLNR. In addition,

Hawai‘i Institute of Marine Biology (HIMB) has a special activities permit from DLNR for the collection of marine organisms within the 64 acre Hawai‘i Marine Laboratory Refuge surrounding Moku o Lo‘e. The collection of marine organisms for research purposes in the rest of the proposed He‘eia Research Reserve’s marine waters would require a special activities permit issued by DLNR.

Other permits for activities associated with the study of fish, wildlife (including birds), threatened or endangered species, or marine mammals could require consultations with or permits issued by NOAA’s National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending on the type of activity proposed and the species potentially affected. All required permits will be obtained and/or consultations carried out in accordance with all applicable requirements. See Section 5.3 for more information.

As needed, impacts to cultural and historic resources from reserve activities will be considered. Consultations about future activities will be carried out, if needed, with appropriate entities, including DLNR’s State Historic Preservation Division.

An agreement, finalized prior to designation, that describe the roles and responsibilities between the University of Hawai‘i and landholders or their lessees including HIMB, DLNR, Hawai‘i Community Development Authority (Kāko‘o ‘Ōiwi), Kama‘aina Kids, and Kamehameha Schools (Paepae o He‘eia) will be available with publication of the Final Enivirnmental Imapact Statement (Appendix C).

CHAPTER 4: ALTERNATIVES INCLUDING THE PROPOSED ACTION

4.1 Description of Alternatives

The federal action proposed by the National Oceanic and Atmospheric Administration (NOAA) is the establishment of a National Estuarine Research Reserve (NERR) in the He‘eia estuary of O‘ahu, based on the proposal for designation from the State of Hawai‘i. This proposed action includes formal designation by the NOAA Administrator and joint declaration by the NOAA Administrator and the Governor of Hawai‘i. This would result in eligibility, as funding allows, for the awarding of annual financial assistance from NOAA for up to 70 percent of operation and program costs, and additional potential funding for acquisition and construction of facilities through a competitive award process. The alternatives described below and summarized in Table 4.1 include the preferred alternative (i.e., to designate the proposed He‘eia National Estuarine Research Reserve (He‘eia Research Reserve, reserve, or He‘eia NERR) and support management plan implementation), a review of possible alternative boundary configurations (i.e., larger or smaller boundaries than currently proposed), and the no action alternative (i.e., not designating the proposed reserve). Each alternative has programmatic impacts and impacts on the environment (with physical, biologic, and socioeconomic effects) that inform the analysis of the different reserve configurations reviewed and described in Chapter 6.3.

Under scenarios other than the no action alternative, the University of Hawai‘i Insititute of Marine Biology (HIMB) would be the lead management agency for the proposed reserve. The university would employ the He‘eia NERR Manager and staff to assist in implementing the day-to-day activities of the reserve. Reserve staff will initially include education and research coordinators who implement reserve programs and receive advice from various advisory groups. The proposed He‘eia National Estuarine Resarch Reserve Draft Management Plan (DMP) indicates that as the reserve builds capacity, it is anticipated that stewardship/cultural resource and training coordinators would be added to support evolving programs. Reserve partners, including the land owners and key collaborators would engage with reserve staff to address the goals and objectives identified in the DMP and through a reserve advisory board or other mechanisms identified in a multi-party agreement in Appendix A.

Within the DMP, two key management strategies have been identified that will guide the future direction of the reserve. The first management strategy of ecological restoration is typical of contemporary conservation projects where the primary goal is to restore a damaged or degraded ecosystem to its historical trajectory by using pre-human conditions as the starting point for restoration design (Society for Ecological Restoration 2004). This is a generally accepted approach that is advocated by most federal and state agencies, and is on a continuum of ecosystem-based management approaches with an emphasis on ecosystem recovery (Society for Ecological Restoration 2004).

The second management strategy based on the *ahupua‘a* system is an ecosystem-based management approach successfully employed by Native Hawaiian cultural practitioners in

He‘eia for at least 600 years prior to Western contact. Its’ essential premise is to care for the land and water so that it can in turn care for human sustenance (Jokiel 1991, Bahr et al. 2015).

The proposed He‘eia Research Reserve seeks to understand how different ecosystem-based management strategies influence a broad array of services that contribute to a healthy and sustainable estuarine ecosystem in the face of ongoing anthropogenic impacts and human use demands. The reserve plans to examine the ecosystem services provided by two management strategies: (1) an approach based on contemporary ecological restoration techniques and (2) an approach that embraces traditional Hawaiian management practices (see Section 4 of DMP for more detail on the management strategies and ecosystem services). This approach will not only direct management strategies of the reserve’s natural resources, but will also influence the reserve’s programmatic areas of research and monitoring; education, training, and interpretation; and public outreach and engagement.

The mission of the proposed He‘eia Research Reserve is:

Kuleana (privilege and responsibility): To practice and promote responsible stewardship and outreach consistent through the principles and values of the ahupua‘a land management system. Our efforts will be supported by traditional knowledge, innovative research, education, and training that nourishes healthy and resilient ecosystems, economies, and communities.

To meet this end, the DMP (Appendix A) for the proposed He‘eia Research Reserve identifies the goals and objectives to support both the goals of the National Estuarine Research Reserve System (NERRS), 15 C.F.R. § 921.1(b), and advance our understanding of Hawaiian Island estuaries and their stewardship. The proposed goals of the He‘eia Research Reserve are:

- *Research and Monitoring*: Promote directed and applied scientific investigations, including research and monitoring and traditional knowledge, through the He‘eia Research Reserve to increase our understanding of the effects of human activities and natural events to improve informed decision-making affecting the He‘eia estuary, coastal ecosystems, and ultimately the entire ahupua‘a of He‘eia.
- *Education, Training, and Interpretation*: Develop a place-based education and training program for the He‘eia Research Reserve that inspires and educates the community about estuaries, coastal ecosystems, and traditional Hawaiian practices, such as lo‘i (taro patches) and loko i‘a (fishponds), that mālama (nurture) these systems sustainably.
- *Public Outreach and Resource Management*: The He‘eia Research Reserve will engage various communities to create opportunities for collaboration to practice and promote stewardship that sustains cultural, biological, and natural resources.

4.2 Boundary Alternatives

Once the He‘eia estuary was nominated by the Governor of Hawai‘i, several alternative reserve configurations were identified for analysis and consideration. Each of the potential boundary alternatives analyzed encompass a smaller geographic area than contained

within the preferred alternative with the exception of alternative A as shown in Table 5. However, this section briefly describes the distinct differences between each of the three potential boundary alternatives and the preferred alternative.

As required under the Council on Environmental Quality Regulations for implementing the National Environmental Policy Act (NEPA), a "no action" alternative is also considered in this analysis. The "no action" alternative is simply what would happen if the agency did not act upon the proposal for agency action. Table 4.1 summarizes the alternatives considered.

Table 4.1. Summary of alternatives

Alternatives	Alternative Size (acres)
Preferred Alternative (Nominated site with the addition of the entire HCDA parcel boundary; marine reefs 7, 8, 9, and 10; and implementation of a management plan)	1,385
Boundary Alternative A (Nominated site with land additions including the entire HCDA parcel, City and County of Honolulu parcel, and the town pier; and implementation of a management plan)	1,759
Boundary Alternative B (Nominated site with the addition of the marine water areas centered around reefs 7, 8, 9, and 10; and implementation of a management plan)	1,685
Boundary Alternative C (Nominated Site Boundary and the implementation of a management plan)	1,070
No Action Alternative (Proposed He'eia site is not designated as a National Estuarine Research Reserve)	0

4.2.1 Proposed Action (Preferred Alternative)

The preferred alternative identified for the He'eia Research Reserve site consists of designating the nominated site boundary with the addition of the remaining portion of the Hawai'i Community Development Authority (HCDA) parcel and additional marine waters comprising of reefs 7, 8, 9, and 10 and their surrounding waters owned by the State and managed by the State of Hawai'i Department of Land and Natural Resources (Figure 4.1). This alternative also includes implementing a DMP.

Figure 4.1. Boundary map of the preferred alternative for the He‘eia National Estuarine Research Reserve

The site provides many of the beneficial attributes including:

- Willing local and state partners committed to working together to form a He‘eia National Estuarine Research Reserve;
- An area representative of the diverse challenges facing coastal areas across the Hawaiian Islands ranging from invasive species;
- New opportunities to conduct research, monitoring, education, cultural and restoration activities in an estuarine setting; and,
- A venue for incorporating traditional Hawaiian cultural ecological practices into reserve activities.

NOAA requires applicants to go through a rigorous site selection and evaluation process to evaluate the best site to meet the requirements of the Coastal Zone Management Act (CZMA) and implementing regulations (Appendix A of DMP). The site selection process the State of Hawai‘i Office of Planning undertook is summarized in Chapter 2 and can be found in their site nomination (May 2014). The proposed site and implementing a DMP are described at length in Appendix A and are summarized in the following section.

4.2.2 Alternative A – Nominated Site with Land Additions Including Entire HCDA Parcel, C&CH Parcel and the Small Boat Harbor and Pier

In this alternative, the total land area of the He‘eia Research Reserve would be expanded to include additional land parcels on the north side of the final configuration (Figure 4.2) of the nominated site boundary. The additional parcels included are the City and County of Honolulu (C&CH) parcel and the He‘eia Kea Small Boat Harbor and pier that is owned and operated by the State of Hawai‘i Department of Land and Natural Resources (DLNR) Division of Boating and Ocean Recreation (DOBOR).

The C&CH parcel is an approximately 210 acre undeveloped area contiguous to the northern boundary of the proposed reserve (i.e., the HCDA parcel and He‘eia State Park). The land is zoned primarily as preservation and has been investigated by the C&CH as the location of a future He‘eia Kea Valley Nature Park. In 2012, a conceptual master plan was developed for the site that includes botanical gardens and open space for passive recreation (e.g., hiking). The parcel is relatively flat. Despite current plans, it is potentially developable as indicated by the zoning of a portion of the parcel for residential units (e.g., R-10). As public land, the R-10 portion of the parcel could be rezoned in the future to provide additional opportunities to support future reserve facility needs, especially considering the limited availability of land at He‘eia State Park. The C&CH parcel is within the He‘eia ahupua‘a, but does not physically drain into the He‘eia Stream.

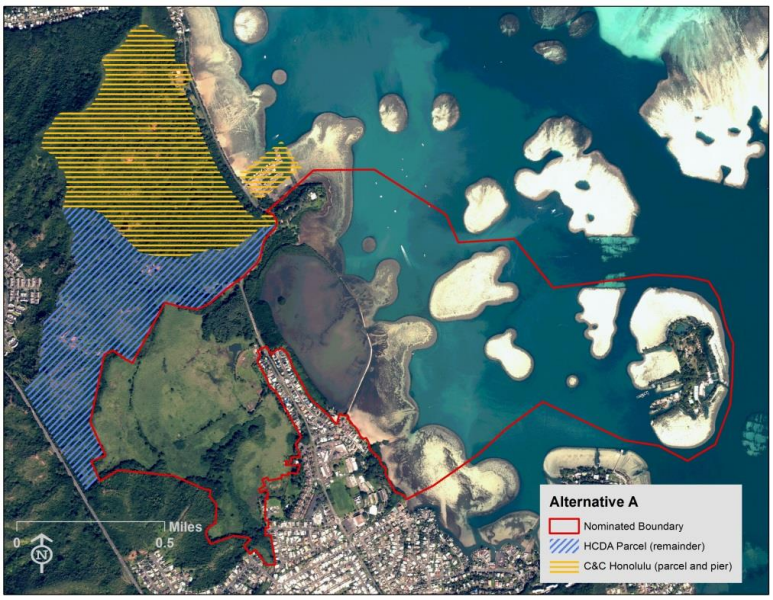


Figure 4.2. Map of Alternative A (nominated site with land additions including entire HCDA parcel, C&CH parcel and the He‘eia Kea Small Boat Harbor and pier)

Including the C&CH parcel in the final boundary configuration would not be expected to affect the current status of the site or impact future programmatic activities within the preferred boundary. Despite not being critical to the designation of the proposed He‘eia Research Reserve, this area, if developed as a nature park, could provide expanded opportunities for cultural, and educational programming at the reserve. Ecologically, the parcel is dominated by ‘alien’ or non-native forest and grassland habitats according to the land cover map of the He‘eia Research Reserve Watershed (Hawai‘i Office of Planning 2016). The parcel could provide additional areas to implement upland forest restoration in support of relevant ecosystem services. As a result, inclusion of the parcel could need additional investment of reserve resources to restore the area to more natural habitat dominated by native species. These restoration efforts may result in dilution of the funds available for other programmatic activities in the future reserve.

The smaller parcel includes the He‘eia Kea Small Boat Harbor, owned and operated by the Hawai‘i DLNR DOBOR. This parcel includes a 1 acre pier and 13 acres of water and is directly adjacent to He‘eia State Park at the park’s northern border. This parcel could provide additional water access within the Reserve to the proposed marine areas in support of reserve-related research, education and stewardship activities. However, it has multiple current commercial entities using the facilities and requires periodic maintenance dredging to keep boat access open for commercial fishing and ecotourism vessels. Were this parcel to be included within the reserve boundaries, these current uses would need to be reevaluated for consistency with the applicable NERRS regulations.

Alternative A would also create partnerships, represent diverse challenges, provide new opportunities for research, monitoring, education/outreach, restoration, and cultural practices similar to those outlined under the preferred alternative.

4.2.3 Alternative B – Nominated Site with Inclusion of Additional Water Components Centered Around Reefs 7, 8, 9, and 10

Focusing on expansion of marine water area beyond the nominated site boundary, this alternative would add 292 acres to the proposed He‘eia NERR’s marine waters including patch reefs and sand flats known as reefs 7 through 10 (Figure 4.3). The patch reefs within this expanded area are subject to several different management regimes and are regulated under different DLNR divisions. DLNR’s DOBOR manages an area around reefs 7 and 8 for recreational purposes as an Ocean Recreational Management Area, reserved for motorized activities (e.g., personal watercraft, water skiing). Just south of reef 10, DOBOR has designated 32 acre rectangular area as a boat mooring area. Throughout this area, especially around reef 8, recreational activities like kayaking, fishing, snorkeling, and boating occur frequently. Additional users include commercial fisherman catching species like Papio (Travally *Caranx spp.*), Hawaiian bonefish (*Albula spp.*) and mullet (*Mugil cephalus*) and ecotourism operators using the reefs and sand flats.

Figure 4.3. Map of Alternative B (nominated site with inclusion of additional water components centered around reefs 7, 8, 9, and 10)

Reefs 9 and 10 are currently being considered for inclusion within a proposed coral reef mitigation bank. In Kāneʻohe Bay, the proposed mitigation bank would restore a number patch reefs by controlling invasive algae (*Eucheuma spp.* and *Kappaphycus spp.*) populations. One reef is being considered to serve as a control reef and one a restoration reef.

The additional water area considered under alternative B has sufficient state control to warrant inclusion within an expanded boundary. This water area was previously identified and included by HIMB and local community partners in their original site proposal to the State. However, the State's nomination to NOAA failed to include these additional water areas centered on patch reefs 7, 8, 9 and 10.

Alternative B would also create partnerships, represent diverse challenges, provide new opportunities for research, monitoring, education/outreach, restoration, and cultural practices similar to those outlined under the preferred alternative.

4.2.4 Alternative C – Nominated Site Boundary

This alternative is comprised exclusively of the nominated site. The site configuration includes Heʻeia State Park (18.5 acres) on its northern coast; the Heʻeia Fishpond, one of the largest fishponds in the Hawaiian Archipelago (88 acres) at its estuarine border; and an upland area wetland and agricultural restoration project (405 acres) on HCDA land. The proposal also includes the HIMB (28 acres) on Moku o Loʻe (Coconut Island) and 530 acres of marine water area include patch and fringing reefs (not reefs 7, 8 9 or 10). The entire site is located in Kāneʻohe Bay, on the northeastern or windward shore of the island of Oʻahu. Kāneʻohe Bay is the largest sheltered body of water in the Hawaiian Island. This alternative's total acreage is 1,070 acres (Figure 4.4) and is protected by the only barrier reef in US waters (PBR 2014).

Alternative C would also create partnerships, represent diverse challenges, provide new opportunities for research, monitoring, education/outreach, restoration, and cultural practices similar to those outlined under the preferred alternative.

Figure 4.4. Map of Alternative C (nominated site)

4.2.5 No Action Alternative

Nationally, there are several types of estuarine areas not represented in the Naitonal Estuarine Research Reserve System (NERRS). The greatest gaps in the system as of 2015 are within the Great Lakes, northern Alaska and the Pacific Islands. Potential future NERR sites can be found in the numerous biogeographic subregions of these broad areas. While NOAA provides funding to applicants to undertake a site evaluation process, there are no guarantees that a site will be selected, thus the no action alternative is considered a viable alternative. Under this option no portion of the He‘eia estuary on the island of O‘ahu would be designated as part of the NERRS. There would be no change in current management of the areas associated with the proposed reserve. Publicly and privately owned lands and waters would maintain their current status.

The marine waters, including the patch and fringing coral reefs and sand flats (i.e., reefs 2-10), would continue to be managed by the State of Hawai‘i through DLNR. The He‘eia Fishpond would continue to be managed under a lease from Kamehameha Schools. Moku o Lo‘e (Coconut Island) would continue as a marine laboratory under HIMB and the University of Hawai‘i property with the island’s fringing reef would remain part of the Hawai‘i Marine Laboratory Refuge. On land, He‘eia State Park would continue to be operated by Kama‘āina Kids under a lease from DLNR, and the HCDA parcel would continue to be managed by Kāko‘o ‘Ōiwi as the lessee.

4.3 Detailed Description of the Preferred Alternative Boundary

The He‘eia estuary is located in the southern portion of Kāne‘ohe Bay, the largest sheltered body of water in the Hawaiian Island chain, on the windward shore of the island of O‘ahu. The site includes the He‘eia Stream, uplands, traditional agricultural and cultural heritage lands, wetlands, a large fishpond and marine waters that include reefs, sand flats, and Moku o Lo‘e

(Coconut Island). The site totals 1,385 acres of land and water areas. The major components of the site are:

- **Upland Areas (437 acres):** The portion of the preferred alternative that is referred to as the "upland" areas are primarily comprised of a mix of public and private lands mostly west of the Kamehameha Highway (H830) including HCDA lands and He'eia State Park. This area encompasses the entire HCDA parcel, a mix of wetlands and forested land that includes demonstration lo'i (taro) fields in the southwestern part of the wetland complex. This parcel is managed by Kāko'o 'Ōiwi, a local non-profit. Also, two privately owned Hawaiian homestead lots (e.g., kuleana parcels) and a future health center location are found within this area but are specifically excluded from the proposed Reserve boundaries. These exclusions are identified in Figure 4.5. In the state nomination, only a portion of the HCDA parcel was included. Through the public scoping process and in consultation with DLNR, the decision to include the entire parcel, less the homestead lots, as a preferred alternative was made. These additional lands provide a buffer for core estuarine and marine habitats (see DMP Section 1 for additional discussion of reserve core and buffer areas). NERRS regulations define the core area as ''*key land and water areas*'' so vital to the functioning of the estuarine ecosystem that it must be under a level of control sufficient to ensure the long-term viability of the Reserve for research on natural processes. And core areas must also be ecological units of a natural estuarine system which preserve, for research purposes, a full range of significant physical, chemical and biological factors contributing to the diversity of fauna, flora and natural processes occurring within the estuary. While buffer areas are considered areas adjacent to or surrounding key land and water areas and essential to their integrity. These buffer zones protect the core area and provide additional protection for estuarine-dependent species, including those that are rare or endangered (NERRS Regulations 15 C.F.R. § 921.11(c) (3)).

  He'eia State Park (19 acres), also located in the upland portion of the preferred alternative, protects some key historic and cultural sites. It borders the HCDA parcel to the west, the He'eia Fishpond and stream to the south and the marine areas of the reserve to the east. Just north of the State Park, and not included within the preferred alternative boundary, is the He'eia Kea Small Boat Harbor and fishing pier.

- **Marine Areas (822 acres)**: Making up the largest component of the preferred alternative boundary, the marine area is managed by the DLNR and comprised primarily of patch and fringing coral reefs and sand flats. This area is bordered on the west by the He'eia Fishpond and fully surrounds Moku o Lo'e (Coconut Island). The marine area is part of Kāne'ohe Bay and is protected by an outer barrier reef that strongly influences habitat diversity. Some of the most pristine coral reef habitat within the proposed Reserve are found in the waters around Moku o Lo'e and comprise the 64 acres of the Hawai'i Marine Laboratory Refuge.

Figure 4.5. Kuleana parcels and health center within the preferred alternative boundary

- **He‘eia Fishpond (88 acres):** This culturally and historically significant fishpond is privately owned and leased to Paepae o He‘eia, a local non-profit, by Kamehameha Schools through the Bishop Trust. It is one of the largest remaining intact fishponds in the Hawaiian Islands.

- **Moku o Lo‘e (Coconut Island) (28 acres):** The island is owned by the University of Hawai‘i Foundation and operated by the University of Hawai‘i as a research lab under the HIMB (PBR 2014). The Hawai‘i Marine Laboratory Refuge surrounds the island and is the most protected habitat within the reserve with no fishing or take of marine resources allowed. The refuge is entirely within the reserve boundary core area due to its higher level of protection.

Within the preferred alternative, the DMP (see Section 1.2.4 He‘eia NERR Boundary Description) delineated the proposed core and buffer areas of the site (Figure 4.6). Federal regulations (15 CFR 921.11) state that reserve boundaries generally encompass two areas: core and buffer areas. The regulations define key or “core” land and water areas as containing ecological units of a natural estuarine system which preserves, for research purposes, a full range of significant physical, chemical, and biological factors contributing to the diversity of fauna, flora, and natural processes occurring within the estuary.

The He‘eia NERR core areas were selected based on the following criteria:

1. They are vital to the function of the He‘eia estuary.
2. State can maintain a sufficient level of control over the areas to ensure the long-term viability of the He‘eia estuary for research and natural processes.
3. The areas encompass resources representative of the He‘eia estuary system.

4. The preservation of the core areas will contribute to the preservation of a full range of significant physical, chemical, and biological factors essential to the diversity of fauna, flora, and natural processes occurring within the He‘eia estuary, as informed by:

- the Recovery Plan for Hawaiian Waterbirds (U.S. Fish and Wildlife Service 2011),
- the Kāne‘ohe Bay Master Plan (OP 1992), and
- the Atlas of Hawaiian Watersheds and Their Aquatic Resources, Bishop Museum and Division of Aquatic Resources (Parham et al. 2008).

The federal regulations (15 CFR 921.11) define a buffer area as an “area adjacent to or surrounding key lands and water areas and essential to their integrity. Buffer zones protect the core area and provide additional protection for estuarine-dependent species.” The buffer area may include areas for research and education facilities (see Sections 1.2.4.3 and 1.2.4.4 for descriptions of the core area and buffer area in the He‘eia NERR, respectively).

The He‘eia NERR buffer areas were selected based on the following criteria:

1. The areas are able to protect the core area and provide additional protection for species that rely on the core area.
2. The areas are located adjacent to or surrounding, or are essential to the integrity of, the core area.
3. The buffer areas provide an opportunity to accommodate future shifts in the core area as a result of successful restoration or climate impacts.
4. Managers can maintain a level of control over the areas sufficient to support the long-term viability of the He‘eia NERR for the recovery of natural processes, as well as for research and education.

Core areas are exclusively found in the marine portion of the proposed site, encompassing about 624 acres of aquatic habitats including the reef immediately surrounding Moku o Lo‘e and additional portions of the coral reefs and waters in Kāne‘ohe Bay. The 475 acres of land in the He‘eia NERR buffer area consist of HCDA’s He‘eia lands, the He‘eia Fishpond, He‘eia State Park, and Moku o Lo‘e. The 286 acres of aquatic areas in the He‘eia NERR’s buffer consist of the He‘eia Fishpond; patch reefs 7, 8, 9, and 10; about 111 acres of water immediately surrounding patch reef 7, and about 32 acres of water to the south of patch reef 10.

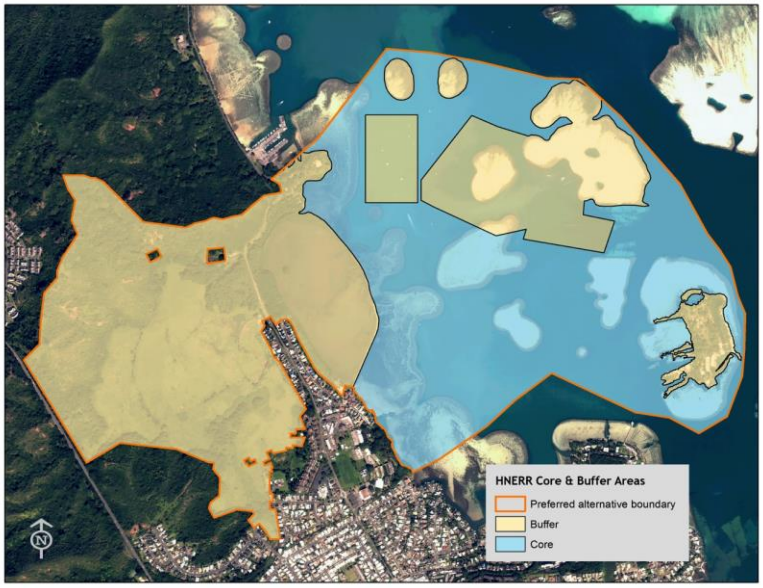


Figure 4.6. Preferred alternative reserve core and buffer

4.4 Other Alternatives Previously Considered but Eliminated

Areas Within He‘eia Estuary

In addition to supporting the overall mission and goals of the NERRS program, the proposed He‘eia Research Reserve will support the practice and promotion of responsible stewardship consistent with the principles and values of the traditional ahupua‘a land management system supported by innovative research, traditional knowledge, education, and training that supports a healthy and vibrant ecosystem that in turn nourishes the community. As such, many factors were considered when developing the proposed He‘eia Research Reserve boundary. A consistent message received during the public scoping process was to include additional portions of the ahupua‘a which were not included in the state’s nomination package. Including the entirety of the ahupua‘a within the reserve boundary, however, would not be feasible due, in part, to the types of ownership (i.e., private property) and types of existing uses (e.g. commercial, residential) that would prevent the state from meeting the requirements of the NERRS regulations related to having adequate state control over key land and water areas sufficient to provide long-term protection for reserve resources to ensure a stable environment for research (NERRS Regulations 15 C.F.R. § 921.30(a)(2)). In addition, NOAA believes that the preferred alternative is adequate to accomplish the identified purpose of and need for the proposed action without inclusion of the entire ahupua‘a. Accordingly, expansion of the proposed reserve boundary to fully encompass the ahupua‘a was considered, but not fully developed.

As discussed above, several areas which expanded the original nomination boundary to include additional portions of the ahupua‘a were developed and are analyzed herein (see Chapter 3.4 and Table 5).

4.6.1 He‘eia Uplands Controlled by Department of Hawaiian Home Lands

An option to create a reserve that included the 138 acres of the ahupua‘a upland forests controlled by the Department of Hawaiian Home Lands (DHHL) was also considered for inclusion in a proposed He‘eia Research Reserve (Figure 4.7). This 138-acre parcel, however, is not contiguous with the nominated site, with private property existing between land within the boundary of the preferred alternative and this upland area. The addition of this parcel would provide additional cultural resources for a proposed reserve and protect watershed areas that could influence water quality. There are several burial sites and other historically significant cultural resources within these land holdings. The remnants of a military radio navigation station are found in this parcel. Much of the upland forest is dominated by non-native vegetation. Also, this parcel would provide visitors with an opportunity to view the entire watershed and gain a perspective on the physical ahupua‘a, from mauka to makai (from the mountains to the sea). Finally, there are some existing structures which could be repurposed for reserve activities to support the goals and objectives of the DMP.

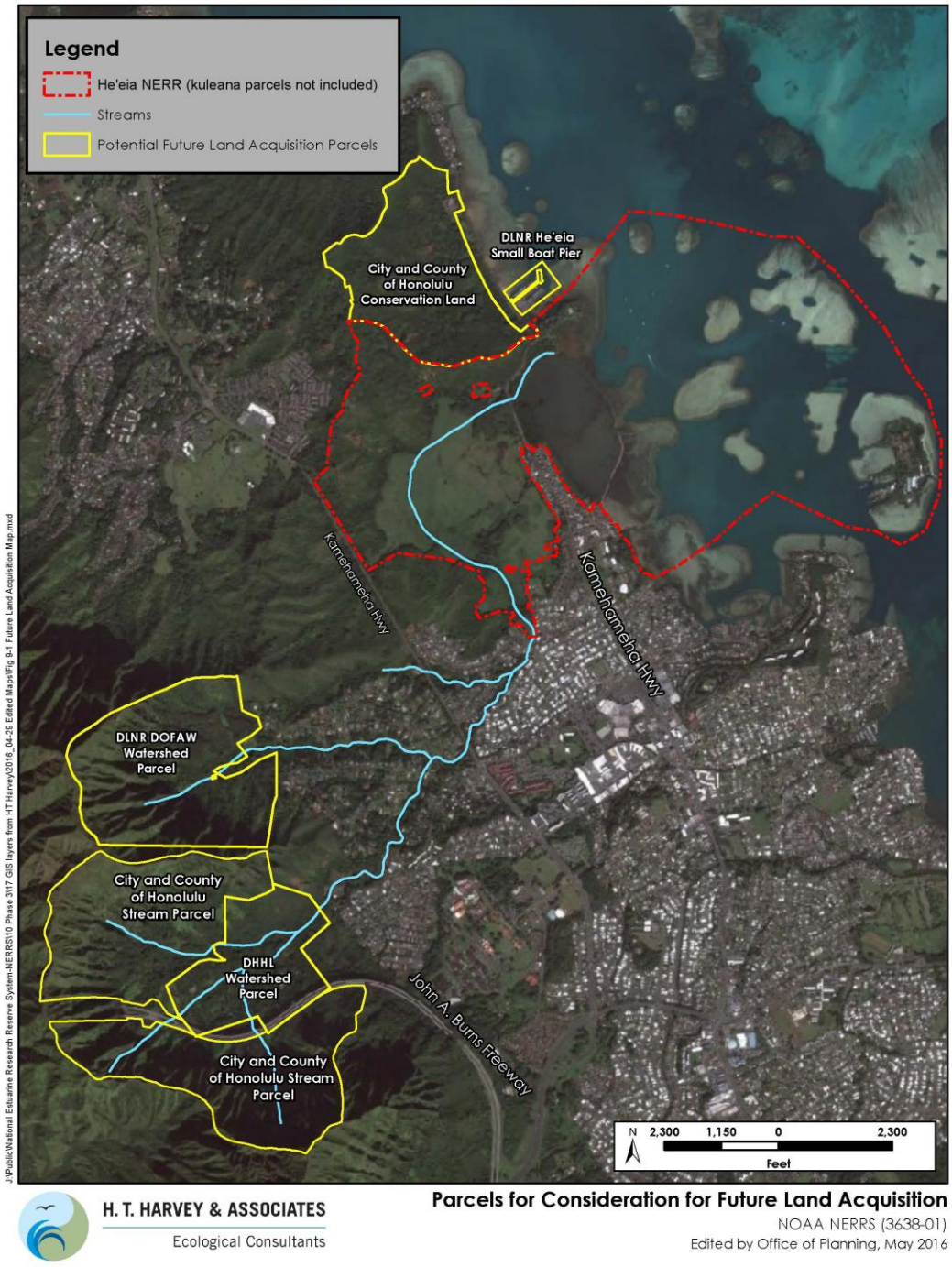


Figure 4.7. Potential areas for future reserve expansion

Several potential management issues have been identified, however, which make this parcel unsuitable for inclusion within the proposed reserve at this time. There is no current management plan in place for the area and there are issues of trespassing on the property and

vandalism at the former radio navigation station, which suggest a lack of adequate control over human activities occurring within the area (see NERRS Regulations 921.20). Finally, given the current structural deterioration of the former radio navigation station, there would be safety concerns for reserve staff and the public visiting this site. For these reasons, the inclusion of these He‘eia uplands is not further considered as part of an alternative for this environmental analysis. The DMP, however, does include discussion on this area for a possible future boundary expansion (Section 9 – Land Acquisition Plan).

4.6.2 Tributaries of He‘eia Stream

There are at least three tributaries to He‘eia Stream, including Ha‘ikū Stream, Ioleka‘a Stream, and the main stem of He‘eia Stream that were considered for inclusion in the He‘eia NERR (Figure 4.8). Consideration of this option was based in part on the public’s expressed desire to include monitoring sites along these streams and tributaries in order to conduct research on water quality within the watershed. While DLNR has jurisdiction over these waters, the tributaries flow through properties owned by various state entities (DHHL and Office of Hawaiian Affairs), the City and County of Honolulu, and private citizens. This mixed ownership would add additional complexity to management of a reserve that included these tributaries. Due to the added complexity, combined with the fact that inclusion of these tributaries is not necessary to meet the purpose of and need for the proposed action, the inclusion of these He‘eia Stream tributaries will not be further considered in this environmental analysis.

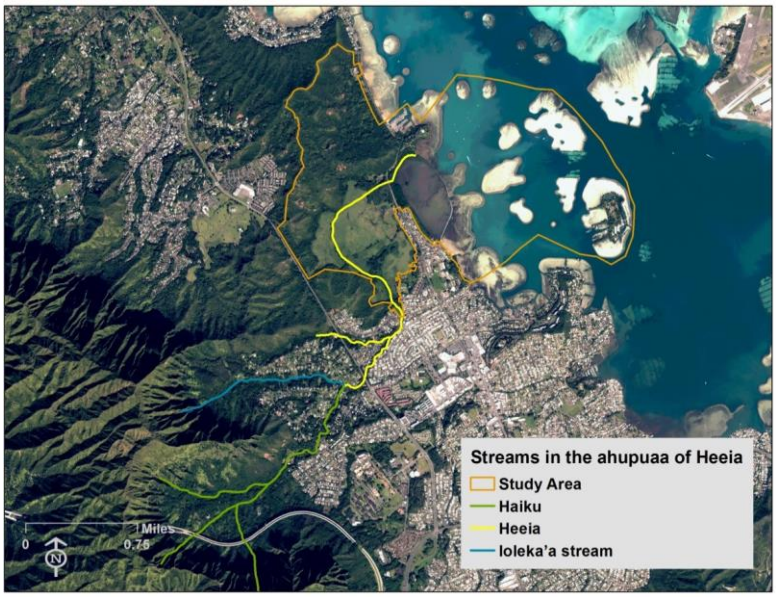


Figure 4.8. Streams in the Ahupua‘a of He‘eia

With respect to the anticipated benefits from water quality research that could be conducted on these tributaries, it should be noted that Section 921.50(a) of the NERRS regulations provides that: “*research may be conducted within the immediate watershed of the reserve*”[6] Therefore,

[6] Although, the majority of research activities of any single research project funded under this subpart may be conducted within Reserve boundaries. *See* 15 C.F.R. § 921.50(a).

water quality research and monitoring could occur along the He‘eia tributaries without the need to include these areas within the proposed reserve boundary. In this way, HIMB would need only to enter into individual agreements with landowners at discrete monitoring sites, as necessary.

4.6.3 Mōkapu Peninsula

A portion of the Marine Corps Base Hawai‘i (MCBH) on Mōkapu peninsula is included within the He‘eia ahupua‘a. There are important cultural and natural resources in the peninsula area. These include traditional salt ponds and the Nu‘upia Ponds Wildlife Management Area, an important habitat for the federally endangered Hawaiian stilt (*Himantopus mexicanus knudseni*).

MCBH maintains and operates an airfield in the ahupua‘a section of the peninsula and conducts training activities from this military installation. As such, there are public access restrictions to the air station and public use restrictions in some of the water areas surrounding MCBH (due to a 500-yard security buffer around the base). These uses and restrictions are not consistent with the purpose of and need for the proposed action.

NOAA, HIMB, and the United States Marine Corps (USMC) have discussed the proposed designation of the proposed He‘eia Research Reserve and potential partnerships in education and outreach and resource management. NOAA and HIMB intend to continue communication with USMC in the operation of any future research reserve in He‘eia to raise awareness of reserve activities and provide for coordination, where appropriate. Including portions of the airfield are not under further consideration given the types of activities occurring within, and the limited public access to this area.

Alternative Management Strategies

An alternative considering management strategies focused more exclusively on natural resources, with a reduced focus on cultural resources and traditional practices, was considered but not further developed, as it contradicts the stated mission and goals of the proposed He‘eia Research Reserve as laid out in the DMP. In this alternative management strategy, contemporary natural resource restoration and research activities would be the focus of reserve. While there is merit to understanding such natural processes as the ecological role of invasive mangroves with respect to shoreline stabilization and sediment management or the ecological restoration of tidal wetlands to a state that excludes traditional uses, this type of approach would not meet the stated research, education, and stewardship goals and objectives of the proposed reserve nor did it receive broad support from the public or community.

Chapter 5: AFFECTED ENVIRONMENT

This chapter provides an environmental baseline for the proposed site and surrounding area that are potentially impacted by the proposed action to designate a reserve. Each of the following subsections provides an overview of the current conditions found in the area of the proposed action.

5.1 Natural Environment

The proposed site is located on the windward (east) side of Oʻahu, and is situated along the southern coastline of Kāneʻohe Bay (Figure 5.1). The steep, grooved cliffs of the Koʻolau Mountain Range are the dominant topographic features that define Windward Oʻahu and form the region's scenic background. Low ridges that shape that Heʻeia valley stretch makai (toward the ocean) from the base of the Koʻolau Mountains and gradually fade into the lower reaches of the coastal plains, spreading out into Kāneʻohe Bay. While the upper section of Heʻeia valley is narrow and hilly, similar to other Windward Oʻahu mountain areas, the lower section becomes an extremely flat coastal plain covered almost entirely by marshland. Lae O Ke ʻAlohi, or Kealohi Point, which is a peninsula formed by the northern ridge of Heʻeia valley that measures 55 feet above mean sea level at its summit, is located to the north of the fishpond.

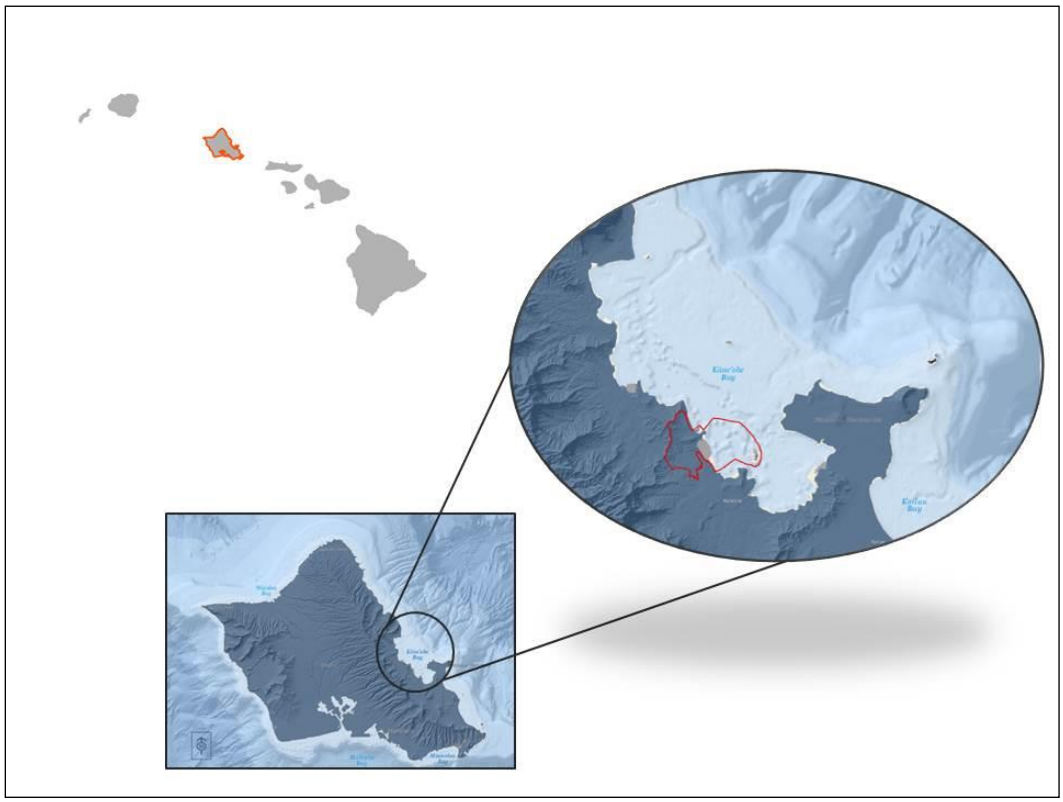


Figure 5.1. Location of project area within the Island of Oʻahu

Kāne‘ohe Bay is the largest sheltered body of water in the Hawaiian Islands. The bay, at its longest points, is about 12.7 km (8 miles) long and about 4 km (2.6 miles) wide, with a total surface area of 18 square miles (11,000 acres) and an average depth of 8 meters. The salinity of the bay water normally ranges from 33 to 35, and the variation in water temperature is usually between 60 to 80 °F (Tanaka et al. 2005) (Figure 5.2).

The proposed site is located along the southern portion of Kāne‘ohe Bay. The proposed He‘eia National Estuarine Research Reserve (NERR) features both terrestrial and marine components. The marine portions of the site include patch and fringing reefs and marine areas surrounding an island. Kāne‘ohe Bay is protected by an outer barrier reef. The barrier reef has a major influence on bay circulation and the relatively large freshwater inputs from numerous streams have created diverse marine habitats. The site’s estuarine waters are directly influenced by runoff from the surrounding watershed as well as by the exchange of seawater from the ocean.

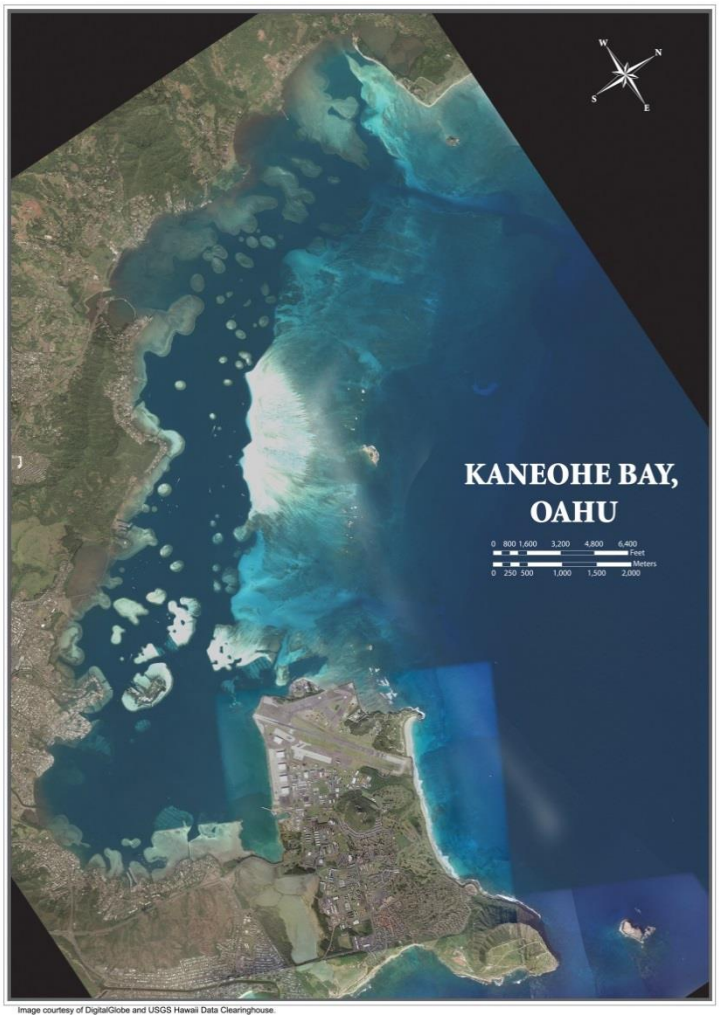


Figure 5.2: Kāne‘ohe Bay, O‘ahu (credit: DigitalGlobe and Hawai‘i Data Clearinghouse).

5.1.1 Physical Environment

5.1.1.1 Climate

5.1.1.1.1 Weather and Climate

Hawai‘i has a semitropical climate, with a rainy season lasting from October to May; the wettest months of the year are during November through February. Many high volume rain events happen during the rainy season (Figure 5.3). The islands have steady trade winds which blow from the northeast a majority of the time at approximately 20 km per hour (10-11 knots). Trade wind patterns have a significant effect on Windward O‘ahu’s climate. The trade winds bring warm moist air from the ocean onto the land, which is deflected up along the Ko‘olau Mountains. As the air is deflected up the mountains, it cools, forms clouds, and releases rain onto the land below.

The mountainous regions of Windward O‘ahu experience the most frequent rainfall and are often covered by clouds. Fog drip at higher elevations also contributes to overall precipitation. The coastal areas and central plains of Windward O‘ahu have moderate to frequent rainfall (Honolulu Board of Water Supply, 2012), with an annual average total precipitation of 76.03 inches (Hawai‘i Institute of Marine Biology, 2016). The average rainfall in the He‘eia watershed is 94 inches annually. The average annual temperature in Kāne‘ohe ranges from 68.8 to 79.8 °F (Hawai‘i Institute of Marine Biology, 2016). Figure 5.3 displays annual rainfall data for the Ahuimanu Loop rain gauge located in close proximity to the proposed site (Giambelluca 2013).

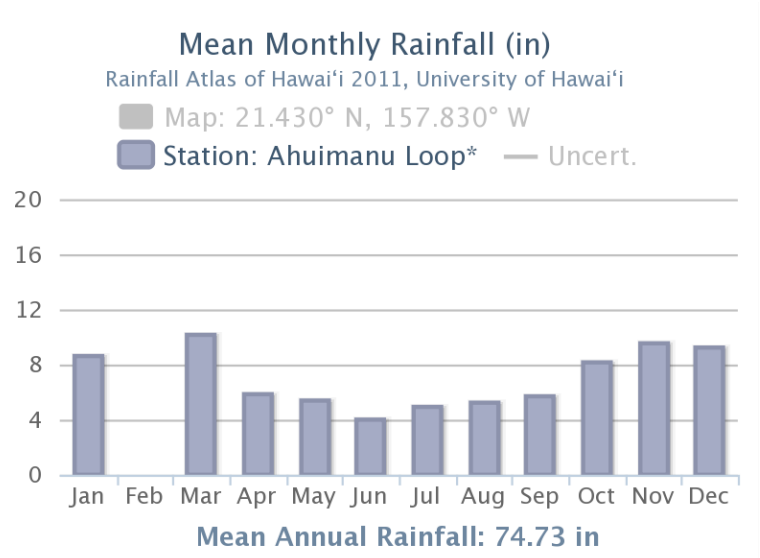


Figure 5.3. Mean annual rainfall Ahuimanu Loop, Kāne‘ohe

5.1.1.1.2 Climate Change

Within the proposed He'eia National Estuarine Resarch Reserve Draft Management Plan (DMP) (Appendix A), the impacts of climate change to Hawai'i and Pacific Islands are considered. These impacts include increased air temperatures and warmer oceans, changes to precipitation and freshwater supplies, sea level rise, coral bleaching, and ocean acidification. See Climate Change Impacts in the United States report (Melillo et al. 2014) for additional information on climate change impacts in the Hawaiian Islands. The *Climate Sensitivity of the National Estuarine Research Reserve System* (Robinson et al. 2013) report discusses climate change vulnerability of the estuaries of the National Estuarine Research Reserve System (NERRS) and the communities dependent on the estuarine resources of the research reserves. This report could provide a framework for the proposed He'eia NERR to understand the sensitivity and vulnerability of the He'eia wetland and Kāne'ohe Bay to climate change impacts.

5.1.1.1.3 Air Quality

The State of Hawai'i Department of Health (DOH) monitors air quality on a continuous basis on each of the four main Hawaiian Islands at specific stationary monitoring stations[7]. As required under the Clean Air Act, the DOH notifies the public of an exceedance of a National Ambient Air Quality Standard (see Chapter 7 for additional information on the Clean Air Act and its relevance to the proposed action). There are no DOH monitoring stations on the windward side of O'ahu. Long-term air quality data for the Kāne'ohe Bay area is not available.

The USEPA's Toxic Release Inventory (TRI) tracks the management of certain toxic chemicals that may pose a threat to human health and the environment. Within the project area, Marine Corps Base Hawai'i (MCBH) on the Mōkapu peninsula is the only TRI facility and as such must report annually how much of each chemical is released[8] to the environment and/or managed through recycling, energy recovery and treatment. For 2014 MCBH[9] has reported releases of ethylene glycol, copper, lead, and nitrate compounds, although none of these are reported as air emissions.

Additional sources of air pollution within the project area include vehicle emissions and noise pollution from road and boat traffic as well as from the military aircraft using MCBH on the Mōkapu peninsula.

5.1.1.2 Water Resources

5.1.1.2.1 Water Quality

Primary pollutants identified by the Hawai'i Department of Health in the project area include nutrients, suspended solids and sediment, turbidity, polychlorinated biphenyls (PCBs), bacteria, and phosphorus. Pollutants of concern identified at the monitoring station closest to the preferred alternative (He'eia Kea Small Boat Harbor Station 000362) consist of pathogens,

[7] Near-real time air quality data at monitoring stations available http://emdweb.doh.hawaii.gov/air-quality/

[8] A "release" of a chemical means that it is emitted to the air or water, or placed in some type of land disposal. See USEPA's Toxic Release Inventory website for additional information

[9]

nutrients, and nitrogen (Helber Hastert and Fee Planners 2007). There are additional DOH marine recreation water quality monitoring site at Kāneʻohe Beach Park (Station 000190) and Kokokahi Pier (Station 000191). These monitoring sites are in the southern portion of Kāneʻohe Bay, south of the project area of the proposed action.

Hawaiʻi Administrative Rules (H.A.R.) on Water Quality Standards define both the classification of state waters (H.A.R. §11-54.2) and the classification of water uses (H.A.R. §11-54.3) for inland and marine waters. Table 5.A identifies the classification and uses of bodies of water within the project area.

The Clean Water Act (33 U.S.C. § 1251) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. See Chapter 7 for more information on the Clean Water Act and its relevancy to the proposed action. Within Hawaiʻi, certain types of water quality standards for surface water bodies, which are based on the state's intended uses for the water body (e.g., swimming or fishing), are used to help states identify target levels for water quality indicators and prioritize which water bodies are most in need of water pollution reduction plans, called Total Maximum Daily Loads (TMDLs). Data collected and reported for that purpose, among others, are available for several locations in Kāneʻohe Bay, including the Central Bay, Heʻeia Kea Small Boat Harbor, and Heʻeia Stream. As presented in the State of Hawaiʻi Department of Health *2014 State of Hawaiʻi Water Quality Monitoring and Assessment Report*, the types of pollutants exceeding applicable water quality standards for the following sampling locations are

(a) Heʻeia Kea Small Boat Harbor (wet season)– total nitrogen (TN), chlorophyll a
(b) Kāneʻohe Bay Central Region (includes Heʻeia Fishpond and Moku o Loʻe, wet season) –TN, nitrate+nitrite-nitrogen (NO_3+NO_2), ammonia (NH3), and turbidity
(c) Heʻeia Stream - NO_3+NO_2 (both wet and dry seasons), total phosphorus (wet season only), and turbidity (wet season only)

Heʻeia Kea Small Boat Harbor, Kāneʻohe Bay Central Region, and Heʻeia Stream are on the list of impaired water bodies due to non-attainment of one or more of the applicable water quality standards (Hawaiʻi State Department of Health 2014) (Table 5.1).

Table 5.1 Water quality classification and impairment status for bodies of water within the project area

Body of Water	Classification of State waters	Classification of water uses	Definition of water uses (from H.A.R. §11-54.3, see rules for more details).	Impairment Status*
Moku o Loʻe	Inland waters	Class 1	Remain in their natural state as nearly as possible with an absolute minimum of pollution from any human-caused source.	Yes^{+} (wet season)

He‘eia Stream	Inland waters	Class 2	To protect use for recreational purposes, the support and propagation of aquatic life, agricultural and industrial water supplies, shipping, and navigation.	Yes (both wet season and dry season)
Kāne‘ohe Bay, Central Region (includes He‘eia Fishpond)	Marine waters	Class AA	Remain in natural pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality from any human-caused sources or actions.	Yes (wet season)
He‘eia Kea Small Boat Harbor	Marine waters	Class A	Protect for use for recreational purposes and aesthetic enjoyment. Any other use shall be permitted as long as it is compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters.	Yes (wet season)

*Impairment meaning at least one use of water body not obtained
[+]Impairment and non-attainment for Moku o Lo‘e based on findings for Kāne‘ohe Bay Central Region

5.1.1.2.2 Hydrology

The He‘eia Stream, which runs through the site and discharges into the bay, is a perennial stream formed from two upland streams, Ha‘iku and Ioleka‘a. Haiku Stream and Ioleka‘a Stream converge upstream of the wetlands of He‘eia to form He‘eia Stream. The He‘eia Stream drainage basin is 3.6 square miles in area and extends 3.2 miles from the ocean to the summit of the Ko‘olau Mountains.

Flooding in the He‘eia Stream is restricted almost entirely to the low-lying area starting at approximately 40 feet above mean sea level (the wetlands of the He‘eia region). Most of the wetlands of the He‘eia region are within the Federal Emergency Management Agency (FEMA) AE flood zone, and a large portion of the wetlands are also within the floodway (Figure 5.4). The City and County of Honolulu (C&CH) participates in the FEMA National Flood Insurance Program (NFIP)[10]. See the State of Hawai‘i DLNR Engineering Division for additional information on the state’s participation in NFIP.

[10] FEMA Community Status Book Report for Hawai‘I https://www.fema.gov/cis/HI.html

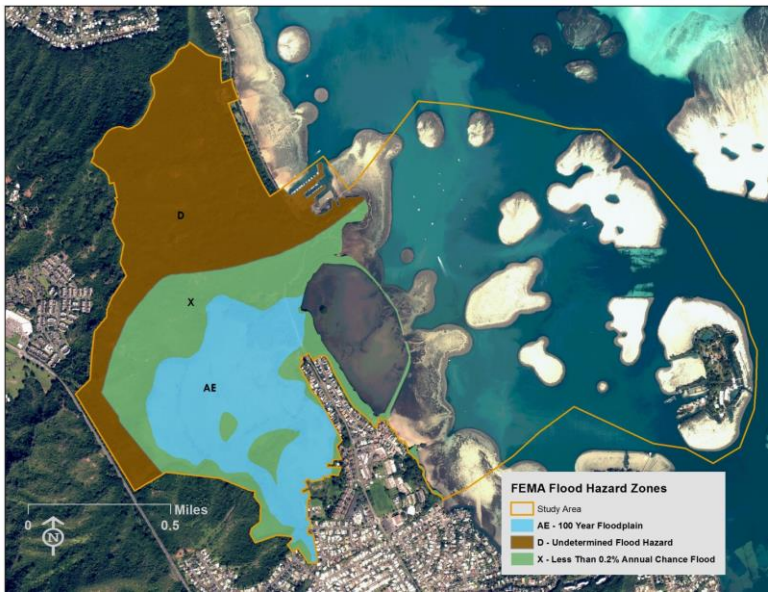


Figure 5.4. FEMA Flood Hazard Zones within the project area (data source FEMA 2011)

Discharge records from Haiku Stream and Ioleka'a Stream date back to 1915 and 1941, respectively. The largest flood on record at both the Haiku and Ioleka'a United States Geological Survey stations occurred in May 1965. The peak discharge was estimated to be 5,740 cubic feet per second (cfs) at the Haiku station and 797 cfs at the Ioleka'a station. FEMA estimated the 100-year flood peak discharge at He'eia wetlands to be approximately 9,500 cfs. Dense growths of mangrove at the outlet of He'eia Stream restrict water flow and form small ponds. Increasing silt loads in He'eia Stream (as a result of urban development in the watershed) and decreasing groundwater levels have reduced the amount of open water in the wetlands of He'eia. Open-water areas remaining in the wetlands of He'eia generally range in depth from 6 inches to 3 feet, but can increase to more than 6 feet in depth after rain events (Townscape 2011).

The He'eia Fishpond is an 88-acre brackish-water pond that extends from the shoreline out into Kāne'ohe Bay. It is enclosed by a 7,000-feet long wall built from volcanic rock and coral. This wall is 12-15 feet wide. Kāne'ohe Bay is semi-enclosed by a barrier reef, restricting some ocean/sea water circulation and therefore heavily influenced by freshwater inputs. He'eia Stream is a relatively minor source of freshwater input to Kāne'ohe Bay, as it is only one of 11 streams that discharge into the bay. Kāne'ohe Stream, just south of the nominated site, is the largest source, accounting for more than 75% of the discharge into the southern section of the Kāne'ohe Bay (Hawai'i Office of Planning, 2015a).

5.1.1.2.3 Groundwater

The aquifer beneath the area is within the Ko'olaupoko Aquifer System of the Windward Aquifer Sector. This aquifer mainly consists of high level dike-impounded groundwater. There are many groundwater seeps and springs in the wetlands of He'eia. There are no groundwater wells located on site or in the vicinity of the property. The nearest groundwater wells are located in

Upper Haiku Valley, on the mountainside end of He‘eia watershed. These wells are not listed as having contaminants (PBR 2014).

5.1.1.3 Geology

The steep, grooved cliffs of the Ko‘olau Mountain Range are the dominant topographic feature that defines Windward O‘ahu, forming the region’s scenic background. While the upper section of the He‘eia area is narrow and hilly, similar to other Windward O‘ahu mountain areas, the lower section becomes an extremely flat coastal plain covered almost entirely by marshland. The topography of the region contributes to the rapid runoff and low infiltration rates.

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) characterized the soils in the wetlands of He‘eia in 2011 (Figure 5.5). The majority of the area has Hanalei silty clay and Marsh soils. In a typical profile, Hanalei silty clay is composed of poorly drained silty clay and silty clay loam from 0 to 36 inches in depth. Marsh soil is composed of mucky peat from 0 to 60 inches in depth. Hanalei silty clay is poorly drained, with frequent flooding, occasional ponding, and a moderate available water capacity. Marsh soils are very poorly drained, with frequent flooding and ponding, and a very high available water capacity (Hawai‘i Office of Planning 2015a).

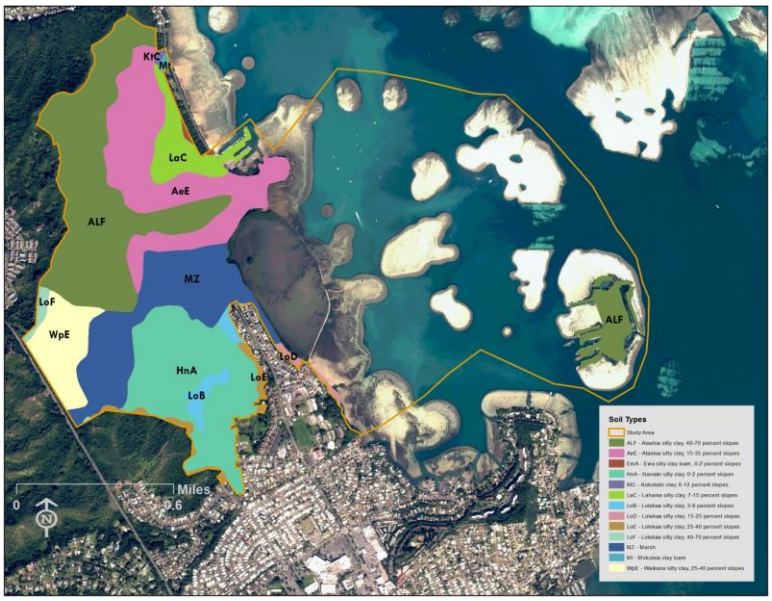


Figure 5.5. Soil types within the project area (Data source: NRCS, 2013)

The uplands within the He‘eia watershed that are to the north of the wetland area are characterized as Waikane silty clay, 25 to 40% slopes, and Alaeloa silty clay, 15 to 70% slopes. These soils are silty and well-drained, although they have less available water capacity than the soil in the wetland areas. These hillside soils are classified as highly erodible (Hawai‘i Office of Planning 2015a).

5.1.2 Biological Environment

The proposed He‘eia NERR includes a number of different habitat systems represented generally by terrestrial, estuarine and marine areas (Figure 5.6), which are discussed below, along with some of the species each habitat supports.

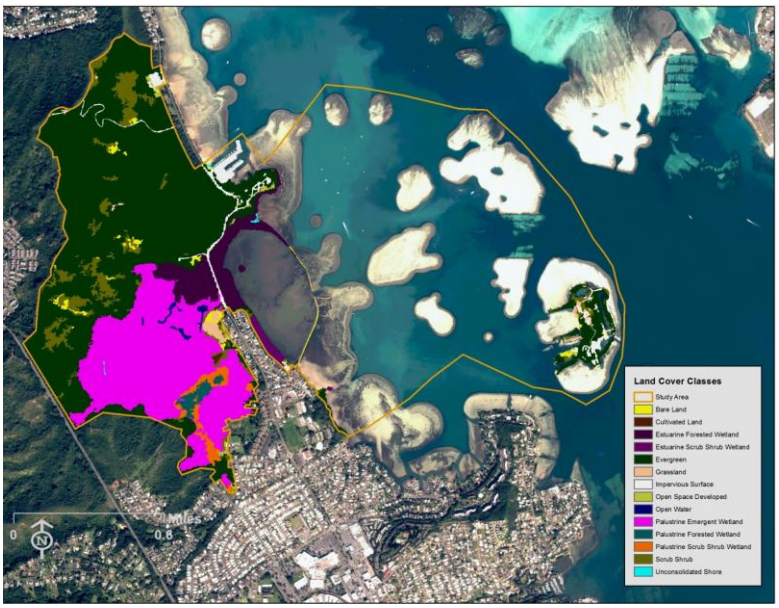


Figure 5.6. Land cover classes within the project area (Data Source: NOAA OCM C-CAP, 2011)

5.1.2.1 Terrestrial Habitats

The terrestrial areas in project are for the proposed He‘eia Research Reserve are a mosaic of built-up or developed areas and undeveloped or natural areas. The undeveloped or natural uplands occur in He‘eia State Park, areas between the He‘eia Fishpond and the residential neighborhood, emergent lands on Moku o Lo‘e, uplands within the C&CH parcel, and upland areas surrounding the wetlands and forested land at the foothills of the Ko‘olau Mountains on the Hawai‘i Community Development Authority (HCDA) property. These uplands are dominated by invasive plan species with few native species in the forested areas (see Section 5.1.3.1 Living Resources – Flora for more description of terrestrial plants). The more developed sites include facilities at the He‘eia Fishpond, He‘eia Kea Small Boat Harbor, and the campuses of He‘eia State Park and of the HIMB on Moku o Lo‘e.

5.1.2.3 Estuarine Habitats

The wetlands of He‘eia are fed by the waters of Haiku Stream and loleka’a Stream, which converge upstream of the wetlands to form the He‘eia Stream. NOAA’s Coastal Change Analysis Program (C-CAP) land cover dataset (2011) identifies five wetland types that occur within the project area preferred alternative: (1) estuarine forested, (2) estuarine scrub shrub, (3) palustrine emergent, (4) palustrine forested, and (5) palustrine scrub shrub. Most of the wetlands occur on HCDA lands to the west of Kamehameha Highway, along the banks of the He‘eia Stream in He‘eia State Park, and along the northwestern, western, and southwestern walls of the fishpond (Hawai‘i Office of Planning 2015).

The estuarine wetlands occur in the northern part of the HCDA wetland area, and largely comprise thick mangrove swamp (Calvin Kim and Associates 1990, Brooks 1991, PBR Hawai‘i 1993, USDA 2011). Red mangrove *(Rhizophora mangle*), introduced to the area around 1910, is the dominant species, followed by the oriental mangrove (*Bruguiera sexangula*) and black mangrove (*Bruguiera gymorhiza*), both of which are introduced species as well. The expansion

of mangroves and deposition of sediments over time has reduced the estuarine environment and altered water flow patterns with respect to both the stream channel locations and the extent of tidal water incursions (Hawai‘i Office of Planning 2015). The estuarine and freshwater wetlands are inundated with waters from He‘eia Stream as well as sea water when the tide is high. This results in large fluctuations in water conditions including dissolved oxygen, pH, and temperature. The mangroves capture sediment and organic material from the stream flow, which creates a silty mud bottom along the coast.

In addition to the sedimentation and water quality impacts described above, mangroves have impacts on habitats for native and non-native species. Although the mangroves are not native to Hawai‘i, they are known to provide habitat to a variety of marine and estuarine organisms (albeit mostly non-native species). These areas act as breeding grounds and a nursery for marine life, and many associated resident coastal species are tolerant to changes in salinity (Hawai‘i Office of Planning 2015). However, mangroves have colonized important foraging and nesting habitat of four endemic (and endangered) Hawaiian waterbird species, overgrown Native Hawaiian archaeological sites, invaded anchialine pools, and caused localized drainage and aesthetic problems (Allen, 1998). In addition, invasive mangroves facilitate the persistence and spread of introduced species, which may ultimately impact the ~500 estuarine and marine endemic species in Hawai‘i. Facilitation of exotic species and especially the reduction of available habitat for native species (e.g. waterbirds) by invasive mangroves are likely to become significant problems if subtropical regions and associated new mangrove habitats expand due to global warming (IPCC 2007) (Demopoulos and Smith, 2010).

He‘eia Fishpond is the largest inland body of water in the proposed action area. This 88-acre seashore pond is located on the shoreline of Kāne‘ohe Bay and is completely surrounded by a rock wall. The waters of the pond receive freshwater input from the He‘eia Stream, which drains the He‘eia watershed and empties into the northwestern corner of the fishpond. The fishpond retains a brackish character resulting from tidal flux of seawater from the adjacent Kāne‘ohe Bay. Water flux into and out of the fishpond is regulated by a series of eight sluices. The pond has been used primarily as a site to promote aquaculture using Native Hawaiian resource management practices.

5.1.2.2 Riparian and Freshwater Habitats

The riparian and freshwater habitats of the project area include streams and associated riparian buffer areas, freshwater emergent wetlands, freshwater forested/shrub wetland, and freshwater ponds. Haiku Stream and Iolekaa Stream converge in the upland portion of the project area to form He‘eia Stream. As He‘eia Stream flows through the HCDA parcel, it forms freshwater forested/shrub wetlands. Freshwater emergent wetlands are located throughout the HCDA parcel and immediately upstream from the mangrove swamp. He‘eia Stream flows through these wetlands and discharges into Kāne‘ohe Bay. Surface water flow is often restricted by the presence of thick, non-native vegetation such as California grass (*Urochloa mutica*). Similarly, the floodplain along the stream, identified as marsh habitat, is overgrown with California grass.

5.1.2.4 Marine Habitats

NOAA's National Centers for Coastal Ocean Science (NCCOS) identified 29 different habitats in the bay, including emergent vegetation, sand, mud, seagrass, macroalgae, encrusting coralline algae, linear reef, spur and groove reef, patch reef (individual and aggregated), coral head (individual and aggregated), scattered coral rock, and colonized volcanic rock/boulder (NOAA 2003). Figure 5.7 depicts the major marine habitats present within the preferred alternative boundary.

Kāneʻohe Bay has three reef zones: a fringing reef zone, a lagoon zone, and a barrier reef complex. Fringing reefs are present along most of the shoreline, except where freshwater streams enter the bay or where the reefs have been dredged. A large barrier reef covers the middle portion of Kāneʻohe Bay, channeling the movement of water from the open ocean into the northern Mokoliʻi Passage and southern Sampan Channel. This barrier reef protects the bay from tradewind swells, making the bay conducive for extensive coral reef development. The southernmost embayment of Kāneʻohe Bay is home to extensive coral reefs which provide important breeding areas for fish and other marine life. The southern basin of Kāneʻohe Bay is isolated from direct exchange of water with the open ocean thus, pollutants are trapped in the southern area of Kāneʻohe Bay for longer periods of time than in other areas of the bay.

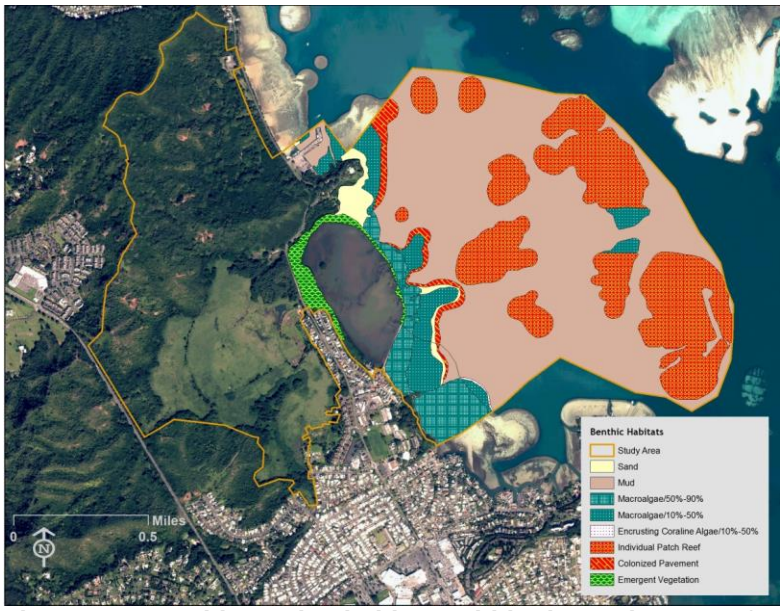


Figure 5.7. Benthic marine habitats within the project area (Data Source: NOAA NCCOS, 2003)

5.1.3 Living Resources

5.1.3.1 Flora[11]

[11] Flora species lists are not comprehensive. List include common and dominant species, invasive species, rare species, and protected species (i.e., species listed as threatened or endangered under the Endangered Species Act).

Terrestrial plant species present within the uplands of the project area (He‘eia State Park, areas between the He‘eia Fishpond and the residential neighborhood, emergent lands on Moku o Lo‘e, and upland areas surrounding the wetlands and forested land at the foothills of the Ko‘olau Mountains on the HCDA property) are listed in Table 5.2. They include a variety of plants which are native to the Hawaiian Islands (e.g., ‘ahu‘awa sedge), introduced species (e.g., Indian fleabane), decorative trees (e.g., plumeria), and important food sources (fruit trees like banana, guava, and papaya). This variety of plants reflects the nature of the area as a mosaic of developed areas and undeveloped natural areas.

Table 5.2. Terrestrial flora found within the project area

Common Name	Scientific Name	Family	Common Name for Family
hala	*Pandanus tectorius*	Pandanaceae	(none)
‘ahu‘awa	*Cyperus javanicus*	Cyperaceae	Sedges
basket grass	*Oplismenus hirtellus*	Poaceae	Grasses
Bermuda grass	*Cynodon dactylon*	Poaceae	Grasses
Hilo grass	*Paspalum conjugatum*	Poaceae	Grasses
pitted beardgrass	*Bothriochloa pertusa*	Poaceae	Grasses
coconut	*Cocus nucifera*	Arecaceae	Palm trees
loulu	*Pritchardia sp.*	Arecaceae	Palm trees
phoenix palms	*Phoenix sp.*	Arecaceae	Palm trees
red ginger	*Alpinia purpurata*	Zingiberaceae	Ginger family
banana	*Musa x paradisiaca*	Musaceae	(none)
‘ahinahina (chaff flower)	*Achyranthes splendens var. rotunda*	Amaranthaceae	Amaranth family
Indian fleabane	*Pluchea indica*	Asteraceae	Daisy family
wedelia	*Sphagneticola trilobata*	Asteraceae	Daisy family
naupaka	*Scaevola taccada*	Goodeniaceae	(none)
Chinese violet	*Asystasia gangetica*	Acanthaceae	Acanthus family
naio	*Myoporum sandwicense*	Scrophulariaceae	Figwort family
ixora	*Ixora sp.*	Rubiaceae	Coffee, madder, or bedstraw family
maile pilau	*Paederia foetida*	Rubiaceae	Coffee, madder, or bedstraw family
plumeria	*Plumeria pudica*	Apocynaceae	Dogbane family
octopus tree	*Schefflera actinophylla*	Araliaceae	Ivy family
ironwood	*Casuarina equisetifolia*	Casuarinaceae	She-oak or ironwood family
koa haole	*Leucaena leucocephala*	Fabaceae	Legume (pea or bean) family
red powderpuff	*Calliandra haematocephala*	Fabaceae	Legume (pea or bean) family
bauhinia	*Bauhinia purpurea*	Fabaceae	Legume (pea or bean) family
milo	*Thespesia populnea*	Malvaceae	Mallows
hau	*Hibiscus tiliaceous*	Malvaceae	Mallows
akia	*Wikstroemia uva-ursi*	Thymelaeaceae	(none)

allspice	*Pimenta dioica*	Myrtaceae	Myrtle family
guava	*Psidium guajava*	Myrtaceae	Myrtle family
Java plum	*Syzygium cumini*	Myrtaceae	Myrtle family
strawberry guava	*Psidium guajava*	Myrtaceae	Myrtle family
Christmas berry	*Schinus terebinthifolius*	Anacardiaceae	Cashew family
mango	*Mangifera sp.*	Anacardiaceae	Cashew family
ʻaʻaliʻi	*Dodonaea viscosa*	Sapindaceae	Soapberry family
kukui	*Aleurites moluccana*	Euphorbiaceae	Spurge family
spurges	*Euphorbia sp.*	Euphorbiaceae	Spurge family
papaya	*Carica papaya*	Caricaceae	(none)
star fruit	*Averrhoa carambola*	Oxalidaceae	Wood sorrel family
silver oak	*Grevillea robusta*	Proteaceae	Protea, Banksia, and grevillea

The estuarine area where the Heʻeia Stream meets the Heʻeia Fishpond is dominated by a red mangrove (*Rhizophora* mangle) forest. This introduced species will be removed from the estuarine wetlands near the mouth of Heʻeia Stream on the HCDA parcel. It is the focus of a habitat restoration project led by reserve partner Kākoʻo ʻŌiwi. Plant species of the estuarine habitats in the project area are listed in Table 5.3.

Table 5.3. Estuarine flora found within the project area

Common Name	Scientific Name	Family	Common Name for Family
swordfern	*Microsorium scolopendria*	Polypodiaceae	Ferns (epiphytes)
basket grass	*Oplismenus hirtelius*	Poaceae	Grasses
Job's tears	*Coix lachrymal-jobi*	Poaceae	Grasses
sedge	*Frimbristylis littoralis*	Cyperaceae	Sedges
aki aki	*Schoenoplectus tabernaemontani*	Cyperaceae	Sedges
umbrella sedge	*Cyperus alternifolius*	Cyperaceae	Sedges
arrowhead	*Sagittaria sagittaefolia*	Alismataceae	Water-plantains
ʻape	*Xanthosoma robustum*	Araceae	Arum family
dumb cane	*Dieffenbachia sp.*	Araceae	Arum family
honohono	*Dendrobium anosmum*	Orchidaceae	Orchids
sensitive plant	*Mimosa pudica*	Fabaceae	Legume (pea or bean) family
kamole	*Ludwigia octovalvis*	Onagraceae	Evening primrose family
rose apple	*Eugenia jambos*	Myrtaceae	Myrtle family
red mangrove	*Rhizophora mangle*	Rhizophoraceae	Mangrove trees
oriental mangrove	*Bruguiera sexangula*	Rhizophoraceae	Mangrove trees
black mangrove	*Bruguiera gymorrhiza*	Rhizophoraceae	Mangrove trees
macranga	*Macaranga grandifolia*	Euphorbiaceae	Spurge family
wedelia	*Sphagneticola trilobata*	Asteraceae	Daisy family

California grass (*Brachiaria mutica*) is an important invasive species within the riparian and freshwater areas of the project area. This species can affect (i.e., restrict) water flow through the stream and wetlands. Reserve partner Kāko'o 'Ōiwi is leading an extensive invasive species removal and habitat restoration project to control invasive California grass and create a natural riparian buffer around He'eia Stream in the HCDA parcel. Riparian and freshwater flora species are listed in Table 5.4.

Table 5.4. Riparian and freshwater flora found within the project area

Common Name	Scientific Name	Family	Common Name for Family
neke fern	*Cyclosorus interruptus*	Thelypteridaceae	Ferns (terrestrial)
California grass	*Brachiaria mutica*	Poaceae	Grasses
makaloa	*Cyperus laevigatus*	Cyperacea	Sedges

The dominant marine flora are various algal species found on the shallow reefs, reef flats, and mud flats in the near vicinity of He'eia Fishpond and Hawai'i Institute of Marine Biology (HIMB). Of particular note is gorilla ogo, an invasive species within the reef habitats of Kāne'ohe Bay and other parts of Hawai'i that is the target of extensive restoration projects by the Division of Aquatic Resources (DAR) within the Hawai'i Department of Land and Natural Resources (DLNR). Marine flora species are listed in Table 5.5.

Table 5.5. Marine flora found within the project area

Common Name	Scientific Name	Phylum/Division
gorilla ogo	*Gracilaria salicornia*	Rhodophyta (red algae)
tambalang	*Eucheuma spinosum*	Rhodophyta
n/a	*Acanthophora spicifera*	Rhodophyta
green bubble algae	*Dictyosphaeria cavernosa*	Chlorophyta (green algae)
n/a	*Dictyota sp.*	Heterokontophyta
n/a	*Padina sp.*	Heterokontophyta

5.1.3.2 Fauna[12]

The fauna found in the terrestrial areas includes coastal native birds (e.g., black noddy) and introduced birds (e.g., cardinal and dove species) and mammals (e.g., rats and feral cats) typically found in beachside areas, gardens, parklands, and agricultural areas on O'ahu. Migratory bird species such as Pacific golden plover and wandering tattler are also present. Feral cats and other introduced mammalian predators of native bird species will be a target of predator control activities proposed by reserve partner Kāko'o 'Ōiwi. Terrestrial fauna are listed in Table 5.6.

[12] Fuana species lists are not comprehensive. List include common and dominant species, invasive species, rare species, and protected species (i.e., species listed as threatened or endangered under the Endangered Species Act).

Table 5.6. Terrestrial fauna found within the project area

Common Name	Scientific Name	Phylum	Class
cane spider	*Heteropoda sp.*	Arthropoda	Arachnida
honeybee	*Apis mellifera*	Arthropoda	Insecta
globe skimmer dragonfly	*Pantala flavenscens*	Arthropoda	Insecta
monarch butterfly	*Danaus plexippus*	Arthropoda	Insecta
cane toad	*Rhinella marina*	Chordata	Amphibia
bullfrog	*Rana catesbiana*	Chordata	Amphibia
great frigatebird	*Fregata minor*	Chordata	Aves (birds)
black noddy	*Anous minutus*	Chordata	Aves
black-crowned night heron	*Nycticorax nycticorax*	Chordata	Aves
cattle egret	*Bubulcus ibis*	Chordata	Aves
mallard-koloa hybrid	*Anas wyvilliana x A. platyrhynchos*	Chordata	Aves
Pacific golden plover	*Pluvialis fulva*	Chordata	Aves
wandering tattler	*Tringa incana*	Chordata	Aves
red-crested cardinal	*Paroaria coronate*	Chordata	Aves
northern cardinal	*Cardinalis cardinalis*	Chordata	Aves
red-vented bulbul	*Pycnonotus cafer*	Chordata	Aves
shama thrush	*Copsychus malabaricus*	Chordata	Aves
common myna	*Acridotheres tristis*	Chordata	Aves
common waxbill	*Estrilda astrild*	Chordata	Aves
spotted dove	*Streptopelia chinensis*	Chordata	Aves
zebra dove	*Geopelia striata*	Chordata	Aves
Japanese white-eye	*Zosterops japonicas*	Chordata	Aves
Hawaiian hoary bat*	*Lasiurus cinereus semotus*	Chordata	Mammalia
house mouse	*Mus musculus*	Chordata	Mammalia
rat	*Rattus sp.*	Chordata	Mammalia
feral cat	*Felis catus*	Chordata	Mammalia

*Protected under the Endangered Species Act

The diversity of fauna species found within the estuarine areas of the project site reflects the variety of habitats within these areas. Additionally, as estuarine areas represent areas where fresh and salt water meet, certain species (barracuda) may be found both within estuarine and marine habitats and others could be found in both freshwater and estuarine areas (anchialine shrimp of the genus Atyidae). Estuarine species of the tidal wetlands and fishpond are listed in Table 5.7.

Table 5.7. Estuarine fauna found within the project area

Common Name	Scientific Name	Phylum	Class
shrimp	*Atyidae sp.*	Arthropoda	Crustacea [sub-phylum]
moray eel	*Gymnothorax sp.*	Chordata	Actinopterygii (ray-finned fishes)
barracuda	*Sphyraena barracuda*	Chordata	Actinopterygii

Dussumier's surgeonfish	*Acanthurus dussumieri*	Chordata	Actinopterygii
porcupinefish	*Diodontidae sp.*	Chordata	Actinopterygii
threadfin	*Polydactylus sexfilis*	Chordata	Actinopterygii
Hawaiian flagtail	*Kuhlia xenura*	Chordata	Actinopterygii
Hawaiian lady fish	*Elops hawaiensis*	Chordata	Actinopterygii
milkfish	*Chanos chanos*	Chordata	Actinopterygii

Similar to some estuarine species described above, some species of riparian or freshwater animals can be found within both the freshwater and estuarine habitats. A list of species which are primarily associated with riparian and freshwater habitats in the project area presented in Table 5.8.

Table 5.8. Riparian and freshwater fauna found within the project area

Common Name	Scientific Name	Phylum	Class
dragonfly	*Pantala flavescens*	Arthropoda	Insecta
blackline Hawaiian damselfly*	*Megalagrion nigrohamatum nigrolineatum*	Arthropoda	Insecta
stream gobi	*Awaou guamensis*	Chordata	Actinopterygii (ray-finned fishes)
Hawaiian moorhen*	*Gallinula chloropus sandvicensis*	Chordata	Aves (birds)
Hawaiian stilt*	*Himantopus mexicanus knudseni*	Chordata	Aves
Hawaiian coot*	*Fulica americana alai*	Chordata	Aves
Hawaiian duck*	*Anas wyvilliana*	Chordata	Aves

*Species protected under the Endangered Species Act

Kāneʻohe Bay offers a diverse array of habitats for marine organisms, ranging from intertidal to pelagic, within only a few kilometers. Kāneʻohe Bay is famous for its abundant coral habitats, and one reef alone may support as many as 3,000 species (HIMB 2016). The coral reef systems serve as breeding grounds and nursery areas for many other marine species. Heʻe (day octopus, *Octopus cyanea*) is an important recreational fishery within Kāneʻohe Bay. See Section 5.2.3 for more information on fisheries within the project area of the proposed action. Marine species are listed in Table 5.9.

Table 5.9. Marine fauna found within the project area

Common Name	Scientific Name	Phylum
sponges	*Porifera*	Porifera
zoanthids	*Zoanthidea*	Cnidaria
sea anemones	*Anemonia sulcate*	Cnidaria
Hawaiian reef coral*	*Montipora dilatata*	Cnidaria
rice coral	*Montipora capitata*	Cnidaria
mushroom coral	*Fungia scutaria*	Cnidaria
ocellated coral	*Cyphastrea ocellina*	Cnidaria
corrugated coral	*Pavona varians*	Cnidaria

cauliflower coral	*Pocillopora damicornis*	Cnidaria
finger coral	*Porites compressa*	Cnidaria
inarticulated brachiopod*	*Lingula reevii*	Brachiopoda
collector urchins	*Tripnuestes gratilla*	Echinodermata
long spined urchin	*Echinothrix diadema*	Echinodermata
red slate pencil urchin	*Heterocentrotus mammillatus*	Echinodermata
short spined urchins	*Echinometra mathaei*	Echinodermata
blue pincher crabs	*Callinectus sapidus*	Arthropoda
hermit crab	*Paguroidea sp.*	Arthropoda
ghost crabs	*Ocypode ceratophthalma*	Arthropoda
mantis shrimp	*Gonodactylus glabrous*	Arthropoda
black nerite shells	*Nerita picea*	Mullosca
periwinkle shells	*Littorina littorea*	Mullosca
little necks clams	*Mercenaria mercenaria*	Mullosca
he'e (day octopus)	*Octopus cyanea*	Mullosca
bristle worms	*Polychaeta sp.*	Annelida
tunicates	*Tunicata sp.*	Chordata (tunicate)
hammerhead shark	*Sphyrna lewini*	Chordata (cartilaginous fishes)
tiger shark	*Galeocerdo cuvieri*	Chordata (cartilaginous fishes)
whitetip reef shark	*Trianodon obesus*	Chordata (cartilaginous fishes)
butterflyfish	*Chaetodontidae sp.*	Chordata (ray-finned fishes)
damselfish	*Pomacentridae sp.*	Chordata (ray-finned fishes)
goatfish	*Mullidae sp.*	Chordata (ray-finned fishes)
gobies	*Gobiidae sp.*	Chordata (ray-finned fishes)
parrotfish	*Scaridae sp.*	Chordata (ray-finned fishes)
surgeonfish	*Acanthuridae sp.*	Chordata (ray-finned fishes)
wrasse	*Labridae sp.*	Chordata (ray-finned fishes)
green sea turtle+	*Chelonia mydas*	Chordata (reptilia)
hawksbill sea turtle+	*Eretmochelys imbricata*	Chordata (reptilia)
Hawaiian monk seal+•	*Neomonachus schauinslandi*	Chordata (mammalia)

*Species identified by NOAA NMFS as a "Species of Concern" under the Endangered Species Act
+Species listed as Threatened or Endangered under the Endangered Species Act
•Species protected under the Marine Mammal Protection Act

5.1.3.3 Special-Status Species and Habitats

Within the project area there are many special-status species which may be be affected by the proposed action. Listed species, and in some cases their habitats, are protected under the Endangered Species Act, Marine Mammal Protection Act, Magnuson-Stevens Fishery Conservation and Management Act, and the Migratory Bird Treaty Act. Additional species considered here are proposed for listing or candidate species for listing.
See Chapter 7 for detail on these laws and relevancy to the proposed action.

5.1.3.3.1 Threatened and Endangered Species

There are several species protected pursuant to the federal Endangered Species Act (ESA) that are present within or near the boundary of the proposed He‘eia NERR that could be impacted by the proposed action. *See* Chapter 7 for a discussion on the ESA and relevancy to the proposed action.

The State of Hawai‘i automatically lists any species that is listed on the federal Endangered Species List on the State Endangered Species List and provides these species with state protection in addition to federal protection. HRS §§ 195D-1 *et seq*.

In addition to considering threatened and endangered species, species proposed for listing, candidate species, and Species of Concern were also considered. Additionally, where designated, the critical habitats for listed species are considered as part of the effected environment. The below subsections discuss the species afforded recognition under the ESA that could be found within the project area.

5.1.3.3.1.1 Endangered Species Act – listed species

Within the project area there are 11 endangered species and two threatened species that are known to occur or have the potential to occur (Table 5.10).[13,14] Critical habitat within the Hawaiian Islands has only been designated for two species, the blacklined Hawaiian damselfly (*Megalagrion nigrohamatum nigrolineatum*) and the Hawaiian monk seal (*Neomonachus schauinslandi*).

Table 5.10. Threatened and endangered species known to occur or have the potential to occur within or near the proposed He‘eia National Estuarine Research Reserve project area

Threatened or Endangered Species under the Endangered Species Act	Scientific Name	Hawaiian Name	Status	Critical Habitat Designation (in Hawai‘i)
blackline Hawaiian damselfly	*Megalagrion nigrohamatum nigrolineatum*		Endangered	Yes
Hawaiian hoary bat	*Lasiurus cinereus semotus*	‘ope‘ape‘a	Endangered	None
Newell’s shearwater	*Puffinus auricularis newelli*	‘a‘o	Threatened	None

[13] The federally endangered chaff flower or ‘ahinahina (*Achyranthes splendens* var. *rotunda*) has been reported as cultivated in the residential neighborhood near the fishpond (Hawai‘i Office of Planning 2015). The provenance of these individuals could not be determined and therefore the same protection status afforded under the Endangered Species to wild plants is not conferred to these cultivated plants (Hawai‘i Administrative Rule Section 13-107-7). No further consideration or analysis to ‘ahinahina as an endangered species is included for this environmental assessment.

[14] List of species based upon review of draft management plan (Hawai‘i Office of Planning 2016) and gap analysis (Hawai‘i Office of Planning 2015a), field observations, and technical assistance from USFWS Pacific Islands Fish and Wildlife Office and NOAA National Marine Fisheries Service Office of Protected Resources and NOAA National Marine Fisheries Service Pacific Islands Fisheries Science Center in June 2016.

Hawaiian coot	*Fulica americana alai*	‘alae kea	Endangered	None
Hawaiian duck	*Anas wyvilliana*	Koloa	Endangered	None
Hawaiian gallinule (moorhen)	*Gallinula chloropus sandvicensis*	‘alae ‘ula	Endangered	None
Hawaiian stilt	*Himantopus mexicanus knudseni*	ae’o	Endangered	None
Hawaiian goose	*Branta* (=*Nesochen*) *sandvicensis*	nēnē	Endangered	None
hawksbill sea turtle	*Eretmochelys imbricata*	honu ‘ea	Endangered	None[@]
green sea turtle (Central North Pacific Distinct Population Segment)	*Chelonia mydas*	Honu	Threatened	None[@]^
Hawaiian monk seal*	*Neomonachus schauinslandi*	ilio-holo-i-ka-uaua or na mea hulu	Endangered	Yes
humpback whale (Hawai‘i Distinct Population Segment)*	Megaptera novaeangliae	kohola	Endangered[#]	None
false killer whale (main Hawaiian Island insular)*	*Pseudorca crassidens*		Endangered	None

*Species is also protected under the Marine Mammal Protection Act
[#]Humpback whale Hawai‘i Distinct Population Segment proposed for delisting. See 80 Fed. Reg. 22303
[@]Critical habitat for the hawksbill sea turtle and green sea turtle has been designated in the Caribbean. No critical habitat for these species has been designated in Hawai‘i. See 63 Fed. Reg. 46693
^Critical habitat for the green sea turtle Central North Pacific distinct population segment is under consideration for future rulemaking. see 81 Fed. Reg. 20058

Blackline Hawaiian Damselfly (*Megalagrion nigrohamatum nigrolineatum*)
This endemic damselfly was once widespread across O‘ahu, found from sea level to 2,400 feet on both the windward and leeward sides of the Ko‘olau and Wainae mountain ranges. This species’ range has been restricted to 11 streams in the Ko‘olau Mountains and is threatened by predation from non-native species and habitat loss (71 Fed Reg. 53756) Within the project area of the proposed action, the blackline Hawaiian damselfly was recorded within the middle reach of He‘eia Stream during surveys conducted between 1975 and 2003 (Parham et al. 2008).

Critical habitat has been designated for the blackline Hawaiian damselfly (77 Fed. Reg. 57648). All designated critical habitat is west of the Kahekili Highway (Hawai‘i Route 83) and is beyond the scope of any of the alternatives considered within this analysis.

Hawaiian hoary bat, ‘ope‘ape‘a (*Lasiurus cinereus semotus*)
The Hawaiian hoary bat or ‘ope‘ape‘a (*Lasiurus cinereus semotus*) can be found in several different habitat types, using forested areas for roosting and foraging over open areas adjacent to forests or over open water. Habitat requirements for roosting and breeding are unknown; bats are most frequently observed in association with non-native vegetation, not native vegetation (USFWS 1998) such as coconut palms (*Cocus nucifera*) and pandanus trees (*Pandanus tectorius*) (Hawai‘i Department of Land and Natural Resources 2005), both of which are found within the project area. In the He‘eia estuary, invasive mangrove areas within wetlands and along the He‘eia Fishpond wall provide potential roosting habitat for the Hawaiian hoary bat.

Open areas above the fishpond and wetlands are potential foraging areas for this species. Critical habitat has not been designated for this species.

Newell's Shearwater, ʻaʻo (*Puffinus auricularis newelli*)
Like several other Hawaiian seabirds, Newell's shearwater nest in mountainous areas and feed out to sea in open water. Although historically found on all major Hawaiian Islands (USFWS 1983), the most recent U.S. Fish and Wildlife Status Review (USFWS 2011) of this species does not document any presence of this species on Oʻahu. Fledging and adult birds traverse portions of the islands to reach their nesting and feeding grounds. Within the project area of the proposed action, Newell's shearwaters may traverse this area during breeding season (between September 15 and December 15). Major threats to this threatened species include predation by introduced mammalian species (e.g., rats and feral cats) and light pollution which affect the bird's nocturnal flight navigation.

Hawaiian Waterbirds

Hawaiian coot, ʻalae kea (*Fulica americana alai*)
Hawaiian duck, koloa (*Anas wyvilliana*)
Hawaiian gallinule (moorhen), ʻalae ʻula (*Gallinula chloropus sandvicensis)*
Hawaiian stilt, ae'o (*Himantopus mexicanus knudseni*)

Of the vegetated habitats in the project area, the wetlands offer the greatest potential to support or attract special-status species. Biannual waterbird counts conducted at Heʻeia marsh confirm that the site is used by the Hawaiian stilt (*Himantopus mexicanus knudseni)*, Hawaiian moorhen (*Gallinula chloropus sandvicensis*), Hawaiian coot (*Fulica americana alai*), and Hawaiian duck (*Anas wyvilliana)*.

Critical habitat has not been designated for any of the listed waterbird species, and the Heʻeia marsh was not identified as one of the "core" wetlands in the most recent recovery plan for endangered Hawaiian waterbirds. However, Heʻeia marsh was identified as a "supporting" wetland (USFWS 2011). The USFWS recovery plan describes Heʻeia as a site that historically had value as a complex of tidal marshes and open-water areas, but which has been substantially modified and presently consists of non-native mangroves, remnants of ponds, and wet pasture. The recovery plan recommends that Heʻeia be restored and managed by the State to provide enhanced habitat for endangered waterbirds.

Hawaiian goose, nēnē (*Branta* (=*Nesochen*) *sandvicensis*)
The Hawaiian goose or nēnē is known to occur on the Island of Kauaʻi, Maui, Molokaʻi, and the Island of Hawaiʻi. Although nēnē are not known to occur on Oʻahu, habitat types found within the project area of the proposed action are suitable for this endangered species. Non-native grasslands such as though found in the Heʻeia HCDA parcel are potentially a suitable habitat for nēnē. Recovery objectives in the draft revised recovery plan for nēnē include the restoration and maintenance of self-sustaining populations on Kauaʻi, Maui Nui (Maui, Molokaʻi, Lānaʻi, and Kahoʻolawe), and the Island of Hawaiʻi (See 69 Fed. Reg. 57356).

Sea Turtles

Hawksbill sea turtle, honu ʻea (*Eretmochelys imbricate*)
Green sea turtle, honu (*Chelonia mydas*)

Hawksbill sea turtles utilize the coral reef habitats within Kāneʻohe Bay for foraging, where they primarily feed on sponges, invertebrates (crabs), and algae. Within the Hawaiian Islands, hawksbill sea turtles nest primarily on the Island of Hawaiʻi, but a few females nest on the beaches of Maui and Molokaʻi and possibly Oʻahu[15]. This species of turtle is threatened by habitat loss (beach erosion and coastal construction), tourism development, and nest predation (NOAA and USFWS 1998). NOAA NMFS reports that the Hawaiʻi population of hawksbill sea turtles is isolated from all other hawksbills in the Pacific Ocean (NOAA 2016b).

Green sea turtles live in nearshore coastal habitats throughout Hawaiʻi. Most of their time is spent at depths less than 100 feet, but they can dive to depths of over 500 feet when migrating. During the breeding season males and females swim 500-800 miles from their feeding grounds in the main Hawaiian Islands to their nesting beaches, primarily at French Frigate Shoals, in the Northwest Hawaiian Islands (NOAA 2016b).

The green sea turtle is present year-round in the waters of Kāneʻohe Bay, including the marine environments of the proposed Heʻeia NERR (Hawaiʻi Office of Planning, 2015). No critical habitat in the Hawaiian Islands has been designated by the USFWS for this species in Hawaiʻi. However, critical habitat for the green sea turtle Central North Pacific distinct population segment is under consideration for future rulemaking. See 81 Fed. Reg. 20058.

Hawaiian monk seal, ilio-holo-i-ka-uaua, or na mea hulu (*Neomonachus schauinslandi*)
Hawaiian monk seals may travel through Kāneʻohe Bay or utilize portions of Kāneʻohe Bay for foraging, using bottom habitats to flush or pin their prey. However, this species is not documented as present in Kāneʻohe Bay according to HIMB's Kāneʻohe Bay Taxonomic Information List (HIMB 2016). Most foraging occurs at depths less than 200 meters, which encompasses the entirety of Kāneʻohe Bay. Hawaiian monk seals use terrestrial areas with adjacent shallow, sheltered aquatic areas for pupping and nursing and use additional terrestrial areas for hauling out, resting, and molting. Within the Kāneʻohe Bay area, Hawaiian monk seals have been observed on the ocean side beaches of the Mōkapu peninsula at Marine Core Base Hawaiʻi (MCBH 2016). Critical habitat for the Hawaiian monk seal was recently revised (effective September 21, 2015), expanding the previous designation in the Northwestern Hawaiian Islands and identifying new key beach areas and marine-foraging areas in the main Hawaiian Islands. See 80 Fed. Reg. 50925 for additional information on critical habitat for Hawaiian monk seals. (Figures 5.8 and 5.9). The project area does not contain terrestrial habitat or key beach areas

[15] U.S. Fish and Wildlife Service Pacific Islands Fish and Wildlife Office notes that nesting occurs on Oʻahu (https://www.fws.gov/pacificislands/fauna/hawksbillturtle.html) but NOAA National Marine Fisheries Service Pacific Islands Regional Office does not identify Oʻahu has a nesting site for hawksbill sea turtles http://www.fpir.noaa.gov/PRD/prd_hawksbill.html

for the monk seal; however, the marine component of the proposed He‘eia NERR site does include marine critical habitat. Hawaiian monk seal marine critical habitat extends from the shoreline out to the 200 meter depth contour, but only includes the seafloor and marine habitat that extends 10 meters in height from the sea floor.

Figure 5.8. Cross-section of Hawaiian monk seal critical habitat (from National Marine Fisheries Service)

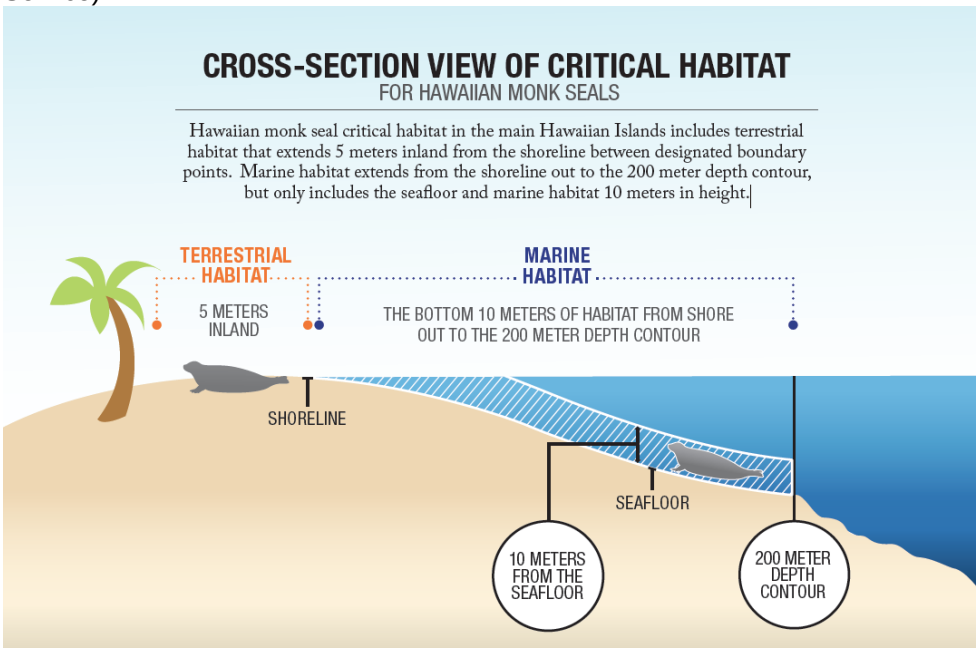
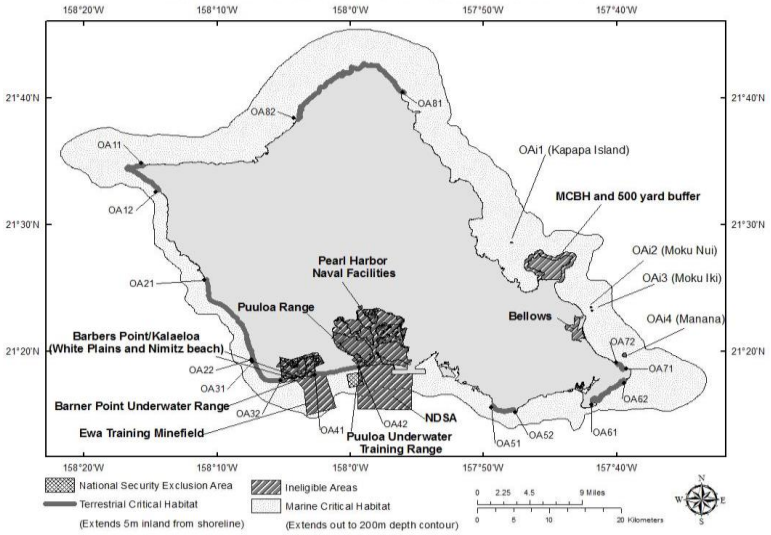


Figure 5.9. Hawaiian monk seal critical habitat in O‘ahu (80 Fed. Reg. 50925)



Humpback whale, koholā (*Megaptera novaeangliae*)

The Hawai‘i Distinct Population Segment of the humpback whale is listed as threatened under the ESA. This population was determined to be discrete based on significant genetic

differentiation from other populations within the North Pacific and evidence of low rates of movement among breeding areas in the North Pacific (Bettridge et al. 2015). In 2015, NMFS announced that the Hawaiian Distinct Population Segment was under review for de-listing. See 80 Fed. Reg. 22303. Based on a NMFS status review, NMFS concluded that the Hawai‘i Distinct Population Segment is not at risk for extinction with high certainty (Bettridge et al. 2015). NMFS is considering whether to de-list this population. No critical habitat has been designated for this species.

The humpback whale is known to be present on the seaward side of the Mōkapu peninsula, which separates the marine portion of the project area of the proposed action within Kāne‘ohe Bay from the open ocean. Through their Sanctuary Ocean Count project, the Hawai‘i Humpback Whale National Marine Sanctuary engages the public to conduct whale counts during peak whale season (January through March) each year on O‘ahu, Hawai‘i, and Kaua‘i. Two monitoring sights are at either end of Kāne‘ohe Bay: Kualoa Ranch (near Chinaman’s Hat) at the northwest end of Kāne‘ohe Bay and Pyramid Rock on the ocean side of Marine Corps Base Hawai‘i on the Mōkapu peninsula at the southeast end of Kāne‘ohe Bay. The results of the counts of the Sanctuary’s project are evidence that humpback whales are utilizing the open ocean environment adjacent to Kāne‘ohe Bay (NOAA 2016c). However, there are no survey points within Kāne‘ohe Bay so this survey project cannot determine whether the interior of Kāne‘ohe Bay is utilized by this species. Kāne‘ohe Bay is relatively shallow, with a mean depth of 10m (33 feet) (Jokiel 1991). Although humpback whales utilize deeper water habitats, humpback whale cows and newborn calves are known to use shallow water, presumably to separate them from mating activity and harassment of males, more turbulent offshore conditions, and predators (Darling 2001) While humpback whales could use the shallower marine habitats of Kāne‘ohe Bay, Kāne‘ohe Bay has not been identified as a biologically important area (see data summarized in Chapter 6). Regardless, an analysis of the actions which may occur within the project area under the proposed action should consider the potential to effects to humpback whale in or near Kāne‘ohe Bay.

False killer whale (*Pseudorca crassidens*), Main Hawaiian Island Insular Stock

Of the three stocks[16] of false killer whale found within the Hawaiian Islands, the main Hawaiian Island insular stock has the potential to occur within Kāne‘ohe Bay. This stock has been declining over the past two decades (Reeves et al. 2009, Baird 2009). The main Hawaiian Island stock is a distinct population from other false killer whales based on the uniqueness of their behavior related to habitat use patterns and their existence in a unique ecological setting (Oleson et al. 2010). Additionally, the Hawaiian insular false killer whale is distinguishable from other false killer whales based on significant difference in DNA (Oleson et al. 2010). The main Hawaiian Island insular stock is the only stock listed as a Distinct Population Segment under the ESA. Significant risks to this population include modification of habitat, overfishing and prey reduction, and risks inherent to small populations. NMFS indicates that occurrence information for this species within the Kāne‘ohe Bay region are lacking.

[16] The Marine Mammal Protection Act defines stock as a group of marine mammals of the same species or smaller taxa, in a common spatial arrangement, that interbreed when mature. (16 U.S.C. 1362(11))

5.1.3.3.2 Candidate and proposed species for listing under the Endangered Species Act[17]

There are two candidate species whose range includes the Hawaiian Islands: two species of manta ray (giant manta ray, *Manta alfredi,* and reef manta ray, *M. birostris*). Neither of these species is documented as present in Kāneʻohe Bay according to HIMB's Kāneʻohe Bay Taxonomic Information List (HIMB 2016). However, these species are known to occur in the Hawaiian Islands and the NMFS status review will provide additional information on these manta species.

In September 2015, seven species of yellow-faced bees (*Hylaeus spp.*) were proposed for listing as endangered under the Endangered Species Act. All but one of these seven species is found on Oʻahu *H. hilaris* is only found on Molokaʻi and is historically known from Maui and Lānaʻi. This species will not be considered further in this analysis. The remaining six species of yellow-faced bees proposed as endangered are found on Oʻahu within habitats that are included within the project area. According to the U.S. Fish and Wildlife ecosystem classification scheme, these six species occur in either coastal ecosystems or lowland mesic ecosystems (a variety of grasslands, forests, and shrublands generally found below 3,300 ft. in elevation and receives between 50 and 75 in of precipitation annually). See 81 Fed. Reg. 8874. Table 5.11 lists both the candidate and proposed species for listing under the Endangered Species Act that could be found within the project area.

Fifteen species of Indo-Pacific corals were designated as threatened or endangered under the Endangered Species Act in 2014. See 79 Fed. Reg. 53851. This was part of a larger consideration for species proposed for listing that included coral species which are found within the Hawaiian Islands. However, none of the 15 designated species are known to occur in the Hawaiian Islands. An additional three foreign species of Indo-Pacific corals were designated in 2015, none of which occur in Hawaiʻi. See 80 Fed. Reg. 60560.

Table 5.11. List of candidate species and species proposed for listing found within or near the boundary of the proposed Heʻeia National Estuarine Research Reserve project area which are under consideration for listing under the Endangered Species Act

Common Name	Scientific Name	Hawaiian Name	Status	Federal Register Notice
giant manta ray	*Manta birostris*	Hāhālua	Candidate for listing	81 Fed. Reg. 8874
reef manta ray	*Manta alfredi*	Hāhālua	Candidate for listing	81 Fed. Reg. 8874
anthricinan yellow-faced bee	*Hylaeus anthracinus*	nalo meli maoli	Proposed Endangered	80 Fed. Reg. 58819
assimulans yellow-faced bee	*Hylaeus assimulans*	nalo meli maoli	Proposed Endangered	80 Fed. Reg. 58819
easy yellow-faced bee	*Hylaeus facilis*	nalo meli	Proposed	80 Fed. Reg.

[17] List of candidate and proposed species developed based on technical assistance with U.S. Fish and Wildlife Service Pacific Islands Fish and Wildlife Office and NOAA National Marine Fisheries Service Office of Protected Resources and NOAA National Marine Fisheries Service Pacific Islands Fisheries Science Center (June 2016).

		maoli	Endangered	58819
Hawaiian yellow-faced bee	*Hylaeus kuakea*	nalo meli maoli	Proposed Endangered	80 Fed. Reg. 58819
Hawaiian yellow-faced bee	*Hylaeus longiceps*	nalo meli maoli	Proposed Endangered	80 Fed. Reg. 58819
Hawaiian yellow-faced bee	*Hylaeus mana*	nalo meli maoli	Proposed Endangered	80 Fed.Reg. 58819

5.1.3.3.3 Species of Concern under the Endangered Species Act

There are two National Marine Fisheries Service-identified Species of Concern present in the marine component of the proposed reserve: Hawaiian reef coral (*Montipora dilatata*) and inarticulated brachiopod (*Lingula reevii*) (Table 5.12). Species of Concern[18] are "those species about which there are some concerns regarding status and threats, but for which insufficient information is available to indicate a need to list the species under the Endangered Species Act. Species of Concern status does not carry any procedural or substantive protections under the ESA but draws proactive attention and conservation action to these species." NMFS identifies several benefits to identifying Species of Concern. These include:

- Identifies species potentially at risk
- Identifies data deficiencies and uncertainties in species' status and threats
- Increases public awareness about those species
- Stimulates cooperative research efforts to obtain the information necessary to evaluate species status and threats
- Fosters voluntary efforts to conserve the species before listing becomes warranted

The designation of a species as a Species of Concern does not carry any procedural or substantive protections under the ESA.

Table 5.12 NOAA NMFS-designated Species of Concern found within or near the boundary of the proposed He'eia National Estuarine Research Reserve project area

Common Name	Scientific Name	Status
Hawaiian reef coral	*Montipora dilatata*	Not warranted for listing under Endangered Species Act 79 Fed. Reg. 53852
inarticulated brachiopod	*Lingula reevii*	Not formally evaluated for listing

5.1.3.3.4 Other Marine Mammals

All marine mammals are protected under the federal Marine Mammal Protection Act (16 U.S.C. §§ 1361 – 1423h). For additional information on the Marine Mammal Protection Act (MMPA) and its relevancy to the proposed action, see Chapter 7. In addition to the marine mammals considered under the Endangered Species Act (Hawaiian monk seal, humpback whale, and

[18] For more information on Species of Concern, visit the National Marine Fisheries Service website at http://www.nmfs.noaa.gov/pr/species/concern/

false killer whale), there are seven additional species of marine mammals which could be found in Kāneʻohe Bay and the proposed project area[19] but which are not protected under the Endangered Species Act (Table 5.13).

Table 5.13 Marine mammals found within or near the boundary of the proposed Heʻeia National Estuarine Research Reserve project area which are not listed under the Endangered Species Act

Common Name	Scientific Name	Hawaiian Name
Pacific bottlenose dolphin	*Tursiops truncatus truncatus*	nai'a
spinner dolphin	*Stenella longirostris longirostris*	nai'a
striped dolphin	*Stenella coeruleoalba*	
rough-toothed dolphin	*Steno bredanensis*	
melon-headed whale	*Peponocephala electra*	
pygmy killer whale	*Feresa attenuata*	
short-finned pilot whale	*Globicephala macrorhynchus*	

It is likely that some species (Pacific bottlenose dolphin and spinner dolphin) may be present in the project area due to the availability of preferred habitat or food sources (e.g., shallow inshore waters). For other marine mammal species it is unlikely that they would be present within the project area or immediate region given the lack of suitable habitat (i.e., deep water areas). None of these cetacean species are documented as present in Kāneʻohe Bay according to HIMB's Kāneʻohe Bay Taxonomic Information List (HIMB 2016). However, that list is not comprehensive. Regardless of presence or absence within the immediate project area, all marine mammals listed in Table 5.13 will be considered as part of the affected environment as they could be present or the activities taking place under the proposed action could affect marine mammal species beyond the project area or Kāneʻohe Bay.

Pacific bottlenose dolphin, nai'a (*Tursiops truncatus truncatus*)

Within the Hawaiian Islands, Pacific bottlenose dolphins are found in shallow inshore waters, such as those within Kāneʻohe Bay, and deeper water. As reported in a stock assessment conducted by NOAA NMFS, there is limited movement of bottlenose dolphins between islands and offshore waters, suggesting the existence of demographically distinct resident populations, including one population designated as an Oʻahu stock. Threats to Pacific bottlenose dolphins include mortality from fishing gear and they are known to steal bait and catch from sport and commercial fisheries (NMFS 2014a).

Spinner dolphin, nai'a (*Stenella longirostris longirostris*)

Spinner dolphins use sheltered bays as rest areas during the day. Although not recorded from Kāneʻohe Bay, the day-time habitat used by spinner dolphins is present within Kāneʻohe Bay, but not within the project area of the proposed action. A stock assessment by NOAA NMFS identifies six distinct stocks of spinner dolphin within the Hawaiian Islands, include an Oʻahu/4-

[19] Based on technical assistance from NOAA National Marine Fisheries Service Office of Protected Resources and Pacific Islands Fisheries Science Center (June 2016 and July 2016).

islands[20] stock. For the O‘ahu/4-islands stock there is increasing concerns of potential effect of swim-with-dolphin programs and other tourism activities (NOAA 2012).

Striped dolphin (*Stenella coeruleoalba*)
Striped dolphins are unlikely to occur within the project area of the proposed action though may be found in the open ocean areas adjacent to Kāne‘ohe Bay (NOAA 2014f). Foraging zones for this species are pelagic to benthopelagic zones, to depths as dep as 200-700m, in continental slope or oceanic regions. (Hammond et al. 2008) These habitat types do not occur within the project area.

Rough-toothed dolphin (*Steno bredanensis*)
Rough-toothed dolphins prefer deep water areas of tropical and warmer temperate areas where their prey of squid and fish are concentrated. This habitat type is not found within project area nor within Kāne‘ohe Bay, although suitable habitat may be found off the windward coast of O‘ahu. The NMFS stock assessment of this species (NOAA 2014d) considers this species as a single stock within the Hawaiian Islands although there are scientific studies which suggest that there may be at least two stocks within the main Hawaiian Islands. Threats to this stock include mortality or serious injury from interaction with sport and commercial fisheries infection from the bacteria *Brucella* and virus *Morbillivirus.*

Melon-headed whale (*Peponocephala electra*)
Melon-headed whales are found in moderately deep water where their prey (fish, squid, and some crustaceans) are found, foraging near cold and warm-core eddies (Woodworth et al. 2012). Within the Hawaiian Islands, satellite telemetry data showed distant offshore movements for this stock, nearly to the edge of the U.S. Exclusive Economic Zone (NOAA 2014). NOAA NMFS stock assessment (2014b) reports sightings for melon-headed whales along the leeward (west) coast of O‘ahu, with no observations on the windward (east) coast. Active sonar, seismic operations, and other loud underwater sounds are increasing concerns for melon-headed whales (Southall et al. 2006).

Pygmy killer whale (*Feresa attenuata*)
Pygmy killer whales in Hawai‘i are found in deep water, generally within 20km of shore (Baird et al. 2011) and are rarely encountered during nearshore surveys (Baird et al. 2013). NOAA NMFS stock assessment identifies one stock in Hawai‘i, which is resident to the main Hawaiian Islands (NOAA 2014c). Active sonar, seismic operations, and other loud underwater sounds are increasing concerns for pygmy killer whales (Brownell Jr et al. 2009).

Short-finned pilot whale (*Globicephala macrorhynchus*)
Short-finned pilot whales are generally found offshore in moderately deep water in areas with high densities of squid. Photo-identification and telemetry studies suggest that there may be inshore and pelagic populations of short-finned pilot whales in Hawai‘i (NOAA 2014e). NOAA

[20] 4-islands refers to the four major islands that constitute Maui Nui (or Greater Maui): Maui, Moloka‘i, Lāna‘i, and Kaho‘olawe

NMFS stock assessment identifies commercial longline fisheries as a source of incidental mortality and serious injury for the short-finned pilot whale (NOAA 2014e).

5.1.3.3.5 Essential Fish Habitat[21]

Under the Magnuson-Stevens Fishery Conservation and Management Act, Fishery Management Councils identify Essential Fish Habitat for marine and anadromous species, as defined in 16 U.S.C. § 1855(b). See Chapter 7 of this document for additional discussion on the Magnuson-Stevens Fishery Conservation and Management Act and its relevance to the proposed action.

Essential Fish Habitat (EFH) includes all waters and substrate necessary for fish for spawning, breeding, feeding, or growth to maturity. Pursuant to the act, the marine water column and seafloor in and surrounding the project area of the proposed action have been designated as EFH, which supports various life stages of management unit species (MUS) identified in the Western Pacific Regional Fishery Management Council's Pelagic and Hawai'i Archipelago Fishery Ecosystem Plans.[22]

In particular, Kāne'ohe Bay has been designated as part of the EFH for Hawai'i Bottomfish (Figure 5.10), Hawai'i Coral Reef Ecosystems (Figure 5.11), Hawai'i Crustacean Fishery (Figure 5.12), and the Hawai'i Pelagic Group. The MUS and life stages found in these waters include eggs, larvae, juveniles and adults of Coral Reef Ecosystem MUS (CRE-MUS); eggs, larvae, juveniles and adults of Bottomfish MUS (BMUS); eggs, larvae, juveniles and adults of Crustacean MUS (CMUS); and eggs, larvae, juveniles, and adults of Pelagic MUS (PMUS). Habitat areas of particular concern are discrete subsets of EFH that provide extremely important ecological functions or are especially vulnerable to degradation. The Habitat Area of Particular Concern (HAPC) designation does not confer additional protection or restrictions upon an area, but can help prioritize conservation efforts. Kāne'ohe Bay has also been designated a HAPC for coral reef ecosystems. In February 2016, the Western Pacific Fishery Management Council announced that its proposed Amendment 4 to the Fishery Ecosystem Plan for Fisheries of the Hawaiian Archipelago would also designate Kāne'ohe Bay as Habitat Area of Particular Concern for Bottomfish. See 81 Fed. Reg. 7494. The proposal has not yet gone into effect. No HAPC has been designated in Kāne'ohe Bay under either Hawai'i Crustacean or Hawai'i Pelagic FEPs.

[21] Discussion is based on draft Fishery Ecosystem Plan for the Hawai'i Archipelago, Western Pacific Regional Fishery Management Council (2016). This section will be updated based on a finalized version of that document if or when such document becomes available.

[22] The Pelagic and Hawai'i Archipelago FEPs are available via the the Western Pacific Regional Fishery Management Council website. See http://www.wpcouncil.org/fishery-plans-policies-reports/

Figure 5.10. Hawaiian Archipelago Fishery Ecosystem Plan for Hawaiian Islands Bottomfish Shallow Species (from draft Fishery Ecosystem Plan for the Hawai'i Archipelago, Western Pacific Regional Fishery Management Council, 2016)

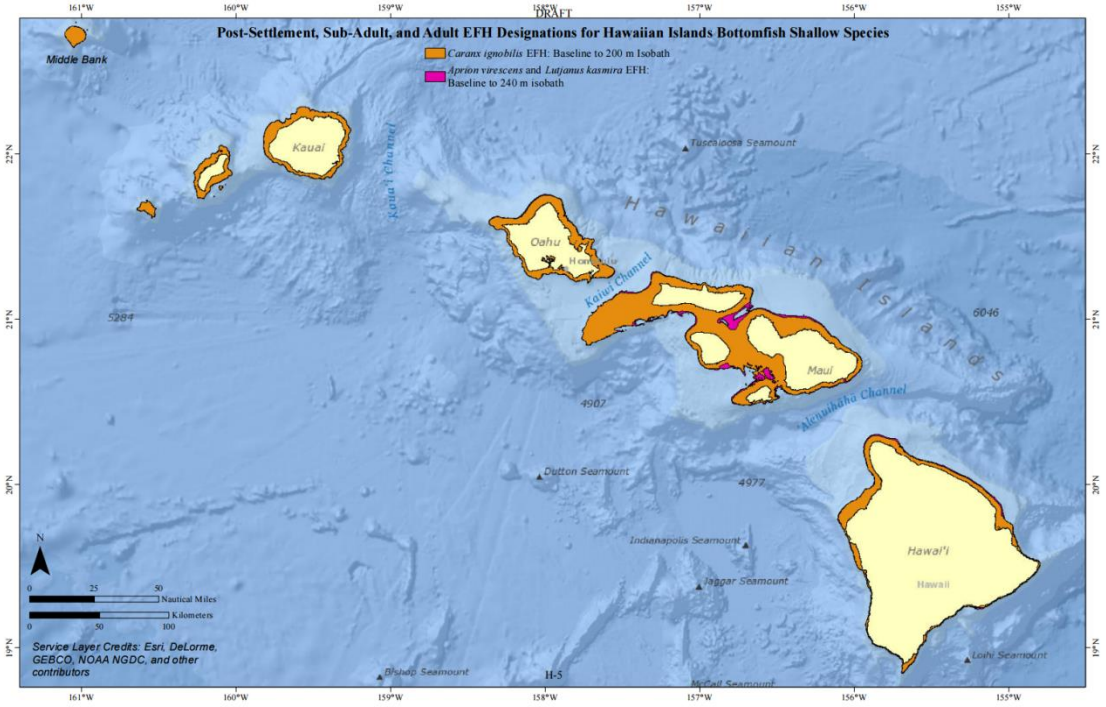
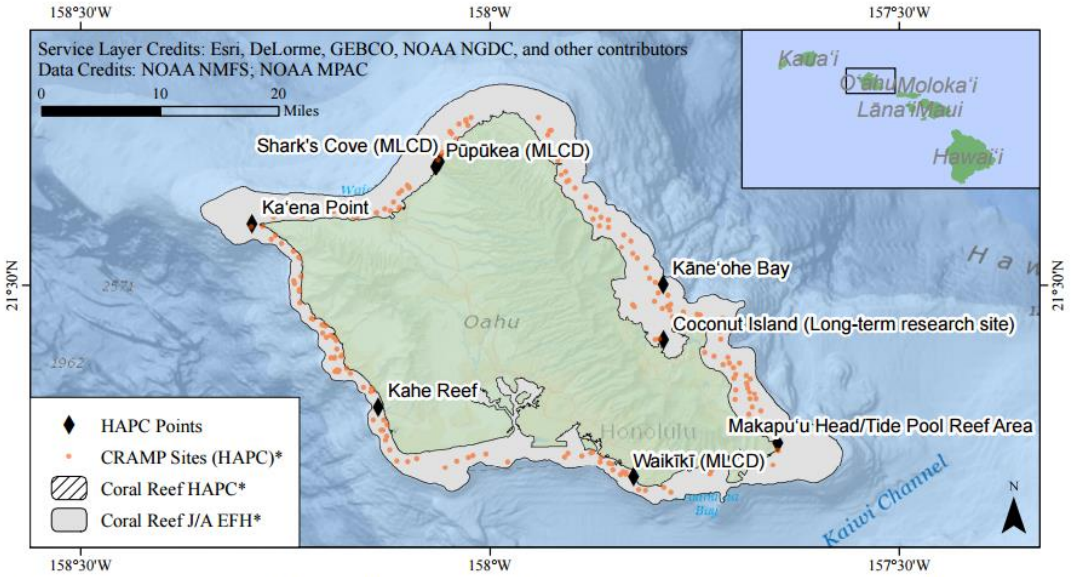
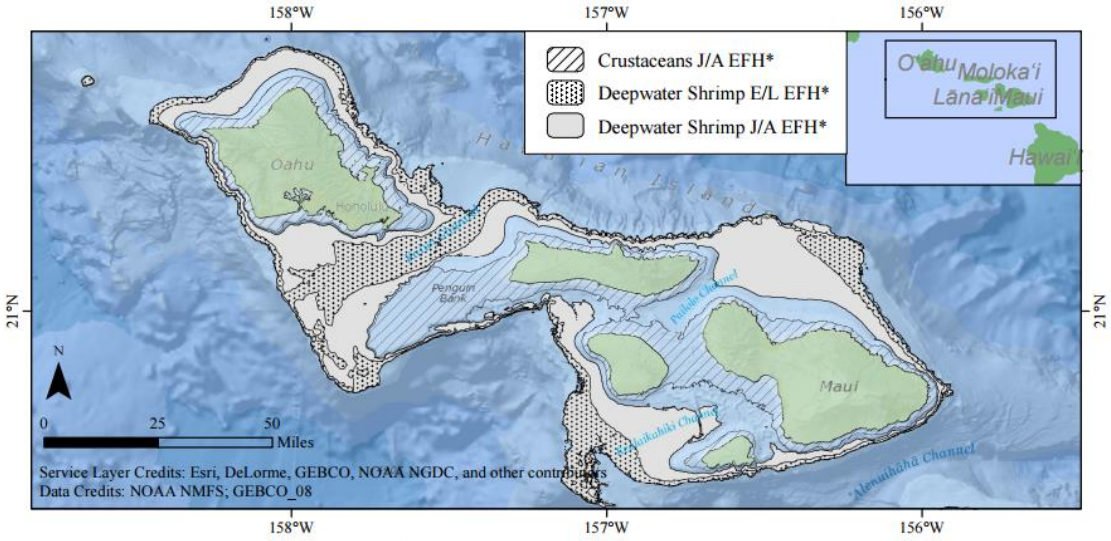


Figure 5.11. Hawaiian Archipelago Fishery Ecosystem Plan, Coral Reef Essential Fish Habitat: O'ahu (from draft Fishery Ecosystem Plan for the Hawai'i Archipelago, Western Pacific Regional Fishery Management Council, 2016)



**The geographic extent of juvenile/adult (J/A) EFH is shown. EFH for eggs and larvae is the water column to a depth of 100 m from the shoreline to the outer boundary of the EEZ, while J/A EFH is all bottom habitat and the adjacent water column to a depth of 100 m to the extent shown. The type of bottom habitat varies by family. HAPC in the MHI includes all CRAMP sites.*

5.12. Hawaiian Archipelago Fishery Ecosystem Plan, Crustaceans Essential Fish Habitat: O‘ahu to Maui Nui (from draft Fishery Ecosystem Plan for the Hawai‘i Archipelago, Western Pacific Regional Fishery Management Council, 2016)



**The geographic extent of EFH is shown. EFH for crustaceans eggs and larvae (E/L) is the water column to a depth of 150 m from the shoreline to the outer boundary of the EEZ, while juvenile/adult (J/A) EFH is all bottom habitat to a depth of 100 m to the extent shown.. HAPC is all banks in the NWHI with summits shallower than 30 m. Deepwater shrimp E/L EFH is the water column and outer reef slopes between 550 m and 700 m to the extent shown, while deepwater shrimp J/A EFH is the outer reef slopes between 300 and 700 meters to the extent shown.*

5.1.3.3.6 Migratory Birds

A number of migratory birds have been recorded as visiting the study area. The USFWS has statutory authority and responsibility for enforcing the Migratory Bird Treaty Act. Chapter 7 describes in more detail the Migratory Bird Treaty Act and its relevancy to the proposed action. Numerous species protected under the act may be found within the project area and these species will be considered collectively for the impact analysis.

Several migratory birds could potentially be found in the project area (Table 5.14). According to USFWS Information for Planning and Conservation (IPaC) report, there are eight migratory birds that could potentially be found in the affected environment.

Table 5.14 List of bird species protected under the Migratory Bird Treaty Act which have the potential to be found within or near the boundary of the proposed He‘eia National Estuarine Research Reserve project area

Common Name	Scientific Name	Habitat	Season/Activity
‘apapane	*Himatione sanguinea*	on land	year-round
bar-tailed godwit	*Limosa lapponica*	at sea	migration
black-footed albatross	*Phoebastria nigripes*	at sea	migration
Christmas shearwater	*Puffinus nativitatis*	on land	breeding
Laysan albatross	*Phoebastria immutabilis*	on land	breeding, wintering
Tahiti petrel	*Pseudobulweria rostrate*	on land	wintering

Tristram's storm-petrel	*Oceanodroma tristrami*	on land	wintering
whimbrel	*Numenius phaeopus*	on land	wintering

Two of these species have been documented by HIMB as found within Kāneʻohe Bay and its adjacent watersheds, the Laysan albatross and the black-footed albatross (HIMB 2016). However, the majority of black-footed albatross nest in the Northwest Hawaiian Islands; they are not reported as nesting on Oʻahu, although Oʻahu is within their range. In 2011, USFWS found that the black-footed albatross did not warrant listing under the ESA. See 76 Fed. Reg. 62504. The Laysan albatross attempts to nest in a few parts of Oʻahu, including at MCBH Kāneʻohe Bay, the island of Moku Manu (which means bird island and is approximately 2 km from the Mōkapu peninsula), and four other sites. In fact, Laysan albatross still try to nest near an active runway at MCBH and, sometimes, in an active firing range. When this occurs, all adults and eggs are removed from MCBH to discourage nesting and reduce the chance of aircraft strikes (Young et al. 2009). It is possible that Laysan albatross that nest at Moku Manu forage in Kāneʻohe Bay.

Kāneʻohe Bay contains other areas that migratory birds might prefer over the areas within the study area, including uninhabited islands.[23] OCM compared the list of birds identified by USFWS to other available data sources about birds present in the project area. The Kāneʻohe Bay Information System lists two migratory birds identified by USFWS and numerous other seabirds as using the bay and its watersheds. Because the area that the information system covers is broad, the birds it lists do not necessarily use the areas that would be affected by the preferred alternative and alternatives A, B, or C. An environmental assessment for the Coconut Island Infrastructure Rehabilitation and Replacement Project summarized a bird survey conducted at HIMB in September 2013 and other data when it identified the following species as found on and adjacent to Moku o Loʻe:

- Wandering tattler (*Tringa incana*)
- Pacific golden plover (*Pluvialis fulva*)
- Great frigatebird (*Fregata minor*)
- Black noddy (*Anous minutus*)

That report also noted the black noddy is known to forage in Kāneʻohe Bay, including in and along the nearshore waters of HIMB. All four of these birds are protected under the Migratory Bird Treaty Act. Another report, which summarizes the birds seen at Heʻeia Fishpond, also mentions the latter three birds and two native waterbirds as having been reported in the area around the fishpond: black-crowned night heron (*Nycticorax nycticorax)* and Hawaiian stilt (*Himantopus mexicanus knudseni*) (Helber Hastert and Fee Planners 2007). In short, while data on migratory birds potentially present in the study area vary, none mention migratory bird

[23] According to https://sites.google.com/site/kbisathimb/biology/seabirds-shorebirds, the bay contains three bird sanctuaries, an offshore island, and two wildlife refuges associated with the MCBH. Moku Manu is a seabird refuge, used by rare and native birds of numerous species as a nesting and breeding ground. Seabirds also nest on other islands within the bay, including Kapapa Island.

nesting within the study area, but they do confirm that some migratory birds sometimes visit the study area. Some migratory birds, on the other hand, are not anticipated to use the habitat within the study area. For example, the ʻapapane (*Himatione sanguinea*) is the most abundant and widely distributed Hawaiian honeycreeper. It is found in native forests dominated by ʻōhiʻa and koa trees, primarily at elevations greater than 300 meters (975 feet), which is a higher altitude than any of the land currently being considered for inclusion in the reserve.

5.2 Human Environment

5.2.1 Human and Economic Setting

5.2.1.1 Population

Kāneʻohe experienced a major population increase between the years of 1940-1960; in that time period, it is estimated that the local population expanded from approximately 5,000 to 30,000 residents. By 1980, the population of Kāneʻohe had further increased to 47,000. More recently, by 2010, it had risen to roughly 54,000 individuals (Department of Business, Economic Development and Tourism 2013, Hawaiʻi Office of Planning 1992).

Concurrent with the population boom, many changes were occurring in and around the Bay. Starting in 1918, the U.S. Navy constructed a military base on Mōkapu Peninsula (now known as the Marine Corps Base Hawaiʻi (MCBH). The Navy dredged over 15 million cubic yards of reef from the bay to use as fill, used across approximately 280 acres of land. Corresponding with the population increase, urbanization began to affect the local environment. Eight of the nine streams that drain into Kāneʻohe Bay were altered in some fashion (e.g. diverted or channelized), mostly between 1960 and 1973. By 1993, it was estimated that some form of shoreline modification, including sea wall construction, harbor creation, dredging, fill, or fishpond creation or maintenance, had affected 58% of the bay shoreline. Approximately 14% of the total fringing reef had been dredged or filled, and 19 of the original 28 fishponds built by early Hawaiians were partially or completely destroyed to create more land for housing development (Hunter 1995).

Demographic characteristics of residents of the Kāneʻohe Zip Code Tabulated Area (ZCTA) are shown in Table 5.15, based on data from the American Community Survey (ACS) for 2009 through 2013. Comparing the demographic profiles of the ZCTA with those of the City and County of Honolulu as a whole illuminates distinctive qualities of the local population, such as:

- Kāneʻohe's age structure is a little older than that of the state as a whole, with a median age of 41.8 years old.
- Nearly 71% of residents are Hawaiʻi-born, a higher percentage than in the state as a whole.
- The ethnic mix of the population is similar to that across the state as a whole.

Table 5.15 Demographic characteristics for the State of Hawai‘i and Kāne‘ohe Zip Code Tabulated Area (ZCTA) (data source American Community Survey for 2009 through 2013)

	State of Hawai‘i	Kāne‘ohe
Population		
Total Population	1,376,336	52, 509
Under 5 years	89,223	3,218
5 to 9 years	81,708	2,998
10 to 14 years	83,842	2,954
15 to 19 years	83,355	3,002
20 to 24 years	99,953	3,583
25 to 34 years	193,523	6,945
35 to 44 years	175,079	6,454
45 to 54 years	188,425	8,171
55 to 59 years	91,805	3,843
60 to 64 years	85,466	3,254
65 to 74 years	107,791	4,927
75 to 84 years	63,137	3,160
85 years and over	32,991	1,309
Median age (years)	38.3	41.8
Race		
White	25.00%	21.6%
Black or African American	1.80%	0.8%
American Indian and Alaska Native	0.20%	0.3%
Asian	38.30%	36.2%
Native Hawaiian and Other Pacific Islander	9.80%	8.9%
Hispanic	9.30%	9.1%
Two or more races	23.80%	23.1%
Place of Birth		
Hawai‘i	54.50%	71.1%
Other state	24.70%	18.4%
US Island	2.90%	2.7%
Foreign born	17.90%	7.8%

5.2.1.2 Employment

The military maintains a large presence in the bay area due to the continued existence of the MCBH, located on Mōkapu Peninsula. Portions of the bay and Mōkapu Peninsula are used for military training and research activities, and thus public use (e.g., fishing and surfing) is restricted. The largest employer on the windward side of O‘ahu is MCBH. MCBH’s presence has a significant impact on individuals and businesses in the local community. In 2012, MCBH employed more than 14,000 military and civilian personnel. It is estimated that the spending by base employees and spending by base suppliers generated more than 2,280 jobs in local communities that surround the base. In all, base personnel generated an estimated $1.1 billion in economic output retained within the neighboring communities (Marstel-Day 2014).

Another important community resource located in Kāneʻohe Bay is the HIMB. HIMB is a world-renowned marine biology research institute. Programs at the facility are organized across five broad areas of research: coral physiology and ecology; behavior, physiology, and population dynamics of fish; marine endocrinology and aquaculture; marine mammal research; and environmental toxicology. Moku o Loʻe (Coconut Island) serves as an education center for undergraduate and graduate students from the University of Hawaiʻi, as well as other institutions. The facility also hosts approximately 4,000 primary and secondary students through field trips each year (Hawaiʻi Institute of Marine Biology).

Table 5.16 highlights the economic characteristics of the region. The median household income ($85,608) in the Kāneʻohe ZCTA is 127% larger than the state median. The unemployment rate in the Kāneʻohe ZCTA 5.8%, which is 22% lower than the state-wide rate of 7.1%. Major industries in the Kāneʻohe ZCTA area include retail, educational services, and public administration (Hawaiʻi Office of Planning 2016).

Table 5.16 Selected economic characteristics for the State of Hawaiʻi and Kāneʻohe Bay Zip Code Tabulated Area (ZCTA) (data source: US Census)

	State of Hawaiʻi	Kāneʻohe ZCTA 96744
Employment Status		
Population 16 years and over	1,104,534	43,953
In labor force	728,795	29,478
Civilian labor force	688,820	28,534
Percent unemployed	7.10%	5.80%
Industry		
Civilian employed population 16 years and over	640,072	26,878
Agriculture, forestry, fishing and hunting, and mining	1.50%	0.60%
Construction	7.00%	9.20%
Manufacturing	3.10%	2.90%
Wholesale trade	2.40%	2.50%
Retail trade	11.80%	10.20%
Transportation and warehousing, and utilities	5.80%	6.90%
Information	1.60%	1.90%
Finance, insurance, real estate, rental and leasing	6.50%	5.80%
Professional, scientific, and management	10.10%	9.90%
Educational services, health care and social assistance	20.90%	25.00%
Arts, entertainment, recreation, accommodation and food services	16.20%	9.40%
Other services, except public administration	4.50%	5.10%
Public administration	8.60%	10.60%
Median Household Income (Dollars)	$67,402	$85,608

5.2.1.3 Ocean Economy

This section will provide a summary analysis of the ocean economy for He‘eia and the neighboring communities. The information provided was created using NOAA’s Digital Coast Economics: National Ocean Watch (ENOW) methodology. ENOW is a nationally consistent time series data that describes six economic sectors that depend on ocean resources:

- Living Resources
- Marine Construction
- Marine Transportation
- Offshore Mineral Resources
- Ship and Boat Building
- Tourism and Recreation

This report uses 2014 Zip Code Business Pattern data produce by the U.S Census Bureau (US Census 2014). Although this dataset does not include self-employed workers, this report provides a general overview in a small and more localize scale of the ocean economics using ENOW framework and the Zip Code Business Patterns to derive ocean economic data for Kāne‘ohe zip code 96744 (Figure 5.13).

Figure 5.13 Boundary map of Kāne‘ohe Bay zip code 96744

Data derived from 2014 Zip Code Business Pattern data, for zip code 96744, revealed nine ocean industries reported in the area (Table 5.17). The data includes number of establishment and total employment for these nine different industries reported to U.S Census.

Table 5.17 Ocean sectors and industries for zip code 96744

Ocean Sector	Ocean Industry
Marine Transportation	Other support activities for Water Transportation
Ship and Boat Building	Ship Building and Repair
Tourism and Recreation	Boat Dealers
	Eating and Drinking Places
	Marinas

	Scenic Water Tours
	Sporting Goods
	Amusement and Recreational Services
	Zoos and Aquaria (Including recreational parks)

Table 5.18 represents the distribution of the ocean economic activities in the shore adjacent to the zip code 96744 (Kāneʻohe). There are 109 business establishments, employing 1,886 people that are dependent on ocean resources. “Eating and Drinking” places is the most dominant industry, accounting for over 82.12 percent of the establishments, and 80.73 percent of the employment. The ocean economy in the shore adjacent to Kāneʻohe including restaurants and tourism related activities accounts for 4.47 percent or about 1 in 25 employee in the county.

Table 5.18 Overview of the ocean economy in zip code 96744

Ocean Industry	Total Business Establishment	Business Establishment as a Percent of Total Business	Total Employment	Employment as a Percent of Total Employment
Amusement and Recreation Services	8	12.33%	233	7.34%
Boat Dealer	1	0.11%	2	0.92%
Eating and Drinking Places	88	82.12%	1552	80.73%
Marinas	1	0.79%	15	0.92%
Marine Transportation Services	1	0.11%	2	0.92%
Scenic Water Tours	5	3.49%	66	4.59%
Ship Building and Repair	1	0.11%	2	0.92%
Sporting Goods	2	0.21%	4	1.83%
Zoos and Aquaria	2	0.74%	14	1.83%
Ocean Industry Totals	**109**	**100%**	**1890**	**100%**

5.2.2 Cultural and Historic Setting

5.2.2.1 Cultural History and Land Use

The ahupuaʻa of Heʻeia is located in the Moku (district) of Koʻolaupoko. The neighboring ahupuaʻa of Kahaluʻu is located to the north and by Kāneʻohe in the south, and extends eastward across Kāneʻohe Bay to include the tip of the left lobe of Mōkapu Peninsula. Historically, Heʻeia sustained a dense human population based on a robust and flourishing agricultural and aquacultural community (Figure 5.14). Owing to the frequent rainfall, abundant water resources, and flatlands, the area also is known to have contained the most extensive early wetland agricultural complex on Oʻahu (Cruz et al. 2012).

The early land division records indicate that the area included numerous shoreline fisheries and extensive loʻi kalo. Between 1840 and 1850, more than 60 land commission awards were issued for the area, reflecting the ability of the ahupuaʻa of Heʻeia to support a vibrant and self-sustaining community. Heʻeia is associated with wahi pana (sacred places), akua kiʻi (guardians), demigods, and goddesses. Traditional accounts and several former and existing archaeological features such as burial grounds and heiau also indicate the cultural significance of the ahupuaʻa of as a favored and important place during traditional Hawaiian times (Cruz et al. 2012).

Figure 5.14 Kāneʻohe circa 1880 (source Bishop Museum)

A shift in land use patterns throughout Kāneʻohe Bay began to occur the 1880s to the 1920s, many of the abundant taro patches were converted to rice. Although abundant throughout the Kāneʻohe Bay, taro farming occurred in relatively small areas. In contrast, rice was cultivated in large plantations, necessitating the construction of large irrigation channels. By about 1910, rice farming had declined, making way for the pineapple industry. Where taro and rice were confined to the low flat lands, pineapple could be cultivated in steeper areas. As a result the agriculture expanded into the upper slopes of Kāneʻohe Bay. By the 1920s a majority of the pineapple industry had moved to central Oʻahu. Thus, Kāneʻohe Bay's pineapple fields were converted to pasture or became uncultivated land (Hawaiʻi Office of Planning 1992).

From the 1920s to the 1950s impacts such as dredging, sedimentation, and sewage discharge had profound effects on Kāneʻohe Bay's marine environment. Prior to 1930, the reefs of Kāneʻohe Bay were in excellent condition (Bahr et al. 2015). Around the time of the pineapple industry's decline, there was an increase in military presence. In 1918, Fort Hase was established on Mōkapu peninsula (the current location of the MCBH), becoming one of Oʻahu's oldest military bases. Between 1939-1945 extensive dredging occurred throughout the bay to

support military activity. Bahr et. al. (2015) estimate that during this period 25 of the 79 patch reefs within Kāneʻohe Bay experienced some degree of dredging, affecting 5% of the total patch reef area (Figure 5.15). Notable long-term impacts from the large scale dredging effort include significant changes to the depth and bathymetry of the bay, as well as extensive coral damage. An estimate of the total volume of dredged material removed from the bay was 11,616,300 m^3, and surveys have revealed an average decrease of 1.7m in the depth of bay between 1927 through 1969 (Bahr et al. 2015).

As noted previously, the rapid urbanization occurred in Kāneʻohe Bay between 1940 and 1960. During this timeframe, increased sedimentation and sewage discharge further impacted the marine environment within Kāneʻohe Bay. Estimates from 1970 state that 70% of sediment in the bay was derived internally (from dredging and breakdown of calcium carbonate materials) and 30% of the sedimentation came from terrestrial-based sources (Roy 1970). Bahr et al. (2015) note prior to 1963 the community within Kāneʻohe largely used private septic tanks and cesspools, both of which the effluent of ended up in the bay. The net effect of the sewage effluent discharge into the bay included “decreased species diversity, increased eutrophication, and substantially altered ecosystem structure.” (Bahr et al. 2015)

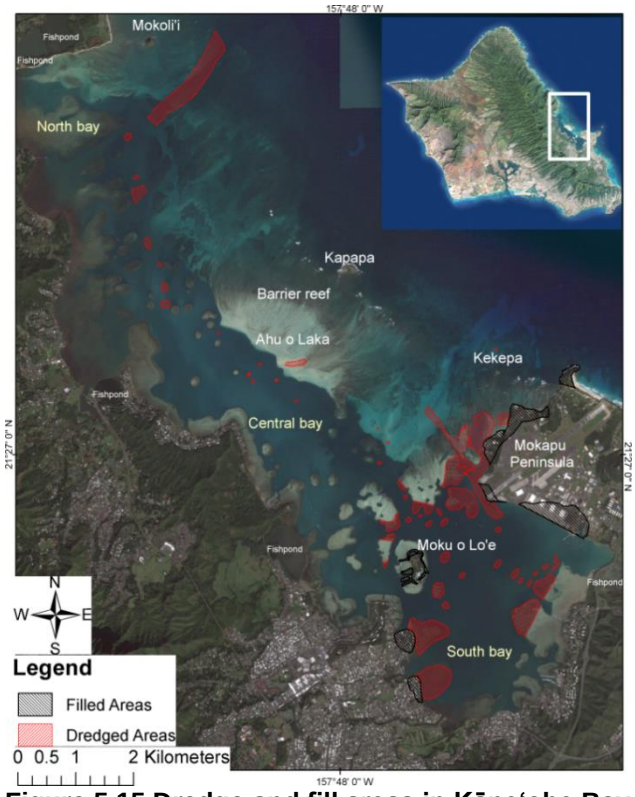


Figure 5.15 Dredge and fill areas in Kāneʻohe Bay (credit: Bahr et al. 2015)

5.2.2.2 Historic Agriculture

Taro was a staple in the diet of the early Hawaiians, and in Kāneʻohe Bay there was a significant amount of land dedicated to the cultivation of taro (Hawaiʻi Office of Planning, 1992). The environmental conditions that define Heʻeia such as frequent rainfall, numerous streams,

broad valleys and flatlands, all helped to establish the area as a productive agricultural region. A prominent natural feature in historic He‘eia was a large wetland complex where taro was traditionally grown.

Taro remained the dominant crop through the 1870s, however crop production began to shift to rice and sugar cultivation. During the 1880s there was an influx of Chinese and a decline in native Hawaiians in He‘eia, and this population changed an underlying factor in the large scale conversion from taro to rice cultivation (Bahr et al. 2015). As sugarcane production gained momentum, immigrant farm workers (mostly of Asian descent) were brought to the area. He‘eia Sugar Plantation was established in 1869 and an associated sugar mill was also constructed around that time. Around 1880 He‘eia Rice Plantation was established and a rice mill was built (of which remaining historic relics such as the concrete foundation and access road exist within the affected environment). He‘eia Kea pier was constructed in the 1880’s to support the sugar industry’s need to transport product and materials to and from Honolulu Harbor. He‘eia Sugar Plantation ceased operations in 1903 and the date that He‘eia Rice Plantation ceased operations is unknown (Fa‘anunu 2009).

The rice industry took a big hit in the early 1900’s, largely this industry began to relocate to ‘Ewa, and local production declined. Similarly, the pineapple industry, which peaked from about the early 1900s to the mid-1920s, the lands around He‘eia did not prove to be extremely productive for this crop, and the industry left He‘eia to relocate to ‘Ewa. Between 1920s and 1940s there was a resurgence of taro planted within the He‘eia’s wetlands and many of the other agricultural areas within the vicinity of the affected environment were either converted to pasture or became uncultivated land. This is a summary of the major agricultural shifts that affected lands within the vicinity of He‘eia, for a more detailed summary please see Devaney et al. (1976) and Fa‘anunu et al. (2009).

5.2.2.3 Historic Aquaculture

Fishponds, a traditional form of aquaculture, were used to ensure a consistent protein supply from culturing and harvesting fish from an enclosed system. It is estimated that throughout the 1800’s there were roughly 28 fishponds dispersed around Kāne‘ohe Bay. By early 1900, only 16 were in commercial use. In the present day, there are approximately 12 fishponds in the bay, in varying degrees of inactiveness and productivity (Jokiel 1991).

Fishponds were often constructed around sheltered areas of the coastline and made from coral and basalt. The constructed walls extended from the shoreline and enclosed shallow bodies of water. Gates (mākāhā) were built into the walls to help control water depth and salinity, and also capture the fish. The size of fishponds varied greatly, ranging from 0.5 to over 500 acres (Stone 1989). The most common cultured fish were ‘anae (mullet, *Mugil cephalus*) and awa (milkfish, *Chanos chanos)*. Fishponds were very efficient and productive aquaculture systems, which when operating at peak performance could yield an average of 400-600 pounds per acre per year, which is significant considering the limited amount of input required to run the system (Keala 2007).

Loko iʻa o Heʻeia (Heʻeia Fishpond) is both an archaeological and a cultural resource, and it is one of the largest intact and operating fishponds in Hawaiʻi. It was listed on the National Register of Historic Places (50-80-10-327) in 1973 (USACE 2012a). The fishpond wall measures approximately 7,000 feet in length, encircling nearly 88 acres of water area. Although the original construction date of Heʻeia Fishpond is unknown, it is likely that the fishpond was constructed sometime between AD 1400 to 1600 (Kelly 1975). The first recorded owner of the fishpond was High Chief Abner Paki (1893). Paki was the konohiki of Heʻeia and thus owned all lands within the ahupuaʻa. After his passing, Paki's daughter, Princess Bernice Pauahi, received the lands of Heʻeia. Princess Pauahi married Charles Reed Bishop, and before her passing established the Bishop Estate. In present day the fishpond is owned by Kamehameha Schools, which was formerly called the Kamehameha Schools Bishop Estate.

Heʻeia Fishpond was operational until a large storm, in 1965, caused widespread damage to the intact Fishpond wall. The Keapuka Flood of 1965 was responsible for destroying over 200 feet of the previously intact wall. When the wall was damaged, the pond was exposed to tidal fluctuations, making it nearly impossible to control salinity levels and water depth. Thus, the pond was deemed unusable at that time(Jokiel 1991). Heʻeia Fishpond went mostly unused for almost 25 years. During this time, mangrove introduction and its widespread growth further damaged the fishpond's productive potential (Paepae o Heʻeia 2016). Restoration efforts began around 1988 and continue today, largely through the work of Paepae o Heʻeia (a local non-profit group) (Keala 2007).

5.2.2.4 Moku o Loʻe – Coconut Island

Moku o Loʻe, commonly referred to as Coconut Island and the current home of the HIMB, was once owned by Hawaiian royalty (including Kamehameha I and Princess Bernice Pauahi). Similar to the fishpond, Moku o Loʻe was incorporated into the holdings of the Bishop Estate. However, in 1933 it was purchased by Christian Holmes with the intention of transforming the island into a tuna packing factory. Holmes was responsible for major landscape changes to the island such as physically enlarging the island, building fishponds, harbors and the seawall which surrounds the island. At the time of purchase, the island was 12 acres in size, however, after the physical changes were complete the island expanded to nearly 28 acres. Much of the fill material for the expanded island came from a sandbar in Kāneʻohe Bay (HIMB 2016).

After Holmes passed away in 1944, Coconut Island was used as rest and relaxation post for Army Officers. The Army built many of the barracks which now serve as HIMB's marine labs. In 1947 Edwin Pauley became the sole owner of the island, and in 1951 Pauley helped establish the Hawaiʻi Marine Lab on the island, now known as HIMB (Jokiel 1991).

5.2.2.5 Kealohi Point – Heʻeia State Park

As noted previously, Kealohi Point was said to be the dividing point between Heʻeia Uli (dark Heʻeia) from Heʻeia Kea (white Heʻeia), where these two worlds came together and from the point, dead souls would leap into their deemed afterlife (either Heʻeia Uli or Heʻeia Kea). Kealohi

Point was also the home of ancient heiau, called Kalaeʻulaʻula, which was destroyed and replaced by a sugar mill sometime around 1880 during the peak of sugar production in the area (Heʻeia State Park 2016). After the sugar cultivation decline, Kealohi Point was used for pineapple cultivation and as a cattle ranch. Around 1960, interest spurred to develop the marine areas around the point into a marina, however the plan never came to fruition. In 1963 a cultural center, named Ulumau Village was relocated from Ala Moana Park to Kealohi Point. The state of Hawaiʻi acquired the14 acres at the point to be used as a state park in 1976. From 1982-2010, the state granted a non-profit educational organization, Friends of Heʻeia, a 28-year lease to run its programs. In 2010, a similar lease was established with Kamaʻaina Kids, also a non-profit educational organization, for an additional 25-year period (Heʻeia State Park 2016).

5.2.2.6 Cultural Resources

Within the area under consideration, cultural resources range from tangible historic structures (*e.g.,* Heʻeia Fishpond) and other historic sites (*e.g.*, bridge, distillery, roads, etc.) to the intangible rich cultural legends (moʻolelo) which pervade the natural environment. For a more detailed description see, e.g., Heʻeia NERR DMP (Appendix A), Cruz and Hammatt (2012), Faʻanunu et al. (2009) and Pukui et al. (1974).

Place names such as Heʻeia, Keaholi Point, Koʻamano Reef, and Luamoʻo reveal the strong cultural connection. Heʻeia was named after the foster child of the goddess Haumea and grandson of ʻOlopana. The name Heʻeia means “washed out to sea”, in reference to a tidal wave that washed locals out to sea, and back, after a victorious battle. Koʻamano reef is located close to Heʻeia Fishpond. The term Koʻamano can be translated to mean “many shrines”, shedding light on the abundant underwater caves found in that reef. Heʻeia fishpond is said to have been guarded by Meheanu, the moʻo (water spirit). Meheau lived at Luamoʻo which is also in close proximity to the fishpond. For additional information, refer to the references listed in the previous paragraph.

The area under consideration has been subject to numerous archaeological and cultural resource studies (McAllister 1933, Yent and Griffin 1977, Kawachi 1990, Nagata 1992, Henry 1993, Freeman and Hammatt 2004, Carson 2006, Altizer et al. 2011, Cruz and Hammatt 2012, Groza and Monahan 2012, Soltz et al. 2014). McAllister (1933) was the first to document the major sites around Oʻahu in 1933; with regard to Heʻeia, he documented three cultural sites: Heʻeia Fishpond, Kaualaukī Heiau, and the dwelling place of Meheanu at Luamoʻo.

The Heʻeia Fishpond was listed on the National Register of Historic Places (50-80-10-0327) in 1973. An archaeological assessment associated with the replacement of the caretaker’s house at Heʻeia Fishpond did not identify any surface or subsurface cultural resources (Carson 2006). A literature review and field inspection for a Heʻeia Fishpond wall repair project identified no potential adverse effects on cultural resources and recommended no further archaeological work (Groza and Monahan 2012). A separate cultural impact assessment (CIA) done for the Heʻeia Fishpond involved community consultation and formal interviews (Cruz and Hammatt 2012). This CIA discussed the important relationship between Heʻeia Fishpond and inland taro

loʻi, which mitigated the effects of flooding on the fishpond. The CIA concluded that the fishpond wall repairs would not adversely affect cultural practices and resources.
Surface and subsurface archaeological surveys of Heʻeia State Park in 1977 (Yent and Griffin 1977) did not report any significant findings. However, relevant to the area, a 1982 report documented ancestral remains at Heʻeia State Park, which was confirmed by a 1992 (Nagata 1992) archaeological survey of the same parcel. An archaeological and cultural impact study conducted for the Kamehameha waterline project did not identify any historical properties or traditional cultural practices, and Keʻalohi Point was noted as leina ʻuhane (leap of the soul) (Freeman and Hammatt 2004).

Literature and field review for portions of Kākoʻo ʻŌiwi's Māhuahua ʻAi o Hoi project documented a pre-contact (i.e. predating 1778) basalt quarry, the foundation of an ʻōkolehao distillery, two ranching enclosures, fences and roads possibly related to agriculture, and possible subsurface loʻi berms (Altizer 2011). Work conducted at the Kākoʻo ʻŌiwi property identified the following 17 sites (Soltz et al. 2014) (see Figure 5.16 and Table 5.19 for the sites' State Inventory of Historic Places number, location and description):

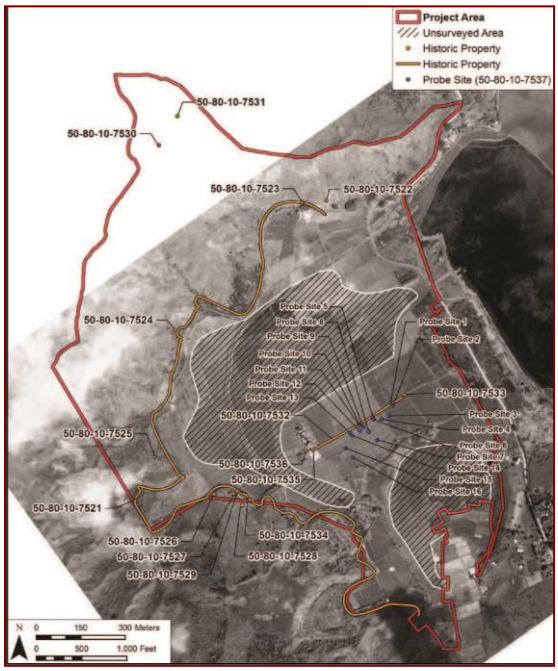


Figure 5.16 Location of archaeological features found on Heʻeia Community Development District parcel (Soltz et al. 2014)

Table 5.19 Archaeological features found on Heʻeia Community Development District (CDD) parcel

SIHP Site	Description	SIHP Site	Description
50-80-10-7521	plantation-era road	50-80-10-7530	Complex of five terraces and two mounds
50-80-10-7522	basalt quarry with traditional debitage	50-80-10-7531	World War II-era earthen terrace and foxhole depressions
50-80-10-7523	concrete foundation, possibly	50-80-10-7532	Plantation-era road, possibly

	for ōkolehao distillery		to/from rice mill
50-80-10-7524	Ranching-era enclosure	50-80-10-7533	Plantation-era bridge
50-80-10-7525	Ranching-era enclosure	50-80-10-7534	Plantation-era ʻauwai
50-80-10-7526	Glass and ceramic fragment scatter	50-80-10-7535	Two concrete foundations, possibly for rice mill
50-80-10-7527	glass and ceramic fragment scatter and three depression features	50-80-10-7536	Ranching-era wooden and metal cattle run
50-80-10-7528	Four plantation-era depressions with glass and ceramic fragments	50-80-10-7537	Subsurface loʻi and rice berms
50-80-10-7529	Stone and mortar		

The Office of Hawaiian Affairs (OHA) Kipuka Database(Office of Hawaiian Affairs 2016), an online resource providing historic data and geographic locations, features additional sites found in the vicinity of the affected environment. The Kipuka database provides the State Inventory of Historic Place numbers for each site as well as brief descriptions (Table 5.20 and Figure 5,17).

Table 5.20 Archaeological features listed in the Kipuka Database

SIHP Site	Description	SIHP Site	Description
50-80-10-00327	Heʻeia Fishpond	50-80-10-04141	Heʻeia Kea agriculture terrace
50-80-10-04135	Heʻeia Kea terrace	50-80-10-04142	Historic agriculture complex
50-80-10-04137	Heʻeia Kea platform	50-80-10-04143	Heʻeia Kea WWII bunkers
50-80-10-04138	Heʻeia Kea Road retaining wall	50-80-10-04144	Heʻeia Kea Shrine
50-80-10-04139	Heʻeia Kea mound/platform	50-80-10-04264	Historic ʻauwai
50-80-10-04140	Heʻeia Kea terrace/retaining wall		

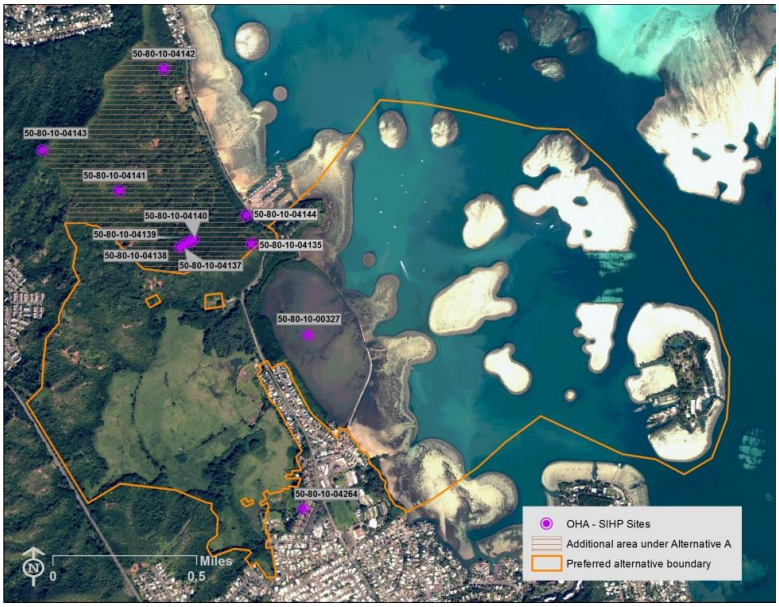


Figure 5.17 SIHP sites features in OHA's Kipuka Database

5.2.2.7 Maritime Heritage Resources

This section provides a brief overview of the known submerged artifacts that exist in the vicinity of the affected environment within Kāneʻohe Bay. Existing knowledge is rather limited about these resources because there has yet to be a comprehensive assessment of relevant resources within the waters of Kāneʻohe Bay. The information gathered in this document comes from two main sources: NOAA Office of Coast Survey's nautical charts and informal consultations with NOAA Office of National Marine Sanctuaries staff. The NOAA Office of National Marine Sanctuaries' Marine Heritage Program supports maritime heritage discover and resource preservation. Although Kāneʻohe Bay is outside any official Sanctuary boundaries, their staff is knowledgeable about relevant resources throughout the state.

Hawaiʻi's maritime resources generally fall into three broad categories relating to traditional aquaculture production (e.g. fishponds), plantation and ranching-era artifacts, and military (Van Tilburg 2014). Maritime heritage resources within the affected environment are predominately military related. The exceptions to this are historic fishponds in the vicinity of the affected environment which includes Heʻeia Fishpond as well as three others identified by McAllister (1933), Oʻohope Fishpond and two smaller unknown named fishponds (Faʻanunu 2009). The data gathering effort for this DEIS analysis did not identify any information describing submerged historic aquaculture-related artifacts for any of these fishponds.

NOAA Office of Coast Survey's nautical chart identifies four wrecks within a four-mile radius of the proposed site, three of which are located within the bay (Figure 5.18). The wrecks labeled W1 and W3 are noted as visible wrecks, "partially submerged at high water." Wreck W2 is identified as the "distributed remains" of a wreck and is always submerged under water. Record W4 is noted as a "submerged dangerous wreck"; however, it is not considered a navigation hazard because of its location within a prohibited area around Mōkapu Peninsula. All of these wrecks are military-related relics.

NOAA's Office of Marine Sanctuaries Marine Hertiage Program's internal database includes four additional wrecks within a 4-mile radius of the nominated boundary for the proposed site. However, location information for these resources are estimates, and NOAA does not have permission to release the information to the public. Therefore these sites are not featured in Figure 5.18.

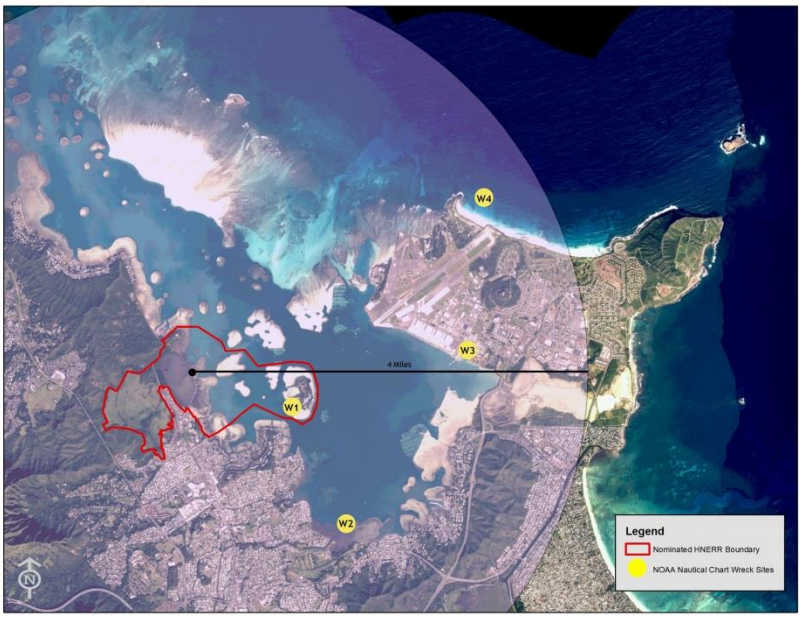


Figure 5.18 Wreck sites within a 4-mile radius of the nominated site boundary (credit NOAA Office of Coast Survey)

5.2.3 Current Human Uses

5.2.3.1 Agriculture

Kākoʻo ʻŌiwi, through its Māhuahua ʻAi o Hoi (To Restore the Fruit of Hoi) project (see DMP Section 6.3.1), plans to establish a land management program to return the wetlands of Heʻeia to productive agricultural, cultural, and educational use. In cooperation with the Natural Resources Conservation Service (NRCS), the group has developed a detailed conservation plan (Townscape 2011), the implementation of which is in progress. This work includes rehabilitating wetlands to taro patches (loʻi kalo). As part of the rehabilitation of organic loʻi kalo in the wetlands of Heʻeia, historic kuāuna (taro patch walls) have been identified by a certified archaeologist as part of an archaeological inventory survey and will be restored to the extent possible. New kuāuna will be constructed to replace kuāuna from earlier times are no longer present. Kuāuna will be built by excavating soil from within the loʻi and using this soil to create the kuāuna. The loʻi kalo will be used to grow different varieties of taro and will also serve as habitat for native birds. Presently, approximately 1 acre of the wetlands within the HCDA parcel have been converted to loʻi kalo. Kākoʻo ʻŌiwi ultimately plans to convert 176 acres into a working agricultural landscape.

5.2.3.2 Aquaculture

The 600 to 800 year old Heʻeia Fishpond went mostly unused for almost 25 years and during this time, mangrove introduction and widespread growth further damaged the fishpond's productive potential (Paepae). Paepae o Heʻeia aims to rehabilitate the ancient kuapā (fishpond wall) and manage the fishpond to support a unique cultural, educational, and aquacultural program (Paepae o Heʻeia 2016). To rehabilitate the ancient kuapā, Paepae o Heʻeia volunteers, using simple handsaws, loppers, and later chainsaws, working tens of thousands of labor hours, have been removing mangroves over the years. As of 2014, Paepae o Heʻeia had physically removed mangroves from approximately 3,500 feet

of the 7,000-foot-long kuapā. In the future, Paepae o He‘eia intends to conduct ongoing maintenance of the rehabilitated fishpond wall and removal of invasive seaweed within the fishpond, as fragments of three species of invasive seaweed periodically enter the pond during high tide events. The fishpond is currently being used to produce the aquacultural products listed below as part of a community-based economic development program to research, develop, and feature various products and services from the He‘eia Fishpond and make them available to the public.

- Moi (Pacific threadfin) – Paepae o He‘eia has been successfully raising moi since 2006 and will continue to do so. The fish are offered for sale to restaurants and the public.
- ‘Ama‘ama (Striped or Grey Mullet) – Ama‘ama is one of the historic fishpond species and an important food fish in ancient Hawai‘i. A very choice indigenous food fish that Paepae o He‘eia will continue to raise and offer for sale to restaurants and the public.
- Limu as food (Gorilla ogo – *Gracilaria salicornia*) – Despite being an invasive pest, this seaweed is closely related to the native manauea (*Gracilaria coronopifolia*) and common ogo species (*Gracilaria parvisipora*) that are commonly eaten. This product is not actively cultivated in the fishpond, but once removed as part of the invasive species eradication efforts, it is offered for sale to restaurants and the public.
- Limu as fertilizer – Farmers have successfully used the invasive limu that grows in the fishpond to fertilize gardens and lo‘i. Individual farmers and members of the public are encouraged to gather limu themselves. If self-picked, limu is given away rather than sold.
- Oysters (Pacific (*Crassostrea gigas*) and Hawaiian (*Dendrostrea sandvicensis*)) – In collaboration with University of Hawai‘i Hilo and the Pacific Aquaculture and Coastal Resources Center, Paepae o He‘eia is researching the survivability and growth rates of two species of edible oysters in He‘eia Fishpond.
- Mangrove firewood – Paepae o He‘eia occasionally gives away mangrove wood. The dense hard wood is useful as fuel for barbeques, imu (underground oven), smoke houses, and other such purposes.
- Mangrove wood for construction – Mangrove wood is resistant to termites and bugs and can be used for hālau (meeting house) construction, hula implements, picture frames, lomi (massage) sticks, and other work. It is also given away rather than sold.

Kāko‘o ‘Ōiwi is also planning to reestablish historic loko i‘a kalo (a different style of aquaculture system that combines a fishpond with taro patch) in the wetter parts of the wetlands in the makai portion of the property. The loko i‘a kalo which was historically present in the area will serve several purposes, including production of fish and taro for consumption, trapping of sediment during rain events, and provision of native bird habitat. Aquaponics, much like the loko i‘a kalo, will be used to cultivate and support fish stocks, which will then be placed in the stream. The aquaponics system will also support the growth of native limu. Water used for the aquaponics system will be well or tap water, and will not be taken from or added to the stream. Kāko‘o ‘Ōiwi is expected to convert approximately 1.8 acres of the wetlands to loko i‘a kalo.

5.2.3.3 Fishing

Historically, fishing within Kāneʻohe Bay and the larger Hawaiian Islands played a central role in the harvesting and conservation of marine resources. It was considered a primary protein source in the Native Hawaiian diet. Within the ahupuaʻa management system, fishing was carefully regulated with harvests adaptively managed according to changes in the ecosystem. In the past 200 years, western fisheries management approaches have gradually replaced the traditional Hawaiian system (Bahr et al. 2015). In addition, three non-endemic fish species were introduced to the region in the 1950's as a harvestable food source.

The peacock grouper (*Cephalopholis argus*), introduced in 1956 from Mo'orea, are a predatory fish that preys on native reef fish species but is not consumed by other endemic piscovores. This grouper is known to have high instances of ciguatera, a common marine toxin disease, known to cause debilitating gastrointestinal, neurologic, and cardiovascular symptoms within a few hours of consuming contaminated fish. The other two introduced species are the Blacktail snapper (*Lutjanus fulvus*) and the Blueline snapper (*Lutjanus kasmira)* are both considered aggressive reef fish predators. These introduced species are not preferred by Hawaiian fishers and as a result, all three are threating the balance of natural marine systems in Hawaiʻi (HIMB 2016).

An historical fishery that is nonexistent in modern times was the black-lipped pearl oyster (*Pinctada margaritifera*). Originally introduced from the Northwest Hawaiian Islands in the 1930's, Kāneʻohe Bay annual harvests of the black-lipped pearl oyster were up to 21 tons by 1938. By the 1990's less than 200 of these oysters remained in the entire bay due to overharvesting (HIMB 2016).

Today, there are significant commercial, recreational and subsistence fisheries found within Kāneʻohe Bay**.** As recently as 2014, landings of fish and invertebrate species for Kāneʻohe Bay were 168,549 lbs. out of a total of 29,391,287 lbs. for the entire island of Oʻahu. Data from 2010 to 2014 indicate that the fisheries landings fluctuate from year to year (Table 5.21). Historical trends in landings and catch per unit effort for have characterized the bay's fisheries as overfished (Bahr et al. 2015).

Table 5.21 Commercial fishing – Kāneʻohe Bay landings by year, in pounds (Division of Aquatic Resources 2014b)

	2010	2011	2012	2013	2014
For Oʻahu	25,238,873	26,411,330	28,063,170	29,900,365	29,391,287
For Kāneʻohe	158,991	362,724	228,415	274,692	168,549

The reported 2014 landings identified yellowfin tuna and Mahi Mahi as the top two species harvested in the bay. Other species of significance harvested in Kāneʻohe Bay included Aku (Skipjack tuna – *Katsuwonus pelamis*), Bigeye tuna (*Thunnus obesus*), Kawakawa (Mackerel tuna – *Euthynnus affinis*), and Ono (Wahoo – *Acanthocybium solandri*) primarily caught by trolling (15,570 lbs. in 111 trips (140.3 lbs./trip)). No other data was available on gear type due to low levels of reporting for other fishing methods. And catch data on other fisheries was unavailable for the area.

One previously significant fishery for Kāneʻohe Bay unaccounted for in recent catch data is the Day Octopus (*Octopus cyanea*). According to catch data, the Day Octopus comprised 44.7% (25,851 lbs.) of the estimated total annual harvest of fishes and invertebrate species in Kāneʻohe Bay during the period of March 1991 to February 1992 (Everson 1994). At the time, this was considered a major fishery within the bay and most of the catch was reported as not being sold for commercial use. A 1998 study of population densities of Day Octopus in the bay found higher densities of octopi within the protected Coconut Island Refuge that the in other areas of the bay (Sims 1998). No additional data was discovered on current harvest trends.

In 1991-1992, Kāneʻohe Bay supported a recreational or subsistence harvest of multiple species including Jacks (*Carangidae*), Crabs (*Brachyura*), Goatfishes (*Mullidae*), Sharks (primarily hammerheads – *Sphyrna spp*), Bigeye scad (*Selar crumenophthalmus*), Giant herring (*Elops hawaiensis*), and Parrotfish (*Scaridae*). These were caught using a variety of methods including spearing, line fishing, trolling, throw netting, and crab netting. However, gill and surround netting accounted for half the fish species catch. No data was discovered on current harvests or trends for these species.

Overall, it is generally agreed that the bay's fish populations are considered stressed and largely depleted from historical levels (HIMB 2016).

5.2.3.4 Tourism and Recreation

Tourism and recreation activities have been a key sector of the Hawaiʻi's economy since statehood in 1959 and is a primary source of revenue and jobs. In 2005, the State Department of Business, Economic Development, and Tourism (DBEDT) reported nearly 7.5 million visitors visited the state and visitor expenditures totaled $11.5 billion. Tourism and recreational is the main generator of employment in the state and accounts for 22.3% of all Hawaiʻi jobs (Hawaiʻi Tourism Authority 2006).

The island of Oʻahu receives the largest number of overall visitors, first time visitors, and international travelers of all the Hawaiian Islands (Table 5.22). Many of these visitors focus on the attractions around Honolulu and specifically at Waikīkī.. Specific information on tourism and recreation activities for Kāneʻohe Bay are limited.

Table Table 5.22 Visit statistics for Oʻahu (data source Hawaiʻi Tourism Authority 2006)

	2014 YTD*	2015 YTD*	% Change
Expend ($ millions)	$6,072.2	$5,972.4	-1.6%
Arrivals	4,321,418	4,427,960	2.5%

Source: Hawaiʻi Tourism Authority *YTD (year to date) actuals through October.

Kāneʻohe Bay supports a variety of tourism and recreational activities that include snorkeling, kayaking, stand-up paddle boarding, outrigger canoe sailing, catamaran sailing, guided kayak

and snorkeling tours organized through several ecotour operators in the area. The primary access point for the majority of these recreational activities is the He‘eia Kea Small Boat Harbor.

An example of a typical ongoing ecotour activity in the area is the “Kāne‘ohe Bay Kayak and Snorkel tour to Coconut Island” provided by Holokai Kayak and Snorkel Adventure. The kayak tour includes a 6-hour eco-adventure that includes professional instruction with certified guides for a maximum of 16 participants. The 6-hour ecotour includes approximately three hours on water and three hours on land. Participants will paddle to Coconut Island, once a filming location for the TV show Gilligan’s Island, as the guides interpret the natural and cultural history of the island, Kāne‘ohe Bay and its unique reefs, and the different types of marine life you may encounter. Later, participants will set out on a snorkeling tour in a pristine section of fringe coral reef around the island’s edge (Tripadvisor 2015). However, no specific ecotourism data was discovered for the bay.

Another tourism and recreational destination is the He‘eia State Park. The park has spectacular views of Kāne‘ohe Bay and is situated on a peninsular jutting out into the bay called Ka Lae O Kealohi, which means “the point of shimmering light”. A large hall for luaus, wedding and special events is available to the public and organizations for rent. Kama’aina Kids, a non-profit organization manages the park for DLNR and offer guided tours, interactive classes on canoe building (with the Puakea Foundation), and kayaking and snorkeling tours to Moku o Lo‘e (e.g., Coconut Island) (He‘eia State Park 2016).

5.2.3.5 Education

Several existing education and community programs are offered through HIMB and community partners (Table 5.23). These range from formal classroom instruction for students, programs for school groups and community groups, and community engagement through “workdays” whereby participants learn the ecological and cultural foundations of the natural environment as well and the traditional agriculture and aquaculture practices of Hawai‘i. See the reserve’s DMP for more detail on the education and outreach activities underway at proposed site.

Table 5.23 Examples of existing education and outreach programs at the proposed He‘eia National Estuarine Research Reserve

Site Partner	Examples of Education and Outreach Programs
Hawai‘i Institute of Marine Biology	- **Undergraduate and graduate courses** - **Educational programs to individuals, families, and school and community groups** - **Guided walking tours of Moku o Lo‘e** - **Moku o Lo‘e Marine Science Overnights**
Paepae o He‘eia	- **Ka ‘Ai Kamaha‘o program** - **He‘eia Ahupua‘a Internship program** - **educational field programs for K-12 and college students**
Kāko‘o ‘Ōiwi	- **Māhuahua ‘Ai o Hoi (Regrowing the Fruit of Hoi)**

	- **community work days**
Kamaʻāina Kids	- **before and after school programs** - **environmental education programs**

5.2.3.6 Research and Monitoring

The University of Hawaiʻi's HIMB has been conducting ecological research and monitoring in Kāneʻohe Bay since its establishment in 1951 (HIMB 2015). Located on Moku o Loʻe, HIMB is surrounded by 64 acres of coral reef designated by the State of Hawaiʻi as the Hawaiʻi Marine Laboratory Refuge which is used for research activities only. HIMB offers cutting edge research facilities for faculty, students, and visiting scientists. Research that HIMB is conducting in Kāneʻohe Bay covers a broad range of topics, such as coral bleaching and disease, symbiosis, ocean acidification, marine microbial ecology, fisheries and top predator research, aquaculture and fish physiology, and biogeochemistry and biophysical analysis of reef systems. See Heʻeia NERR DMP (Appendix A) for additional information.

5.2.3.7 Military

In 1994 the Marine Corps consolidated all of its properties under a new name, "Marine Corps Base Hawaiʻi" (MCBH), which now includes all Marine Corps installations in the Hawaiian Islands, and seven of the eight Marine Corps Installations are on Oʻahu. MCBH- Kāneʻohe Bay is the largest of the installations and serves as the main headquarters. MCBH- Kāneʻohe Bay is located on Mōkapu Peninsula covering 2,951 acres. MCBH- Kāneʻohe Bay is also one of the largest employers on the windward side of Oʻahu with roughly 14,000 active duty personnel and civilian employees (Marstel-Day 2014).

MCBH- Kāneʻohe Bay holds a notable historical significance, being the first location on Oʻahu to be attacked by the Japanese military on December 7, 1941. Seven minutes prior to the attack on Pearl Harbor, Japanese forces attacked hangars at the Naval Air Station on base, and the air strike left 19 dead and 67 wounded. The hangars were destroyed, as were three American aircrafts. One Japanese plane was shot down crashing down on the northwest side of the peninsula (Tomonari-Tuggle and Arakaki 2014). For a detailed historical account of the Mōkapu Peninsula please see Tomonari-Tuggle and Arakaki (2014).

CHAPTER 6: ENVIRONMENTAL CONSEQUENCES

Most impacts of designating the proposed He‘eia estuary and adjacent Kāne‘ohe Bay waters as a National Estuarine Research Reserve (NERR), as well as implementing a reserve management plan, are expected to be environmentally beneficial and result in positive social, cultural, economic and ecological impacts. From a national perspective, this action will result in the establishment of the 29th National Estuarine Research Reserve. The proposed He‘eia NERR will fill a critical gap in the National Estuarine Research Reserve System (NERRS), supporting a more complete network of estuarine systems representing the array of biologically and geomorphologically diverse estuaries found in the U.S. and its territories. Hawaiian estuaries have a long history of human-influenced impacts on their natural processes and functions (Maragos 1975). The proposed He‘eia NERR will focus estuarine research, traditional ecological knowledge, and educational opportunities toward improving our understanding of these unique estuaries. The reserve could help Hawai‘i work toward achieving the goals set forth in the Coastal Zone Management Act (CZMA) – namely, to provide a stable environment for research and enhance public awareness and understanding of estuarine areas. The proposed He‘eia NERR is planning to conduct and coordinate applied research and long-term environmental monitoring of the He‘eia ahupua‘a and its various ecological components; develop training and educational programs that inspire and educate local communities about coastal ecosystems; and collaborate with local communities to incorporate local traditional ecological knowledge in stewardship activities that work to sustain the cultural and natural resources of the area. Federal funds, along with matching funds provided by the University of Hawai‘i Institute of Marine Biology (HIMB), would support increased and more coordinated efforts with partners toward these goals and create opportunities to improve our understanding and appreciation of the role and health of estuaries in the Ko‘olaupoko region of the island of O‘ahu (Hawai‘i Office of Planning 2015a). Some of these activities may result in relatively minor adverse impacts (such as potential sedimentation, traffic, or habitat modification), as discussed below.

6.1 Affected Resources and Potential Impacts

The National Environmental Policy Act (NEPA) requires federal agencies to prepare an EIS for any action that may significantly affect the quality of the human environment. The Council on Environmental Quality (CEQ) regulations implementing NEPA state that an EIS should discuss the significance, or level of impact, of the direct and indirect impacts of the proposed alternatives (40 C.F.R. § 1502.16), and that significance is determined by considering both the context in which the action will occur and the intensity of the action (40 C.F.R. § 1508.27).

Effects and impacts used in this environmental analysis are synonymous. Effects/impacts may include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. For this analysis, the potential impacts, both beneficial and adverse, have been evaluated using the criteria or characteristics identified in Table 6.1 and subsequently described below. The criteria or characteristics of type, magnitude, duration, and

the implementation of mitigation measures are used to determine whether an impact is significant under NEPA.

Table 6.1 Summary of evaluation criteria and characteristics

Type of Impact	Duration of Impact	Magnitude of Impact	Mitigation	Significance
No effect *Direct* *Indirect* *Cumulative*	*Short-term* *Long-term*	*Negligible* *Minor* *Moderate* *Major*	*Reduce* *Avoid*	*Less than Significant* *Significant*

6.1.1 Types of Potential Impacts

Type of potential impact refers to the various components of the affected environment in which the proposed action to designate parts of Heʻeia estuary and adjacent Kāneʻohe Bay waters as a NERR will occur. Direct and Indirect impacts are defined in 40 C.F.R. § 1508.8, and are described below. Cumulative impacts are defined at 40 C.F.R. § 1508.7, and also described below as well as in subchapter 6.4. The categories of potential impacts to the affected environment used in the analysis include:

- **No effect** – No known or potential impacts caused by the proposed action
- **Direct Impacts** – Are known or potential impacts caused by the proposed action and occur at the same time and place. This could include impacts that are an immediate result of project-related activities (e.g., direct mortality of species or removal of vegetation and habitat) and are reversible or permanent and irreversible.
- **Indirect Impacts** – Are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. These effects tend to be diffuse, resource-specific, and less amenable to quantification or mapping than direct effects.
- **Cumulative impacts** – Are the known or potential impacts on the environment which results from the incremental effects of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

6.1.2 Duration of Potential Impacts

The duration of a potential impact or effect is defined by two periods of time (short or long-term) and refers to the temporal nature of the impact resulting from the proposed action. The duration of each potential impact is defined as:

- **Short-term:** A known or potential impact of limited duration of 6 months or less depending on the specific impact and affected environment.

- **Long-term:** A known or potential impact of extended duration of more than 6 months depending on the specific impact and affected environment.

6.1.3 Magnitude of Potential Impacts

The magnitude or intensity refers to the severity of the impact and is defined on a spectrum ranging from negligible impacts to major impacts. For the purpose of this analysis, potential adverse and beneficial impacts are qualitatively assessed by their relative magnitude according to the criteria defined below and are identified using color coding depicted in Figure 6.1:

- **Negligible:** No impact to resources or the impact would be at or below levels of detection.
- **Minor:** A detectable change to resources; however, the impact would be small, localized, and of little consequence. Generally, minor impacts do not have the potential to satisfy the considerations of 'significance' set forth in regulations (40 C.F.R. § 1508.27) or NOAA guidance (NAO 216-6A).
- **Moderate:** A readily apparent change to the resource which would not constitute a major change. Generally, moderate impacts could possibly be measured or quantified and do not have the potential to satisfy the considerations of 'significance' set forth in regulations (40 C.F.R. § 1508.27) or NOAA guidance (NAO 216-6A).
- **Major:** A substantial change to the character of the resource over a large area. Generally, major impacts are quantifiable changes that have the potential to satisfy the considerations of 'significance' set forth in regulations (40 C.F.R. § 1508.27) or NOAA guidance (NAO 216-6A).

The assessment of the magnitude or intensity of potential impacts is based on a review of available and relevant references and resource materials; and is based on the professional judgment of NOAA staff using the criteria previously described, as well as, the potential that mitigation measures can either avoid or reduce significant impacts.

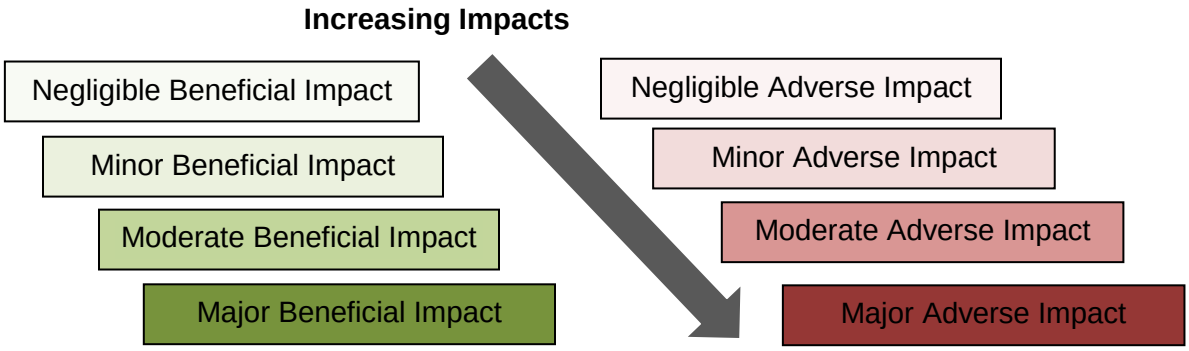


Figure 6.1 – Relative magnitude of beneficial and adverse impacts

6.1.4 Potential Impact Mitigation Measures

Mitigation measures refer to actions that either avoid or reduce potentially significant impacts. The general categories of mitigation approaches for impacts or effect described under this analysis are defined as:

- **Reduce:** A mitigation approach used to lessen the significance of action's impact to the natural or human environment

- **Avoid:** A mitigation approach used to preclude an action's otherwise significant impact or effect on the natural or human environment

6.1.5 Alternative Boundary Configurations

The subsequent sections in this chapter will evaluate the impacts associated with the implementation of each of the alternatives (previously discussed in Chapter 4). Figure 6.2 shows the boundaries side by side to serve as a visual reminder of different configurations for the action alternative.

Figure 6.2 He'eia Nation Estuarine Research Reserve boundary configurations

6.1.6 Summary of Impacts

Impacted Resource	Alternatives				Type of Impact	Duration of Impact	Magnitude of Impact	Mitigation
	Preferred Alternative	A	B	C				
Air Quality	X	X	X	X	Direct	Long-term	Negligible	None
Water Quality	X	X	X	X	Indirect	Long-term	Moderate	None
	X	X	X	X	Direct	Long-term	Minor	None
Hydrology	X	X	X	X	Direct	Long-term	Major	None
Terrestrial	X				Indirect	Long-term	Minor	None
		X			Direct	Long-term	Moderate	None
			X	X	Indirect	Long-term	Moderate	None
Estuarine	X	X	X	X	Indirect	Long-term	Minor	None
Riparian/Freshwater	X	X	X	X	Indirect	Long-term	Minor	None
Marine	X		X	X	Indirect	Long-term	Minor	None
		X			Direct	Short-term	Minor	None
Flora	X	X	X	X	Indirect	Short- and Long-term	Moderate	None
		X			Direct	Long-term	Minor	None
Fauna	X	X	X	X	Indirect	Long-term	Minor	None
	X	X	X	X	Direct	Short- and Long-term	Minor	None
Threatened and Endangered Species	X	X	X	X	Indirect	Short- and Long-term	Minor	None
	X	X	X	X	Indirect	Short- and Long-term	Negligible	BMPs
Candidate or Proposed Species	X	X	X	X	Indirect	Short-term	Negligible	BMPs
	X	X	X	X	Indirect	Short-term	Negligible	BMPs
Species of Concern	X	X	X	X	Indirect	Long-term	Minor	BMPs
Other Marine Mammals	X	X	X	X	Indirect	Long-term	Minor	BMPs
	X	X	X	X	Indirect	Short-term	Negligible	BMPs
EFH	X	X	X	X	Indirect	Long-term	Minor	None
Migratory Birds	X	X	X	X	Indirect	Long-term	Minor	None
	X	X	X	X	Indirect	Short-term	Negligible	None
Employment	X	X	X	X	Direct	Long-term	Minor	None
Ocean Economy		X			Indirect	Long-term	Minor	None
	X		X	X	Indirect	Long-term	Negligible	None

Cultural History and Land Use	X	X	X	X	Indirect	Long-term	Minor	None
Cultural	X	X	X	X	Indirect	Long-term	Minor	Reduce
Maritime Heritage	X	X	X	X	Direct	Long-term	Moderate	None
Agriculture	X	X	X	X	Indirect	Long-term	Minor	None
Aquaculture	X	X	X	X	Indirect	Long-term	Minor	None
Fishing	X		X	X	Indirect	Long-term	Moderate	None
		X			Indirect	Long-term	Minor	None
Tourism and Recreation	X	X	X	X	Indirect	Long-term	Moderate	None
Research and Monitoring	X	X	X	X	Indirect	Long-term	Minor	None
	X	X	X	X	Direct	Short- and Long-term	Negligible	None
Education	X	X	X	X	Direct	Long-term	Moderate	None
Military	X	X	X	X	Indirect	Long-term	Negligible	None

Table 6.2 Summary of impacts for He‘eia National Estuarine Research Reserve designation and management plan implementation

6.2 Natural Environment

6.2.1 Physical Environment

6.2.1.1 Climate

1. Weather and Climate

As described in Chapter 5, “Affected Environment,” Hawai‘i has a semitropical climate, with a rainy season lasting from October to May. Kāne‘ohe Bay is located on the windward side of O‘ahu, which experiences moderate to frequent rainfall (Townscape 2012), with an annual average total precipitation of 76.03 inches (HIMB 2016). The area in proximity to the proposed He‘eia NERR averages 94 inches of precipitation annually and the average annual temperatures range from 68.8 to 79.8 degrees Fahrenheit (HIMB 2016). Resulting impacts to weather and climate from the range of alternatives analyzed are provided in Table 6.3.

Table 6.3 Impacts to weather and climate

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Weather and Climate	No direct or indirect impacts are expected	Same as no action alternative	Same as no action alternative	Same as no action alternative	Same as no action alternative

No Action Alternative
Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners currently represented within the He‘eia estuary. No direct or indirect impacts (beneficial or adverse) on the weather and climate of the area are expected. It is expected that any future changes to weather and climate would be the result of larger regional and global factors that are independent of the local conditions and changes.

Preferred Alternative, Alternatives A, B, C
None of the alternatives analyzed are expected to result in any direct or indirect impacts (beneficial or adverse) on the weather and climate of the area. It is expected that any future changes to weather and climate would be the result of larger regional and global factors that are independent of the local conditions and changes.

2. Climate Change

As described in Chapter 5, “Affected Environment,” the expected impacts of climate change to Hawai‘i and Pacific Islands include increased air temperatures and warmer oceans, changes to precipitation and freshwater supplies, sea level rise, coral bleaching, and ocean acidification. See Melillo et al. 2014 for additional information on climate change impacts in the Hawaiian Islands. Resulting impacts related to climate change from the range of alternatives analyzed are provided in Table 6.4.

Table 6.4 Impacts to climate change

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Climate Change	Do direct or indirect impacts are expected	Same as no action alternative	Same as no action alternative	Same as no action alternative	Same as no action alternative

No Action Alternative
Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners currently represented within the He‘eia estuary. No direct or indirect impacts (beneficial or adverse) to climatic changes are expected. It is expected that any future climatic changes would be the result of larger regional and global factors that are independent of the local conditions and changes.

Preferred Alternative, Alternatives A, B and C
None of the alternatives analyzed are expected to result in any direct or indirect impacts (beneficial or adverse) to climate changes affecting the area. It is expected that any future climatic changes would be the result of larger regional and global factors that are independent of the local conditions and changes.

The *Climate Sensitivity of the National Estuarine Research Reserve System* report (Robinson et al. 2013) identified in Chapter 5 could provide a framework for the proposed He‘eia NERR to understand the sensitivity and vulnerability of the He‘eia wetland and Kāne‘ohe Bay to climate change impacts.

3. Air Quality

As described in Chapter 5, “Affected Environment,” air quality is monitored on each of the four main Hawaiian Islands by the State of Hawai‘i Department of Health (DOH) on a continuous basis. On O‘ahu, none of the DOH’s stationary air quality monitoring stations are located on the windward side. As a result, localized long-term air quality data for the Kāne‘ohe Bay area is not available. For the County of Honolulu, all air quality parameters were in attainment in 2016 according to USEPA air quality statistics. Resulting impacts to air quality from the range of alternatives analyzed are provided in Table 6.5.

Table 6.5 Impacts to air quality

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Air Quality	Negligible adverse impacts from road and boat traffic-related emissions in the area as well as from military aircraft on the Mōkapu peninsula are expected.	Negligible adverse impacts from increased vehicle traffic in the area as reserve activities and programs are implemented	Same as preferred alternative	Same as preferred alternative	Same as preferred alternative

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners currently represented within the He‘eia estuary. However, continued negligible adverse impacts to air quality from vehicle emissions and noise pollution from road and boat traffic in the area as well as from the military aircraft using Marine Corps Base Hawai‘i (MCBH) on the Mōkapu peninsula are expected.

Preferred Alternative, Alternatives A, B, C

Each of the proposed alternatives analyzed are expected to result in long-term negligible minor direct adverse impacts to local air quality as vehicle and boat traffic increases to the area in connection with reserve implemented activities and programs. All vehicles would be expected to be operated in accordance with applicable air quality requirements.

6.2.1.2 Water Resources

1. Water Quality

As described in Chapter 5, “Affected Environment,” the He‘eia Kea Small Boat Harbor, Kāne‘ohe Bay Central Region, and He‘eia Stream have been identified by the Hawai‘i Department of Health as impaired water bodies due to non-attainment of one or more of the applicable water quality standards based on their classification for water use. The primary

pollutants in the area that were identified by the State include nutrients, suspended solids and sediment, turbidity, polychlorinated biphenyls (PCBs), bacteria, and phosphorus. Historically, these water quality impacts have been linked to soil erosion, fertilizer, pesticides and animal waste in the Heʻeia estuary and Kāneʻohe Bay. A summary of the expected impacts to water quality from the range of alternatives analyzed is provided in Table 6.6.

Table 6.6 Impacts to water quality

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Water Quality	Changes to nutrient levels in receiving waters from manipulation and restoration activities. Short-term adverse increases in sedimentation from harbor dredging, upland and estuarine habitat manipulations, or restorations. Beneficial long-term improvements to water filtration, infiltration, and retention of soils.	In addition to the impacts identified for the potential long-term beneficial improvements through enhanced water infiltration, filtration, and soils retention from hybrid upland forest restoration and stream buffer.	In addition to the impacts identified for the preferred alternatives. Expanded geographic scope of moderate beneficial impact from additional acreage under upland restoration.	Same as preferred alternative.	Same preferred alternatives.

No Action Alternative

Under the no action alternative, the expected habitat manipulation activities by site partners such as those related the wetland agriculture, fishpond reconstruction and aquaculture, and the rehabilitation of maintenance roads and water conveyances would continue as planned. In addition, wetland, upland forest, riparian area, and coral reef restoration activities, identified in the draft management plan, are expected to be implemented as future funding is secured by those partner organizations. Furthermore, areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners represented within the Heʻeia estuary. Additional analysis of the anticipated effects of the site partner-led ongoing or planned manipulation and restoration activities are described below as well as other ongoing activities in the vicinity of the proposed reserve.

Currently, within the uplands and estuarine habitats, significant wetland manipulations, and forest, stream, and wetlands restoration efforts are anticipated to have both direct beneficial and adverse impacts to the water quality of the area's receiving water bodies. An important beneficial water quality impact from the reestablishment of the historic loko iʻa kalo (e.g., taro patches) agricultural areas on the Hawaiʻi Community Development Authority (HCDA) parcel includes the trapping and retention of sediments taro patches during rain events. Given the planned extent of this activity identified by Kākoʻo ʻŌiwi, the reductions in sediment loads to the receiving estuarine and marine waters could be significant.

Upland forest restoration through improved forest management by Kākoʻo ʻŌiwi is expected to have positive long-term water quality benefits including increased water infiltration, reduced erosion and improved retention of upland soils, and improved water filtration during rain events. Similarly, restoration of the Heʻeia Stream channel by replacing invasive vegetation with native plants is anticipated to have minor to moderate beneficial effects over the long term.

Over time, the diversity of site partner-led manipulation and restoration activities are anticipated to support improvements in local aquatic habitat conditions and ecosystem services. Notwithstanding the overall beneficial impacts, short-term, but minor, adverse water quality impacts might occur as a result of these activities. The physical reconstruction of the taro patches could have short-term impacts to elements of water quality including higher nutrient levels downstream of the taro patches and increased turbidity and sedimentation to the receiving marine waters. Removal of current plant cover from the uplands, riparian areas and the estuarine wetlands may also result in short-term water quality impacts including increased turbidity and sedimentation from surface waters as invasive flora holding soils in place is removed and replaced with appropriate native plants. In addition, fish waste byproducts of the ongoing aquaculture at the fishpond may also affect nutrient levels as water is exchanged with adjacent marine waters

Heʻeia Kea Small Boat Harbor, located northeast of Heʻeia State Park and the fishpond, is a high-use facility for fishermen, tour operators, and other user groups. Vessels operating out of the harbor are expected to continue causing minor adverse impacts to water quality through minor fuel or sewage spills either directly to the marine waters or through surface runoff from the harbor. To mitigate the potential impacts of sewage releases, the harbor has a marine sanitation device (MSD) pump out station. According to the DLNR's Division of Boating and Ocean Recreation (DOBOR), MSDs are designed to prevent the overboard discharge of untreated sewage (Department of Land and Natural Resources 2001).

Additionally, the harbor conducts regular maintenance dredging. Increased turbidity and disturbance of bottom sediments from the dredging produces sedimentation impacts that affect local water quality and the coral reef habitats within Kāneʻohe Bay. These periodic impacts have a moderate short-term adverse water quality impact to the marine waters immediate adjacent to the harbor. According to previous environmental analysis of the activity, as periodic maintenance dredging occurs, coordination between appropriate state and federal agencies occurs to ensure that impacts to the marine water are either avoided or reduced. As a result, the maintenance dredging was found to result in no significant impact to the environment (Department of Land and Natural Resources 2001).

Lastly, a portion of the City and County of Honolulu (C&CH) upland parcel within the project area is currently zoned for residential development. This part of the parcel has the potential, if developed, to have minor adverse impacts to water quality through nonpoint sources (i.e., landscaping runoff; leaking septics; or imperious surfaces) or construction-related sediment loading from surface runoff to Kāneʻohe Bay. The likelihood of residential development on this parcel is highly speculative. Further study would be needed to identify the nature of the potential

environmental impacts associated with development in the area. As such, the potential impacts of residential development were not considered under this analysis.

Preferred Alternative

Designation of a reserve under the preferred alternative boundary could potentially result in minor to moderate beneficial impacts to the water quality within the affected environment. As outlined in the proposed He‘eia Reserve’s draft management plan (Appendix A), specific estuarine research, education and stewardship activities, including technical and planning assistance, are expected to occur within the preferred alternative boundary in the years subsequent to designation. The activities identified are not intended to result in significant effects on water quality, but prior to being awarded federal funds, will be evaluated individually for their significance when more details are available.

Including the previously identified habitat manipulation and restoration activities conducted by site partners under the no action alternative, additional or expanded restoration activities identified under the draft management plan are expected to support improvements to quality and extent of the affected habitats and ecosystem processes that could have measurable long-term water quality benefits.

Under the preferred alternative, the upland forest restoration on the HCDA parcel is expected to be enhanced as described in the draft management plan. In the short-term, the removal of invasive non-native plant species and the planting of native forest species could adversely affect water quality by increasing soil erosion that could lead to sedimentation impacts on receiving waters downstream. However, over time, the establishment of significant hybrid forest cover along the higher sloped upland areas is expected to have generally positive long-term water quality benefits as a restored forest structure from the canopy to the ground cover increase water infiltration, retain of upland soils, and improve water filtration during rain events. Similarly, restoration of a 100 foot buffer around the He‘eia Stream channel by replacing invasive vegetation with native plants is anticipated to have short-term minor adverse impacts on water quality during the implementation phase, and minor to moderate beneficial effects over the long term.

In addition to the water quality impacts associated with reforestation efforts, implementation of the preferred alternative is also expected to have long-term minor beneficial impacts to water quality that are directly associated with potential programmatic activities as outlined in the proposed He‘eia Reserve’s draft management plan. Upon designation, the initial buildout of research and monitoring infrastructure within the preferred alternative boundary is anticipated to produce water quality data that establish baseline conditions and measure short and long-term changes to key water quality parameters. Based on experience with other reserves in the NERRS, water quality data derived from research and monitoring efforts could support reserve staff and site partners to adaptively manage current and planned habitat manipulation and restoration activities by setting water quality performance targets and habitat design parameters (NOAA 2005). Monitoring changes in salinity, nutrient loading, and sedimentation rates as these

activities are managed is anticipated to result in long-term beneficial water quality impacts in the vicinity of the reserve.

Notwithstanding the these beneficial impacts, short-term, minor, adverse water quality impacts might occur from the installation and use of instruments for scientific research and water quality data gathering (instrumentation required as part of the NERRS System-Wide Monitoring Program). Minor sedimentation may occur during the installation of monitoring infrastructure and instruments, such as data sondes, meteorological stations, surface elevation tables, nets, or grab samplers. Based on previous analysis of reserve operational funding awards in the NERRS, installation of research and monitoring infrastructure could be done in a manner designed to minimize adverse water quality impacts and occupy a small footprint (i.e., one piling with instrument attached), and thereby reduce any potential adverse impacts to water quality from the installation of monitoring infrastructure. In addition, given that traffic increases associated with potential reserve programs are expected be negiligible as discussed under 'Population' in subchapter 6.1.1.1, any road pollutant related impacts to water quality are also expected to be negligible.

Alternatives A, B and C

The water quality impacts (adverse and beneficial) described under both the preferred and no action alternatives apply to the boundaries identified under each of the other alternatives unless subsequently noted. Under alternative A, an additional 200 acres of land could be included for upland forest restoration and stewardship activities related to reserve designation. This could potentially expand the anticipated benefits of planned restoration activities to water quality over a larger geographic area. As previously noted, these moderate beneficial impacts include improved water infiltration, filtration, and soil retention. Thus, there would potentially be additional beneficial impacts beyond those described under the preferred alternative to water quality under alternative A.

2. Hydrology

As described in Chapter 5, "Affected Environment," the He'eia Stream runs through the project area and discharges into Kāne'ohe Bay, is a perennial stream that drains into a 3.6 square mile area and extends 3.2 miles from the summit of the Ko'olau Mountains to the ocean. The stream partially discharges into the 88-acre fishpond that extends from the shoreline out into Kāne'ohe Bay. The rest of the stream flow discharges directly into the bay. The bay itself is semi-enclosed by a barrier reef, restricting some ocean/sea water circulation and therefore heavily influenced by freshwater inputs. A summary of the resulting impacts to site hydrology from the range of alternatives analyzed is provided in Table 6.7.

Table 6.7 Impacts to hydrology

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Hydrology	Restoration of natural hydrologic flows through the area. Long-term	Increased geographic extent of the impacts described in the	Increased geographic extent of the reforestation related impacts	Same as no action alternative	Same as no action alternative

	major increases in water infiltration, improved groundwater recharge, and reduced sediment loadings to receiving waters. Short-term minor adverse impacts from increased surface runoff and sediment loads.	no action alternative and enhanced beneficial impacts. Moderate long-term beneficial impacts from Increasingly stabilized He'eia streambanks.	described in the no action and preferred alternatives.		

No Action Alternative

Under the no action alternative, the planned habitat manipulation activities by site partners such as those related the wetland agriculture, fishpond reconstruction and aquaculture, and the rehabilitation of maintenance roads and water conveyances would be expected to remain in place and continue to cause minor effects on hydrologic flows through the watershed as water flows are managed through traditional land management practices. As these habitat manipulations, as well as planned habitat restoration activities (i.e., upland reforestation, estuarine wetland, and the He'eia Stream channel) are implemented, short-term adverse effects, as well as major long-term and primarily beneficial impacts to the hydrology of the watershed are expected to occur. Additional analysis of the intended hydrological effects of these ongoing or planned manipulation and restoration activities are described below.

The planned restoration of the estuarine habitat and the He'eia Stream channel by Kāko'o 'Ōiwi is intended to have positive long-term hydrologic benefits for the watershed as invasive species, like mangroves, are removed and replanted with habitat appropriate native plants. These actions will open up previously choked water channels and create a more stable floodplain. With a more natural and meandering estuarine floodplain and stream channel, the intensity of runoff and flooding during precipitation events may be moderated, resulting in a more stable hydrologic system over time.

The reestablishment of the historic agricultural areas and the upland forest restoration on the HCDA parcel is also expected to have positive long-term major hydrologic benefits to the He'eia watershed by moderating peak flood discharge to estuarine wetlands and retaining silt loads from the He'eia Stream within the taro patches during rain events. This is accomplished by the trapping and retention of sediments within the taro patches or the forested areas during rain events. Given the planned extent of these activities identified by Kāko'o 'Ōiwi, the reductions in delivery of water quantity and sediment loads to the receiving estuarine and marine waters could be significant. Over time, the range of planned site partner-led manipulation and restoration activities are anticipated to support sustained major improvements to the local hydrology of the He'eia watershed by retaining more water, nutrients and sediments on the land and moderating the impacts of storm events.

Notwithstanding the overall beneficial impacts, minor adverse and short-term hydrologic impacts to the He‘eia watershed may occur. For example, temporary water diversions maybe used during the rehabilitation of maintenance roads and water conveyances supporting the reestablishment of the historic loko i‘a kalo. Also, removal of existing vegetative cover could adversely impact rainfall infiltration within the affected area and increase surface water runoff to receiving waters downstream. Overall, during the implementation of these activities, short-term increased intensity of stream flows that are not absorbed could adversely impact sediment loads and stream channel shape.

Preferred Alternative
In addition to the impacts described in the no action alternative, designation of the preferred alternative is anticipated to have major long-term beneficial and minor short-term adverse impacts to the surface water hydrology of the He‘eia watershed as new habitat restoration activities are implemented by the reserve and its site partners.

As described in the proposed He‘eia National Estuarine Resarch Reserve Draft Management Plan (DMP), additional restoration activities are expected to be implemented if a reserve is designated. Two of these activities directly affect the hydrological conditions of the He‘eia watershed. The first of these restoration activities is the extensive hybrid native forest restoration of upland areas within the HCDA parcel and is an extensive enhancement and geographic expansion of Kāko‘o ‘Ōiwi’s reforestation efforts described under the no action alternative. This restoration calls for the removal of invasive non-native plant species, the planting of native forest species, and the retention of select non-native species that have significant cultural values using contemporary restoration science approaches. Similar to the no action alternative, the removal of existing vegetative cover could adversely impact rainfall infiltration and increase surface water runoff in the short-term. This could result in increased soil erosion and water flows through the watershed during storm events causing sedimentation and flooding impacts that can adversely affect hydrological conditions within the watershed. However, over time, the establishment of significant native forests along the higher sloped upland areas is anticipated to have positive major long-term hydrologic benefits including increased water infiltration, improved groundwater recharge and reduced sediment loadings downstream during rain events.

In addition to the stream channel restoration already planned by Kāko‘o ‘Ōiwi, restoration of a 100 foot native vegetative buffer on either side of the He‘eia Stream channel is planned by replacing invasive vegetation with native plants is anticipated to have minor short-term adverse impacts to watershed hydrology during the implementation phase as invasive plants are removed and replaced with native species. Moderate long-term beneficial effects are expected to increase over time as the buffer becomes established. The beneficial impacts to the affected hydrology are expected to include slowing down floodwaters, improved groundwater recharge, and trapping of sediments which would stabilize streambanks.

Furthermore, as described in the DMP, the proposed He’eia NERR would be expected to provide technical assistance, environmental monitoring, and planning support for the site

partners as they implement habitat restoration and manipulation activities within the site boundaries. The restoration and manipulation activities may themselves result in minor adverse and short-term impacts to the hydrology of the He'eia ahupua'a, mostly during project implementation, for example, due to temporary water diversions. However, reserve involvement with these activities through additional contributions of reserve funding, technical assistance, and other programmatic activities is expected to enhance beneficial, and reduce adverse, effects on the hydrology of the He'eia watershed. As a result, the preferred alternative is expected to mitigate adverse impacts on affected hydrology by reducing the anticipated minor negative effects associated with the site partners' planned restoration and manipulation activities.

For example, a planned hydrology and hydraulic study implemented with site partners, is anticipated to increase knowledge and understanding of the He'eia watershed hydrology under varying flow conditions and provide new data on short and long-term trends. Data derived from this study combined with the development of new monitoring infrastructure (i.e., pore water samplers, flow meters, etc.) typically found at reserves in the NERRS should enable reserve staff to monitor short and long-term hydrologic changes within the He'eia ahupua'a. The long-term beneficial impact of this information will be to inform future management decisions (i.e., channel design for the estuarine wetland restoration) related to the different habitat manipulation and restoration efforts.

Alternatives A, B and C

The hydrological impacts described under the preferred and no action alternatives apply to the boundaries identified under each of the other alternatives unless subsequently noted. Under alternative A, an additional 100 acres of land with the C&CH parcel could be targeted for upland forest restoration and stewardship activities related to reserve designation. Expansion of the forest restoration would be expected to mirror the anticipated major benefits of the planned restoration activities to the hydrologic conditions by expanding geographic footprint of the impact despite this area not be hydrologically connected to the He'eia Stream.

Additionally, a portion of this 210 acre undeveloped parcel fronting the King Kamehameha Highway is zoned as residential (e.g., R-10). If developed, potentially minor adverse impacts to the local hydrology in the immediate vicinity could occur. Similar to the construction and impervious surface impacts typically associated with residential development, the area could experience, increased surface runoff and flooding to receiving waters and a reduced capacity for groundwater recharge. Any impact from the boat harbor included in alternative A would be negligible.

3. Ground Water

As described in Chapter 5, "Affected Environment," the area of the proposed He'eia NERR lies over the Ko'olaupoko Aquifer System of the Windward Aquifer Sector. As a primarily high level dike-impounded groundwater, many seeps and springs have been found in the wetlands of He'eia. Resulting impacts to ground water resources from the range of alternatives analyzed are provided in Table 6.8.

Table 6.8 Impacts to ground water

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Ground Water	No direct or indirect impacts are expected	Same as no action alternative	Same as no action alternative	Same as no action alternative	Same as no action alternative

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners currently represented within the He‘eia estuary. No direct or indirect impacts (beneficial or adverse) on ground water resources in the area are expected. Previous studies have found that the groundwater recharge area for this system is found in the Haiku Valley at the base of the Ko‘olau range. Future changes to ground water resources could be expected if expanding populations result in increased demand for freshwater resources. No additional studies were found for the Hawaiian Islands that considered the effects of land cover changes on ground water resources.

Preferred Alternative, Alternatives A, B and C

None of the alternatives analyzed are expected to result in any direct or indirect impacts (beneficial or adverse) to the ground water resources of the area.

6.2.1.3 Geology

As described in Chapter 5, “Affected Environment,” the steep, grooved cliffs of the Ko‘olau Mountain Range are the dominant topographic feature that defines Windward O‘ahu. Similar to other Windward O‘ahu mountain areas, there is a short transition from the steep mountains to an extremely flat coastal plain covered almost entirely by marshland. Within this topography, silty clay and marsh soils dominate. Resulting impacts to the area geology from the range of alternatives analyzed are provided in Table 6.9.

Table 6.9 Impacts to geology

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Geology	No direct or indirect impacts are expected	Same as no action alternative	Same as no action alternative	Same as no action alternative	Same as no action alternative

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners currently represented within the He‘eia estuary. No direct or indirect impacts (beneficial or adverse) to the geology of the area are expected.

Preferred Alternative, Alternatives A, B and C

None of the alternatives analyzed are expected to result in any direct or indirect impacts (beneficial or adverse) to the geological conditions of the area.

6.2.2 Biological Environment

6.2.2.1 Terrestrial Habitats

Terrestrial habitats within the study area include upland forest and shrub areas. These upland areas are mostly dominated by non-native invasive species, with few native species present (see Section 5.1.3.1 Living Resources – Flora for more description of terrestrial plants). Resulting impacts to terrestrial habitats from the range of alternatives analyzed are provided in Table 6.10

Table 6.10 Impacts to terrestrial habitats

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Terrestrial Habitats	Improved habitat from partner reforestation activities. Short-term and long-term, moderate, direct beneficial impacts including enhanced habitat for native species, removal of certain invasive species, and increased biodiversity. Short-term, direct, negligible adverse impact from soil disturbance and erosion.	Minor, indirect, beneficial over the long-term resulting from implementation of reserve programs (e.g., staff provides technical assistance and coordination, and increased community support and participation in restoration efforts). Installation of research and monitoring infrastructure leading to short-term, direct, negligible, adverse impacts such as sedimentation, habitat loss, or habitat modification.	Additional 200 acres of terrestrial habitat included in the boundary (compared to the preferred alternative). Long-term, direct, moderate, beneficial impacts resulting from the inclusion of the additional terrestrial habitat in reforestation effort (described under the no action alternative). Short-term, direct, negligible adverse impact from soil disturbance and erosion.	Significantly less terrestrial habitat included in the reserve boundary. When compared to the preferred alternative, lack of research, coordination and monitoring in terrestrial areas would be expected to limit the overall impact and efficacy of these reserve programs and reduce the total benefits to the terrestrial habitat of the affected environment.	Significantly less terrestrial habitat included in the reserve boundary. When compared to the preferred alternative, lack of research, coordination and monitoring in terrestrial areas would be expected to limit the overall impact and efficacy of these reserve programs and reduce the total benefits to the terrestrial habitat of the affected environment.

No Action Alternative

Under the no action alternative, there would be no changes to the local partners' existing or planned activities within the terrestrial areas of the affected environment. The uses of He'eia State Park are primarily low impact. The park contains a large hall that can be rented for luaus, wedding and special events. In addition, Kama'aina Kids offers guided tours (on land and in the water) and interactive classes. The primary impacts to terrestrial habitats in the park are from human visitors and the traffic coming through the park, which has only a negligible adverse effect because the land is already developed. On Moku o Lo'e (Coconut Island), all visitors to terrestrial areas must have a HIMB-affiliated host. Because of HIMB's commitment to sustainability and environmental quality, regular human use of the island (apart from any new

construction projects) likely does not have any appreciable impacts in already-developed areas.

In the upland forested area of the He‘eia CDD parcel (sometimes called instead the HCDA parcel), Kāko‘o ‘Ōiwi is planning to implement a 196 acres reforestation project, the timeline for the implementation of this activity is unknown at this time. The upland reforestation would include removal of invasive non-native plant species, but also allow for select non-native plants to remain, particularly those species that provide key forest structural attributes, have cultural relevance, or provide an important ecosystem service.

Once implemented, it is anticipated that the reforestation effort could result in both short-term and long-term moderate beneficial impacts to terrestrial habitats. As detailed in the DMP, this restoration activity would be implemented with the intention of ultimately providing increased or enhanced habitat for native species and improving the ecological function of the site’s terrestrial habitats. In the short-term, removal of the invasive non-native plant species could increase potential habitat that could be colonized or planted with appropriate native or select non-native plant species. In the long-term, it is anticipated that the reforestation effort could lead to measured improvements in the ecosystem services provided by the reforested terrestrial habitat. Potential beneficial ecosystem services may include increased biodiversity, increased native species presence, and increased natural resources that support cultural traditions and practices. Any potential erosion impacts associated with the reforestation efforts as invasive species are removed and replaced with new species are expected to be at most short-term, direct, and negligible because best management practices will be used to minimize sediment transport that could result from plant removal or the planting of new ones. These activities will occur over time, broken up across small segments of the total area, allowing impacts to be better controlled and mitigated. Erosion control measures could include diverting or controlling drainage, as well as preparing and stabilizing disturbed soil areas. Mulching, geotextiles mats, fiber rolls, and temporary drainage swales are examples of best management practices that could be applied to mitigate potential adverse impacts.

Preferred Alternative

Under the preferred alternative the planned reforestation effort, described under the no action alternative, would continue. The designation of a research reserve would however add an additional layer of research, coordination, and monitoring to existing or planned activities. It is anticipated that under the preferred alternative the research reserve-related activities of research, coordination, monitoring, and education could have minor, indirect, beneficial impacts to terrestrial habitats over the long-term and temporary, direct, negligible, adverse impacts over the short-term.

As detailed in the DMP, it is anticipated that reserve staff would potentially provide technical assistance, environmental monitoring and/or planning support, which would tie directly to the proposed reserve’s ecosystem-based management research activities occurring within the terrestrial areas. Future reserve staff could potentially work with site partners to initiate monitoring programs during project implementation to allow for adaptive management of these restoration efforts, as needed. Environmental compliance reviews would be carried out in

advance of each project, and all necessary permits and authorizations would be obtained. With technical assistance and/or other support from reserve staff, it is anticipated that the terrestrial habitat restoration effort could bring about, in the long-term, minor, indirect, beneficial impacts, particularly to species and ecosystems. For example, reserve staff could work with site partners to identify and implement appropriate mitigation measures so that the planned terrestrial habitat restoration activities will be achieved in a manner that minimizes negative impacts to sensitive environments and species. Mitigation measures may include working with site partners to ensure that the various projects are implemented using best management practices to minimize erosion and sediment loss (e.g., using erosion control blankets on steep-sloped areas during construction).

In addition to providing technical assistance and environmental monitoring support to site partners, it is anticipated that reserve staff would play a key role in coordinating external research, monitoring, education and outreach efforts occurring throughout the terrestrial areas. Thus, reserve designation could improve coordination of these efforts, and thereby, provide support to the reserve and site partners' programs aimed at promoting, understanding and improving terrestrial habitats. This support, in turn, is expected to provide long-term, minor, and indirect beneficial impacts to affected terrestrial habitats.

Reserve-specific research and monitoring efforts would focus, at least initially, on developing baseline habitat and ecosystem service data related to terrestrial habitats. Designation of the proposed He'eia NERR would result in the installation and use of instruments for scientific research and data gathering. These instruments could include for example meteorological stations or soil monitoring systems. It is expected that their installation and use could result in temporary, direct, adverse impacts to terrestrial habitats, such as negligible sedimentation, habitat loss, or habitat modification. These impacts are expected to be negligible because the instruments will be placed and used in a manner designed to minimize negative impacts to sensitive environments, and in compliance with all environmental, historic preservation, and other applicable mandates.

Implementation of the proposed He'eia NERR's education, and outreach programs could help site partners and key audiences improve their understanding of the ecological value the terrestrial habitats provide. Reserve outreach efforts are anticipated to result in increased participation in community restoration and stewardship activities intended to improve the ecological character and functionality of the terrestrial habitats. This increased participation, in turn, is expected to provide long-term, minor, and indirect beneficial impacts to affected terrestrial habitats. It is for these reasons that, if designated, the reserve's research, education, and outreach efforts would be expected to have long-term, minor beneficial impacts and would not be expected to have any significant adverse impacts on affected terrestrial habitats.

Alternative A

Implementation of alternative A would add approximately an additional 200 acres of terrestrial habitat to the proposed He'eia NERR beyond those included in the preferred alternative. The DMP describes this additional land as "mixed native and non-native forest", and it would likely

be targeted for inclusion in the reforestation effort described under the no action alternative. The restoration of degraded upland forest habitat could result in measurable improvements to specific ecosystem services, as well as improve habitat and ecosystem function, and could potentially result in long-term, direct, moderate, beneficial impacts to these additional terrestrial habitats, depending on the nature and extent of the forest restoration. Any potential erosion impacts associated with the reforestation efforts as invasive species are removed and replaced with new species are expected to be at most negligible because best management practices will be used to minimize sediment transport that could result from plant removal or the planting of new ones. These activities will occur over time, broken up across small segments of the total area, allowing impacts to be controlled and mitigated. Erosion control measures could include diverting or controlling drainage, as well as preparing and stabilizing disturbed soil areas. Mulching, geotextiles mats, fiber rolls, and temporary draining swales are examples of best management practices that could be applied to mitigate potential adverse impacts. For the same reasons described above, erosion-related adverse impacts are anticipated to be short-term, direct, and negligible.

Alternatives B and C

Implementation of alternatives B and C contain limited terrestrial habitats within the research reserve's boundary, and these areas have some degree of development on them (e.g., He'eia State Park, or the staging/staff offices on the HCDA parcel). The reforestation effort described under the no action alternative would still be implemented. However, the additional long-term, moderate, beneficial impacts that could result from the research reserve program's (e.g., research, coordination, and monitoring) would not be expected to occur within the terrestrial habitats because these areas would be outside the boundary of the proposed site. When compared to the preferred alternative, lack of research, coordination and monitoring in terrestrial areas would be expected to limit the overall impact and efficacy of these reserve programs and reduce the total impacts (beneficial and adverse) to the terrestrial habitat of the affected environment.

6.2.2.2 Estuarine Habitats

The estuarine habitats within the study area include tidally influenced wetlands, a mangrove forest, and He'eia Fishpond. On the makai (seaward) part of the HCDA parcel, an invasive mangrove forest has altered the He'eia estuarine habitat and is choking the He'eia Stream. Resulting impacts to estuarine habitats from the range of alternatives analyzed are provided in Table 6.11

Table 6.11 Impacts to estuarine habitats

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Estuarine Habitats	Improved habitat from partner restoration activities (mangrove and invasive algae removal). Long-term, direct, major,	Minor, indirect, beneficial impacts over the long-term resulting from implementation of reserve programs (e.g., staff provide	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

	beneficial impacts resulting from the restoration of native habitat. Potential short-term minor adverse impacts sedimentation and habitat loss during the implementation of mangrove removal and construction of the loko iʻa kalo. Short-term, direct, negligible adverse impacts resulting from invasive algae removal.	technical assistance and coordination, and increased community support and participation in restoration efforts). Installation of research and monitoring infrastructure leading to short-term, direct, negligible, adverse impacts such as sedimentation, habitat loss, or habitat modification.			

No Action Alternative

Under the no action alternative, there would be no changes to the local partners' existing or planned activities within the estuarine areas of the affected environment. As indicated in the DMP, Kākoʻo ʻŌiwi intends to remove the invasive mangroves and replace them with approximately 20 acres of native wetland sedges and open-water pools, which will serve as habitat for native birds and as a nursery for juvenile fish. During the implementation of the mangrove removal effort, potential short-term minor adverse impacts could occur. During the removal increased sediment and debris could enter Heʻeia Stream, thereby temporarily affecting the overall water quality of the stream and other downstream habitats (e.g., the fishpond). However it is anticipated that the project would be implemented in a manner designed to reduce such adverse effects. The U.S. Army Corps of Engineers (USACE) issued a permit in 2012 to Paepae o Heʻeia to close an 80-foot breach in the wall of Heʻeia Fishpond and associated sluice gate (makaha). The permit required the restored wall to have the same alignment and footprint as the original fishpond wall. Restoration was to be accomplished by hand, using hand tools, without mortar. Most stone and rocks were to come from the site; some pieces of dead coral came from a local quarry. No heavy equipment was used below the high-water mark; in some cases, floating pontoon flat beds were to be used to transport stone. The permit also covers 10 years of maintenance work, including manual replacement of dislodged stone, as well as removal by hand and with hand tools (but without pesticides) of invasive mangroves, invasive algae, and other invasive plants. Paepae o Heʻeia proposed a series of best management practices (BMPs) for its restoration efforts, incorporated into the permit (USACE 2012b). The restoration work at Heʻeia Fishpond could also modify the natural environment leading to temporary habitat loss and reduced habitat value in discrete areas, but these adverse effects are expected to be generally minor given that mobile species such as Hawaiian hoary bats and migratory shorebirds could potentially relocate to nearby habitats with similar characteristics. All necessary permits and authorizations for the proposed projects in estuarine habitats would be secured prior to their implementation. The long-term goal and beneficial impact of replacing the mangrove forest with approximately 20 acres of native wetland sedges and open-water pools would be to improve the function of the currently degraded estuarine environment, and the

anticipated long-term, direct, major, beneficial impacts would be of a larger magnitude than anticipated short-term adverse impacts.

In the brackish wetland, Kākoʻo ʻŌiwi also plans to implement a historic loko iʻa kalo, a traditional combined taro patch and fishpond. It is anticipated that establishing a loko iʻa kalo in the brackish wetlands will help restore the degraded ecosystems and ultimately improve habitat and ecosystem function. Although the exact size and depth of the planned loko iʻa kalo is unknown at this time, the DMP identifies an approximate area where this activity will occur (see Section 10.2, Figure 10.1). Due to the proximity of the planned area to the mangrove forest, the implementation of this activity is expected to occur after the removal of the mangrove forest. All necessary permits and authorizations will be obtained prior to establishing a new loko iʻa kalo system. The loko iʻa kalo is anticipated to yield direct beneficial impacts to the estuarine environment (primarily through improved habitat for select native fish species and other ecosystem services). However, the implementation and construction of the loko iʻa kalo may result in short-term, minor adverse impacts, as some plants or animals that currently inhabit the brackish wetlands might not survive once the conversion of this ecosystem is completed. In addition, adverse impacts would be contained to a specific area and located within an environment that is currently degraded.

Within the Heʻeia Fishpond, the removal of invasive limu (seaweed) is another restoration activity currently underway, which is expected to continue. This activity improves the estuarine environment within the fishpond by supporting the growth of native seaweed species (e.g., manauea and common ogo). The invasive limu grows in large dense mats, spreading quickly, and essentially out-competes the native algae species, preventing the native algae species from colonizing potentially-habitable areas. As previously described, the invasive limu is gathered by hand or net, placed into large bags, removed from the site, and taken to local farms to be used as organic fertilizer. No mechanical equipment is used to remove the invasive limu. The short-term, direct, adverse impacts of gathering the limu are so limited, primarily affecting aquatic invertebrates in the estuarine habitat, that they would be negligible. There would be no anticipated long-term adverse impacts associated with this activity.

Preferred Alternative and Alternatives A, B and C

Under the preferred alternative, the planned restoration and manipulation activities described under the no action alternative would continue. The designation of a proposed Heʻeia NERR would, however, add the elements of dedicated research, coordination, monitoring, and education to existing or planned activities that collectively are expected to have indirect, minor, beneficial impacts to estuarine habitats over the long-term.

As detailed in the DMP, it is anticipated that reserve staff would potentially provide technical assistance, environmental monitoring and/or planning support, which would benefit the proposed reserve's ecosystem-based management research activities occurring within the estuarine areas. Future reserve staff could potentially work with site partners to initiate monitoring programs during project implementation to allow for adaptive management of these restoration and manipulation efforts, as needed. Any necessary environmental compliance

reviews would be carried out in advance of each project, and all necessary permits and authorizations would be obtained. With technical assistance and/or other support from reserve staff, it is anticipated that the estuarine habitat restoration effort would result in additional long-term, indirect, minor, beneficial impacts, particularly to species and ecosystems. For example, reserve staff could work with site partners to identify and implement appropriate mitigation measures so that the planned activities described above will be achieved in a manner that minimizes negative impacts to sensitive environments and species. Mitigation measures may include actively monitoring for the presence of protected species during the planning and implementing of site partner activities or working with site partners to ensure that the various projects are implemented using best management practices to minimize potential water quality and sedimentation impacts (e.g., using erosion control blankets on the shallow slopes of the estuarine areas).

In addition to providing technical assistance and environmental monitoring support to site partners, it is anticipated that, once hired, reserve staff would play a key role in coordinating external research, monitoring, education and outreach efforts occurring throughout the estuarine areas. Thus, reserve designation could improve coordination of these efforts, and thereby, provide support to the reserve and site partners' programs aimed at promoting, understanding and improving terrestrial habitats. This support, in turn, is expected to provide long-term, minor, and indirect beneficial impacts to affected estuarine habitats.

Reserve-specific research and monitoring efforts would focus, at least initially, on developing baseline habitat and ecosystem service data related to estuarine habitats. Designation of a proposed He'eia NERR would result in the installation and use of instruments for scientific research and data gathering. These instruments include data sondes, meteorological stations, surface elevation tables, nets, and grab samplers. It is expected that their installation and use could result in temporary adverse impacts to estuarine habitats, such as negligible sedimentation, habitat loss, or habitat modification. These impacts are expected to be negligible because the instruments will be placed and used in a manner designed to minimize negative impacts to sensitive environments, and in compliance with all environmental, historic preservation, and other applicable mandates.

Implementation of the research reserve's education, and outreach programs could help site partners and key audiences improve their understanding of the ecological value the estuarine habitats provide. Reserve outreach efforts are anticipated to result in increased participation in community restoration and stewardship activities intended to improve the ecological character and functionality of the terrestrial habitats. This increased participation, in turn, is expected to provide long-term, minor, and indirect beneficial impacts to affected terrestrial habitats. It is for these reasons that, if designated, the reserve's research, education, and outreach efforts would be expected to have long-term, minor beneficial impacts and would not be expected to have any significant adverse impacts on affected estuarine habitats.

6.2.2.3 Riparian and Freshwater Habitats

The riparian and freshwater habitats of the project area include streams and associated riparian buffer areas, and freshwater wetlands. These habitats are all located within the HCDA parcel. Resulting impacts to riparian and freshwater habitats from the range of alternatives analyzed are provided in Table 6.12.

Table 6.12 Impacts to riparian and freshwater habitats

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Riparian/ freshwater habitats	Improved habitat from partner activities. Long-term, direct, major, beneficial impacts from rehabilitation of the loʻi kalo and restoration of Heʻeia Stream and buffer. Short-term, direct, and negligible adverse impacts from erosion and sedimentation.	Minor, indirect, beneficial impacts over the long-term from implementation of reserve programs (e.g., staff provide technical assistance and coordination, and increased community support and participation in restoration efforts). Installation of research and monitoring infrastructure leading to short-term, direct, negligible, adverse impacts, such as sedimentation, habitat loss, or habitat modification.	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

No Action Alternative

Under the no action alternative, there would be no changes to the local partners' existing or planned activities within the freshwater and riparian areas of the affected environment. In the freshwater wetlands, Kākoʻo ʻŌiwi, through its Māhuahua ʻAi o Hoi project plans to establish a land management program to return the wetlands of Heʻeia to productive agricultural, cultural, and educational use. In cooperation with the Natural Resources Conservation Service, the group has developed a detailed conservation plan, the implementation of which is in progress (Townscape 2011). This work includes rehabilitating wetlands to loʻi kalo. The loʻi kalo will be used to grow different varieties of taro and will also serve as habitat for native birds. Presently, approximately 1 acre of the freshwater wetlands within the HCDA parcel has been converted to loʻi kalo. Kākoʻo ʻŌiwi ultimately plans to convert 176 acres into a working agricultural landscape. Also proposed is potentially restoring a historic poi mill, which would occur only after any consultations required under applicable federal and/or state law.

As part of the rehabilitation of loʻi kalo in the wetlands of Heʻeia, historic kuāuna (taro patch walls) have been identified by a certified archaeologist as part of an archaeological inventory survey and will be restored to the extent possible. New kuāuna will be constructed to replace kuāuna from earlier times are no longer present. Kuāuna will be built by excavating soil from within the loʻi and using this soil to create the kuāuna. In addition, historical agricultural roads

and ‘auwai (water conveyance channels) also remain within freshwater wetlands. It is anticipated that the roads will be rehabilitated and reinforced with geotextile material and ‘auwai will be restored and vegetated with native riparian plants. As needed, consultation with the State Historic Preservation Division will be conducted.

These planned activities could have potential long-term, direct, major, beneficial impacts resulting from the rehabilitation of the lo‘i kalo including providing native wildlife habitat, soil and nutrient retention, clean groundwater, and restored water flow. In the short-term, direct, and negligible adverse impacts could occur such as increased erosion and sedimentation as soil is displaced and relocated within an individual lo‘i kalo (e.g., to reinforce kuāuna or historic roads). Water quality impacts resulting from erosion and sedimentation could be an issue. It is anticipated that during the rehabilitation or construction of lo‘i kalo, the waters coming from He‘eia Stream could be temporarily diverted, minimizing risk of affecting water quality within the Stream. Loose soil and debris would be confined to the lo‘i kalo, a relatively closed unit, resulting adverse impacts are expected to be manageable. The rehabilitation of lo‘i kalo will occur over time, broken up across small segments of the total area, allowing impacts to be controlled and mitigated.

In the He‘eia Stream channel, California grass and other invasive plants dramatically reduce water flow and adversely affect water quality. Water quality samples collected by the HIMB in areas of the stream overgrown with California grass suggest that the oxygen content of the water is so low that it cannot support aquatic animals. Kāko‘o ‘Ōiwi plans to replace the current California grass and other invasive plants in the stream with native plants as well as within a 100 ft. wide buffer along both sides of the stream. The stream channel and riparian area will be restored to improve water quality and flow and provide better habitat for native aquatic plant, invertebrate, and bird species. Direct, major, beneficial impacts to riparian habitats are likely to occur over the long-term. These beneficial impacts could include increased native species abundance and diversity, increased habitat suitable for native species, and improved water quality.

During the implementation of the restoration effort, it is possible that potential erosion, sedimentation, and water quality-related impacts could occur when removing the California grass and replacing it with new species. However, these potential adverse impacts are expected to be at most short-term, direct, and negligible because best management practices will be used to minimize sediment transport that could result from plant removal or the planting of new ones. These activities will occur over time, broken up across small segments of the total area, allowing impacts to be controlled and mitigated. Erosion control measures could include, avoiding work during rain events, diverting or controlling drainage, as well as preparing and stabilizing disturbed soil areas. Mulching, geotextiles mats, fiber rolls, and temporary drainage swales are examples of best management practices that could be applied to mitigate potential adverse impacts.

Preferred Alternative and Alternatives A, B and C

Under the preferred alternative, the site partners' planned restoration and manipulation activities described under the no action alternative would continue. The designation of a proposed He'eia NERR would, however, add a more comprehensive regional perspective of research, coordination, and monitoring to existing or planned activities. It is anticipated that under the preferred alternative, research reserve-related research, coordination, monitoring, and education could have indirect, minor, beneficial impacts to riparian and freshwater habitats over the long-term.

As detailed in the DMP, it is anticipated that reserve staff would potentially provide technical assistance, environmental monitoring and/or planning support, which would tie directly to the proposed reserve's ecosystem-based management research activities occurring within the riparian and freshwater wetland areas. Future reserve staff could potentially work with site partners to initiate monitoring programs during project implementation to allow for adaptive management of these restoration and manipulation efforts, as needed. Environmental compliance reviews would be carried out in advance of each project, and all necessary permits and authorizations would be obtained. With technical assistance and/or other support from reserve staff, it is anticipated that the estuarine habitat restoration effort could bring about, in the long-term, indirect, minor beneficial impacts, particularly to species and ecosystems. For example, reserve staff could work with site partners to identify and implement appropriate mitigation measures so that the planned activities described above will be achieved in a manner that minimizes negative impacts to sensitive environments and species. Mitigation measures may include actively monitoring for the presence of protected species during the planning and implementing of site partner activities or working with site partners to ensure that the various projects are implemented using best management practices to minimize potential water quality and sedimentation impacts (e.g., using erosion control blankets on the banks of He'eia Stream).

In addition to providing technical assistance and environmental monitoring support to site partners, it is anticipated that, once hired, reserve staff would play a key role in coordinating external partners' research, monitoring, education and outreach efforts occurring throughout the research reserve. Thus, reserve designation could improve coordination of these efforts, and thereby, provide support to the reserve and site partners' programs aimed at promoting, understanding and improving riparian and freshwater wetland habitats. This support, in turn, is expected to provide long-term, minor, and indirect beneficial impacts to affected estuarine habitats.

Reserve-specific research and monitoring efforts would focus, at least initially, on developing baseline habitat and ecosystem service data related to riparian and freshwater habitats. Designation of a proposed He'eia NERR would result in the installation and use of instruments for scientific research and data gathering. These instruments include data sondes, meteorological stations, surface elevation tables, nets, and grab samplers. It is expected that their installation and use could result in temporary adverse impacts to riparian and freshwater habitats, such as negligible sedimentation, habitat loss, or habitat modification. These impacts are expected to be negligible because the instruments will be placed and used in a manner

designed to minimize negative impacts to sensitive environments, and in compliance with all environmental, historic preservation, and other applicable mandates.

Implementation of the research reserve's education, and outreach programs could help site partners and key audiences improve their understanding of the ecological value the riparian and freshwater wetland habitats provide. Reserve outreach efforts are anticipated to result in increased participation in community restoration and stewardship activities intended to improve the ecological representativeness and functionality of the riparian and freshwater habitats. This increased participation, in turn, is expected to provide long-term, minor, and indirect beneficial impacts to affected riparian and freshwater habitats. It is for these reasons that, if designated, the reserve's research, education, and outreach efforts would be expected to have long-term, indirect, minor, beneficial impacts riparian and freshwater habitats and would not be expected to have significant adverse impacts on affected areas. It is anticipated that the community restoration and stewardship events would be (e.g., assisting with building loʻi kalo or removing California grass) carried out using the best management practices described above and led by experienced and knowledgeable staff. It is anticipated that potential adverse impacts would be short-term, direct, and negligible.

6.2.2.4 Marine Habitats

The affected environment features six major habitat classes within the marine environment: sand, mud, macroalgae, coralline algae, patch reef, and colonized pavement. Of these habitat classes, the shallow patch reefs provide the highest ecological value and are the targets of the marine-based restoration efforts within the study area. However, other habitat classes provide important areas for a variety of different species during different stages of their life cycles. Resulting impacts to marine habitats from the range of alternatives analyzed are provided in Table 6.13.

Table 6.13 Impacts to marine habitats

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Marine habitats	Long-term, direct, minor to moderate, beneficial impacts from partner restoration activities. Short-term, direct, negligible, adverse impacts from algae removal (e.g. accidental damaging of coral). Direct adverse impacts from boat traffic (e.g. pollution) and indirect adverse impacts waves created by motorized vessels.	Minor, indirect, beneficial impacts over the long-term from implementation of reserve programs (e.g., staff provide technical assistance and coordination, and increased community support and participation in restoration efforts). Installation of research and monitoring infrastructure leading to short-term, direct, negligible, adverse	Less marine habitat acreage could dilute the benefits described in the preferred alternative. Direct adverse impact on the marine habitat (e.g., loss of coral reef habitat), which could be temporary or long-term depending on the severity of the disturbance. Increased turbidity could result in short-term, direct,	Same as preferred alternative.	Less marine habitat acreage could dilute the benefits described in the preferred alternative.

		impacts, such as sedimentation, habitat loss, or habitat modification.	adverse impact. Negligible, short-term, indirect, beneficial impacts could result from implementing mitigation strategies.		

No Action Alternative

Under the no action alternative, there would be no changes to the public's or local partners' existing or planned activities within the marine areas of the affected environment. Kāneʻohe Bay is the site of varied and, in places, intense use by humans and other species. Boat traffic in the bay can have adverse effects on the habitat from spills of oils, fuels, pollutants, and other wastes, as well as other indirect adverse impacts, such as from the waves created by motorized vessels. HIMB has its own fleet, which includes a few 17-foot Boston Whalers that have Honda 40-horsepower outboard engines, one or two 22-foot Boston Whalers with twin Yamaha 90-housepower outboard engines, and one 40-foot support vessel that can transport up to 10,000 pounds of passengers and cargo (and is available for scientific research and educational project support, as needed). The 40-foot vessel sometimes picks people up from and drops them off at a pier at the Heʻeia Kea Small Boat Harbor. One HIMB boat inventory also references a community education program boat that can hold up to 49 people that HIMB is expecting to put into service. The other reserve partners do not report owning motorboats in the inventory of existing facilities and equipment (Table 8-1) in the DMP.

The boat harbor requires periodic maintenance dredging. This activity is coordinated with appropriate state and federal agencies to ensure that impacts to marine substrate and coral are avoided or minimized. Dredging could result in physical removal of substrate and potentially increase sedimentation. Increased sedimentation could in turn increase turbidity levels, temporarily reducing visibility within the water column. The physical removal of substrate could have a direct adverse impact on the marine habitat (e.g., loss of coral reef habitat), which could be temporary or long-term depending on the severity of the disturbance. Increased turbidity could result in short-term, direct, adverse impact on the marine habitats by temporarily reducing the amount of sunlight entering the water column and affecting coral health.

The Department of Land and Natural Resource's (DLNR) Division of Aquatic Resources (DAR) is implementing a program to control alien algae on coral reefs in Kāneʻohe Bay. The DAR staff uses a mechanical suction device called the "Super Sucker" (i.e., an underwater vacuum system) while snorkeling to collect invasive algae removed by hand from the reefs in Kāneʻohe Bay. The algae are collected aboard a barge anchored near the site of collection. After the removal, captive-reared sea urchins are released to graze on the remaining algae and thereby slow the regrowth of the infestation. The algae is removed from the bay, and given to local farmers. The algae are high in nutrients and used by the farmers as a natural fertilizer to support healthy crop growth.

In addition, the DAR is proposing to establish a coral reef mitigation bank on several patch reefs within Kāneʻohe Bay, including patch reef 10. DAR is also proposing to use patch reef 9 as a "control" or reference area to which results in the mitigation bank area could be compared (US Army Corps of Engineers 2014). In other words, no management or restoration would occur in patch reef 9. For additional details regarding the mitigation bank process, including how it is established, used, and managed, refer to the U.S. Army Corps of Engineers Public Notice, 2014. If established, the coral mitigation bank would contribute to the restoration of degraded patch reefs within the proposed boundaries where invasive algae have taken over and caused partial or full mortality of live corals. The mitigation bank will direct additional financial resources to support future efforts to mechanically remove invasive algae and out-plant sea urchins to patch reef 10.

Finally, the study area also includes 64 acres of coral reefs immediately surrounding Moku o Loʻe which comprise the Hawaiʻi Marine Laboratory Refuge. This refuge is highly protected by limitations on public access and a prohibition on the removal of marine organisms, except for research purposes. Also, in support of the restoration activities described previously an in-situ pilot coral nursery is currently proposed for a small area off Moku o Loʻe. The nursery, covering an area of approximately 5 meters^2, is intended to provide source material for DAR-led restoration efforts by collecting corals damaged by ship groundings and other adverse impacts (NOAA 2016d). The activity has undergone an environmental compliance review by NMFS, which found that this activity does not adversely affect listed species or critical habitats. In addition, NMFS also determined that the activity will have no adverse effect to EFH given the best management practices being implemented for the activity such as avoiding the placement of any coral nursery related equipment and materials such as concrete blocks on substrate colonized by coral. Placement should ideally be on sand only. The impacts of this activity could potentially have minor beneficial impacts to marine habitats depending on the success of the project.

Overall, the restoration efforts in the marine habitats are anticipated to result in long-term, direct, minor to moderate, beneficial impacts, depending on the success of the efforts. The removal of the algae results in immediate short-term benefits (e.g., improved habitat), however the long-term success is contingent on the urchin's presence and survival. If the urchin populations decline (e.g., disease or reproduction challenges), this would inhibit the sustained pressure the urchins place on algae growth, and the algae could return to their dominating state. Potential, short-term, direct, negligible, adverse impacts could occur during the algae removal efforts. Corals could be inadvertently damaged during the algae removal process. However, damage of this nature is temporary (i.e., the coral is not expected to die) and is not likely to occur often.

Preferred Alternative and Alternative B

In this section, the Preferred Alternative and Alternative B will be addressed because they contain the same marine habitats. Under the Preferred Alternative and Alternative B, the planned restoration activities described under the no action alternative would continue. There would not be any expected changes in permitted human use of the different marine areas included within the reserve. It is possible there might be a very small increase in the number of

boat trips within the bay associated with future reserve visitors, likely practically imperceptible in terms of the effects on marine habitats given the large volume of existing boat traffic and the fact that no new types of boats are anticipated to be introduced into the marine landscape with impacts different from those of current boats used. The designation of a proposed He'eia NERR would however add a more comprehensive regional perspective of research, coordination, and monitoring to existing or planned activities. It is anticipated that under the Preferred Alternative and Alternative B research reserve-related research, coordination, monitoring, and education could have indirect, minor, beneficial impacts to marine habitats over the long-term.

As detailed in the DMP, it is anticipated that reserve staff would potentially provide technical assistance, environmental monitoring and/or planning support, which would tie directly to the proposed reserve's ecosystem-based management research activities occurring within the marine areas. Future reserve staff could potentially work with site partners to initiate monitoring programs during project implementation to allow for adaptive management of these restoration and manipulation efforts, as needed. Environmental compliance reviews would be carried out in advance of each project, and all necessary permits and authorizations would be obtained. With technical assistance and/or other support from reserve staff, it is anticipated that the marine habitat restoration effort could bring about, in the long-term, indirect, minor, beneficial impacts, particularly to marine species and ecosystems. For example, reserve staff could work with site partners to identify and implement appropriate mitigation measures so that the planned activities described above will be achieved in a manner that minimizes negative impacts to sensitive environments and species.

In addition to providing technical assistance and environmental monitoring support to site partners, it is anticipated that, once hired, reserve staff would play a key role in coordinating external partners' research, monitoring, education and outreach efforts occurring throughout the marine habitats. Thus, reserve designation could improve coordination of these efforts, and thereby, provide support to the reserve and site partners' programs aimed at promoting, understanding and improving marine habitats. This support, in turn, is expected to provide long-term, minor, and indirect beneficial impacts to affected marine environment.

Reserve-specific research and monitoring efforts would focus, at least initially, on developing baseline habitat and ecosystem service data related to marine habitats. Designation of a proposed He'eia NERR would result in the installation and use of instruments for scientific research and data gathering. These instruments include data sondes, meteorological stations, surface elevation tables, nets, and grab samplers. It is expected that their installation and use could result in short-term adverse impacts to marine habitats, such as negligible sedimentation, habitat loss, or habitat modification. These impacts are expected to be negligible because the instruments will be placed and used in a manner designed to minimize negative impacts to sensitive environments, and in compliance with all environmental, historic preservation, and other applicable mandates.

Implementation of the research reserve's education, and outreach programs could help site partners and key audiences improve their understanding of the ecological value the marine

habitats provide. Reserve outreach efforts are anticipated to result in increased participation in community restoration and stewardship activities intended to improve the ecological character and functionality of the marine habitats. This increased participation, in turn, is expected to provide long-term, minor, and indirect beneficial impacts to affected marine habitats. It is for these reasons that, if designated, the reserve's research, education, and outreach efforts would be expected to have long-term, indirect, minor, beneficial impacts marine habitats and would not be expected to have significant adverse impacts on affected areas.

Alternative A

The implementation of alternative A would result in approximately 300 acres of marine habitats being excluded from the research reserve boundary compared to the preferred alternative. The boundary of alternative A excludes reef patches targeted for the coral mitigation bank and associated control reefs (i.e., reefs 9 and 10). Therefore, under the implementation of alternative A the linkage between the research reserve's programs and the proposed coral mitigation bank would not be cohesive. The potential long-term, direct, minor, beneficial impacts that could result from the partnership between the research reserve and the DAR, with overlapping boundaries of the research reserve and the proposed coral mitigation bank, may be lessened (compared to the preferred alternative). Also, inclusion of the boat harbor within the proposed proposed He'eia NERR boundary might have negligible, short-term, indirect, beneficial impacts to the marine environment in that reserve staff would be able to work with managing authorities to implement additional mitigation strategies to reduce impacts, such as providing monitoring data that informs approaches to dredging, which could reduce adverse impacts.

Alternative C

The implementation of alternative C would result in approximately 300 acres of marine habitats being excluded from the research reserve boundary (compared to the preferred alternative). The boundary of alternative C excludes reef patches targeted for the coral mitigation bank and associated control reefs (i.e., reefs 9 and 10). Therefore, under the implementation of alternative C the linkage between the research reserve's programs and the proposed coral mitigation back would not be cohesive. The potential long-term, indirect, minor, beneficial impacts that could result from the partnership between the proposed He'eia NERR and the DAR, with overlapping boundaries of the research reserve and the proposed coral mitigation back, may be lessened (compared to the preferred alternative). There would be no anticipated additional impacts to the marine environment under this alternative.

6.2.3 Living Resources

The discussions below analyze the potential impacts to living resources of the five alternatives evaluated. The DMP describes the types of activities that reserve partners are working on or planning that affect flora and fauna, as well as how reserve activities would support efforts to study and restore different environments and species. If there is any need for scientific collection or destructive sampling of aquatic flora, fauna, coral, or other living organisms, researchers might be required to obtain permits from the Hawai'i DAR or the Hawai'i Division of Forestry and Wildlife (DOFAW), in the case of birds, for example. If there were a need for

scientific collection or destructive sampling of federally protected species, authorizations would be obtained, if needed, from the US Fish and Wildlife Service (USFWS) and/or the National Marine Fisheries Service (NMFS).

6.2.3.1 Flora

6.2.3.1.1 Terrestrial Flora

Individual projects that have the potential to impact terrestrial flora have been summarized above. For more information about potential habitat manipulations, see above subchapter on "Terrestrial Habitats." Resulting impacts to terrestrial flora from the range of alternatives analyzed are provided in Table 6.14.

Table 6.14 Impacts to terrestrial flora

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Terrestrial Flora	Minor to moderate, direct, beneficial impacts to some species over the long term from restoration projects. Minor indirect and direct adverse impacts to some plants removed (largely invasive species). Adverse, short- and long-term impacts to species not targeted for removal from proposed projects vary, but would typically be minor. Other stressors could also have moderate adverse effects on plant species, e.g., hydrologic alterations and introduction of invasive species.	Minor, long-term benefits from reserve support for research, planning, and observations, which could support integration of BMPs and adaptive management into projects, producing long-term, minor, indirect, beneficial effects. Minor indirect benefits from reserve education efforts. Installing monitoring devices could cause short-term, negligible adverse impacts.	Same as preferred alternative, except another 200 acres of land would be included in the reserve, adding impacts of the types described under the preferred alternative from Reserve-initiated activities in that parcel (including restoration of forested areas).	Same as preferred alternative, except for effects of including a smaller terrestrial area in the reserve. Benefits to flora from reserve research, coordination, and monitoring could be reduced, limiting the impact and efficacy of reserve programs and reducing reserve benefits compared to the preferred alternative.	Same as alternative B.

No Action Alternative

There could be minor to moderate, direct, beneficial impacts to some terrestrial flora species over the long term from restoration projects. Some of these projects and other activities could directly and indirectly impact plants by modifying such characteristics as light availability, soil-water regimes, nutrient cycling and species composition (e.g., replacing invasive species that dominate terrestrial areas with native species). Minor indirect and direct adverse impacts to some plants removed (largely invasive species). Adverse, short- and long-term impacts to species not targeted for removal would vary, but typically be minor. For more information about

habitat modifications planned, see above subchapter on “Terrestrial Habitats.” Other stressors could also have moderate adverse effects on plant species (e.g., hydrologic alterations, introduction of invasive animal species).

Preferred Alternative
The preferred alternative is expected to include the same activities described in the no action alternative, plus additional support from reserve staff for research, planning and coordination, monitoring, etc., which could facilitate integration of best management practicies (BMPs), mitigation measures, monitoring, and adaptive management into projects, producing long-term, minor, indirect, beneficial effects. Additional indirect benefits would be expected to derive from reserve education efforts. New reserve initiatives could have negligible to minor adverse effects to some species from restoration, manipulation, and/or monitoring efforts. There could also be impacts to localized areas of developing spaces in which visitors could congregate; potential impacts of any such projects would be analyzed in the future, as part of the environmental compliance process.

Alternative A
Under alternative A, the consequences in terrestrial areas would be similar to under the preferred alternative, except another 200 acres of terrestrial areas would be included within the reserve, and there could be additional minor adverse and beneficial impacts of Reserve-initiated activities in that area, such as those that could result from regularly bringing visitors to the additional parcel, restoring it (e.g., reducing the number of invasive plants), and conducting research there.

Alternatives B and C
The impacts to terrestrial flora of alternative B are expected to be the same as those under the preferred alternative, except that there would be reduced impacts associated with including a smaller terrestrial area in the reserve, such as reducing the adverse and beneficial impacts from reserve staff involvement in projects affecting flora. The benefits to flora from reserve research, coordination, and monitoring would be expected to be less widespread under these two alternatives than they would be under the preferred alternative, limiting the impact and efficacy of these reserve programs and providing reduced benefits to terrestrial flora compared to the preferred alternative.

6.2.3.1.2 Estuarine Flora
Individual projects that have the potential to impact estuarine flora have been summarized above. For more information about potential habitat manipulations, see above subchapter on “Estuarine Habitats.” Resulting impacts to estuarine flora from the range of alternatives analyzed are provided in Table 6.15.

Table 6.15 Impacts to estuarine flora

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C

Estuarine Flora	Effects from efforts to manipulate estuarine systems, including restoring the fishpond, nearby wetlands, and a historic taro patch and fishpond. Minor to moderate, long-term, direct and indirect adverse and beneficial effects to some flora and associated ecosystem services. Other stressors include nonpoint source pollution and climate change.	Adds minor, long-term, indirect benefits from reserve support for research, planning, and observations, which could facilitate integration of BMPs and adaptive management into projects, producing long-term, minor, indirect, beneficial effects. Minor, indirect benefits from reserve education efforts. Installing monitoring devices could cause short-term, negligible adverse impacts.	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

No Action Alternative

Under baseline conditions, there are already plans to further restore or modify estuarine systems, including at the fishpond (including to remove invasive species within it) and in other areas dominated by mangroves. These manipulations could cause negligible to moderate, short-term (e.g., during construction phases) or long-term, direct and indirect adverse and beneficial effects to some flora species (e.g., from changes to competition, predation, or composition). For example, there would be adverse impacts to the invasive species removed from the fishpond. Changes wrought by manipulations could enhance ecosystem services (Hawai‘i Office of Planning 2016). Of the changes to estuarine systems underway and planned, recreating loko i‘a kalo and efforts to remove invasive species from estuarine systems might have the most perceptible effects on the distribution, abundance, and health of plant species. Other stressors affecting estuarine areas include nonpoint source pollution, development, and climate change.

Preferred Alternative and Alternatives A, B and C

Under this alternative, all the same activities would be expected to occur as under the no action alternative, plus additional support from reserve staff for research, planning and coordination, monitoring, etc., which could facilitate integration of BMPs, mitigation measures, monitoring, and adaptive management into projects, producing additional long-term, minor, indirect, beneficial effects. Additional indirect benefits are expected from reserve education efforts about native and invasive plant species, for example. New reserve initiatives could have negligible to minor adverse effects to some plant species from restoration, manipulation, and/or monitoring efforts. There could also be adverse impacts to plants in localized areas where facility development occurs to allow visitors and staff to congregate and work. The potential impacts of any such projects would be analyzed in the future, as part of the environmental compliance process.

6.2.3.1.3 Riparian and Freshwater Flora

Individual projects that have the potential to impact riparian and freshwater flora have been summarized above. For more information about potential habitat manipulations, see above

subchapter on “Riparian and Freshwater Habitats.” Resulting impacts to riparian and freshwater flora from the range of alternatives analyzed are provided in Table 6.16.

Table 6.16 Impacts to riparian and freshwater flora

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Riparian and Freshwater Flora	Species composition would change along He‘eia Stream and in the He‘eia wetlands. Where invasive plants are removed and replaced with native or naturalized flora, there would be negligible to minor, short-term, adverse impacts to flora removed and moderate to major, long-term, beneficial impacts to species present post-restoration. Short-term, indirect, negligible adverse impacts to flora could occur from foot traffic in riparian areas, restoration of the taro patch walls, and road rehabilitation. Long-term, major, direct benefits would arise from the ecosystem services provided by the species planted (including taro). Another stressor is reduced stream flow.	Adds minor, long-term, indirect benefits from reserve support for research, planning, and observations, which could facilitate integration of BMPs and adaptive management into projects, producing long-term, minor, indirect, beneficial effects on plants. Minor, indirect benefits from reserve education efforts. Installing monitoring devices could cause short-term, negligible adverse impacts.	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

No Action Alternative

Stressors affecting plants under the no action alternative include development and invasive species that compete with and/or prey on plants. Because of activities already underway or planned by Kākoʻo ʻŌiwi, species composition is expected to change along He‘eia Stream and in the He‘eia wetlands on the HCDA parcel. Where invasive plants are removed and replaced with native or naturalized flora, minor or negligible, short-term adverse impacts to flora removed and major, long-term, direct, beneficial impacts to the species present post-restoration are expected. Native species abundance and diversity would be expected to grow as a result of the stream restoration project. Also, long-term, major, direct benefits from the ecosystem services provided by the species planted (including the taro to be cultivated in the restored loʻi kalo or taro patches) would be expected, such as providing habitat suitable for native animal species. Any adverse impacts to some plants in the taro patches from the efforts to restore to loʻi kalo, including the taro patch walls and the maintenance roads, are expected to be short-term and

negligible, primarily during the rehabilitation efforts. There are a number of other relevant stressors, such as reduced stream flow.

Preferred Alternative and Alternatives A, B and C

The preferred alternative is expected to include the same activities as the no action alternative, plus additional support from reserve staff for research, planning and coordination, monitoring, etc., could facilitate integration of BMPs, mitigation measures, monitoring, and adaptive management into projects, producing long-term, minor, indirect, beneficial effects. Additional indirect benefits would derive from reserve education efforts about native and invasive plant species, for example. New reserve initiatives could have negligible to minor adverse effects to some plant species from restoration, manipulation, and/or monitoring efforts. There could also be adverse impacts to plants in localized areas where any future facility development occurs. The potential impacts of any such projects would be analyzed in the future, as part of the environmental compliance process.

6.2.3.1.4 Marine Flora

Individual projects that have the potential to impact terrestrial flora have been summarized above. For more information about potential habitat manipulations, see above subchapter on "Marine Habitats." Resulting impacts to marine flora from the range of alternatives analyzed are provided in Table 6.17.

Table 6.17 Impacts to marine flora

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Marine Flora	Human activities in marine areas have minor long-term adverse impacts on marine flora. Removal of alien algae would moderate, long-term, beneficial impacts to native algae and potentially other marine flora (and negligible, short-term adverse impacts on the invasive algae removed). If approved, the coral reef mitigation bank would result in restoration of patch reef 10. Dredging at the boat harbor and boat traffic throughout the bay have the potential to have direct, minor adverse effects	Adds minor to moderate, long-term beneficial impacts to some plant species from reserve support for research, planning, and observations, which could support integration of BMPs and adaptive management into projects, producing long-term, minor, indirect, beneficial effects. Minor indirect benefits from reserve education efforts. Negligible to minor adverse effects to some plant species in areas in areas where there are additional boat trips. Installing monitoring devices could cause short-term, negligible adverse impacts.	Some of the same impacts as under the preferred alternative, without the benefits reserve staff could bring to work in reefs 7-10 by assisting with coordination and monitoring, because those reefs would not be part of the reserve. If the boat harbor were included within the reserve, it is possible that reserve staff provide technical assistance about additional ways	Same as preferred alternative.	Similar minor beneficial effects as under alternative A from possible Reserve-supported restoration and possible minor adverse effects from increased boating. Since reefs 7-10 would not be included within the reserve, those areas would benefit from funding or technical assistance related to research, monitoring,

	on plants that are damaged or destroyed during dredging, the transits of boats (e.g., by their propellers), etc. Climate change is an example of another stressor.		to mitigate the adverse effects of dredging.		education, and habitat restoration that could be associated with reserve designation.

No Action Alternative

Under current conditions, boat traffic, fishing, other recreational use, sediment transport, and other anthropogenic activities would continue to have minor long-term adverse impacts on marine flora. Climate change is an example of another stressor. In addition, practices designed to remove alien algae from coral reefs (e.g., use of a "Super Sucker" and introduced urchins) would have minor to moderate, long-term, beneficial impacts to native algae and potentially other marine flora, but could also have negligible, short-term adverse impacts on alien algae and potentially other marine flora. The State of Hawai‘i would continue to manage different marine areas for different uses, including in the Ocean Recreational Management Area and Marine Laboratory Refuge. See above for more information about marine habitat modification. For example, the He‘eia Kea Small Boat Harbor requires periodic maintenance dredging, which removes flora and fauna that live on the seafloor of the areas dredged and has the potential to cause other effects described above.

Preferred Alternative and Alternative B

Impacts of the preferred alternative are expected to be similar to those described under the no action alternative, plus there could be additional minor to moderate, long-term beneficial impacts from reserve support for research, planning, coordination, and monitoring of the types of projects underway and proposed. This assistance could support integration of BMPs, mitigation measures, monitoring, and adaptive management into projects, producing long-term, minor, indirect, beneficial effects. Reserve education efforts could bring additional possible minor indirect benefits. Future reserve initiatives could have negligible to minor adverse effects to some plant species where habitats are manipulated, infrastructure is installed, or additional boating associated with reserve researchers, managers, or visitors occurs. The preferred alternative would also be expected to bring additional moderate, long-term, beneficial effects to some plant species, particularly those that provide ecosystem services, such as in coral reefs.

Alternative A

Under alternative A, there would be some of the same impacts as under the preferred alternative, without the benefits reserve staff could bring to work in reefs 7-10 by assisting with coordination and/or monitoring, because those reefs would not be included within the reserve. If the boat harbor were included in the He‘eia Reserve, staff affiliated with the reserve could potentially work with harbor management to implement additional mitigation strategies to reduce impacts of dredging. Although it is possible that reserve staff could still work with harbor management to reduce potential marine flora impacts, it could be expected that greater

collaboration or opportunities to address these impacts would be available if the harbor is included within the proposed boundaries.

Alternative C
Under alternative C, there could be some of the same impacts as under the preferred alternative, without the benefits reserve staff could bring to work in reefs 7-10 by assisting with coordination and/or monitoring, because those reefs would not be included within the reserve.

6.2.3.2 Fauna

6.2.3.2.1 Terrestrial Fauna
Individual projects that have the potential to impact terrestrial fauna have been summarized above. For more information about potential habitat manipulations, see above subchapter on "Terrestrial Habitats." Resulting impacts to terrestrial fauna from the range of alternatives analyzed are provided in Table 6.18.

Table 6.18 Impacts to terrestrial fauna

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Terrestrial Fauna	Potential minor to moderate, direct, beneficial impacts to some species over the long term from habitat restoration efforts, particularly upland reforestation. Possible indirect and direct, short- and long-term, negligible to minor, adverse impacts to any fauna species displaced. Other stressors could also have moderate to major effects, e.g., habitat fragmentation.	Adds minor, indirect, long-term benefits from reserve support for research, planning, and observations, which could support integration of BMPs and adaptive management into projects, producing long-term, minor, indirect, beneficial effects. Minor indirect benefits to some species from reserve education efforts. Installing monitoring devices could cause temporary, negligible adverse impacts to some species by modifying habitats.	Same as preferred alternative, except another 200 acres of land would be included in the reserve, adding impacts of the types described under the preferred alternative from Reserve-initiated activities in that parcel (e.g., long-term, indirect, minor beneficial impacts from habitat restoration).	Same as preferred alternative, except for effects of including a smaller terrestrial area in the reserve. Benefits to fauna from reserve research, coordination, and monitoring could be reduced, limiting the impact and efficacy of these reserve programs and reducing reserve benefits compared to the preferred alternative.	Same as alternative B.

No Action Alternative
Potential minor to moderate, direct, beneficial impacts to some species could result over the long term from habitat restoration efforts, particularly upland reforestation. There might also be indirect and direct, short- and long-term, negligible to minor, adverse impacts to any fauna species displaced during manipulation and restoration projects. Stressors outside the control of

reserve partners could have moderate to major effects (e.g., changes to numbers or types of predators and habitat fragmentation).

Preferred Alternative
This alternative is expected to have the same impacts as the no action alternative, plus additional minor, indirect and long-term benefits from reserve support for research, planning, coordination, and observations. This assistance could support integration of BMPs, mitigation measures, monitoring, and adaptive management into projects in the study area. There might also be some minor indirect benefits to some animal species from reserve education efforts, associated with public awareness, understanding and subsequent action (e.g., to protect sensitive species). Installation of monitoring devices could potentially have temporary, negligible adverse impacts to some species by slightly modifying habitat in localized areas. To the extent that there might be additional impacts in localized areas from future, in-situ reserve projects or development of additional facilities, potential impacts would be analyzed in the future as part of environmental compliance processes, after projects are proposed.

Alternative A
This alternative is expected to have the same consequences as the preferred alternative, but another 200 acres of land would be included within the reserve. Thus, there could be additional long-term, indirect, minor beneficial impacts from improvements to fauna habitat resulting from restoration and indirect short-term adverse effects from manipulation activities related to reserve support for activities in the additional parcel.

Alternatives B and C
The consequences of this alternative are expected to be similar to those under the preferred alternative, except for the consequences of including a smaller terrestrial area in the reserve, which could reduce the impacts (both adverse and beneficial) resulting from reserve staff involvement in projects affecting fauna. The benefits to fauna from reserve research, coordination, and monitoring could be reduced, limiting the impact and efficacy of these reserve programs and providing reduced benefits to terrestrial fauna compared to the preferred alternative.

6.2.3.2.2 Estuarine Fauna
Individual projects that have the potential to impact estuarine fauna have been summarized above. For more information about potential habitat manipulations, see above subchapter on "Estuarine Habitats." Resulting impacts to estuarine fauna from the range of alternatives analyzed are provided in Table 6.19.

Table 6.19 Impacts to estuarine fauna

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Estuarine Fauna	Effects from efforts to manipulate estuarine	Adds minor, indirect long-term benefits from	Same as preferred	Same as preferred	Same as preferred

	systems, including restoring the fishpond, nearby wetlands, and a taro patch and fishpond, could result in minor to moderate, long-term, direct and indirect beneficial effects to some fauna species, as well as minor adverse effects to other species that use these habitats. Other stressors include disease and predation.	reserve support for research, planning, and observations, which could support integration of BMPs and adaptive management into projects, producing long-term, minor, indirect benefits. Minor indirect benefits from reserve education efforts. Installing monitoring devices could cause short-term, negligible adverse impacts by modifying habitats.	alternative.	alternative.	alternative.

No Action Alternative

A number of efforts are underway or planned that are expected to result in modification of estuarine systems, including efforts to restore the fishpond and the mangroves along its perimeter, to remove invasive species as part of restoring nearby wetlands, and to recreate a loko iʻa kalo (combined taro patch and fishpond) in brackish wetlands. These restoration projects have the potential to cause direct and indirect, moderate, short- and long-term beneficial impacts to fauna, including birds and fish (potentially yielding major benefits to the habitat as a whole, as described under the "Estuarine Habitats" subchapter). There could also be some additional minor, short-term and/or long-term, direct and indirect, adverse effects to some fauna species that utilize existing habitats that are undergoing or will undergo alteration. Other stressors that affect estuarine fauna include disease and predation.

Preferred Alternative and Alternatives A, B, and C

Beyond the impacts described above under the no action alternative, this alternative is expected to bring about additional minor, indirect and long-term benefits to some species from reserve support for research, planning, coordination, and observations. This assistance could support integration of BMPs, mitigation measures, monitoring, and adaptive management into projects. In addition, there could be minor, indirect benefits to some species from reserve education efforts, associated with subsequent behavior modification efforts (e.g., to protect sensitive species). Installation of monitoring devices could potentially have temporary, negligible adverse impacts to some species by slightly modifying habitat in localized areas. To the extent that there might be additional impacts in localized areas from future, in-situ reserve projects or development of additional facilities, potential impacts would be analyzed in the future as part of environmental compliance processes, after projects are proposed.

6.2.3.2.3 Riparian and Freshwater Fauna

Individual projects that have the potential to impact riparian and freshwater fauna have been summarized above. For more information about potential habitat manipulations, see above subchapter on "Riparian and Freshwater Habitats." Resulting impacts to riparian and freshwater fauna from the range of alternatives analyzed are provided in Table 6.20.

Table 6.20 Impacts to riparian and freshwater fauna

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Riparian and Freshwater Fauna	Efforts to enhance habitat for fish and other fauna along He'eia Stream and in the He'eia wetlands would lead to negligible, short-term adverse impacts to fauna present while restoration (of taro patch walls, roads, etc.) is underway, followed by moderate to major long-term, beneficial impacts to some of the species that use the habitat after restoration, including fish in the stream and waterbirds drawn to areas with lo'i kalo (taro patches). Another stressor is reduced stream flow.	Adds minor, long-term, indirect benefits from reserve support for research, planning, and observations, which could facilitate integration of BMPs and adaptive management into projects, producing long-term, minor, indirect, benefits to some species. Minor indirect benefits to some species from reserve education efforts. Installing monitoring devices could cause temporary, negligible adverse impacts by modifying habitats.	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

No Action Alternative

Efforts to enhance habitat for fish and other fauna along He'eia Stream and in the He'eia wetlands are expected to lead to negligible, short-term, adverse impacts to fauna present while restoration is underway. The restoration efforts are expected to be followed by moderate to major long-term, beneficial impacts to some of the animal species that use the habitat, including fish in the stream and waterbirds drawn to areas with restored lo'i kalo (taro patches). An example of another stressor affecting riparian and freshwater fauna is reduced stream flow.

Preferred Alternative and Alternatives A, B and C

These alternatives are expected to have the same impacts as the no action alternative, plus there would be additional minor, indirect long-term benefits to some species from reserve support for research, planning, coordination, and observations. This assistance could support integration of BMPs, mitigation measures, monitoring for target species, and adaptive management into projects, leading to long-term, minor, indirect, beneficial effects on some species. There could also be minor, indirect benefits to some species from reserve education efforts, associated with public awareness, understanding and subsequent action (e.g., to protect sensitive species). In addition, installation of monitoring devices could cause temporary, negligible adverse impacts to some species by slightly modifying habitat in localized areas. To the extent that there might be additional impacts in localized areas from future, in-situ reserve

projects or development of additional facilities, potential impacts would be analyzed in the future as part of environmental compliance processes, after projects are proposed.

6.2.3.2.4 Marine Fauna

Individual projects that have the potential to impact terrestrial fauna have been summarized above. For more information about potential habitat manipulations, see above subchapter on "Marine Habitats." Resulting impacts to marine fauna from the range of alternatives analyzed are provided in Table 6.21.

Table 6.21 Impacts to marine fauna

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Marine Fauna	Human activities in marine areas have moderate to major, short- and long-term adverse impacts on fauna. Removal of alien algae would have moderate, long-term, beneficial impacts to reef-dwelling species, but could also have negligible, short-term adverse impacts on any coral accidentally damaged. The proposed 5-square meter in-situ pilot coral nursery is unlikely to have more than negligible impacts to fauna in the Hawai'i Marine Laboratory Refuge. The coral reef mitigation bank would enable restoration of patch reef 10, which would have moderate, long-term, direct benefits to the reef community. Dredging at and boat traffic throughout the bay have the potential to have direct and indirect, moderate to major adverse effects on fauna (e.g., because behavioral patterns can be altered by dredging, the transits of boats etc.). Other stressors include climate change.	Adds minor, indirect, long-term benefits to some species from reserve support for research, planning, and observations, particularly related to species targeted for protection. Reserve assistance could integrate BMPs and adaptive management into projects, leading to long-term, minor, indirect benefits to some species, particularly those targeted for restoration. Minor indirect benefits from reserve education efforts. Installing monitoring devices could cause short-term, negligible adverse impacts by modifying habitats. Negligible to minor adverse effects to some species in areas where there are additional boat trips.	Some of the same impacts as under the preferred alternative, without the benefits reserve staff could bring to work in reefs 7-10 by assisting with coordination and/or monitoring, because those reefs would not be part of the reserve. Additional minor, adverse, short- and long-term effects to fauna near the small boat harbor if it were within the reserve because it is heavily trafficked and regularly dredged.	Same as preferred alternative.	Similar effects as listed under the preferred alternative. However, because reefs 7-10 would not be included within the reserve, those areas would not receive benefits that derive from the funding and technical assistance related to research, monitoring, education, and habitat restoration associated with reserve designation.

No Action Alternative

Under current conditions, boat traffic, fishing, other recreational uses (including snorkeling and diving), sediment transport, and other anthropogenic activities have moderate to major short-

and long-term adverse impacts on a variety of marine fauna. For example, dredging (including at the boat harbor) and vessels that traverse the bay have the potential to have direct and indirect, moderate to major adverse effects on fauna, e.g., causing adverse behavioral changes or mortality to some fauna. Other stressors include climate change. Uses within different portions of the study area are subject to some restrictions, most notably in the Hawai‘i Marine Laboratory Refuge. The proposed 5-square meter in-situ pilot coral nursery is unlikely to have more than negligible impacts to fauna in the vicinity, but could offer major benefits to reefs outside the study area to which coral is transplanted in the future. Removal of alien algae from coral reefs would have minor to moderate, long-term, beneficial impacts to coral reefs and species dependent on these habitats, but could also have negligible, short-term adverse impacts on any coral accidentally damaged. If approved, the coral reef mitigation bank is expected to result in restoration of patch reef 10, which would have moderate, long-term, direct benefits to the reef community.

Preferred Alternative and Alternative B
These alternatives are expected to have the same impacts as the no action alternative, plus additional minor to moderate, indirect, long-term benefits to some species from reserve support for research, planning, coordination, and observations, particularly animal populations targeted for enhancement or protection. Reserve assistance could support integration of BMPs, mitigation measures, monitoring for target species, and adaptive management into projects, leading to long-term, minor, indirect, beneficial effects on some species. There could be moderate, long-term, indirect benefits to some species from reserve education efforts, associated with public awareness, understanding and subsequent action (e.g., to protect sensitive species). Installation of monitoring devices could cause temporary, negligible adverse impacts to some species by causing habitat modifications in localized areas. To the extent that there might be additional impacts in localized areas from future, in-situ reserve projects or development of additional facilities, potential impacts would be analyzed (as part of environmental compliance reviews), after projects are proposed. In addition, there could be negligible to minor adverse effects to some species in areas where there are additional boat trips or where infrastructure is installed.

Alternative A
This alternative is expected to result in some of the same impacts as the preferred alternative, without the benefits reserve staff could bring to work in reefs 7-10 by assisting with coordination and/or monitoring, because those reefs would not be part of the reserve. If the boat harbor were included in the reserve, it is possible that reserve staff might be able to offer technical assistance regarding additional mitigation measures that could reduce the adverse effects of dredging in the boat harbor.

Alternative C
This alternative is expected to result in effects similar to those listed under the preferred alternative. However, because reefs 7-10 would not be included within the reserve, those areas would not receive the benefits (most of them indirect) that derive from funding or technical

assistance related to research, monitoring, education, and habitat restoration that could be associated with reserve designation.

6.2.3.3 Special-Status Species and Habitat

The following discussions address species and habitats with special status pursuant to the Endangered Species Act (ESA) and the Magnuson-Stevens Fishery Conservation and Management Act. The descriptions of effects relating to species protected under ESA and critical habitat use several terms defined by NMFS and USFWS. They are as follows (NOAA 2011, NOAA 2014g):

No Effect: The action will have no direct or indirect effect on the species or critical habitat.

May Affect But Not Likely to Adversely Affect: All effects of the action on listed species or critical habitat will be discountable, insignificant, or completely beneficial.[24] With respect to critical habitat, this determination applies if defined essential features of the critical habitat are not present or if essential features are present, but the action cannot plausibly affect them.

Likely to Adversely Affect: Adverse effects on listed species or critical habitat may occur (including take) as a direct or indirect result of the proposed action, and the effects are not discountable, insignificant, or completely beneficial. This determination applies even if the overall effect of the proposed action is beneficial.

Insignificant Effects: The action could plausibly affect species, but the effects cannot be meaningfully detected, measured, or evaluated. Any effect will not harm, harass, or otherwise result in take of a listed species. With respect to critical habitat, insignificant effects may be temporary or minor, but cannot have a discernible impact on the conservation function of the essential features of the critical habitat unit.

Discountable Effects: Potential effects that are extremely unlikely to occur.

Completely Beneficial Effects: All potential effects that might result to individual plants or animals are positive.

6.2.3.3.1 Threatened and Endangered Species

Based on initial technical assistance from the USFWS and NMFS, the Office for Coastal Management (OCM) does not anticipate that reserve designation would adversely impact endangered or threatened species potentially present in the study area. During the public comment period for this draft EIS, OCM plans to consult with NMFS and USFWS, pursuant to

[24] For more information about possible rationales for this determination, see http://www.fpir.noaa.gov/Library/PRD/ESA%20Consultation/pdf%20files%20of%20word%20docs/Effects%20Determination%20Guidance%20-%206.14.11.pdf.

Section 7 of the ESA; the results of the consultations will be published in the Final EIS and information summarized herein will be updated, if needed. If a reserve is designated, OCM would expect reserve staff to work with partners, members of the community, and visitors to ensure they are aware of BMPs to be followed when their activities could impact any threatened or endangered species. For instance, reserve staff can refer to BMPs for marine protected species, such as those in a handbook jointly developed by NOAA and Hawai'i DLNR in 2007 (NOAA and DLNR 2007). There are BMPs distributed by USFWS for species under its jurisdiction, as well. Reserve designation could have beneficial effects on species protected under ESA by addressing recovery strategies that align with the proposed reserve's DMP. OCM developed a preliminary evaluation of the potential consequences to listed species of the alternatives considered, which suggested reserve implementation would not be likely to result in adverse impacts to species. If a reserve is designated, future federal actions (including actions funded through NOAA cooperative agreements) would be evaluated individually to determine any necessary compliance activities pursuant to applicable mandates, including ESA. Resulting impacts to threatened and endangered species from the range of alternatives analyzed are provided in Table 6.22.

Table 6.22 Impacts to threatened and endangered species

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Threatened and Endangered Species	Depending on the species, potential impacts from existing activities range from having no effect, to completely beneficial effects, to adverse impacts on the species.	Depending on the species, potential impacts range from no effect, to completely beneficial effects, to not likely to adversely affect the species, based on the expectation that applicable BMPs will be followed.	Depending on the species, potential impacts range from no effect, to completely beneficial effects, to not likely to adversely affect the species, based on the expectation that applicable BMPs will be followed.	Depending on the species, potential impacts range from no effect, to completely beneficial effects, to not likely to adversely affect the species, based on the expectation that applicable BMPs will be followed.	Depending on the species, potential impacts range from no effect, to completely beneficial effects, to not likely to adversely affect the species, based on the expectation that applicable BMPs will be followed.

Based on technical assistance from USFWS and NMFS, OCM has identified a number of species listed as threatened or endangered under the ESA that could potentially be affected by the proposed action (even if they are not within the immediate project area). The alternatives are expected to impact each species (or group of species) differently. The anticipated effects to threatened and endangered species from reserve designation are summarized in Table 6.23, then discussed in greater detail below.

Table 6.23 Potential effects of reserve designation on listed species

Listed Species	Potential Effects of Reserve Designation

Blackline Hawaiian damselfly	May affect, but is not likely to adversely affect
Hawaiian hoary bat	May affect, but is not likely to adversely affect
Newell's shearwater	No effect
Endangered Hawaiian waterbirds (four species)	May affect, but is not likely to adversely affect
Hawaiian goose	No effect
Sea turtles (green and hawksbill)	May affect, but is not likely to adversely affect
Hawaiian monk seal	May affect, but is not likely to adversely affect
Humpback whale (Hawaiian distinct population segment)	May affect, but is not likely to adversely affect
Main Hawaiian islands insular false killer whale	May affect, but is not likely to adversely affect

While there would be no anticipated effects to listed species associated with designation of a reserve in and of itself, designation would set in motion a number of potential future activities that may affect listed species. For example, an assessment of future facility needs would be conducted for the proposed He'eia Reserve, if designated. The needs assessment would identify future facility requirements and potential sites and that could potentially be followed by construction of new facilities. Additionally, future research and monitoring actions could potentially affect threatened or endangered species. OCM intends to complete the required environmental compliance evaluations, including consultations under Section 7 of the ESA, after individual actions are proposed, when OCM has sufficient details about the methods and locations of the activities.

The research objectives of proposed He'eia NERR, as described in the DMP, are guided by the underlying view that baseline environmental data and reference conditions will help researchers to understand the magnitude of change in the various He'eia ecosystems. It is possible that research at the proposed reserve will need to go beyond passive activities such as ecological and water quality monitoring information obtained through instruments and observations, to more active fieldwork that may involve experimentation and manipulation in order to meet the broader research objectives of the proposed reserve. If future research activities will require consultation under Section 7 of the ESA or other consultations under state or federal laws, as appropriate, OCM will carry out the consultations, and researchers may be required to obtain the appropriate authorizations. Environmental compliance reviews occur during review of federal financial assistance actions.

A. Blackline Hawaiian damselfly (*Megalagrion nigrohamatum nigrolineatum*)

As noted in Chapter 5, the blackline Hawaiian damselfly was reportedly observed within the middle reach of He'eia Stream during at least one previous survey (Parham et al. 2008). The map in the associated report shows the species was found in He'eia Stream upstream of the parcels being considered for inclusion in the proposed reserve. OCM did not identify any other reports of the species in the study area. The blackline Hawaiian damselfly prefers headwaters and mid-reach portions of perennial slow-moving streams and associated or seep-fed pools. The species is found along portions of streams not occupied by non-native predatory fish, typically the headwaters or upper reaches of streams that are separated from the sea by some

barrier to fish passage. Threats to the species include predation by non-native fish and other insects, conversion of habitat for urban or agricultural uses, and stream diversions or modifications (Department of the Interior 2011). Critical habitat for the species has been designated in the upper reaches of He‘eia Stream (and in other locations outside the study area).

No Action Alternative

When OCM requested technical assistance from USFWS, the service did not report the blackline Hawaiian damselfly as occurring within the study area. Non-native fish that could prey on the damselfly are known to occur in, at least, the lower reaches of the stream, according to the proposed He‘eia NERR’s DMP. However, the DMP also notes that some portions of He‘eia Stream are so choked by California grass that the oxygen content of the stream is so low it cannot support aquatic animals. The main types of anthropogenic activities that can adversely affect the blackline Hawaiian damselfly are changes to stream flow, other habitat alterations, and introductions of non-native species that prey on or compete with the Hawaiian blackline damselfly. Extant blackline Hawaiian damselfly populations are located upstream of the parts of He‘eia Stream being modified, but the exact location in the middle reach of He‘eia Stream where it was found was not published. (The middle reach of the stream extends from Interstate H3 to where an unnamed tributary joins He‘eia Stream east of Kahekili Highway.) The no action alternative could have an impact on the blackline Hawaiian damselfly if there are no impediments to fish passage in the stream between where it is restored and where it serves as blackline Hawaiian damselfly habitat once California grass is removed and the stream contains enough oxygen to support aquatic animals. However, in its 2012 rule announcing the final listing of the blackline Hawaiian damselfly as endangered, USFWS indicated that funding was provided to restore habitat for the blackline Hawaiian damselfly and native fish at the lower elevations of He‘eia Stream in 2010 and 2011. The rule further noted that USFWS would pursue funding to construct a barrier into the upper elevation of the He‘eia watershed (77 Federal Register 57648 and 57656). Through the National Fish Passage Program, which will allow for migration of native fish and invertebrates (while excluding non-native fish) into essential headwater stream reaches, once such a barrier is constructed, restoration of the lower reach of He‘eia Stream will not affect the blackline Hawaiian damselfly.

Preferred Alternative and Alternatives A, B, and C

The blackline Hawaiian damselfly is not present in the lower portions of He‘eia Stream, and it is not known exactly where and when the species was reported in the middle reach of the stream. Neither the preferred alternative, nor alternatives A, B, or C would be expected to have any direct or indirect effects on the species. He‘eia Stream restoration is going to be carried out independent of reserve designation. However, under the proposed He‘eia NERR’s first goal listed in the DMP, Objective 1 indicates that the reserve hopes to conduct research on hydrology of He’eia estuary and survey its biodiversity. Thus, if a proposed He‘eia NERR were designated, researchers affiliated with the reserve could help monitor for the presence of blackline Hawaiian damselfly within the reserve and/or conduct other research related to the species. This research would not directly affect the species, but could lead to indirect benefits, such as enhanced conservation of the species if the damselflies are discovered in habitats not

previously documented by reserve staff. Thus, reserve designation may affect, but is not likely to adversely affect the species. If new information becomes available that suggests blackline Hawaiian damselfly are present within the portion of He‘eia Stream proposed for inclusion within the reserve, OCM will contact USFWS, if needed (i.e., if reserve activities have the potential to affect the species). Reserve staff, in partnership with Kāko‘o ‘Ōiwi could monitor the status of plans to construct a barrier to non-native fish passage in He‘eia Stream to ensure that non-native species of fish that enter the stream cannot reach blackline Hawaiian damselfly populations.

B. Hawaiian Hoary Bat, ‘ope’ape’a, (*Lasiurus cinereus semotus*)

The federally endangered Hawaiian hoary bat is known to inhabit forested areas on the island of O‘ahu. According to USFWS, it roosts in both exotic and native woody vegetation (USFWS 1998). While it is thought to favor trees at least 15 feet high, little is known about its distribution because it is a solitary species that is difficult for biologists to find (Department of Land and Natural Resources 2015). If trees or shrubs suitable for bat roosting are cleared during the breeding season, there is a risk that young bats could inadvertently be harmed or killed, especially because adults leave young unattended in “nursery” trees and shrubs when they forage. Young bats, typically born in June, cannot fly during the first few months of their lives. OCM did not identify any reports of locations within the study area where the presence of the Hawaiian hoary bat has been confirmed. However, because the species could be found in woody portions of the terrestrial, estuarine, and riparian habitats, the potential for it to be impacted in the study area is summarized below.

No Action Alternative

A 1993 Environmental Impact Statement for He‘eia State Park mentions a variety of tree species present and states that there are no threatened or endangered species known to be present at the park (PBR Hawai‘i 1993). Nearby, Paepae o He‘eia is working on restoring the walls of He‘eia Fishpond and promoting fishpond aquaculture. A final environmental assessment for Aquaculture Support Facilities at He‘eia Fishpond stated that it was possible for the Hawaiian hoary bat to occur on occasion in the area, in part because it forages over bays and ponds and tends to roost in dense forests, including areas with mangroves, which are present near the fishpond. However, the species was not identified during a one-day survey of birds and mammals in 2006 that was summarized in the final environmental assessment (Helber Hastert and Fee Planners 2007). In 2012, when USACE issued a permit to Paepae o He‘eia for restoration of He‘eia Fishpond, the USACE identified a few threatened and endangered species potentially affected by the restoration project, but did not include the Hawaiian hoary bat among them (USACE 2012b).

Kāko‘o ‘Ōiwi is planning habitat restoration projects that could affect tree species that might potentially provide habitat for Hawaiian hoary bats. For example, the group plans to restore 20 acres of native wetland habitat on the HCDA parcel, following the He‘eia Stream downstream of the taro fields, where an invasive mangrove forest would be replaced with native wetland sedges and open-water pools. Kāko‘o ‘Ōiwi intends to schedule removal of invasive mangroves and native wetland habitat restoration to avoid June 15 through September 15, during the bat’s

breeding season. Kākoʻo ʻŌiwi is also planning to restore taro patches on the HCDA property and has consulted USACE about the initial portions of that project. The Corps notified Kākoʻo ʻŌiwi that it would not need a permit for that portion of the project, but should reconsult USACE once its plans for the portions of the project that include floodplain restoration, estuarine wetland restoration, and detention pond construction have been further developed. Additional roosting habitat is potentially available for the Hawaiian hoary bat in the forested uplands of the HCDA parcel, adjacent to some open wetlands. However, it is not known whether the Hawaiian hoary bat uses the upland forest area of the HCDA parcel. Kākoʻo ʻŌiwi is also planning to restore this area, including by removing some invasive plant species, while allowing select non-native plants to remain, particularly those offering key structural attributes to the forest or important ecosystem services. The trees to be planted will mainly be native species; appropriate species will be determined after further study. Restoration of the upland area is not sufficiently far along in the planning process for Kākoʻo ʻŌiwi to have determined what authorizations will be needed. If any portion of the upland forest restoration is federally-funded or federally-permitted, Kākoʻo ʻŌiwi would likely be subject to any BMPs identified by USFWS. In the long-term, upland forest restoration could create additional habitat for the species, a potential moderate beneficial effect. In the short run, the removal of mangroves or other non-native trees throughout the HCDA parcel could result in a reduction of roosting habitat for the hoary bat. However, the impacts would be insignificant because they cannot be meaningfully detected or evaluated because so little is known about the habitats preferred by the species and individuals are difficult to locate. If tree removal is conducted outside the bat's breeding season, it would probably have no more than a negligible effect.

In sum, there are a number of activities that are already being conducted in the study area under the no action alternative. There have been no reports of Hawaiian hoary bats within the study area, but the species is difficult to detect and solitary. Activities planned under the no action alternative are conducted pursuant to consultations with federal and state agencies, when appropriate. Both USFWS and the Hawaiʻi DOFAW have recommended avoiding tree removal or trimming during the time when bat pups are most vulnerable. These recommendations would be expected to be followed on state lands, such as Heʻeia State Park. Kākoʻo ʻŌiwi has already indicated that it is committed to avoiding taking down trees in estuarine mangrove forests during the time when bat pups would be most vulnerable. Kākoʻo ʻŌiwi is likely to also plan to avoid cutting down trees during the bat's breeding season when it restores the upland forest portion of the HCDA parcel and when it restores taro loʻi. Work conducted on and around Heʻeia Fishpond by Paepae o Heʻeia is subject to the conditions of the USACE permit described above. The fact that endangered species section of the USACE permit addresses sea turtles and Hawaiian monk seals, but not hoary bats, suggests the Corps determined the actions it permitted would have no effect on hoary bats.

As long as the time of year restrictions suggested by state and federal fish and wildlife agencies are followed, the no action alternative would not be expected to result in adverse effects on Hawaiian hoary bats. It is unknown whether removing mangroves and other invasive trees and replacing them with native species will have any beneficial effects on the bat species, since some habitat will be removed, whereas other habitat would be created, and the species is not

known to prefer native trees over exotic trees. Nonetheless, beneficial effects from efforts to restore uplands are possible.

Preferred Alternative and Alternatives A, B and C
Reserve designation could lead to reserve staff providing technical assistance for projects that are already planned under the no action alternative. There could be habitat for the hoary bat within the areas proposed for inclusion within the reserve under each of the alternatives. It is unknown whether reserve implementation would have any effect on Hawaiian hoary bats. OCM will carry out informal consultation for its own proposed action during the public comment period for this draft EIS. USFWS identified four actions within its Hawaiian hoary bat recovery plan that would be needed to delist this species (US Fish and Wildlife Service 1998). None of the recommendations and proposals within the proposed He‘eia NERR’s DMP directly address these recovery actions, many of which are beyond the programmatic scope of the proposed He‘eia NERR. However, if a reserve were designated, reserve staff might provide additional technical assistance or research and monitoring capacity to support habitat and species restoration efforts, which could result in beneficial effects to the species. In addition, there might be future projects, not yet proposed, that require tree removal. Future activities with the potential to impact any threatened or endangered species, including the Hawaiian hoary bat, will be evaluated pursuant to the applicable fish and wildlife laws and regulations. If there is any potential for a federally-funded or federally authorized project to affect a listed species, the responsible federal agency would be required to consult with the USFWS, as needed, prior to approving the action. Similarly, state agencies would be likely to consult with the State Division of Forestry and Wildlife, as needed, and follow its recommendations as part of approving or conducting activities on state lands.

OCM received technical assistance from USFWS in June 2016 regarding Hawaiian hoary bats and other species, in advance of carrying out informal consultation under the ESA. USFWS recommended that, to minimize potential impacts to the bat, woody plants greater than 15 feet tall not be disturbed or removed during the bat birthing and pup rearing season, which it indicates is from June 1 through September 15. USFWS also indicated that Hawaiian hoary bats forage for insects in a broad area, as low as 3 feet from the ground to more than 500 feet aboveground. Hawaiian hoary bats can become entangled in barbed wire used for fencing, so USFWS recommends barbed wire not be used for fencing (and, if it must be used, it only be used within 2 inches of the ground surface) (D. Bruns, personal communication, June 30, 2016). OCM will convey these recommendations to its reserve partners. NOAA’s preliminary determination is that, if restoration efforts are conducted in such a way as to avoid disturbing Hawaiian hoary bats from June 1 to September 15, the restoration work would not be likely to adversely affect the bats. In addition, in the long-term, restoration efforts might create new suitable habitat for the bats, which would be a minor beneficial effect.

C. Newell’s Shearwater, ‘A‘o (*Puffinus auricularis newelli*)
USFWS published a status review of this species in 2011, and another such review is underway. The 2011 status review indicated that 75%-90% of the population of Newell’s shearwaters is found on Kaua‘i. The birds tend to nest in mountainous areas and feed in pelagic

areas. Nonetheless, USFWS indicated, when it provided technical assistance to OCM, that the species could be present in the study area. Major threats to the species include predation from introduced mammals and adverse effects from outdoor lighting. Artificial outdoor lighting can both attract and disorient seabirds, which can result in their falling to the ground, injury, or mortality. (Once the birds are on the ground, they are subject to increased mortality due to collisions with vehicles, starvation, and predation.) Fledglings take their first flights from their nests to the sea between September 15 and December 15, when they are particularly vulnerable to disorientation from outdoor lighting. USFWS recommended that, between September 15 and December 15, nighttime construction be avoided and outdoor lights be only used when necessary and fully shielded, which allows the bulb to be seen from below bulb height, but not above it (D. Bruns, USFWS, personal communication, June 30, 2016).

No Action Alternative

The best available data about the population of this species is currently being analyzed so that a new 5-Year Status Review can be published by USFWS. OCM has not identified publicly-available documentation of this species' use of the study area. If it were present, Newell's shearwater could potentially be adversely affected by light pollution and, potentially, predation. At this time, OCM does not have information about whether any construction is being carried out in the study area at night, nor information about whether and where outdoor lights are shielded. It is OCM's expectation that not all lights in the study area are shielded, given the cost of replacing existing outdoor light fixtures. Thus, the potential for minor to moderate adverse impacts to this species cannot be ruled out.

Preferred Alternative and Alternatives A, B and C

None of the alternatives that involve reserve designation are expected to affect this species. Reserve implementation would make use of existing facilities, at the outset. Thus, reserve implementation would not have any effects beyond those existing under the baseline that exists under the no action alternative. There is insufficient information about future construction plans to analyze their potential effects at this time. OCM will ensure appropriate ESA compliance activities are carried out for future federally supported projects. OCM will communicate the USFWS BMPs to Reserve partners, including those related to shielding outdoor lights, minimizing their use between September 15 and December 15, and avoiding nighttime construction during that time.

D. Endangered Hawaiian Waterbirds

- Hawaiian stilt, ae'o (*Himantopus mexicanus knudseni*)
- Hawaiian gallinule (moorhen), 'alae 'ula (*Gallinula chloropus sandvicensis*)
- Hawaiian coot, 'alae kea (*Fulica americana alai*)
- Hawaiian duck, koloa (*Anas wyvilliana*)

The vegetated wetlands of He'eia estuary are known to attract and support four endangered species of Hawaiian waterbird. Biannual waterbird counts conducted at He'eia marsh confirm that all four species use habitat in the vicinity of the study area. Critical habitat has not been designated for any of the listed waterbird species, and the He'eia marsh was not identified as

one of the “core” wetlands in the most recent recovery plan for endangered Hawaiian waterbirds. However, He‘eia marsh was identified as a “supporting” wetland. The USFWS recovery plan describes He‘eia as a site that historically had habitat value because of the complex of tidal marshes and open-water areas, but which has been substantially modified and presently consists of non-native mangroves, remnants of ponds, and wet pasture. As of 2011, there had been few confirmed sightings of all four species at the He‘eia marsh site (US Fish and Wildlife Service 2011). OCM staff have observed Hawaiian stilt within the taro fields of He‘eia estuary over the past two years (personal observations, Chasse and Migliori, April 2016). Areas adjacent to man-made low-lying bodies of freshwater such as taro patches have been identified as Hawaiian stilt nesting areas.

The Recovery Plan for Hawaiian Waterbirds recommends that He‘eia waterbird habitat be restored and managed by the State of Hawai‘i to provide enhanced habitat for endangered waterbirds. In the past, important factors contributing to the reductions in the size of populations of endangered Hawaiian waterbirds included loss of wetland habitat and altered hydrology, water quality degradation, and hunting. Other contributing factors include predation by introduced animals (currently the most significant threat to most of these species) and habitat alteration (including by non-native plants and disease). Hybridization with the mallard duck is also a threat to the Hawaiian duck.

No Action Alternative

Under this alternative, within the study area, removing invasive plant species from waterbird habitat and other wetland restoration efforts that are already underway and planned could have a minor, beneficial, indirect impact on the endangered waterbirds. For example, California grass and mangrove outcompete native species and eliminate open-water, exposed mudflats, or shallows, which these waterbirds use. For the most part, there would be no anticipated significant increases in the above-listed factors that have contributed to reduced Hawaiian waterbird populations. Hawaiian stilts are an exception, because they tend to nest on human-maintained wetlands, because others tend to be too overgrown; the stilts use taro ponds in their wet fallow and early stages of planting (before the plants form a canopy), but harvest and flooding of the taro patches can adversely affects reproduction, according to the recovery plan. Some of the other waterbirds use taro fields for feeding. Table 6.24 identifies recommendations made by USFWS in the Recovery Plan for Hawaiian Waterbirds that could potentially be supported by reserve designation and operation. The table identifies actions included in the DMP for the reserve, most of which would be carried out under the no action scenario.

Preferred Alternative and Alternatives A, B and C

Available data suggest that reserve designation may affect, but is not likely to adversely affect, endangered Hawaiian waterbird species because designation would have completely beneficial impacts to the species. The management strategies, objectives, and activities outlined in the DMP for the activities at the reserve, such as wetland and stream restoration, water quality monitoring, and predator control (most of which would occur under the no action scenario), are consistent with specific recommendations made by the USFWS to support Hawaiian waterbird recovery. If there are any effects from the Preferred Alternative or Alternatives A-C on this

species, the effects would likely be minor and beneficial (e.g., associated with landscape-scale planning under the auspices of the reserve, technical assistance reserve staff might provide associated with the removal of invasive species and restoration of habitat features needed by Hawaiian waterbirds, and/or any data collection on waterbird use of habitat within the reserve).

Table 6.24 Actions proposed in the He'eia NERR Draft Management Plan which support Hawaiian waterbird recovery needs

USFWS Hawaiian Waterbird Recovery Recommendation for He'eia Marsh	Aligned Objectives Identified in He'eia Reserve DMP
1.1 Develop management plans for core and supporting wetlands.	Development of (and regular updates to) a reserve MP (preferred alternatives and alternatives A, B, and C).
1.3.1 Secure water sources and manage water levels to maximize nesting success, brood survival, food availability, and recruitment of waterbirds.	Although water levels will not necessarily be managed for these species, the reserve plans to conduct research on hydrology of He'eia estuary and survey its biodiversity (Goal 1, Objective 1) (under the preferred alternatives and alternatives A-C). The reserve will also support existing and future efforts to restore and manage wetland resources (Goal 3, Objective 10) (Reserve support for plans under no action alternative).
1.3.2 Manage vegetation to maximize nesting success, brood survival, food availability, and recruitment of waterbirds.	Although plant composition will not be managed solely to benefit waterbirds, the reserve will provide technical assistance and support for restoration activities planned by Kākoʻo ʻŌiwi to encourage desirable plants and manage invasive/non-native plant species (Goal 3, Objective 10) (Reserve support for plans under No Action alternatives).
1.3.3 Eliminate or reduce and monitor predator populations.	Kākoʻo ʻŌiwi will develop and implement a predator control program for rats, mongooses, cats, and dogs, in cooperation with USFWS and DOFAW (Goal 3, Objective 10) (Reserve support for plans under no action alternative).
1.3.5 Minimize human disturbance to waterbirds and their habitats.	Develop a public access plan (see Section 7 of draft MP for details) and identify allowable uses within the reserve (preferred alternatives and alternatives A-C). HIMB, Paepae o He'eia and Kākoʻo ʻŌiwi restrict access to the areas they manage, which limits human disturbances to those they approve (no action alternative).
1.3.6 Monitor and control avian disease.	Kākoʻo ʻŌiwi will develop a plan for early identification of and response to avian botulism (no action alternative).
1.3.7 Minimize contamination of waterbird habitat by toxic substances/contaminants.	Develop a restoration and monitoring plan (preferred alternative and alternatives A-C). Support management of resources to improve ecosystem services, including water quality (Goal 3, Objective 10) (Reserve support for plans under no action alternative).

E. Hawaiian Goose, Nēnē (*Branta sandvicensis*)

As noted in Chapter 5, nēnēs are not known to occur on Oʻahu, and the recovery plan for the species does not call for reestablishing it on Oʻahu (Department of Interior 2004). It is not well-documented what areas the species uses outside the nesting season, but non-native grasslands, including those found within the HCDA parcel in the study area, could potentially be suitable habitat for nēnē (Department of Interior 2004).

No Action Alternative, Preferred Alternative, and Alternatives A, B, and C

None of the alternatives are expected to have any effect on nēnēs because they are not present in the study area. USFWS has identified BMPs for avoiding adverse effects to Nēnēs. If a

reserve is designated, OCM will share these BMPs with reserve staff, but they only apply when nēnēs are visible in a project area while work if being conducted, and that is considered very unlikely.[25]

F. Sea Turtles

There are two species of sea turtles that could potentially be found in Kāneʻohe Bay, hawksbill and green, but, of the two, only the green sea turtle is known to frequent the bay. After specific information is presented about the two species, the potential effects of the alternatives are presented for both, as there is considerable overlap in the impact on both species.

Green Sea turtle, honu (*Chelonia mydas*)

The threatened green sea turtle is present year-round in and around the waters of Kāneʻohe Bay (Hawaiʻi Office of Planning 2015b). Behaviors that occur within Kāneʻohe Bay could include resting and foraging on algae and seagrass. Turtles rest in underwater refugia, where they are relatively free from strong currents and disturbance; in Hawaiʻi they typically choose areas with fine-grained sand or powdery silt. Turtles need to periodically swim to the surface to breathe, or they can float at the surface to thermoregulate and rest. Technical assistance from NMFS in 2016 indicates that Kāneʻohe Bay is considered an important foraging area and refugia for the species. One study tracked 12 juvenile turtles in the bay for approximately 2 weeks. These juveniles used patch reefs within the study area, as well as sandy reef flats, the large sandbar, and other parts of Kāneʻohe Bay, most of them just northwest of Moku o Loʻe (Brill et al. 1995). There are no sea turtle nesting beaches in the study area (and few beaches of any kind within the study area). No critical habitat has been designated to date for green sea turtles in Hawaiʻi. Designation of critical habitat for the green sea turtle Central North Pacific Distinct Population Segment is under consideration (see 81 Fed. Reg. 20058).

Hawksbill Sea Turtle, honu ʻea (*Eretmochelys imbricata*)

Hawksbill turtles feed primarily on sponges, invertebrates, and algae. Hawksbills prefer to forage in shallow water (not more than 65 feet deep) around reefs, bays and inlets. Key foraging habitat can be found around most of the main Hawaiian Islands, especially the north coasts. Fewer than 30 hawksbill turtles are known to nest in Hawaiʻi, primarily on the Island of Hawaiʻi (NOAA and USFWS 1998). Nesting on Oʻahu is infrequent and has not been reported in Kāneʻohe Bay (Parker and Balazs 2015). Also, HIMB reports that hawksbill turtles are rarely seen in Kāneʻohe Bay (HIMB 2016). However, since

[25] If a Nēnē appears within 100 feet (30.5 meters) of ongoing work, all activity should be temporarily suspended until the animal leaves the area of its own accord. Moreover, if any number of Nēnē are observed loafing or foraging within the project area during the Nēnē breeding season (October through March), a biologist familiar with the nesting behavior of Nēnē should survey in and around the project area prior to the resumption of any work, or after any subsequent delay of work of three or more days (during which the birds may attempt to nest). If a nest is discovered within a radius of 150 feet of proposed work, or a previously undiscovered nest is found within said radius after work begins, all work should cease immediately and the Service will be contacted for further guidance. (D. Bruns, USFWS, personal communication, June 30, 2016).

Kāneʻohe Bay could offer foraging habitat, potential hawksbill turtle impacts are addressed. No critical habitat for hawksbill turtles has been designated in the Pacific.

Threats to sea turtles include harvesting (of eggs, juveniles, or adults); degradation of foraging habitat; degradation and loss of nesting habitat; beachfront development and lighting; nest predation and vandalism; disease; marine debris and pollution; watercraft strikes; and incidental take from commercial fishing. Actions called for in the Recovery Plans for both species of sea turtle that address conservation of foraging habitat include preventing degradation or destruction of reefs and seagrass beds caused by upland erosion and siltation, trampling by fisherman and divers, boat groundings and anchoring, environmental contaminants, dredging and improper disposal practices, and other threats. The Recovery Plans for both species recommend actions to protect and manage sea turtle populations, including by eliminating directed take; determining the species' distribution, abundance, and status in the marine environment; reducing adverse effects from entanglement and ingestion of marine debris; reducing incidental mortality due to fishing; and eliminating the harassment of turtles at sea through education and enforcement NOAA and USFWS 1998 and1998b).

No Action Alternative

As there are no known terrestrial habitats (i.e., beaches) used by these species within the study area, activities in upland areas, estuarine areas, and riparian areas are not expected to directly impact sea turtles. One potential indirect effect, however, is transport of sediment or pollutants to sea turtle habitats. Because of modern point source and nonpoint source pollution control requirements, the types of activities underway in the study area are not likely to affect sea turtles. In the marine environment, threats to sea turtles in the study area include direct and indirect incidental harm from recreational boaters and from fishing activities. Direct impacts could occur from injury from boats, fishing line or nets, or other equipment used for recreation. Indirect effects could occur from damage to habitats preferred by turtles, including near reefs, and from disruption of behavior patterns due to human use of the area. For example, some resting or foraging turtles are disturbed by human activity, including boating, and try to swim away from the source of disturbance. Human activities can therefore disrupt their ability to feed and rest (NOAA NMFS unpublished data). There is already a great deal of activity in Kāneʻohe Bay. Thus, the potential for adverse impacts to sea turtles under the no action alternative cannot be ruled out. However, because it is well known that sea turtles are protected under the ESA, it is likely that some of the education and outreach that is already ongoing contributes to educating people about protecting and avoiding harassment of sea turtles. Also, while it is possible that there could be temporary disturbances caused by people studying reefs and removing invasive algae (including when invasive algae is fed into the "Super Sucker"), projects requiring federal approval or federal funding would be subject to applicable requirements under ESA. (NOAA funds some use of the Super Sucker in Kāneʻohe Bay.) The long-term effect of removing invasive algae would be to improve habitat for sea turtles.

Preferred Alternative and Alternatives A, B and C

Designation and implementation of a proposed Heʻeia NERR could result in increased research, boating, and/or recreational use of Kāneʻohe Bay (e.g., use of motorboats, fishing, or diving), in

part because designation could increase the number of visitors and recreational users to the study area. Increased research and monitoring efforts by reserve staff and partners could also increase the amount of in-water activities for research purposes, and it is possible that the number of educational tours on boats owned by reserve partners could also increase. However, it should be noted that the same boats already used by reserve partners would continue to be used for research and educational purposes, at least in the near term. In addition, there is already extensive human use of Kāneʻohe Bay, including in the areas designated for motorized recreation.

Impacts from reserve-related boating are expected to be negligible because reserve partners would be expected to adhere to BMPs identified by NOAA for in-water activities. Those BMPs include maintaining a vigilant watch for turtles (and other protected marine species), particularly in areas of suspected turtle activity. Observers and boats should keep their distance from turtles, even if that means altering their course. No one should attempt to feed, touch, ride, or otherwise intentionally interact with any listed species, including sea turtles. See Appendix I for additional BMPs. Reserve staff and other educators should inform visitors to the reserve and researchers about applicable BMPs.

Adherence to these BMPs is intended to ensure that while reserve activities may affect listed sea turtles, they are not likely to adversely affect sea turtles. Some of the management strategies identified within the DMP are intended to enhance marine habitats, providing an indirect benefit to sea turtles and other marine species. In addition, some of the reserve's education and outreach activities would improve the understanding of reserve visitors about their interactions with marine species. Those efforts would improve public awareness of BMPs to follow when they encounter sea turtles and other special-status species, which could reduce the amount of disturbance to these species, another potential beneficial impact. OCM plans to consult with NMFS regarding the potential for its action to affect sea turtles during the public comment period for this draft EIS; the results of the consultation will be published in the Final EIS and the information summarized herein will be updated, if needed.

G. Hawaiian Monk Seal, *ilio-holo-i-ka-uaua* or *na mea hulu* (*Monachus schauinslandi*)

Between 1985 and 2015, NMFS received 23 reports of Hawaiian monk seals in Kāneʻohe Bay. In most instances, the monk seals were observed in the water. Twice, monk seals were reported as having hauled out on land, including once on Moku o Loʻe. (In general, Hawaiian monk seals prefer to haul out on sandy beaches and lava benches.) Of the 23 Hawaiian monk seals reported, 7 were reported in the vicinity of Moku o Loʻe, 2 were in the vicinity of Heʻeia Kea Small Boat Harbor, 2 were in the vicinity of Heʻeia State Park, and the other 12 were elsewhere in Kāneʻohe Bay (but not necessarily the portion of Kāneʻohe Bay in the study area). Between 2005 and 2015, there were a total of six sightings, four of them in Kāneʻohe Bay, one on Moku o Loʻe, and one at Heʻeia State Park. These data represent only the instances when NMFS was notified of the presence of a monk seal, whereas actual monk seal use could be more frequent. In addition, some monk seals are monitored using telemetry (a subset of the total monk seal population), but none have been tracked in Kāneʻohe Bay, although they do use nearby areas (NOAA and DLNR 2007). In short, while Hawaiian monk seals are observed rarely

in Kāneʻohe Bay, they are known to use the study area. As noted in Chapter 5, Hawaiian monk seals travel through Kāneʻohe Bay and can use portions of the bay for foraging or resting, but they are not known to use Kāneʻohe Bay for pupping or nursing. The primary threats to the species in the main Hawaiian Islands include entanglement in marine debris and fishing gear, disease, habitat loss, and human disturbance. Monk seals prey on a wide variety of bottom-dwelling species, including fish, eels, octopus, squid, and crustaceans (NOAA and DLNR 2007).

Critical habitat for the Hawaiian monk seal (*Monachus schauinslandi*) was revised in 2015, in response to the identification of key beach areas and marine-foraging areas in the main Hawaiian Islands. Although the study area does not contain terrestrial habitat or key beach areas for the monk seal, the marine component of the area does include marine critical habitat (which extends from the shoreline out to the 200 meter depth contour, but only includes the seafloor and marine habitat that extend 10 meters in height from the sea floor). The physical and biological features that must be present in marine areas essential to the conservation of Hawaiian monk seals have been defined as, "[m]arine areas from 0 to 200 m in depth that support adequate prey quality and quantity for juvenile and adult monk seal foraging . . . [including] submerged reefs and banks, nearby seamounts, barrier reefs, and slopes of reefs and islands . . . [where conditions support] the growth and recruitment of bottom-associated prey species that support monk seals" (80 Fed. Reg. 50925).

No Action

Visitors to Kāneʻohe Bay have the potential to encounter Hawaiian monk seals. Depending on the type of encounter, it can result in harassment during human-seal interactions (e.g., due to intentional efforts to approach, feed or swim with monk seals); seals becoming "conditioned" or used to humans; injuries from boating and fishing (including from hooking/entanglement); or even monk seal death. Given that monk seals have been reported in Kāneʻohe Bay in fewer than half of the past 30 years, human-monk seal encounters would be expected to be infrequent (NOAA and DLNR 2007). However, there is already considerable human activity in and around Kāneʻohe Bay, including by users with commercial, fishing, recreational, research, and educational interests, as well as by users associated with the marine corps base. Some of these human activities could also have indirect effects on Hawaiian monk seals, such as on their behavior. Given efforts on the part of multiple entities to educate the public, including by reserve partners, about the protections afforded to Hawaiian monk seals under the ESA and Marine Mammal Protection Act (MMPA), most visitors probably know that they should keep their distance from any monk seals they see and avoid intentional, direct impacts to the species. However, the potential for take of Hawaiian monk seals under the no action alternative cannot be ruled out.

Preferred Alternative and Alternatives A, B and C

If a reserve were designated (under the Preferred Alternative or Alternatives A, B, or C), increased visitation to the study area would be expected to increase the frequency and number of researchers and visitors to the portion of Kāneʻohe Bay in the study area. This could potentially have direct or indirect impacts, but their magnitude is expected to be insignificant in the context of all the other activity within the bay. It is theoretically possible that reserve

operation could increase the frequency of encounters between humans and Hawaiian monk seals, but Hawaiian monk seals have only been reported in this area in 4 of the last 10 years (NOAA and DLNR 2007). Thus, Hawaiian monk seal encounters are expected to continue to be very rare. In addition, many of the same BMPs for marine species listed in the appendix would apply to anyone who sees Hawaiian monk seals. The reserve would be expected to publicize those BMPs and any other applicable NOAA BMPs. Adherence to the BMPs will reduce the likelihood of any monk seal harassment or take by reserve staff, researchers, or visitors. Whether any future human-monk seal encounters in Kāneʻohe Bay would be attributable to the reserve or other recreational activities in the bay would be hard to discern. In other words, any potential adverse effects of reserve operation to Hawaiian monk seals would be insignificant (as defined under ESA, i.e., difficult to detect and not of a magnitude that would be expected to cause take). In addition, any researchers whose work requires authorization from NMFS (including researchers studying endangered species) will be expected to obtain the authorization before the beginning the research. NERRS research policy requires researchers to have secured all necessary approvals and permits prior to obtaining written approval from a NERR research coordinator. In addition, environmental compliance reviews will be carried out by OCM prior to further federal actions at the reserve site. After future actions are proposed, when appropriate, OCM will consult with NMFS to evaluate the potential impacts to protected species and critical habitat and to ensure compliance with the Marine Mammal Protection Act and ESA.

Under the ESA, federal actions must avoid destruction or adverse modification of critical habitat defined for a listed species. Destruction or adverse modification means “a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical.” See 50 C.F.R. § 402.02. With respect to Hawaiian monk seal foraging areas, OCM must evaluate the effect of its federal action on the characteristics of Kāneʻohe Bay that allow it to support adequate prey quality and quantity for monk seal foraging and that facilitate the growth and recruitment of seal prey. OCM does not anticipate that its proposed action would adversely affect the species in Kāneʻohe Bay upon which monk seals might prey. Therefore, it appears that the proposed action may affect, but is not likely to adversely affect, Hawaiian monk seal critical habitat.

H. Humpback whale, koholā (*Megaptera novaeangliae*)

In Hawaiʻi, it is not permitted to come within 100 yards of whales at sea or 1,000 feet of whales while in the air, unless authorized under a permit. In addition, it is unlawful to disrupt the normal behavior or prior activity of a whale by any other act or omission (50 C.F.R. § 224.103). The humpback whale mates, calves, and nurses its young in Hawaiʻi, usually during the winter. In the spring and summer, the species migrates to feeding areas beyond Hawaiʻi. Threats to the species include ship strikes, entanglement in fishing gear or with marine debris, acoustic disturbances, and illegal whaling (NOAA and DLNR 2007). Vessels in Kāneʻohe Bay create noise that may be audible to marine mammals. However, as noted in Chapter 5, while whales are known to use oceanic areas just outside of Kāneʻohe Bay, they have not been not been

reported to date inside of Kāneʻohe Bay. That does not mean, however, that whales could not enter Kāneʻohe Bay or that noise from within Kāneʻohe Bay could not impact whales outside the bay.

No Action Alternative

Potential impacts to humpback whales under all the alternatives, including the no action alternative, include chronic exposure to underwater noise resulting from human activities in Kāneʻohe Bay, including recreational and commercial vessel traffic (Bettridge et al. 2015). Other threats to humpback whales include ship strikes, which have the greatest potential to be an issue for large vessels, which are not typically found in Kāneʻohe Bay. Large military watercraft sometimes transit the bay. There are already numerous sources of noise, primarily from boat engines on vessels (and other vehicles, such as personal watercrafts) in Kāneʻohe Bay. A typical fishing vessel radiates noise at a source level of about 158 decibels (referenced to 1 micropascal). There are also natural, ambient sounds in Kāneʻohe Bay and other marine areas produced by snapping shrimp and other marine life. For example, the sound produced from individual snaps from snapping shrimp in Kāneʻohe Bay produced almost 190 decibels referenced to 1 micropascal at 1 meter (Au and Banks 1998). When sound is generated in air, it travels through the water primarily in the narrow area right below the aircraft. The U.S. Navy's Hawaiʻi-Southern California Training and Testing EIS/OEIS notes, "A sound wave propagating from an aircraft must enter the water at an angle of incidence of 13° or less from the vertical for the wave to continue propagating under the water's surface. At greater angles of incidence, the water surface acts as an effective reflector of the sound wave and allows very little penetration of the wave below the water . . . ." Even a F/A-18 Subsonic plane at 1,000 feet and a H-60 Helicopter hovering at 50 feet generate less sound below the water surface than a typical fishing vessel and snapping shrimp, respectively (Rim of the Pacific 2002). Since there are Biologically Important Areas identified by NMFS for humpback whales along the northeastern coast of Oʻahu, to the northwest and southeast of Kāneʻohe Bay, humpback whales probably favor those habitats over the bay (NOAA 2016e). The boundaries of the Hawaiian Islands Humpback Whale National Marine Sanctuary in the waters offshore of Oʻahu extend to the l00-fathom isobaths, from Puaʻena Point eastward to Mahie Point (on the north shore of Oʻahu) and from the Ala Wai Canal eastward to Makapuʻu Point (on the southeastern side of Oʻahu). The Sanctuary's boundaries include some of the areas mapped as Biologically Important Areas, but do not include Kāneʻohe Bay. However, the potential for adverse effects to humpback whales, particularly any that enter Kāneʻohe Bay, from existing activities cannot be ruled out.

Preferred Alternative and Alternatives A, B and C

Potential impacts to humpback whales are expected to be similar under all the alternatives. The incremental increase in boat noise under any of the alternatives that involve designation and operation of a reserve, as currently understood, would likely not be perceptible given the large volume of existing boating and the fact that, at least initially, reserve visitors and researchers would likely use the same boats that are already used by reserve partners for existing activities. Shipping and commercial activity would not be affected by reserve designation or operation. Therefore, the effect of increased underwater noise from increased vessel traffic on humpback whales from the preferred alternative and alternatives A, B or C is likely insignificant, and the

proposed action may affect, but is unlikely to adversely affect humpback whales. OCM will carry out an informal consultation with NMFS during the public comment period for EIS to confirm this assessment.

H. Main Hawaiian Islands Insular False Killer Whale (*Pseudorca crassidens*)

This endangered species, which is in the dolphin family, ranges widely throughout the main Hawaiian Islands. Tagged individuals have been tracked over a broad range of depths, from shallow (< 50 m) to very deep (> 4000 m), using both the windward and leeward sides of all the islands. One of the characteristics that distinguishes the main Hawaiian Island insular false killer whale from other related species is that it tends to stay close to the shoreline, typically within 40 km. Major threats to the species include reduced prey, injury from fishing gear, anthropogenic pollution, and reduced genetic diversity. Since the species uses echolocation for such activities as navigation and foraging, noise can also affect the species.

No Action Alternative

Under the no action alternative, marine animal species, including cetaceans, are chronically exposed to underwater noise resulting from human activities in and around Kāneʻohe Bay. Many of the boats in the bay may be relatively small, but large military watercraft sometimes transit the bay, and planes also fly overhead. The discussion in the Final Rule to list the species as endangered highlighted, in particular, potential impacts of noise from sonar and seismic exploration from military, oceanographic, and fishing sonar sources, because these types of intense sounds can cause permanent or temporary hearing loss, which can interfere with navigation, foraging, communication, and other behaviors (NOAA 2012b). For more information on the effects of noise on marine mammals, see http://www.nmfs.noaa.gov/pr/acoustics/ and the Kāneʻohe Bay Information System webpage at https://sites.google.com/site/kbisathimb/human-dimensions/acoustics-sonar/kbis_references_acoustics-sonar. There is one false killer whale in captivity at HIMB, but OCM did not identify any reports of wild false killer whales in Kāneʻohe Bay or in bays in Hawaiʻi generally. However, technical assistance from NMFS indicates the species could visit Kāneʻohe Bay. In short, because of the human activity in and around Kāneʻohe Bay, the potential for adverse effects to this species from existing activities cannot be ruled out.

Preferred Alternative and Alternatives A, B and C

Under the preferred alternative and alternatives A, B, and C, the effect of increased underwater noise from increased boating in Kāneʻohe Bay on main Hawaiian Island insular false killer whales is likely insignificant, as with humpback whales. For the reasons summarized above, reserve operations under any of these alternatives would not be likely to adversely impact the false killer whales. If there are any research activities that have the potential to adversely affect listed species or marine mammals proposed by the reserve in the future, they will be subject to future environmental compliance reviews, and consultation with NMFS will occur, when appropriate. OCM will carry out an informal consultation with NMFS during the public comment period for this EIS to confirm the determination that the reserve designation and implementation is not likely to adversely affect this species.

6.2.3.3.2 Candidate and Species Proposed for Listing under ESA

Individual projects that have the potential to impact candidate species and species proposed for listing under ESA have been summarized above. Resulting impacts to candidate species and species proposed for listing under ESA from the range of alternatives analyzed are provided in Table 6.25.

Table 6.25 Impacts to candidate species and species proposed for listing under ESA

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Candidate Species (Manta Rays)	Current human uses of Kāneʻohe Bay could potentially adversely affect this species.	Slight increases in human activity would have no effect on the species.	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.
Species Proposed for Listing (Bees)	Some plant removal activities could have adverse effects, with some beneficial effects possible, as well.	If applicable BMPs are followed, vegetation management activities can be expected to have no more than insignificant effects.	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

A. Manta Rays (Candidate Species)

Giant Manta Ray (*Manta birostris*)

Giant manta rays are widely distributed and inhabit tropical to temperate waters worldwide. These rays have been observed visiting portions of shallow reefs where "cleaner fish" will remove parasitic copepods and other unwanted materials from their body. Sometimes giant manta rays are found in areas with sandy bottoms and in seagrass beds, which are present in Kāneʻohe Bay.

Reef Manta Ray (*Manta alfredi*)

This species of manta ray is observed in inshore portions of tropical areas, near coral and rocky reefs, as well as along productive coastlines. Its range includes the Hawaiian Islands. The species sometimes moves between areas diurnally, using shallower waters (feeding grounds less than 10 meters deep and locations frequented by cleaner fish) during the day and deeper habitats further offshore at night.

No Action Alternative

One of the major threats to both species of manta rays is directed fishing to satisfy demand for their gill-rakers, which are used in Asian medicine. Other threats include injury or death when the rays are caught as bycatch, damage from marine debris, and destruction or modification of their habitat, including coral reefs. NMFS is in the process of reviewing available information about the two species to determine whether they merit listing as threatened or endangered. There is no significant fishing effort for this species in Hawaiʻi (NOAA 2016f). There is a possibility that current human use of Kāneʻohe Bay could adversely affect these species, e.g., via effects related to coral reef degradation, marine debris, or fishing.

Preferred Alternative and Alternatives A, B and C
Any increased use of Kāneʻohe Bay under these alternatives would be not be likely to adversely affect manta rays because the increased human activity would likely have either no effect or insignificant effects on the species. NMFS does not consult on candidate species, but these species are to be considered when making natural resource decisions. Candidate species have no legal protection under the ESA.

B. Yellow-faced Bees (Proposed as Endangered)
The six species commonly known as yellow-faced bees that are or were found on Oʻahu (*Hylaeus anthracinus*, *H. assimulans*, *H. facilis*, *H. longiceps*, *H. kuakea*, and *H. mana*) prefer coastal ecosystems, lowland dry ecosystems, and lowland mesic ecosystems. Habitat destruction and modification threatens yellow-faced bees, reducing the availability of and fragmenting habitat used for foraging and nesting. Loss of native vegetation has also reduced the availability of habitats that yellow-faced bees prefer. In particular, California grass is known to adversely affect habitats for some of the yellow-faced bees. Predation by and competition with non-native insects also threatens these species. Some of the species have only been identified at higher elevations than are found in the study area. *H. anthracinus* and *H. assimulans* appear to be closely associated with plants in the genus *Sida*, particularly *Sida fallax* (Department of the Interior 2015). (Since yellow-faced bees prefer native species, it is unclear whether *H. assimulans* (and, potentially, other bees species) is only closely associated with native plants in the *Sida* genus, however.) USFWS reports that some of the yellow-faced bee species can be found in the study area.

Recommended BMPs to minimize the potential for adverse effects to these species provided by USFWS include restricting vehicle use to existing roads and trails, as well as limiting areas in which vegetation is cut so that they are no more than 3 meters (10 feet) wide. Outside existing developed areas, USFWS recommends clearing fewer than 5 acres. If vegetation must be cut or removed from outside of existing developed areas, the service encourages people to avoid cutting or removing plants in the *Sida* genus. Finally, USFWS also recommends restoring cleared areas using native vegetation, when possible (D. Bruns, USFWS, personal communication, June 30, 2016).

No Action Alternative
It is unknown whether there are any yellow-faced bees in the project area. The primary threat to these bee species is habitat degradation, including reduced native plant populations. Thus, development has adversely impacted the species. California grass degrades habitat for these bee species, and effort by Kākoʻo ʻŌiwi to remove it from the Heʻeia Stream channel and a buffer surrounding the stream could have beneficial impacts on any bees in the area. There are Cuba jute (*Sida rhombifolia*) trees, which are in the *Sida* genus on the upland portion of the HCDA parcel, mixed in with other non-native species. Efforts by Kākoʻo ʻŌiwi to remove invasive species and plant native species could have beneficial and/or adverse impacts on the bee species. The draft management plan indicates that the plant species to be targeted for removal will be determined after a more thorough evaluation of existing conditions. The USFWS BMPs

indicate that, if vegetation must be cut or removed, disturbing trees in the *Sida* genus should be avoided. (That suggestion is probably linked to the fact that multiple bees are associated with the ilima (*Sida fallax*), and one bee species is associated with multiple species in the *Sida* genus.) Without further information on use by yellow-faced bees of Cuba jute, it is difficult to assess the effects of future restoration efforts on the bees, including removing Cuba jute on the HCDA parcel; however, adverse effects to yellow-faced bees are possible. Otherwise, Kāko‘o ‘Ōiwi’s efforts to remove some invasive plants and replace them with native plants could potentially beneficially impact the bees. The specific species to be removed and planted are to be determined.

Preferred Alternative and Alternatives A, B and C

Reserve operation might lead to the identification of the need to improve public access to habitats or other future needs that might necessitate vegetation management. OCM will convey the USFWS BMPs to Reserve partners and encourage that they be followed to protect these bee species. If the BMPs are followed, restoration activities can be expected to have insignificant effects, allowing vegetation management activities to avoid adverse effects to species proposed for listing. OCM will submit this determination to USFWS for its concurrence during the public comment period for this draft EIS.

6.2.3.3.3 Species of Concern under the ESA

Reserve designation could have beneficial impacts on the two Species of Concern identified by NMFS as occurring within Kāne‘ohe Bay. Resulting impacts to Species of Concern under the ESA from the range of alternatives analyzed are provided in Table 6.26.

Table 6.26 Impacts to Species of Concern under ESA

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Hawaiian Reef Coral (*Montipora dilatata*)	Minor, indirect benefits from coral reef research, monitoring, and restoration, including efforts to remove invasive alga species. If this species occurs in areas used for motorized recreation, fishing, or swimming, potential moderate or major direct, adverse effects from physical damage to the coral. Potential moderate, indirect, adverse effects from pollution, sedimentation, boating, and introduction of non-native alga species.	The same potential beneficial effects related to coral reef research, monitoring, and restoration and the same adverse effects from human uses described under the no action alternative, plus additional beneficial effects from research, monitoring, and technical assistance or other support for alien algae removal projects.	Likely the same as under the no action alternative, unless the species is found within the reefs included under this alternative.	Same as preferred alternative.	Likely the same as under the no action alternative, unless the species is found within the reefs included under this alternative.
Inarticulated Brachiopod (*Lingula reevii*)	Moderate adverse impacts from habitat degradation and human activities, as well as minor to moderate beneficial impacts from ongoing research, husbandry, and efforts to remove invasive algae from	The same potential impacts as the no action alternative, plus potential additional, minor benefits through reserve coordination of research and	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

	brachiopod habitat.	monitoring efforts relevant to humans' understanding of this species and support for invasive algae removal efforts.			

A. Hawaiian reef coral (*Montipora dilatata*)

NMFS listed the Hawaiian reef coral, *Montipora dilatata*, as a Species of Concern due to its rarity (though it was formerly abundant), restricted distribution, and vulnerability to several threats (coral bleaching, thermal kills, freshwater kills, habitat degradation, and damage by anchors, swimmers, fishers, and other human activities). This species was considered for listing under the ESA; however, NMFS determined that *M. dilatata* did not meet the definition of a threatened or endangered species, so it was not listed (79 Federal Register 53851). Within the main Hawaiian Islands, the species has only been observed at Kāneʻohe Bay, where it is rare. A bay-wide snap assessment survey conducted for the U.S. Army Corps of Engineers identified invasive algae and coral species present at 41 patch reefs in 2014, including patch reefs 2, 4, 7, 9 and 10. No Hawaiian reef coral were found in reefs 2, 4, 7, 9 and 10, whereas the species was found in one of the other reefs surveyed (USACE 2014). This species is difficult to distinguish from other species in the same genus. In 2008, one colony was identified by a coral reef expert in reef 8 (Hunter 2009). However, in 2010, no *M. dilatata* colonies were identified on reefs 1, 3, 8, 9, or 10; and all the colonies identified at that time were in reefs more than 1.8 miles (3,000 meters) further to the north. The 2010 study reported 43 colonies of *M. dilatata* in Kāneʻohe Bay (Hunter 2011). These studies suggest that the distribution of the species is not well known, though there are habitat variables conducive to its occurrence, such as areas protected from wave action. The species is restricted to shallow reef environments, with low wave motion, which can be found in the study area.

No Action Alternative

Existing restoration efforts, including those intended to reduce invasive algae present in Kāneʻohe Bay, could potentially have minor, indirect, beneficial impacts on *M. dilatata*, if carried out in areas where the species is present. In addition, some of the research and monitoring already conducted within the bay has the potential to offer minor, indirect benefits to coral reef species, including *M. dilatata*, especially if the research and monitoring help resource managers understand the spatial distribution of the species and the variables that affect its distribution. In addition, the only place within the study area where the species has been identified to date is within reef 8, also known as Checker's Reef. The State of Hawaiʻi manages the area around that reef (and reef 7) for recreational use, particularly for motorized on-water activities (including personal watercraft and water skiing). These uses and other uses of Kāneʻohe Bay have the potential to adversely affect the coral directly. For example, coral can sustain moderate or major damage directly, from anchors, fish pots, swimmers, and divers. Coral can also be moderately affected indirectly, such as through habitat degradation and modification from sedimentation, pollution, boating, and introduction of non-native alga species.

Preferred Alternative and Alternative B

Proposed reserve boundaries under the Preferred Alternative and Alternative B would include reef 8. Under these alternatives, reserve designation could increase human understanding of *M. dilatata* and potentially lead to the collection of more definitive information about where the species exists within the parts of Kāneʻohe Bay included in the reserve under these alternatives, as well as the factors contributing to its abundance. Thus, reserve designation could have a minor, beneficial, indirect impact on this species. While not developed to directly address needs associated with this particular species, some of the activities identified in the proposed Heʻeia NERR DMP related to research, monitoring, and coral reef restoration are consistent with the management needs identified for the species by NMFS. See Table 6.27, which is derived from the proposed Heʻeia NERR DMP and a detailed fact sheet developed by NMFS that identifies management needs for the species, published in 2015 (NOAA 2015). Reserve designation would not change the way marine areas are managed by the State, so the potential adverse effects identified under the no action alternative from human uses could also occur under this alternative.

Table 6.27 Heʻeia NERR DMP objectives aligned with management needs for Hawaiian reef coral (*Montipora dilatata*)

Applicable Management Need Identified by NMFS	Aligned Objectives in Heʻeia NERR DMP
Quantitative surveys of Kāneʻohe Bay to monitor reported location and abundance and measure variables such as temperature, salinity, pH, reef size, currents, and sedimentation to further an understanding of the environmental variables driving spatial patterns	Support environmental monitoring and biodiversity baseline studies (Goal 1, Objectives 1 and 2)
Expand efforts to out-plant additional sea urchins, particularly smaller individuals that might be better able to move into areas between cology plates and branches, to facilitate biocontrol of invasive algae and improve coral survival	Support coral reef restoration activities conducted by Hawaiʻi DLNR Division of Aquatic Resources (Goal 3, Objective 10)

Alternatives A and C

Under these alternatives, patch reef 8 would not be included within the reserve, but other reefs would be. The only reef being considered for possible inclusion within the reserve where *M. dilatata* has been documented to date is reef 8. Thus, there would only be indirect benefits to the species from alternatives A and C. However, it is possible *M. dilatata* could be identified in the future in the marine area that would be included within the reserve under these scenarios. In addition, reserve operation could also increase human understanding of the species, if reserve staff or researchers become more involved in *M. dilatata* research.

Inarticulated brachiopod (*Lingula reevii*)

The inarticulated brachiopod has been identified as a Species of Concern by NMFS because it is rare and it is only known to occur in Kāneʻohe Bay, in shallow (intertidal and subtidal), sandy reef flats. It is a sessile species, and its density affects its success propagating. Its density is declining (from a high of 500 per square meter in the 1960s to less than 5 per square meter in the last 10 years). Threats to the species include habitat degradation and alteration, overexploitation, pollution, sedimentation, a vulnerable life history, and limited distribution. The inarticulated brachiopod retracts into the sediment when the surrounding benthos is disturbed, which reduces the amount of time it can spend feeding. Also, non-native alien algae species

have invaded habitat for inarticulated brachiopods and form mats that makes the habitat much less suitable for brachiopods (NOAA 2015b). The species has been identified around the perimeter of Moku o Loʻe, as well as in other locations, including reef flats to the west of the island (including within areas that would be within the reserve's boundaries under the preferred alternative and alternatives A-C) (Hunter 2009b).

No Action Alternative

There are a number of activities that occur in Kāneʻohe Bay that are thought to contribute to the decline of the inarticulated brachiopod population. These include human activities, reduced levels of nutrients being introduced into the bay, and habitat disturbance due to invasive algae. Human uses of the bay could continue to have adverse effects on the species through disturbance (causing individuals to retract and therefore spend less time filter feeding), but the sandbars that the species use are more protected from recreational boating than some other areas. The extent to which current human activities are currently affecting the species is not well understood, but is estimated to be moderate for the purposes of this assessment, especially compared to the changes to the species' habitat over time. Another factor that could be affecting the habitat's suitability for the species is the spread of invasive algae. Under the no action alternative, efforts to remove invasive algae by reserve partners and others will continue, although the extent to which invasive algae removal activities are occurring in inarticulated brachiopod habitat versus in other parts of reefs may be limited. Research on the inarticulated brachiopod and its habitat requirements is also anticipated to continue under the no action alternative, to the extent funding allows. The research and conservation activities already underway and planned could have minor to moderate beneficial impacts (including limited removal of invasive algae by researchers and efforts to make it possible for the species to propagate in captivity so that additional individuals could potentially be reintroduced into the bay in the future).

Preferred Alternative and Alternatives A, B and C

The species has been documented in the areas proposed for inclusion within the reserve under all four of these alternatives. Under the preferred alternative and alternatives A-C, proposed proposed Heʻeia NERR activities could advance efforts to study and potentially alleviate some of the threats to the inarticulated brachiopod (e.g., by supporting research, restoration and management strategies detailed in the DMP that result in improving habitat suitability for the species). See Table 6.28, which lists the management needs NMFS identified that could potentially be supported by reserve designation and operation. The research, management, and restoration efforts supported by the reserve under its DMP could provide minor benefits to this species (to the extent these efforts are conducted in the shallow, sandy reef flats that provide suitable habitat for the inarticulated brachiopod, especially efforts to remove invasive algae in areas where they reduced habitat suitability for this species).

Table 6.28 Heʻeia NERR DMP objectives aligned with management needs for inarticulated brachiopod (*Lingula reevii*)

Applicable Management Need Identified by NMFS	Aligned Objectives in Heʻeia Reserve DMP

Applicable Management Need Identified by NMFS	Aligned Objectives in He‘eia Reserve DMP
Continue quantitative surveys of Kāne‘ohe Bay to monitor reported abundance and location	Conduct baseline studies (Goal 1, Objectives 1 and 2)
Preserve habitat and water quality in Kāne‘ohe Bay	Support resource management and restoration activities that seek to improve ecosystem services, including water quality (Goal 3, Objective 10)
Further refine research on habitat preferences (e.g., effects of salinity, pH, water quality, water depth, sediment depth, and alien algal species on *L. reevii*)	Not directly addressed in proposed He‘eia Reserve draft MP, but consistent with Goal 1, Objective 2 (coordinating independent research and monitoring); researchers visiting the reserve could advance this work

6.2.3.3.4 Marine Mammals

There is no mention of plans for any marine mammal research or monitoring in the DMP for the proposed He‘eia NERR. However, there are a number of marine mammals that could occur in Kāne‘ohe Bay. Chapter 7 describes the responsibilities and restrictions that apply to persons and federal entities (respectively) with species protected under the ESA and the restrictions under the MMPA with respect to human interactions with any marine mammal. The MMPA makes it unlawful for any person subject to the jurisdiction of the United States to take (meaning to hunt, harass, capture, or kill) any marine mammal within U.S. waters or on the high seas (16 U.S.C. § 1372(a)). Regulations adopted under the MMPA also prohibit harassment, defined “any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering” (16 U.S.C. § 1362(13) and (18)(A)). There are some exceptions to the prohibitions, including for directed research on marine mammals and a mechanism for obtaining authorization from NMFS for “incidental,” but not intentional, taking, of small numbers of marine mammals.

As discussed above, the marine mammal species that are protected under the ESA that could be present in Kāne‘ohe Bay include the Hawaiian monk seal, main Hawaiian Islands insular false killer whale, and the humpback whale. However, the Hawaiian monk seal is the only wild marine mammal known to regularly occur in the project area. Since those three species are discussed above, they are not specifically addressed in this subchapter. Rather, this subchapter analyzes the potential effects of the alternatives on other marine mammal species that could be present in the study area. According to NMFS, two cetacean species that are potentially regularly present in Kāne‘ohe Bay are spinner dolphins and Pacific bottlenose dolphins.[26] Technical assistance from NMFS also indicates that striped dolphins and a number of whale species (killer whales, melon-headed whales, and short-finned pilot whales) could also potentially pass through Kāne‘ohe Bay, but would be unlikely to spend much time there because those species prefer other habitat types.[27] Resulting impacts to marine mammals other than the

[26] There are also three Pacific bottlenose dolphins and one false killer whale in captivity, where researchers from HIMB’s Marine Mammal Research Program study the two species.
[27] This technical assistance was provided by a representative of the Cetacean Research Program at the Pacific Islands Fisheries Science Center in July 2016.

Hawaiian monk seal, main Hawaiian Islands insular false killer whale, and humpback whale from the range of alternatives analyzed are provided in Table 6.29.

Table 6.29. Impacts to marine mammals other than the Hawaiian monk seal, main Hawaiian Islands insular false killer whale, and humpback whale

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Other Marine Mammals [28]	No changes to human-marine mammal interactions in Kāneʻohe Bay. Restrictions under the MMPA make it unlikely that marine mammals would be taken in the study area.	The proposed action would not be expected to result in the incidental take of marine mammals. Implementation of the reserve's DMP could lead to an increased number of boat trips in areas already used extensively for boating, as well as additional research projects. Safeguards used to protect threatened and endangered species would, in general, be expected to protect any marine mammals in the area. If there were any adverse impacts to marine mammals, they would likely be short-term, indirect, and negligible, and they could be mitigated to avoid take by following BMPs.[29] Future reserve actions will be evaluated individually with respect to their potential impacts and to identify any procedures that might be needed to protect marine mammals. For example, applicable NOAA BMPs for in-water work should be followed to reduce the potential for any incidental marine mammal take.	Impacts would be similar as those in the preferred alternative, but within a larger area, including the small boat harbor.	Same as preferred alternative.	Impacts would be similar to those in the preferred alternative, but within a smaller area.

No Action Alternative

Various activities supporting tourism, recreation, education, industry (including fishing), commerce, military needs, maritime transportation, and other sectors occur in and along Kāneʻohe Bay. Military overflights and significant boating, diving, snorkeling, fishing, research, and restoration efforts occur within the study area; however, a detailed assessment of the impacts of current activities on marine mammals in Kāneʻohe Bay is outside the scope of this document. Under the no action alternative, there are expected to be no change to human-marine mammal interactions in Kāneʻohe Bay. While the MMPA reduces the likelihood that marine mammals would be killed, captured, or harassed in Kāneʻohe Bay and other settings, the potential for marine mammal impacts in any location cannot be ruled out. Restrictions on take of marine mammals under the MMPA would reduce the likelihood that marine mammals would be killed, captured, or harassed.

[28] This assessment focuses on marine mammals potentially present in Kāneʻohe Bay other than Hawaiian monk seals, humpback whales, and Main Hawaiiian Islands insular false killer whales because those three species were discussed above. Technical assistance from NMFS suggests the other marine mammals that could use the bay include spinner dolphins, Pacific bottlenose dolphins, striped dolphins, pygmy killer whales, melon-headed whales, and short-finned pilot whales.

[29] The word negligible, as used throughout this chapter, was defined in Chapter 6.1.1. This use of the word negligible is different from how negligible is defined under the MMPA at 50 C.F.R. § 216.103; no reference to that definition is implied.

Preferred Alternative and Alternative B
These alternatives are discussed together because the boundaries of marine areas included within the reserve and the reserve activities conducted therein would be the same, and thus, the expected impacts to marine mammals are also expected to be the same. The main activity that can be anticipated to result from reserve operation that has the potential to increase human-marine mammal interactions would be a greater number of boat trips for research or educational purposes. At this time, it is anticipated that reserve partners would use existing small boats for these purposes, just as they currently use such boats and other equipment for research and educational tours in areas that are already used extensively by humans. Marine research and restoration activities, including research that requires swimming or diving, already underway or planned by reserve partners would also continue and might have the potential to result in human-marine mammal interactions. New in-water activities might occur as a result of designation, such as installation and monitoring instruments that collect data as part of the System-Wide Monitoring Program (SWMP).

The incorporation of the safeguards used to protect threatened and endangered species into future reserve efforts would, in general, also help protect any marine mammals in the area. Thus, any potential adverse effects to marine mammals from reserve operations would be negligible. Future actions will be evaluated individually with respect to their potential impacts and to determine applicable procedures and BMPs to protect marine mammals. For example, applicable NOAA BMPs for in-water work should be followed. (See, for example, “Best Management Practices (BMPs) for General In-Water Work Including Boat and Diver Operations,” published by the NMFS Protected Resources Division.) reserve designation could provide site partners with opportunities to reach broader audiences to educate them about marine mammals and appropriate BMPs to avoid harassment of marine mammals.

Because HIMB is a reserve partner, it would be expected to advise on the potential for any reserve-related activities to affect the marine mammals housed by the HIMB Marine Mammal Research Program located within an enclosure pen approximately 220 feet (70 meters) from Lighthouse Pier on Moku o Loʻe (Community Planning and Engineering, Inc. 2014). Because most of the motor boats used for reserve activities are already owned by HIMB, impacts to these marine mammals from additional boat trips are not expected to be significant, especially in light of all the other noise these animals are exposed to, including overflights of planes from MCBH. Although not anticipated, any incidental take of marine mammals is to be reported to NMFS promptly.

Alternative A
Impacts would be similar as those in the preferred alternative, but within a larger area, including the small boat harbor.

Alternative C
Impacts would be similar as those in the preferred alternative, but within a smaller area. That would reduce the footprint of reserve-related activities, would concentrate use by reserve staff,

researchers, teachers, and other visitors in locations where they might interact with marine mammals in a smaller area.

6.2.3.3.5 Essential Fish Habitat

As noted in Chapter 5, Kāneʻohe Bay has been designated as Essential Fish Habitat (EFH) for Hawaiʻi Bottomfish, Hawaiʻi Coral Reef Ecosystems, the Hawaiʻi Crustacean Fishery, and the Hawaiʻi Pelagic Group. For more information about the Magnuson-Stevens Fishery Conservation and Management Act and EFH consultation requirements, see Chapter 7. In brief, federal agencies must consult NMFS regarding actions proposed, authorized, funded, or undertaken that may adversely affect (i.e., reduces the quality or quantity of) EFH. Resulting impacts to EFH from the range of alternatives analyzed are provided in Table 6.30.

Table 6.30 Impacts to Essential Fish Habitat

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Essential Fish Habitat	No impacts beyond those contributing to the current baseline. For information about the current baseline, see preceding subchapters on the marine environment.	Reserve designation and approval of the DMP are not expected to adversely affect EFH. There is insufficient information at this time to determine whether future in-water activities at the reserve would have any adverse effects on EFH. After federally supported projects within EFH are proposed and at other appropriate times, OCM will consult with NMFS, when needed, to avoid, minimize, or offset any adverse effects on EFH.	Impacts are expected to be similar to those from the preferred alternative, but within a larger area. Availability of a spot from which reserve visitors and staff could board boats at the small boat harbor might reduce the potential for the reserve to need a new dock or pier elsewhere, which could affect EFH.	Same as preferred alternative.	Impacts would be similar to those in the preferred alternative, but within a smaller area corresponding to the boundary of this alternative.

No Action Alternative

The marine water column and seafloor in Kāneʻohe Bay, including the entire study area, have been designated as EFH and, for some ecosystems, Habitat Area of Particular Concern (a subset of EFH). The above discussions of the no action alternative, marine habitats, marine flora and marine fauna summarize the types of impacts on Kāneʻohe Bay from existing and planned activities. For more information about the effects of existing and planned activities on the marine environment in Kāneʻohe Bay, see preceding subchapters, particularly those devoted to marine habitats, marine flora, and marine fauna. Because that information is presented above, it is not summarized again here.

Under the no action alternative, some of the current and planned restoration and research activities in Kāneʻohe Bay, including those implemented by site partners, do or would result in EFH restoration and enhancement. For example, the invasive algae removal efforts on patch reefs are intended to have beneficial impacts on EFH. Other activities in the study area would have no effects on EFH. Since an adverse effect on EFH is defined as any reduction in the

quality or quantity of EFH, it is likely that there also are and will be adverse effects from ongoing and planned non-federal actions to EFH under the no action scenario. (The EFH consultation provisions only apply to federal actions.) It is beyond the scope of this analysis for OCM to provide a more thorough analysis of the impacts to EFH of activities under the no action alternative.

Preferred Alternative and Alternative B

Reserve designation and approval of the reserve management plan would not in and of themselves be expected to adversely affect EFH. OCM will review potential future activities that are federally-funded or authorized to determine whether future activities associated with reserve implementation may adversely impact EFH. The management plan does not contain sufficient detail about in-water activities planned for OCM it to reveal any potential for adverse effects to EFH. At this time, there are insufficient data to determine whether future in-water activities at the reserve would have any adverse effects to EFH, but some potential methods for securing access to and placement of equipment or personnel have the potential to adversely affect EFH, depending on how they are implemented. What is known is that designating a reserve would result in installing monitoring (and potentially other) equipment in support of research efforts. It has not been determined where and how equipment needed for research and monitoring will be installed. If a reserve is designated, reserve staff and partners will need to determine what in-water activities to propose and whether there is a need for equipment to be anchored in Kāneʻohe Bay (and whether that would require new or could use existing moorings, pilings or piers). Because of the requirements of the Magnuson-Stevens Fishery Conservation and Management Act, reserve staff would be expected to seek options that would minimize or avoid potential adverse effects to EFH. Similarly, the specific details associated with future education, research, restoration and other efforts are unknown, so their potential impacts to EFH cannot be evaluated at this time. Once specific activities are proposed, they will be subject to environmental compliance reviews.

The Preferred Alternative and Alternative B would be likely to have some long-term, minor beneficial impacts on EFH because the alternatives would result in enhanced coordination and scientific knowledge associated with restoring and enhancing EFH, as well as the role and status of EFH. After projects that are to be federally authorized, funded, or undertaken are proposed (and at other appropriate times), OCM will assess potential effects to determine whether consultation with NMFS is needed and then initiate dialogue, as necessary. Information gleaned from EFH consultations with the Pacific Islands Regional Office Habitat Conservation Division will allow partners to avoid, minimize, or offset any adverse effects on EFH. (After receiving an EFH assessment, NMFS has an opportunity to offer EFH conservation recommendations, including measures to avoid, minimize, or offset any adverse impacts associated with an activity.)

Alternative A

The potential impacts on EFH under this alternative are expected to be very similar to those described under the Preferred Alternative and Alternative B, but under alternative A, they would

extend across a larger area. In short, it is difficult to assess all the indirect effects on EFH of Reserve designation and DMP approval at this time.

Alternative C
Potential effects on EFH under alternative C are expected to be quite similar to those described under the Preferred Alternative and Alternative B, but under alternative C, they would extend across a smaller area.

6.2.3.3.6 Migratory Birds

OCM analyzed potential effects of the alternatives on migratory birds. Resulting impacts to migratory birds from the range of alternatives analyzed are provided in Table 6.31.

Table 6.31 Impacts to migratory birds

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Migratory Birds	A range of human activities could have minor to moderate direct or indirect effects on foraging habitats for migratory birds, but would not be expected to cause direct migratory bird take. Restoration of some environments, such as the fishpond, could benefit any migratory birds for which the habitat is suitable.	Reserve operation could have indirect, negligible, adverse effects or negligible to minor beneficial effects on migratory birds, but would not be expected to cause migratory bird take. Potential indirect, minor benefits to migratory birds due to reserve education, monitoring, research and restoration projects that enhance their habitat. Potential negligible adverse effects from increased human use.	Same as preferred alternative, except this alternative would also include the City and County of Honolulu parcel on land and the small boat harbor. If migratory birds occur within those parcels, reserve staff would be expected to ensure that reserve activities would not result in take of migratory birds and to comply with other provisions of the Migratory Bird Treaty Act.	Same as preferred alternative, although this alternative includes a smaller land area.	Same as preferred alternative, although this alternative includes smaller land and water areas.

The Migratory Bird Treaty Act prohibits the take of migratory birds unless it is authorized by USFWS. In addition, USFWS can offer recommendations related to projects undertaken or funded by federal agencies. USFWS typically offers recommendations at the same time as it comments on Endangered Species Act Section 7 consultation letters. OCM will send out a consultation letter during the public comment period for this Draft Environmental Impact Statement and will identify any recommendations USFWS offers with respect to migratory birds in the Final Environmental Impact Statement.

No Action Alternative

Historically, development patterns, habitat alteration, and other human activities may have adversely affected the suitability of the areas along the coast of Kāneʻohe Bay for migratory birds. Most migratory birds that nest in the vicinity of Kāneʻohe Bay would probably nest on uninhabited islands, where there are fewer stressors, such as domesticated or feral animals. Certain migratory birds sometimes forage in and along Kāneʻohe Bay. OCM's research indicates that feeding within the study area would be more likely than nesting. Under the no action alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners currently represented within the Heʻeia estuary. Restoration projects, including those focused on Heʻeia Fishpond or upland forested areas, could have potential beneficial impacts to any migratory birds for which the habitat is suitable for feeding or other behaviors. Other human activities in the study area could have minor to moderate direct or indirect adverse effects to foraging habitats for migratory birds, but would not be expected to cause direct migratory bird take. Future changes to migratory bird populations or ranges could result from larger regional or global factors, such as climate change.

Preferred Alternative and Alternatives A, B, and C

Reserve operation could have negligible, indirect, adverse effects or negligible to minor beneficial effects to migratory birds, depending on how exactly the reserve operations. No new restoration or alteration of habitats suitable for migratory birds has been proposed under the Reserve DMP, beyond restoration expected under the no action alternative. (Alternative A could potentially result in restoration of the C&CH parcel, but it is unlikely that the parcel provides suitable habitat for migratory birds. The Apapane, the only forest bird listed as potentially present in the vicinity of Heʻeia, would use areas higher in elevation than the C&CH parcel.) Additional visitor use from reserve designation would not have any more than negligible adverse effects to migratory birds because the only migratory birds known to use the area forage, but do not nest, in the areas considered for inclusion within the reserve. If disturbed while they are foraging, birds could temporarily forage elsewhere until visitors leave the area. No migratory bird take would be expected to result from reserve operation, as described under the DMP. Potential impacts from future federal actions related to developing facilities for reserve staff and visitors, installing monitoring platforms or other reserve infrastructure, or otherwise addressing research needs will be analyzed once proposed to assess effects on migratory birds and ensure that they do not cause migratory bird take. Technical assistance and other support provided by the reserve and its affiliates for research, monitoring, education, and restoration projects related to migratory birds and their habitat could result in indirect, minor benefits to migratory birds, particularly if this support led to incorporating into the proposed Heʻeia NERR's operational plans additional ways to protect migratory birds.

6.3 Human Environment

6.3.1 Human and Economic Setting

6.3.1.1 Population

As described in Chapter 5, "Affected Environment," between the years of 1940-2010, the Kāneʻohe region experienced a major population increase expanding from approximately 5,000 to 54,000 individuals (Department of Business, Economic Development and Tourism 2013). Kāneʻohe residents are a little older than that of the state as a whole, with a median age of 41.8 years old with nearly 71% of residents are Hawaiʻi-born. The ethnic mix of the population is similar to that across the state as a whole.

Corresponding with the population increase, urbanization began to impact the local environment. Eight of the nine streams that drain into Kāneʻohe Bay were altered (e.g. diverted or channelized) and by 1993, 58% of the bay shoreline was modified, including sea wall construction, harbor creation, dredging, fill, or fishpond creation or maintenance, and 19 of the original 28 fishponds built by early Hawaiians were partially or completely destroyed to create more land for housing development (Hunter 1995). Resulting impacts to area population from the range of alternatives analyzed are provided in Table 6.32.

Table 6.32 Impacts to population

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Population	Negligible long-term adverse indirect impacts from traffic increases. Potential adverse environmental impacts and beneficial socioeconomic benefits from the development of residential parcels.	Negligible long-term adverse indirect impacts from traffic increases.	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

No Action Alternative

Under this alternative, ongoing and planned habitat manipulation activities by site partners such as those related the wetland agriculture, fishpond reconstruction and aquaculture, and the rehabilitation of maintenance roads and water conveyances would remain in place. In addition, wetland, forest, riparian, and coral reef restoration activities, identified in the draft management plan, are expected to be implemented as future funding is secured by those partner organizations. No direct or indirect impacts (beneficial or adverse) to the area's population are anticipated at this time from these activities. And the lands and waters of the area would continue to be protected and managed by the various site partners currently represented within the Heʻeia estuary.

Based on historical data, continued population increases in the Kāneʻohe Bay area are expected and may result in additional vehicle and boat traffic and potentially affect property

values over the long-term. The Kamehameha Highway, one of the area's major roadways, crosses through the He'eia estuary as a two lane road. Despite being a major transportation corridor, current traffic on this portion of the highway is light in comparison to other major roadways around the Kāne'ohe Bay area. Traffic volume data from 2013 showed that a larger volume of vehicular traffic moves toward the center of Kāne'ohe versus moving north toward He'eia (Hawai'i Office of Planning 2015b). The highway has the capacity to handle the added vehicle traffic generated by forecasted population increases to the area (Hawai'i Office of Planning 2015b). Any indirect impacts (beneficial or adverse) to the population of the area are anticipated to be negligible.

The 210 acre C&CH parcel, fronting the King Kamehameha Highway, is partially zoned residential (e.g., R-10) but undeveloped at this time. These lots could be developed in the future, and it is anticipated that the development would result in potential adverse environmental impacts and beneficial socioeconomic impacts.

Preferred Alternative, Alternatives B and C

Designation of a reserve under the preferred alternative boundary could potentially result in negligible adverse impacts to the population surrounding the proposed reserve. As outlined in the proposed He'eia Reserve's draft management plan (Appendix A), specific estuarine research, education and stewardship activities, including technical and planning assistance, are expected to occur within the preferred alternative boundary in the years subsequent to designation. In addition to the previously identified habitat manipulation and restoration activities conducted by site partners under the no action alternative, none of the programs or additional activities identified are expected to result in significant effects on the area population.

Similar to the no action alternative, vehicle and boat traffic within the boundaries is expected to increase based on anticipated area population increases. Additional traffic increases are anticipated as a result of adults and school groups participating in reserve education and outreach programming. However, neither is expected to result in additional traffic or boat congestion as Kamehameha Highway has the capacity to handle the anticipated added vehicle traffic as do the identified boat launch areas. As a result, no direct or indirect impacts (beneficial or adverse) to the area's population are expected.

6.3.1.2 Employment

As described in Chapter 5, "Affected Environment," the largest employer on the windward side of O'ahu is MCBH. In 2012, MCBH's more than 14,000 military and civilian personnel generated more than 2,280 jobs in local communities that surround the base. In all, base personnel generated an estimated $1.1 billion in economic output retained within the neighboring communities (Marstel-Day 2014).

Another important employer in Kāne'ohe Bay is the HIMB. Known as a world-renowned marine biology research institute, HIMB serves as an education center for undergraduate and graduate students from the University of Hawai'i, as well as other institutions. The facility also hosts

approximately 4,000 primary and secondary students through field trips each year(HIMB 2016). Other major industries in the Kāneʻohe area include retail, educational services, and public administration (Hawaiʻi Office of Planning 2016). The area's unemployment rate is 5.8%, which is 22% lower than the state-wide rate. Resulting impacts to area employment from the range of alternatives analyzed are provided in Table 6.33.

Table 6.33 Impacts to employment

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Employment	No direct or indirect impacts	Minor beneficial impact from the hiring of reserve staff to support the implementation of reserve programs and activities. Long,-term, negligible, direct beneficial impacts form new employment opportunities in fields dependent on well-functioning ecosystems.	Same as the preferred alternative	Same as the preferred alternative	Same as the preferred alternative

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners currently represented within the Heʻeia estuary. No direct or indirect impacts (beneficial or adverse) to employment in the area are expected. Future changes to area employment could occur as a result of changes in the size and activities of the area's largest employers (e.g., MCBH and HIMB) or other factors that are independent of the local employment conditions.

Preferred Alternative, Alternatives A, B and C

Designation of a reserve under the preferred alternative boundary and implementation of the proposed Heʻeia National Estuarine Resarch Reserve Draft Management Plan is expected to have minor long-term beneficial impacts to employment in the Kāneʻohe area. The initial hiring of up to five reserve staff to implement the programs and activities described in the draft management plan is expected to be the most direct impact to employment.

In the long-term, the reserve's activities to help address current watershed, water quality, habitat, and other local coastal management issues, as well as, facilitating a better understanding of traditional Hawaiian land use management and stewardship practices could lead to new employment opportunities in natural resources (i.e., fishing and agriculture), ecotourism, and other fields dependent on a well-functioning estuarine ecosystem. Overall these beneficial impacts to the employment of the Kāneʻohe area are expect to be negligible and indirect over the long-term.

6.3.1.3 Ocean Economy

As described in Chapter 5, "Affected Environment," the National Ocean Watch (ENOW) analysis revealed that three of the six ocean-dependent economic sectors, are represented in the Kāneʻohe area (i.e., marine transportation, ship and boat building, and tourism and recreation). Within these three sectors, nine ocean industries ranging from *Ship Building and Repair* to *Scenic Water Tours* were reported to the U.S. Census totaling 109 businesses employing 1,886 people. "*Eating and Drinking*" places accounts for over 80 percent of the reported establishments and employment. Resulting impacts to the ocean economy from the range of alternatives analyzed are provided in Table 6.34.

Table 6.34 Impacts to the ocean economy

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Ocean Economy	No direct or indirect impacts	Negligible, indirect, beneficial impacts over the long-term from increased patronage to specific ocean economy-related industries.	Negligible, indirect, beneficial impacts from increased visitors and associated commerce at the harbor. Long-term, adverse, indirect impacts from increased vehicle and vessel congestion at the harbor.	Same as the preferred alternative	Same as the preferred alternative

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners currently represented within the Heʻeia estuary. No direct or indirect impacts (beneficial or adverse) on the ocean economy of the area are expected. Any potential future changes to the ocean economy are expected to be the result of larger regional and global factors or other changes to local economic conditions.

Preferred Alternative, Alternatives B and C

Under the preferred alternative, designation of the proposed proposed Heʻeia NERR is anticipated to have negligible, indirect, beneficial impacts over the long-term. As the research reserve programs mature, and the site evolves (e.g. construction of new facilities), it is anticipated that additional visitors (e.g., researchers, students, interested members of the public, etc.) will come to the site and patronize business establishments within the vicinity of the research reserve. The dominant ocean economy industries (as defined by ENOW) likely to be positively affected by the influx of visitors include "*Eating and Drinking Places,*" "*Scenic Water Tours,*" and "*Amusement and Recreational Services.*"

Alternative A

The Heʻeia Kea Small Boat Harbor is the primary access point for a majority of the recreational and commercial activities that occur within Kāneʻohe Bay. Under alternative A, inclusion of the harbor within the reserve boundaries would expand access to the Bay for reserve activities and

could be expected to potentially have some negligible, indirect, beneficial impacts over the long-term. The proposed He‘eia NERR would likely leverage the harbor as a gathering place for Reserve-based programs and as a key area for education and outreach efforts (e.g., installing relevant signage). This could attract additional visitors to the harbor and as a result, establishments such as the restaurant in the harbor could receive additional business. Although negligible, this would positively affect the ocean economy of the affected environment.

It is anticipated that increased visitor use to the reserve under alternative A could result in long-term, indirect, minor adverse impacts from increased vessel and vehicle congestion in and around the harbor. With the inclusion of the harbor as a primary access point in the reserve, the development and implementation of marine-oriented research and education programs associated with the reserve would add additional users to the harbor and within the neighboring waters. However it is anticipated that reserve staff and site partners are expected to conduct their programs in a manner which attempts to minimize any potential adverse impacts from the additional vehicle and boat traffic to commercial and recreational users of the harbor.

6.3.2 Cultural and Historic Setting

6.3.2.1 Cultural History and Land Uses

As described in Chapter 5, “Affected Environment,” the He‘eia area has historically had a robust and flourishing agricultural and aquacultural community. He‘eia also has a strong cultural legacy. Starting in the early 1900s, land-use related impacts resulting from activities like dredging, sedimentation, and sewage discharge had profound effects on Kāne‘ohe Bay’s marine environment. Resulting impacts to the cultural history and land use of the area from the range of alternatives analyzed are provided in Table 6.35.

Table 6.35 Impacts to cultural history and land use

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Cultural History and Land Use	Long-term, direct, moderate beneficial impacts from the rehabilitation of historic agricultural and aquacultural practices by site partners.	Minor long-term benefit of improved baseline information on archaeological, historic, and cultural resources.	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

No Action Alternative

Under this alternative, activities proposed under the proposed He‘eia NERR’s DMP related to wetland agriculture, fishpond reconstruction and aquaculture, and the rehabilitation of maintenance roads and water conveyances that are already underway and planned by local partner organizations would remain in place. Implementation of these activities is anticipated to convert the existing land uses (i.e., fallow lands overrun with invasive flora species) within the estuary back to a traditional Hawaiian land management system that is firmly linked to the

cultural history of the area. According to plans from the site partners, it is expected that these activities would continue following the historic land use footprint of taro patches and the fishpond. Reestablishing these traditional Hawaiian practices will result in direct, moderate, beneficial impacts to the historic land use over the long-term.

Preferred Alternative, Alternatives B and C
Under the preferred alternative, reserve research and monitoring, education, and outreach programmatic efforts are expected to have beneficial, long-term minor indirect impacts to the cultural history and land use of the He‘eia estuary. As described below, Reserve-supported activities are anticipated to have positive benefits on the existing efforts of site partners to restore culturally significant traditional Hawaiian agricultural (e.g., taro patches) and aquaculture (e.g., fishpond) practices to the site.

Reserve-supported research and monitoring activities are expected to create a baseline of archaeological, historic, and cultural resource information for the estuary. It is expected that this effort could result in minor beneficial indirect impacts to the cultural history and land use of the area through improved documentation about the area that can inform the future placement of reserve infrastructure or by influencing the location and extent of reserve and partner activities within the estuary over time, thereby minimizing any potential adverse impacts.

In addition, implementation of the preferred alternative is expected to lead to a fuller appreciation by a wider audience of the cultural history and land use resources and their collective contribution to the history of He‘eia. As such, minor beneficial impacts to the cultural history and land uses in the area are expected as the heightened public awareness has the potential to translate to greater public support for these aspects of the human environment in He’eia.

Alternative A
In addition to the impacts described in the preferred alternative and the no action alternative, the inclusion of the C&CH parcel (i.e., He‘eia Kea Valley) to the north and the He‘eia Kea Small Boat Harbor could potentially yield some beneficial impacts to the cultural history and land use of the area. He‘eia Kea Valley is thought to have close spiritual ties to the neighboring Kealohi Point (currently He‘eia State Park), the He‘eia Fishpond, and the wetlands along the lower reaches of He‘eia Stream. Collectively, these geographic landmarks play a major role in the myths and legends for the ahupua‘a of He‘eia. Inclusion of this area within a reserve could enable greater education and outreach opportunities, through the proposed He‘eia NERR, to explore the cultural significance of this portion of the estuary. If He‘eia Kea Valley were incorporated into a designated reserve, additional studies would be needed to determine the magnitude of the potentially beneficial impact this area could offer in bolstering community understanding of the cultural history and land use resources of the area.

6.3.2.2 Historic Agriculture

There are no impacts to historic agricultural practices. The environmental consequences relating to implementing contemporary interpretations of historic or traditional agricultural practices will be discussed in subchapter 6.3.3.1 Agriculture.

6.3.2.3 Historic Aquaculture

There are no impacts to historic aquaculture practices. The environmental consequences relating to implementing contemporary interpretations of historic or traditional aquaculture practices will be discussed in subchapter 6.3.3.2 Aquaculture.

6.3.2.4 Cultural Resources

As described in Chapter 5, "Affected Environment," cultural resources found in the He'eia area range from tangible historic structures (*e.g.,* He'eia Fishpond) and other historic sites (*e.g.*, bridge, distillery, roads, etc.) to the intangible rich cultural legends (mo'olelo) which pervade the natural environment. Several significant cultural sites have been documented in the area including the He'eia Fishpond, Kaualaukī Heiau, Keaholi Point, and the dwelling place of Meheanu at Luamo'o. The He'eia Fishpond, listed on the National Register of Historic Places (50-80-10-0327), is the most visible historic structure in the estuary. Given the number of cultural resources found in the area, resulting impacts to these resources from the range of alternatives analyzed are provided in Table 6.36.

Table 6.36 Impacts to cultural resource

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Cultural Resources	Direct, moderate long-term beneficial impacts of rehabilitated taro patches and the fishpond to support traditional Hawaiian practices. And improved long-term community connections to the traditional cultural knowledge and minor long-term beneficial impacts of forest restoration that supports plant species valued for their cultural significance. Minor indirect beneficial impacts from partner educational programs. Potential negligible adverse impacts from inadvertent disturbance of archaeologic resources.	Long-term, indirect, beneficial impacts from reserve staff-directed coordination and technical assistance. Potential long-term minor adverse visitor use impacts are mitigated.	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

No Action Alternative
Under the no action alternative, there would be no changes to the local partners' existing or planned activities and the areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners.

In the upland areas, Kākoʻo ʻŌiwi is supporting manipulative activities to restore Heʻeia's traditional agricultural landscape (i.e., taro fields). Part of this includes rehabilitating the historical agricultural roads and water conveyance channels that support the agricultural landscape. Currently, this historical and culturally significant resource is in poor condition. Rebuilding the taro patches and supporting infrastructure to its historical footprint are anticipated to have no adverse impacts on the cultural resources. Any potential adverse impacts to these cultural resources, from the implementation of these activities, are expected to be mitigated using best management practices identified through consultations with the State Historic Preservation Division and the Office of Hawaiian Affairs prior to commencing.

As Kākoʻo ʻŌiwi implements these different efforts, its activities are expected to have moderate long-term direct beneficial impacts to the cultural resources of the area by restoring the traditional agricultural landscape of the area, and strengthening community connections to the traditional cultural knowledge of the Heʻeia estuary.

Additional beneficial impacts are expected to be derived from the restoration of the upland forest areas. For example, within the upland forest areas that are restored, many of the restored plant species are valued for their cultural significance (e.g. traditional use of certain native tree species for making houses, canoes, tools, etc., or various plants and herbs gathered for medicinal and ceremonial purpose). As a result, the upland restoration effort is expected to provide minor beneficial impacts by retaining and improving the inventory of cultural relevant plant species in the estuary.

Site partner, Paepae o Heʻeia, is currently rehabilitating and maintaining the historic fishpond wall as part of a larger restoration of the Heʻeia Fishpond and traditional Hawaiian aquaculture. This restoration effort is anticipated to result in direct, moderate, beneficial impacts to the traditional Hawaiian practice.

The fishpond wall rehabilitation entails Paepae o Heʻeia removing invasive mangrove vegetation and manually rebuilding compromised sections using a traditional Hawaiian dry-stacking method that uses no mortar to keep the wall upright and intact. This allows the pond to maintain a base water level even at the lowest tides. And, according to Paepae o Heʻeia's USACE Section 404 permit, BMPs, such as, the hand removal of mangroves and use of traditional Hawaiian dry-stacking are designed to avoid or minimize any short-term adverse impacts to this historic and cultural resource (USACE 2012a). Based on surveys conducted in 2012, no other historically significant cultural materials were observed in or near the immediate vicinity of this rehabilitation effort. As a result, a determination by the USACE noted that the rebuilding of the fishpond wall and associated maintenance activities will not adversely impact the historical,

structural, or cultural integrity of the historic fishpond (USACE 2012a). Additionally, the rehabilitation of the historic fishpond wall is anticipated to support minor beneficial impacts to Paepae o He‘eia’s educational and cultural outreach programming that support traditional cultural knowledge about the fishpond.

Combined these pre-existing and planned partner-led manipulation and restoration activities are expected to potentially have direct, moderate long-term beneficial impacts to the cultural resources of the area. There is a possibility that partner-led activities could potentially adversely impact cultural and archaeological resources found within the affected environment by inadvertent disturbance. However based on fact that site partners described above are sensitive to the significance of resources, and the fact that appropriate consultations with relevant state agencies, anticipated adverse impacts ate expected to be negligible.

Preferred Alternative, Alternative A, B and C
Implementation of the preferred alternative is expected to bring new coordination and technical assistance support to site partners and their various manipulation and restoration efforts. The added reserve support to these activities could provide some additional long-term, indirect, beneficial impacts to the cultural resources of the area. An example might include providing new opportunities for people to learn about, reconnect with, and care for the historical and cultural resources that occur within the preferred alternative boundaries. It is also anticipated that reserve staff could highlight cultural connections to specific plants (e.g., Taro or Koa trees) or animals (e.g., mullet) as they develop relevant education and outreach programs.

Under the preferred alternative there could be potentially adverse impacts to archaeological, historic, and cultural resources from visitor use. As reserve and partner-led activities are implemented, increased human presence and activity has the potential to damage or otherwise diminish these resources. These potential impacts would be expected to be minor. The restoration of cultural resources (i.e., taro fields and fishpond) within the estuary is a priority for both site partners and the reserve. As a result, reserve staff, site partners, and scientists are expected to conduct their activities in such a way that minimize disturbances and protect the integrity of these and other archaeological and cultural resources. As described in the draft management plan, public access to the reserve will be determined by, and be compatible with, the public access policy of each of the agencies and site partners that have title to or management responsibility for the lands (i.e., HIMB, DLNR, Kākoʻo ʻŌiwi and Paepae o He‘eia). This is intended to protect potentially vulnerable archaeological and cultural assets within the preferred alternative. Despite a probable increase in visitor use, it is anticipated that site partners and reserve staff will work together to protect and minimize any potential adverse impacts to the archaeological, historic, or cultural resources of the affected environment. Overall, impacts that result from visitor use are anticipated to be mitigated by managing public access in coordination with site partners.

6.3.2.5 Maritime Heritage Resources

As described in Chapter 5, “Affected Environment,” Hawai‘i’s maritime resources generally fall into three broad categories relating to traditional aquaculture production (e.g. fishponds), plantation and ranching-era artifacts, and military (Van Tilburg 2014). Within the area proposed for NERR designation, the maritime heritage resources are predominately military related with the exceptions being the historic fishponds also in the vicinity (He‘eia Fishpond, O‘ohope Fishpond and two smaller unnamed fishponds) (Fa‘anunu et al. 2009). Resulting impacts to these maritime heritage resources found of the area from the range of alternatives analyzed are provided in Table 6.37.

Table 6.37 Impacts to maritime heritage

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Maritime Heritage	Moderate, direct, beneficial impacts from the restoration of He‘eia Fishpond.	Same as no action alternative.	Same as no action alternative.	Same as no action alternative.	Same as no action alternative.

No Action Alternative
Under this alternative, the various areas proposed for inclusion in a proposed He‘eia NERR would continue to be protected and managed by the various site partners currently represented within the He‘eia estuary. There will mostly be no direct impacts (beneficial or adverse) on maritime heritage resources in the area are expected. However, He‘eia Fishpond is the exception. The restoration and rehabilitation of the fishpond is expected to provide moderate, direct, beneficial impacts to this specific maritime heritage resource over the long-term.

Preferred Alternative, Alternatives A, B and C
None of the alternatives analyzed are expected to result in any additional direct impacts (beneficial or adverse) to the maritime heritage resources of the area.

6.3.3 Human Uses

6.3.3.1 Agriculture
As described in Chapter 5, “Affected Environment,” the affected area has a rich agricultural history and this history had a large influence of the socioeconomic dynamics of the associated communities. Expected resulting impacts to the historical agriculture of the area from the range of alternatives analyzed are provided in Table 6.38.

Table 6.38 Impacts to agriculture

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Agriculture	Reestablishing historic agricultural practices and related	Minor, indirect, long-term beneficial impacts from	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

	infrastructure. Long-term, direct, major, beneficial impacts from rehabilitation of the loʻi kalo.	research reserve programs.			

No Action Alternative

Under the no action alternative, there would be no changes to the local partners' existing or planned activities and areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. Kākoʻo ʻŌiwi, through its Māhuahua ʻAi o Hoi project (see draft management plan, Section 6.3.1), plans to establish a land management program to return the wetlands of Heʻeia to productive agricultural, cultural, and educational use. In cooperation with the Natural Resources Conservation Service, the group has developed a detailed conservation plan, the implementation of which is in progress.

This work includes rehabilitating wetlands to loʻi kalo (taro patches). Supporting this traditional agricultural landscape, Kākoʻo ʻŌiwi is also rehabilitating historical agricultural roads, and water conveyance channels. These activities have received a Section 404 permit from the USACE and a State of Hawaiʻi Conservation District Use Permit (CDUP) that require that these activities to avoid or minimize impacts to water quality and local hydrology. Historic kuāuna (taro patch walls) have been identified by a certified archaeologist as part of an archaeological inventory survey and will be restored to the extent possible. New kuāuna will be constructed to replace kuāuna from earlier times that are no longer present. Kuāuna will be built by excavating soil from within the loʻi kalo and using this soil to create the kuāuna. The loʻi kalo will be used to grow different varieties of taro and will also serve as habitat for native birds.

Presently, approximately 1 acres of the freshwater wetlands within the Heʻeia HCDA parcel have been converted to loʻi kalo. Kākoʻo ʻŌiwi ultimately plans to convert 176 acres into a working agricultural landscape, much of this land is overgrown with invasive species (e.g., California grass), and offers limited ecological benefits. In addition to the loʻi kalo, Kākoʻo ʻŌiwi plans to continue practicing organic agriculture of additional crops in a relatively small area (approximately several acres) adjacent to the loʻi kalo. Also proposed is potentially restoring a historic poi mill, which would occur only after any consultations required under the state law.

Under the no action alternative, the primary impacts to agriculture are expected to be direct, long-term, major, and beneficial. Kākoʻo ʻŌiwi's rehabilitation effort seeks to recreate a traditional Hawaiian practice and promote Heʻeia's agricultural legacy. Kākoʻo ʻŌiwi is also inspired by the vision to integrate traditional ahupuaʻa land management practices with contemporary scientific research and knowledge, and ultimately raise awareness of stewardship principles embedded within traditional Hawaiian practices.

Preferred Alternative, Alternatives A, B and C

Designation of a reserve under the preferred alternative boundary and implementation of the proposed Heʻeia Reserve's draft management plan is expected to have minor, indirect, long-term, beneficial impacts to historic agriculture. As detailed in the DMP, it is anticipated that

reserve staff would potentially provide technical assistance, environmental monitoring and/or planning support, which would tie directly to the proposed reserve's ecosystem-based management research activities.

The reserve's research will evaluate two different "ecosystem-based" management approaches – one of which "embraces traditional Native Hawaiian management practices" – and evaluate the various ecosystem services provided by each management approach. It is anticipated that historic agriculture will be a fundamental component of the proposed He'eia NERR's research as well as other programs such as education and outreach. At a minimum, it is anticipated that the proposed He'eia NERR's programs will highlight He'eia's historic agricultural legacy (e.g., through education and outreach programs) and investigate the ecosystem benefits that result from the modern-day interpretation of this historic practice. The implementation of the preferred alternative is expected to result in minor, indirect, beneficial impacts to historic agriculture over the long-term. Anticipated beneficial impacts include increased awareness of the role historic agriculture played in shaping the social fabric of the study area and promoting its relevance to current natural resource management practices.

6.3.3.2 Aquaculture

As described in Chapter 5, "Affected Environment," there are two historic aquacultural practices that existed within the estuarine portion of the study area: loko i'a kalo and the fishpond. The expected resulting impacts to aquaculture of the area from the range of alternatives analyzed are provided in Table 6.39.

Table 6.39 Impacts to aquaculture

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Aquaculture	Reestablishing historic aquaculture practices. Long-term, direct, major, beneficial impacts from rehabilitation of the loko i'a kalo and fishpond.	Minor, indirect, long-term beneficial impacts from research reserve programs.	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

No Action Alternative

Under the no action alternative, there would be no changes to the local partners' existing or planned activities and areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. Kāko'o 'Ōiwi plans to implement a historic loko i'a kalo, a traditional combined taro patch and fishpond.

In addition, Paepae o He'eia, has a long-term lease with Kamehameha Schools to restore He'eia Fishpond and practice traditional Hawaiian aquaculture. As part of its ongoing efforts, Paepae o He'eia is focused on four main activities:

1. Removal of introduced and invasive red mangrove that is currently threatening the fishpond wall's structural integrity;
2. Rehabilitation of the fishpond wall which allows the organization to operate a functioning traditional Hawaiian aquaculture site;
3. Invasive seaweed removal within the fishpond;
4. In the future, as the other activities progress, Paepae o He'eia will continue to support on-site aquaculture operations to produce a variety of local finfish and mollusks (i.e., Pacific Threadfin, Striped or Grey Mullet, Pacific and Hawaiian Oysters). Currently, some aquaculture products are produced by the pond as part of community economic development efforts focused on food security.

Under the no action alternative, the primary impacts to aquaculture are expected to be direct, long-term, major, and beneficial in nature. Through implementation of these historic aquaculture practices, Kāko'o 'Ōiwi and Paepae o He'eia are restoring a traditional aquaculture practice of cultural significance and creating an opportunity to raise awareness of the role historic aquaculture played in shaping the social fabric of He'eia, and promoting its relevance to current natural resource management practices.

Preferred Alternative, Alternative A, B and C
Designation of a reserve under the preferred alternative boundary and implementation of the proposed He'eia NERR's DMP is expected to have minor, indirect, long-term beneficial impacts to aquaculture in the affected area. As detailed in the DMP, it is anticipated that reserve staff would potentially provide technical assistance, environmental monitoring and/or planning support, which would tie directly to the proposed reserve's ecosystem-based management research activities.

As the reserve staff work with site partners to implement the restoration activities and rehabilitation of traditional Hawaiian practices such as lo'i kalo, upstream of the fishpond, it is anticipated that water quality within He'eia stream will improve. This could result in minor, indirect, long-term beneficial impacts to aquaculture, as the fish stock would likely have a positive response to the water quality improvement.

6.3.3.3 Fishing
As described in Chapter 5, "Affected Environment," effective management of fishing activities has played a central role in conservation of marine resources within Kāne'ohe Bay and the larger Hawaiian Islands. Overfishing has been a longtime concern in the bay, even in ancient times (Bahr et al. 2015). Hawaiian fishponds are an example of management strategy used to address this issue and increase fish production. Over the past 200 years, contemporary fisheries management approaches have gradually replaced the traditional Hawaiian management system (Bahr et al. 2015).

Today, there are commercial, recreational and subsistence fisheries found within Kāne'ohe Bay with yellowfin tuna and dolphinfish (Mahi Mahi) listed as the top two species harvested in the

bay (Bahr et al. 2015). As recently as 2014, landings of fish and invertebrate species for Kāneʻohe Bay were 168,549 lbs. out of a total of 29,391,287 lbs. for the entire island of Oʻahu. Data from 2010 to 2014 indicate that the fisheries landings fluctuate from year to year. Historical trends in landings and more recent catch per unit effort data suggest that the bay's fisheries may be overfished (Bahr et al. 2015). Resulting impacts to the fishing resources from the range of alternatives analyzed are provided in Table 6.40.

Table 6.40 Impacts to fishing resources

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Fishing	Indirect long-term minor adverse impacts of ongoing sediment or nutrient inputs that reduce potential harvests. Minor indirect beneficial impacts of increased fish population that use restored coral reefs.	Indirect moderate beneficial impacts as improved fisheries data informs resource management	Same as preferred alternative and negligible adverse impacts from congestion at the small boat harbor.	Same as preferred alternative	Same as preferred alternative.

No Action Alternative

Marine areas within Kāneʻohe Bay are expected to continue being protected and managed by the DLNR, Division of Aquatic Resources (DAR). Despite the extensive alterations to Kāneʻohe Bay between 1960 and 1993, the calm waters and diverse marine ecosystems of the bay support important commercial, subsistence, and recreational fishing activities, such as tuna and dolphinfish (Bahr et al. 2015).

Current fisheries landing data from 2010-2014 shows fluctuating annual catches (Division of Aquatic Resources 2014b). As a result, future changes to the fisheries cannot be predicted with confidence; however, indirect long-term minor adverse impacts (i.e., reduced catches) could possibly occur due to continued environmental impacts that affect local marine habitat conditions. This could potentially include ongoing sediment or nutrient inputs to the bay or more undefined impacts as a result of larger regional and global factors. Regardless, under the no action alternative, historical trends in landings and catch per unit effort indicate the bay's fisheries as overfished (Bahr et al. 2015).

Within the marine area, DAR is implementing a coral reef restoration project and is proposing a coral reef mitigation bank. Since 2007, DAR has been restoring the patch reefs of Kāneʻohe Bay by mechanically removing invasive algae and releasing native sea urchins for long-term biocontrol of the remaining algae. This restoration effort is expected to have an overall beneficial on the health of targeted marine patch reefs. It is expected that some long-term minor benefits to fishing would also be an outcome for increased populations of harvested species that use the patch reefs during their life cycle. The coral reef mitigation bank is anticipated to build upon DAR's existing restoration efforts (USACE 2014).

Preferred Alternative, Alternatives B and C

Designation of the preferred alternative is expected to result in beneficial indirect long-term impacts to the management of local fisheries by DAR as more information is learned about the local fishery resources from reserve activities and informed resource management decisions are made. The proposed He‘eia Reserve’s various research, monitoring, education, and outreach capabilities are expected to have beneficial indirect impacts to local fisheries through the support these activities would provide DAR in its fishery management. Specifically, future reserve research and monitoring activities are expected to provide more baseline data on the variability and spatial distribution of nekton communities (NOAA 2005). Also, reserve led education and outreach activities may increase public support for more active fisheries and habitat conservation efforts by local communities and reserve partners.

Once the reserve’s monitoring efforts are fully operational, biophysical data captured by the reserve would be expected to be used to track changes to fisheries over time documenting the impacts of the various restoration and manipulation activities to key ecosystem services that are linked to commercial and recreational fishing. Ultimately, this information is expected to enable improved management decisions that could result in increasingly sustainable fish stocks having beneficial impacts to the different fishing interests within Kāne‘ohe Bay. As a result, it is expected that the preferred alternative will result in long-term moderate indirect beneficial impacts on the socioeconomic fishing resources of the affected area.

Notwithstanding these potential benefits, it is also possible that reserve research and monitoring activities may result in changing fisheries management decisions that could lead to minor adverse impacts on commercial and recreational fishers as data is used by DAR to adaptively manage local fisheries. For example, if research conducted by the reserve indicates an otherwise unknown decline in a socioeconomically relevant fish species in Kāne‘ohe Bay, DAR or other regulatory agencies could use that information in a management decision to limit allowable catches for that species. Given the potential for both beneficial and adverse impacts that could result from the information generated by the proposed He‘eia Reserve, and the uncertainties associated with whether and to what extent these potential effects would occur, the adverse impact of this proposed action on the fishing industry is difficult to quantify, but is generally not expected to be significant.

Alternative A

As a primary access point to Kāne‘ohe Bay, the He‘eia Kea Small Boat Harbor is a major source of the marine activities that occur within the Bay. These activities include commercial, subsistence, and recreational fishing, as well as other recreational activities such as sailing, personal watercraft, paddle boarding, and snorkeling. As part of alternative A, the boat harbor would be expected to play a greater role in support of future research and educational activities within the marine area of the proposed reserve, such as, coral reef restoration. Reserve-related use of the boat harbor would be expected to have negligible long-term adverse impacts to fishing. Future congestion in the harbor could be a minor issue, especially if marine-oriented research and education programs have significant boat use components. However, reserve staff and site partners would be expected to coordinate activities at the boat harbor in a manner

which minimizes any adverse impacts to commercial and recreational users of the affected environment.

6.3.3.4 Tourism and Recreation

As described in Chapter 5, “Affected Environment,” tourism and recreation activities have been a key sector of the Hawai‘i’s economy since statehood in 1959 and are a primary source of revenue and jobs. This sector is the main generator of employment in the state and accounts for 22.3% of all Hawai‘i jobs (Hawai‘i Tourism Authority 2006).

Kāne‘ohe Bay supports a variety of tourism and recreational activities that include snorkeling, swimming, kayaking, stand-up paddle boarding, outrigger canoe sailing, catamaran sailing, and guided kayak and snorkeling tours organized through several ecotour operators in the area. However, specific information on tourism and recreation activities for Kāne‘ohe Bay is limited. Expected resulting impacts to the area tourism and recreation from the range of alternatives analyzed are provided in Table 6.41.

Table 6.41 Impacts to tourism and recreation

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Tourism and Recreation	No direct or indirect impacts are identified	Minor to moderate beneficial impact from ecotourism operations connected to the reserve programs. Long-term, minor, indirect beneficial impacts from improved environmental conditions. Long-term, minor adverse impacts from increased visitor use and traffic.	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

No Action Alternative

Under this alternative, area land and waters would continue to be protected and managed by the various site partners currently represented within the He‘eia estuary. The He‘eia Kea Small Boat Harbor is the primary access point for a majority of the tourist and recreation activities that occur within Kāne‘ohe Bay. With limited available information for the Kāne‘ohe Bay specifically, no direct or indirect impacts (beneficial or adverse) on tourism and recreation within the area are expected. Future changes to tourism and recreation would be expected to be the result of targeted island-wide or state-wide efforts to boost tourism related activities within Kāne‘ohe Bay and its surroundings.

Preferred Alternative, Alternatives A, B and C

Under the preferred alternative, the lands and waters of the He‘eia estuary would continue to be protected and managed by the various site partners for specific conservation or manipulation purposes. As a site within a larger national network of Estuarine Research Reserves, knowledge of the He‘eia estuary and Kāne‘ohe Bay are expected to increase at the national level. As a result, greater visibility of the reserve could potentially provide beneficial long-term impacts to tourism and recreation as new ecotourism opportunities become available (Up a Creek Kayak Tours, Inc. 2015). Over time, the beneficial impact to local tourism and recreation, especially ecotourism, could be minor to moderate.

Reserve programs will support partner-led restoration and manipulation activities within the preferred alternative boundary. By providing technical assistance and coordination to site partners, it is anticipated that reserve programs could have indirect, beneficial impacts to tourism and recreation over the long-term. As described in the draft management plan, the restoration and manipulation activities are intended to improve the overall ecological value and functionality of habitats found within the preferred alternative. With this long-term goal, it is expected that as environmental conditions improve, and this could have long-term, minor, indirect, beneficial impacts to recreation and tourism (e.g., increased interest in snorkeling and exploring coral reefs within the preferred alternative boundary).

Notwithstanding this potential long-term benefit, vehicle and boat traffic within the boundaries is expected to increase as tourism and recreational opportunities associated with the reserve become known. Additional traffic increases are anticipated primarily as a result of adults and school groups participating in reserve education and outreach programming. This increase in traffic could detract from the overall tourism experience in the area. However, Kamehameha Highway has the capacity to handle the anticipated added vehicle traffic as do the identified boat launch areas. Also, reserve staff and site partners would be expected to coordinate activities at the harbor in a manner which minimizes any adverse impacts to commercial and recreational users of the affected environment. As a result, traffic-related adverse impacts to the area’s tourisms and recreational sector are expected to be minor over the long-term.

6.3.3.5 Education

As described in Chapter 5, “Affected Environment,” there are existing education and community programs offered by HIMB and community partners, which include formal classroom instruction for students, programs for school groups and community groups, and community engagement through “workdays” whereby participants learn the ecological and cultural foundations of the natural environment as well and the traditional agriculture and aquaculture practices of Hawai‘i. Expected resulting impacts to education in the Kāne‘ohe Bay area from the range of alternatives analyzed are provided in Table 6.42.

Table 6.42 Impacts to education

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Education	Major direct beneficial impacts	Long-term, direct moderate beneficial	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

	to area educational resources from partner-led educational programs and field-based experiences	impacts from the development of new educational programs.			

No Action Alternative

Under the no action alternative, there would be no changes to the local partners' existing or planned activities and areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. Similarly, local partners' ongoing education and outreach efforts within the study area would persist.

HIMB's education efforts are expected to continue to target university students, individuals, families, and both K-12 school and community groups. For university students, the Edwin W. Pauley Summer Program in Marine Biology, a graduate-level research and training program, is expected to continue. As part of the program, HIMB faculty and researchers give seminars and instruct students in field and laboratory techniques that take advantage of the HIMB campus and the surrounding marine environment.

At the high school level, students are expected to continue participating in the hands-on scientific inquiry based curriculum developed by HIMB staff at the Marine Science Research Learning Center on Moku o Loʻe. HIMB also offers innovative summer training courses, research internships, and pre- and in-service teacher workshops.

Hands-on educational programs to individuals, families, upper elementary and middle school classes and community groups are anticipated to continue to be offered by the HIMB Community Education Program. These programs include a walking tour of Moku o Loʻe that includes a guided discovery of the island's natural and human history; a family Sunday tour of the HIMB campus; expedition to Moku o Loʻe where participants become part of a marine biology research team on the water and in the lab; and their marine science overnight where participants set up a marine biology field camp (HIMB 2016).

The site partners are also expected to continue their existing educational programs. Paepae o Heʻeia has the most extensive extensive educational programming where participants learn about mālama loko iʻa, place-based knowledge and ecological-based studies that foster values and concepts of traditional fishpond management.

Paepae o Heʻeia is expected to continue its partnership with Hawaiian-based charter schools through a program that allows students visiting the Heʻeia Fishpond to utilize it as an outdoor classroom where they can examine the ecological life and surrounding environs of Heʻeia Fishpond. Other partners including Kākoʻo ʻŌiwi and Kamaʻāina Kids have a variety of educational programming for students and the local community.

These current education and outreach efforts have major beneficial impacts to education in the area by providing world class hands-on field experiences connected to science-based inquire and place-based cultural knowledge. The ongoing educational programs provided by the site partners are expected to continue to have major beneficial impacts to the educational resources of the area.

Preferred Alternative, Alternatives A, B and C
As described in the DMP, with implementation of the preferred alternative, the proposed He'eia NERR would strive to achieve a number of goals and objectives in the first five years of operation. The DMP identifies three main goals for the site, one of which relates to education, and is stated as follows:

Develop a place-based education and training program for the He'eia NERR that inspires and educates the community about estuaries, coastal ecosystems, and traditional Hawaiian practices

To achieve this goal, the plan identifies two main objectives: increase student, educator, and community understanding of estuaries; and provide a framework to integrate and enhance coordination and effectiveness of place-based education and training progams. With the existence of several independently organized educational programs in the area, the reserve would be expected to help the partners collaborate on and integrate their educational programs. In the long-term, it is expected that the reserve would build upon the existing resources, expertise, and facilities to create comprehensive educational program that spans the learning continuum and allows students to explore resource management and science research (Hawai'i Office of Planning 2016). Additionally, the reserve is expected to develop and implement the NERRS national educational programs such as K-12 Estuary Education Program (KEEP), Teachers on the Estuary (TOTE) program. These additional educational efforts are expected to have moderate beneficial long-term direct impacts to educational resources through the development of new programs, reductions in program duplication across partners and improved efficiencies through collaboration and coordination.

6.3.3.6 Research and Monitoring
As described in Chapter 5, "Affected Environment," the University of Hawai'i's HIMB is the leading entity coordinating and conducting research and monitoring activities in Kāne'ohe Bay. Resulting impacts to the research and monitoring activities in the area from the range of alternatives analyzed are provided in Table 6.43.

Table 6.43 Impacts to research and monitoring

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Research and Monitoring	Sustained research interest in the effected	Major, direct, beneficial impacts over the long-term resulting from	Same as preferred alternative. In addition potential long-term, direct,	Same as preferred alternative, only over a smaller area.	Same as preferred alternative, only over a smaller area.

	environment and associated habitats.	increased coordination of research efforts, production and analysis of baseline trends, and synthesis of research to inform resource natural resource management decisions.	beneficial, negligible impacts resulting from increased access to marine habitats (via the harbor), and long-term negligible adverse impacts resulting from increased visitor use.		

No Action Alternative

Under the no action alternative, there would be no changes to the local partners' existing or planned activities and areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. Similarly, local partners' ongoing research and monitoring efforts within the study area would persist. Largely because of the University of Hawai'i's presence in Kāne'ohe Bay, the affected environment has been, and will continue to be, an area that attracts a lot of research attention.

Hawai'i Institute of Marine Biology's research covers a broad range of topics, such as coral bleaching and disease, symbiosis, ocean acidification, marine microbial ecology, fisheries and top predator research, aquaculture and fish physiology, and biogeochemistry and biophysical analysis of reef systems. In addition to the HIMB's core research in the marine areas of the affected environment, the DLNR's DAR has conducted various research and monitoring efforts relating to coral reef restoration. Other researchers at the University of Hawai'i Mānoa have established and ongoing projects within the estuarine and terrestrial habitats of the affected environment. Refer to the DMP Section 4.1 "Research and Monitoring Programs" for additional information.

Preferred Alternative

Based off the experience and capacity of the 28 other sites included within the National Estuarine Research Reserve System, the designation of a research reserve would likely result in long-term, direct, major beneficial impacts to research and monitoring in the affected environment. As part of the national system of estuarine research sites, each reserve contributes to a nationwide effort of collecting long-term water quality, biotic, physical, and land use and habitat change information that represents an unprecedented effort to compare data across a network of sites.

Under the preferred alternative, and as described in the DMP, the designation of a proposed He'eia NERR could also result in the additional beneficial impacts of:

- Establishing baseline data for environmental conditions;
- Creating a research program that examines how different ecosystem-based management strategies contribute to a healthy and sustainable estuarine ecosystem in the face of ongoing anthropogenic impacts, and human use demands;

- Integrating traditional cultural knowledge and practices with contemporary science and research to sustainably manage resources in the vicinity of the reserve site;
- Increasing knowledge of natural and anthropogenic processes, restoration efforts and their impacts to the estuary, and key ecosystem services; and
- Informing resource management decisions enabling local communities to effectively address key coastal issues like climate change, habitat restoration, and water quality.

As described in the DMP, with implementation of the preferred alternative, the reserve would strive to achieve a number of goals and objectives in the first five years of operation. The DMP identifies three main goals for the site, one of which relates to research and monitoring, and is stated as follows:

Research and Monitoring: Increase our understanding of the effects of human activities and natural events to improve informed decision-making affecting the He'eia estuary, coastal ecosystems, and ultimately the entire ahupua'a of He'eia.

To achieve this goal, the plan identifies three main objectives: collect baseline information, coordinate independent research and monitoring efforts, and synthesize the information gathered through the efforts to inform local management decisions.

Reserve-specific research and monitoring efforts would focus at least initially on developing baseline habitat and ecosystem service data related to terrestrial, estuarine, riparian, and marine habitats, as well as baseline cultural and archaeologic information. The proposed He'eia NERR's long-term research focus will investigate two different ecosystem-based management strategies: (1) an approach based on contemporary ecological restoration techniques and (2) an approach that embraces traditional Native Hawaiian management practices. These two management strategies will be evaluated through measuring a suit of ecosystem services provided by each approach. The baseline studies will help inform future planning efforts related to the design and implementation of the long-term research focus of the research reserve.

In regards to monitoring, one of the first objectives for reserve staff would be to work with site partners to implement necessary infrastructure that would support the proposed He'eia NERR's SWMP. The SWMP tracks short-term variability and long-term changes to provide basic information characterizing how human activities and natural events can change coastal ecosystems.

Within the Marine environment, it is anticipated that reserve staff would partner with the DAR, and support existing restoration-related programs in the in the marine habitats (e.g., algae removal and the coral mitigation bank). The reserve staff, in partnership with the DAR, would support the development and implementation of a coral reef monitoring strategy to measure the effectiveness of the restoration efforts. The designation of a reserve is expected to enhance the state-directed marine habitat restoration activities by improving coordination related to monitoring and providing additional research support resulting in minor, indirect, beneficial impacts over the long-term. This heightened coordination is expected to enhance the ability of

site partners to evaluate the success of the restoration activities on the fringing and patch coral reefs on targeted ecosystem services.

Under the preferred alternative, the proposed He'eia NERR's research and monitoring programs would help facilitate increased knowledge and understanding of habitats, based on expanded and more granular data generated which will characterize baseline conditions, short and long-term ecological trends, and ecosystem services data. Most of this information would not be produced in the absence of a reserve designation. Improved localized data can be used by decision-makers and applied to inform resource management decisions within the affected environment. For example, data collected from the SWMP's instruments provide researchers and managers with valuable information on water quality and weather at frequent time intervals. Local coastal managers can use this real time, site-specific monitoring data to make informed coastal management decisions on issues of local or regional relevance.

In addition, reserve staff could play a key role in coordinating external research and monitoring, efforts occurring throughout the site. Thus, reserve designation could improve coordination of these efforts. In the future, it is anticipated that, given sufficient appropriations, research reserve funds could be leveraged to construct additional facilities (e.g., research laboratories) and infrastructure (e.g., research and monitoring equipment, which could support and improve the capabilities of the research and monitoring efforts within the affected environment.

Alternative A
The environmental consequences to research and monitoring resources of alternative A are similar, for the most part, to those of the preferred alternative. However, alternative A represents a larger land area (approximately 200 acres of terrestrial habitat compared to the preferred alternative) and therefore these same impacts would inevitably occur over a larger area within the terrestrial habitats. In regards to the installation of research and monitoring equipment, it is anticipated that the additional terrestrial habitats would be targeted for reserve-related activities.

There would be no additional adverse or beneficial impacts expected with the implementation of alternative A other than what was already discussed under the preferred alternative.

Alternative B
Under the implementation of alternative B, reserve-related research and monitoring efforts would be limited to the estuarine and marine habitats of the preferred alternative (the terrestrial habitats are excluded from the boundary of this alternative). However impacts would be identical to what was identified under the preferred alternative, but would occur within a smaller footprint. The duration, magnitude, and extent of the beneficial impacts identified under the preferred alternative would not change under the implementation of alternative B.

Alternative C
When compared to all the other alternatives, alternative C encompasses the least amount of acreage. Alternative C excludes the terrestrial habitats (approximately 196 acres) and a significant portion of the marine habitats (approximately 300 acres) of marine habitats. Reserve-

related research and monitoring efforts would be limited to estuarine, riparian, freshwater wetlands, and marine habitats. The impacts of implementing this alternative would be identical to the preferred alternative, but confined within the specific habitats mentioned above. The duration, magnitude, and extent of the beneficial and adverse impacts identified under the preferred alternative would not change under the implementation of alternative C.

6.3.3.7 Military

As described in Chapter 5, "Affected Environment," the 2,951 acre MCBH – Kāneʻohe Bay is located on Mōkapu Peninsula. MCBH - Kāneʻohe Bay is also one of the largest employers on the windward side of Oʻahu with roughly 14,000 active duty personnel and civilian employees. Resulting impacts to the military activities in the area from the range of alternatives analyzed are provided in Table 6.44.

Table 6.44 Impacts to military

	No Action	Preferred Alternative	Alternative A	Alternative B	Alternative C
Military	Military conducts operations in the vicinity of Mōkapu Peninsula. Potential adverse impacts from aviation operations (noise pollution).	Long-term negligible beneficial impacts resulting from increased outreach and education events for base residents.	Same as preferred alternative.	Same as preferred alternative.	Same as preferred alternative.

No Action Alternative

Under the no action alternative, MCBH - Kāneʻohe Bay will continue managing and conducting operations in and around on Mōkapu Peninsula.

Preferred Alternative, Alternative A, B, and C

Designation of the proposed Heʻeia Reserve is anticipated to have no adverse impacts to the MCBH - Kāneʻohe Bay's programs and operations, but may have long-term negligible beneficial impacts for its residents. For example, the residents of the base could participate in future Reserve-based outreach and education events which may offer minor beneficial impacts including increased education and awareness, or improve the perceived quality of life of military personnel and their families. The MCBH - Kāneʻohe Bay is located outside the proposed alternative boundaries. As a result, designation is expected to have no impacts to the MCBH - Kāneʻohe Bay or on any of its programs.

6.4 Cumulative Effects

6.4.1 Introduction to Cumulative Effects Analysis

For the purpose of this analysis, a cumulative impact is an "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over time." (40 C.F.R. § 1508.7)

Although reserve designation and approval of the proposed He'eia NERR's DMP would be largely administrative actions, they would be followed by operation of a reserve, with associated education, research, stewardship, and monitoring opportunities and activities. These and other potential future management activities, including restoration projects, within the boundaries of the proposed He'eia NERR would likewise be expected to have a variety of either beneficial or adverse impacts of varying magnitude and duration, as discussed previously. In addition, proposed He'eia NERR would also be incorporated into the national system, which could bring additional research, restoration, education, and stewardship opportunities. Selection of any of the action alternatives (i.e., the Preferred Alternative or Alternatives A, B, or C) would not trigger any changes in land ownership.[30] Current uses of public and private lands and waters within the proposed reserve's boundaries would continue to be managed under existing regulatory and administrative authorities.

If a reserve were designated, existing office space has been identified for it to use in its first few years of operation. A formal facilities needs assessment would be conducted, resulting in prioritize list of needs, and then plans would likely begin to be outlined for the development of facilities to support proposed reserve activities outlined in the DMP. The facilities needs assessment would be expected to identify the types of facilities needed (e.g., office space, laboratories, and classrooms, a visitors' center, resource library, and equipment storage), financial resources, and how existing site partners might be able to fill some of the needs by renovating existing facilities or building new ones. Future facilities, any future land acquisition proposals, and other future federal actions would be reviewed by OCM pursuant to applicable mandates (e.g., environmental and historic preservation laws, applicable executive orders, and other regulations, including NERRS regulations) and potential Presidential budget requests, as well as within the context and scope of the analysis contained in this EIS. In general, future facilities would be expected to be developed in a manner designed to minimize adverse impacts to sensitive environments and species.

[30] If a He'eia Reserve were designated, the Reserve would be eligible for federal funding in the future (subject to appropriations) for NERRS construction and land acquisition. The only parcels identified to date in the DMP as under consideration for future inclusion in the Reserve (see DMP Tables 9-1 and 9-2) are already publicly held by government agencies at the county and state level; none of the parcels are privately owned. However, the potential for future changes in land ownership cannot be ruled out.

As discussed in chapters 6.2 and 6.3, designation and implementation of a proposed He‘eia NERR, under all the alternatives analyzed, would not be expected to result in significant adverse impacts to either the natural or human environment. As shown in Table 6.2, many of the adverse effects would be expected to be short-term (e.g., during periods of active construction) and negligible to minor in intensity, whereas most beneficial effects would be expected to have minor to moderate impacts over the short-term and the long-term. This cumulative effects analysis notes that, even under the no action alternative, ongoing manipulation and restoration activities by local partners would be expected to have long-term beneficial impacts, which could be accompanied by (primarily minor) adverse effects. Existing and planned activities in the affected environment that are not directly connected to this action have been included in this cumulative effects analysis to the extent they are relevant.

The descriptors of intensity used earlier in this subchapter (ranging from negligible to major) are not used throughout this discussion of cumulative impacts. They were retained in some places, but did not apply in other contexts. Where omitted, information in narrative form is presented to ensure that the full range of consequences for the proposed action are considered.

According to Council on Environmental Quality guidance on “Considering Cumulative Effects under the National Environmental Policy Act,” as part of determining whether cumulative effects are significant, it is appropriate to consider whether the affected environment can withstand the stress of cumulative impacts without crossing ecological thresholds. That guidance notes:

> The significance of cumulative effects depend[s] on how they compare with the environmental baseline and relevant resource thresholds (such as regulatory standards).... The [action agency] must determine the realistic potential for the resource to sustain itself in the future and whether the proposed action will affect this potential.... By definition, cumulative effects analysis involves comparing the combined effect[s] with the capacity of the resource, ecosystem, and human community to withstand stress. (Council on Environmental Quality 1997)

The spatial extent of the cumulative effects analysis is environment-specific and is broader for effects in some environments than it is for others. For instance, because sound may cover long distances, the spatial extent of the cumulative effects analysis for the acoustic environment is broader than for those environments where impacts are more localized. To assess potential cumulative impacts related to noise, air quality, and marine waters, OCM used a broader spatial extent (e.g., including impacts from MCBH - Kāne‘ohe Bay) to evaluate relevant impacts to the affected environments. For other types of impacts (including in terrestrial areas, estuarine environments, and riparian and freshwater areas), the spatial extent is more limited; it focuses on known activities occurring or likely to occur in Moku o Lo‘e and areas within the watershed of He‘eia Stream.

Similarly, the temporal bounds of this analysis were selected intentionally. First, a few important “historical activities” are summarized (see Table 6.5). After that discussion, most assessments

of past impacts in this subchapter focus primarily on the 21st century. This time period was chosen because looking back over data reflecting conditions over the past approximately 5-15 years provides a baseline to which future scenarios can be compared. Similarly, this cumulative effects analysis is limited in the number of years it can look ahead. Research reserves have regular opportunities to revise their management plans to adapt to changing conditions and needs. As reserves operate, considerable new information can come to light about local conditions, constraints, and needs. Because of the potential for circumstances on the ground to evolve, federal regulations call for reserves to update their management plans every five years. Because of the many factors that are not well understood before reserve designation, this cumulative effects analysis looks ahead to the first approximately 5-15 years after reserve designation, in order to meet the mandate under NEPA to focus on future scenarios that are reasonably foreseeable.

6.4.2 Major Historic Activities Affecting the Current Environment

Table 6.5 highlights some of the long-term impacts of the activities that have degraded the health and productivity of the environment of the He‘eia estuary and Kāne‘ohe Bay. Development, military buildup, and economic activities have also impacted the marine areas (e.g., dredging parts of Kāne‘ohe Bay and filling other parts of it to support expansion of MCBH). The region is now highly urbanized, which also affects ecosystems and communities.

Table 6.45 Examples of Major Historical Activities and Trends in the Region

Historical Activity	Examples of Impacts
Construction of MCBH	- Dredging of 15 million cubic yards of reef to use as fill across approximately 280 acres of land
Urbanization	- 58% of shoreline modified, including sea wall construction, harbor creation, dredging or fill - 19 of the original 28 fishponds built by early Hawaiians were partially or completely destroyed - Increased eutrophication from sewage effluent discharge into the bay
Agricultural land conversion	- Construction of large irrigation channels - Agricultural fields converted to pasture or became uncultivated land - Sedimentation of estuarine and marine habitats
Introduction of non-native fish and algae	- Increased pressure on native reef fish and other species - Damage to coral reefs and associated biota

In addition, changes in agricultural use have left their mark on the landscape. Historically, one of the most prominent natural features in the He‘eia estuary was a large marshland called Hoi, where taro was traditionally grown. As described previously (under “Affected Environment”), throughout the 1800s and 1900s, agricultural activity in the estuary went through cycles of taro, sugarcane, pineapple, rice, and, later, cattle. In modern times, the intense agricultural manipulations within the wetland and its associated land use practices led to major adverse impacts on water quality, hydrology, and habitats. Specific to water quality and hydrology, these historic practices resulted in severe soil erosion in the uplands, followed by subsequent

increased sedimentation, nutrient loading to receiving waters, and increased flooding in the estuarine areas during rain events.

Finally, a variety of invasive species, introduced either purposely (e.g., red mangrove, red algae, and peacock grouper) or accidentally (e.g., California grass), resulted in dramatic shifts in habitats over time. As noted above, species such as California grass and red mangrove are choking water flows in the He‘eia Stream channel and reducing estuarine wetland habitat for native species. In addition, invasive algae are smothering coral reef ecosystems in Kāne‘ohe Bay.

6.4.3 Introduction to Current Outlook

The activities, plans, and partners identified in Figure 6.3 highlight major ongoing or planned activities that have the potential to contribute to a range of cumulative impacts that may have potential short- and long-term effects on the affected environment.

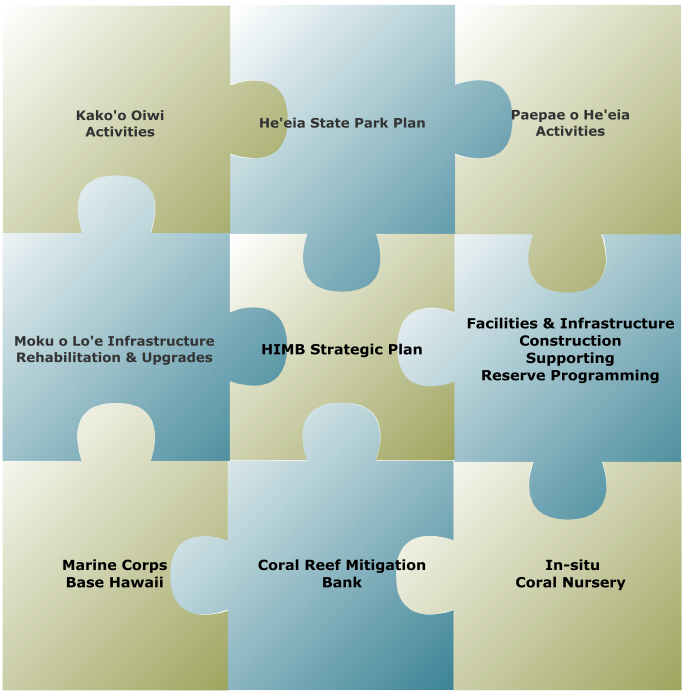


Figure 6.3. Major External and Partner Activities Contributing To Cumulative Impacts

However, that is not to say that other ongoing, planned, and proposed projects do not contribute to potential cumulative effects. Accordingly, individual ongoing, planned, and proposed projects are summarized below. The following subchapters retain the general organization of earlier parts of this chapter by addressing, first, cumulative impacts to the natural environment, then cumulative impacts to the socioeconomic environment. This subchapter concludes with a summary.

6.4.4 Air Quality

As noted earlier, there no areas within the State of Hawai‘i, including Kāne‘ohe Bay, that are designated as non-attainment for any of the federal National Ambient Air Quality Standards (NAAQS). With respect to specific air quality impacts in and around the study area, A Final EIS published in 2012 for MCBH, describes the largest anthropogenic sources of air emissions in the state are power generating facilities on the leeward side of the island (Department of the Navy 2012). Air emissions at the base in Kāne‘ohe Bay come primarily from combustion of fuel by aircraft, vehicular engines, boilers, and generators. In addition, short-term air quality impacts can result from demolition, earth-moving, and construction-related equipment, from fuel combustion and emissions of fugitive dust. Potential pollutants, including particulate matter, estimated to be associated with the proposal under review at that time – basing MV-22 and H-1 aircraft at the MCBH – are summarized in that Final EIS in its Chapter 3.4. The Navy’s analysis indicated that construction-related emissions would not be significant because they would be short-term and existing requirements and other practices (e.g., fugitive dust control measures and BMPs) would minimize impacts. A summary of the air quality impacts to operational changes in stationary sources (related to power generation, which are regulated under the Clean Air Act) and mobile sources (which the Navy commented would readily disperse) is also presented in the Final EIS. In short, operational changes were determined not to have significant impacts.

Some of the environmental documents prepared in connection with other projects in the study area focus on possible dust generation as an air quality impact. Most project descriptions identify dust abatement practices planned (including some of the projects planned at Moku o Lo‘e), which are common to many types of projects involving construction and demolition, in part because of applicable state requirements (see Hawai‘i Administrative Rules, Title 11, Chapter 60-11.1, “Air Pollution Control”). Also, emissions from fuel combustion can potentially be reduced by minimizing idling of heavy equipment.

If designated, the primary effect a new reserve would have to air quality in the region would probably be related to vehicles driven by visitors and staff. Emissions from mobile sources, including boats, are controlled using best available technology suited to a particular engine and time period it was manufactured. These emissions would disperse into the larger environment rapidly. In addition, possible manipulation and construction projects at the proposed He‘eia NERR could result in fugitive dust emissions, which would also be limited through appropriate BMPs. State requirements would be expected to ensure that cumulative impacts from individual projects in the study area, including any future reserve-related projects, would not be cumulatively significant. The use of voluntary BMPs could further reduce air quality impacts.

6.4.5 Hydrology and Water Quality

As discussed, considerable changes to the hydrology of the He‘eia estuary and Kāne‘ohe Bay have occurred over time. In addition, many contributors to source and nonpoint source pollution degraded water quality, with major adverse impacts, sometimes compounded by invasive

species. Since the advent of the Clean Water Act and modern point- and nonpoint source pollution control programs, however, water quality has been improving. In the 21st century, a number of projects already described could offer substantial benefits in terms of restoring natural hydrologic functions. For example, removing invasive species choking He‘eia Stream would greatly improve stream flow. Restoring wetland hydrology also would contribute to improved water quality. If the proposed He‘eia NERR were designated, it could potentially provide technical, planning, or monitoring assistance for such projects.

At a regional level, the He‘eia estuary falls within the Ko‘olau Poko District. In 2012, the Ko‘olau Poko Watershed Management Plan was published, in consultation with stakeholders. The plan was prepared in accordance with the State Water Code and Hawai‘i Water Plan, and it is a component of the O‘ahu Water Management Plan. The plan identifies a number of projects underway that address water supply and water quality needs, including projects ranging from He‘eia Stream Restoration, to He‘eia wetland restoration (on the HCDA parcel), to Stewardship of He‘eia Fishpond, and to implementation of the MCBH Integrated Natural Resources Management Plan. It also identified a number of recommended management strategies promoting taro agriculture, mitigating impacts from feral pigs and mammals, reducing illegal dumping, and preserving forested areas above groundwater sources (Townscape 2012).

All the projects undertaken to restore wetlands, streamflow, and impairments to waterbodies by federal, state, local, non-governmental, and military officials have contributed to improved water quality and restored hydrologic functions. Nonetheless, natural hydrology has not been restored along numerous stream segments and in some wetlands. He‘eia Kea Small Boat Harbor, Kāne‘ohe Bay, He‘eia Stream, inland waters of Moku o Lo‘e, and other water bodies in the Ko‘olau Poko District are still listed as impaired (at least seasonally) by the State of Hawai‘i because they have not fully attained applicable water quality standards. Projects proposed by reserve partners will only seek to address some of many complex water resource management needs in the He‘eia estuary, many of which may persist for more than another 15 years. Nonetheless, because of the predominantly beneficial impacts associated with these activities, cumulative impacts to hydrology and water quality are not expected to be cumulatively significant.

6.4.6 Terrestrial Environment

Native Forest Restoration on HCDA Parcel

Kāko‘o ‘Ōiwi proposes to partner with other entities, including the reserve (if designated), to restore at least 150 acres of the upland areas of the HCDA parcel. As planned, restoration of the upland areas is expected to include the removal of selected invasive, non-native plant species and replanting of native forest species. This effort is expected to restore the habitat to a state characterized primarily by native tree species, which could contribute to supporting a more resilient habitat for native and endemic fauna and flora in the long term. As noted previously, there could be some short-term adverse impacts to soil, plants, and animals during the construction phase of the project. If designated, the reserve’s staff could coordinate with Kāko‘o

ʻŌiwi on designing and implementing a monitoring strategy to assess the effects of the short- and long-term restoration, including on specific ecosystem services.

He‘eia State Park

He‘eia State Park was acquired by the state in 1976. The park represents the only relatively large shoreline parcel that is publicly owned, other than Kualoa Park at the northern end of the bay. Friends of He‘eia, a non-profit educational organization, was granted a lease in 1980, which lasted through 2010, to manage the park. In 2010, Kama‘aina Kids, another non-profit educational organization, was granted a 25-year lease to manage He‘eia State Park (He‘eia State Park 2016). Kama‘aina Kids and its partners operate waterfront programs for school-aged children and other visitors. Members of the public can take advantage of non-motorized boating experiences organized by Holokai Kayak and Snorkel Adventures (which passes along the proceeds from its operation to Kama‘aina Kids). Each year, approximately 12,000 visitors, on average, come to He‘eia State Park, according to Kama‘aina Kids. Existing facilities at the state park are shown in Figure 8-3 of the DMP and summarized in Table 8-1 of the DMP. These facilities include a visitors’ center where classes are sometimes held, exhibit hall, canoe hale, outdoor pavilion, two boat launch sites, maintenance buildings, parking for 80 vehicles, a trail, and shoreline access.

The most recent planning study associated with He‘eia State Park appears to have been published in 1993, during the time the property was leased by Friends of He‘eia. Thus, it does not reflect Kama‘aina Kids’ ideas for the property. However, the website for Kama‘aina Kids communicates some information about its hopes to expand facilities. Most notably, it is in the process of fundraising to erect new facilities at the site of a former pavilion that was demolished by high winds, near the entrance to the park. The proposed He‘eia Learning Center, as it would be called, could serve multiple purposes, including: a community center that local organizations could use for meetings; a training facility dedicated to the promotion of environmental education and exploration of coastal and marine environments; and “community office space,” which organizations in the community could use to support goals related to promoting educational and cultural values. See http://www.kamaainakids.com/purpose. If erected, the He‘eia Learning Center could theoretically potentially address, at least on an interim basis, some of the gaps in facilities for the reserve on the mainland noted in the DMP (see Section 8.2, which identifies a need for office space, a large teaching space, and meeting space). However, if Kama‘aina Kids has other plans for the learning center, that might not be the case. New facilities on state park lands would require a license amendment or special use permit issued by the Division of State Parks and/or DLNR. In addition, the habitats within the park have been affected by more than 35 years of visitor use as a state park; it is likely that any additional impacts assocated with pedestrian traffic in the park would result in negligible additional impacts on its terrestrial flora and fauna. Potential impacts would be evaluated in greater detail prior to facility construction.

Facilities Projects at HIMB (on Moku o Loʻe)

Recent upgrades to HIMB infrastructure are largely driven by its vision to become an international leader of tropical marine ecosystem-related research and education, and the desire to make its facilities a model for sustainability (HIMB 2010 and University of Hawai‘i 2015). The

HIMB Strategic Plan (2010-2015) identifies several key upgrades to its facilities to accommodate expanding programs (e.g., education and research). For a map of the existing facilities on the island, see Figure 8-2 of the DMP.

In 2010, HIMB opened the Marine Science Research Learning Center to support its marine education program. The center is designed to serve as both a laboratory and a classroom, and it is equipped with computers, microscopes, and other research instruments. Also, the 10-year old Pauley Laboratory Building is under renovation. The renovations include constructing state of the art research and teaching laboratories, as well as general structural upgrades. HIMB is also installing a 250kW photovoltaic array on the new laboratories to produce solar-generated electricity. It is estimated that this system of solar panels will provide 25 percent of HIMB's energy needs (University of Hawai'i 2012).

The University of Hawai'i is also implementing infrastructure rehabilitation and replacement projects. A "Final Environmental Assessment for the Hawai'i Institute of Marine Biology Coconut Island Infrastructure Rehabilitation and Replacement Project" contains more information about this work and is incorporated by reference (Community Planning and Engineering, Inc. 2014). The project elements are also summarized below. Although no threatened or endangered species, candidate species, or critical habitats were found in the project area, mitigation measures (such as the use of a silt-fence during trench construction and closure) and BMPs recommended by USFWS are being followed to ensure that species that have been historically observed in the area are not significantly impacted.

The portion of Infrastructure Rehabilitation and Replacement Project that impacts terrestrial environments the most is the rerouting of sewer connections on the island. A temporary, 350-foot long trench was needed on the island as part of rerouting sewer connections, so that the sewer line tie-in (to the main sewer line) could be rerouted. This could result in minor, short-term adverse effects on flora or fauna present during construction, but would have long-term beneficial impacts to the terrestrial and marine environment by ensuring that the failing utilities and infrastructure will not adversely impact habitats and species in the future. The work on Coconut Island itself would have a *de minimus* impact on the terrestrial environment, which has already been greatly modified by development on the island. Also, while the pier was out of service, boats were pulling onto land using the HIMB front loading gate to unload passengers, but HIMB identified that as presenting logistical and safety concerns, obviated once the replacement pier opened (Community Planning and Engineering, Inc. 2014).

All construction projects on Coconut Island will require a CDUP and will be reviewed by the DLNR. Overall, the facility improvements that require work outdoors could have short-term adverse effects on the surrounding environment (including flora and fauna) during construction, but would likely have negligible impacts given the fact that the university is subject to state oversight and is consulting federal agencies, when appropriate. In addition, the improvements described above will likely have long-term beneficial impacts to the human environment by providing better-equipped, spacious facilities to students and researchers and ultimately help HIMB achieve its research and education goals. From its evaluation of the reasonably

foreseeable projects on Coconut Island identified by HIMB, combined with other factors affecting the terrestrial environment on the island, OCM's assessment indicates that the cumulative impacts of facilities would not be significant. If any new facilities were needed on Coconut Island, they could potentially be built in already-disturbed areas. The 40-foot shoreline setback line (inland from the certified shoreline) established by the City and County of Honolulu would also apply, unless a variance were obtained. In short, projects are subject to scrutiny by multiple entities, HIMB has shown itself to be open to implementing BMPs and mitigation measures, and OCM has not identified any evidence that ecosystems on the island are approaching any tipping points.

Future Facilities and Infrastructure to Support Reserve Programming (locations unknown)
If a research reserve were designated in He'eia, the DMP indicates that the administrative offices for the proposed He'eia NERR would initially be located on Coconut Island. These offices will provide a base of operations and logistics support to get He'eia NERR programs started. The facilities' needs assessment, which would occur within the first approximately 5 years after the reserve begins operating, would yield a prioritized list of facilities needs for the long term, some of which might be pursued as funds permit. As noted previously, if a He'eia Reserve is designated, new infrastructure will likely be needed to support the various programmatic activities, according to the DMP. Chapter 8 of the DMP describes the overall process for identifying future facility needs. Facilities would primarily be located in the "buffer areas" (not the reserve's core area) and would be implemented in ways intended to avoid significant adverse impacts to the reserve's resources and habitats. As noted, one possible site for future expansion might be He'eia State Park. On the HCDA parcel and the Kamehameha Schools parcel, there are already small outdoor pavilions; but parking areas are quite small, too small to sustain much additional visitation. As needs are assessed and projects identified and planned, OCM and reserve staff will work to conduct any required environmental reviews and obtain required clearances to implement such projects. Also, the site partners, given their missions, would be expected to implement activities that seek to minimize disturbances to sensitive habitats and species. In short, future reserve infrastructure development would be implemented to mitigate or reduce potentially adverse impacts and would promote efforts to maximize long-term benefits new facilities could offer with respect to supporting reserve programming and partner efforts. Reserve programmatic activities would be expected to draw additional visitors regardless of whether new facilities are developed.

Potential additional boat traffic is discussed below under marine environment, and potential additional pedestrian, automobile, and bus traffic is discussed below under socioeconomic effects. Most land available for development has already been developed. Given available information, the cumulative impacts to terrestrial environments from current land uses by property-owners in terrestrial areas within the He'eia region and from potential future land use related to reserve designation are not expected to be significant. This is attributable in part to the many layers of government oversight (the City and County of Hawai'i, state agencies, and federal agencies, as applicable) and permitting (e.g., special management area permitting) related to different types of potential land uses. Requirements for low-impact development, BMPs, and other mitigation measures would help keep cumulative impacts from reaching the

level of significance. (This threshold could be exceeded, theoretically, if landscapes or resources were not expected to be able to sustain themselves into the future or if it appeared resources might be pushed to the brink of undesirable tipping points).

All future He‘eia NERR construction or acquisition projects will be reviewed by OCM. The results of the facilities needs assessment will provide a sense of the array of future facilities needed, providing all reserve partners with a better idea of their potential cumulative effects. Future updates to the proposed He‘eia NERR DMP, which will be subject to OCM review and approval, will also discuss future facilities’ needs, allowing many opportunities for review and discussion before new reserve-related construction projects are undertaken. Once additional future facilities are proposed, OCM will conduct necessary NEPA and environmental compliance evaluations, including assessing how the proposed new facilities may affect the cumulative impacts analysis of this EIS. In addition, OCM expects that all consultations, authorizations, and permits required for individual construction projects will be obtained. OCM’s review role will also ensure that potential construction project impacts are scrutinized from many perspectives.

6.4.7 Estuarine Environment

He‘eia Fishpond Reconstruction and Aquaculture

As noted previously, Paepae o He‘eia, has a long-term lease from Kamehameha Schools to restore the He‘eia Fishpond and to support the practice of traditional Hawaiian aquaculture. According to Paepae o He‘eia, the historic fishpond is one of the largest in the islands and its pond wall (kuapā) is possibly the longest, approximately 1.3 miles (7,000 feet) (Paepae o He‘eia 2016). As part of its ongoing efforts, Paepae o He‘eia has been focused on removing red mangrove threatening the fishpond wall’s structural integrity, rehabilitating the fishpond wall, removing invasive algae from the fishpond, and supporting on-site aquaculture operations to produce finfish and mollusks.

The fishpond related manipulation activities do have the potential for minor and short-term adverse water quality impacts, from introducing sediment and nutrients to the adjacent marine waters. BMPs that are designed to avoid or minimize these impacts have been identified and are summarized in the USACE Clean Water Act Section 404 permit (USACE 2012b). At the time of permitting, NMFS provided a determination that fishpond restoration would not adversely affect EFH. Furthermore, NMFS determined that the activities may affect, but are not likely to adversely affect, federally listed species, species proposed for listing, or their critical habitats. Additionally, the USACE consulted the Hawai‘i State Historic Preservation Division pursuant to Section 106 of the National Historic Preservation Act. The Corps determined that the restoration project would have no adverse impacts to the historical, structural, or cultural integrity of the fishpond (which is listed on the National Register of Historic Places).

Reserve designation could result in additional technical assistance, coordination, research, monitoring, education, and other activities at the fishpond, which could have long-term, indirect, minor beneficial effects. The DMP indicates the proposed He‘eia NERR will collect baseline

habitat and ecosystem service data. The only potential adverse environmental consequences from installing most types of monitoring equipment are expected to be negligible, as explained above. It is not yet known whether reserve researchers would monitor the fishpond or nearby areas.

Looked at together, the impacts to the fishpond from the activities proposed to date by Paepae o He‘eia and potential reserve-related activities would not be expected to be cumulatively significant, largely because of the limited nature of the activities and plans to follow BMPs to reduce sediment or nutrient transport to a level that would be *de minimus* and to reduce the potential for impacts to protected species and habitat. Potential impacts of other activities to marine waters of the bay are discussed below, consistent with the convention throughout this draft EIS.

6.4.8 Riparian and Freshwater Environments

The 38-year lease (starting in 2010) that Kāko‘o ‘Ōiwi has with HCDA allows the organization to alter 400 acres to “[e]stablish a land management program to feed the community and sustain its culture and economy, improve the health of coastal resources, and develop sustainable infrastructure” (Townscape 2011). Requirements specific to the He‘eia Community Development District mandate that the site be used for cultural practices, culturally appropriate agriculture, education, and restoration and management of natural resources associated with the He‘eia wetlands. Portions of the property are in the county’s special management area.

Kāko‘o ‘Ōiwi has begun planning and implementing efforts to convert the He‘eia uplands and wetlands into a traditional agricultural landscape and restore the wetlands, uplands, and He‘eia Stream. As upland restoration efforts have been discussed above, the activities discussed below revolve around lo‘i kalo restoration, restoration of associated structures and conduits, stream restoration, and wetland restoration. The consequences of the habitat conversions have been summarized above. Impacts to flora would primarily be associated with removing invasive vegetation dominating the parcel, then planting other types of vegetation. There could be minor direct impacts to non-native predator species as subsequently discussed under native wetland restoration and above under actions proposed for recovery under the waterbird action plan in Chapter 6.2.3.3.1. In addition, these activities would be expected to result in some changes to hydrology and could potentially have minor water quality impacts. BMPs could help reduce potential short-term adverse impacts, such as sediment transport. If a reserve were designated and included these lands, reserve staff could help monitor changes to the biological environment resulting from activities organized by Kāko‘o ‘Ōiwi. There would be expected to be socioeconomic benefits to the local economy from the restoration work and then producing taro, as well as to local communities by educating interested individuals about traditional agricultural practices.

<u>Wetland Agriculture, Maintenance Roads and Water Conveyances</u>
All told, Kāko‘o ‘Ōiwi plans to rehabilitate approximately 176 acres of organic taro patches, several acres of traditional combined taro patches and inland fishponds, and 4.6 acres of

existing organic dryland food crops. Historically, these areas were part of the taro growing district called Hoi, discussed previously. Supporting this traditional agricultural landscape, Kākoʻo ʻŌiwi is also planning to rehabilitate historical taro patch walls, agricultural roads, and water conveyance channels. USACE determined that a Section 404 permit was not necessary for removal of invasive vegetation in historic taro patches, tilling the soil, excavating soil, and otherwise restoring historic taro patch walls and historic agricultural roads. USACE also found that use of the BMPs proposed would prevent degradation of Heʻeia Stream (USACE 2012b).

Heʻeia Stream Buffer and Channel Restoration

In addition, Kākoʻo ʻŌiwi is planning to restore 25 acres along the stream channel, including a 100 foot riparian buffer, which will require removing invasive California grass. Specific plans are still being developed and could potentially benefit from data from future research on Heʻeia streamflow and hydrology. Over the long term, restoration of the Heʻeia stream channel could improve habitat suitability for native aquatic and bird species (including endangered waterbirds) within the 100-foot buffer and downstream.

Native Wetland Restoration

Finally, Kākoʻo ʻŌiwi is planning to restore 30 acres of wetland habitat between the taro fields and the fishpond along Heʻeia Stream. The aim of the effort would be to replace the invasive red mangroves dominating the area with native wetland sedges and open-water pools. The effect would be to improve habitat for native birds and nursery grounds for juvenile fish species. In addition, Kākoʻo ʻŌiwi is planning to develop a predator control program for rats, mongooses, pigs, cats, and dogs to minimize future impacts on native birds that utilize wetland habitats (Hawaiʻi Office of Planning 2015b). To minimize potential impacts related to the Hawaiian hoary bat, Kākoʻo ʻŌiwi indicates that actions requiring removing mangroves from forested areas will not be carried out between June 15 through September 15, during the bat's breeding season. Any federally-funded activities with the potential to impact the hoary bat will be subject to further evaluation pursuant to the ESA, as needed, to reduce the potential for any adverse effects to hoary bats. Other impacts to fauna expected from the wetland habitat restoration effort would include enhancing habitat for native bird species and fish, potentially resulting in an increase in their numbers in the project area and reducing numbers of non-native animals that prey on native birds (if the predator control program is effective). Kākoʻo ʻŌiwi would be expected to consult with appropriate agencies about these efforts when they are at an appropriate point in the planning process (e.g., USACE suggested it could determine the applicability of the Clean Water Act to efforts to restore the stream, floodplain, and estuarine wetlands, as well as the possible creation of a detention pond to capture sediments and debris from storm events in the southern portion of the parcel, along the Heʻeia Stream) (USACE 2012c).

Some of the projects underway or planned by Kākoʻo ʻŌiwi could have potential short-term adverse impacts, but these will be reduced by carrying out projects without heavy machinery and in accordance with BMPs. The projects are anticipated to have long-term impacts to water quality within the watershed that are primarily beneficial, e.g., by potentially reducing sediment and nutrient loads entering surface water bodies once periods of active construction have ended. There would also be benefits to hydrology, particularly water flow, as areas are actively

managed and restored. The various activities to be carried out by Kākoʻo ʻŌiwi and its partners would also be expected to improve habitat for flora and fauna species (particularly native species) in the fashion summarized above. The active management of the many habitats contained within the HCDA parcel will restore fallow land to greater productivity and to uses that provide many ecosystem service benefits. The lack of development pressure would be expected to allow benefits to accrue over the long-term. If a reserve were designated, OCM, DLNR, and other partners that are not yet engaged with activities planned for the HCDA parcel would potentially have an improved platform for coordination. As noted above, this could result in additional technical assistance, research, monitoring, and other resources beyond those expected under the no action alternative. Cumulative impacts would include both potential adverse effects and potential beneficial effects, but they would not be cumulatively significant. One reason for this is the amount of strategic planning for the parcel that has already occurred. A second reason is that project plans are not so rigid that adaptive management will be impossible. And, finally, the projects will be subject to many future reviews to ensure environmental compliance, which will allow agencies to suggest mitigation measures to minimize any potential adverse effects.

6.4.9 Marine Environment

Coral Reef Research and Restoration Projects

Three other actions that impact the environment in Kāneʻohe Bay are focused on coral reef ecosystems, some of which have already been summarized above. Pertinent information to the cumulative impacts analysis is summarized in this subchapter. What the three projects have in common is that most effects are intended to be beneficial, but there could be some minor short-term impacts during construction phases or other phases of work that involve habitat manipulation. If a proposed Heʻeia NERR were designated, its additional contributions to cumulative impacts would be limited. Reserve designation and funding for reserve staff portions could allow new reserve staff to offer technical assistance and assistance with coordination related to coral reef projects. In addition, there could be reserve-related monitoring at the project sites. There is already oversight by state and federal agencies over these projects, as discussed below. In the future, if reserve funding were proposed for manipulation projects, OCM would evaluate the proposals to ensure any additional environmental compliance responsibilities required for federal actions were fulfilled. The types of impacts from each of the three projects are summarized below.

Invasive Algae Removal
First, as discussed previously, a project is being implemented by DLNR's Division of Aquatic Resources (DAR) and other partners to mechanically remove large quantities of invasive algae from the patch reefs of Kāneʻohe Bay. Divers remove the invasive algae by hand, feed it into the "Super Sucker" to be collected, and sea urchins are later released to help control the remaining algae. According to The Nature Conservancy, a project partner, the algae originally became established in the central portion of the bay, but natural barriers prevented the algae from spreading south. The "Super Sucker" has been in use in Kāneʻohe Bay for almost 10 years. One

recent focus has been to prevent the invasive algae from spreading beyond the bay by using the “Super Sucker” and reintroduced urchins in areas infested with invasive algae near the northern end of the bay. In the local areas where restoration occurs, beneficial impacts include improved coral health and ecosystem services, such as habitat for fish, invertebrates, and other species. An environmental assessment prepared in connection with expanding the use of these restoration techniques to the northern portion of Kāneʻohe Bay concluded that “effects would be local and are not expected to significantly affect the human environment alone or in combination with other reef restoration projects around the Oʻahu coast.”

In-situ Coral Nursery

Second, an in-situ pilot coral nursery is currently proposed for a small area off Moku o Loʻe and within the Hawaiʻi Marine Laboratory Refuge that could ultimately support coral reef restoration activities within the bay. This two-year “proof of concept” project would involve accepting coral fragments from a damaged site in Kāneʻohe Bay and placing them in a nursery area in the Hawaiʻi Marine Laboratory Refuge to grow. After two years, the fragments grown in the nursery would be returned to donor sites and monitored. The project would be funded in part by NOAA’s Coral Reef Conservation Program and carried out through a partnership between DAR and HIMB. If successful, the project nursery could help researchers understand some of the parameters that affect coral nursery success. Future efforts could build on this foundation to help support nursery design for future DAR-led restorations of reefs damaged by ship groundings and other adverse impacts. The benthic environments at the nursery sites will change temporarily while the nurseries operate. The nurseries will not be installed where there are live coral reefs. Also, sea turtle resting areas will not be sources of donor fragments. In addition, the donor coral fragments will not leave Kāneʻohe Bay. Several BMPs were proposed for the project relating to minimizing the potential impacts to both listed species and EFH. NMFS also determined that the proposal would cause no or minimal adverse effect to EFH as long as certain BMPs were followed, such as only transporting coral fragments between sites that are free of disease and invasive species and avoiding placing any equipment and materials related to the nursery on substrate colonized by coral. NOAA’s NMFS concurred with an OCM determination that the proposed project is not likely to adversely affect species listed under the ESA and monk seal critical habitat. Oversight by the many agency and institutional partners involved in the project would be expected to ensure that there are no significant impacts related to the pilot nursery site.

Coral Reef Mitigation Bank

Third, building on the Kāneʻohe Bay coral reef restoration project, DAR proposed a coral reef mitigation bank to continue these restoration efforts on four patch reefs within Kāneʻohe Bay and an additional three patch reefs as control reefs for the restoration reefs. One restoration and one control reef proposed as part of the bank are found within the proposed boundary of the reserve, under the preferred alternative (Figure 6.4). Patch reefs 9 (control) and 10 (restoration) have a combined area of 58,441 m^2. As part of the bank, DAR is also considering outplanting healthy coral from the proposed coral nursery to reef 10 to restore coral coverage (Hawaiʻi DLNR Aquatic Umbrella Mitigation Bank Prospectus, 2014). In the future, coral from the Moku o Loʻe pilot in-situ coral nursery could potentially be a source of restoration material.

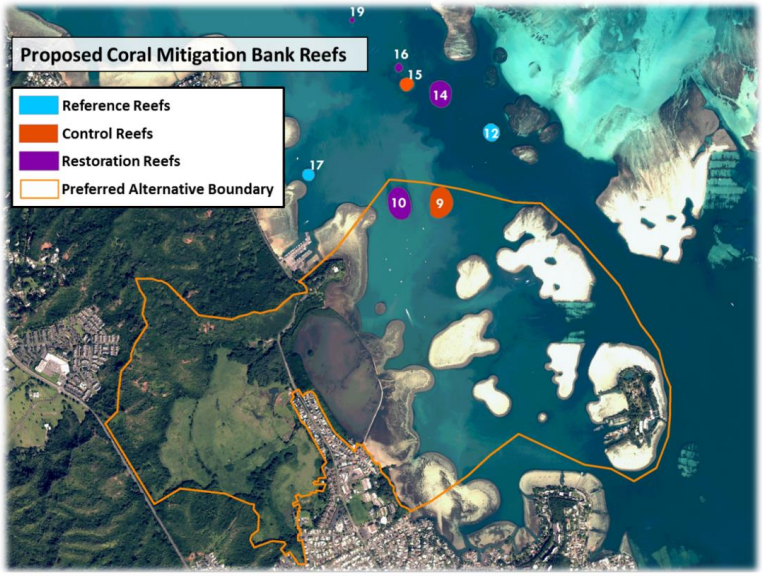


Figure 6.4. Proposed Mitigation Bank Reefs in Kāneʻohe Bay

The restoration efforts focused on the coral reefs of Kāneʻohe Bay and the proposed Heʻeia Reserve are anticipated to have overall minor to moderate beneficial effects (both in the short and long term) on marine habitats and associated species. The cumulative impacts of the three projects described above, any other restoration projects that might occur, and reserve designation could provide benefits to habitats, fisheries, other ecosystem services, and ecotourism. In addition, the restored patch reefs could become more resilient to other stressors, as important factors such as the ecosystem condition, biological diversity, connectivity and local environment improve (Marshall and Schuttenberg 2006). Some additional negligible beneficial effects may occur as local coastal farmers replace some of their chemical fertilizer costs with the algae removed from the reefs. In the long term, minor benefits to the socioeconomic environment from reserve designation, combined with other projects, could include better visibility of the area as a destination for tourists, educators, and students (and other uses compatible with reserve goals). Cumulatively, these factors would not be expected to inhibit the potential for reef ecosystems to sustain themselves. Available information therefore suggests that reserve designation, implementation, and continued work on the projects in coral reef ecosystems identified to date would not have cumulatively significant effects in the foreseeable future.

HIMB Activities Affecting Marine Areas

A portion of the Coconut Island Infrastructure Rehabilitation and Replacement Project involved work on utilities on the island to prevent them from failing: replacing utility lines, rerouting sewer connections on the island, and replacement of pumps at the sewer pumping station. Also, horizontal directional drilling was to be used to install new utility lines from the mainland to Coconut Island (Moku o Loʻe) under the seabed, to prevent the release of sediment during installation and to install new lines where they will not impact marine habitats. These elements of the Coconut Island Infrastructure Rehabilitation and Replacement Project could have minor, short-term adverse effects on flora or fauna present during construction, as discussed in the associated environmental assessment, published in 2014 (Community Planning and Engineering, Inc. 2014). There could be direct impacts to the marine environment in a very-localized area, near the pier and near where the tunnel for the utility lines begins. However, the project would have long-term beneficial impacts to the marine environment by ensuring that the failing utilities and infrastructure will not adversely impact marine habitats and species in the future. Once installed, the upgraded utilities and wastewater lines were expected to support indirect long-term beneficial impacts to research, monitoring, and educational programming that could use those resources.

The Lighthouse Pier had been in such disrepair that it was a safety hazard and needed to be removed, and then replaced with a new pier with the same footprint. The project was undertaken beginning around 2015 in a fashion consistent with HIMB's commitment to protect and preserve marine resources. As part of implementing that project, the university planned not to do work on the pilings supporting the pier other than to reinforce them. According to the environmental assessment, there would be no in-water work on supports to which corals are attached, to prevent impacts to those corals, and no work on the west end of the pier, where corals are present in shallow water. On the other end of the pier (where corals are 6 feet under water at low tide), all in-water work was to be scheduled to avoid the spawning period for most coral species. A survey of species present in the vicinity of the pier was conducted to inform construction plans. Information about the marine environment collected during the survey is incorporated by reference from the environmental assessment. The environmental assessment also indicated that there were no known past or future projects that would compound impacts that would occur if the proposed work were to be carried out as planned. Its explanation of why work on the pier and utilities would not result in any significant impacts is incorporated by reference (Community Planning and Engineering, Inc. 2014). There could be indirect effects of the pier replacement project if boat traffic to the island increases, discussed below.

MCBH-Related Boating in Kāneʻohe Bay

There is a Naval Defense Sea Area that serves as a 500-yard buffer around the Mokāpu Peninsula, surrounding all of MCBH Kāneʻohe Bay. It is off-limits to most civilians (other than certain civilians associated with the Department of Defense). There are two shallow channels that cross barrier reefs into Kāneʻohe Bay. The Sampan Channel or Kāneʻohe Passage cuts diagonally through the bay, a little more than 500 yards from the northwestern tip of Mokāpu Peninsula and ending at He'eia Fishpond. It has a natural depth of 8 feet (2.4 m) and can be used by smaller boats. The other channel that crosses the reefs is called Mokoliʻi Passage (near

Mokoli‘i Island, also known as Chinaman’s Hat), in the northwestern portion of the bay. It was dredged by the Navy in the early 1940’s to a depth of approximately 25 feet (7.6 m) (Bahr et al. 2015). A dredged ship channel (approximately 30 to 45 feet deep, according to the NOAA Nautical Chart 19359) extends the length of the bay, connecting MCBH with Mokoli’i Channel and providing deep-draft ship access between the bay and open ocean. The ship canal ends near a pier inside the prohibited area that extends into Kāne‘ohe Bay, not far from an on-base marina.

There is limited readily available information about the use of the pier at the base. It is reportedly used intermittently by large vessels, such as logistics support vessels, to refuel. Anecdotal reports from staff at the facility indicated that, at times, the pier might be used as infrequently as once per month by large vessels. The pier also offers a site for exercises or other maneuvers. Finally, it could allow equipment to be loaded onto or off of vessels (Unpublished data from MCBH – Kāne‘ohe Bay Environmental Compliance and Protection Department, 2016). Larger military vessels would have the potential to have more significant adverse impacts to marine biota in the vicinity, including protected species (if present). The lack of detailed information available about large military vessels and how they might operate in Kāne‘ohe Bay preclude a more detailed analysis herein. OCM did not find any information suggesting any large vessels are permanently stationed at the marine corps base. Many would be stationed at Naval Station Pearl Harbor, according to the Commander, Navy Region Hawai‘i, who also reports it has three dozen operational aircraft stationed at MCBH Kāne‘ohe Bay (Commander Navy Installations Command 2016). Marine Corps Training Area Bellows (also part of MCBH) is located in Waimānalo, southeast of Kailua and the Mokāpu Peninsula. One source reports that Amphibious Assault Vehicles travel between the two Marine Corps bases so that personnel can practice beach landing maneuvers at Marine Corps Training Area Bellows (adjacent to Bellows Air Force Station) (Marine Corps Base Hawai‘i 2006).

This Marine Corps recreational marina rents sailboats, kayaks, powerboats (including for fishing and waterskiing), and pontoon boats to military personnel. Some training on boat use is available on site, and a license from the marina is required to operate any of its boats. There is also a boat launch for boat owners. The powerboats available for rent are Boston Whalers that can accommodate six people. As of summer 2016, a comment on the marina’s website noted: “The Marina is undergoing construction of a wave attenuator and new piers for approximately eight months. Full operations will continue, but there may be delays.” (Marine Corps Community Services Hawai‘i 2016). There is a reference to those upgrades in an environmental assessment (EA) published in 2014 associated with relocating an unmanned aerial vehicle squadron to the base. The EA mentions that projects planned at the marina included installing a floating wave attenuator, relocating moorings, and constructing new docks, a boat rinse area with improved drainage, a fuel pump, and a fuel dock. This information appears in a table of planned projects, without any other details about the projects. The lack of detailed information about most of the projects proposed in the vicinity of the marina precludes a detailed analysis of their impacts. A number of federal laws would apply to the projects, e.g., the MMPA and Clean Water Act, compliance with which could avoid or reduce potential adverse impacts. The USACE

did issue a permit related to the demolition of an existing boat ramp and its replacement with a new boat ramp that addressed potential impacts to coral (USACE 2013).

Other Boating in Kāneʻohe Bay

OCM did not identify any thorough inventories or summaries of vessel use in Kāneʻohe Bay. However, by most accounts, boating activity in the bay is reportedly extensive. There is at least one private yacht club along the bay, called Kāneʻohe Yacht Club. In addition, Holokai Kayak and Snorkel Adventures offers activities such as stand-up paddling, kayaking, snorkeling, guided Hobie catamaran sailing, an interpretive tour of the fishpond by kayak, etc (Holokai Kayak and Snorkel Adventures 2016). These trips depart from Heʻeia State Park. An article in Honolulu Magazine in 2007 reported that five companies operated commercial boats at Heʻeia Kea Harbor to take visitors out to the reefs. At that time, the two largest companies accounted for most of the tourist trade, and those two companies managed more than a dozen vessels and employed nearly 50 people (Hollier 2016). There are also operators who rent personal watercrafts to be used in the appropriate Ocean Recreation Management Area within the bay. A survey that compiled certain types of information about the boating industry throughout Hawaiʻi in 2003 did not have any information about other boating in Kāneʻohe Bay, although it did imply that boats that can be chartered for fishing make up some of the boating industry on Oʻahu (Markrich 2004). Kāneʻohe Bay supports commercial, recreational and subsistence fishers, who primarily target yellowfin tuna and dolphinfish (mahi mahi).

Potential Future Boating Associated with Reserve Designation

The amount of boat traffic to Coconut Island could increase as a result of the proposed Heʻeia NERR designation, particularly given that reserve offices are proposed to be on the island for the first few years it operates. HIMB reports that it hosts 4,000 school-aged visitors to the island each year. HIMB also operates a regular shuttle from Lilipuna Pier to the islands, owns more than half a dozen boats, and has active research and educational programs (involving both graduate and undergraduate students). Small numbers of additional staff commuting at times the boat shuttle runs and has adequate capacity could potentially travel back and forth on the Boston Whalers currently employed to shuttle people to and from the island. If groups of 13 or more people required transport, those trips would require a larger boat. Regardless of vessel used, boat operators at HIMB are required to hold a boating certification recognized by the US Coast Guard, and successfully complete an on-water skills checkout, which includes boat docking and handling skills. HIMB also offers formal boat training opportunities and has a Marine Safety Officer (HIMB 2016). HIMB would be expected to inform individuals who go through its on-water skills checkout of the BMPs that must be followed while operating, docking, or anchoring a boat. Even if there were additional round-trips on the HIMB Boston Whalers to transport reserve staff and visiting researchers, plus a few additional round-trips on the HIMB cargo vessel (or a new education vessel) for larger groups, the increase in activity would be comparatively small relative to particularly busy times at HIMB. Reserve-related boating would therefore be unlikely to materially increase total boating activity in Kāneʻohe Bay and the waters around Coconut Island.

Boaters without a specific connection to Moku o Loʻe could use watercraft in the vicinity. Public access to the island is permitted in designated areas not situated near ongoing research activities. The main public access points are Maile Point, on the southwestern corner of the island, and the sandy beach on the eastern side of the island. Any members of the public visiting those parts of the island would also add to the total amount of boating that occurs in the vicinity. In addition, military personnel, private citizens, and tourists who own or rent motorboats could visit the area. Cumulative effects of the reserve designation and its implementation, and the replacement of Lighthouse Pier would not be expected to cause marine species or ecosystems to cross any ecological thresholds such that they would have difficultly sustaining themselves into the future, taking into account other stressors on the marine environment, such as invasive species.

6.4.10 Noise

Underwater Sound

With respect to marine mammals, several MBCH-related documents reprint summary information about potential impacts of overflights to marine mammals originally included as an appendix produced by Wyle Laboratories for MCBH Kāneʻohe Bay, in support of a 2008 Airfield Noise Study. The appendix, titled "Discussion of Noise and its Effect on the Environment," notes that there are differences in how different animals or groups of animals receive frequencies of sound. It also notes that marine mammals are sometimes startled by airborne noise, but some can become habituated to it over time. Rates of habituation vary by species, population, and demographics (primarily age and sex). In addition to airplanes, low-flying helicopters and loud boat noises could potentially disturb some marine mammals, not just airplanes. Further, this analysis notes that the continued presence of a single noise source (or of multiple sources) could cause some marine mammals to leave a preferred habitat, but that does not always occur. In particular, a few studies exist where researchers did not observe marine mammals departing an area where overflights occurred regularly. Thus, the summary comments that "other anthropogenic noises in the marine environment from ships and pleasure craft may have more of an effect on marine mammals than aircraft noise." (AECOM 2016). This may be in part because sound generated in the air travels through the water primarily in the narrow area right below the aircraft. The angle of incidence must be 13° or less from the vertical for the wave to continue propagating under the water's surface. Further, both depth of water and bottom conditions affect sound propagation and levels of underwater noise audible from passing aircraft. Aircraft typically pass over a given area quickly, which reduces the duration of any sound that can be heard underwater (US Navy 2013).

To illustrate how aircraft noise is transmitted to marine species, a model of underwater sound pressure level as a function of time at various depths (2 to 50 m) was run for an F/A-18 Hornet aircraft making subsonic (250 knots) overflights at various altitudes. For the most extreme modeled case, of an F/A-18 at the lowest altitude (300 m), the sound level at 2 m below the surface of the water peaked at 152 dB referenced to 1 micropascal, and the sound level at 50 m below the surface of the water peaked at 148 dB referenced to 1 micropascal. When an F/A-18 flight was modeled at 3,000 m altitude, peak sound level at 2 m depth dropped to 128 dB

(referenced to 1 micropascal). The Navy's study also addresses the effects of sonic booms on underwater sound (see Table 3.0-15). It further notes that sound from helicopters is transient and varies in intensity, just like sound from fixed-wing aircraft, but helicopters tend to produce lower-frequency sounds and vibration at a higher intensity than fixed-wing aircraft (Department of the Navy 2013).

Although acoustic signatures of naval vessels are considered classified information, a summary of the effects of naval vessel noise is also provided in the same chapter of the Navy's report. Noise radiated from Navy ships is, in some cases, compared to the noise of a typical fishing vessel, approximately 158 dB referenced to 1 micropascal. After commenting on some of the types of watercraft that support naval operations in the Pacific and presenting general, qualitative differences between the watercraft, the EIS assesses, broadly, the relative contributions of Navy vessels versus other vessels to the overall ambient noise in the marine environment. It concludes that in the vicinity of inland waters near ports with naval activity, the contribution of Navy vessels to the overall noise in these environments is minimal because the areas in question typically have large amounts of commercial and recreational vessel traffic. Based on that assessment and the very limited documentation about military watercraft (particularly large vessels) that use Kāneʻohe Bay, it appears the focal areas for a cumulative impacts analysis of sound in Kāneʻohe Bay should be recreational and commercial vessel noise, discussed above. OCM did not identify adequate sources of data about boat traffic, the frequencies and intensities of the sounds, and spatial distribution of sources and receptors (e.g., the distance from boats to potentially affected marine mammals) to permit a quantitative analysis of the cumulative impacts from sound that on marine species in the bay. Boating activities associated with the proposed Heʻeia NERR would likely be minimal and conducted in vessels with relatively small acoustic signatures in the scheme of total boating activity in the bay. Further, reserve partners would be required to adhere to applicable BMPs if they identify marine mammals or other threatened or endangered species in their immediate vicinity, e.g., requirements to reduce vessel speeds and maintain their distance from protected species until they leave the area of their volition.

Sound Transmitted Through Air

Noise from military overflights exceeds ambient noise levels only beneath approach and departure corridors, as well as certain on-base areas. According to the Department of Defense, as aircraft altitude increases, noise audible from the ground drops and soon becomes indistinguishable from other ambient noise. Coconut Island lies near approach pathways for MCBH -- Kāneʻohe Bay. An *Air Installations Compatible Use Zones* (AICUZ) study is periodically updated for MCBH, most recently in June 2016. The study analyses parameters associated with aircraft operations, primarily related to noise and safety, and offers recommendations about compatible land uses. Pertinent information about noise in the area is incorporated by reference. One important change to AICUZs in 2016 pertains to Coconut Island. AICUZ noise levels projected on the island in the 2016 report increased by approximately 5 decibels (dB) compared to 2003 and 2012. (The 2012 analysis was part of a *Final EIS for the Basing of MV-22 and H-1 Aircraft in Support of III MEF Elements in Hawaiʻi* and contains more detailed information about noise generated by different types of aircraft at the base or that were

proposed to be shifted to the base. That Final EIS also summarized baseline flight operations at the base under the scenarios evaluated in its Appendix D-1, which is incorporated by reference. (Department of the Navy 2012) Impacts occur at Coconut Island and in its vicinity even though aircraft departing from Runway 22 at the base are instructed to avoid Coconut Island and populated areas.

The 2016 AICUZ study depicts areas projected (based on modeling) to experience different sound levels; see figures throughout that report, e.g., Figure 4-4. The contours are intended to inform land use planning; they do not describe the level of sound a person might hear during a single event. The analysis published in 2016 finds that, by 2018, much of the land on Coconut Island and some of nearby marine areas would be anticipated to fall within the contours representing 65-74 dB Day-Night Average Sound Level (DNL, a unit of measure that averages and weights noise over 24 hours). The Marine Corps considers this area moderately impacted and recommends the University of Hawai‘i take the results of the updated AICUZ study into account as part of future land use planning. Also, some marine areas within the reserve would potentially experience a 60-64 dB DNL. Some areas along the shoreline proposed for inclusion in the reserve, including near He‘eia Fishpond, would potentially experience DNLs of 55-59 dB. Table A-1 in the study shows Department of Defense land use recommendations in different noise zones. It shows activities not recommended in the 65-74 dB DNL range, including residential uses, unless designed and built for noise reduction. Some other land uses are either not recommended in the zone experiencing 70-74 dB DNLs (e.g., including nature exhibits and places of public assembly) or would need noise level reduction techniques.

The AICUZ study also contains some information about maximum sound levels during aircraft overflights. See Table 4-2. The maximum sound level heard for a fraction of a second (Lmax) at He‘eia State Park (Kealohi Point) could range from 73 to 105 dB, depending on the type of aircraft and its flight pattern. Other studies produced for MCBH indicate that noise from traffic on highways can also be heard in some areas. The potential impacts of different sound levels to humans and a number of different kinds of animals are discussed in detail in the 2016 AICUZ study and are incorporated by reference. In brief, they include annoyance, interference with speech, interference with sleep, and non-auditory health effects (AECOM 2016).

An EA developed in connection with infrastructure upgrades at HIMB indicated that noise sources in the area include boat traffic, aircraft overflights, and occasional construction-related noise (generally limited by the Department of Health to 55 A-weighted decibels during the day). The study prepared for HIMB also notes that, generally, noise due to construction equipment can fall between 70 and 100 A-weighted decibels. Mufflers and noise barriers can be used to decrease these levels. HIMB follows state requirements for its construction projects and obtains noise permits when needed. With mitigation measures implemented, the assessment concluded that noise impacts would be reduced to less than significant, even when assessed in the context of other noise sources (such as overflights) (Community Planning and Engineering, Inc. 2014). On the basis of this assessment, OCM concludes that its proposed He‘eia NERR designation and any associated increase in individuals visiting or working at the island, even the increase associated with short-term constructions projects, would not result in cumulatively significant

impacts to noise heard on land. OCM recommends, however, that the results of the 2016 AUCIZ Study Update be taken into account as the reserve considers where to site future facilities. Anecdotal information suggests that aircraft overflights can sometimes be heard from shoreline areas, including He‘eia Kea Harbor, so every portion of the reserve likely is subject to some intermittent noise from the marine corps base; and it might only be one factor of many to be considered as part of future planning efforts.

6.4.11 Human Environment

Many different facets of the human environment were addressed individually in Chapter 6.3. Rather than revisiting those analyses at an equally granular scale, this subchapter groups some sectors together, where they are interrelated.

Ocean Economy, Fishing, Tourism, and Recreation

Major sectors boosting the ocean economy include tourism (and nearshore businesses, including restaurants), recreation, fishing, marine transportation services, and related businesses. Readily available information about tourism along (and within) Kāne‘ohe Bay was summarized in Chapter 5, as well as in Chapter 6.4.9, under the header “Other Boating in Kāne‘ohe Bay.” Proposed He‘eia NERR designation and operation could result in small increases to the numbers of recreational users and tourists who visit the region, but, were that to occur, no cumulatively significant adverse effects would be expected to occur given the fact that areas that draw tourists and recreational users appear to still have adequate capacity to cater to a larger number of visitors and residents.

The marine environments of Kāne‘ohe Bay are a primary driver of the ocean economy in the study area. As noted earlier, there are a number of projects ongoing in the reefs of Kāne‘ohe Bay that, if successful, could potentially result in minor improvements to habitat for fish. Such projects could lead to greater species abundance and diversity, which in turn, could make the area more appealing for fishing, tourism and recreational activities. Were a reserve designated, no new regulations or restrictions would be imposed on these ocean economy activities, however, new data about the status of fishery resources in the bay could be generated that could inform future management decisions. Over the medium- to long-term, these fisheries management decisions could either benefit or have adverse effects on commercial and recreational fishers or other resource users depending on the resulting management decisions. However, given the strong fishery management requirements already in place, and the robust ongoing research in the study area, it is not expected that the effects associated with improved fishery management decisions derived from the work of the reserve would result in significant adverse cumulative effects on the ocean economy.

Employment, Military, and Traffic

Proposed He‘eia NERR designation is not expected to have an appreciable impact on any of these sectors. As noted in Chapter 6.3, numerous factors affect employment and the economy in the study area. Major changes in employment trends are not reasonably foreseeable. MCBH is the largest employer in the region, and the population at the MCBH – Kāne‘ohe Bay is on the

order of 10,000 people. The military regularly reassesses which squadrons to “home base” at different installations, but changes resulting since 2000 from such decisions typically have not resulted in a net change in the population of more than about 10% at any given time. Other employers in the study area, including HIMB, are small by comparison and historically do not significantly impact the local employment rate. Military use of the coast is also a prominent feature of the economy. Reserve designation and operation would not be expected to result in changes to military operations, but could offer the same benefits to base residents as would be offered to other community members.

Also, regardless of whether and where new facilities are constructed, designation of a reserve could increase the amount of traffic traveling along Kamehameha Highway. The highway, however, has the capacity to handle anticipated added vehicle traffic, as noted in Section 1.5.1.4 of the DMP. Accordingly, the designation of research is not expected to result in significant cumulative effects to employment, the military, or traffic in the affected area.

Cultural, Historic, and Archaeological Resources

Hawai‘i Revised Statutes, Chapter 6E, Historic Preservation, outlines the state’s historic preservation program and recognizes the unique value accorded to historic and cultural heritage sites. With very limited exceptions, historic preservation program review applies to projects proposed by state and private entities that own historic properties, as well as to federal actions under the provisions of the NHPA, as amended. Within the study area, there are a number of historic properties, including areas traditionally important (because of their cultural or religious significance) to Native Hawaiian Organizations. These areas are more fully described in chapters 5 and 6 of this document.

Beyond the proposed action, NOAA is aware of a number of other activities being conducted in the area – primarily by the reserve’s site partners – that have the potential to impact historic or archaeological resources. For example, there are archaeological resources on the HCDA parcel, managed by Kāko‘o ‘Ōiwi (see Figure 1.21 in the DMP). As noted in the DMP, activities proposed in the area containing historic, cultural, and archaeological resources will need to undergo additional review to ensure that the resources are protected. As mentioned above, the Hawai‘i State Historic Preservation Division (SHPD) was consulted before the USACE authorized the He‘eia Fishpond restoration efforts to ensure the restoration would have no adverse impacts to the historical, structural or cultural integrity of the fishpond (which is listed on the National Register of Historic Places). As discussed in Chapter 6, the likelihood for significant impacts from activities outlined under the no action alternative is thought to be relatively low due to the need for SHPD review to preserve and protect historic resources as a part of most permitting and planning processes, as well as due to site partners’ awareness and sensitivity to the possible presence of historic and archaeological resources.

Any federal actions, including those that may be undertaken in connection with a proposed He‘eia NERR, will be subject to the requirements of NHPA, including, when appropriate, consultation with the SHPD and interested Native Hawaiian Organizations. Accordingly, each OCM undertaking that has the potential to affect historic and traditionally important properties

will be evaluated individually pursuant to NHPA, after the undertaking is proposed. Consultations, when needed, will help ensure that the historical significance of individual areas is accounted for when projects are planned. As the result of these safeguards, the identified external activities, when combined with the potential impacts from the proposed He'eia NERR and other identified federal actions in the vicinity, are not expected to result in significant cumulative effects to historic resources in the study area.

Cultural History, Maritime Heritage, Agriculture, and Aquaculture

The study area is home to a vibrant cultural history that is actively cultivated and maintained by local residents and organizations including a number of site partners for the proposed He'eia NERR. Subchapter 5.2.2.1 outlines a few major elements of the cultural history of the area. The HCDA parcel and the He'eia Fishpond (where traditional agriculture and aquaculture techniques are being applied) serve not only as sites of agricultural and aquacultural operations, but they also reflect a commitment to apply traditional management techniques to guide operations. Traditional agricultural and aquacultural operations offer many benefits In addition to providing local sources of food, they can increase community involvement, strengthen relationships among community members, offer educational opportunities, and help maintain cultural heritage and traditions. In this instance, the projects allow Native Hawaiian Organizations (including Paepae o He'eia and Kāko'o 'Ōiwi) to connect others to traditional culture and knowledge. Organic relationship-building among community members offers its own benefits, as well. As community dialogue grows, additional community members will become aware of and potentially interested in cultural history of the region, which should increase the number of people in communities that understand and promote their heritage.

The maritime heritage of the area is also diverse: it spans from the use of fishponds and other traditional fishing practices to wrecks in Kāne'ohe Bay related to military operations. While the proposed action could indirectly promote fishpond agriculture, designation of a reserve is not anticipated to affect traditional (or modern) fishing practices. Wrecks in Kāne'ohe Bay are protected under the aforementioned federal and state laws and are similarly not anticipated to be affected by the proposed action.

Given the strong awareness of the area's cultural history and the numerous individuals and organizations working in the area to support this history and heritage, it is highly unlikely that research reserve activities conducted in coordination with site partners, would interfere with sustainability or push communities beyond tipping points, and thus no cumulatively significant adverse impacts are anticipated.

Education and Outreach

Information about outreach and education efforts ongoing at Moku o Lo'e, He'eia State Park, He'eia Fishpond, and a number of other formal and informal venues has already been presented, including in Table 5.22 and Subchapter 6.3.3.5. For example, various educational and community programs are offered by HIMB and other entities in the study area. The programs range from formal classroom instruction for students, to programs for school groups and community groups, to community engagement through "work days." In addition, numerous

other entities also provide educational opportunities for children and adults to learn about many facets of local ecosystems. These contributions by non-governmental organizations, schools and universities, cultural and religious groups, government agencies, and others contribute to informing the public about the interrelationships between ecosystems, the potential effects of human behaviors, and best practices for resource conservation, among other topics.

If established, the proposed He‘eia NERR’s education goal for the site would be to increase the community’s “understanding of the effects of human activities and natural events, to improve informed decision-making affecting the He‘eia estuary, coastal ecosystems, and ultimately the entire ahupua‘a.” The reserve could also help its partners and others in the region collaborate on and integrate their educational programs. Finally, He‘eia Reserve would carry out its own education and outreach programs for teachers, K-12 students, and interested members of the coastal management community (through the Coastal Training Program). Despite years of grappling with coastal management challenges, an array of complex coastal issues still challenge communities in the region. This suggests that there will continue to be a need for further community engagement about locally-relevant issues. Goals for the proposed He‘eia NERR’s educational and outreach activities might potentially extend beyond educating individuals towards bolstering community engagement and stewardship in the He‘eia estuary.

Even with added capacity from the proposed He‘eia NERR, given growing interest in sustainability and growing awareness of the need to better understand environmental stressors, there will continue to be an enduring need for more formal education, field trips, interactions between researchers and the public, and other types of community involvement opportunities. The activities of the reserve are expected to support expanded educational and outreach opportunities in the area, and thus, are not expected to result in cumulatively significant adverse impacts in the next 10 to 15 years.

Research and Monitoring

A number of institutions (academic, governmental, and non-governmental) have active research and monitoring programs in Kāne‘ohe Bay and the He‘eia estuary. The primary research topics studied at HIMB are summarized on its website. However, there are still many topics yet to be explored by researchers, information gaps with respect to areas being studied, and a large number of locations for which baseline data are not yet available.

If designated, the proposed He‘eia NERR would collect baseline data about environmental conditions, including habitat and ecosystem service data, as well as baseline cultural and archaeologic information. The reserve’s research program plans to compare and evaluate two different “ecosystem-based” management approaches – one which “embraces traditional Native Hawaiian management practices;” the other based on contemporary ecological restoration techniques to increase native species biodiversity, ecological resilience, and ecosystem integrity. Through this, the reserve proposes to evaluate the various ecosystem services provided by each management approach.

Reserve research and monitoring is expected to contribute a great deal to efforts to increase the awareness of community members and decision-makers about natural and anthropogenic processes, restoration efforts and their impacts, and key ecosystem services. Specifically, the reserve could help broaden and deepen community knowledge about key ecosystem attributes and services, their impacts, and management options. Reserve Staff could also serve to facilitate collaboration among outside researchers and practitioners. Because of the many outstanding research needs associated with the He‘eia estuary as a whole, any cumulative adverse impacts related to research and monitoring in the study area would not be anticipated to be significant.

Stewardship

The DMP articulates several goals for the proposed He‘eia NERR, including that the reserve could be a center for integrating sound estuarine science with traditional Hawaiian knowledge and cultural practices. Also, the reserve will seek to inform resource managers and local communities about ways to address key coastal issues. The proposed reserve could also put decision-makers who need to make resource management decisions in touch with the data and resources they need to effectively address key coastal issues like climate change, habitat restoration, and water quality. Ultimately, this could lead to more informed ecosystem-based management decisions that factor in many complex elements and interrelationships. Over time, the reserve would most likely serve as a clearinghouse for access to trusted sources for decision-makers facing resource management challenges, as well as for students and visitors to learn about Hawaiian uplands, estuaries, and marine areas and the challenges facing them. As important as ongoing activities in this vein and reserve contributions would be, in looking at the considerations applicable to determining whether impacts are cumulatively significant, OCM judges that even the cumulative impacts of anticipated education, research, monitoring, and stewardship activities would not be significant.

6.4.12 Summary

In summary, this evaluation does not identify cumulatively significant adverse effects from designation and operation of the proposed He‘eia NERR or from past, present, or reasonably foreseeable actions. For more detailed information, see preceding subchapters and the documents OCM considered as part of preparing this EIS. All available information indicates that natural resources and human communities would be expected to continue to be able to sustain themselves into the future, despite the cumulative effects of stressors, without crossing ecological thresholds. However, there are some unknown or poorly-understood factors that could intervene, for example, climate change. While other factors such as disease could potentially make it more difficult for some portions of ecosystems to maintain their current quality, designation of the proposed He‘eia NERR and the availability of reserve staff to coordinate with researchers and resource managers about ecosystem functioning should support the development of management strategies to address and, to the extent practicable, mitigate the cumulative effects of natural and anthropogenic stressors.

6.5 RELATIONSHIP TO OTHER APPLICABLE STATE, REGIONAL, LOCAL AND NATIVE HAWAIIAN PLANS AND POLICIES

It is anticipated that the establishment of the proposed He‘eia NERR would not conflict with the objectives of federal, state, regional or local land use plans, policies or controls for the areas within the designated boundaries. The DMP describes the activities that take place in and around the proposed reserve and the authorities that govern those uses (Appendix A). All the lands and waters comprising the proposed He‘eia Research Reserve are currently under either public or private ownership by entities anticipated to become a party to a voluntary multi-partner Memorandum of Understanding or other agreement (hereafter “MOA”) that will describe the roles and responsibilities of each party within the administrative boundary of the proposed He‘eia NERR (Appendix A). If designated, reserve staff would coordinate with the landowning entities and their lessees at the programmatic and strategic partnership levels on an as needed basis to address any issues that may arise after the proposed reserve is designated. Any advice provided, or action taken, by the proposed reserve staff or signatory parties to the MOA is expected to be consistent with NERRS, local, state, or federal regulations and the roles and responsibilities detailed in the MOA. Proposed He‘eia NERR staff would regularly meet with the future reserve advisory board, various strategic partners, and key community leaders to share ideas, promote efficiencies, and resolve conflicts. Using a collaborative process, the reserve staff and its partners will ensure the implementation of the reserve’s Management Plan. The following paragraphs summarize some of the state, regional, and local plans that apply to the He‘eia estuary and vicinity.

Portions of the proposed He‘eia NERR fall into the Conservation District managed by the DLNR Office of Conservation and Coastal Lands, pursuant to Hawai‘i Revised Statute (HRS) Chapter 183C and Hawai‘i Administrative Rules Title 13, Chapter 5. The Conservation District includes areas “with important natural resources essential to the preservation of the State’s fragile natural ecosystems, and the sustainability of the State’s water supply.” (HRS Chapter 183C-1). The Conservation District includes Coconut Island and surrounding waters, He‘eia Fishpond, the upland forests within the HCDA parcel, and the He‘eia Kea Small Boat Harbor. DLNR has established categories of allowable uses and activities in the Conservation District, some of which require a permit (e.g., construction of facilities and potentially permanent installation of research instruments). Because the proposed federal action does not involve any immediate changes to use or on-the-ground activities on the areas proposed for inclusion in the reserve, no CDUP would be needed at the time of reserve designation. However, to the extent that future activities trigger the requirement for a permit, reserve partners will be responsible for obtaining them, as discussed in the DMP. Thus, the proposed action is expected to be consistent with State requirements for the Conservation District.

Legislation passed by Hawai‘i’s legislature in 1990 created a task force charged with developing and implementing a master plan for Kāne‘ohe Bay to support planning for the preservation and protection of the bay as a natural and cultural resource and resolving conflicts among recreational users, among other purposes. Issues identified in the plan included coastal development, open space, public access, water quality, fishing, commercial recreation, and

fishpond restoration. The Kāneʻohe Bay Regional Council was established by RS 200D to facilitate the implementation and periodic review of the Kāneʻohe Bay Master Plan. The Regional Council was also set up to coordinate public and private activities in Kāneʻohe Bay, educate and facilitate dialogue among bay users and the public, offer relevant recommendations regarding data and information needs relevant to the Bay, and advise the State and County on matters regarding the use of Kāneʻohe Bay. The Council is chaired by the administrator of DAR, and meets quarterly. For more information about the Council, see http://dlnr.hawaii.gov/dar/kaneohe-bay-regional-council/. Of particular note is that the Kāneʻohe Bay Master Plan mentions the possible designation of a NERR. As noted in the DMP, the proposed Heʻeia NERR would benefit from partnering with the Council to coordinate on reserve operation and receive feedback on how proposed programs and activities at the NERR would affect other users in the bay. The proposed action is consistent with the Kāneʻohe Bay Master Plan.

Another plan for the region is the Sustainable Communities Plan (SCP) for the Koʻolau Poko planning area, updated in April 2016. The planning area includes the entire study area, as Koʻolau Poko spans from Kualoa in the north to Makapuʻu Point in the south (a distance of about 20 miles). The SCP was prepared to implement objectives and policies set forth in the Oʻahu General Plan and to help guide public policy, investment, and decision-making through 2035. The SCP indicates that General Plan calls for the Koʻolau Poko area to "experience essentially no growth" and to maintain the characteristics typical of urban fringe and rural areas. The SCP's vision for Koʻolau Poko's future is focused on protection of natural, scenic, cultural, historic, and agricultural resources and addressing the region's infrastructure needs. In particular, the vision references adapting the *ahupuaʻa* model for land use and natural resource management, as well as preserving and enhancing scenic, historic, recreational, agricultural, aquacultural (fishpond), and cultural features that define the region's sense of place. The DMP for the proposed Heʻeia NERR mirrors these goals (City and County of Honolulu 2016).

The policies identified in the Koʻolau Poko SCP are diverse. The policies most relevant to the proposed Heʻeia NERR include: "promote access to mountain and shoreline resources for recreational purposes and traditional hunting, fishing, gathering, religious, and cultural practices;" "seek to restore the natural filtering, flood control, recreational, biological and aesthetic values of streams, fishponds and wetlands;" "encourage continuation of small-scale agricultural uses in urban areas, provided that there are standards for compatibility between adjacent uses;" and "promote restoration of fish population in nearshore waters." The DMP for the proposed Heʻeia NERR reiterates these goals. The SCP covers such topics as the desirability of protecting scenic views, providing for recreation, promoting access to shoreline and mountain areas, preserving significant historic features, protecting visual landmarks, and emphasizing physical references to the history of the area and its cultural roots. Many of these themes also are addressed in the DMP for the proposed Heʻeia NERR. Further, the SCP calls for providing public access to the shoreline, including spaces for passive and active recreation. Establishment of the proposed Heʻeia NERR could help promote recreational and educational use of the study area. The SCP indicates that the vision for Heʻeia wetland is to produce taro once again, which is consistent with the goals of Kākoʻo ʻŌiwi and the proposed Heʻeia NERR's

DMP. Finally, the SCP recommends ensuring environmental compatibility in the design and construction of park facilities, something emphasized throughout the NERRS. A review by OCM of the SCP indicated no conflicts between it and the DMP. Thus, there are no apparent conflicts between designation and operation of the proposed He‘eia NERR and the formally-adopted plan that lays out the vision for the larger community for the next 20 years. OCM also reviewed the Ko‘olau Poko Watershed Management Plan and determined that establishment of a reserve would not be inconsistent with that plan (City and County of Honolulu 2016).

Hawai‘i’s Shoreline Protection Act established Special Management Areas (SMAs) along the coast of the State, extending from the shoreline inland, to protect coastal resources. Counties issue SMA permits for some uses, whereas other uses are exempt from SMA permitting requirements (e.g., agriculture). Coastal zone management objectives and supporting policies provide guidance to the counties in administering SMAs. SMA guidelines can be found in HRS 205A-26. The proposed He‘eia NERR’s DMP identifies the areas considered for inclusion within the reserve that are subject to SMA permitting requirements. When needed, the reserve and its partners will obtain the required permits prior to undertaking activities subject to permitting requirements. For a complete list of all the existing rules and regulations governing activities and uses within the study area (e.g., the Ocean Recreation Management Area), see Appendix L of the DMP. In addition, Figure 6.5 depicts the Ocean Recreation Management Areas.

In summary, based on its review of existing federal, state, regional, local and/or Native Hawaiian land use plans, policies or controls, OCM did not identify any conflicts between any of them and plans for the proposed He‘eia NERR, as outlined in the DMP.

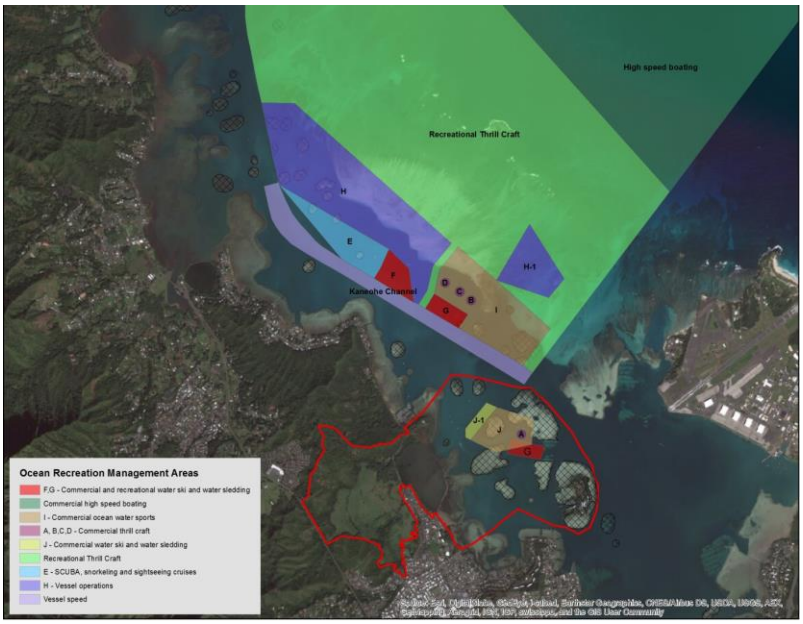


Figure 6.5. Ocean Recreation Management Areas in Kāne‘ohe Bay, North of HIMB
(Note: Potential boundaries of the Reserve identified under the Preferred Alternative are outlined in red.)

6.6 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

NEPA requires an analysis of the extent to which the proposed action's direct and indirect effects would commit operational resources to uses that cannot be recovered or that future generations would be unable to reverse.

A resource commitment is considered irreversible when impacts from its use would limit future use options and the change cannot be reversed, reclaimed, or repaired. Irreversible commitments generally occur to nonrenewable resources such as minerals or cultural resources, and to those resources that are renewable only over long time spans, such as soil productivity.

A resource commitment is considered irretrievable when the use or consumption of the resource is neither renewable nor recoverable for use by future generations until reclamation is successfully applied. Irretrievable commitments generally apply to the loss of production, harvest, or natural resources and are not necessarily irreversible.

The designation of the proposed He'eia NERR and implementation of the DMP should result in few irreversible or irretrievable commitments of resources. The action alternatives would require minor commitments of both renewable and nonrenewable energy and material resources for the management, research, education and outreach activities associated with designation and operation of the proposed He'eia NERR. Designation of a reserve is also expected to result in the commitment of substantial resources, staff time, and funds associated with NERRS activities. Nonrenewable resources that would be used during these activities include fuel, water, power and other resources necessary to implement and operate a reserve. Ongoing operational funding is needed to plan, manage, and otherwise implement the proposed He'eia NERR. Once these operational funds are spent, they become irretrievable. Also, to the extent that any buildings or permanent infrastructure were to be installed in support of the proposed He'eia Reserve's operations, those efforts would also effectively irretrievably commit resources unless the infrastructure were removed or the reserve were de-designated.[31]

Under the no action alternative, the staff time invested in analyzing and planning for potential reserve designation and implementation would not result in an action that achieved the purpose and need for the proposed action. A team of individuals prepared the DMP for the reserve, staff at NOAA thoroughly evaluated the proposed designation, the preparers of the report listed below prepared this DEIS, and staff affiliated with a number of proposed partners have contributed time, effort and information in support of a potential reserve designation. However, partner actions in furtherance of habitat manipulations and restoration activities or associated education and outreach could continue, even under the no action scenario.

[31] Upon de-designation, the State would be responsible for returning procurement acquisition and construction funding at the fair-market value at the time of de-designation.

In addition, limited environmental change is anticipated or permitted through the NERR program (other than minor disturbances associated with research). The proposed He‘eia NERR would be operated and managed with advice of the land holding partners and/or their lessees. Each of these partners has a vested interest in the reserve due to land ownership, existing activities, and/or their interest in conserving natural resources. This partnership is voluntary, executed through a multi-party MOA that provides structure for the long-term support of the proposed He‘eia NERR by local Native Hawaiian Organizations. However, any partner, could, if it chose, withdraw from the partnership. The multi-party MOA details the relationships between partners and each partner’s commitment to the proposed He‘eia NERR. It has been developed by signatories and will be available in the Final Management Plan.

Recreational and commercial fishing, traditional agricultural and aquaculture, and other traditional uses are expected to continue under current regulatory authorities, and these activities are not directly tied to the proposed proposed He‘eia NERR’s implementation or management. Regardless of whether a reserve is designated, it is expected that the site partners, Paepae o He‘eia and Kāko‘o ‘Ōiwi, would continue the implementation of planned habitat restoration and associated agricultural and aquacultural manipulation activities within the proposed buffer areas, albeit without the benefits associated with the coordination and resources afforded through the existence of a He‘eia NERR. It is one of the goals of the proposed He‘eia NERR is to better understand the He‘eia estuary, and coastal habitats of the He‘eia ahupua‘a, to provide decision-makers and the public with a balance of contemporary science and traditional knowledge to ensure that few irreversible or irretrievable commitments of resources occur beyond the staff time that would be associated with the designation of the site as a NERR. If a reserve is designated, the operational funding OCM awards to it each year could also lead to irreversible or irretrievable commitments of resources in the study area.

6.7 LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

NEPA requires consideration of the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. The short-term uses of the environment relating to the preferred alternative and the proposed alternatives A, B and C are expected to result, generally, in overall improvements to the health and quality of the affected natural and socioeconomic environments by: (1) improving the scientific understanding of the ecological functioning of the area; (2) expanding opportunities for public education and outreach related to the estuarine system; and (3) providing future He‘eia NERR staff to assist site partners in the conduct of their ongoing and planned management of the reserve and to help advise on ways to mitigate any associated adverse environmental impacts stemming from these site partner activities. As noted previously, most of the adverse effects from the preferred alternative and alternatives A, B, and C would be short-term (e.g., during the restoration or construction process) and particular to just some of the species present (e.g., invasive species). These predominantly short-term, adverse effects are expected to co-occur with long-term benefits to ecosystem services and productivity.

The long-term productivity related to the preferred alternative and the proposed alternatives A, B and C is based on the goals of the proposed He‘eia NERR and the DMP designed to achieve these goals. This includes use of ecosystem-based management strategies as a driving force for habitat manipulation and restoration activities within the proposed reserve so as to improve understanding of the environmental services provided. This management approach is expected to result in substantial improvements to natural resources management in the He‘eia estuary in the long-term and to promote scientific investigations to improve informed decision-making, develop place-based education and training programs that inspire and educate the community, and create opportunities to practice and promote stewardship that sustains cultural, biological, and natural resources.

Under the no action alternative, it is expected the short-term improvements to the health and quality of the environment and the long-term productivity of the area as indicated by improved environmental services would be less pronounced. Although the planned site partner activities could be expected to provide some of these benefits without a research reserve designation, it is expected that, absent the coordinating function and resources provided by the NERRS, these benefits would not be as great as those provided under the action alternatives.

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CHAPTER 7: COMPLIANCE WITH OTHER ENVIRONMENTAL AND ADMINISTRATIVE REVIEW REQUIREMENTS

7.1 Clean Air Act

The Clean Air Act (42 U.S.C. §§ 7401 *et seq*.) directs the U.S. Environmental Protection Agency (USEPA) to set limits on air emissions to ensure basic protection of health and the environment. The fundamental goal is the nationwide attainment and maintenance of the National Ambient Air Quality Standards (NAAQS). Primary NAAQS are designed to protect human health. Secondary NAAQS are designed to protect the public welfare (for example, to prevent damage to soils, crops, vegetation, water, visibility, and property).

Compliance: Operation of a research reserve has the potential to bring additional visitors to the project area, which could result in additional car, bus, and/or boat traffic. However, all vehicles are required to be maintained and operated in accordance with all applicable requirements intended to improve air quality, including State of Hawai‘i requirements. All vehicles and machinery that emit any air pollution are expected to be operated by reserve staff and others in compliance with all applicable federal, state, and local air quality rules and associated requirements.

7.2 Clean Water Act

The Clean Water Act (33 U.S.C. §§ 1251 *et seq.*) is the principal federal law governing water quality. The act's objective is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The act regulates both the direct (sometimes called point source) and indirect (sometimes called nonpoint source) discharge of pollutants. Section 404 authorizes a permit program for the discharge of dredged or fill material into the waters of the United States. The United States Army Corps of Engineers (USACE) administers that program. Section 401 of the act requires applicants for federal licenses or permits to conduct activities that may result in a discharge of pollution into navigable waters to obtain certification of compliance with applicable state water quality standards and goals (or a waiver from the state). Other sections of the act govern point source and nonpoint source pollution.

Compliance*:* There are no compliance requirements under the Clean Water Act that must be followed in order to designate a National Estuarine Research Reserve (NERR), and there are no anticipated Clean Water Act requirements associated with implementing the proposed He‘eia National Estuarine Research Reserve Draft Management Plan (DMP).

7.3 Coastal Zone Management Act

The goal of the federal Coastal Zone Management Act (CZMA) (16 U.S.C. §§ 1451, *et seq*.) is to preserve, protect, develop, and, where possible, restore and enhance the nation's coastal resources. The portions of the act relating to the National Estuarine Research Reserve System (NERRS) are discussed in previous chapters. Under the act, NOAA's Office for Coastal Management (OCM) also supports implementation of federally-approved, state coastal zone management programs (CMP). NOAA approved the State of Hawai‘i's CMP on September 18,

1978. Section 307 of the CZMA requires any federal action inside or outside of a state's coastal zone that affects any land or water use or natural resources of the coastal zone to be consistent, to the maximum extent practicable, with the enforceable policies of approved state management programs. It provides that no federal license or permit may be granted without giving the state the opportunity to concur that the project is consistent with the state's coastal policies. Regulations outline the consistency procedures.

Compliance: Within the Hawai'i Office of Planning (OP), the Hawai'i CMP has the authority to review, pursuant to the federal consistency provisions of the CZMA, federal licenses, permits, financial assistance, and certain other activities that affect the coastal zone for consistency with the program's enforceable policies. These policies are found in Hawai'i Revised Statutes Chapter 205A. The Hawai'i CMP has been closely involved in the evolution of proposals for development of a NERR in Hawai'i. In addition, the draft MP proposes that the HI CMP be represented on the future reserve advisory board. Activities such as reserve designation, any future federally supported construction projects, and any future federally supported land acquisition carried out by reserve partners could be subject to OP review for consistency with applicable enforceable policies of the Hawai'i CMP. Prior to reserve designation and approval of the proposed He'eia NERR DMP, OCM will provide the state of Hawai'i with a consistency determination related to the proposed actions, and OP will perform a federal consistency review.

7.4 Endangered Species Act

The federal Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. §§ 1531, *et seq*.), aims to protect animal and plant species from extinction and directs all federal agencies to conserve endangered and threatened species and the ecosystems upon which they depend. Under the act, NOAA's National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) (collectively, the services) publish lists of endangered, threatened, candidate, and other species with special status under the act. The services also may designate critical habitat for endangered or threatened species. Section 7 of the ESA requires every federal agency to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species and that it will not result in the destruction or adverse modification of critical habitat for those species. When a federal agency action may affect a protected species or its critical habitat, that agency is required to consult with NMFS and/or the USFWS, depending upon the protected species potentially affected.

Compliance*:* NOAA's OCM requested lists of species and habitats with special status under the ESA from NMFS and USFWS. Chapter 5 lists the species and habitats that the services identified in mid-2016 as having the potential to occur within the proposed boundaries of the reserve (or sufficiently near the proposed boundaries of the reserve that potential activities within the reserve could affect such species). OCM is planning to carry out informal consultation with the services pursuant to Section 7 of the ESA during the public comment period for the DEIS and draft MP.

OCM anticipates that the proposed He‘eia NERR designation in and of itself will neither have any effect on species listed or proposed for listing as threatened or endangered, nor adversely affect critical habitat, candidate species, or of concern species (i.e., resources with special status under the ESA). However, operation of the reserve and implementation of its DMP could lead to activities on land or in the water that have the potential to affect these types of resources. For example, the DMP identifies a need for office space on the mainland within the reserve and a space for educating large groups of people. After a needs assessment is carried out to better characterize requirements and potential locations for future facilities, construction of new facilities (such as a building) for the proposed He‘eia NERR may be proposed. Federal funding support could be requested for acquisition or construction. In addition, some research methodologies require in-situ placement of instruments and equipment, while others involve researchers observing or manipulating species or environments.

After the locations of these and other activities have been proposed, OCM will carry out environmental compliance reviews, including an assessment of the potential for resources with special status under the ESA to be affected by the proposed future activities. As required under the ESA, prior to approving the proposed action or any future federal actions that may affect resources with special status under the ESA, OCM will consult the service(s) for their input on OCM’s analysis of the potential for adverse effects, any additional data and information they might have, and any best management practices that should be followed to protect special-status resources.

7.5 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §§ 1801 *et seq*.), as amended and reauthorized by the Sustainable Fisheries Act (Public Law 104-297), established a program to promote the protection of Essential Fish Habitat (EFH) for federally-managed species in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. After EFH has been described and identified in fishery management plans, federal agencies are obligated to consult with the National Marine Fisheries Service (NMFS) with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any EFH. An adverse effect is defined as any impact that reduces quality or quantity of EFH. Consultation is not required for actions that will not adversely affect EFH.

Compliance: Within Kāne‘ohe Bay, the marine water column and seafloor in and surrounding the proposed He‘eia NERR have been designated as EFH for Hawai‘i Bottomfish, Hawai‘i Coral Reef Ecosystems, Hawai‘i Crustacean Fishery, and the Hawai‘i Pelagic Group, as noted in Chapter 5. Kāne‘ohe Bay also serves as the Habitat Area of Particular Concern (HAPC) for Coral Reef Ecosystems. In February 2016, Kāne‘ohe Bay was also proposed as HAPC for Bottomfish, but a decision with respect to that proposal has not been issued. Reserve designation does not in and of itself have the potential to adversely affect EFH or HAPC. However, new research conducted under the auspices of the reserve might allow resource managers to understand and mitigate adverse effects to EFH from projects implemented in Kāne‘ohe Bay.

Operating a NERR is expected to have long-term, minor beneficial impacts on EFH by contributing to habitat enhancement, improving scientific knowledge associated with EFH, and encouraging the protection of EFH. With respect to activities conducted in the water, analysis of alternative designs, options for installation, and appropriate best management practices by reserve partners can lessen or eliminate potential adverse effects on EFH. As projects are proposed and at other appropriate times, OCM will consult with NMFS about the potential for other federal actions (e.g., federal approval of a Final Management Plan or deployment of new monitoring equipment for the reserve) to adversely affect EFH. At the present time, there is insufficient specific information available about future in-water activities to assess their potential to adversely affect EFH. EFH consultation with Habitat Conservation Division staff in NOAA Fisheries' Pacific Islands Regional Office will occur, as needed, to avoid, minimize, or offset any adverse impacts to EFH and HAPC, consistent with procedures outlined in the EFH federal consultation regulations at 50 C.F.R. § 600.920, and associated guidance.

7.6 Marine Mammal Protection Act

The primary management objective of the Marine Mammal Protection Act (16 U.S.C. §§ 1361 *et seq.*), as amended, is to maintain the health and stability of the marine ecosystem, with a goal of obtaining an optimum sustainable population of marine mammals within the carrying capacity of the habitat. The Marine Mammal Protection Act (MMPA) prohibits the taking of marine mammals in U.S. waters and by U.S. citizens on the high seas, as well as the importation of marine mammals and marine mammal products into the U.S. The act is intended to work in concert with the provisions of the ESA. There are some exceptions to the prohibitions on taking marine mammals, including a mechanism for requesting authorization from NMFS's Office of Protected Resources for "incidental," but not intentional, taking, of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing or directed research on marine mammals) within a specified geographic region. The MMPA and regulations adopted thereunder restrict harassment (meaning any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal in the wild by causing disruption of behavioral patterns, including breathing, breeding, feeding, migration, and sheltering).

Compliance: The research and education efforts described in the draft MP for the proposed reserve would result in additional activity in and around Kāneʻohe Bay. The Hawaiian monk seal, also protected under the ESA, is known to use the habitat in the Bay. In addition, it is possible that other marine mammals, such as dolphins, could sometimes use the habitat within or near the boundaries of the proposed Heʻeia NERR. Humpback whales protected under the MMPA, have not been documented in Kāneʻohe Bay by NMFS (based on 2016 technical assistance provided by the NOAA Fisheries Cetacean Research Program, based at the Pacific Islands Fisheries Science Center), but they have been documented near Kāneʻohe Bay, according to data from the Hawaiian Islands Humpback Whale National Marine Sanctuary (NOAA 2004). Incorporation of the safeguards used to protect threatened or endangered species during implementation of projects by NERR staff would, in general, be expected to protect any marine mammals in the area. However, future actions will be evaluated individually for compliance with all applicable mandates, including the MMPA. Best management practices

(summarized in Appendix I), such as monitoring for protected species before, during, and/or after project implementation, would be used to reduce the potential for there to be adverse impacts from NERR activities on marine mammals. Other mitigation measures will also be considered, if needed, such as time of year restrictions for projects or boating speed restrictions. If required for future projects, consultation with NMFS will be carried out. Therefore, designation of the proposed reserve and implementation of the associated federal actions described herein would comply with the MMPA.

7.7 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (16 U.S.C. §§ 715 *et seq*.) provides for the protection of migratory birds. The act makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird (or parts, nests, or eggs of such a bird) except under the terms of a valid permit issued pursuant to federal regulations. The act also regulates scientific collection and possession of migratory birds for educational purposes. The act does not specifically protect migratory bird habitat, but USFWS may suggest consideration of time of year restrictions for construction or remedial activities at sites where it is likely migratory birds may be nesting or project schedules that would avoid migratory bird nesting seasons.

Compliance: Designation of a proposed He‘eia NERR would have no direct effects on migratory birds because it would not result in changes to ownership or management of land or water areas. Individuals and agencies within the reserve would need to comply with the act. OCM has contacted the USFWS in accordance with its obligation to consult the services under the ESA. The input OCM expects to receive from the USFWS in response to its planned informal consultation letter will also address migratory birds, pursuant to the Migratory Bird Treaty Act. If the USFWS has any recommendations regarding migratory birds, OCM will share the input with its partners so that they may take the recommendations into account in planning future activities at the proposed He‘eia NERR.

7.8 National Historic Preservation Act

The National Historic Preservation Act (NHPA) (16 U.S.C. §§ 470 *et seq.*), as amended, is intended to provide for the preservation of historic sites, buildings, objects, and antiquities of national significance and promote preservation of historical and archaeological resources that might otherwise be lost or destroyed. Under the act and its implementing regulations, federal agencies undertaking an action that potentially affects any property with historic, architectural, archaeological or cultural value that is listed on or eligible for listing on the National Register of Historic Places (National Register) must comply with specific procedures for consultation with the appropriate State and/or Tribal Historic Preservation Officers and others. The act further requires that federal agencies consult with any Native Hawaiian organization that attaches religious and cultural significance to historic properties that may be affected by an undertaking. Amendments to the act clarified that properties of religious and cultural significance to Native Hawaiian Organizations may be eligible for listing in the National Register.

Compliance: Pursuant to NHPA, NOAA's OCM contacted more than 80 Native Hawaiian Organizations (see Appendix G) on June 18, 2015, to: (1) gain assistance with identifying properties within the area of potential effect that might be eligible for listing on the National Register of Historic Places; (2) request information related to the significance any such organizations attach to the areas potentially affected by the proposed action; (3) invite Native Hawaiian Organizations to advise NOAA if they would like to participate in the NHPA consultation process as a consulting party; and (4) identify any additional Native Hawaiian Organizations to involve in the process. OCM received two responses to its letter in July 2015, one from the State's Office of Hawaiian Affairs, and one from the Maluʻōhai Residents Association. Neither respondent requested to be a consulting party, as provided for under the NHPA. In its response letter, the Office of Hawaiian Affairs identified eight historic sites for consideration. The two response letters collectively identified a total of nine organizations to engage, all of which NOAA had already coordinated with in some fashion (including some entities that are expected to serve as reserve partners, such as Kākoʻo ʻŌiwi, and others with which NOAA representatives met or otherwise conferred with during the reserve scoping process). After the DEIS is released for public comment, OCM will propose a finding in accordance with the procedures for implementing the NHPA.

7.9 National Marine Sanctuaries Act

Under the National Marine Sanctuaries Act (NMSA)(16 U.S.C. §§ 1431 *et seq.*), the Secretary of Commerce is authorized to designate and protect as national marine sanctuaries areas of the marine environment requires the protection and conservation of marine environments with special national or international significance due to their conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or esthetic qualities. Pursuant to the act, federal agency actions likely to destroy, cause the loss of, or injure any sanctuary resource are subject to consultation with the National Marine Sanctuaries Program. Each federal agency proposing such an action must provide a written statement describing the action and its potential effects on sanctuary resources no later than 45 days before the final approval of the action. In addition, sanctuary permits may be required for certain actions that would otherwise be prohibited.

Compliance: The proposed project is not likely to destroy, cause the loss of, or injure any National Marine Sanctuary resources. The nearest National Marine Sanctuary is the Hawaiian Islands Humpback Whale National Marine Sanctuary, created in 1992 to protect humpback whales and their habitat in Hawaiʻi. The Sanctuary includes, among others, marine areas that wrap around Kahuku Point, in northern Oʻahu, as well as marine areas off the southeastern corner of Oʻahu, extending approximately as far north as Makapuʻu Point. However, it does not include Kāneʻohe Bay or immediately adjacent waters, and the affected area is unlikely to be frequented by humpback whales. Accordingly, proposed Heʻeia NERR designation and implementation is not likely to affect the sanctuary resources of the Hawaiian Islands Humpback Whale National Marine Sanctuary.

7.10 Environmental Justice

Executive Order 12898 on Environmental Justice and Executive Order 12948 (Amendment to Executive Order 12898) require each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. The Department of Commerce (DOC) Environmental Justice Strategy also requires funding recipients to ensure projects have no disproportionately high and adverse human health or environmental effects on minority or low-income populations.

Compliance: As noted in Chapter 5, the population in the immediate vicinity of the proposed reserve site is comprised predominantly of individuals from racial and ethnic minorities. However, the poverty rate across this population is lower than that of Hawai‘i as a whole. Consistent with Executive Orders 12898 and 12948, as well as the DOC's Environmental Justice Strategy, the designation of a reserve in Hawai‘i would not be expected to have disproportionately adverse human health or environmental effects on minority or low-income populations. He‘eia NERR designation and operation would not be expected to cause significant adverse human health effects, and any adverse environmental effects caused by the proposed action are expected to be minor. Proposed He‘eia NERR designation also is expected to have numerous beneficial effects, as detailed herein. Many of the future program activities identified in the DMP, such as the education program to bring school children to the proposed He‘eia NERR, will benefit all populations, including minorities. According to the DMP, the proposed He‘eia NERR would endeavor to provide opportunities for classes from all interested schools to visit and participate in educational activities, which is one respect in which the proposed He‘eia NERR could provide positive effects to minority populations.

7.11 Executive Order 11990 − Protection of Wetlands; Executive Order 11988 – Floodplain Management; and Executive Order 13690 − Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input

Executive Order 11990 requires federal agencies to avoid the adverse impacts associated with the destruction or loss of wetlands, to avoid new construction in wetlands if alternatives exist, and to develop mitigation measures if adverse impacts are unavoidable. Executive Order 11988 requires federal agencies to avoid, to the extent possible, long and short-term adverse impacts associated with the occupancy and modification of floodplains. Executive Order 13690 updates Executive Order 11988 and establishes a new federal flood risk management standard intended to reduce risks and costs associated with future flood disasters by requiring all federal investments in and affecting floodplains to meet higher flood risk standards. It also requires all future federal investments in and affecting floodplains to be resilient to flooding, including as it is anticipated to be exacerbated by climate change.

Compliance: Portions of the He‘eia region, including many of its wetlands, are within the flood zone designated as AE by the Federal Emergency Management Agency (FEMA), and a large portion of the wetlands are also within the floodway, as noted in Chapter 5. The City and County of Honolulu participates in the National Flood Insurance Program. NOAA's "Guidance Manual on Compliance with Implementing Executive Orders 11988 and 11990" (issued in 2012) outlines

an eight-step evaluation process for most projects that extend into floodplains and wetlands, with a few exceptions.[32] Under this guidance, the eight-step evaluation process does not apply to "site characterization, environmental monitoring, or environmental research activities in a floodplain or wetland, unless these activities would involve building any structure; involve draining, dredging, channelizing, filling, diking, impounding, or related activities or result in long-term change in the ecosystem." Under the action alternatives, OCM proposes to designate a He'eia NERR and approve its DMP. Reserve staff efforts would primarily revolve around research, monitoring, coordination, technical assistance, and education. No actions proposed by OCM at this time will involve building any structure, carrying out activities that would result in long-term change in an ecosystem, or dredging, channelizing, impounding, or filling wetlands or water bodies. Thus, these executive orders would not apply to the proposed action. In the future, OCM will reevaluate the applicability of the three executive orders if federal funds are requested to support projects that both: (1) would be located in delineated wetlands or floodplains (or other areas to shown as the new federal flood risk management standard applies); and (2) would involve the construction of buildings, altering wetlands and waterbodies, and/or long-term ecosystem changes.

7.12 Executive Order 13089 – Coral Reef Protection

Among other things, Executive Order 13089 directs federal agencies whose actions may affect U.S. coral reef ecosystems to identify their actions that may affect these ecosystems, utilize their programs and authorities to protect and enhance the conditions of these ecosystems, and ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems (to the extent permitted by law).

Compliance: Ongoing activities by prospective reserve partners, such as the Hawai'i Division of Aquatic Resources (DAR), are intended to enhance coral reef ecosystems in Kāne'ohe Bay. The DMP for the proposed He'eia NERR includes a strategy supporting coral reef restoration. That strategy, identified as 10(h), is to "collaborate with partners on existing coral reef restoration and monitoring initiatives that are occurring within the marine boundaries of the reserve." (The strategy supports Objective 10, which is to "support contemporary restoration of key areas in the reserve to improve habitat and increase ecosystem services.") HIMB researchers and others are already conducting coral reef monitoring, and the proposed He'eia NERR is committed to, in coordination with partners, supporting development and implementation of a reef monitoring strategy. Plans for additional monitoring call for assessing the effects of coral reef restoration approaches compared to specific control areas left undisturbed. Implementation of a proposed He'eia NERR could also result in additional technical or planning assistance associated with coral reef research and restoration (including restoration projects on land that have the potential to reduce sedimentation, which can

[32] NOAA is in the process of updating its 2012 Guidance Manual and procedures for federally funded projects affected by Executive Order 13690. In the meantime, the existing Guidance is applicable, consistent with the October 8, 2015, "Guidelines for Implementing Executive Order 11988, Floodplain Management, and Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input."

adversely affect coral reef ecosystems through sediment transport). In short, future reserve activities affecting reefs would likely be intended to study, slow, or reverse the effects of coral reef degradation. Since the reefs in Kāneʻohe Bay serve as Habitat Areas of Particular Concern (a type of Essential Fish Habitat) for coral reef ecosystems, the OCM will consult with NMFS if reserve-related activities proposed for funding have the potential to adversely affect coral reef ecosystems. OCM will also consider any conservation recommendations provided by NMFS to avoid, minimize, or offset potential adverse impacts. Thus, designation and implementation of a proposed Heʻeia NERR would be consistent with this Executive Order.

7.13 Executive Order 13112 − Invasive Species

The purpose of Executive Order 13112 is to prevent the introduction of invasive species; respond to and control invasions in a cost-effective and environmentally sound manner to minimize their economic, ecological, and human health implications; and to provide for restoration of native species and habitat conditions in ecosystems that have been invaded.

Compliance: Combatting invasive species has been identified as a priority coastal management issue facing the proposed Heʻeia NERR, according to the DMP. Reserve partners have been working to reduce populations of several invasive species, including California grass around Heʻeia Stream, mangroves near the mouth of Heʻeia Stream and around the edge of Heʻeia Fishpond, and invasive seaweed and weeds in and along Heʻeia Fishpond. According to the DMP, upland reforestation efforts by Kākoʻo ʻŌiwi on the HCDA parcel will result in removal of some invasive plant species, but allow for selected non-native plants to remain (particularly species that provide key forest structural attributes or important ecosystem services). Neither OCM, nor anticipated Heʻeia NERR partners, are proposing introducing any invasive species within the reserve. (The urchins being added to Kāneʻohe Bay are a native species.) reserve partners are already in the process of educating students and other visitors about invasive species, and these activities will continue whether or not a reserve is designated.

Reserve partners are very aware of risks associated with invasive species and how to combat their spread. One of the restoration objectives identified under the DMP, Objective 10(g), is to "provide technical assistance and support for the removal of invasive species and the establishment native plant communities within the Heʻeia stream buffer and stream channels." Implementation of the proposed Heʻeia NERR's DMP could enhance efforts to remove invasive species and educate the community about their impacts. In addition, as part of providing technical assistance to NOAA under ESA, the USFWS provided a list of recommended invasive species minimization measures in June 2016. OCM will pass these recommendations along to its partners in Hawaiʻi. In addition, the State of Hawaiʻi has a number of regulations and policies related to combatting non-native species whose introduction causes (or is likely to cause) economic or environmental harm or harm to human health. See http://dlnr.hawaii.gov/hisc/info/policy for more information. State invasive species control mandates, along with Executive Order 13112, also direct agencies and others to do their best to avoid the introduction of invasive species through any Reserve-supported activities. In short, the proposed action complies with this Executive Order.

7.14 Executive Order 13158 − Marine Protected Areas

Executive Order 13158 promotes strengthening the management, protection, and conservation of existing marine protected areas (MPAs), establishing new or expanded MPAs, and development of a national system of MPAs representing diverse marine ecosystems and their natural and cultural resources. The Executive Order defines MPAs to mean any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein. It directs the Department of Commerce and the Department of the Interior, in consultation with certain other federal departments, USEPA, and the National Science Foundation, to develop a national system of MPAs. The Executive Order also requires that each federal agency whose authorities provide for the establishment or management of MPAs take appropriate actions to enhance or expand protection of existing MPAs and establish or recommend, as appropriate, new MPAs. It also requires federal agencies whose actions may affect the natural or cultural resources within MPAs to identify such actions and avoid harming those resources.

Compliance: If designated, the proposed He‘eia NERR would meet the definition of an MPA. Establishment of a He‘eia NERR would be consistent with this Executive Order because it would establish a new MPA and seek to avoid actions harming natural or cultural resources within reserve boundaries. Some of the other reserves that are part of the NERRS have joined the National Network of Marine Protected Areas; this would be an option that could be considered after designation. There would also be an MPA within the proposed reserve: the Hawai‘i Marine Laboratory Refuge. The protections afforded to that refuge have been discussed above. Establishment of the proposed He‘eia NERR could also strengthen the management of Hawai‘i Marine Laboratory Refuge by providing additional partners interested in its protection.

7.15 Executive Order 13175 − Consultation and Coordination with Indian Tribal Governments

Executive Order 13175 requires each federal agency to establish procedures for meaningful consultation and coordination with tribal officials in the development of federal policies that have implications for federally recognized tribes. The DOC subsequently issued a Tribal Consultation and Coordination Policy and a Departmental Administrative Order (DAO 218-8). Procedures outlined in the “NOAA Procedures for Government-to-Government Consultation with Federally Recognized Indian Tribes and Alaska Natives” (also known as the NOAA Tribal Consultation Handbook) provide guidance to NOAA to support a consistent, effective, and proactive approach to conducting tribal consultations.

Compliance: The proposed He‘eia NERR would not be expected to have any tribal implications because there are no federally recognized tribes in Hawai‘i (see 80 Fed. Reg. 1942). Thus, Executive Order 13175, the Department of Commerce Tribal Policy, and the NOAA Administrative Order on Tribal Consultation do not apply. NOAA is engaging Native Hawaiian Organizations under the framework of the NHPA, as discussed above.

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APPENDIX A. HE‘EIA NATIONAL ESTUARINE RESEARCH RESERVE DRAFT MANAGEMENT PLAN 2016 – 2021

See attachment

APPENDIX B. MEMORANDUM OF UNDERSTANDING BETWEEN HAWAIʻI INSTITUTE OF MARINE BIOLOGY AND NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Under development and will be available for Final Environmental Impact Statement

APPENDIX C. MULTI-PARTY AGREEMENT BETWEEN HAWAIʻI INSTITUTE OF MARINE BIOLOGY AND SITE PARTNERS

Under development and will be available for Final Environmental Impact Statement

APPENDIX D. RESPONSE TO PUBLIC COMMENTS ON DRAFT ENVIRONMENTAL IMPACT STATEMENT AND DRAFT MANGEMENT PLAN

Will be available in the Final Environmental Impact Statement

APPENDIX E. FEDERAL CONSISTENCY DETERMINATION

Pending

APPENDIX F. NATIONAL HISTORIC PRESERVATION ACT CONSULTATION

Pending

APPENDIX G. NATIVE HAWAIIAN ORGANIZATION ENGAGEMENT

List of Native Hawaiian Organizations Contacted During DEIS Development

For contact information for each organization, visit https://www.doi.gov/hawaiian/NHOL. Please note, this list is updated on a regular basis, and some organizations may have changed.

ʻAha Kāne
ʻAhahui Siwila Hawaiʻi O Kapōlei
Aha Kukaniloko Koa Mana mea ola kanaka mauli
Aha Moku O Kahikinui
Aha Moku o Maui Inc.
Aha Wahine
Ahupuaʻa o Molokaʻi
Aloha First
Association of Hawaiian Civic Clubs
Association of Hawaiians for Homestead Lands
Au Puni O Hawaii
Brian Kaniela Naeʻole Naauao
Charles Pelenui Mahi Ohana
Council for Native Hawaiian Advancement
Friends of ʻIolani Palace
Friends of Mokuʻula, Inc.
George K. Cypher ʻOhana
God's Country Waimanalo
Hauʻouiwi Homestead Association on Lānaʻi
Hawaiian Civic Club of Hilo
Hawaiian Civic Club of Wahiawa
Hawaiian Community Assets, Inc.
Ho Ohana
Hoʻokano Family Land Trust
Hui Hoʻoniho
Hui Huliau
Hui Kaleleiki Ohana
Hui Mālama I Nā Kūpuna O Hawaiʻi Nei
Hui Mālama Ola Nā ʻŌiwi
Kaha I Ka Panoa Kaleponi Hawaiian Civic Club
Kākoʻo ʻŌiwi
Kalaeloa Heritage and Legacy Foundation
Kalamaʻula Mauka Homestead Association
Kalihi Palama Hawaiian Civic Club
Kamealoha

Kamehameha Schools – Community Relations and Communications Group, Government Relations
Kamiloloa One Aliʻi Homestead Association
Kanu o ka ʻĀina Learning ʻOhana
Kapolei Community Development Corporation
Kawaihapai Ohana
Kingdom of Hawaiʻi
Koʻolau Foundation
Koʻolaupoko Hawaiian Civic Club
Koa Ike
Laʻi ʻŌpua 2020
Lahui Kakaʻikahi
Maʻa ʻOhana c/o Lani Maʻa Lapilio
Machado-Akana-Aona-Namakaeha Ohana
Mahu Ohana
Mainland Council Association of Hawaiian Civic Clubs
Makaha Hawaiian Civic Club
Makuʻu Farmers Association
Maluʻōhai Residents Association
Marae Haʻa Koa
Meleana Kawaiaea, LLC
Menehune Foundation
Moku o Kaupo
Na Aikane O Maui
Na Kuʻauhau ʻo Kahiwakaneikopolei
Nā Kuleana o Kānaka ʻŌiwi
Na Ohana o Puaoi a me Hanawahine
Nanakuli Housing Corporation
Native Hawaiian Church
Native Hawaiian Economic Alliance
Native Hawaiian Education Council
Nekaifes Ohana
Office of Hawaiian Affairs
Order of Kamehameha I
Pacific Agricultural Land Management Systems
Pacific Justice and Reconciliation Center
Papa Ola Lokahi
Papakōlea Community Development Corporation
Partners in Development Foundation
Paukukalo Hawaiian Homes Community Association
Peahi Ohana
Piihonua Hawaiian Homestead Community Association
Royal Hawaiian Academy of Traditional Arts
The Friends of Hokuleʻa and Hawaiʻiloa

The I Mua Group
Wai‘anae Hawaiian Civic Club
Waiehu Kou Phase 3 Association
Waimānalo Hawaiian Homes Association

Sample letter distributed to U.S. Department of Interior’s Native Hawaiian Organization List
June 18, 2015

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office for Coastal Management
Silver Spring Metro Center, Building 4
1305 East-West Highway
Silver Spring, Maryland 20910

18 June 2015

G. Umi Kai
'Aha Kāne
P.O. Box 31303
Honolulu, HI 96820-1303

Dear Mr. Kai:

The State of Hawai'i nominated the He'eia estuary within the He'eia Ahupua'a and the Kāhe'ohe Bay watershed to be established as a National Estuarine Research Reserve (NERR). The NERR System is a federal-state partnership administered by the National Oceanic and Atmospheric Administration (NOAA). NERR sites are managed in order to facilitate long-term research and monitoring, education and training, and stewardship of coastal resources. The proposed reserve would be managed by the Hawai'i Institute of Marine Biology, in collaboration with local partners, and with oversight by NOAA. NOAA also provides states with technical assistance, guidance, and funding. Funding supports such program purposes as research, monitoring, facility construction and operation, teacher training, education, restoration, and stewardship activities.

The nominated site is shown on the enclosed map. The area of potential effects include: He'eia State Park (18.5 acres) on its northern coast; He'eia fishpond (88 acres) at its estuarine border (where traditional Hawaiian aquaculture takes place); the He'eia wetlands (where an ongoing wetlands restoration project aims to restore traditional agricultural uses) at the proposed site's upland end (405 acres); and the Hawai'i Institute of Marine Biology (28 acres) on Moku o Lo'e (Coconut Island). An additional 530 acres of water area include patch and fringing reefs. Just outside the site is a barrier reef. The total acreage of the proposed site is 1,070 acres.

Section 106 of the National Historic Preservation Act (NHPA) requires that federal agencies identify historic properties that may be impacted by a federal undertaking, and seek to protect those properties that are listed, or eligible for listing, on the National Register of Historic Places. NHPA regulations at 36 CFR Part 800 identify a process to determine site eligibility, to evaluate potential impacts, and to identify impact avoidance or mitigation actions.

NOAA, which approves the designation of proposed NERRs, is currently evaluating the nominated site. Designation as a NERR would constitute an "undertaking" under the National Historic Preservation Act (NHPA). See 36 Code of Federal Regulations (C.F.R.) § 800.16(y). Pursuant to the NHPA, we are seeking your assistance in identifying properties within the area of potential effects that may be eligible for the National Register listing, and providing us with any information you may have relating to religious or cultural significance that your organization attaches to the property that might be affected by designation of the NERR in Hawai'i. If you have any information you wish to share with us about the site, please contact me. We would also like to take this opportunity to request your assistance in identifying any additional Native Hawaiian Organizations that may be interested in commenting on this action. If you would like to participate as a consulting party, submit your request in writing to me at the mailing address provided in this letter (below). See 36 CFR 800.3(f).

In addition, as part of the evaluation process associated with Designation of the proposed reserve, an Environmental Impact Statement (EIS) will be prepared in accordance with the National Environmental Policy Act. Once drafted, the EIS will be released for public comment, likely this autumn. There will be a 45-day public comment period, including a public hearing, to solicit input on the draft EIS from interested parties.

For more information about the NERR designation process, see 15 C.F.R., Part 921, Subpart D. See also the Hawai'i Office of Planning website at http://planning.hawaii.gov/czm/initiatives/nerrs-site-proposal-process.

Please do not hesitate to contact me if you have any questions or comments. I can be reached via telephone at (301) 563-1127, via mail at patmarie.nedelka@noaa.gov, or via mail addressed to my attention and sent to: NOAA Office for Coastal Management, 1305 East West Hwy, 11th Floor, N/OCM-1, Silver Spring, Maryland 20910.

Sincerely,

Patmarie S. Nedelka
NEPA and Environmental Compliance Coordinator

Enclosure

Enclosure: Map of **Proposed National Estuarine Research Reserve Site**

Malu'ōhai Residents Association
P.O. Box 700911
Kapolei, HI 96709

July 3, 2015

Patnarie S. Nedelka
NERR and Environmental Compliance Coordinator
Office for Coastal Management
1305 East-West Highway
Silver Spring, MD 20910

Aloha Ms. Nedelka:

Mahalo for inviting Malu'ōhai Residents Association to submit comment on the State of Hawaii's nomination of He'eia estuary to be established as a National Estuarine Research Reserve (NERR) in Kāne'ohe Bay.

Specifically, your letter seeks our assistance in identifying properties within the area of potential effects that may be eligible for the National Register listing, and providing you with any information we may have relating to the religious or cultural significance that our organization attaches to the property that might be affected by designation of the NERR in Hawai'i.

In addition, you also asked for assistance in identifying any additional Native Hawaiian Organizations that may be of interest in commenting on this action.

When a site for review is located in another ahupua'a (district) of our island in which we have little connection or familiarity; it is our organizations' practice to defer comments to those with closer ties, historical knowledge and/or cultural practitioners with familiarity of the review site.

Your letter did not list any Native Hawaiian Organizations (NHO's) serving the ahupua'a of Ko'olaupoko which I found disturbing. Disturbing because I am aware there are several NHO's who for countless years have been and continue to be very involved with restoration projects both ma'uka and ma'kai.

I ask that you kindly include and consult with Paepae O He'eia – P.O. Box 6355, Kāne'ohe, 96744 and Ko'olaupoko Hawaiian Civic Club – P.O. Box 664, Kaneohe, HI 96744. Both of these organizations can educated and provide a wealth of information on the pass religious and cultural practices of our ancestors; and their present efforts to restore these places and practices to ensure our future generations will have a place to continue living our culture.

We are supportive of establishing He'eia estuary as a National Estuarine Research Reserve (NERR) in Kāne'ohe Bay.

Respectfully,

Homelani Schaedel
President

PHONE (808) 594-1888

FAX (808) 594-1938

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

HRD15/7521

July 7, 2015

Patmarie S. Nedelka
National Oceanic and Atmospheric Administration
1305 East-West Highway
11th Floor N/OCM-1
Silver Spring, MD 20910

Re: Request for Consultation Under NHPA Section 106 for the State of Hawai'i Nomination of the He'eia Estuary to be Established as a National Estuarine Research Reserve
He'eia Ahupua'a, Ko'olaupoko Moku, O'ahu Mokupuni

Aloha Ms. Nedelka:

The Office of Hawaiian Affairs (OHA) is in receipt of your June 18, 2015 letter requesting consultation under the National Historic Preservation Act Section 106 for the State of Hawai'i nomination of He'eia estuary as a National Estuarine Research Reserve (NERR).

OHA is the constitutionally established body responsible for protecting and promoting the rights of Native Hawaiians. Hawai'i law mandates OHA to "[s]erve as the principal public agency in the State of Hawai'i responsible for the performance, development, and coordination of programs and activities relating to native Hawaiians and Hawaiians; . . . and [t]o assess the policies and practices of other agencies impacting on native Hawaiians and Hawaiians, and conducting advocacy efforts for native Hawaiians and Hawaiians." Hawai'i Rev. Stat. § 10-3.

The NERR is administered by the National Oceanic and Atmospheric Administration (NOAA) facilitating long-term research and monitoring, education and training, and stewardship of coastal resources. The estuary will be managed by the Hawai'i Institute of Marine Biology in collaboration with local partners, and oversight from NOAA.

OHA is aware of the following historic sites within the He'eia Ahupua'a[1]:

- Loko I'a O He'eia: He'eia Fishpond
  - State Inventory of Historic Places (SIHP) 50-80-10-00327
- He'eia Kea Terrace
  - SIHP 50-80-10-04135
- He'ia Kea Slope Cut
  - SIHP 50-80-10-04136
- He'eia Kea Platform
  - SIHP 50-80-10-04137
- He'eia Kea Retaining Walls
  - SIHP 50-80-10-04138
- He'eia Kea Mound/Platform
  - SIHP 50-80-10 04139
- He'eia Kea Retaining Walls
  - SIHP 50-80-10-04140
- He'eia Kea Shrine
  - SIHP 50-80-10-04144

OHA would like to suggest that the following entities and individuals be contacted:

- Kākoʻo ʻŌiwi
- Hawai'i Institute of Marine Biology
- Koʻolaupoko Hawaiian Civic Club
- Kama'āina Kids
- Paepae o He'eia
- The Nature Conservancy of Hawai'i
- Papahana Kuaola
- Hawai'i Community Development Authority, and
- Conservation International, Hawai'i

Mahalo for the opportunity to consult. Should you have any questions, please contact Jeannin Jeremiah at 594-1790 or by email at jeanninj@oha.org.

ʻO wau iho nō me ka ʻoia ʻiʻo,

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

KC:jj

[1] These historic sites are listed on OHA's geographical information system (GIS) Kipuka Database www.kipukadatabase.com

APPENDIX H. FEDERAL RESPONSES FOR PROTECTED RESOURCES CONSULTATIONS

Pending

APPENDIX I. BEST MANAGEMENT PRACTICES FOR PROTECTED RESOURCES

Hawaiian Hoary Bat

- **The endangered Hawaiian hoary bat may be present within the proposed project area. The Hawaiian hoary bat roosts in both exotic and native woody vegetation and will leave young unattended in "nursery" trees and shrubs when they forage. If trees or shrubs suitable for bat roosting are cleared during the breeding season, there is a risk that young bats could inadvertently be harmed or killed.**
- **To minimize impacts to the endangered Hawaiian hoary bat, woody plants greater than 15 feet (4.6 meters) tall should not be disturbed, removed, or trimmed during the bat birthing and pup rearing season (June 1 through September 15).**
- **Additionally, Hawaiian hoary bats forage for insects from as low as three feet to higher than 500 feet above the ground. When barbed wire is used in fencing, Hawaiian hoary bats can become entangled. It is recommended that barbed wire not be used for fencing or only within 2 inches of the ground surface.**

Hawaiian Goose

- **If Hawaiian goose (nēnē) appears within 100 feet (30.5 meters) of ongoing work, all activity will be temporarily suspended until the animal leaves the area of its own accord.**
- **Moreover, if any number of nēnē are observed loafing or foraging within the project area during the nēnē breeding season (October through March), a biologist familiar with the nesting behavior of nēnē will survey in and around the project area prior to the resumption of any work, or after any subsequent delay of work of three or more days (during which the birds may attempt to nest).**
- **If a nest is discovered within a radius of 150 feet of proposed work, or a previously undiscovered nest is found within said radius after work begins, all work will cease immediately and the U.S. Fish and Wildlife Service will be contacted for further guidance.**

Sea Turtle

- **Sandy beaches in Hawai'i and the Pacific Islands may be used by nesting sea turtles.**
- **Optimal nesting habitat is a dark beach free of barriers that restrict their movement.**
- **Nesting turtles may be deterred from approaching or laying successful nests on lighted or disturbed beaches. If they do come ashore, they may become disoriented by artificial lighting.**
- **If they do come ashore, they may become disoriented by artificial lighting, leading to exhaustion and placement of a nest in an inappropriate location (such as at or below the high tide line where nests are unlikely to be successful). Hatchlings that emerge from unprotected nests may be disoriented by artificial lighting.**
- **Sea turtles come ashore to nest on beaches from May through September, peaking in June and July.**
- **Construction on or in the vicinity of sea turtle nesting beaches can result in sand compaction, beach erosion, and increase in direct and ambient light pollution.**
- **The rate of habitat loss because of erosion and escarpment may be increased when humans attempt to stabilize the shoreline, either through re-nourishment or through placement of hard structures, such as sea walls or pilings.**

- **Off-road vehicle traffic also contributes to habitat loss through erosion, especially during high tides or on narrow beaches where driving is often concentrated on the high beach and fore dune.**
- **To avoid crushing sea turtle nests or increased erosion, driving should be restricted to existing roads.**
- **No hard structures such as seawalls should be constructed and dune vegetation should not be cleared.**

Best Management Practices (BMP) for General In-Water Work Including Boat and Diver Operations

January 2015

National Marine Fisheries Service Protected Resources Division recommends implementation of the following best management practices (BMPs) to reduce potential adverse effects on protected marine species. These BMPs are not intended to supplant measures required by any other agency, and compliance with these BMP shall always be considered secondary to safety concerns.

All workers associated with this project, irrespective of their employment arrangement or affiliation (e.g. employee, contractor, etc.) should be fully briefed on required BMP and the requirement to adhere to them for the duration of their involvement in this project.

A. Constant vigilance shall be kept for the presence of ESA-listed marine species during all aspects of the proposed action, particularly in-water activities such as boat operations, diving, and deployment of anchors and mooring lines.

1. The project manager shall designate an appropriate number of competent observers to survey the areas adjacent to the proposed action for ESA-listed marine species.
2. Surveys shall be made prior to the start of work each day, and prior to resumption of work following any break of more than one half hour. Periodic additional surveys throughout the work day are strongly recommended.
3. All work shall be postponed or halted when ESA-listed marine species are within 50 yards of the proposed work, and shall only begin/resume after the animals have voluntarily departed the area. If ESA-listed marine species are noticed within 50 yards after work has already begun, that work may continue only if, in the best judgment of the project supervisor, that there is no way for the activity to adversely affect the animal(s). For example; divers performing surveys or underwater work would likely be permissible, whereas operation of heavy equipment is likely not.
4. Before entering the water, all divers shall be made aware of ESA-listed corals, and the requirement to avoid contact with those organisms while performing their duties. This shall include taking measures to avoid kicking the reef with fins and to secure dive and survey equipment in a manner that will prevent that material from being drug across the substrate.
5. Special attention will be given to verify that no ESA-listed marine animals are in the area where equipment or material is expected to contact the substrate before that

equipment/material may enter the water. This includes the requirement to limit anchoring to sandy areas well away from coral.

6. All objects will be lowered to the bottom (or installed) in a controlled manner. This can include the use of buoyancy controls such as lift bags, or the use of cranes, winches, or other equipment that affect positive control over the rate of descent.
7. In-water tethers, as well as mooring lines for vessels and marker buoys shall be kept to the minimum lengths necessary, and shall remain deployed only as long as needed to properly accomplish the required task.
8. When piloting vessels, vessel operators shall alter course to remain at least 100 yards from whales, and at least 50 yards from other marine mammals and sea turtles.
9. Reduce vessel speed to 10 knots or less when piloting vessels at or within the ranges described above from marine mammals and sea turtles. Operators shall be particularly vigilant to watch for turtles at or near the surface in areas of known or suspected turtle activity, and if practicable, reduce vessel speed to 5 knots or less.
10. If despite efforts to maintain the distances and speeds described above, a marine mammal or turtle approaches the vessel, put the engine in neutral until the animal is at least 50 feet away, and then slowly move away to the prescribed distance.
11. Marine mammals and sea turtles shall not be encircled or trapped between multiple vessels or between vessels and the shore.
12. Do not attempt to feed, touch, ride, or otherwise intentionally interact with any ESA-listed marine species.

B. No contamination of the marine environment shall result from project-related activities.

13. A contingency plan to control toxic materials is required.
14. Appropriate materials to contain and clean potential spills shall be stored at the work site, and be readily available.
15. All project-related materials and equipment placed in the water shall be free of pollutants.
16. The project manager and heavy equipment operators shall perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations shall be postponed or halted should a leak be detected, and shall not proceed until the leak is repaired and equipment cleaned.
17. Fueling of land-based vehicles and equipment shall take place at least 50 feet away from the water, preferably over an impervious surface. Fueling of vessels shall be done at approved fueling facilities.
18. Turbidity and siltation from project-related work shall be minimized and contained through the appropriate use of erosion control practices, effective silt containment devices, and the curtailment of work during adverse weather and tidal/flow conditions.
19. A plan shall be developed to prevent debris and other wastes from entering or remaining in the marine environment during the project.

APPENDIX J. GLOSSARY OF HAWAIIAN WORDS*

***Glossary adapted from the proposed He‘eia National Estuarine Research Reserve draft management plan (2016)**

The Hawaiian translations are from Pukui and Elbert (1986). For some of the words, a more contemporary meaning may be used by Hawaiians today; for these words they are placed before the Pukui and Elbert (1986) translations and marked with “(common).”

The ‘okina and the kahakō are diacritical markings that are part of the Hawaiian alphabet and used in the Hawaiian words. The ‘okina, or glottal stop, is found only between two vowels or at the beginning of a word that starts with a vowel. A break in speech is created between the sounds of the two vowels. The pronunciation of the ‘okina in the word Kāko‘o is similar to saying “ka-koh-oh.” The kahakō is found only above a vowel. It stresses or elongates a vowel sound from one beat to two beats. The kahakō is written as a line above a vowel. There are differing pronunciations of some words depending on the area or island.

Hawaiian Word	English Translation
‘aha moku	A system of best practices based on indigenous resource management practices within specific moku (district) boundaries to sustain resources and the community of that moku A series of district councils that would manage land and natural resources for tenants and the community through the implementation of site specific cultural conservation coupled by utilitarian practices.
ahupua‘a	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 (pua‘a), or because a pig or other tribute was laid on the altar as tax to the chief.
akua ki‘i	Image representing a god.
‘āina	Land.
ali‘i	Chief, chiefess, officer, ruler, monarch, peer, headman, noble, aristocrat, king, queen, commander.
‘ama‘ama	Mullet (*Mugil cephalus*), a very choice indigenous fish.
‘aumakua	Family of personal gods, deified ancestors who might assume the shape of sharks, owls, hawks [etc.]. A symbiotic relationship existed; mortals did not harm or eat ‘aumakua, and ‘aumakua warned and reprimanded mortals in dreams, visions, and calls. Aumākua—plural of ‘aumakua.
‘auwai	Ditch, canal, water conveyance channels
awa	Milkfish (*Chanos chanos*).
hala	Pandanus or screw pine (*Pandanus odoratissimus*).
hālau	Meeting house.
hau	Lowland tree (*Hibiscus tiliaceus*), found in many warm countries, some spreading horizontally over the ground forming impenetrable thickets, and some trained on trellises.
heiau	Pre-Christian place of worship, shrine; some heiau were elaborately constructed stone platforms, others simple earth terraces. Many are preserved

Hawaiian Word	English Translation
	today.
kalo	Taro (*Colocasia esculenta*), a kind of aroid cultivated since ancient times for food, spreading widely from the tropics of the Old World. In Hawai‘i, taro has been the staple from earliest times to the present, and here its culture developed greatly, including more than 300 forms.
konohiki	Overseer, headman of an ahupua‘a land division under the chief; land or fishing rights under control of the konohiki.
kuapā	Wall of a fish pond.
kuāuna	Taro patch walls (common). Bank or border of a taro patch; stream bank.
kuleana	Native Hawaiian land rights (common). Right, privilege, concern, responsibility, title, business, property, estate, portion, jurisdiction, authority, liability, interest, claim, ownership, tenure, affair, province.
kupuna, kūpuna	Elders (common). Grandparent, ancestor, relative or close friend of the grandparent’s generation, grandaunt, granduncle. Kūpuna—plural of kupuna.
limu	Seaweed, algae (common)
lo‘i	Irrigated terrace, especially for taro, but also for rice; paddy.
lo‘i kalo	Irrigated taro patch.
loko i‘a	Fishpond (common).
loko i‘a kalo	Combined fishpond and taro patch.
mākāhā	Sluice gate, as of a fishpond; entrance to or egress from an enclosure.
makai	Toward the sea.
mauka	Toward the mountain.
moku	District, island, islet, section.
mo‘olelo	Story, tale, myth, history, tradition, literature, legend, journal, log, yarn, fable, essay, chronicle, record, article; minutes, as of a meeting. (From mo‘o ‘ōlelo, succession of talk; all stories were oral, not written.)
poi	The Hawaiian staff of life, made from cooked taro corms, or rarely breadfruit, pounded and thinned with water.
‘uala	Sweet potato (*Ipomoea batatas*).
uhi	Yam (*Dioscorea alata*).
wahi pana	Celebrated, noted, or legendary place.
wai	Fresh water (common).
waiwai	Wealth, abundance, prosperity.

Common and Scientific Names for Plants and Animals

Common Names		Possible Scientific Names		Source
Hawaiian	Other	Genus	Species	
ʻaʻama	crab	*Grapsus*	*grapsus*	Pukui and Elbert 1986
āholehole	juvenile āhole (Hawaiian flagtail)	*Kuhlia*	*xenura*	Hoover 1993
ʻanae	Striped mullet (full-sized)	*Mugil*	*cephalus*	Hoover 1993
ʻamaʻama	striped mullet	*Mugil*	*cephalus*	Hoover 1993
awa	milkfish	*Chanos*	*chanos*	Hoover 1993
haole (kūhonu)	white crab	*Portunus*	*sanguinolentus*	Pukui and Elbert 1986
hau	beach hibiscus	*Hibiscus*	*tiliaceus*	Wagner et al. 1999
kalo	taro	*Colocasia*	*esculenta*	Wagner et al. 1999
kūhonu	crab	*Portunus*	*sanguinolentus*	Pukui and Elbert 1986
limu ʻeleʻele	seaweed, algae	*Entermorpha*	*prolifera*	Abbott and Williamson 1974
limu huluhuluwaena	seaweed, algae	*Grateloupia*	*filicina*	Abbott and Williamson 1974
limu kohu	seaweed, algae	*Asparagopsis*	*taxiformis*	Abbott and Williamson 1974
limu manauea	seaweed, algae, Ogo	*Gracilaria*	*coronopifolia*	Abbott and Williamson 1974
māmaki	an endemic nettle	*Pipturus*	spp.*	Wagner et al. 1999
manini	convict tang	*Acanthurus*	*triostegus*	Hoover 1993
ʻōʻio	bonefish	*Albula*	spp.*	Hoover 1993
ʻōlena	turmeric	*Curcuma*	*domestica*	Pukui and Elbert 1986
ʻōpae lōlō	brackish-water shrimp or prawn	*Penaeus*	*marginatus*	Pukui and Elbert 1986
weke	goatfish	*Mulloidichthys*	spp.*	Hoover 1993

* spp. = multiple species

APPENDIX K. GAP ANALYSIS FOR THE PROPOSED HE‘EIA NATIONAL ESTUARINE RESEARCH RESERVE PROGRAMMATIC EIS

See attachment

APPENDIX L. NATURAL, CULTURAL, AND SOCIOECONOMIC IMPACT ANALYSIS FOR THE PROPOSED HE‘EIA NATIONAL ESTUARINE RESEARCH RESERVE

See attachment