Alakoko Loko I‘a Conceptual Master Plan

Niumalu Ahupua‘a, Puna District, Kaua‘i

Mālama Hulē`ia

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Mālama Hulēʻia Board members (2025) at Alakoko Loko iʻa. (L to R): Mason Chock, Emory Griffin-Noyes, Kilohana Haitsuka, Jan TenBruggencate, LaVerne Bishop, Ruby Pap, Chris Kauwe, Sabra Kauka, Lee Evslin, Pelika Andrade, Allan Smith.

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The National Park Service – Rivers, Trails, and Conservation Assistance program (NPS-RTCA) supports locally-led conservation and outdoor recreation projects across the United States. NPS-RTCA assists communities and public land managers in developing or restoring parks, conservation areas, rivers, and wildlife habitats, as well as creating outdoor recreation opportunities and programs that engage future generations in the outdoors.

August 2025, Mālama Hulēʻia

Mahalo

This conceptual master plan is a testament to the thousands of people who have shaped the work of Mālama Hulēʻia. The restoration of this special place is rooted in community and sustained by the generosity of kūpuna, educators, students, volunteers, families, organizations, and donors who have shared their time, knowledge, and resources.

Mālama Hulēʻia extends heartfelt mahalo to the many hands and hearts that have nurtured this work. While it is impossible to name every individual who has contributed, their presence lives on in the ʻāina and in the spirit of this place.

He iki unu paha, akā paʻa ka pōhaku nui ʻaʻole kaʻa.

Perhaps it is a small wedge stone that can stop the big stone from rolling.

Contents


Mālama Hulē'ia

ʻŌlelo Hawaiʻi-English Glossary

This ʻŌlelo Hawaiʻi-English glossary includes English translations of Hawaiian words used throughout the conceptual master plan. It is not intended to provide the entire range of meanings that some Hawaiian words have, but only the specific usage(s) of the terms in this context.

ʻŌlelo Hawaiʻi	English	Scientific Name
ʻaʻama	a type of crab	*Grapsus tenuicrustatus*
aeʻo	Hawaiian stilt	*Himantopus mexicanus knudseni*
āholehole	Hawaiian flagtail	
ahu	altar or shrine	
ʻahuʻawa	sedge, a flood-tolerant sedge that can be used for erosion control	*Cyperus javanicus*
ahupuaʻa	land division, a traditional watershed-based land division	
ʻāina	that which feeds, land	
ʻāina momona	fertile land, rich and fertile land, or fat or fertile land that which feeds	
ʻāina kumu wai	watershed	
ʻakēʻakē	band-rumped storm-petrel	*Oceanodroma castro*
ʻakiʻaki	a native grass, also known as mānienie	*Sporobolus virginicus*
akua	god, goddess, spirit, ghost, devil, image, idol, corpse; supernatural, godly	
akule	big-eyed scad or mackerel	*Trachurops crumenophthalmus*
ʻākulikuli	a very low plant that provides ground cover	*Sesuvium portulacastrum*
ʻalae keʻokeʻo	Hawaiian coot	*Fulica alai*
ʻalae ʻula	Hawaiian moorhen (gallinule)	*Gallinula chloropus sandvicensis*
ʻalamihi	a type of native crab	
alawai	the main drainage ditch or irrigation channel	
aliʻi	chief or chiefess	
aloha	respect	
ʻamaʻama	striped mullet	*Mugil cephalus*
ʻaʻo	Newell's shearwater	*Puffinus auricularis newelli*
ʻaukuʻu	black-crowned night heron	*Nycticorax nycticorax hoactli*
ʻauwai	irrigation channel or ditch	

ʻŌlelo Hawaiʻi	English	Scientific Name
ʻawa	beverage made from the root of the kava plant	
iʻa	fish or marine animal	
ʻike kūpuna	ancestral knowledge	
ili	a small division of land	
ʻiliahi	Hawaiian sandalwood	
ʻilima	yellow mallow, a herbaceous flowering plant in the Hibiscus family	*Sida fallax*
imu	underground oven	
ʻohana	family	
ʻōiwi	Hawaiian ancestry	
oli	chants	
ʻoʻopu	freshwater goby (a bony fish)	*Lentipes concolor*
ʻōpae	shrimp	
ʻopeʻapeʻa	Hawaiian hoary bat	*Lasiurus cinereus semotus*
ʻuala	sweet potato	*Ipomoea batatas*
ʻuaʻu	Hawaiian petrel	*Pterodroma sandwichensis*
ʻuhaloa	mallow, small medicinal shrub	*Waltheria indica*
uhau humu pōhaku	Indigenous drystack masonry	
ʻulu	breadfruit	*Artocarpus altilis*
hala	screwpine tree	*Pandanus tectorius*
hale	traditional Hawaiian house or building	
hale hālāwai	meeting house	
hale imu	cook house	
hale kiaʻi	caretaker house	
hale kuahui	maintenance facility	
hale kuke	kitchen house	
hale noho	dormitory	
hale waʻa	canoe house	
hīhīwai	a freshwater snail	*Neritina granosa*
hinana	young ʻoʻopu (freshwater goby)	*Lentipes concolor*
hua	eggs	
huakaʻi	field trip	

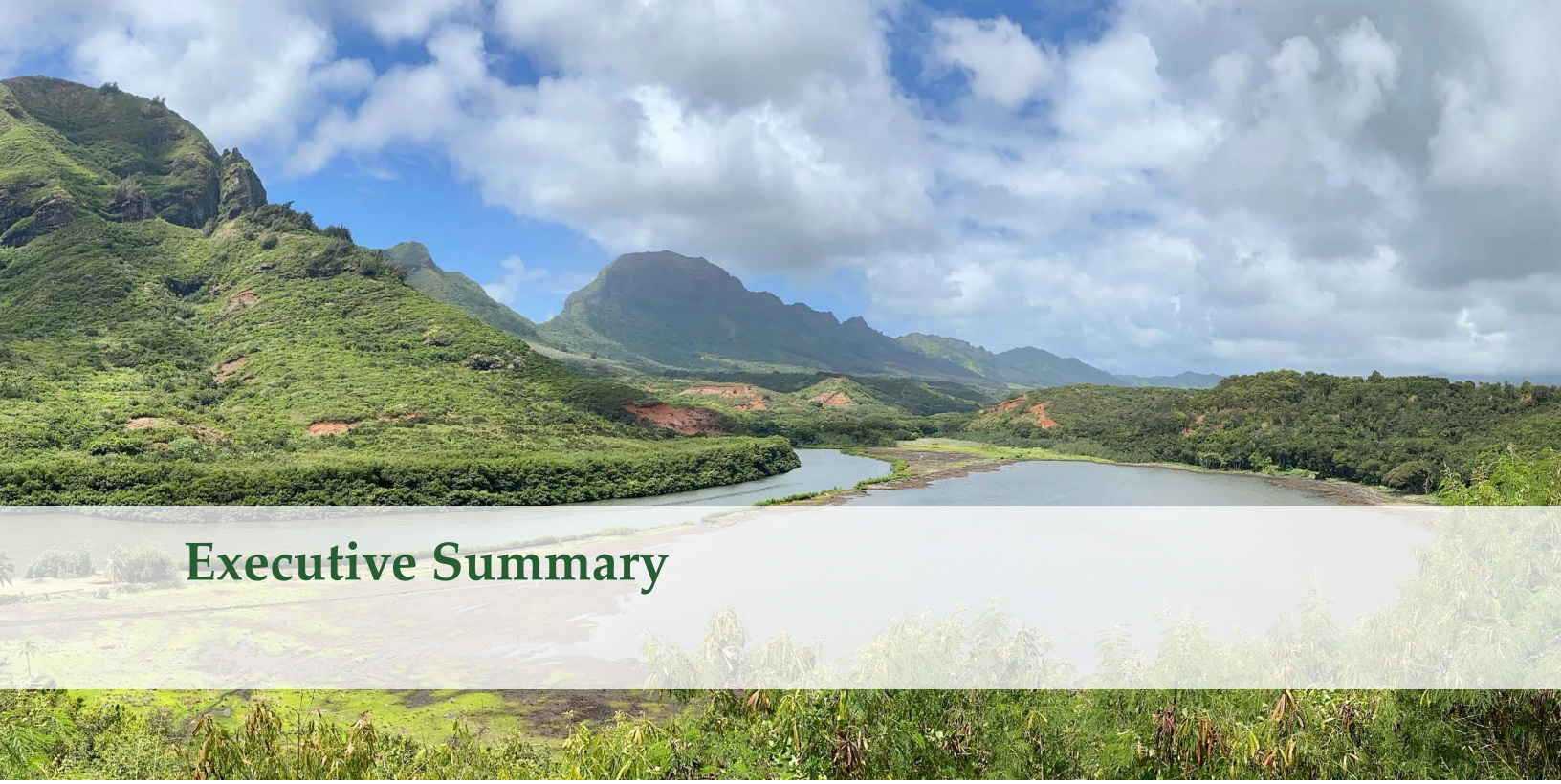
ʻŌlelo Hawaiʻi	English	Scientific Name
hui	club, association, team	
hula	Hawaiian dance form	
kahakai	coastal zone	
kahawai	freshwater stream or river	
kai	sea or ocean	
kākū	barracuda	*Sphyraena barracuda*
kalo	taro	*Colocasia esculenta*
kānāwai	law or the equal sharing of water	
kapu	taboo, forbidden	
keʻena	headquarters, office	
kīhāpai	a small garden	
kiʻo pua	a type of pond for raising juvenile fish (fry)	
kilo	observation	
kinolau	ceremonial use	
kīpuka	native habitat refuges or floating islands	
kōʻele	A small pond, reserved for a chief, where fish could be kept alive until required	
koloa maoli	Hawaiian duck	*Anas wyvilliana*
konohiki	overseer of chief's estate	
kuāna	earthen material	
kuāuna	earthen bank or border to a water system (taro patch, pond, stream, or ditch)	
kuapā	wall, fishpond wall	
kūhonu	a type of crab	
kukui	candlenut	*Aleurites moluccana*
kuleana	privilege and/or responsibility	
kupa	resident, native, citizen	
kupuna	elder	
lauhala	Pandanus leaves	
laulima	many hands, cooperation	
lawaiʻa	traditional fisherman	
limu	aquatic vegetation including seaweed	
limu kala wai*	a type of seaweed	*Sargassum echinocarpum*

ʻŌlelo Hawaiʻi	English	Scientific Name
limu lūʻau*	red seaweed	
loʻi	Hawaiian taro patch/garden; a patch of water used to grow food	
loʻi iʻa kalo	a taro patch that supports freshwater aquaculture	
loʻi kalo	a taro patch	
loko	pond	
loko iʻa	traditional Hawaiian fishpond	
loko iʻa kuapā	walled fishpond	
loko kuapā	walled fishpond	
loko wai	freshwater fishpond	
lumi keʻena	office building, administration	
māhele	land redistribution	
maiʻa	banana	
makaʻāinana	common people	
mākāhā	saltwater inlet/outlet, or control gate	
makai	towards the ocean	
makaloa	a small rounded sedge	*Cyperus laevigatus*
makawai	freshwater inlet or outlet	
māla	garden	
māla ʻai	cultivated food garden	
māla lāʻau	medicine garden	
mālama	to care for, stewardship	
mālama ʻāina	care for the land	
mālama kai	care for the sea	
manaʻo	thought, belief, intention, concept	
mānienie	a native grass, also known as ʻakiʻaki	*Sporobolus virginicus*
manini	convict tang	
mauʻu ʻakiʻaki	a native sedge	*Fimbristylis cymosa*
mauka	towards the mountain	
mele	song, poetry used as recordings of the past	
Menehune	in some legends, a race of people who first inhabited the Hawaiian Islands	

ʻŌlelo Hawaiʻi	English	Scientific Name
moʻala	a type of crab	
moi	Pacific threadfin	*Polydactylus sexfilis*
moku	district	
moʻo	lizard, water spirit	
moʻolelo	ancestral knowledge or traditional or past Hawaiian stories	
muliwai	estuaries, mouths of rivers, wetlands	
nahele	forest or tree grove	
neke	a native fern	*Cyclosorus interruptus*
nēnē	Hawaiian goose	*Branta sandvicensis*
pāpio	juvenile in the trevally or jack family	
piko	navel, or where life begins	
pilina	connection, relationships	
pōhaku	stone	
pono	moral, ethical, proper	
poʻowai	main water inlet	
pōpolo	glossy nightshade	*Solanum americanum*
pualu	yellow-fin surgeonfish	
pulehu	to cook on coals	
punawai	freshwater spring	
puʻu kāhea	calling hill	
wahi pana	storied places	
wai	fresh water	
waihona	archive	
waiwai	wealth	
wao akua	mountain top and sky	
wao kanaka	agriculture zone	
wao nahele	inland forest zone	
wauke	paper mulberry	*Broussonetia papyrifera*

Abbreviations

ACOE	Army Corps of Engineers
ADA	Americans with Disabilities Act
ARC	Archipelago Research and Conservation
BMPs	best management practices
CCP	Comprehensive Conservation Plan
DAR	State Division of Aquatic Resources
EbA	Ecosystem-based adaptation
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
HWJV	Hawai'i Wetland Joint Venture
IRM	Indigenous Resource Management
KIUC	Kaua'i Island Utility Cooperative
MOU	Memorandum of Understanding
NbS	nature-based solutions
NBWC	Nāwiliwili Bay Watershed Council
NCWCG	National Coastal Wetland Conservation Grants
NHO	Native Hawaiian Organization
NOAA	National Oceanic and Atmospheric Administration
NWR	National Wildlife Refuge
ONHR	Office of Native Hawaiian Relations
SLR	sea level rise
SUP	Special Use Permits
TPL	Trust for Public Land Hawai'i
USFWS	U.S. Fish and Wildlife Service



Executive Summary

This conceptual master plan outlines Mālama Hulēʻia's long-term vision, priorities, and path forward for the restoration and stewardship of Alakoko loko iʻa, a more than 600-year-old loko iʻa kuapā (walled fishpond) located along the Hulēʻia River in the ahupuaʻa (traditional watershed-based land division) of Niumalu, Kauaʻi. Now under the care of Mālama Hulēʻia, the 102-acre property, including the 40-acre loko iʻa, serves as both a living classroom and a cultural treasure with deep ecological, historical, and spiritual significance.

The plan reflects nearly a decade of community-based restoration, technical study, cultural research, and collaborative planning. It is both a guiding document and a call to action for the next generation of stewardship, grounded in Hawaiian values and ecological resilience.

The first three chapters provide the foundation for this plan, introducing the purpose and need for restoration, tracing the history and evolution of Mālama Hulēʻia, and recounting the cultural and ecological story of Alakoko. Together, these chapters, supported by further information in the appendices, establish the context of place, community, and history that grounds the restoration vision.

Purpose and Vision

The primary purpose of this plan is to:

- Guide restoration of the loko iʻa and surrounding ecosystem.
- Ensure compliance with regulatory and grant responsibilities.
- Align site development, cultural practice, and education programming.
- Strengthen partnerships with adjacent landowners and agencies (e.g., U.S. Fish and Wildlife Service [USFWS]).
- Serve as a framework for community, cultural, and ecological resilience.

Mālama Hulēʻia's vision is a "free-flowing, healthy and productive Hulēʻia ecosystem sustaining our community culturally, physically, and spiritually, perpetuating community pride."

Key Components of the Plan

1. Conceptual Restoration Plan (Chapter 4)

- Removal of 26 acres of invasive red mangrove (completed 2018–2021), reopening hydrological flows and revealing the historic kuapā (wall).
- Restoration of native wetland, coastal, and forest plant species.
- Rebuilding the kuapā through traditional uhau humu pōhaku (Indigenous drystack masonry) practices.
- Support for threatened and endangered species including aeʻo (Hawaiian stilt), koloa maoli (Hawaiian duck), ʻalae ʻula (Hawaiian moorhen [gallinule]), ʻalae keʻokeʻo (Hawaiian coot), and ʻōpeʻapeʻa (Hawaiian hoary bat).

2. Climate Change Adaptation (Chapter 5)

- Identification of sea level rise vulnerabilities.
- Use of ecosystem-based adaptation strategies to enhance resilience.
- Integration of ʻike kūpuna (ancestral knowledge) with contemporary climate science.

3. Kuhikuhi Puʻuone (Architecture or Site Development) (Chapter 6)

- Development of the infrastructure necessary to fulfill Mālama Hulēʻia's mission of restoration, stewardship, cultural practice, and educational and cultural programming. The hale hālāwai (meeting house) and hale waʻa (canoe house) will be constructed with traditional methods and materials.
- Phased construction in alignment with conservation district permitting and cultural priorities.

4. Cultural Foundations

- Emphasis on moʻolelo (Hawaiian stories), ʻike kūpuna, and mālama ʻāina (care for the land).
- Integration of education programming, including virtual huakaʻi (field trip) and K-12 partnerships.
- Engagement with Hui Mālama Loko Iʻa and other statewide cultural practitioners.

Land Ownership and Legal Commitments

In 2021, Mālama Hulēʻia acquired ownership of the property with support from the Trust for Public Land. The deed ensures that the land will be protected in perpetuity for:

- Native Hawaiian ʻāina-based education and stewardship.
- Restoration of ecosystems and aquaculture.
- Cultural perpetuation and pono (moral, ethical, proper) public access.

Grant agreements (e.g., National Coastal Wetland Conservation Grants [NCWCG]) require at least 20 years of active stewardship and monitoring of restoration outcomes, reinforcing long-term accountability.

Collaboration with Hulēʻia National Wildlife Refuge

Parts of Alakoko loko iʻa ecosystem fall within the Hulēʻia National Wildlife Refuge boundary. This plan assumes collaborative management with the USFWS to meet shared goals for habitat protection, endangered species recovery, and access agreements. This relationship is a vital piece of Mālama Hulēʻia's stewardship strategy and ongoing federal partnership efforts.

Looking Ahead

This plan is both a declaration of kuleana (privilege/responsibility) and a strategic roadmap. Its success will require continued:

- Ongoing investment in capacity, infrastructure, and restoration efforts.
- Strong coordination across community, agencies, and partnerships.
- Expanding and deepening of ʻāina-based education and cultural learning opportunities.
- Sustained advocacy for policy support and climate resilience funding.

Over the next 10–20 years, Mālama Hulēʻia's focus will be on building the foundation for long-term sustainability, including:

- Stabilization of the full 2,700-foot kuapā through uhau humu pōhaku.
- Restoration of hydrological flows, with functioning punawai (freshwater springs) and ʻauwai (irrigation channels or ditches).
- Creation of thriving habitat for endangered waterbirds and other native species.
- Expansion of ʻāina-based education programs reaching thousands of learners annually.

While these are the immediate milestones, the overarching vision extends across generations. Alakoko is not just a site—it is a living, breathing wahi pana (storied place), calling Native Hawaiians and community members to act with integrity, humility, and vision so that future generations may inherit abundance and resilience.

Chapter 1 Introduction Purpose and Need

In 2021, Mālama Hulēʻia became the landowner of Alakoko loko iʻa (Hawaiian fishpond) and surrounding property. The 40-acre (16.2-hectare) fishpond is located on two parcels totaling 102 acres (41.2-hectare). Alakoko loko iʻa is on the Hulēʻia River in Kauaʻi, approximately 0.6 mile (1 km) upstream from Nāwiliwili Small Boat Harbor in Līhuʻe. This document was created by Mālama Hulēʻia to guide the organization in the restoration, stewardship, site planning, uses, programming, and overall approach to care for land and water in a way that restores the functions of a Hawaiian loko iʻa.

Alakoko Loko Iʻa Description and Need

Mālama Hulēʻia prefers the name "Alakoko loko iʻa." Alakoko is the spelling used in historical references from the 1800s, versus the later spelling of Alekoko. The pond is known by several other names, including most notably "Menehune Fishpond." The naming of places is reflective of the moʻolelo (story), the ʻoli (chants), and mele (songs) that entwine and perpetuate people and place. See Appendix 1 for more details.

Alakoko loko iʻa sits in a geomorphic bend in the Hulēʻia River. An ancient Hawaiian stone-faced dirt wall with a length of more than 2,700 feet (820 m) long separates the loko iʻa from the Hulēʻia River. Alakoko is considered a loko iʻa kuapā (walled fishpond), one of the six general types of loko iʻa. Alakoko is tidally influenced and has brackish water due to its proximity to freshwater springs and Nāwiliwili Harbor. A full history is found in Chapter 3.

Alakoko loko iʻa was listed on the National Register of Historic Places in 1973, and is on the Hawaiʻi Register of Historic Places. It is considered to be the most significant loko iʻa on Kauaʻi and is estimated to be 600 years old. A loko iʻa is an important component of an ahupuaʻa (traditional watershed-based land division) that contributes to a healthy and robust food system. They are unique aquaculture

systems that exist throughout Hawaiʻi, and were developed to optimize natural patterns of watersheds, nutrient cycles, and fish biology.

However, during the 20th century, Alakoko loko iʻa became overrun by invasive red mangrove (*Rhizophora mangle*). This led to significant damage to the kuapā (wall), fundamental changes in the pond's size, hydrology and ecology. The dense mangrove overgrowth also made the loko iʻa itself virtually inaccessible to people. Removing the mangrove was needed to save Alakoko loko iʻa from destruction. Mangrove removal was only the first step in restoring Alakoko as a functioning loko iʻa. The restoration of native and traditional plants and water flow will allow it to once again be an integral part of the ahupuaʻa and regional ecosystem, reflecting Hawaiian ingenuity.

Location

Located just south of Līhuʻe on the Hulēʻia River, Alakoko loko iʻa is in the ahupuaʻa of Niumalu within the moku (district) of Puna (Figure 1-1). The Hulēʻia River flows through several ahupuaʻa, including Haʻikū, Kīpū, Niumalu, Nāwiliwili, and Kalapakī. The area has long been a center of human activity on Kauaʻi. This ʻāina momona (fertile land) is a region known for its abundance (Fechner et al. 2022). At one time, there were loʻi kalo (taro patches) and other food crops that flourished along the many streams and valleys of Hāʻupu, a nearby mountain summit. With such abundance, the ahupuaʻa was likely as noted 19th-century Hawaiian historian Samuel Mānaiakalani Kamakau described (Mackenzie et al. 2015 and Smith et al. 1972):

Figure 1-1. Location map.

“places that had taro patches and… fishponds loved the lands where they dwelt… [food was] laid in a food bowl and one ate until he was full.”

“The lands where the freshwater ponds, loko wai, were, for they furnished them with fresh ‘ōpae [shrimp], crisp limu kala wai [seaweed], reddish ‘o‘opu [freshwater goby] roe, and limu Iū‘au [red seaweed].”

The Hulēʻia River is the longest and largest of the many streams, including Pūʻali, Papalinahoa, and Nāwiliwili that flow into Nāwiliwili Bay (Fechner et al. 2022). Hulēʻia serves as a vital freshwater artery in the southern portion of Puna. This waterway holds historical significance, being a crucial resource for traditional Hawaiian agriculture and aquaculture. The waiwai (wealth) derived from Hulēʻia was shared among several adjacent ahupuaʻa, illustrating its role in fostering interconnectedness and sustainability across mountain-to-sea land divisions.

Land Ownership and Stewardship

In 2021, with an outpouring of community support and assistance from the Trust for Public Land (Hawaiʻi) (TPL), Mālama Hulēʻia purchased the property containing Alakoko loko iʻa. Deed restrictions ensure the property will be used in perpetuity for Native Hawaiian ʻāina-based stewardship (see sidebar next page). ʻĀina-based stewardship is the Hawaiian approach that involves the caring for and learning from the land, sea, and air, recognizing the interconnectedness and responsibility to address the needs of future generations. The property is within State Conservation District lands and a Special Management Area, requiring processes and restrictions to address conservation and access to coastal lands and public resources.

Māla (garden) overlooking Alakoko loko iʻa

Alakoko loko iʻa is adjacent to the Hulēʻia National Wildlife Refuge (NWR), managed by the U.S. Fish and Wildlife Service (USFWS). Other direct neighbors include single family homes, the Niumalu community, and Grove Farm, which leases agricultural lands (Figure 1-2).

The purpose of Hulēʻia NWR is to protect and assist in the recovery of threatened and endangered species, especially native waterbirds, other wildlife, and plants, under the Endangered Species Act of 1973 (16 U.S.C. § 1534). The Alakoko property also provides habitat for these vulnerable endangered and

The Alakoko Loko iʻa Property Deed Ensures that the Property Will Be Used in Perpetuity for:

- Native Hawaiian ʻāina -based education, natural resource management, and stewardship;
- Perpetuation of traditional and customary Native Hawaiian cultural practices;
- Preservation and restoration of historic and culturally important land and sites;
- Preservation and restoration of significant native habitats or ecosystems;
- Preservation and restoration of land and water used for sustainable aquaculture and agriculture to increase local food self-sufficiency;
- Preservation and restoration of Niumalu watershed lands for water quality and quantity;
- Preservation and restoration of land to reduce erosion, floods, landslides and runoff;
- Pono (moral, ethical, proper), responsible, reciprocal, managed, safe, guided public access that ensures its cultural and natural resources are protected;
- Conservation of property for open space and scenic values.

The deed restriction also limits development on and subdivision of the property.

threatened species that are known to live in or pass through the area around the project site.

The restoration plan described in Chapter 4 includes efforts that are on Hulēʻia NWR lands as the refuge boundary overlaps with parts of the overall loko iʻa system, including part of the pond itself. Grant requirements mandate that Mālama Hulēʻia be able to work on Hulēʻia NWR property in order to restore and maintain Alakoko loko iʻa. In addition to the initial work Mālama Hulēʻia did to remove invasive plants and restore wetlands, they are required to maintain the restored areas for a minimum of 20 years (see Appendix 2). Mālama Hulēʻia will continue to restore native vegetation and traditional Hawaiian agricultural and medicinal plants, provide habitat for native species including threatened and endangered waterbirds, and ensure that there are on-going efforts to steward the lands. Therefore, this plan is built upon the premise that Mālama Hulēʻia and the Hulēʻia NWR managers will work collaboratively to manage the lands along the Alakoko-Hulēʻia NWR boundary, and will implement best management practices to ensure protections for threatened and endangered species and the restoration of the loko iʻa. These species include:

Waterbirds

- Aeʻo, Hawaiian stilt (*Himantopus mexicanus knudsen*i)
- ʻAlae ʻula, Hawaiian moorhen (gallinule) (*Gallinula chloropus sandvicensis*)
- ʻAlae keʻokeʻo, Hawaiian coot (*Fulica alai*)
- Koloa maoli, Hawaiian duck (*Anas wyvilliana*)
- Nēnē, Hawaiian goose (*Branta sandvicensis*)

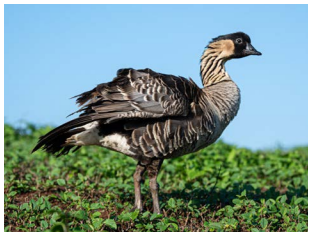
Figure 1-2. Map showing parcel ownership for Alakoko loko i'a and surrounding properties.

Endangered Hawaiian Waterbirds

Five endangered species of endemic waterbirds are present in the area around Alakoko loko iʻa, including in the neighboring Hulēʻia NWR, which was established to aid in their recovery.

Koloa maoli
Hawaiian duck

Aeʻo
Hawaiian stilt



Nēnē
Hawaiian goose

ʻAlae ʻula
Hawaiian moorhen (gallinule)

ʻAlae keʻokeʻo
Hawaiian coot

All photos credited to USFWS: Laurel Smith (koloa maoli, nēnē, ʻalae keʻokeʻo), Gary Kramer (aeʻo, ʻalae ʻula)

Seabirds

- ʻUaʻu, Hawaiian petrel (*Pterodroma sandwichensis*)
- ʻAʻo, Newell's shearwater (*Puffinus auricularis newelli*)
- ʻAkēʻakē, band-rumped storm petrel (*Oceanodroma castro*)

Mammal

- ʻOpeʻapeʻa, Hawaiian hoary bat (*Lasiurus cinereus semotus*)

This plan includes goals and objectives to support these species as well as migratory species (see Chapter 4). For Native Hawaiians, the waterbirds are indications of a healthy ecosystem. While the federal and state laws define the purpose of the refuge to be for these endangered species, Mālama Hulēʻia also sees them as indicators of success. The restoration addresses the need for habitat that supports the life cycles of these endangered species.

Purpose and Vision

Mālama Hulēʻia is a community-based mālama ʻāina (care for the land) nonprofit organization leading the restoration of Alakoko loko iʻa. Malāma Hulēʻia's

Community outreach and educational programming give Mālama Hulēʻia the opportunity to share the rich moʻolelo of Alakoko loko iʻa. As moʻolelo provides lessons, history, and context of place, Mālama Hulēʻia former staff member Tiele-Lauren Doudt developed a new translation of "Moʻolelo O Ka Laāhui Kaānaka I Kapaʻia Menehune, O Kauaʻi." This story for Alakoko loko iʻa describes the role of Menehune (a race of people who first inhabited the Hawaiian islands) in the creation of Alakoko loko iʻa. See Appendix 3.

strategic plan identifies their vision as: "A free-flowing, healthy and productive Hulēʻia ecosystem sustaining our community culturally, physically, and spiritually, perpetuating community pride." To achieve this vision, Mālama Hulēʻia actively advocates, educates, and leads efforts to remove invasive red mangrove along the Hulēʻia River, restore native wetland ecosystems, manage the Alakoko loko iʻa, and develop environmental stewardship programs that honor Hawaiian values.

The purpose of restoring Alakoko loko iʻa is to bring abundance back to the ʻāina through the rehabilitation of a productive loko iʻa with functioning punawai (freshwater spring) and attached ecological systems. Repairing the function of the loko iʻa addresses the needs of native plants and animals, while perpetuating Hawaiian ecological knowledge through practice, kilo (observation), research, and teaching the next generation of practitioners.

The conceptual master plan outlines a vision for the Alakoko loko iʻa over the next 600–800 years, aiming for an abundant and healthy ecosystem while addressing restoration work in the

upcoming 10–20 years. Guided by Hawaiian practitioners, scientists, and subject matter experts, the plan incorporates Hawaiian ecological knowledge, traditional cultural practices, community, student/academic involvement, and Western scientific methods. It focuses on enhancing native biodiversity and ecosystem functions at Alakoko loko iʻa while coordinating with neighboring landowners to eradicate red mangrove and other invasive species throughout the Hulēʻia River watershed. It also serves to bring back aquacultural and agricultural systems that address community needs.

Since 2015, Mālama Hulēʻia has engaged in removing red mangrove within the surrounding Hulēʻia River watershed, including at Alakoko loko iʻa. By 2021, Mālama Hulēʻia had removed 26 acres (10.5-hectare) of mangroves on the Alakoko loko iʻa property (Appendix 3) and has been restoring the area.

In 2021, Mālama Hulēʻia was able to purchase the property that contained most of Alakoko loko iʻa. This provided the nonprofit the opportunity to undertake a comprehensive restoration project and planning process to restore the functionality of Alakoko loko iʻa. These efforts address the restoration of the loko iʻa as well as the infrastructure needed to maintain the restored site, conduct education programming, and continue to work with the community to restore Hawaiian practices through ʻāina-based restoration and stewardship.

Ownership of Alakoko property holds tremendous kuleana (privilege/responsibility). The restoration of Alakoko loko iʻa will bring an important cultural resource back into functionality. Native Hawaiians view this as an opportunity to connect to ancestors, to learn from the land and water, and establish the practices that were an integral part of the cultural and spiritual connections between people and place. Part of Mālama Hulēʻia's stewardship of Alakoko loko iʻa involves researching Hawaiian resources such as ʻike kūpuna (ancestral knowledge), moʻolelo (Hawaiian stories), mele (songs), and oli (chants), Hawaiian language newspapers and accounts, insights from cultural practitioners and subject matter experts, and knowledge from lineal descendants from the ahupuaʻa. This knowledge will serve as a waihona (archive) allowing Mālama Hulēʻia to build a library to share traditional Hawaiian knowledge with the community.

Planning Process

The plan aims to guide ongoing restoration, stewardship, infrastructure development, and programming for the site. It includes comprehensive evaluations of restoration approaches, recommendations for infrastructure to support Mālama Hulēʻia operations, and long-term management of the property.

The plan incorporates required measures that adhere to regulations, such as the National Environmental Policy Act, National Historic Preservation Act, and the Endangered Species Act, as well as requirements of grants that have helped fund Mālama Hulēʻia's work at the site.

In 2022, Mālama Hulēʻia applied to the National Park Service Rivers, Trails, and

Conservation Assistance (NPS-RTCA) Program for technical planning assistance for a conceptual master plan for Alakoko. Mālama Hulēʻia staff and board, along with input from the community, has used this planning process and the technical assistance from NPS-RTCA, to chart a path forward to honor and steward this place for generations to come. This process included developing a purpose statement, vision, and best practices to guide this plan and future work at Alakoko loko iʻa:

The conceptual master plan for Alakoko loko iʻa includes two major components:

- A conceptual restoration plan (Chapter 4)
- Kuhikuhi Puʻuone (Architecture or Site Development Plan) (Chapter 6)

Consideration of the potential impacts of climate change on Alakoko loko iʻa was an important part of these planning efforts. Alakoko may experience chronic flooding due to sea level rise (Chapter 5). But restoration of the site should improve its resilience to the impacts of climate change.

This conceptual master plan also includes a history of Mālama Hulēʻia (Chapter 2) and of Alakoko (Chapter 3 and Appendix 5) as well as other supporting information.

Chapter 2 History of Mālama Hulēʻia

Mālama Hulēʻia was formally established as a 501c(3) organization in 2015 and has been working within the Hulēʻia River and surrounding area to remove the 70 acres (28.3 hectares) of invasive red mangrove within the ahupuaʻa (traditional watershed-based land division) and restore native ecosystems throughout the watershed.

Sara Bowen has led Mālama Hulēʻia as Executive Director since its inception as an independent nonprofit in 2015. Sara is responsible for implementing the organization's strategic plan and its goals and objectives. She also secures the funding, permits, and permissions for Mālama Hulēʻia's restoration work at Alakoko loko iʻa and throughout the Hulēʻia watershed.

Mālama Hulēʻia was spawned by two community organizations that worked in different ways with and on the water: Nāwiliwili Bay Watershed Council (NBWC) and Kaiola Canoe Club. NBWC provided the scientific analysis and recommendations for the watershed that helped Kaiola Canoe Club with the rationale and funding success for the pilot projects.

Mangrove removal began in 2013 and 2014 when Kaiola Canoe Club received two one-year grants from the National Oceanic and Atmospheric Administration (NOAA) and the Hawaiʻi Community Foundation for work at a 2.5-acre (1-hectare) demonstration site next to the Kauaʻi County Niumalu Beach Park. An extension of the pilot project treated an additional 1.5 acres (0.6 hectares). These initial efforts also built community support and partnerships for long-term stewardship of the area. With this successful project, the Kaiola Canoe Club Mangrove Removal Steering Committee developed into Mālama Hulēʻia.

In 2015, Mālama Hulēʻia contracted the services of the University of Hawaiʻi Sea Grant College Program to formulate a strategy to remove red mangrove from the lower Hulēʻia watershed (University of Hawaiʻi Sea Grant College Program

Nāwiliwili Bay Watershed Council

In 1999, a group of citizens united by a concern about the degradation of the watersheds feeding into the Nāwiliwili Bay (including the Hulēʻia River, and Pūʻali, Papalinahoa, and Nāwiliwili streams) formed the NBWC in 1999. Part of the stimulus for formation of this group was the Hawaiʻi Unified Watershed Assessment (State of Hawaiʻi Department of Health 1998), which classified the Nāwiliwili Bay Watershed as Category I - Watersheds in Need of Restoration. Category I watersheds do not currently meet, or face imminent threat of not meeting clean water and other resource goals (Furness et al. 2002). NBWC responded to this classification by assisting with grant-funded projects designed to raise public awareness about the problems of runoff in the watershed. One project resulted in the educational website ʻĀina Kumuwai: Ahupuaʻa of Nāwiliwili Bay (Cockett 2001), which Mālama Hulēʻia uses as a source of historical information and photographs. Another important contribution by the NBWC was in cooperating with the three-phase Assessment and Protection Plan for the Nāwiliwili Watershed (Furness et al. 2002; El-Kadi et al. 2003; and El-Kadi et al. 2004), which formed the basis of the Nāwiliwili Watershed-Based Plan. This is the plan that enables use of the U.S. Environmental Protection Agency (EPA) Section 319 Nonpoint Source Pollution Program to clean up a watershed. The plan covered the nine elements required by the EPA for watershed-based plans that can utilize Section 319 funding.

Kaiola Canoe Club

Kaiola Canoe Club was the mother organization of Mālama Hulēʻia as its formative years were as a project steering committee within the club. As active outrigger canoe paddlers, club members felt the urgency to do something about the red mangrove invasion of the Hulēʻia River and responded by forming Mālama Hulēʻia. The group began mangrove removal while still under the auspices of Kaiola Canoe Club.

2015). Development of this action plan included determination of the extent and locations of red mangrove infestation in the watershed, analysis of effectiveness and costs of various mangrove removal techniques, and facilitated action planning meetings with the Mālama Hulēʻia Board of Directors.

After the pilot project's success, plans were developed to address the remaining 66 acres (26.7 hectares) infested with red mangrove to restore the ecological function and productivity of the river and wetlands, improve water quality, and revive the culturally significant Alakoko loko iʻa by removing 26 acres (10.5 hectares) of mangrove at Alakoko loko iʻa.

In 2018, Mālama Hulēʻia developed a strategic plan and adopted its mission to advocate, educate, and lead community efforts to remove invasive red mangrove along the Hulēʻia River, reestablish native wetland ecosystems, and create an environmental stewardship program honoring Hawaiian values.

Since 2018, Mālama Hulēʻia has made significant progress in the removal of the invasive mangrove and the organization has grown significantly. They became the landowner of Alakoko loko iʻa, and increased their knowledge, experience, and its ability to use biocultural restoration techniques. This prompted the organization to initiate an early update to the strategic plan (Mālama Hulēʻia 2021).

The Mālama Hulēʻia Approach

The vision for Alakoko loko iʻa is not just shaped by Mālama Hulēʻia's board and staff, technical experts, Hawaiian practitioners, conservation professionals, scientists, and educators; it is also deeply rooted in the contributions of community volunteers. These volunteers and the broader community are essential to Mālama Hulēʻia's achievements—in the past, present, and into the future. Their dedication underscores the significance of collective action, especially when guided by the wisdom of Hawaiian culture. This spirit of collaboration is reflected in the Mālama Hulēʻia approach, which is informed by diverse ways of learning, including the Hawaiian practices of moʻolelo and mele (songs), place names, Hawaiian language newspaper articles and documents, chants, and ʻike kūpuna (ancestral knowledge). This cultural lens considers the spiritual, physical, and environmental dimensions of place, guiding restoration with wisdom passed down through generations. Mālama Hulēʻia is guided by the principles of mālama ʻāina (care for the land) and mālama kai (care for the sea).

Hawaiian scholars are documenting indigenous knowledge, creating a new generation of practitioners who integrate cultural practices and traditional knowledge with Western science and ecological understanding (Winter et al. 2021). Under the guidance of Hawaiian Cultural Practitioner Peleke Flores (Figure 2-1), Mālama Hulēʻia embraces a biocultural approach to restoration—one that blends traditional knowledge with scientific methods. This approach acknowledges the interdependence of cultural and ecological systems and focuses on collaborative partnerships that build on past successes and address challenges (Gavin et al. 2015). This program is grounded in kilo, where community members and schools actively participate in monitoring and caring for the land. The community plays an integral role in all aspects of the restoration program from native-plant propagation to water-quality testing.

Figure 2-1. Peleke Flores, Mālama Hulēʻia's Director of ʻĀina and Community Engagement, has led restoration and education at Alakoko since 2018. He previously spent ten years at Heʻeia Fishpond on Oʻahu, building expertise in loko iʻa restoration, invasive species removal, and community stewardship.

Loko iʻa restoration statewide follows this biocultural model and is not done in isolation. Mālama Hulēʻia is a participating member of Hui Mālama Loko iʻa, a statewide group of practitioners who embrace this biocultural model and work across organizations, government agencies, and with Hawaiian cultural practitioners to share the lessons learned, assist one another, and further the understanding and restoration of loko iʻa statewide. This has helped loko iʻa restoration efforts across the islands, advancing

understanding and ways to sustainably restore and manage these resources. One of the major accomplishments of this group is the Hoʻāla Loko iʻa program, a streamlined permitting process for the restoration and maintenance of traditional Hawaiian fishpond systems (Office of Conservation and Coastal Lands 2025). This program has allowed for better understanding of loko iʻa restoration for regulators and addresses county and state permitting on conservation district lands. Further work to address federal laws are still needed to address conflicts with some biocultural approaches and traditional Hawaiian restoration practices. Hui Mālama Loko Iʻa has advanced restoration by adapting lessons learned and sharing knowledge among practitioners (KUA 2025). Their gatherings and workshops foster collaboration, enhancing the restoration of wetlands and loko iʻa to improve ecosystem services.

Through this process of observation, practice, and sharing, the Hawaiian loko iʻa community continues to build resilience and deepen its stewardship of the land and waters. Mālama Hulēʻia collaborates across the state with Hawaiian

Volunteers planting native vegetation on the kuapā following mangrove removal.

"The stewardship of Alakoko is sowing the seeds of kuleana in the hearts and souls of the people."

Community member

practitioners of loko iʻa and loʻi kalo, other organizations and government agencies involved in the restoration of loko iʻa and wetlands, and scientists to amplify the impact of its work.

Mālama Hulēʻia is committed to creating the stewardship that was a large part of Hawaiian culture. The existing volunteer programs provide opportunities for both education and laulima (many hands) that keep the resources thriving. As described below, community involvement in the restoration and programming is an essential

In addition to working with other organizations involved in loko iʻa restoration, Mālama Hulēʻia's approach includes working organizations devoted to preservation and pertetuation of Hawaiian cultural practices and the restoration of natural and cultural resources throughout Hawaiʻi, such as Hui Makaʻāinana o Makana.

From left to right: Punohu Kekaualua, Mālama Hulēʻia staff, Presley Wann, Hui Makaʻāinana o Makana President, Sara Bowen Mālama Hulēʻia Executive Director, Jason Makaneole, Mālama Hulēʻia staff

component of the work. Mālama Hulēʻia envisions a literate and engaged community that cares for the environment and cultural practice, which in turn will nourish them in mind, body, and spirit. Research, monitoring, and study undertaken by Mālama Hulēʻia are continually adding valuable knowledge for the restoration of the pond, honoring the spirit of ʻōiwi (Hawaiian ancestry) in every step of the journey.

Mālama Hulēʻia continues to build the next generation of stewards by delivering educational programs that benefit the entire community (Figure 2-2). This is another aspect of the Mālama Hulēʻia approach, as it builds the next generation of stewards who will have firsthand knowledge and experience with the restoration and stewardship of their ʻāina. With both an outdoor classroom and an online learning platform, the loko iʻa serves as an accessible and vital resource for local schools and visitors. The on-site education program has a strong focus on K-12 students, giving them a sense of place and pride and reinforces the sense of community needed to sustain the island way of life. This living classroom brings together teachers, conservation experts, and students to learn about science, the environment, and Native Hawaiian culture. The online platform, developed in partnership with Kamehameha Schools during the COVID-19 pandemic, has expanded Mālama Hulēʻia's reach, allowing for virtual learning that connects communities both near and far. This platform gives the broader community access to the rich moʻolelo and practices that honor this sacred place, ensuring that the wisdom of the past continues to guide the stewardship of the future.

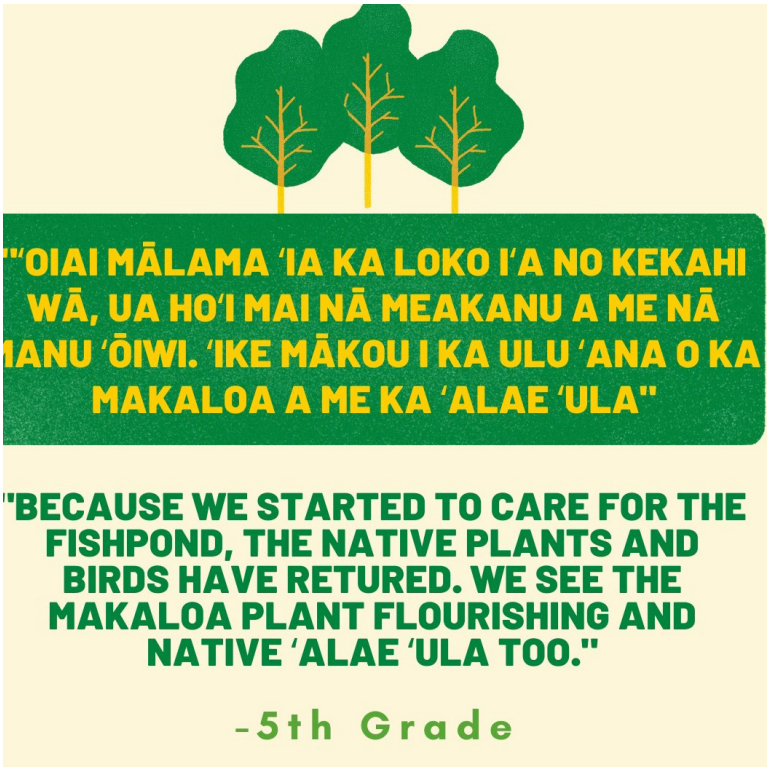


Figure 2-2. Mālama Hulēʻia's educational programming includes educational outreach with local school children, as exemplified by this message from a 5th grader.

History in the Making—Removing 26 Acres of Mangrove

Mālama Hulēʻia has successfully demonstrated their ability to restore ecosystems and continues to enhance their approach to restoring ʻāina. Prior to Mālama Hulēʻia purchasing the property that encompasses Alakoko loko iʻa, they had an agreement from the private landowner to remove the mangrove and restore wetlands (Figure 2-3). This agreement provided the legal mechanism that allowed Mālama Hulēʻia to steward the property for 20 years to ensure the restoration was a success. The mangrove removal process required innovative approaches to make sure the mangrove removal did not impact the cultural resource as well as the endangered species.

Between 2018 and 2021, Mālama Hulēʻia removed 26 acres of red mangrove during the initial phase of the restoration of Alakoko loko iʻa (Figure 2-4),

In the summer of 2018, after extensive planning and securing necessary permits, Mālama Hulēʻia initiated the restoration of Alakoko loko iʻa with a ceremonial ahu to set clear intentions for the project (Figure 2-5). The physical restoration work commenced in October 2018 through a community workday, involving over 100 volunteers to clear invasive species (Figure 2-6). This collaborative effort fostered community connections while revitalizing the ecosystem. Volunteer workdays continued monthly until March 2020.

By January 2019, the effort gained even more momentum. The mangrove removal included a specialized team known as the ʻMenehune Crew,' who focused on sensitive areas near the Alakoko kuapā (wall), taking extra precautions due to the

Figure 2-3. Alakoko loko iʻa at the start of the mangrove removal project from around the circumference of the pond.

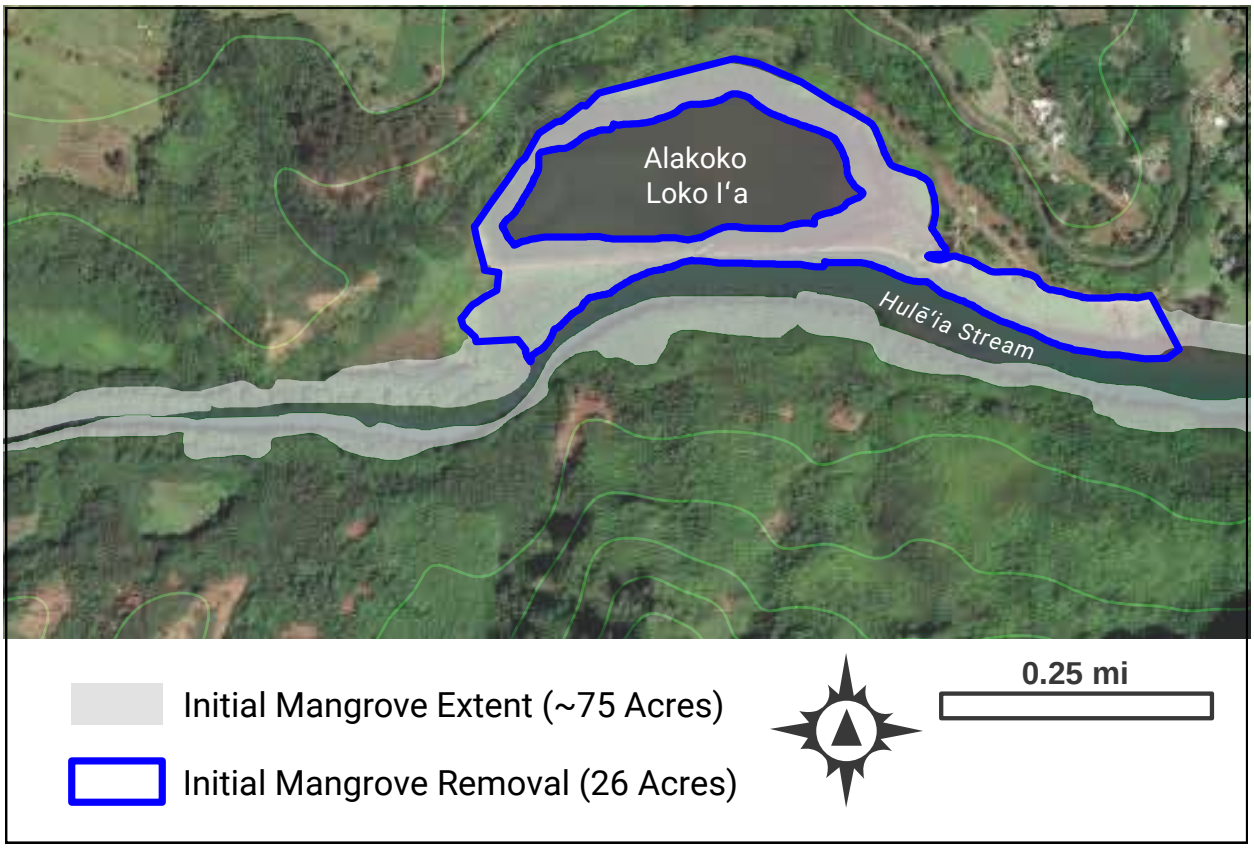


Figure 2-4. Map showing the outline of the area from which mangrove was removed during the initital restoration efforts at Alakoko loko i'a.

archaeological significance of the land (Figure 2-7). Additionally, heavy machinery was employed to prepare the infrastructure, ensuring minimal disruption to the environment (Figure 2-8). A second crew of volunteers were machine operators who cleared the first 10 acres of mangrove surrounding the fishpond, using specialized equipment that could navigate the tricky terrain. As the mangrove removal progressed to more difficult areas, a piece of machinery, an amphibious excavator, was designed and built specifically for Alakoko. It was built to work in conditions where traditional machines would get stuck in the soft, muddy ground. This unique approach allowed the team to clear large sections of land efficiently, preparing the fishpond for the next phase of ecological restoration.

Figure 2-5. Constructing the ceremonial ahu at Alakoko loko iʻa.

When the COVID-19 pandemic halted in-person activities in March 2020, Mālama Hulēʻia adapted their work with the community by transitioning to virtual platforms for educational outreach. Collaborating with the Department of Education, they developed

Figure 2-6. Volunteers removing invasive vegetation near Alakoko loko iʻa.

a virtual huakaʻi (field trip) that helped maintain community engagement and biocultural education, exemplifying resilience amidst challenges.

In June 2020, Mālama Hulēʻia implemented a controlled burning operation for disposing of mangrove waste. This method, approved by the Department of Health, was selected after thorough research into various disposal options, considering factors such as accessibility, environmental concerns, and the protection of historical sites. Controlled burning was utilized only in hard-to-reach areas, while mulch and compost were created from other mangrove waste, further enriching the restoration process (Figure 2-9).

Mālama Hulēʻia ensured the controlled burns were carefully planned with the Kauaʻi Fire Department, adhering to safety protocols and minimizing risks to nearby communities. By gathering ash from the burns for use as mulch and compost, the organization effectively integrated waste disposal into their broader restoration efforts.

Through these creative approaches, Mālama Hulēʻia demonstrated a commitment to preserving both cultural and natural resources while promoting community collaboration and environmental stewardship throughout the Alakoko loko iʻa restoration project.

Figure 2-7. Menehune Crew. From left to right: Mark Hubbard, Clayton Egan, Gary Hofacker, Frank Whitman, Jeff Kalani, and Steve Yee.

Figure 2-8. The use of heavy equipment was essential for mangrove removal in most areas in and around the pond (except for the kuapā).

By 2021, the restoration project completely transformed Alakoko loko iʻa (Figure 2-10). Removal of the mangrove allowed Mālama Hulēʻia and the community to see the footprint of the pond, unveiling its features including the kuapā (wall), punawai (freshwater springs), kahawai (freshwater streams), and native and Hawaiian plants. Mālama Hulēʻia has used an adaptive management approach to understand the changing conditions following mangrove removal. Mangrove removal also set the stage for wetland restoration along the Hulēʻia River and on the banks of the loko iʻa, creating fish passage into the loko iʻa and allowed Mālama Hulēʻia to kilo and develop the details and steps to restore the loko iʻa.

Wetland plants were installed and spread in areas that were once dominated by mangrove, and native and Hawaiian-introduced plants sprouted or were planted in

Figure 2-9. Volunteers building burn piles for mangrove waste.

Figure 2-10. Before (top) and after (bottom) images showing the transformation of Alakoko loko i'a following mangrove removal.

suitable areas. Through further field analysis, kilo and research through Hawaiian and Western sources, a picture of a functioning loko iʻa and its relationship to the ahupuaʻa and moku is being better understood. The next phases of restoration will be further explained in Chapter 4.

Protecting and Monitoring Endangered, Threatened, and Native Species

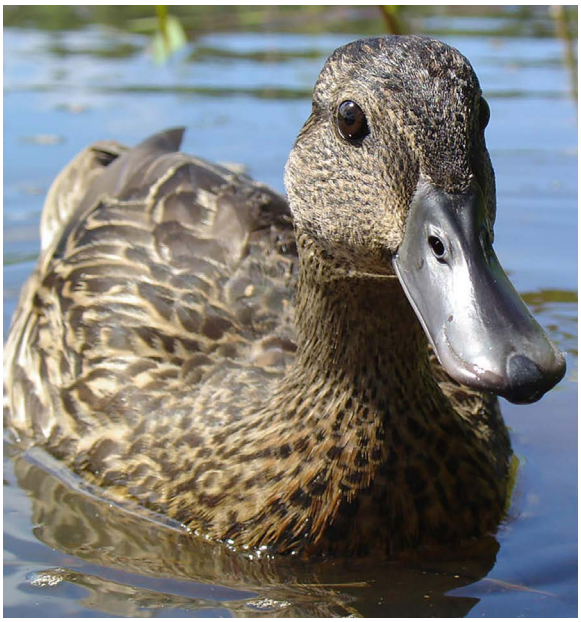


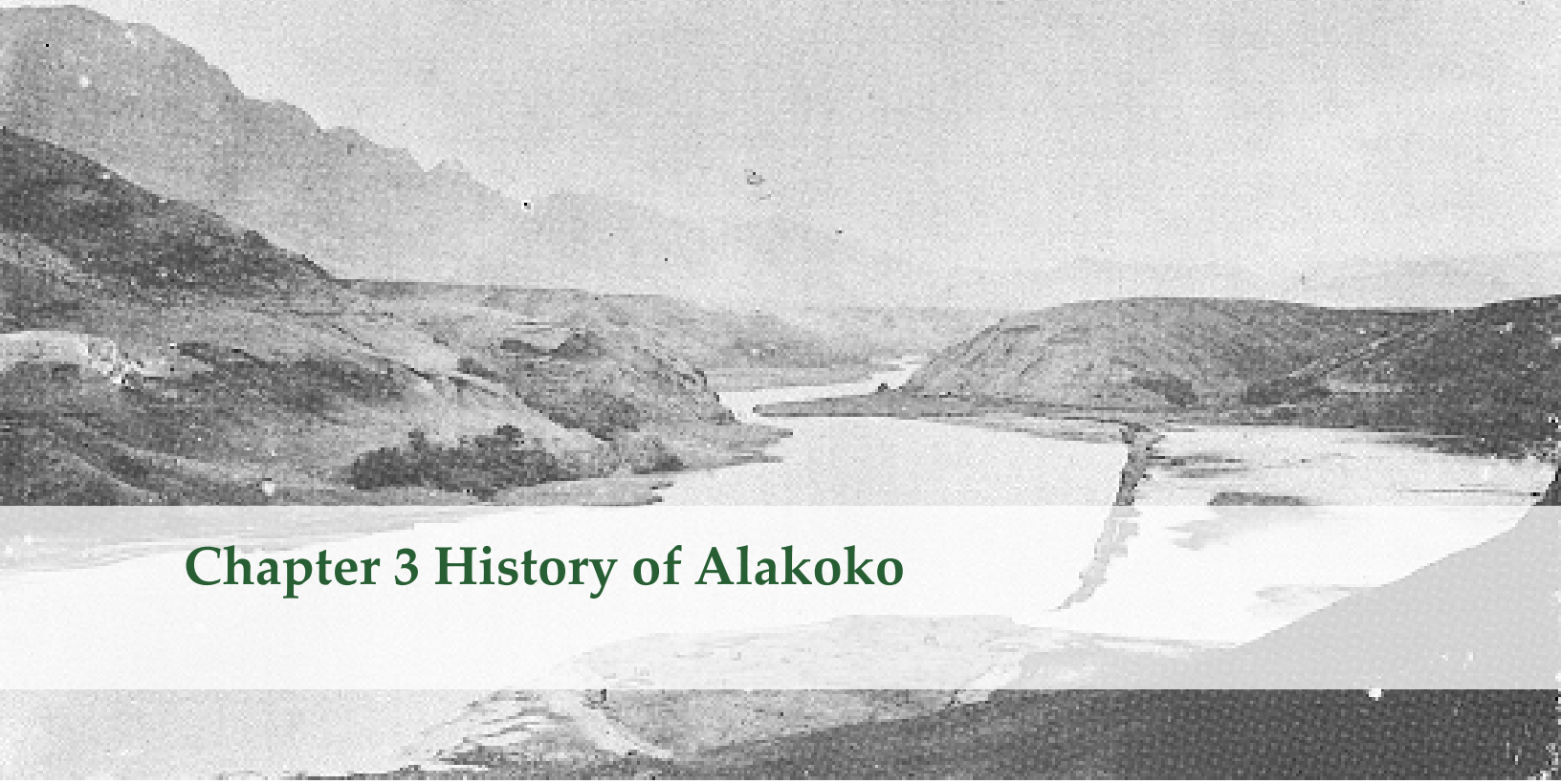
Figure 2-11. Koloa maoli (Hawaiian duck). USFWS photo by Brenda Zaun.

Figure 2-12. ʻŌpeʻapeʻa (Hawaiian hoary bat). Credit: Forest & Kim Starr. CC BY 3.0.

The Hulēʻia River and associated estuarine and marine wetlands provide habitat for endemic waterbirds, migratory birds, and shorebirds (Appendix 2). Removal of the mangrove and restoration of native wetland habitat will benefit the state and federally listed endangered Hawaiian waterbirds (Figure 2-11), the federally endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), and culturally important fish and invertebrates. Conservation of important lowland coastal habitat for foraging is essential for the recovery of the Hawaiian hoary bat (USFWS 1998) (Figure 2-12), which includes the restoration of the nahele (forest) on the hillslope above the loko iʻa.

Numerous mitigation measures were required for the mangrove removal process to protect cultural and natural resources (Appendix 2). Surveys and monitoring have been ongoing for birds, fish, and overall water quality monitoring (Appendix 4).

Mālama Hulēʻia also has a predator control program and is actively working to establish native and cultural vegetation, which both will benefit endangered and other native species (Appendix 4).



Chapter 3 History of Alakoko

Looking Back as the Way Forward

To understand the condition of Alakoko loko iʻa, the Hulēʻia River, and the adjacent land before Western contact, Mālama Hulēʻia has drawn from personal accounts, ʻohana (families), moʻolelo (past stories), oli (chants), Hawaiian newspapers, archaeological reports, and cultural interpretations. This section describes and provides references to cultural, archaeological, and historical information and provides a description of the conditions of Alakoko loko iʻa prior to Western contact. It is recognized that Mālama Hulēʻia will not be able to recreate the past, rather their objective is to look for indicators that show that they are restoring a functioning loko iʻa. The goal is to support native species and uphold the cultural landscape, fostering a harmonious coexistence between the ecological and cultural dimensions. Based on historical data, cultural interpretations, stories, scientific studies, and observations, Mālama Hulēʻia believes that Alakoko loko iʻa will serve as an incubator and nursery of native species that will contribute to a highly productive biocultural ecosystem that will result in an amplification of the existing resources, helping to support ecosystem needs from the kahawai (freshwater stream) to the nearshore fisheries and beyond.

Much of the data on Hawaiian loko iʻa is less than 100 years old and was analyzed from the western lens of aquaculture and fish production. In order to understand the true societal values of Hawaiian loko iʻa, Mālama Hulēʻia is looking at fishpond functions prior to Western contact, focusing on the Hawaiian uses and the impact the loko iʻa had within the larger ahupuaʻa. Both loʻi kalo (taro patches) and loko iʻa were impacted by water diversion, a result of the sugar plantation era where water became a commodity manipulated (diverted and ditched). Wai (fresh water) is a catalyst for biological integrity in riparian, wetland, and estuarine ecosystems. It connects via the many tributaries that flow from the uplands and allows for

the biodiversity from the mountain headwaters to the ocean. The interruption of wai flows is ongoing with the ecological deterioration that continues having dire consequences to land, water, and people.

There are moʻolelo of loko iʻa that include descriptions of loko iʻa as an important nurseries for fish. It suggests that increasing fish populations in a loko iʻa can amplify the fishery in the nearshore marine ecosystem to benefit the lawaiʻa (traditional fisherman). Lawaiʻa is a Hawaiian term that describes both the act of fishing and the person who engages in it. A lawaiʻa is someone skilled in traditional fishing methods. The practice of lawaiʻa is deeply connected to Hawaiian culture where fishing is not just a means of sustenance but also a way of maintaining balance with the natural world.

Loko iʻa played a crucial role in supporting the work of the lawaiʻa by providing a sustainable source of fish. These ingeniously designed loko iʻa were built along the coastlines of Hawaiʻi, where ponds were carefully managed and were integral to both the practice of fishing and the community's deep relationship with the ocean. They served as nursery for fish and increased the productivity of the surrounding waters.

It is essential to preserve traditional knowledge as loko iʻa are restored, ensuring they are not reduced to modern industrial aquaculture systems. Loko iʻa are much more than that—they are an integral part of the ahupuaʻa (traditional watershed-based land division) system (Figure 3-1). A functioning ahupuaʻa requires a healthy kahawai, with water flowing from the mountains through kahawai and punawai (freshwater springs), bringing abundance to the land. The integration of land and water offered abundant food production opportunities, as the Hawaiian people understood the intricacies of their environment. This deep knowledge informed the placement of agricultural fields and the diverse types of loko iʻa, which were crucial to sustaining their communities.

Alakoko Prior to Western Contact

Alakoko loko iʻa is in the ahupuaʻa of Niumalu within the moku (district) of Puna (Figure 3-2). The water that flows through this kahawai flows through the ahupuaʻa of Haʻikū, Kīpū, Niumalu, Nāwiliwili, and Kalapakī. The area has long been a center of activity on Kauaʻi. This ʻāina momona (fertile land) is a region known for its abundance (Fechner et al. 2022). At one time, there were at least six loko iʻa in the area, adding to the resources of Nāwiliwili Bay. Loʻi kalo and other food crops flourished along the many kahawai and valleys of the nearby Hāʻupu mountain range. Hulēʻia River is the longest and largest of the many kahawai that flow (or flowed) into Nāwiliwili, including Pūʻali, Papalinahoa, and Nāwiliwili (Fechner et al. 2022). Hulēʻia serves as a vital freshwater artery in the southern portion of Puna. This waterway holds historical significance, being a crucial resource for traditional Hawaiian agriculture and aquaculture. The waiwai (wealth) derived from the Hulēʻia River was shared among several adjacent ahupuaʻa, illustrating its role in fostering interconnectedness and sustainability across mountain-to-sea land divisions.

Figure 3-1. Hawaiian Ahupua'a. Permission to use from Kamehameha Schools Bernice Pauahi Bishop Estate, Kamehameha Schools Press, Artist: Marilyn Kahalewai, 1974.

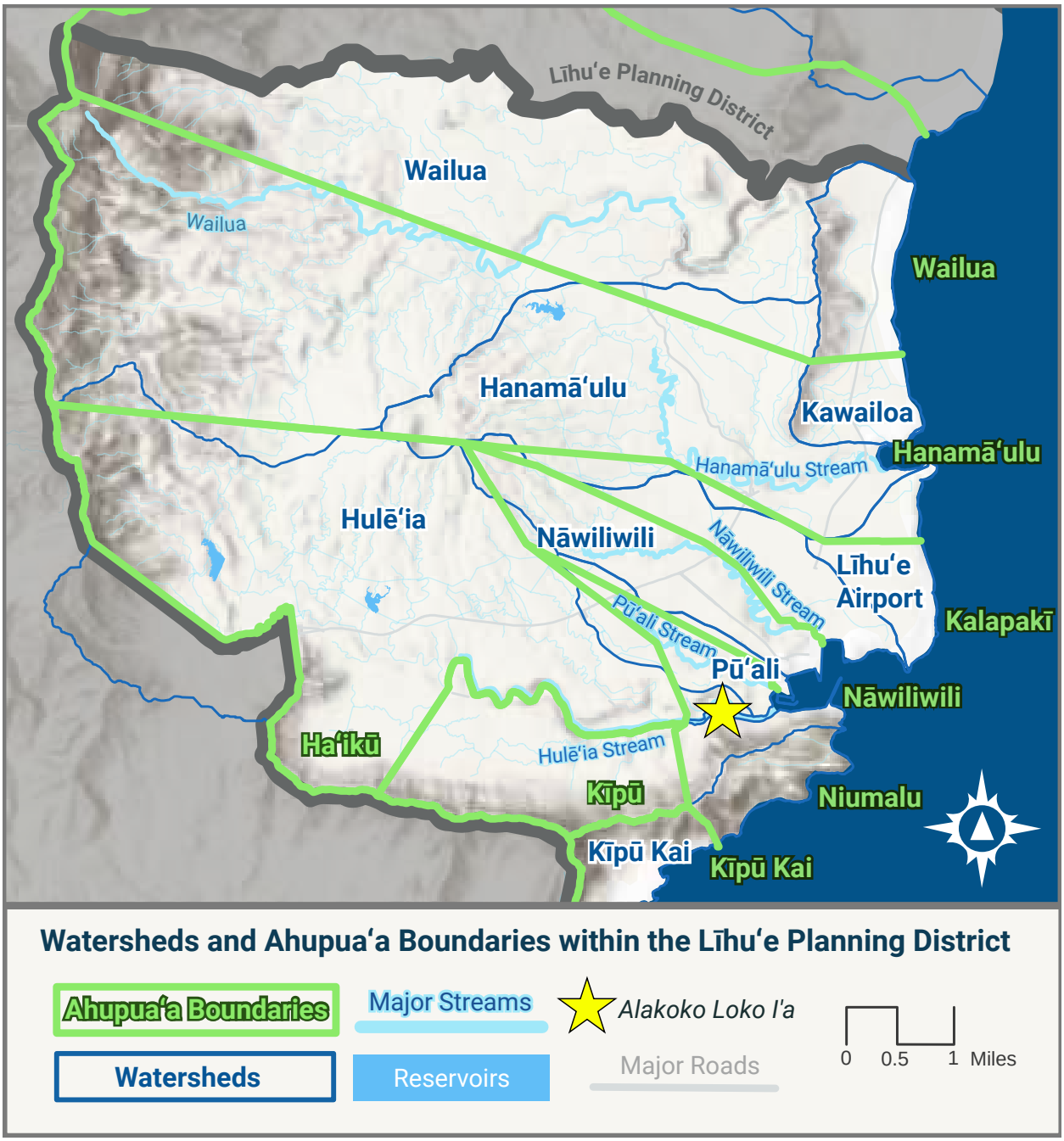


Figure 3-2. Hawaiian moku and ahupuaʻa boundaries for Alakoko loko iʻa.

The presence of such a large and important loko iʻa near the mouth of the Hulēʻia River correlates with the superlative marine resources of Nāwiliwili Bay, which has been noted as one of the most important fishing localities on Kauaʻi (Figure 3-3) (Mackenzie et al. 2015). Large numbers of ʻamaʻama (striped mullet), moi (Pacific threadfin), and akule (Big-eyed scad, or mackerel) once thrived in Nāwiliwili Bay. The Hulēʻia River was the spawning ground for the ʻamaʻama. The ʻamaʻama of Nāwiliwili were so prized that, according to the konohiki (overseer of chief's estate) of Alakoko loko iʻa in the early 1900s, they "have been tabu [kapu] since ancient

Figure 3-3. Alakoko loko iʻa location relative to Nāwiliwili Bay.

times" (Fechner et al. 2022). The movements of schools of fish were monitored from the high point of Kalanipuʻu, a puʻu kāhea (calling hill) located on the south side of the entrance to the bay and the river (Figure 3-4). The existence of loko iʻa within certain ahupuaʻa often indicated that the land was ʻāina momona (fat or fertile land) and signified an aliʻiʻs (chiefʻs) wealth, power, and ability to provide for the ahupuaʻa residents (Mackenzie et al. 2015).

Western Contact's Impact on Native Hawaiians and Traditional Agriculture

Hawaiian traditional food production was interrupted at Western contact when ships stopped at the Hawaiian Islands to resupply. Food production changed from a system that only fed the Hawaiian people to one that also supplied a

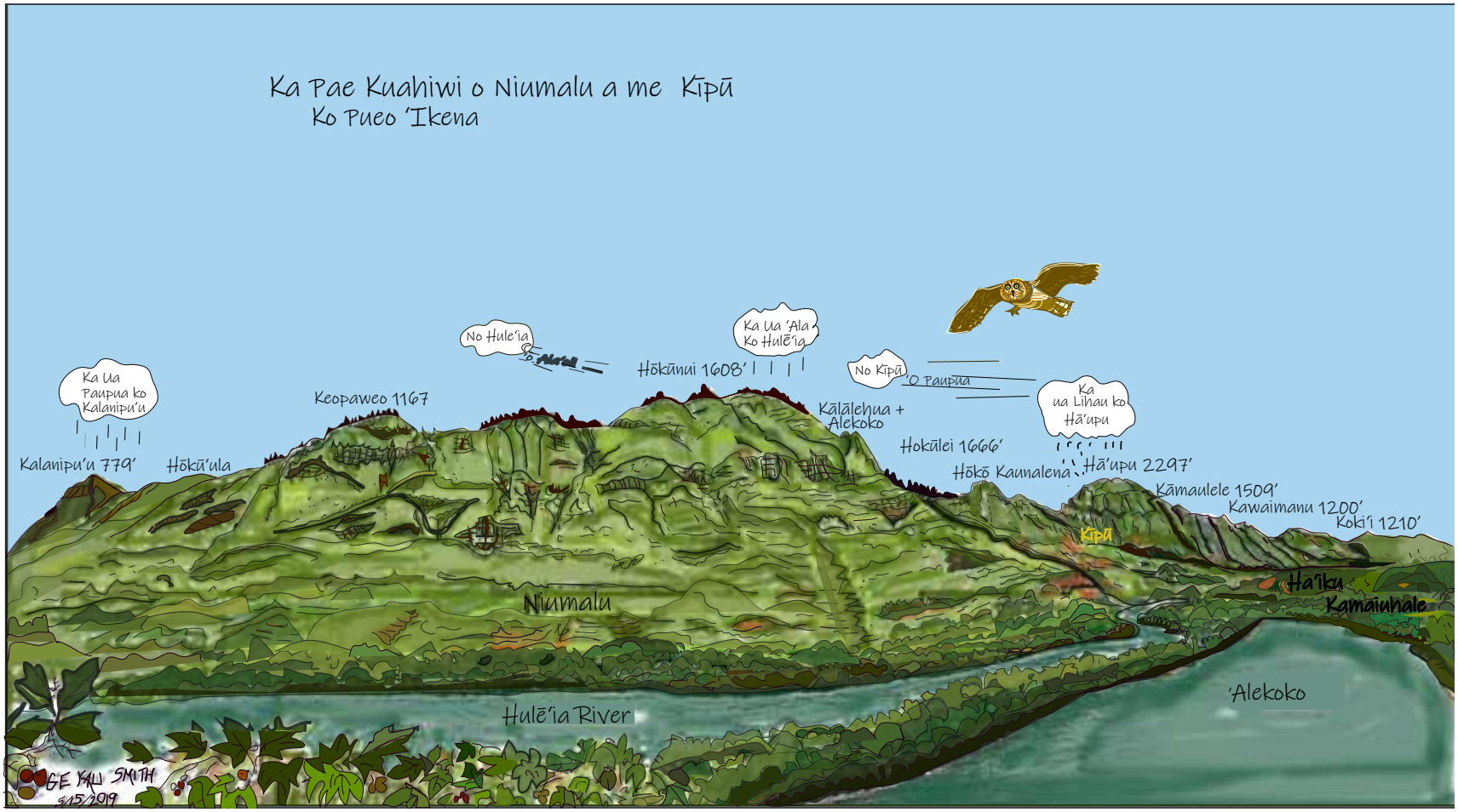


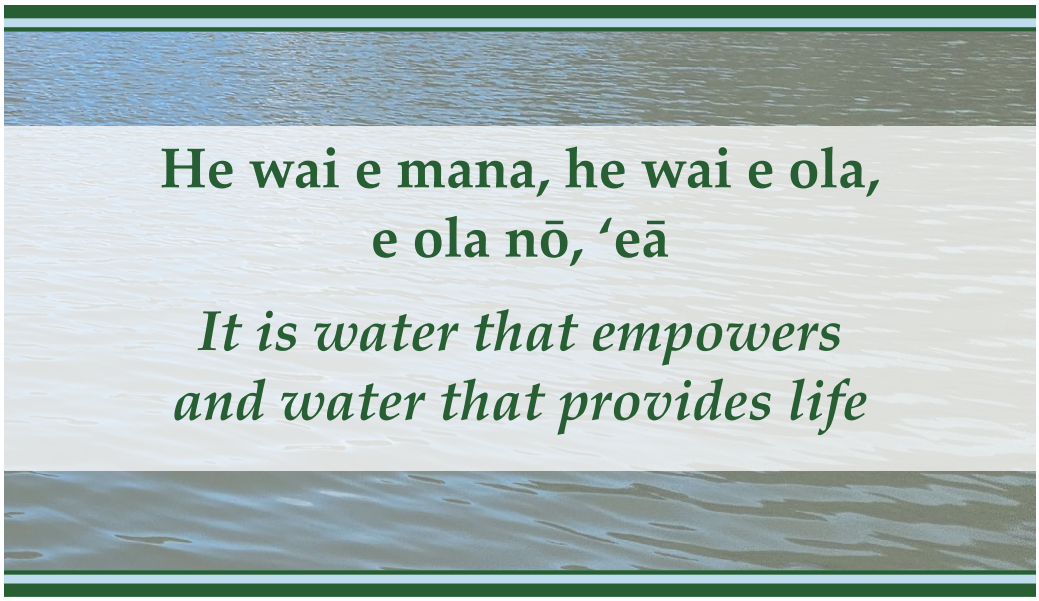
Figure 3-4. Artist GE Kali Smith rendering of Alakoko loko i'a with Hawaiian names and associated winds and rain types. Color added. Kalanipu'u, a pu'u kāhea (calling hill) is located on the left side of the illustration.

multitude of sailing ships. When ʻiliahi (Hawaiian sandalwood) was “discovered,” the makaʻāinana (common people) were taken from their daily work at loʻi kalo and loko iʻa and were sent into the mountains to gather sandalwood. This meant that the Hawaiian people were not able to follow the moon calendar, which guided their agricultural tasks and fishing opportunities and ensured that they could produce ample food and resources. Day and night were now occupied by work in the forests and rest was cherished. Disease became prevalent, as the Hawaiian people were exposed to Western germs, and it decimated the native population, further adding to the burden of providing sustenance for the Hawaiian people. Western concepts of land ownership, the sugar industry, and a new god turned the traditional cultural practice upside down and displaced the Hawaiian people physically, spiritually, and emotionally. Both had disrupted the vital connections that bound the Hawaiian people to ʻāina (that which feeds). The assault on land, water, and culture continues to this day replaced by a host of other industries.

Traditional Knowledge: Wetlands and Their Function

Following the arrival of Polynesian voyagers to Hawaiʻi as early as 900 CE (common era) and no later than 1200 CE (Kirsh 2011), Hawaiians developed complex natural systems that integrated into the ecosystem. They greatly expanded wetland habitats by converting lowland forests and alluvial plains into loʻi (flooded fields) for agro-ecology to cultivate kalo, waterbirds, fish, and invertebrates (Winter et al. 2018). This practice was expanded across the tropical Pacific by the late Holocene (4,000–5,000 years before present). The most recent estimates of the extent of the expansion of wetlands for use in loʻi cultivation suggested that about 31,700 acres (12,824 ha) of loʻi likely existed before European arrival (Hoffman 1991). Hawaiians managed loʻi as a keystone component of Hawaiian socio-ecological systems, viewing the social and ecological components that make up an ecosystem as interconnected, supporting both humans and nature.

“He wai e mana, he wai e ola, e ola nō, ʻeā.” This oli translates as, “It is water that empowers and water that provides life.” This Kauaʻi oli explains the importance of water. Wai is considered sacred by Hawaiians. In the past, people using wai from kahawai took only what was necessary. They were expected to share the wai with others. Such practices gave Hawaiians their word for law which is kānāwai (equal



sharing of water). Water was so valuable to Hawaiians that the word wai also indicates wealth and waiwai signifies abundance and prosperity.

History of Alakoko Land Ownership

At the Māhele (land division/privatization) of 1848, Alakoko and the surrounding land was given to Princess Victoria Kamāmalu (Figure 3-5; Appendix 5). It was then transferred to her father, Kekūanāoʻa and later to Princess Ruth Keʻelikōlani. In 1880, Keʻelikōlani sold the property to Paul Kanoa and for 106 years the land was owned by the Kanoa family and later the Kanoa Estate. In 1986, the Kanoa Estate sold the property to the Okada Trucking Company (Fechner et al. 2022). Mālama Hulēʻia was able to secure a 20-year lease of the property in 2018 to fulfill the requirements of their first National Coastal Wetlands Conservation Grant and to mālama the property. In 2021, the property was put up for sale. With the assistance of the Trust for Public Land, Mālama Hulēʻia purchased it.

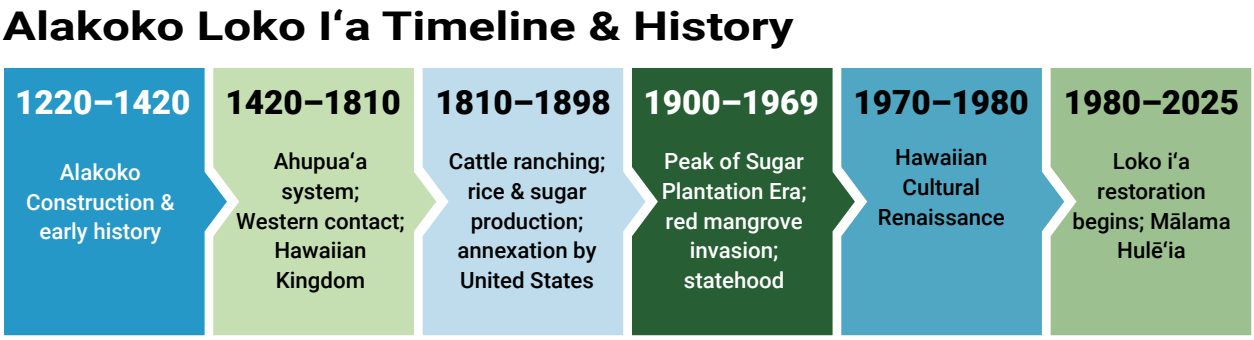


Figure 3-5. Major events in Hawaiian history. Please see Appendix 5 for a full timeline of Alakoko loko iʻa's history.

Invasion of Red Mangrove

In 1902, the Hawai'i Sugar Planters Association brought red mangrove (*Rhizophora mangle*) to Hawai'i when it was planted in southwestern Moloka'i to address erosion from livestock and cultivation. It was introduced to Oahu in Kalihi and He'eia marsh in 1922. Later it was introduced to Kealia Pond on Maui in 1960 when 3,000 propagules were planted to hold down dust when the pond was drawn down (Environment Hawai'i 2015). Red mangrove quickly spread throughout the Hawaiian Islands. By 1977, dense, monotypic stands of mangrove were estimated to occupy nearly a third of all estuarine intertidal habitat in the state (Environment Hawai'i 2015).

Figure 3-6. Red mangrove roots.

Figure 3-7. Peleke Flores during mangrove removal.

A mangrove infestation creates poor habitat for the native plants and animals of Hawai'i. Fibrous mangrove root mats trap sediment and build land (Figure 3-6). Its dense jungle of roots and branches reduces water flow, traps silt, and blocks out sunlight. Heavy leaf litter and its propagules rob the water of oxygen when they decay. When the bottom litter is thick and the water depth is shallow enough, new propagules take root and increase the density of the monoculture. Meanwhile, prop roots descend from increasingly higher positions on the growing tree, expanding the tree's footprint and enabling it to suck greater amounts of nutrients from the soil and oxygen from the air.

Alakoko loko i'a was almost completely obscured by a red mangrove infestation prior to the start of the mangrove removal project (Figure 2-1, Figure 3-7, and Figure 3-8). The dense thickets of red mangrove shrouded the structure of the loko i'a and archaeologists could not access features such as the walls that had been previously identified in archaeological reports (Kikuchi 1976). Therefore, an archaeological study could not be conducted until after mangrove removal.

At Alakoko loko i'a, red mangrove infested the riparian area and reduced the area of open water in the pond to half its original size. This altered the hydrology of the river and loko i'a, and affected the salinity and dissolved oxygen which in turn altered the aquatic ecosystem. Mangroves displaced many of the native and/or endemic plants which provided habitat, spawning grounds,

Figure 3-8. Alakoko loko iʻa was completely surrounded by nearly impenetrable thickets of invasive red mangrove before Mālama Hulēʻia's restoration actions began.

and food for fish, prawns, crabs, and mussels. The red mangrove reduced the productivity and biodiversity within the loko iʻa. Mangroves also invaded portions of the open wetlands surrounding the fishpond, limiting the food and nesting areas for endangered waterbirds and other native and endemic species.

Alakoko Kuapā

Historian and Mālama Hulēʻia board member Jan TenBruggencate authored an article examining the unique structure of the Alakoko kuapā, which has been frequently described yet often misrepresented due to a lack of first-hand inspection (Appendix 6). The kuapā distinguishes itself by combining earthen berms with basalt boulders on the outer river-side, a construction method less common than the all-rock walls typically found in coastal ponds.

William "Pila" Kikuchi noted in 1973 that Alakoko loko iʻa was the first brackish-water loko iʻa built in the Hawaiian Islands and its construction technique reflects Kauaʻi's geological characteristics. Despite conflicting reports regarding its dimensions and structural composition, ongoing restoration work by Mālama

Hulēʻia has revealed that the wall consists primarily of an earthen berm, partially faced with rough basalt stones.

The article addresses debates surrounding the wall's construction materials and methods, including theories that suggest it might consist of cut stones akin to those in the Kikiaola aqueduct. However, TenBruggencate emphasizes that, based on restoration observations, the wall is not entirely made of rock, particularly at its ends, which are predominantly mud and sand.

Historically, many hands have touched the wall, with contributions from commoners and skilled masons across generations, including repairs after significant events like the 1946 tsunami. The wall's design has evolved, with modern replacements for traditional control gates and diverse construction techniques employed over the years.

Archaeologists have conducted limited investigations beneath the wall's surface, revealing ongoing mysteries about its features and historical context. TenBruggencate's article provides an insightful analysis of the Alakoko fishpond wall, capturing the complexities of its structure and the significance of its history.

See Appendix 6 for further information on the kuapā.

Restoring Wetlands and Ahupuaʻa

Learning from the past informs efforts to create the best conditions for the present. Mālama Hulēʻia is committed to restoring Hawaiian land management

Part of the kuapā, with some live mangrove left in place until repair and stabilization actions are completed.

A group of students from Chiefess Kamakahelei Middle School remove invasive mangrove seedlings, helping restore native habitat and strengthen the connection between youth and ʻāina.

approaches and expanding the understanding of Hawaiian practices in wetland management, water uses, and the ahupuaʻa system. In ʻŌlelo Hawaiʻi, the naming of places is reflective of moʻolelo, ʻoli, and mele (songs) that bring a great depth of knowledge to the place. Place names are tied to persons, events, places of significance, and topographical and geological features, as well as biogeographical landscapes. As seen in Figure 3-4, there are various names for the winds, the rains, the mountains, rivers, loko iʻa, and streams in and around Alakoko loko iʻa. The different winds, for example, encourage microclimate conditions and shape the way the rains and sun interact with the environment. They provide clues to understanding the dynamic ecosystem that makes up the ahupuaʻa. They help to guide the needs on the ground to create ideal conditions for the interdependent components of the ecosystem. Expanding into other terminology found within ʻŌlelo Hawaiʻi can uncover more details that enables the development of best management practices to restore and steward an area and can better predict how the ʻāina will respond.

This includes expanding definitions of wetlands to reflect the biocultural importance of wai. The revival of the Hawaiian names of different types of wetlands will reflect their traditional functions within a biocultural context. By

restoring these names, the cultural significance and ecological roles will be highlighted, making their restoration a more holistic and culturally grounded process. This approach will integrate the traditional understanding of wetlands into the restoration focus, fostering a deeper connection to the land and its history.

The restoration of the ahupuaʻa will benefit Alakoko loko iʻa and the moku (district). The different zones of the ahupuaʻa work together to provide balance between human needs and environmental sustainability through cultural practices and principles such as aloha (respect), laulima (cooperation) and mālama (stewardship). An ahupuaʻa generally extends from mountains to the sea, encompassing one or more complete watersheds and marine resources, including both lowland cultivated areas and upland forested regions, providing a variety of resources for the community (see Figure 3-1). These zones recognize people as part of the place, interacting as stewards and users of place. The restoration efforts at Alakoko loko iʻa include more than just the loko itself and incorporate wao nahele (inland forest zone), wao kanaka (agriculture zone), loko iʻa, muliwai (estuarine zone), kahawai, and kahakai (coastal zone). Restoration efforts include community participation through education and programming, hands-on stewardship, and cultural practices and ceremonies. People are an important component to restore, manage, and learn from ʻāina. Alakoko loko iʻa is a wahi pana (storied place), yet for Mālama Hulēʻia, it is not seen as a protected area that is closed off to humans as a way to protect it such as refuges and sanctuaries often are. Instead, it is wahi pana integrating pilina (connection).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Chapter 4 Conceptual Restoration Plan

Mālama Hulēʻia efforts to restore Alakoko loko iʻa are founded on past and present experiences and knowledge. Hawaiian cultural practice gained through oral traditions and decades of wahi pana (storied places) restoration will be integrated with modern scientific methods to restore the loko iʻa (Hawaiian fishpond) and loʻi kalo (taro patch) system of food production. Despite major agricultural landscape changes and multiple landowners over the last hundred years, Mālama Hulēʻia believes that the project will benefit and enhance the remaining native flora and fauna. The project will build a resilient ecosystem and a harmonious collaboration by integrating Indigenous and western scientific concepts.

Alakoko loko iʻa, located on the Hulēʻia River a short distance upstream from Nāwiliwili Bay, is one of the most significant traditional Hawaiian fishponds in Kauaʻi. Alakoko is estimated to be 600 years old. A loko iʻa is a unique aquaculture system that optimize natural patterns of an ahupuaʻa. During the 20th century, Alakoko became overrun by invasive red mangrove, leading to significant damage to its kuapā and fundamentally changing its size, hydrology and ecology. Mālama Hulēʻia has been working to restore Alakoko loko iʻa since 2018.

The ultimate goal of the restoration is to revitalize the loko iʻa as a vital part of the larger ahupuaʻa (traditional watershed-based land division) system, connecting mauka (towards the mountains) to makai (towards the sea). The loko iʻa is one element within this broader ecosystem; it plays a critical role in supporting environmental health: filtering water, cycling nutrients, and nurturing life from the microscopic level to nearshore species. Mālama Hulēʻia's restoration work has deepened understanding of how changes within the loko iʻa—down to the smallest organisms—can ripple out to affect ocean waters and the communities who rely on these resources. In doing so, Mālama Hulēʻia strives to bring back the abundance described in moʻolelo (stories): teeming schools of fish, clean and plentiful waters, and an ʻāina (land) that feeds both body and spirit. Environmentally, the loko iʻa also serves as a bioindicator of a healthy ahupuaʻa system and a reflection of the land and water stewardship throughout the watershed.

This chapter focuses on the restoration of Alakoko loko iʻa (Figure 4-1, Figure 4-2. and Figure 4-3). It includes the goals and objectives that provide the framework that guides the restoration and continued stewardship. It also describes the work that has been completed to date, as well as the phases of the restoration project that are upcoming. Finally, it provides an analysis of the challenges and opportunities in the implementation of the full restoration of the ahupuaʻa and recommendations for collaboration with neighboring landowners. Chapter 6, titled Kuhikuhi Puʻuone (Architecture or Site Development Plan), focuses on the infrastructure necessary to support the restoration, ongoing stewardship, and community and educational programs that support a functioning loko iʻa and ahupuaʻa.

Long-Term Commitment to Stewardship

Ownership of the Alakoko property carries tremendous kuleana (privilege and responsibility) that honors both the legacy of this place and its future. Restoring Alakoko loko iʻa is not just an ecological undertaking, but the reactivation of a vital cultural resource. As an ancient loko iʻa listed on the national and state Registers of Historic Places, Alakoko offers Native Hawaiians and the broader community a unique opportunity to reconnect with ancestral knowledge, learn from the land and water, and revitalize traditional practices that once sustained both people and place.

This restoration is a learning journey. Mālama Hulēʻia embraces adaptive strategies, recognizing that restoration is an evolving process informed by the land itself. Already, the removal of invasive mangrove has revealed punawai (freshwater springs), reopened ʻauwai (irrigation channels or ditches), and welcomed the return of native plants, birds, and iʻa (fish). These early signs of success reflect the landscape's resilience—and its potential to guide best practices as the vision of a fully functioning loko iʻa comes to life.

Principles and Values

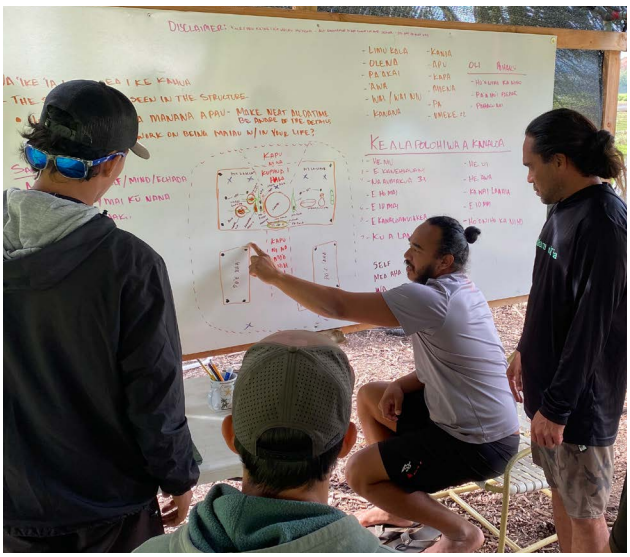
Mālama Hulēʻia's restoration efforts at Alakoko loko iʻa are guided by the following values and principles:

- Repairing the ecosystem functions of Alakoko loko iʻa through the application of Hawaiian ecological knowledge coupled with scientific studies and analysis, archaeological preservation, monitoring, and data collection.
- Increasing the native biodiversity.
- Integrating climate planning.
- Supporting native plants and animals, with special attention to the threatened and endangered species that utilize the area as habitat.
- Working closely with Hawaiian practitioners to influence the collective understanding of loko iʻa and its purpose and function.
- Supporting biocultural research that advances the use of Hawaiian cultural approaches for restoration practices and stewardship of ʻāina.

Planning Process

The National Park Service Rivers, Trails, and Conservation Assistance (NPS-RTCA) program provided technical assistance to Mālama Hulēʻia for the development of this conceptual master plan for Alakoko loko iʻa.

The planning process for the loko iʻa restoration was led by Peleke Flores, Mālama Hulēʻiaʻs Director of ʻĀina & Community Engagement. Through his extensive experience, research, connections with the Hawaiian practitioner network, and work with loko iʻa and loʻi kalo across the state, Peleke developed the initial concept for Alakoko with guidance and support from Mālama Hulēʻia staff, other cultural practitioners, and technical experts. NPS-RTCA staff worked with Pelekeʻs initial design to develop the concept graphic (Figure 4-1).



Peleke Flores with Mālama Hulēʻia staff

NPS-RTCA conducted a series of interviews with Peleke to develop the descriptions of the different components of the loko iʻa restoration, the phasing, and guidance for the overall vision for the restoration of the loko iʻa. On-site visits by NPS-RTCA staff helped further develop an understanding of the restoration process, adaptation opportunities, threats, and needs. Adaptive management principles, including using observations and monitoring of previous restoration actions, are an integral aspect of this plan, and will help Mālama Hulēʻia develop best practices and position them for effective long-term stewardship of Alakoko loko iʻa. The

A diagram used to help develop concepts for Alakoko (left). Examining a map showing possible sea level rise and how it may impact Alakoko loko i'a (right).

restoration plan includes conceptual graphics and a set of goals and objectives that will guide management actions.

Once the conceptual restoration graphics and goals and objectives were developed, NPS-RTCA worked with Mālama Hulēʻia to assess their infrastructure needs in support of the restoration and management of the loko i'a, as well as to provide the education programming and community involvement. This second part of the planning process led to the Kuhikuhi Puʻuone (see Chapter 6).

Sketch of the restoration plan for Alakoko loko i'a generated during the design charrette.

Alakoko loko iʻa during mangrove removal

Conceptual Restoration Plan

A loko iʻa cannot function on its own. The full restoration of Alakoko loko iʻa is only possible within the framework of the restoration of the larger system of which it is a part (Figure 4-1 through Figure 4-3). This system includes the components of the fishpond itself: the kuapā (wall), mākāhā (saltwater inlets/outlets), makawai (freshwater inlets), kuāuna (earthen banks), and kiʻo pua (juvenile-fish pond). It includes the larger hydrologic system of the Hulēʻia River, adjacent wetlands, punawai, kahawai (freshwater streams), alawai (main irrigation channel), and ʻauwai , as well as loʻi iʻa kalo (kalo patch with freshwater aquaculture), and loʻi kalo. The nahele (forest) and dry land areas, including kīhāpai (small garden), māla ʻai (food garden), and māla lāʻau (medicine garden), are also essential components of the overall system and provide important functions that support Alakoko loko iʻa. A successful and functioning loko iʻa is reliant on a healthy and functioning ahupuaʻa.

This conceptual plan will be a tool to guide Mālama Hulēʻia's restoration efforts at Alakoko loko iʻa and may be modified as the restoration progresses and the vision for the loko iʻa and its environs is further developed.

Components of Alakoko Loko iʻa

Alakoko loko iʻa is approximately 40 acres in size and was formed in a meander of the Hulēʻia River by the construction of a 2,700-ft-long kuapā.

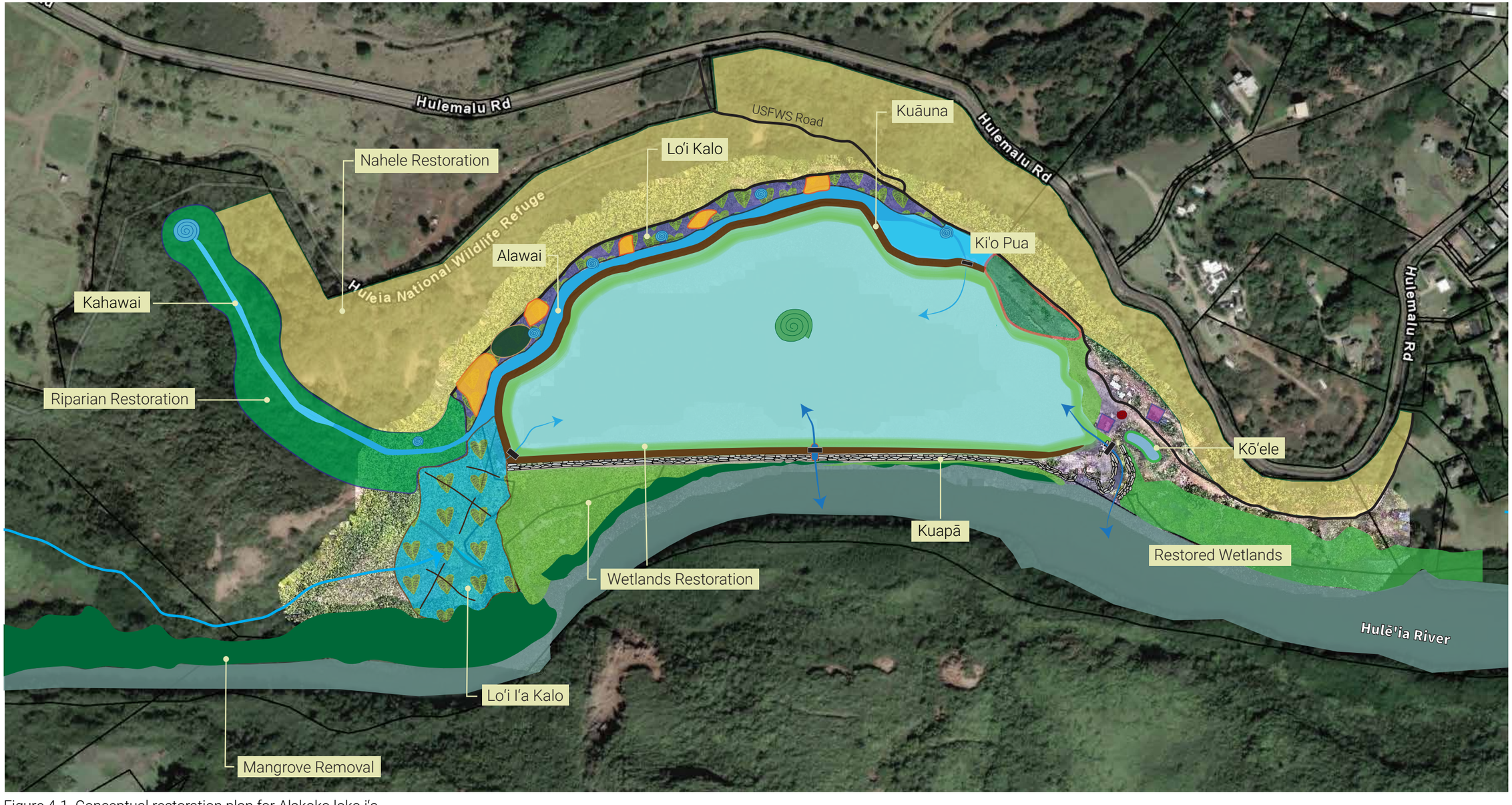


Figure 4-1. Conceptual restoration plan for Alakoko loko i'a.

Alakoko Loko I'a - Conceptual Restoration Plan Graphic

Mālama Hulēʻia is restoring the Alakoko property for the purpose of loko iʻa and ecosystem restoration, preservation, and education in perpetuity. This concept map shows a restored and functioning loko iʻa and its components. The plan includes traditional Hawaiian systems that provide native habitat for iʻa (fish), limu (aquatic vegetation), waterbirds, and invertebrates while providing food and cultural resources. The Concept Graphic will be used as a planning tool to guide Mālama Hulēʻia in the restoration of Alakoko loko iʻa and may need to be modified.

Alakoko Loko I'a
Alakoko loko iʻa is approximately 40 acres in size and was formed in a meander of the Hulēʻia River by the construction of a 2,700-ft-long kuapā. It is filled by brackish water from the estuarine Hulēʻia River combined with wai (fresh water) from punawai and kahawai.

Kuapā
The Alakoko kuapā is the wall of the loko iʻa and is made of pōhaku (stone) and kuāna (earthen material).

Mākāhā
Saltwater inlet and outlet. One is at the center point of the kuapā and the other is where the fish passage joins the loko iʻa. Both will be recreated to replicate the historic aquacultural functions of mākāhā. They allowed juvenile fish to swim freely in and out of a loko iʻa while trapping larger fish.

Kuāuna
Earthen banks border a variety of water systems: loko iʻa, kahawai, loʻi, alawai, and ʻauwai. Kuāuna form a path between them for access to the different components. The main kuāuna separates the loko iʻa from the alawai. Additional kuāuna border the ʻauwai, loʻi kalo, and loʻi iʻa kalo systems.

Punawai
Springs that provide fresh water to Alakoko and increase its biodiversity as the pond has a different salinity than the neighboring Hulēʻia River.

Kahawai
A stream that provide fresh water into the loko iʻa system. A small kahawai flows from the punawai on the hillslope at the west end of Alakoko loko iʻa.

Riparian Restoration
Riparian areas surround waterways such as streams. Riparian areas need invasive species control efforts and revegetation treatments to establish and maintain native vegetation.

Alawai
The alawai is the main irrigation channel that brings wai into Alakoko loko iʻa. It flows along the north side of the pond.

Kiʻo Pua
A kiʻo pua is a pond for raising baby fish (fry). The alawai will flow directly into the kiʻo pua before it enters the loko iʻa.

Makawai
Freshwater inlet. One flows into Alakoko at the west end of the loko iʻa near where the kahawai is and the other is where water from the kiʻo pua enters Alakoko. Both will be spanned by bridges and will provide fresh water to the pond, which is critical for phytoplankton, iʻa, and other aquatic organisms.

Kōʻele
A small pond, reserved for a chief, where fish are kept alive until required.

Loʻi Kalo
A flooded terrace that is part of a Hawaiian agriculture system for growing kalo. Wai flows through the loʻi, and exits back into the ʻauwai. The loʻi will provide traditional foods for the local community, create important bird habitats and contribute to the overall biodiversity of the area.

Loʻi Iʻa Kalo
Loʻi iʻa kalo are a type of loʻi that includes fish aquaculture in addition to kalo cultivation. They generally require more wai input than other kalo patches. The low area immediately southwest of the loko iʻa is targeted for the development of loʻi ia kalo.

Māla ʻAi
Cultivated food gardens located in dryland areas around loʻi. Māla ʻai will provide traditional foods to the community.

Māla Lāʻau
Medicine garden with vegetation that have traditional medicinal uses.

Nahele
Forested area on the hillslope above Alakoko loko iʻa. It currently consists of mostly nonnative invasive plants that negatively impact water flow and erosion, harbor pests, and restrict the growth of native plants. After restoration, the nahele would become a mixed agroforestry system that includes native and endemic species, and kinolau (ceremonial use) and hula plants.

Hala Grove
An established hala grove (Pandanaceae) is located along the border of the loko iʻa.

Ahu
The ahu is the altar or shrine that welcomes people to this wahi pana (storied place). It was created for Alakoko at the beginning of the restoration project to provide the spiritual connection to support the mission of Mālama Hulēʻia.

Wetlands - Restored **Future Area**
The restored wetlands are located where mangrove has been removed and native wetland plants have been restored. Future wetland areas require invasive plant removal.

Plant Nursery
The nursery will be easy to move and adjust in size and location based on restoration needs.

Live Mangrove Wall and Mangrove Removal
Some mangrove trees were left in place to stabilize the kuapā until repairs could be completed.
These trees will be removed at the end of kuapā restoration. Mangrove removal will continue upstream.

<u>Not Shown in Graphic</u>

ʻAuwai
Irrigation channels or ditches bring wai to loʻi kalo and loʻi iʻa kalo as well as to Alakoko itself.

Kīhāpai
Small bordered gardens located in dryland areas around the loʻi.

Kuhikuhi Puʻuone
The architecture and buildings will provide necessary infrastructure to manage Alakoko loko iʻa as well as provide outreach and educational programming.

The property has a deed restriction which ensures that it will be used in perpetuity for: Native Hawaiian ʻāina-based education, natural resource management, & stewardship; Perpetuation of traditional & customary Native Hawaiian cultural practices; Preservation & restoration of significant native habitats or ecosystems; Preservation & restoration of land and water used for sustainable aquaculture & agriculture to increase local food self-sufficiency.

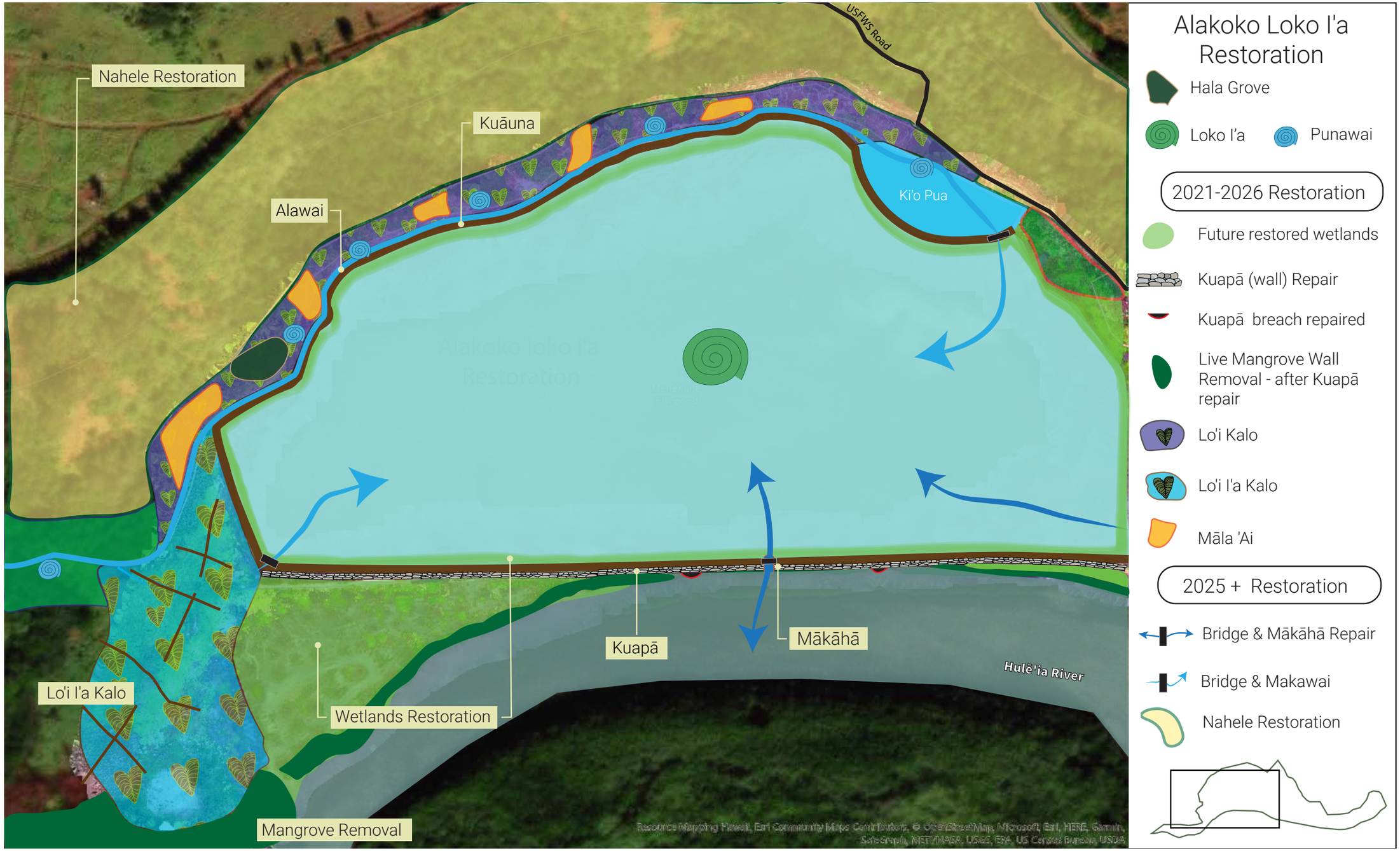


Figure 4-2. Zoom view of the conceptual restoration plan for Alakoko loko i'a showing the west side.

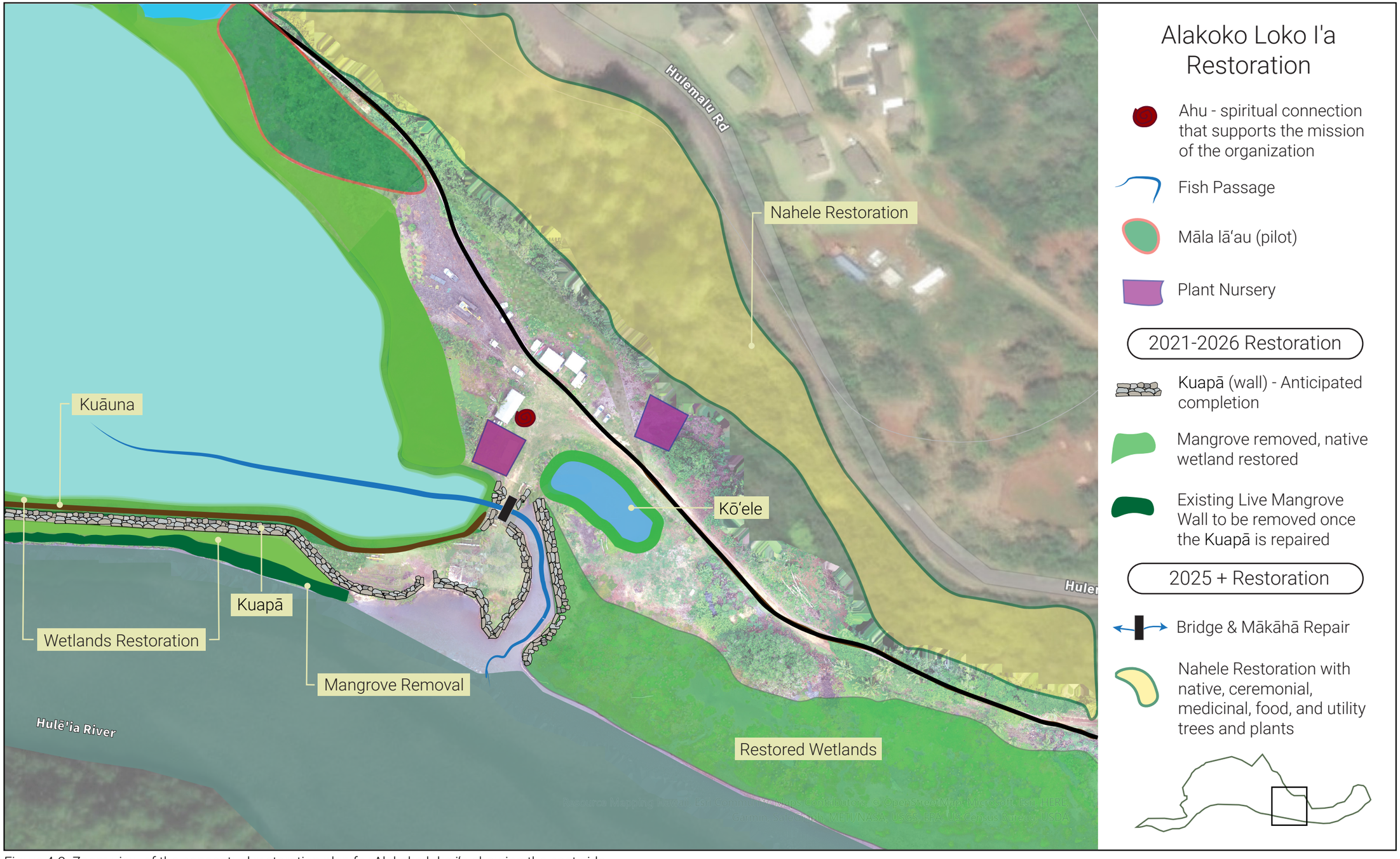


Figure 4-3. Zoom view of the conceptual restoration plan for Alakoko loko i'a showing the east side.

Restoration of the kuapā is central to the healing of Alakoko loko iʻa as well as to that of members of local communities. Traditional cultural practitioners who are skilled in uhau humu pōhaku (traditional dry set masonry) are hosting workshops to build local expertise in these techniques. Events such as E Kū Ana Ka Paia ("the wall will stand") that was held in 2023 not only contribute to the revitalization of Alakoko loko iʻa, but also builds and strengthens local communities and their ties to the land and to the water. For more information, see Appendix 4.

The mākāhā on the east side of Alakoko

Alakoko Loko Iʻa

The restoration of Alakoko loko iʻa began with the removal of 26 acres of red mangrove between 2018 and 2021.The loko iʻa is filled by brackish water from the estuarine Hulēʻia River with wai (fresh water) inputs from punawai and kahawai. The kuapā forms its southern boundary with kuāuna (earthern banks) surrounding the entire loko iʻa. Water flow in and out of the loko iʻa is through mākāhā (saltwater inlets/outlets) and makawai. The interior (pond-side) of the kuapā and the kuāuna were reinforced with sediment dredged from the bottom of the pond. These sloped margins of the pond will be planted with native wetland plants to prevent erosion and establish wetland habitat for endangered Hawaiian waterbirds. Continued vegetation management around the circumference of the loko iʻa is needed to ensure that reinfestations of red mangrove do not occur, and that native vegetation is established.

Kuapā

The Alakoko kuapā is made of pōhaku (stone) and kuāna (earthen material) (see Appendix 6). The kuapā restoration is still ongoing. Two breaches along its length need to be repaired and a remnant live mangrove wall was left in place until repairs can be completed. The remnant live mangrove wall will be removed once repairs are completed, most likely in 2026. Historically, the kuapā had a mākāhā approximately halfway down its length, and this will be restored as well.

Mākāhā

Alakoko loko iʻa has two mākāhā. One is at about the center point of the kuapā and the other is where the fish passage joins the loko iʻa on the east or downstream side of the pond. Both will be recreated with bridges over

The kuāuna during restoration actions

The fish passage and mākāhā

them and sluice gates to replicate the historic aquacultural functions of the loko iʻa. They allowed juvenile fish to swim freely in and out of a loko iʻa while trapping larger fish.

Fish Passage

A channel, or fish passage, was recreated at the east side of the loko iʻa to connect Alakoko loko iʻa with the Hulēʻia River. With the sediment that had accumulated over time, Alakoko was cut off from the river by a mud flat at low tide. Following the removal of the mangrove debris, the fish passage was further widened to allow iʻa (fish) to swim in and out of the loko iʻa. The fish passage connects to the river through the eastern mākāhā.

Kuāuna

Earthen banks border a variety of water systems: loko iʻa, kahawai, loʻi, alawai, and ʻauwai. Kuāuna separate the water systems and form a path between them for access to the different components. The main kuāuna separates the loko iʻa from the alawai. Additional kuāuna border the ʻauwai, loʻi kalo, and loʻi iʻa kalo systems.

Wetlands

Wetlands are an integral part of any estuarine system. Mangrove removal has allowed wetlands to be restored with native vegetation, providing habitat for native fish, other aquatic organisms, and waterbirds. Large areas of wetlands are located both downstream and upstream (east and west, respectively) of Alakoko loko iʻa. The downstream wetland was restored between 2018 and 2021 and the upstream wetland needs mangrove removal followed by restoration treatments. Wetlands are also present along the margins of the loko iʻa. All wetland areas will need continued management to ensure that they are not repopulated by red mangrove.

A punawai with kalo

A kahawai with area that needs riparian restoration

Native plant species include makaloa, mauʻu ʻakiʻaki, ʻākulikuli, ʻahuʻawa, neke, and other native sedges and rushes. (See Appendix 4.)

Punawai

Punawai provide fresh water to Alakoko and increase its biodiversity as the pond has a different salinity than the neighboring Hulēʻia River. Many punawai reemerged after mangrove removal around the circumference of Alakoko loko iʻa. Many of these springs are in lowland areas near the pond itself, but an important upland punawai is on the hillslope west of Alakoko. This spring flows into Alakoko from a small kahawai that descends the hillside.

Kahawai

Kahawai provide fresh water into the loko iʻa system. A small kahawai flows from the punawai on the hillslope at the west end of Alakoko loko iʻa. Another kahawai flows from the west towards Alakoko.

Riparian Restoration

Riparian areas surround waterways such as streams. Riparian areas need invasive species control efforts and revegetation treatments to establish and maintain native and Polynesian-introduced non-invasive plants. The palette of native and Polynesian-introduced non-invasive plants will be developed with biocultural technical experts to address erosion, and water filtration needs, and to provide ecosystem services.

Alawai

The alawai is the main irrigation channel that brings wai into Alakoko loko iʻa. It flows along the north side of the pond. The kuāuna on its north bank will be developed into māla and loʻi.

An ʻauwai during restoration

The kōʻele near the east end of the loko iʻa

Loʻi kalo

ʻAuwai

Irrigation channels or ditches bring wai to loʻi kalo and loʻi iʻa kalo as well as to Alakoko itself. They are located along all margins of the loko iʻa except the kuapā.

Kiʻo Pua

A kiʻo pua is a pond for raising baby fish (fry). The alawai flows directly into the kiʻo pua before it enters the loko iʻa. At Alakoko, the kiʻo pua is located at the northeastern side of Alakoko near the canoe launch and māla lāʻau.

Makawai

Alakoko loko iʻa has two makawai. One flows into Alakoko at the west end of the loko iʻa near where the kahawai is and the other is where water from the kiʻo pua enters Alakoko. Both will be spanned by bridges. Freshwater inputs are critical for phytoplankton, iʻa, and other aquatic life.

Kōʻele

A small pond, reserved for a chief, where iʻa are kept alive until required.

Loʻi Kalo

A flooded terrace that is part of a Hawaiian agriculture system for growing kalo. Wai flows through the loʻi and exit back into the ʻauwai. Loʻi kalo are integral parts of the agricultural and aquacultural systems of Alakoko loko iʻa. The loʻi will provide traditional foods for local community, create bird habitat, and contribute to the overall biodiversity. Loʻi kalo will be developed on the north side of Alakoko.

Loʻi Iʻa Kalo

Loʻi iʻa kalo are a type of loʻi that includes iʻa aquaculture in addition to kalo cultivation.

Māla ʻai and kalo

Māla lāʻau

Nahele

They generally require more wai input than other kalo patches. The low area immediately southwest of the loko iʻa is targeted for the development of loʻi iʻa kalo.

Māla ʻAi

Cultivated food gardens will also be located in dryland areas around loʻi. Māla ʻai will provide traditional foods to the community.

Māla Lāʻau

Māla lāʻau will be established in an area on the west side of Alakoko loko iʻa where there has been volunteer recruitment of native vegetation that have traditional medicinal uses. The presence of plants such as ʻuhaloa (mallow), ʻilima (yellow mallow), and pōpolo (glossy nightshade) suggest that this site may have been used historically as a māla lāʻau.

Nahele

The nahele is found in the hillslope above Alakoko loko iʻa. It currently consists of mostly nonnative invasive plants that negatively impact water flow and erosion, harbor pests, and restrict the growth of native plants.

Restoration of the nahele would also include the restoration of a punawai near the top of the hill close to Hulemalu Road and the kahawai that flows from it.

Needed restoration treatments include removal of nonnative plants as well as trash that has been dumped from Hulemalu Road, followed by the planting of native and culturally appropriate plants and fruit trees.

After restoration, the nahele would become a mixed agroforestry system that includes native and endemic species, and kinolau (ceremonial use) and hula (Hawaiian dance form) plants. The nahele could also supply plant materials

Nahele near the kahawai

Hala grove

Kīhāpai in the Kuhikuhi Puʻuone

for cordage, traditional hale, and other traditional Hawaiian uses for the community.

Hala Grove

An established hala grove (screwpine, Pandanus) is located along the border of the loko iʻa. The lauhala (Pandanus leaves) are used to weave mats, baskets, and other utilitarian uses.

Kīhāpai

Kīhāpai (small bordered gardens) will be located in dryland areas around the loʻi. These gardens will provide food for the community and contribute to the overall biodiversity of the Alakoko system.

Ahu

The ahu is the altar or shrine that welcomes people to this wahi pana (storied place). It was created for Alakoko at the beginning of the restoration project to provide the spiritual connection and to support the mission of Mālama Hulēʻia.

Plant Nursery

The native plant nursery will be used to propagate vegetation for restoration efforts. It will be easy to move and adjust in size and location based on restoration needs.

Kuhikuhi Puʻuone

The architecture and buildings will provide necessary infrastructure to appropriately manage Alakoko loko iʻa as well as provide educational programming and outreach to the community. It will contain a hale hālāwai (meeting house), hale kuahui (maintenance facility), hale kuke/lumi keʻena (kitchen house and office building), hale kiaʻi (caretaker housing), and other facilities. (See Chapter 6.)

Restored wetlands near Alakoko

Restoration Goals and Objectives

These goals and objectives offer a comprehensive framework for restoring Alakoko loko iʻa and the interconnected systems that sustain it. Rooted in traditional Hawaiian knowledge and supported by contemporary conservation strategies, they provide clear guidance for achieving ecological, cultural, and community outcomes.

Each goal is linked to specific actions—ranging from native habitat restoration and predator control to hydrological management and community engagement. Together, these objectives form the backbone of a multifaceted restoration effort shaped by cultural values, informed by science, and aligned with permitting requirements and environmental protection policies. Success will depend on thoughtful sequencing, shared stewardship, and a commitment to learning along the way.

Goal 1:
Invasive plants Are Removed from the Alakoko Property and Watershed

The elimination of invasive plant species that threaten the health of the ecosystem is the foundational goal of the Alakoko loko iʻa restoration. Red mangroves, which have proliferated in the area, alter water flow and outcompete native vegetation. Red mangrove control requires both short-term and long-term strategies to ensure

the return of a native ecosystem that is resilient and supports native plants and wildlife for generations to come.

Between 2018 and 2021, Mālama Hulēʻia removed red mangroves on 26 acres on the Alakoko property, which represented the majority of the mangrove infestation at the site (see Chapter 2). Subsequently, Mālama Hulēʻia has transitioned to a maintenance-level treatment strategy for this invasive plant, requiring constant kilo (observation) and coordinated response to prevent reinfestation.

- **Objective 1:** New mangrove plants, their propagules, and other invasive plants are removed to prevent them from reproducing on the property.
- **Objective 2:** Mangroves are continuously removed throughout the Hulēʻia watershed utilizing community stewardship and involvement of partner organizations to obtain a mangrove-free watershed.
- **Objective 3:** Other nonnative plant species are monitored and removed if found to be a threat to healthy native ecosystems.

Goal 2: Native and Culturally Significant Plants Are Established Throughout the Alakoko Property to Reestablish a Functioning Ahupuaʻa

The restoration of Alakoko loko iʻa includes not only the physical structure of the fishpond itself, but also the broader ecological system of the surrounding ahupuaʻa, including restoration of native and culturally significant plants. Hawaiian loʻi systems play a vital role in restoring a functional loko iʻa. Water movement through loʻi systems attracts birds and enriches the water with nutrients, providing ideal conditions for phytoplankton growth, which helps to provide the water chemistry that attracts fish into the loko iʻa. The restoration will reconnect wetlands with their traditional names and roles, acknowledging the functional knowledge carried in ancestral naming practices. By reintroducing these plants and systems, Mālama

The kuapā with mākāhā and live mangrove wall that will be removed during the final stages of its restoration

Hulēʻia aims to restore the balance and functionality of the ahupuaʻa, ensuring its sustainability for future generations.

- **Objective 1:** Healthy native habitats and ecosystems are restored through revegetation with a diverse array of native and Hawaiian introduced (canoe) plants.
- **Objective 2:** Native wetland plant species are planted to restore wetland habitats and support biodiversity.
- **Objective 3:** Noninvasive Hawaiian agricultural, utilitarian, and medicinal plants are planted in specified locations within the Alakoko property.
- **Objective 4:** Water and nutrients to plants are supported through the establishment and maintenance of a Hawaiian loko iʻa system of alawai, ʻauwai, loʻi kalo, and kiʻo pua.
- **Objective 5:** Traditional Hawaiian names will be reestablished for wetlands and features to reflect their functional roles and carry forward the knowledge of how these places were once used and understood.

Goal 3: Hydrological Connectivity and Water Quality Are Restored to Support a Traditional Hawaiian Ahupuaʻa System

Hydrological connectivity is a critical aspect of the Alakoko loko iʻa restoration and is essential for maintaining a functioning ecosystem within the broader framework of the ahupuaʻa system. The movement and management of wai through traditional water systems, including through alawai, ʻauwai, loʻi, and kiʻo pua systems, to create a healthy loko iʻa environment connected to the rest of the ahupuaʻa plays a key role in ensuring that the loko iʻa is sustainable and is integrated within the surrounding watershed. The goal aims to restore the natural flow of freshwater through the loʻi system surrounding the loko iʻa. By restoring these crucial water flows, Mālama Hulēʻia aims to ensure the loko iʻa functions as a thriving, interconnected component of the larger ahupuaʻa system, providing both ecological benefits and cultural value.

- **Objective 1:** Water quality and water quantity are measured to guide restoration and management decisions.
- **Objective 2:** The historic alawai and ʻauwai are restored and maintained.
- **Objective 3:** In partnership with USFWS, reconnecting Papākolea kahawai to the Alakoko system is accomplished.
- **Objective 4:** Fish passageways will be restored between kahawai and the loko iʻa to benefit native fish.

The kiʻo pua with Alakoko loko iʻa in the background

- **Objective 5:** The upland punawai and kahawai riparian areas are restored to improve the hydrological system and encourage recharge.
- **Objective 7:** Abundance of phytoplankton and zooplankton is monitored to ensure a healthy planktonic ecosystem. Adaptive management strategies will be used to maintain balance. Freshwater flow through traditional aquaculture systems will help promote phytoplankton growth, supporting the overall health of the loko iʻa.

Goal 4:
The Alakoko Kuapā, Kuāuna, and Pond Depths are Restored to Pre-Mangrove Conditions

Restoring the structural integrity of Alakoko loko iʻa involves repairing its physical boundaries and water management systems to support a healthy, functional ecosystem. This goal aims to return the loko iʻa to conditions prior to invasive mangrove growth, which disrupted natural hydrology, deposited sediment, and altered the physical structure of the pond. Central to this effort is the restoration of the Alakoko kuapā, the primary barrier between the loko iʻa and surrounding environment. The kuapā will be repaired using traditional Hawaiian uhau humu pōhaku (drystack masonry), led by cultural practitioner Peleke Flores and supported by archaeological documentation and a historic preservation plan.

In addition to restoring the wall, accumulated sediment and organic debris will be removed and repurposed to reinforce the earthen kuāuna and stabilize the boundary with the alawai. This includes shaping a gentle interior slope within the loko iʻa to support future wetland restoration. Two mākāhā and two makawai will also be repaired to regulate water flow and maintain hydrological function. These

actions aim to ensure the fishpond can hold stable water levels and withstand natural fluctuations, including high tides and periodic flooding.

Ongoing monitoring and adaptive management will be guided by site conditions and observed environmental changes, supporting the long-term resilience of Alakoko as a thriving cultural and ecological resource.

- **Objective 1:** The historic kuapā, will be restored, using traditional Hawaiian uhau humu pōhaku following archaeological documentation.
- **Objective 2:** Accumulated sediment and organic debris will be removed and used to reinforce the earthen portion of the kuapā, the kuāuna surrounding the loko iʻa, including that which separates the alawai from the loko iʻa.
- **Objective 3:** The wall height will be raised to contain high water levels resulting from high tides along with flood events.
- **Objective 4:** The two mākāhā in the kuapā and two makawai will be restored.
- **Objective 5:** Future water level scenarios due to climate change, high tides, and flood events will be planned for through monitoring and kilo.
- **Objective 6:** Kilo and adaptive management will ensure the long-term sustainability of the fishpond as a thriving cultural and ecological resource.

Goal 5:
Hawaiian Place-based ʻĀina Education Supports Community Involvement, Stewardship, and Research

Hawaiian place-based education is central to the restoration and long-term stewardship of Alakoko loko iʻa. By integrating traditional cultural practices with biocultural restoration principles, the educational programming at Alakoko creates lasting connections between students, the broader community, and the ʻāina. This

Mālama Hulēʻia educational programming at Alakoko loko iʻa

approach not only supports the ecological and cultural restoration of the loko iʻa, but also cultivates future generations of stewards, researchers, and community leaders.

- **Objective 1:** New educational materials are developed as the pond is restored that will reflect on its revitalization, and how biocultural restoration practices have reestablished a functioning loko iʻa.
- **Objective 2:** Traditional Hawaiian management and sustainability practices are incorporated into curriculum materials to ensure that students understand the integral connection between people and place.
- **Objective 3:** Students actively participate in the restoration process by assisting with data collection, planting native species, mapping, and removing invasive species, providing them with hands-on learning experiences.
- **Objective 4:** Themes of community-based stewardship are incorporated into the education system at the primary and secondary level.
- **Objective 5:** Curriculum development and community efforts focus on nurturing the relationship between people and place.
- **Objective 6:** Moʻolelo and cultural connections to waterbirds and other native species will be highlighted in curriculum materials to promote an understanding of the relationships between the Hawaiian people and native wildlife.

Goal 6:
A Predator Control Program Will Be Implemented Using Adaptive Management Strategies

Effective predator control is essential to the Alakoko loko iʻa restoration, ensuring that the restored environment remains a safe and supportive habitat for endangered waterbirds and other native wildlife. Invasive predators, such as feral pigs, cats, rodents, and barn owls, pose ongoing threats and require targeted, evolving management strategies. As native wildlife returns and restoration efforts expand, so too does the need for responsive and adaptive predator control.

Electric fencing

- **Objective 1:** An adaptive management plan for predator control targeting feral pigs, feral cats, rodents, and barn owls at Alakoko will be refined and implemented in partnership with key predator-control-focused organizations.
- **Objective 2:** Fencing will be utilized to exclude pigs from specific restoration areas, particularly those used by endangered waterbirds. Fencing may include a perimeter pig-proof fence and electric fencing within exclusion areas. Additional electric fence areas will be established as needed.
- **Objective 3:** Mālama Hulēʻia will stay current with emerging pest threats on Kauaʻi, with a focus on the Alakoko area, and test appropriate control strategies.
- **Objective 4:** Continue testing and implementing best management practices for coconut rhinoceros beetle (CRB), a species that was found at Alakoko in 2024, along with those for other pests of concern.

Goal 7: Climate Adaptation Strategies Are Implemented to Build Resilience

It is essential that the Alakoko loko iʻa restoration incorporates strategies for long-term climate resilience in order to proactively adapt to the impacts of climate change.

The implementation of climate adaptation strategies will be informed by the indicators outlined in Chapter 5 and tailored to meet the specific needs of Alakoko

Test loʻi kalo plots adjacent to a punawai

and its interconnected systems. By restoring and enhancing the ecological functions of the loko iʻa, watershed, and ahupuaʻa, the resilience of these systems will be enhanced.

- **Objective 1:** Adaptive climate resilience strategies are implemented as outlined in Chapter 5.
- **Objective 2:** Resiliency of the ecosystem will be enhanced through restoration and stewardship actions
- **Objective 3:** Climate trends will be monitored, and research will be used to adapt to changing conditions and hazards.
- **Objective 4:** Restoration efforts will include participation in and encouragement of research that addresses climate resiliency as it relates to Alakoko and the ahupuaʻa system. It will also be based on collaboration between traditional ecological knowledge and modern science.

Goal 8: Endangered Waterbirds and Other Native Species Are Protected

Protecting endangered waterbirds and other native species is a cornerstone of the Alakoko loko iʻa restoration effort. This goal aligns with the USFWS Recovery Plan for endangered waterbirds, ensuring that the loko iʻa and surrounding ecosystems provide resilient suitable habitat for species recovery. By integrating predator control (Goal 6), habitat restoration (Goal 4), and hydrological management (Goal 3), Mālama Hulēʻia will help stabilize and increase endangered waterbird populations while reducing threats to their health and survival.

The restored loko iʻa will support essential habitat for key life stages and behaviors such as nesting, foraging, and resting. Environmental conditions will be actively managed to prevent botulism outbreaks, avian influenza, and other disease risks. Restoring the pond's hydrology, maintaining appropriate wetland and loʻi agricultural systems, and managing invasive plants will further support thriving native bird populations.

Regular monitoring of bird populations, including endangered Hawaiian waterbirds, is an important part of Mālama Hulēʻiaʻs restoration efforts.

- **Objective 1:** The restored Alakoko loko iʻa will support habitat to enable populations of endangered waterbirds to be sustained in numbers that are consistently stable or increasing throughout the property.
- **Objective 2:** Endangered waterbird mortality will be reduced through ongoing control of introduced predators (Goal 6) and the monitoring of hydrological conditions (Goal 3) to reduce botulism outbreaks.
- **Objective 3:** The restored Alakoko loko iʻa will support wetlands and traditional Hawaiian loʻi agricultural systems (including wetland plants favorable to life cycle and behavioral needs) that are managed as habitat suitable for waterbirds, including the maintenance of appropriate hydrological conditions and control of invasive nonnative plants.
- **Objective 4:** Traditional ecological knowledge and modern conservation science will be integrated with the intent to improve nesting success and provide refuge from terrestrial predators, including the development of kīpuka (native habitat refuges or floating islands) or other protected nesting areas within the pond. These kīpuka serve multiple purposes: they create habitat for native birds, support water quality improvement by filtering nutrients, and offer space for growing traditional food crops—reviving cultural practices while enhancing ecological function.

Goal 9: Management Goals at Hulēʻia National Wildlife Refuge Will Be Supported

Ongoing monitoring of waterbird populations will remain a shared priority for Mālama Hulēʻia and the USFWS. The presence and recovery of these endangered species serve as vital indicators of the ecosystem's overall health. The co-stewardship approach emphasizes mutual benefits and is reflected in the increased diversity and abundance of native species in the entire region.

Through ongoing consultation, adaptive management, and shared stewardship, Mālama Hulēʻia and the USFWS will continue to build a resilient and sustainable future for the Alakoko loko iʻa, its surrounding habitats, and the Native Hawaiian community.

- **Objective 1:** Mālama Hulēʻia, a registered Native Hawaiian Organization (NHO), will consult with and represent the interests of the Native Hawaiian community within the ahupuaʻa.

ʻAlae ʻula (Hawaiian moorhen [gallinule])

- **Objective 2:** Mālama Hulēʻia will adhere to refuge requirements and support habitat for endangered species. Mālama Hulēʻia supports an ecosystem approach that integrates traditional Hawaiian practices with ecological management.
- **Objective 3:** Mālama Hulēʻia will provide educational programs that support the goals of the refuge.

Concept to Action—Summary of Planning, Progress, and Recommendations Moving Forward

Understanding the Restoration Needs of Alakoko Loko Iʻa

Decades of mangrove growth along with its associated debris and sediment accumulation impaired all aspects of Alakoko loko iʻa. The pond itself was inaccessible due to the dense vegetation, which also choked out native vegetation and habitat for native and migratory waterbirds. The intense water usage of mangroves impacted pond hydrology, including water quality.

Restoration efforts at Alakoko loko iʻa began with the initial mangrove removal work between 2018 and 2021. Since then, Mālama Hulēʻia has been practicing adaptive management, including careful observation of changing conditions and testing restoration techniques using pilot projects.

Mangrove removal changed the water flow and salinity in the loko iʻa, altering the composition of fish populations as it improved habitat for native fish species. It also exposed remnants of an old Hawaiian freshwater system that carried water from the punawai through loʻi into the pond.

Careful observations of Alakoko following mangrove removal, coupled with research into the history, design, use, and functionality of Hawaiian fishponds, provided insight into the ways that freshwater most likely had been used to support the loko iʻa in the past. Mālama Hulēʻia also planted pilot māla (gardens) and loʻi systems to learn about water dynamics, and soil and growing conditions. The organization began surveying and monitoring bird and fish populations (Appendix 4), water quality and aquatic conditions, as well as the native and/or culturally significant plants that have sprouted from the seed bank. This process facilitated an understanding of the changing Alakoko ecosystem, as well as gathering information to guide future restoration efforts.

Project Phases

Mālama Hulēʻia began restoration efforts at Alakoko loko iʻa prior to the initiation of conceptual planning in 2022. However, the current restoration projects as well as planned future projects all are consequent to the organization's initial efforts to remove mangrove throughout the Hulēʻia River starting in 2015 and at Alakoko beginning in 2018.

The restoration of Alakoko loko iʻa requires a phased approach in order to address the needs of the loko iʻa system and to understand the impact of each restoration action. Kilo and adaptive management approaches are fundamental to Mālama Hulēʻia's restoration efforts (Figures 4-4 through 4-6).

Please see the list of major grants and partnerships for information on the entities that have financially supported and/or partnered with Mālama Hulēʻia on restoration projects at Alakoko loko iʻa and in the Hulēʻia River ʻāina kumu wai (watershed).

2018–2021

The restoration of Alakoko loko iʻa began with mangrove removal (Figure 4-4). Once Mālama Hulēʻia started to observe how Alakoko responded to mangrove removal, they initiated additional restoration efforts to restore the pondʻs hydrology and test how traditional Hawaiian agriculture systems would work at the site.

- Mangrove removal around circumference of Alakoko loko iʻa, including the kuapā.
- Mangrove removal in downstream wetlands and wetlands restoration.
- Fish passage reconnection between Alakoko loko iʻa and Hulēʻia River.
- Planting of pilot māla and loʻi systems.
- Testing electric and alternative fencing for predator control.

2021–2026

The second phase of the Alakoko restoration continues actions related to the hydrology of the loko iʻa, mangrove removal, and conceptual planning (Figure 4-5).

- Phase 2 mangrove removal (upstream wetlands and upstream along Hulēʻia River).
- Coastal wetlands restoration project.
- Removal of living mangrove wall along the kuapā.
- Continuation of fish passage projects.
- Sediment management and kuapā restoration.
- ʻAuwai restoration.
- Punawai-related riparian restoration.
- Conceptual planning.

2025+

The third phase of the Alakoko restoration will include the dryland and forested areas and efforts to keep nonnative predators like feral pigs out of the Alakoko property (Figure 4-6).

- Nahele reforestation and restoration.
- Ungulate exclusion.

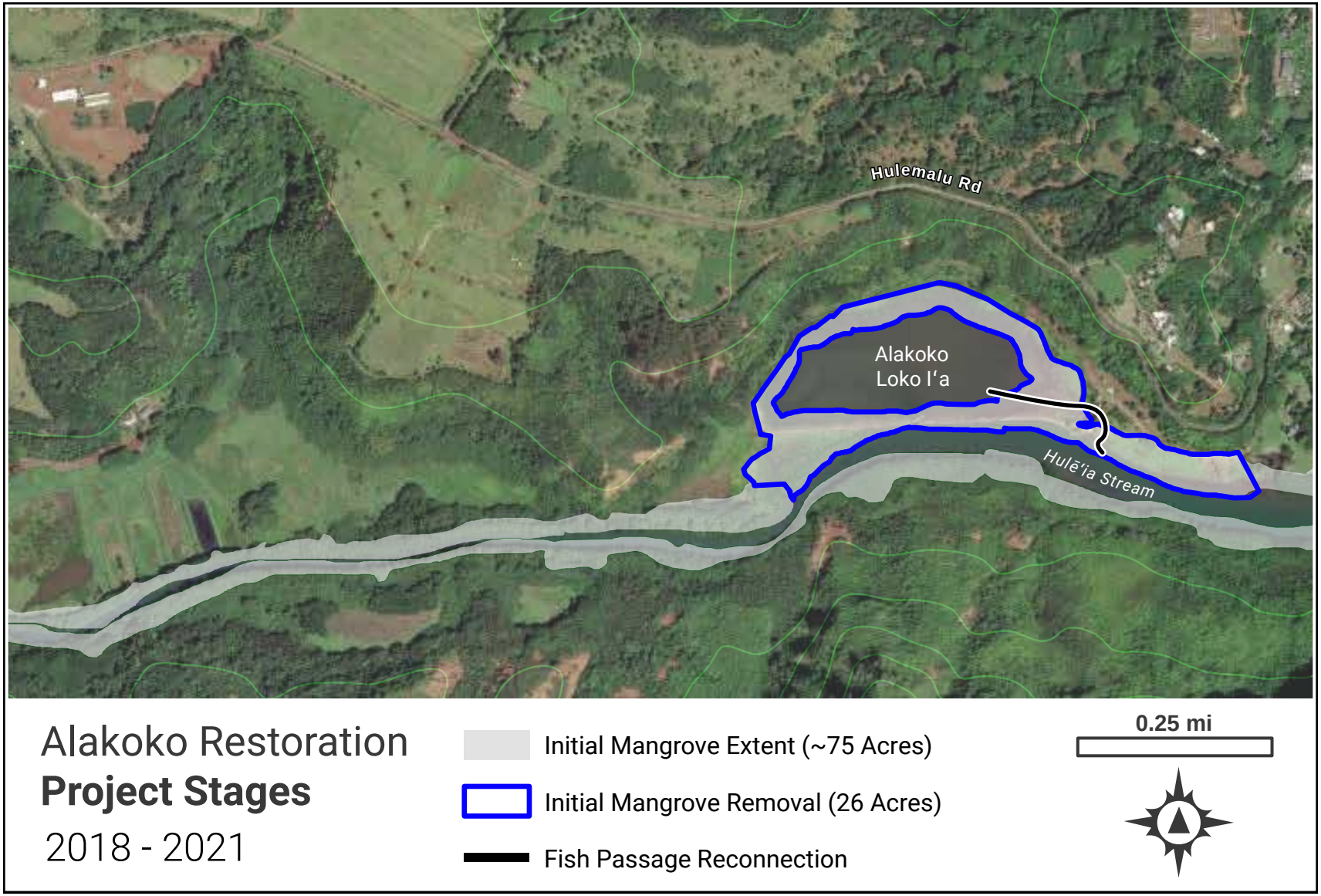


Figure 4-4. Mālama Hulē'ia's initial restoration work at Alakoko loko i'a took place between 2018 and 2021, and consisted of mangrove removal and the initial fish passage project.

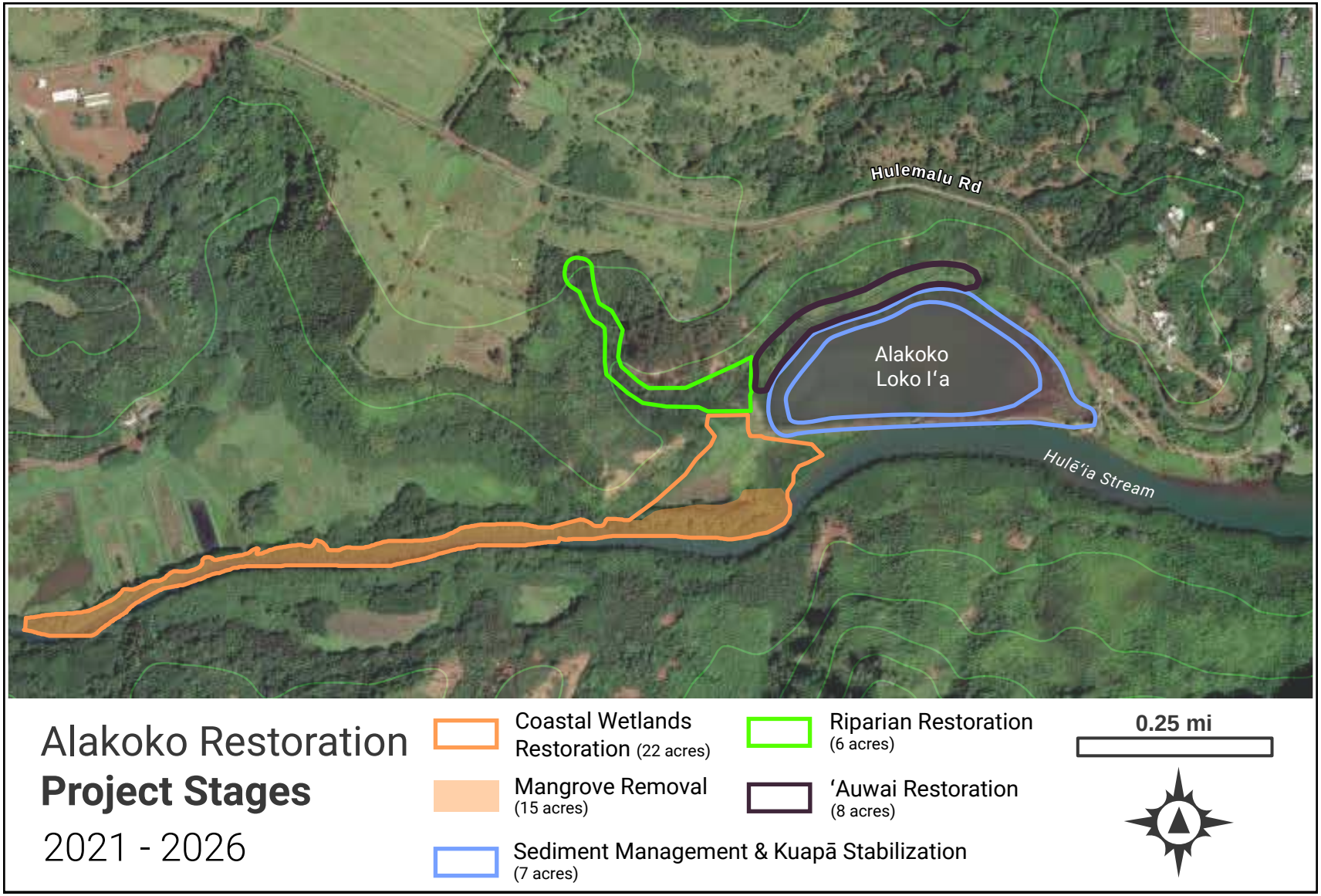


Figure 4-5. Between 2021 and 2025, Mālama Hulēʻia continued mangrove removal, as well as restored the loko iʻa by stabilizing the kuapā and dredging sediment. Riparian and ʻauwai restoration projects also occurred.

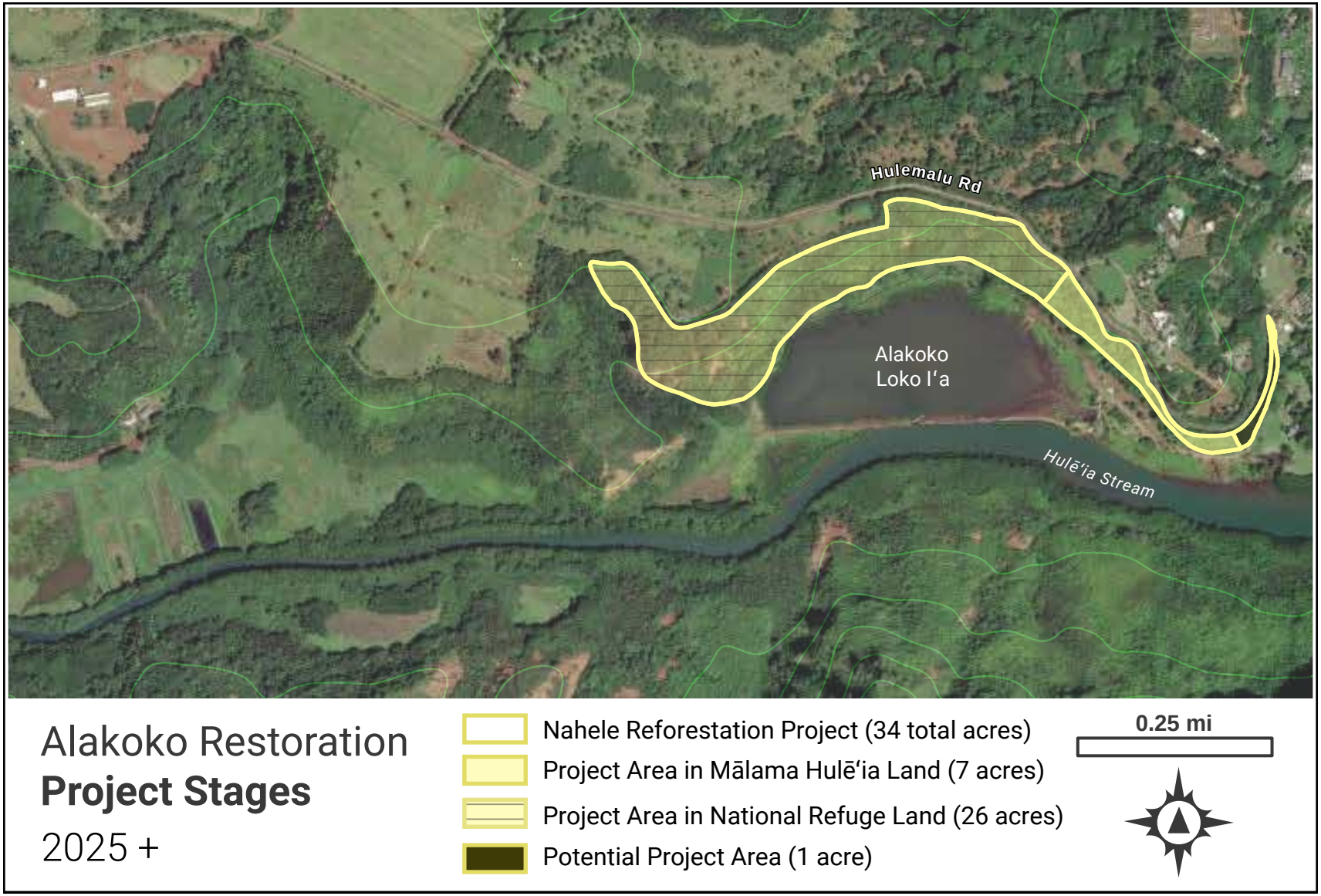


Figure 4-6. Between 2025 and 2025, Mālama Hulē'ia plans to restore the nahele surrounding the loko i'a.

Future Restoration Actions

Additional restoration actions will be needed to fully reestablish Alakoko loko iʻa as an aquacultural and agricultural system that supports both the environment and local community. These future actions depend on making adaptive decisions based on how the system has responded to previous actions, opportunities to collaborate with Hulēʻia NWR, and available funding. Potential actions include:

- Planting of loʻi kalo.
- Planting of māla.
- Habitat creation for waterbirds.
- Papākolea kahawai restoration.

Challenges and Opportunities with Hulēʻia NWR

Undertaking a major restoration project like Mālama Hulēʻia has at Alakoko loko iʻa requires consideration of systems and processes that operate on landscape scales as well as finding opportunities where a variety of entities can collaborate and work together to meet common goals and create outcomes that have broad benefits. Mālama Hulēʻia began working in Nāwiliwili Bay and the Hulēʻia River ʻāina kumu wai to remove invasive red mangrove to restore native vegetation and natural ecosystems, including creation for endangered waterbirds. Since then, the organization has embarked on a more extensive restoration of Alakoko loko iʻa.

The Alakoko system responded in remarkable ways to mangrove removal with growth of native plants, the reemergence of punawai and other wai systems, and expanded habitat for native birds and iʻa, creating opportunities to heal the landscape beyond just invasive plant removal. Throughout this process, Mālama Hulēʻia has worked with a variety of federal, state, and local agencies, NHOs, other nonprofits, community groups, and local landowners.

Mālama Hulēʻia and Hulēʻia National Wildlife Refuge share a property boundary that cuts across parts of Alakoko loko iʻa itself (Figure 1-2). Much of the larger Alakoko system extends up the hillslope above the pond on refuge land, and also includes the Hulēʻia River and adjacent wetlands. Papākolea kahawai, a freshwater stream that joins the Hulēʻia River in Hulēʻia NWR about 0.3 miles upstream of Alakoko, also has importance in the restoration of the loko iʻa.

The realities of the Mālama Hulēʻia-USFWS property boundary as well as the overall context of Alakoko loko iʻa as it relates to other nearby landowners and within the ahupuaʻa mean that collaboration and cooperation are required for the continuing restoration and stewardship of the loko iʻa.

Mālama Hulēʻia and Hulēʻia National Wildlife Refuge also hold values in common related to land stewardship and the protection of native plants and animals.

While there are opportunities that arise from the need to work with other landowners and entities for the long-term stewardship of Alakoko loko iʻa and

Loʻi kalo and pilot māla ʻai with Alakoko loko iʻa in the background

the ahupuaʻa, challenges also exist. For example, the USFWS has strict regulatory mandates related to the protection of endangered species and other landowners may have their own sets of concerns. However, the existence of challenges in themself provides further opportunities for their resolution and for collaboration and cooperation, which in turn may generate new solutions that address large-scale issues that benefit a wide array of stakeholders.

Challenges

The Need for Long-Term Management of Invasive Mangrove throughout the Hulēʻia Watershed

Although Mālama Hulēʻia has made considerable strides towards controlling red mangrove at Alakoko loko iʻa and along the Hulēʻia River, the invasive qualities of this species mean that controlling it will require active management into foreseeable future. Because the plant primarily spreads by propagules that can float long distances, the control of red mangrove requires active management by multiple landowners. Furthermore, requirements of the National Coastal Wetland Conservation (NCWCG) Grants that funded much of Mālama Hulēʻia mangrove removal work include a minimum of 20 years of maintenance. Access to these areas is essential to meeting this grant requirement, requiring work on the refuge.

Regulatory and Permit Limitations for Mālama Hulēʻia's Restoration Work on USFWS Lands

The mangrove removal work that Mālama Hulēʻia does in Hulēʻia NWR is currently conducted under the stipulations of the Special Use Permit (SUP). These permits grant access to the refuge for specific, time-limited actions, a restriction that creates constraints on the ability of an organization like Mālama Hulēʻia to nimbly respond to ecosystem needs based on current conditions such as new infestations of red mangrove. They also make continuous stewardship and long-term restoration more difficult.

Difficulty in Locating the Precise Property Boundary around Alakoko Loko Iʻa

Difficulty in locating the exact property boundary between Mālama Hulēʻiaʻs parcels and the Hulēʻia NWR has created confusion regarding land ownership of specific areas of the larger loko iʻa system, and has complicated restoration, management, and maintenance efforts.

The property boundary also does not always follow logical lines. For example, it traverses the edge of the loko iʻa itself, meaning that not all of the loko i'a is under Mālama Hulēʻiaʻs ownership. Further, areas that are critical to the functioning of the larger loko iʻa system including the locations of many punawai, much of the alawai, and wetlands are on USFWS property. Additionally, areas where loʻi kalo, loʻi iʻa kalo, and māla will be recreated as well as much of the hillslope where nahele restoration needs to occur are also on USFWS lands.

Hulēʻia NWR Staff Do Not Have the Capacity to Actively Manage USFWS Lands Immediately Adjacent to Alakoko Loko Iʻa

The USFWS focuses its management activities to benefit endangered Hawaiian waterbirds in the more central area of Hulēʻia NWR which provides the best and largest areas of available habitat for aeʻo (Hawaiian stilt), ʻalae ʻula (Hawaiian moorhen), ʻalae keʻokeʻo (Hawaiian coot), koloa maoli (Hawaiian duck), and nēnē (Hawaiian goose). As a result of the agencyʻs limited capacity, it has not had the resources available to meet all the management needs of the refuge land immediately adjacent to Alakoko loko iʻa.

Shared Access Road to Alakoko Loko Iʻa and Traffic Impacts on Private Homeowners

The entrance road currently used by Mālama Hulēʻia to access Alakoko loko iʻa passes through a neighborhood of private homeowners, creating traffic and safety concerns among its residents (Figure 4-7).

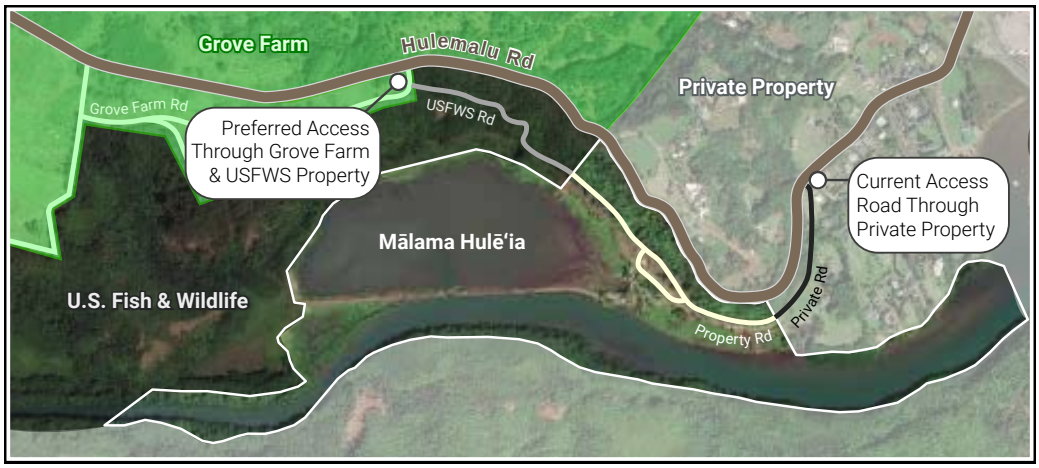


Figure 4-7. Map showing the preferred access to Alakoko loko iʻa using a road through Grove Farm and USFWS property and the current access road through private property.

Opportunities

Development and Enhancement of Cooperative Agreements and Other Relationships with the USFWS on Collaborative Stewardship Goals

The property boundary between Mālama Hulēʻia and the Hulēʻia NWR, as well as shared stewardship goals and USFWS policy, offer important opportunities for collaboration between the two entities. Co-stewardship opportunities exist for Native Hawaiian Organizations to use biocultural approaches in the stewardship of Alakoko loko iʻa and the refuge. See sidebar next page.

Ecological Restoration as a Tool to Create Habitat for Endangered Waterbirds and Endemic Fish

The restoration of Alakoko loko iʻa and adjacent wetlands as well as mangrove removal in the Hulēʻia River watershed offers important venues for the enhancement and expansion of suitable habitat for native iʻa, birds, and plants.

Integration of Traditional Agricultural in Restoration Actions

Loʻi kalo and māla systems as well as reestablishing traditional and medicinal plants in the nahele provide benefits to both the environment and the community. Loʻi kalo can provide important habitats that supports the life cycle of endangered waterbirds, and traditional foods and medicines help sustain the community.

Adaptive Management Practices

The use of adaptive management principles as well the Hawaiian biocultural approaches, historical research, kilo, and data collection offers Mālama Hulēʻia the broadest suite of tools to successfully revitalize Alakoko loko iʻa and improve the health of the ahupuaʻa.

Proposal for Co-Stewardship and Co-Management between Mālama Hulēʻia and Hulēʻia NWR

In early 2023, Mālama Hulēʻia submitted a draft Memorandum of Understanding (MOU) to the USFWS to initiate the process of co-stewardship for the area surrounding Alakoko loko iʻa. The authority for this proposal is in based on USFWS Director's Order 227, Fulfilling the Trust Responsibility to Tribes and the Native Hawaiian Community, and Other Obligations to Alaska Native Corporations and Alaska Native Organizations, in the Stewardship of Federal Lands and Waters. This order states:

> *The Service recognizes the need for strong, healthy communication and relationships with Tribal governments, ANCs [Alaska Native Corporations], ANOs [Alaska Native Organizations], and the Native Hawaiian Community so that we can work together in support of Tribal sovereignty, Tribal self-determination, and our shared goals. We recognize that the Service is entrusted with the management of lands that are the ancestral homelands of Tribes and the Native Hawaiian Community that predate the National Wildlife Refuge System. When the Service and Indigenous peoples work together on managing our lands and waters, along with the fish and wildlife that inhabit them, our long-standing relationships are strengthened, and resources are better protected. It likewise reaffirms the Service's government-to-sovereign relationship with the Native Hawaiian Community, acting through Native Hawaiian organizations, which furthers the United States' special political and trust relationship with the community.*

As a recognized Native Hawaiian Organization (NHO) under the Office of Native Hawaiian Relations (ONHR), and currently involved in active habitat restoration, Mālama Hulēʻia is in a unique situation to work cooperatively with USFWS to restore the lands surrounding the Alakoko loko iʻa, including those that are within Hulēʻia NWR. Such an agreement would help both entities meet their management objectives, improve available habitat for native plants, i'a, and birds, provide further opportunities for community engagement, and use biocultural approaches to resource stewardship.

Another approach to co-stewardship includes the development of a Comprehensive Conservation Plan (CCP) for Hulēʻia NWR that integrates Native Hawaiian approaches to restoration and stewardship. CCPs are long-term management plans for wildlife refuges that are required by National Wildlife Refuge System Improvement Act of 1997. The development of a CCP for Hulēʻia NWR would be an opportunity for collaboration between the USFWS and Native Hawaiian practitioners and Mālama Hulēʻia, a NHO. This would facilitate Hulēʻia NWR working with Mālama Hulēʻia on the stewardship of refuge property adjacent to the loko iʻa itself the restoration of the hillside above the loko iʻa, research and restoration of punawai and

kahawai hydrology, and addressing the threats that endangered species face on lands managed by the two entities.

U.S. Department of the Interior Secretarial Order (S.O.) 3403 calls for federal land agencies to "promote the use of collaborative agreements and/or provisions in land management plans" in order to enhance co-stewardship of federal lands and waters, including wildlife and its habitat. The order also requires agencies to engage Tribes (including the Native Hawaiian Community) "in meaningful consultation at the earliest phases of planning and decision-making relating to the management of Federal lands to ensure that Tribes can shape the direction of management." USFWS policy additionally states that tribal expertise and indigenous knowledge will be incorporated in agency planning processes and that tribal representatives will have opportunities to participate in the implementation of USFWS plans.

Community Engagement

As a community-based ʻāina nonprofit organization, Mālama Hulēʻia can assist with the Hulēʻia NWR's outreach efforts to the local community. In January 2025, the USFWS published the Final Compatibility Determination for Environmental Education and Interpretation for Hulēʻia NWR (USFWS 2025). This agreement allows Mālama Hulēʻia and refuge staff to work collaboratively on the environmental education, and allows Mālama Hulēʻia staff to provide this service for the refuge. It provides a legal mechanism for Mālama Hulēʻia to offer educational programs, community workdays, and opportunities to learn about Hawaiian cultural practices, ecological restoration, and endangered waterbirds on Alakoko and refuge land on behalf of the refuge.

Development of An Alternate Access to Alakoko Loko Iʻa to Alleviate Impacts to Private Landowners

Obtaining a right-of-way (ROW) or other appropriate access agreement from the USFWS for Mālama Hulēʻia to use an existing roadway that crosses Hulēʻia NWR lands to access the Alakoko property would alleviate neighboring homeowners concerns about traffic impacts related to long-term restoration and management of Alakoko loko iʻa. This would also assist with access for school and community groups, as well be advantageous for nahele restoration.

Boundary Adjustment to the Hulēʻia NWR

A minor modification of the boundary of Hulēʻia NWR would alleviate many of the challenges that arise from the location of the existing boundary that cuts across the edge of the pond itself and places critical parts of the larger loko iʻa system including punawai, alawai, and wetlands under USFWS ownership. Such a boundary adjustment would simplify the restoration of Alakoko loko iʻa, yet still allow for collaboration between Mālama Hulēʻia and the USFWS on larger ecosystem restoration goals including ones for providing appropriate and safe habitats for endangered Hawaiian waterbirds.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Chapter 5 Climate Change Adaptation

Introduction

Alakoko loko iʻa is located less than a mile upstream on the Hulēʻia River from Nāwiliwili Small Boat Harbor in Nāwiliwili Bay. It is tidally influenced and was damaged by the 1946 tsunami that impacted the Hawaiʻi Islands. Since Alakoko is at low elevation in the coastal environment, it is among the most vulnerable areas in the Hawaiian Islands in its exposure to impacts from climate change (Figure 5-1) (Keener et al. 2012).

Hawaiʻi is experiencing the impacts of climate change, including a warming air and surface sea temperatures, along with a decrease in trade winds and precipitation as well as changing rainfall patterns (University of Hawaiʻi Sea Grant College Program 2014). The base flow of streams has decreased and drought is expected to become more common.

Sea-level rise in Hawaiʻi has accelerated over the last century, causing coastal erosion, ecosystem damage, and damage to infrastructure in low-lying areas (University of Hawaiʻi Sea Grant College Program 2014). By 2100, cumulative sea level rise in Hawaiʻi is projected to be between 1.0 and 3.2 feet (0.3 to 1.0 m) (University of Hawaiʻi Sea Grant College Program 2014). A state-wide assessment of Hawaiʻi's vulnerability to sea level rise projects that Alakoko loko iʻa and most of the surrounding area may be inundated with a 3.2 ft (1.0 m) (Figure 5-2) (Hawaiʻi Climate Change Mitigation and Adaptation Commission 2021). The projected 3.2-ft rise is based on the upper end of the "business as usual" sea level rise scenario in the International Panel on Climate Change (IPCC) Assessment Report 5 (Frazier at al. 2023).

Information from these models for sea level rise are incorporated in the planning of structures and infrastructure on the Mālama Hulēʻia property (Chapter 6). The

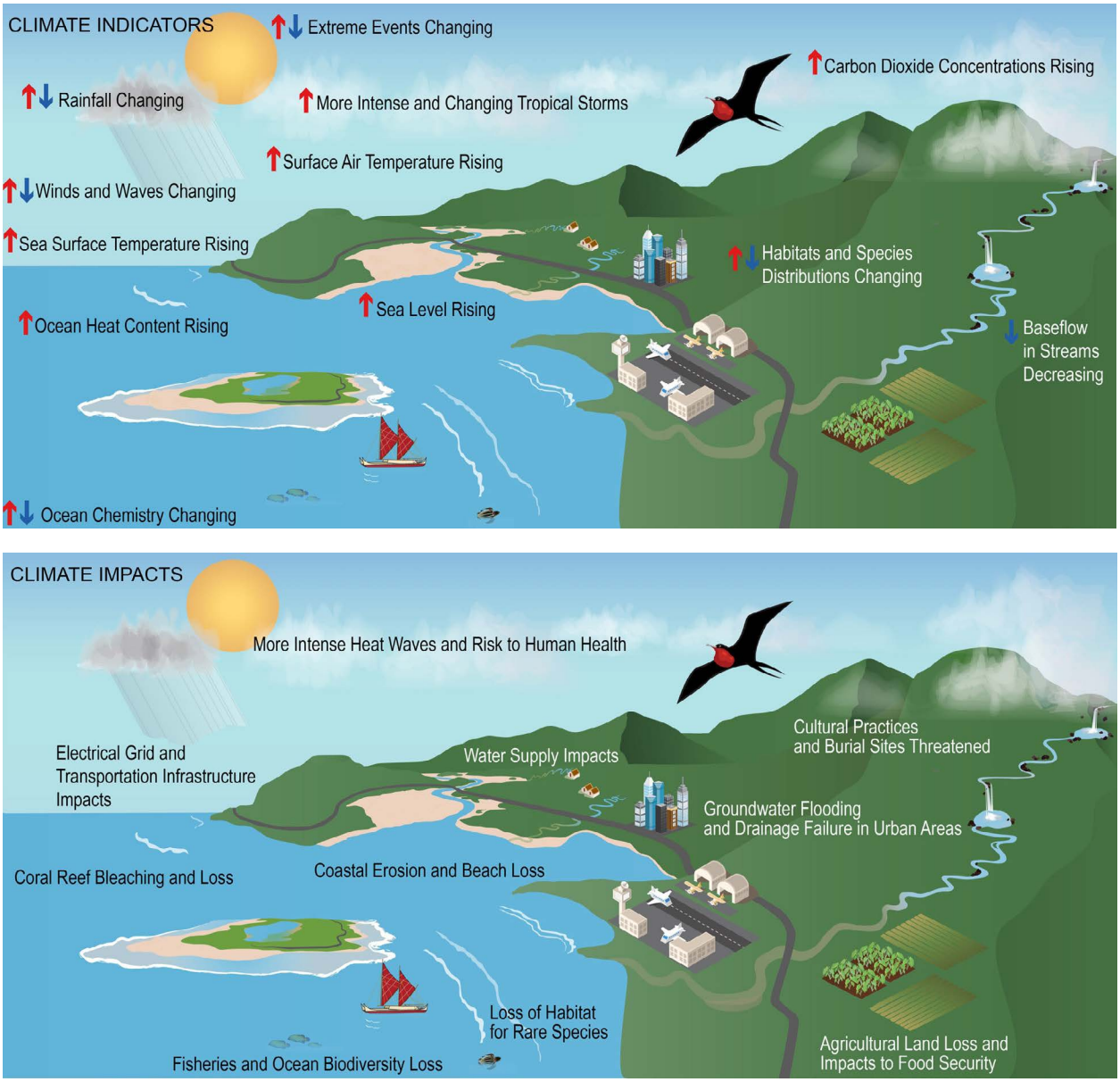


Figure 5-1. Top: Climate indicators for Hawai'i and the Pacific Islands region. Bottom: Climate impacts for Hawai'i and the Pacific Islands region. Graphics from Keener et al. 2012.

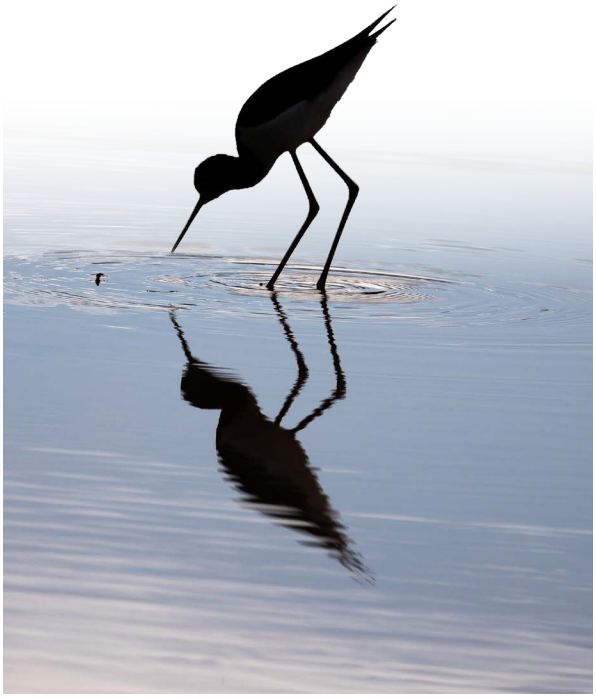
Alakoko restoration project will create a more resilient ecosystem, with adaptive management strategies in place to offer adaptation to address future impacts of climate change.

Existing Climate Indicators, Impacts, and Resilience Opportunities

Many of the impacts of climate change in the Hawaiian Islands will affect Alakoko loko i'a (Figure 5-1; Table 5-1). The five climate change indicators that will have the most profound impacts on the Alakoko system are:

Figure 5-2. Modeling includes three chronic flooding hazards: passive "bathtub" flooding, annual high wave flooding, and coastal erosion. The three hazards were then combined to define the projected extent of chronic flooding due to sea level rise, called the sea level rise exposure area (SLR-XA).

- Rising sea level;
- Reduced rainfall and increased drought;
- Increased surface and air temperatures;
- Extreme rainfall events;
- Increased risk of wildfire.



A‘eo. USFWS photograph by Dan Zimmerman.

Rising sea level, along with reduced rainfall and increased drought, especially when combined with an increase in temperature, may produce significant changes in and impair the ecosystem of the loko i‘a. Reduced streamflow during the dry season may disrupt habitat connectivity between the fishpond and Hulē‘ia River, diminish the fishpond's conservation value, and complicate efforts to preserve its unique biodiversity (Clilverd et al. 2019). These conditions will create heightened risks for aquatic species due to greater vulnerability to diseases and an increase in invasive plants and aquatic organisms (Gagne and Blum 2016). Decreased stream flow, particularly when combined with sea level rise, increases the likelihood of saltwater intrusion, impacting the fresh and brackish water systems at Alakoko. Salt can be a significant contaminant where wave-driven overwash and sea level rise impact the freshwater transition zone (Post et al. 2018), posing critical challenges to the ecological integrity and water quality of Alakoko loko i‘a. Flood events may impact both water quality and increase sedimentation in Alakoko loko i‘a.

The change in frequency and intensity of wildfires in the Pacific Islands, which have been increasingly linked to El Niño events and climate change, may further exacerbate the ecological pressures on the fishpond (Trauernicht et al. 2015).

Because of the red mangrove infestation and the associated changes to its ecosystem, Alakoko loko i‘a has been more likely to experience adverse impacts due to climate change. However, the mangrove removal projects followed by other restoration actions that Mālama Hulē‘ia has undertaken at Alakoko loko i‘a will help Alakoko adapt to future changes brought on by climate change. A healthy ecosystem is more resilient and can more likely recover from disturbance events such as droughts or intense storms. The use of traditional agriculture methods can also provide erosion control and help preserve water quality. Supporting and maintaining resilient ecosystems at places such as Alakoko loko i‘a is an essential component of adapting to climate change (Frazier et al. 2023).

Table 5-1 Climate change impacts on Alakoko loko iʻa, and ongoing and future adaptation strategies.

Climate Indicator	Impact on Alakoko System	Adaptation Strategies
Rising sea level	▸ Increased inundation risk to terrestrial ecosystems. ▸ Coastal erosion leading to the destruction of ecosystems. ▸ More frequent and extensive coastal flooding. ▸ Saltwater intrusion. ▸ Damage to or loss of permanent structures.	▸ Practicing adaptive management. ▸ Regularly evaluating the status of sea level rise and updating planning documents. ▸ Regular monitoring of water quality and salinity levels of the pond. ▸ Reinforcing the loko iʻa kuapā or raising it if necessary. ▸ Strategically using plant and soil systems, permeable surfaces, and water management practices to absorb, store, and filter excess water. ▸ Siting and designing permanent structures to avoid impacts from sea level rise.
Reduced rainfall and increased drought	▸ Reduced stream flow. ▸ Decreased freshwater inflow to the loko iʻa. ▸ Salinity imbalances and reduced water quality. ▸ Reduced growth of native species. ▸ Spread of invasive plants. ▸ Habitat fragmentation and altered food webs. ▸ Increased wildfire risk.	▸ Practicing adaptive management. ▸ Regular monitoring of water quality and water levels in the loko iʻa, loʻi, and punawai. ▸ Connecting punawai and kahawai to the loko iʻa system. ▸ Establishing riparian buffers and employing soil conservation measures (e.g., loʻi kalo). ▸ Removing invasive species and planting native vegetation. ▸ Planting culturally significant drought-resistant crop varieties in agricultural areas to reduce water use.
Increased surface and air temperatures	▸ Increased water temperatures in the loko iʻa that stress native aquatic organisms. ▸ Increased evaporation rates and reduction in stream flow. ▸ Favorable conditions for invasive plants that affect native plant communities.	▸ Practicing adaptive management. ▸ Regular monitoring water temperature and quality, aquatic organisms, invasive plants, and native vegetation and waterbirds. ▸ Planting cultural and native vegetation to provide shade to help regulate land and water temperature. ▸ Creating diverse habitat structures within the loko iʻa, including limu, to provide habitat and breeding areas for native aquatic organisms.

Climate Indicator	Impact on Alakoko System	Adaptation Strategies
Extreme rainfall events	▸ Flooding. ▸ Increased erosion and sedimentation. ▸ Potential breaches in the kuapā due to high water flow. ▸ Compromised water quality. ▸ Spread of invasive species, including mangrove seedlings. ▸ Damage and loss of vegetation, restored habitats, and ecosystems. ▸ Damage to permanent structures. ▸ Disruption of community engagement.	▸ Practicing adaptive management. ▸ Regular monitoring of water levels, sedimentation rates, invasive plants, and vegetation. ▸ Restoring wetland buffers, loʻi kalo, and loʻi iʻa kalo around the loko iʻa to address erosion and help absorb excess water during floods. ▸ Restoring punawai-related riparian corridors on the hillside to address erosion and help absorb excess water during floods. ▸ Creating small ridges and channels to guide water flow and allow infiltration. ▸ Elevating fishpond walls as necessary. ▸ Using permeable surfaces for pathways and parking lots. ▸ Siting and designing permanent structures to avoid flood impacts. ▸ Involving the community in Indigenous and sustainable land management practices.
Wildfires	▸ Loss of cultural and native vegetation and biodiversity. ▸ Disturbances that favor invasive plants. ▸ Destruction of infrastructure. ▸ Social, economic, and psychological impacts on the community. ▸ Disruption of community engagement activities.	▸ Developing a fire safety plan. ▸ Implementing nahele restoration to remove invasive plants and replant with native and culturally significant plants to reduce fuels. ▸ Creating and maintaining firebreaks. ▸ Implementing appropriate setbacks between buildings and adding sprinkler systems where practicable and required by law.

Resilience Through Alakoko Restoration: Enhancing Ecosystem and Community Well-being

Ongoing and future restoration efforts at Alakoko will be pivotal in building the resilience of the ecosystem and the surrounding communities. By engaging in a holistic biocultural restoration strategy that uses ecosystem-based adaptation, the Alakoko restoration project (see Chapter 4) addresses the immediate impacts of climate change and strengthens the socio-ecological fabric against future threats.

Ongoing and proposed ecosystem-based adaptation interventions at Alakoko include (Table 5-2):

- Invasive plant removal;
- Revegetation with native and culturally significant plants;
- Restoration of traditional kalo (taro) agricultural systems;
- Kuapā (wall) restoration;
- Restoration of hydrological connectivity to support fishpond functionality, native fish, wetlands, and traditional Hawaiian agriculture;
- Restoration of uplands with native and Hawaiian plants includes restoring punawai (freshwater spring)-related riparian zones;
- Involvement of the community in restoration efforts through volunteer and environmental education opportunities;
- Collaborative management with adjacent landowners.

Ecosystem-Based Adaptation

Ecosystem-based adaptation (EbA) is a subset of nature-based solutions (NbS) and is an approach informed by Indigenous knowledge to reduce negative impacts of climate change. The Convention on Biological Diversity defines ecosystem-based adaptation as using biodiversity and ecosystem services to help people adapt to the adverse effects of climate change (SCBD 2009). Ecosystem-based adaptation may include sustainable management, conservation, and restoration. It can be a part of an overall adaptation strategy that also considers the multiple social, economic and cultural co-benefits for local communities as well as contributes to the conservation of biodiversity (SCBD 2009).

Mālama Hulēʻia is dedicated to rejuvenating the ʻāina (that which feeds), restoring Alakoko loko iʻa to a state of abundance with functioning and thriving ecosystems. These actions should benefit native plants, native wildlife including endangered waterbirds, and native fish.

Ecosystem-based adaptation also enhances resilience of communities including food security, equity, justice and community engagement, and the conservation of cultural and natural heritage.

Table 5-2: Climate-resilience actions and outcomes

Action	Outcome	Contribution to Resilience
Invasive Plant Removal	▸ Reduction of areas with invasive plant infestations. ▸ Expansion of areas with native vegetation.	▸ Enhances native biodiversity. ▸ Strengthens ecosystem health and stability. ▸ Provides habitat for endangered waterbirds. ▸ Restores natural ecosystem functions and processes, including water filtration, pollination, and soil stabilization. ▸ Mitigates wildfire risk.
Revegetation with native and culturally significant plants	▸ Expansion of areas with native vegetation. ▸ Rejuvenation of native plant seed bank. ▸ Habitat for native waterbirds.	▸ Enhances native biodiversity and available habitats. ▸ Strengthens ecosystem health and stability. ▸ Improves landscape integrity. ▸ Increases the landscape's ability to respond to disturbance events, including floods. ▸ Mitigates wildfire risk. ▸ Facilitates the reestablishment of traditional ecological knowledge practices. ▸ Strengthens connections between communities and ancestral lands.
Restoration of traditional kalo agricultural systems	▸ Functioning lo'i systems. ▸ Healthier aquatic ecosystems. ▸ Habitat for native waterbirds. ▸ Local/cultural food sources.	▸ Supports biodiversity and enhances ecosystem health. ▸ Supports the aquatic food web and fisheries. ▸ Provides habitat for endangered waterbirds. ▸ Assists with flood control and hillslope stability. ▸ Facilitates the reestablishment of traditional knowledge practices related to the cultivation and use of plants for food. ▸ Enhances food sovereignty and security and provides a culturally significant food source.
Uplands restoration	▸ Expansion of areas with native vegetation. ▸ Functional punawai systems.	▸ Enhances native biodiversity and available habitats. ▸ Strengthens ecosystem health and stability. ▸ Improves landscape integrity. ▸ Restores natural ecosystem functions and processes. ▸ Increases the landscape's ability to respond to disturbance events, including floods ▸ Mitigates wildfire risk.

Action	Outcome	Contribution to Resilience
Kuapā restoration	▸ Preserved integrity of the kuapā. ▸ Improved functionality of the loko i'a. ▸ Improved water quality.	▸ Strengthens the loko i'a's ability to withstand flooding and storm surges. ▸ Enhances native biodiversity and available habitats. ▸ Strengthens aquatic ecosystem health and stability. ▸ Supports sustainable fisheries and local food production. ▸ Facilitates the reestablishment of traditional knowledge practices.
Restoration of hydrologic connectivity throughout Alakoko's system	▸ Restored punawai and associated riparian systems. ▸ Restored water flow from Papakolea Stream into the Alakoko system.	▸ Enhances native biodiversity and available habitats. ▸ Strengthens aquatic ecosystem health and stability. ▸ Strengthens ecosystem health and stability. ▸ Improves landscape integrity. ▸ Restores natural ecosystem functions and processes. ▸ Supports wetlands. ▸ Provides habitat for endangered waterbirds. ▸ Supports native fish and sustainable fisheries. ▸ Facilitates the reestablishment of traditional knowledge practices related to the cultivation and use of plants for food.
Community engagement	▸ Strong community ties and relationships. ▸ Community understanding of biocultural practices and kuleana.	▸ Enhances community awareness about local environmental challenges. ▸ Leads to informed and proactive conservation efforts and adaptations to environmental changes. ▸ Helps enable local communities to respond quickly to environmental threats or changes. ▸ Strengthens Hawaiians' sense of place and feelings of ownership towards Alakoko loko i'a. ▸ Builds social cohesion, collaboration, and unity. ▸ Facilitates the intergenerational transfer of Indigenous knowledge about local conditions. ▸ Reaches youth and students through educational outreach. ▸ Creates kuleana and reciprocal relations, allowing sustainable stewardship that crosses generations.

Action	Outcome	Contribution to Resilience
Collaborative management	▸ Restoration and ecosystem management on a landscape scale.	▸ Addresses ecosystem needs that extend beyond individual property boundaries. ▸ Preserves habitat connectivity, ecosystem integrity, and genetic diversity. ▸ Enhances the effectiveness of conservation efforts through coordination among multiple stakeholders. ▸ Provides opportunities to seek larger funding sources and share financial resources. ▸ Provides for economies of scale and makes ambitious projects more feasible and sustainable. ▸ Contributes to a unified voice advocating for policy and regulatory support for restoration efforts and enhances stakeholders' influence in policy making.

Strategies to Support and Sustain Ecosystem-based Adaptation to Deliver Broad Resilience Benefits

Using ecosystem-based adaptation approaches will help Mālama Hulēʻia deliver broad-based resilience benefits to Alakoko loko iʻa, the Hulēʻia River watershed, and local and Indigenous populations. Mālama Hulēʻia will use the following strategies:

1. Implement ecosystem-based adaptation (nature-based) approaches that complement other approaches. A combined strategy can offer more comprehensive protection. For example, native plant restoration, a type of ecosystem-based adaptation, can reduce erosion and sedimentation, while adjacent fishpond walls provide a physical barrier to storm surges. This integrated approach ensures that ecological and structural defenses work together, providing immediate and long-term resilience benefits.
2. Incorporate climate-smart agricultural practices in areas adjacent to restoration sites to enhance carbon sequestration and effective water management so that agricultural lands can serve as buffers and corridors for biodiversity and complement restoration efforts within the loko iʻa itself.
3. Work collaboratively with neighboring and adjacent landowners (governmental and private) on climate resilience and natural resource management. Ecosystem-based adaptation initiatives are often at a landscape-scale that transcends individual property boundaries. Developing joint management plans can address shared challenges and opportunities.
4. Seek out in joint funding opportunities for conservation and restoration projects that can access larger funding pools.
5. Support the adoption of local and national policies that improve climate resilience through ecosystem-based adaptation.
6. Advocate for policies that recognize and support nature-based solutions for climate resilience. Such policy solutions include incentives for the restoration and conservation of natural habitats, promotion of sustainable land use practices, and facilitation of collaborations to enhance ecosystem services. Share and exchange knowledge with similar projects locally and internationally.
7. Conduct vulnerability assessments to ensure targeted and effective implementation of ecosystem-based adaptation strategies so that measures remain responsive to changing conditions.

Chapter 6 Kuhikuhi Pu‘uone (Architecture or Site Development)

Introduction

This conceptual plan for Kuhikuhi Pu‘uone (Architecture or Site Development) at Alakoko loko i‘a was developed with Mālama Hulē‘ia board and staff. It reflects their collective vision for the facilities and infrastructure necessary to support the restoration, stewardship, and maintenance of Alakoko loko i‘a. Restoration actions are anticipated to continue through 2030, with adaptive management and biocultural learning steering the process. Thereafter, stewardship of the restored areas will be an ongoing effort to ensure the loko i‘a and the surrounding ecosystem continue to thrive and support native and endemic species.

This site plan supports the restoration and continued stewardship of Alakoko loko i‘a. The purpose of the hale (buildings) and other structures included herein is to provide Mālama Hulē‘ia with the infrastructure necessary to fulfill their mission of restoration, stewardship, cultural practice, and educational and cultural programming that sustains the community. This Kuhikuhi Pu‘uone plan is a part of a larger conceptual master plan for Alakoko loko i‘a that includes the restoration component.

Alakoko loko i‘a is an approximately 600-year-old traditional Hawaiian fishpond located on the Hulē‘ia River a short distance upstream from Nāwiliwili Bay. It is one of the most significant loko i‘a in Kaua‘i and is listed on the National and Hawai‘i Registers of Historic Places. A loko i‘a is a unique aquaculture system that optimizes natural patterns of an ahupua‘a (traditional watershed-based land division). During the 20th century, Alakoko became overrun by invasive red mangrove (*Rhizophora mangle*), leading to significant damage to its kuapā (wall) and fundamentally changing its size, hydrology, and ecology. Mālama Hulē‘ia has been working to restore Alakoko loko i‘a since 2018.

In 2021, Mālama Hulēʻia was able to purchase the Alakoko property with support from the Trust for Public Land. This gave the nonprofit the opportunity to undertake a comprehensive restoration project and planning process that would restore functionality to Alakoko loko iʻa as well as provide Mālama Hulēʻia with the kuhikuhi puʻuone necessary to do so.

Planning Process

The board and staff of Mālama Hulēʻia have been working to restore Alakoko and revitalize the entire ʻāina kumu wai (watershed) Hulēʻia for years. In 2022 Mālama Hulēʻia applied for technical planning assistance on a conceptual master plan for Alakoko from the National Park Service Rivers, Trails, and Conservation Assistance (NPS-RTCA) Program. With staff and board leadership and community input, Mālama Hulēʻia began charting a path forward together to honor and steward this place for generations to come.

The planning process for the loko iʻa restoration was led by Peleke Flores, Mālama Hulēʻiaʻs Director of ʻĀina & Community Engagement. NPS-RTCA conducted a series of interviews with Peleke to develop the descriptions of the different components of the loko iʻa restoration, the phasing, and guidance for the overall vision for the restoration of the loko iʻa. Adaptive management principles including using observations and monitoring of previous restoration actions is an integral aspect of this plan. It will also help Mālama Hulēʻia to develop best practices and position them for effective long-term stewardship of Alakoko loko iʻa.

Charrette participants then formed teams and developed on-site concepts for Alakoko Loko iʻa under the guidance of the ASLA volunteer landscape architect. NPS Photo/Z. Babb.

Once the conceptual restoration graphics and goals and objectives were developed, NPS-RTCA worked with Mālama Hulēʻia to assess their infrastructure needs in support of the restoration and management of the loko iʻa, as well as to provide the education programming and community involvement. This second part of the planning process led to the Kuhikuhi Puʻuone.

A design charrette for the Kuhikuhi Puʻuone was held on July 1–2, 2023. The charrette was led by Melisa Babb, a landscape architect volunteering through the partnership NPS-RTCA has with the American Society of Landscape Architects. Mālama Hulēʻia board and staff attended the charrette, with NPS-RTCA staff providing support.

Charrette participants broke into groups to each develop a vision for Alakoko, which were shared for the consideration of the broader group. The entire group then explored all the different ideas and approaches for the future of Alakoko.

One key idea that came up within each group independently was the potential value in acquiring land mauka (towards the mountain) of the loko iʻa that is currently owned by Grove Farm. The rationale was that some aspects of operating the loko iʻa should be kept as far from the pond itself as possible. An upland parcel would be the ideal place to store equipment, visitor parking, a secured entry point, and some administrative functions. However, it was decided that the planning process would continue under the assumption that acquiring upland property was not feasible, but that, if possible in the future, it should become a high priority.

After the July charrette, the planning team worked with staff to refine the work of the charrette participants and produced a range of four concepts, one from each of the charrette groups, plus one that was drafted by Peleke Flores, who wasn't able to attend the July session. The planning team returned to Alakoko in September 2023 with the draft concepts and shared them with the board and staff. The outcome of these work sessions was a single concept that everyone felt best met the needs of the loko iʻa and was the best way forward.

After synthesizing the feedback from the board and staff at the September work sessions, the planning team refined the concept adding some mapping of potential hazards, and then returned in February 2024 for a series of meetings with stakeholders, neighbors, and members of the general public who were attending a volunteer day and a dry-stone wall-building course at the loko iʻa. The feedback received during these sessions led to further refinement and some additional new ideas.

Existing Conditions

Alakoko loko iʻa is located on private land owned and managed by Mālama Hulēʻia. Alakoko loko iʻa is a kuapā (wall)-style loko iʻa that sits in a geomorphic bend in the Hulēʻia River. The kuapā, an ancient Hawaiian stone-faced dirt wall with a length of more than 2,700-feet-long, separates the loko iʻa from the Hulēʻia River. Alakoko is tidally influenced and has brackish water due to water inputs from punawai (freshwater springs) and the estuarine environment.

Invasions of red mangrove since the middle of the 20th century impaired all aspects of Alakoko loko iʻa, rendering the pond itself nearly inaccessible due to the dense vegetation and damaging the kuapā. The red mangrove also choked out native vegetation and habitat for endangered Hawaiian waterbirds, and adversely impacted pond hydrology, including water quality.

Between 2018 and 2021, Mālama Hulēʻia removed 26 acres of red mangrove around the pondʻs circumference, exposing the kuapā, several punawai, and components of an ancient aquacultural system. Since purchasing the property in 2021, the organization has embarked on a comprehensive restoration of the loko iʻa and the surrounding area. Wetlands next to the Hulēʻia river have been restored with native vegetation. A fish passageway project was completed to connect the loko iʻa to the river at low tide, and a sediment removal project to restore pond depths is underway. Work to repair kuapā is also in progress and the remnant live mangrove wall which is stabilizing the kuapā will be removed when that project is complete. Mālama Hulēʻia has also planted pilot loʻi kalo (taro patches) and māla (gardens), and has piloted nahele (forest) restoration.

Mangrove removal created a large open area on the east side of Alakoko loko iʻa that Mālama Hulēʻia is using to base its operations (Figure 6-1 and Figure 6-2). Its headquarters are located in that area, and restoration activities are staged from there. On-site educational programming and community events also occur in that area as the grassy lawn is a central place for people to gather.

The ahu (Hawaiian altar or shrine) is the center of the site. Mālama Hulēʻia constructed the ahu prior to initiating the restoration work at Alakoko. The ahu serves as the piko (navel, or where life begins) that grounds people to place and

Figure 6-1. An overview of the open area that will be developed into the Kuhikuhi Puʻuone. The star shows the location of one of the mākāhā (saltwater inlet/outlet).

Figure 6-2. Existing conditions in the area that will be developed into the Kuhikuhi Pu'uone.

serves as a gathering place to welcome and orient people to Alakoko loko iʻa. Hawaiian protocol is used whereby visitors ask permission to enter and they are greeted by staff and are taught the protocol used at the ahu. Participants are asked to introduce themselves, where they are from/where is their home, and to bring an ancestor or important person with them as they work at Alakoko.

The area contains a number of temporary structures. One of the most significant is an open-air tent (Figure 6-3). The tent is approximately 30 ft x 60 ft and serves as a classroom and meeting space. Hundreds of people per week may sit and learn together out of the sun and rain. The tent has a metal frame with tarp-like material serving as the roof. It is prone to damage in high wind and rain events.

Near the tent are a plant nursery and a shower building (Figure 6-4). Storage for supplies and equipment is done using a collection of shipping containers and sheds. There are two port-a-potties next to the storage containers. Parking for motor vehicles is informal with some general areas used more often than others.

Mālama Hulēʻia recently received two “tiny houses,” donated by Kauaʻi residents. One of these tiny houses currently serves as the nonprofit’s office. The other is used for storage, but may possibly be converted to housing.

The only permanent existing structure on the Alakoko property was a dilapidated hale near the Hulēʻia River that was of marginal use and was destroyed in a windstorm in 2025 and two small structures, one used as a shower house and the other for storage.

Current access is primarily via a narrow dirt road to the east of the site. The road has an easement, but neighbors have expressed concerns about the volume of traffic now that activity at the loko iʻa has increased. The neighbors are also concerned with safety in the area, especially with school groups utilizing the shared driveway. There is currently secondary access to the loko iʻa on an old hauling road that crosses US Fish and Wildlife Service (USFWS) and Grove Farm property that enters from the north. Use of this route is preferred and requires a permit from USFWS and permission from Grove Farm.

Development Considerations

Mālama Hulēʻia and the NPS-RTCA planning team adhered to stipulations in the property deed for the Alakoko property as well as regulations outlined in the State Land Use Conservation District and the Kauaʻi Sea Level Rise Constraint District as sideboards throughout the planning process for the Kuhikuhi Puʻuone.

Deed Restrictions

Through the acquisition process with the Trust for Public Land, the deed for the land containing Alakoko loko iʻa includes restrictions that were put into place to ensure the property will be used in perpetuity for Native Hawaiian ʻāina-based stewardship.

Figure 6-3. The tent is a central space at Alakoko. It is where the staff and board meet, where much of the education programming occurs, and is where people gather to eat.

Figure 6-4. Behind the tent, towards the river, is a space used as a plant nursery. Propagating native and canoe plant species is a fundamental part of the restoration and operation of Alakoko.

The property deed includes the following components:

- 1. Native Hawaiian ʻāina (land)-based education, natural resource management, and stewardship grounded in Native Hawaiian culture and values;
- 2. Perpetuation of traditional and customary Native Hawaiian cultural practices, including but not limited to growing culturally important species;
- 3. Preservation and restoration of historic and culturally important land and sites, including but not limited to: Alakoko Fishpond system;
- 4. Preservation and restoration of significant native habitats or ecosystems, including but not limited to: Hulēʻia River, estuary, wetland, pond, springs, coastal areas, and forests;
- 5. Preservation and restoration of land and water used for sustainable aquaculture and agriculture to increase local food self-sufficiency;
- 6. Preservation and restoration of Niumalu watershed lands for water quality and quantity;
- 7. Preservation and restoration of land to reduce erosion, floods, landslides and runoff;
- 8. Providing pono (moral, ethical, proper), responsible, reciprocal, managed, safe, guided public access to the Property that ensures its cultural and natural resources are protected;
- 9. Conserving land for open space and scenic values; and
- 10. Development on the Property shall be limited to buildings, structures, roads, pathways, or other improvements (collectively, "Improvements"): that preserve a sense of place on the Property; that comply with all governmental laws and regulations; and that further and/or are accessory to any of the aforementioned purposes. Such Improvements may include, but are not limited to: one building used for office, community and/or educational purposes; greenhouses; agricultural structures; warehouses or storage buildings; bathroom buildings; one building used as a commercial kitchen and/or for the processing and/or packaging of agricultural and aquaculture products; one single family dwelling unit with a footprint not to exceed 3,000 square feet for occupancy by a caretaker of the Property; and one boarding house or dormitory for stewardship staff or students working on the Property. Hotel and/or transient vacation rental uses and structures shall not be allowed on the Property.
- 11. Except as otherwise provided herein, the amount of land coverage created on the Property shall not exceed five percent (5%) of the Property area. "Land Coverage" means a man-made structure, improvement or covering that prevents normal precipitation from directly reaching the surface of the land underlying the structure, improvement or covering. Structures, improvements and covering include roofs, surfaces that are paved with asphalt, stone, or the like such as roads, streets, sidewalks, driveways, parking lots, patios, and lands so used that the soil will be compacted so as to prevent substantial infiltration, such as parking of cars and heavy and repeated pedestrian traffic. Land coverage shall not include traditional Native

Hawaiian buildings, structures, or architecture, including but not limited to, hale hālāwai (meeting house), hale waʻa (canoe house), hale kiaʻi (guard or caretaker house), kuapā (fishpond walls), mākāhā (saltwater inlet/outlet) and ahu (altars).

State Land Use Conservation District

The Alakoko property is located within the State of Hawaii Conservation District (Act 187, State Land Use Law of 1961; Title 13, Chapter 5, Hawaiʻi Administrative Rules; Chapter 183C, Hawaiʻi Revised Statutes). Act 187 created Conservation Districts to protect watersheds and water supplies; scenic areas; park lands, wilderness and beach reserves; and endemic plants, fish and wildlife. The Department of Land and Natural Resources, Office of Conservation and Coastal Lands (OCCL) is responsible for management of coastal resources including, but not limited to State Conservation District lands and the Hoʻāla Loko Iʻa streamlined permitting process for the restoration and maintenance of traditional loko iʻa systems.

The Conservation District is divided into five subzones that provide different levels of protection and resource use:

- Protective (most sensitive);
- Limited;

An example of a hale hālāwai. Source: APPENDIX X Hawaiʻi Provisions For Indigenous Hawaiian Architecture Structures section of Chapter 12 of the Kauaʻi county Building code, the traditional A-frame style.

- Resource;
- General (least sensitive);
- Special.

The Alakoko property falls within three subzones: Protective, Resource, and Limited. An area near the west side of the loko iʻa is in the Protective subzone, and most of the loko iʻa itself is in the Limited subzone. The eastern portion of the property is in the Resource subzone. All of the infrastructure in the Kuhikuhi Puʻuone that facilitates the restoration and stewardship of Alakoko loko iʻa, as well as Mālama Hulēiʻia's educational and community programming is planned for the Resource and Limited subzones. The placement of structures in the Kuhikuhi Puʻuone reflects what is permitted.

Some key regulatory excerpts regarding the Limited subzone as it applies to Alakoko loko iʻa (Title 13, Chapter 5, Hawaiʻi Administrative Rules):

> In addition to the land uses identified in this section, all identified land uses and their associated permit or site plan approval requirements listed for the Protective subzone also apply to the Limited subzone, unless otherwise noted.
>
> If a proposed use is not presented below or in section 13-5-22, an applicant may request a temporary variance, petition the land use commission for a land use district boundary change, or initiate an administrative rule change to have the proposed use added to the identified land uses.
>
> Identified land uses in the Limited subzone and their required permits (if applicable), are listed below:
>
> 1. Identified land uses beginning with letter (A) require no permit from the department or board;
> 2. Identified land uses beginning with letter (B) require a site plan approval by the department;
> 3. Identified land uses beginning with letter (C) require a departmental permit; and
> 4. Identified land uses beginning with letter (D) require a board permit, and where indicated, a management plan.

L-1 AGRICULTURE

> (C-1): Agriculture, within an area of one acre or less, defined as the planting, cultivating, and harvesting of horticultural crops, floricultural crops, or forest products, or animal husbandry.
>
> (D-1) Agriculture, within an area of more than one acre, defined as the planting, cultivating, and harvesting of horticultural crops, floricultural crops, or forest products, or animal husbandry. A management plan approved simultaneously with the permit, is also required.

L-3 SINGLE FAMILY RESIDENCE

(D-1): A single family residence in a flood zone or coastal high hazard area defined by the boundaries of the Federal Insurance Rate Maps (FIRM) that conforms to applicable county regulations regarding the National Flood Insurance Program and single family residential standards as outlined in this chapter.

L-4 WILDERNESS CAMP

(D-1) Establishment providing educational and recreational programs for youth and adult groups, including campsites for overnight accommodations in tents. Facilities may include unimproved access road or trail(s), portable restrooms, and one meeting shelter not to exceed 600 square feet. A management plan, approved simultaneously with the permit, is also required.

Some key regulatory excerpts regarding the Resource subzone as it applies to Alakoko loko iʻa:

R-8 BOTANICAL GARDENS, PRIVATE PARKS, AND NATURE CENTERS

(D-1): For a profit or non-profit establishment featuring plants or other natural resources and offering tours or other nature-based, outdoors educational and recreational activities, primarily during daylight hours. Facilities may include access road, restrooms, shelters, and not more than one structure for housing, administration, and maintenance not to exceed 1,200 square feet, under a management plan approved simultaneously with the permit.

Kauaʻi Sea Level Rise Constraint District

The Kauaʻi Sea Level Rise Constraint District is a designated area on Kauaʻi aimed at addressing the impacts of sea level rise due to climate change (County of Kauaʻi 2025). The Kauaʻi Sea Level Rise Constraint District Viewer is an online atlas generated by data used in the creation of the Hawaiʻi Sea Level Rise Vulnerability and Adaptation Report (Hawaiʻi Climate Change Mitigation and Adaptation Commission 2021). The viewer provides visualizations depicting projections of future annual high wave run up and passive flooding hazards due to rising sea levels. This district assists landowners by providing data on properties to determine if a structure lies within and is subject to the provisions of the constraint sea level rise district, and provides data on the maximum flood depth that a proposed structure is exposed to. The county enforces this through specific planning and zoning regulations to mitigate risks associated with rising sea levels, such as flooding and erosion.

The Sea Level Rise Constraint District Viewer shows projections of areas expected to be inundated by passive flooding due to sea level rise and those impacted by annual high wave run up. Annual high wave run up is not projected to impact the

Alakoko property; however, some areas of the property, especially those at lowest elevation and closest to the loko iʻa, are mapped as being impacted by passive flooding (Figure 5-2). Because the Alakoko property lies within a mapped tsunami evacuation zone, the site will be secured and evacuated whenever an official tsunami warning is issued.

Mālama Hulēʻia and the NPS-RTCA planning team used the countyʻs Sea Level Rise Constraint District Viewer and related data to site structures outside of areas predicted for inundation.

Climate Change

Climate change threatens Alakoko's socio-ecological well-being and the profound connections local and Native Hawaiian communities have with their environment. Because Alakoko is at low elevation in the coastal environment, it is among the most vulnerable areas in the Hawaiian Islands to impacts from climate change.

The red mangrove infestation and the associated changes to the ecosystem made Alakoko loko iʻa more likely to experience adverse impacts from climate change. However, the mangrove removal projects and other restoration actions will help Alakoko adapt to future changes due to climate change. A healthy ecosystem is more resilient and can more likely recover from droughts or intense storms. The use of traditional agriculture methods can also provide erosion control and help preserve water quality.

For more information on how climate change may impact Alakoko loko iʻa, see Chapter 5.

Alakoko Kuhikuhi Puʻuone

Overview

All buildings, facilities, and other infrastructure components that is proposed in this conceptual plan for Kuhikuhi Puʻuone is intended to mālama (care for) Alakoko loko iʻa (Figure 6-5). As Mālama Hulēʻia shifts from conducting major restoration actions to ongoing management and operations, they are using adaptive management principles that are based on biocultural principles in order to be good stewards. The purpose of the Kuhikuhi Puʻuone is to provide the necessary infrastructure to appropriately manage Alakoko loko iʻa and to provide educational programming and outreach to the community.

Principles and Values

Mālama Hulēʻia's restoration efforts at Alakoko loko iʻa and the development of the Kuhikuhi Puʻuone to support that work are guided by the following values and principles:

Alakoko Loko I'a Master Plan
Site Concept/Not for Construction
June 2025

Figure 6-5. Site conception plan for the Kuhikuhi Pu'uone.

- Repairing the ecosystem functions of Alakoko loko iʻa through the application of Hawaiian ecological knowledge coupled with scientific studies and analysis, archaeological preservation, monitoring, and data collection.
- Increasing the native biodiversity.
- Integrating climate planning into the plan.
- Supporting native plants and animals, with special attention to the threatened and endangered species that utilize the area as habitat.
- Working closely with Hawaiian practitioners to influence the collective understanding of loko iʻa and its purpose and function.
- Supporting biocultural research that advances the use of Hawaiian cultural approaches for restoration practices and stewardship of ʻāina.
- Supporting the Native Hawaiian and local community culturally, physically, and spiritually, while fostering community pride, through community programs and educational outreach.

Site Access

Mālama Hulēʻia intends to use the old hauling road on the western end of the property as the primary means of vehicle access and public entry, pending a right-of-way or other appropriate access agreement from the USFWS and Grove Farm (Figure 6-6). The existing road on the east end of the property, which is within an existing easement, will serve as a secondary administrative access point. It will be gated and will remain locked to restrict unauthorized access.

On-Site Parking

10 parking spaces for staff and handicapped parking will be located on the mauka side of the new road alignment, adjacent to the hale kuke/lumi keʻena (kitchen house and office building). Public parking will be located at the eastern end of the

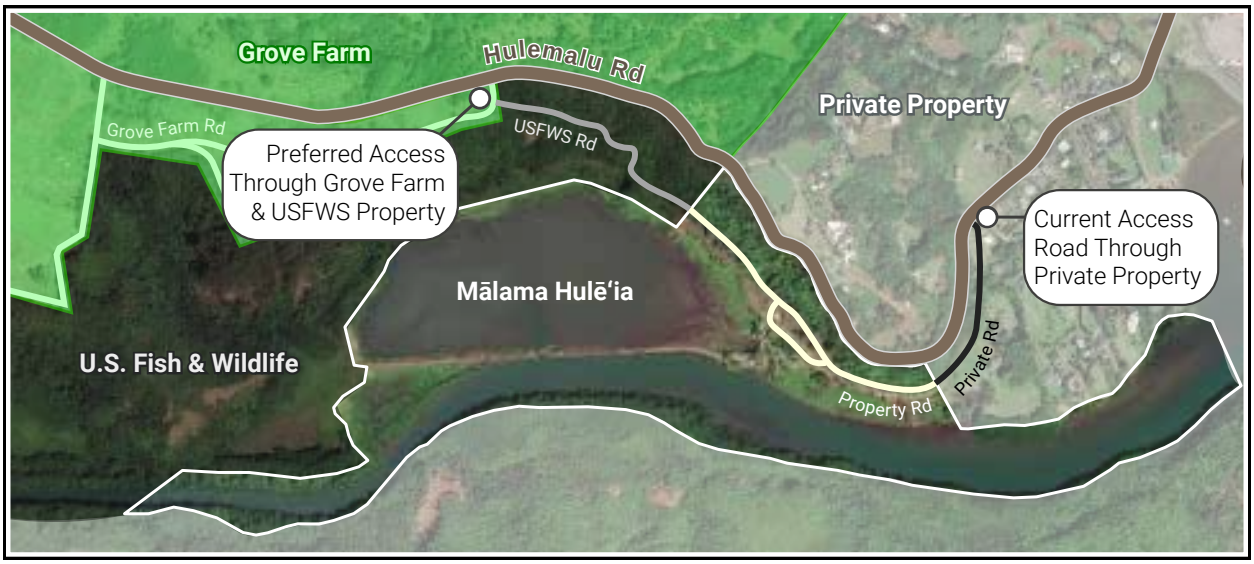


Figure 6-6. Map showing the preferred access to Alakoko loko iʻa using a road through Grove Farm and USFWS property and the current access road through private property.

Boulders, which would later be used to restore the loko iʻa's wall, were staged on what will be a future area for parking.

The ahu is the heart of the Alakoko site. It's where you arrive and gain entry.

Hale hālāwai, Loko Ea fishpond in Haleiwa, Oʻahu.

site and will include 25 spaces developed on already-disturbed land. If Mālama Hulēʻia is able to acquire land from Grove Farm, they will explore relocating the primary vehicle parking area there.

Circulation

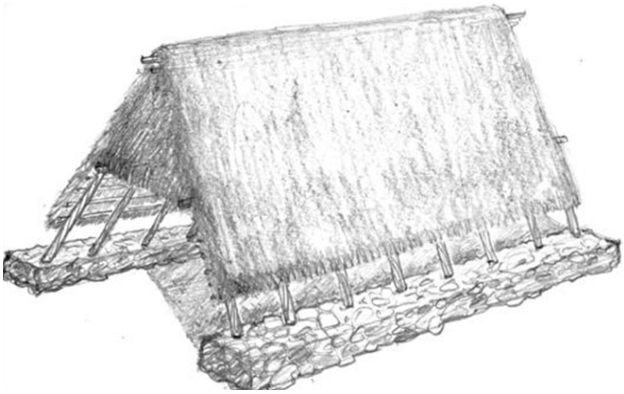
The existing road will be realigned to the north, starting at the eastern end of the hale kiaʻi (caretaker housing). The road will continue mauka of the build-out area, closer to the cliff, and will drop back makai (towards the ocean) to reconnect with the existing road west of the proposed maintenance facility. The old road alignment will be revegetated and used as a foot trail. A bus turn-around loop will be developed between the primary Kuhikuhi Puʻuone area and the caretaker housing.

Ahu

The ahu is the altar or shrine that welcomes people to this wahi pana (storied place). It was created for Alakoko at the beginning of the restoration project and provides the spiritual connection and supports the mission of Mālama Hulēʻia. It makes the heart of the Kuhikuhi Puʻuone and is in an open grassy area that will be used for activities for educational groups and community gatherings.

Hale Hālāwai

The hale hālāwai (meeting house) will be the primary community meeting space in the Kuhikuhi Puʻuone and will be located approximately where the existing tent is, next to the ahu. At 30 ft x 50 ft (1,500 sq ft), it will be constructed with traditional methods and materials as described in Hawaiʻi Provisions For Indigenous Hawaiian Architecture Structures (Appendix X) section of Chapter 12 of the Kauaʻi County building code.



An example of a hale waʻa. Source: APPENDIX X Hawaiʻi Provisions For Indigenous Hawaiian Architecture Structures section of Chapter 12 of the Kauaʻi County building code, the traditional A-frame style.

Future meals for volunteer work days and for community members will be harvested from Alakoko. This plate includes dishes that would be prepared in the hale imu and kuke, including kalo (taro), iʻa (fish), ʻulu (breadfruit), limu (seaweed), and watercress.

Hale Waʻa

There will be two hale waʻa (canoe houses) at Alakoko loko iʻa. One will be located at the western end of the Kuhikuhi Puʻuone, on the edge of the loko iʻa. It will serve the canoe needs of the loko iʻa. The other hale waʻa will be located near the bank of the Hulēʻia River, approximately where the existing canoe house was located. Both will have constructed canoe launches nearby. Each will be designed to fully enclose 3 canoes. At 20 ft x 60 ft (1,200 sq ft) each, they will be constructed with traditional methods and materials as described in Hawaiʻi Provisions For Indigenous Hawaiian Architecture Structures (Appendix X) section of Chapter 12 of the Kauaʻi County building code, the traditional A-frame style.

Hale Imu

The hale imu (cooking area) will include an imu (underground oven), a pulehu (traditional Hawaiian grill), and a smoker. This area, and its components except for the imu, will be mobile and generally located near the hale hālāwai. The total footprint will be approximately 20 ft x 20 ft (400 sq ft) and will be bare soil with some gravel and other treatments applied where necessary. There will be a metal awning set on four metal posts to cover the cooking area with a drying box on top. The awning will be 10–12 ft high.

Washeteria

This will be the primary public shower facility for the site. It will be located near the headquarters building, makai of the new road alignment. The footprint will be approximately 20 ft x 20 ft (400 sq ft) and have a cement foundation. There will be spaces for changing areas and 6 showers. The gray water from the showers should be retained and directed towards the banana grove and other nearby plantings.

Mālama Hulēʻia staff and volunteers get muddy doing restoration work at Alakoko loko iʻa, demonstrating the need for the washeteria on site.

Hale Kuke/Lumi Keʻena

The new Mālama Hulēʻia headquarters facility will be located in the middle of the build-out area, makai of the new road alignment and adjacent to staff parking, and will have a dual role of hale kuke (kitchen house) and lumi keʻena (office building). The building will be two stories, with a footprint of approximately 1,200 sq ft. The top floor will serve administrative needs and provide office space, meeting space, and other functions that need to occur indoors. The bottom floor will be partially enclosed and include amenities such as a food processing area, a small commercial kitchen, and storage. This facility will be constructed using contemporary methods and materials.

Hale Kuahui

The hale kuahui (maintenance facility) will be located mauka of the new road alignment. One large enclosed space approximately 30 ft x 60 ft (1,800 sq ft) with garage doors on both sides will be built to accommodate the equipment, vehicles, and materials needed to manage the loko iʻa. The facility will be located on an apron of graded, compacted, and graveled surface of approximately 4,000 sq ft.

Public Restrooms

Public restrooms will be incorporated into the site in an appropriate area near the hale kuahui. Up to 5 toilets (including 1 ADA accessible) are recommended. The toilets should be composting/incinerating types.

Hale Kiaʻi

The hale kiaʻi (caretaker housing) will be located near the eastern end of the build-out area. It will be one single family residence, one story tall, and approximately 1,200 sq ft. There will be some additional space around the structure for use as private outdoor space, parking, or other uses. The space immediately south of the structure will have heavy vegetative screening for privacy.

Hale Noho

The hale noho (dormitory) will be located near the boundary with the USFWS parcel, mauka of the existing road alignment. Its purpose is to provide temporary

On-site camping during a special event.

Part of the existing plant nursery used to propagate plants used in Mālama Hulēʻia restoration efforts.

shelter for people tending to the loko iʻa, and as a second covered and partially enclosed gathering space when not used for its primary purpose. 30 ft x 50 ft (1,500 sq ft), it will be constructed with elements of traditional methods and materials as described in Hawaiʻi Provisions For Indigenous Hawaiian Architecture Structures (APPENDIX X) section of Chapter 12 of the Kauaʻi County building code.

Camping

Camping will continue to be allowed only when necessary and in support of caring for the loko iʻa. It will continue to be managed as a dispersed activity. Camping will be allowed across the parcel where it makes sense, and it will be managed to minimize adverse impacts to the loko iʻa and its resources.

Plant Nurseries

The propagation of plants is a critical task for the restoration and operation of the loko iʻa. This plan does not designate specific areas to serve as plant nurseries. Instead, this plan identifies the importance of plant nurseries and directs staff to use available space that suits the propagation of each species.

Utilities

Sustainable operations are a primary goal, but they must be weighed against ensuring continuous and reliable energy, water, and waste management for the Alakoko property.

Mālama Hulēʻia will explore the feasibility of operating Alakoko using solely solar power, or of tying into the Kauaʻi Island Utility Cooperative (KIUC) power grid.

Gray water from the washeteria will include no chemicals that are potentially detrimental to the water quality of the loko iʻa. All natural, gray-water-safe soap and cleaning materials will be required.

Grove Farm Acquisition

Mālama Hulēʻia's long term goal is to acquire part of the Grove Farm property. If that happens, some of the functions and facilities currently planned for being in the Kuhikuhi Puʻuone would be relocated mauka to the farm property to the west of the loko iʻa.

The purpose of siting certain facilities there would be to better protect the integrity of the natural systems of the loko iʻa and its watershed and ecosystem, and to create more space for community activities, learning, and cultural practices.

The types of functions and facilities that would be better to move away from the loko iʻa include:

- Equipment and materials storage;
- The primary vehicle parking area;
- Secured entry point;
- Food processing;
- Community spaces for retail, food trucks, and small events;
- Additional housing;
- Agricultural production.

Siting of Components Relative to Conservation District

Most of the facilities in the Kuhikuhi Puʻuone are in the Limited subzone as they are situated near the edge of the loko iʻa and geographic attributes of the site also provide constraints. The hale kiaʻi and parking are in the Resource subzone (Figure 6-7).

Siting of Components Relative to Sea-level Rise Constraint District

Most of the buildings, including the hale kuahui, hale kuke/lumi keʻena, hale noho, and hale kiaʻi, in the Kuhikuhi Puʻuone are outside of future annual high wave run up and passive flooding hazards due to rising sea levels as depicted in the Kauaʻi Sea Level Rise Constraint District viewer (Figure 6-8).

Phasing

This shared vision for the developed parts of Alakoko loko iʻa will be implemented over time as funding becomes available. It is likely that the build-out for all the facilities for the Kuhikuhi Puʻuone in this plan will take many years and that it will be developed one piece at a time, possibly not in the order that was anticipated.

However, it will make sense to attempt to prioritize some aspects of the site plan before others so that further development can occur more quickly and easily. Instead of creating a development timeline, Mālama Hulēʻia has clustered each part of the site plan into three tiers of prioritization. The first tier would ideally be first in line.

Phase 1

- Acquire the Right-of-Way from USFWS and Grove Farm to access the site from the western entrance.
- Construct the Hale Kuahui and consolidate those operations in one location, thereby freeing up space for further development.
- Build the Hale Hālāwai and set it up as one of the key spaces for sharing and learning.
- Reroute the road and set new circulation patterns into place.
- Relocate and replace the Washeteria.

Phase 2

- Build the Hale Kiaʻi to fully secure the loko iʻa.
- Construct the Hale Kuke/Lumi Keʻena.
- Build the Hale Imu.

Alakoko Loko I'a Master Plan
Site Concept/Not for Construction
June 2025

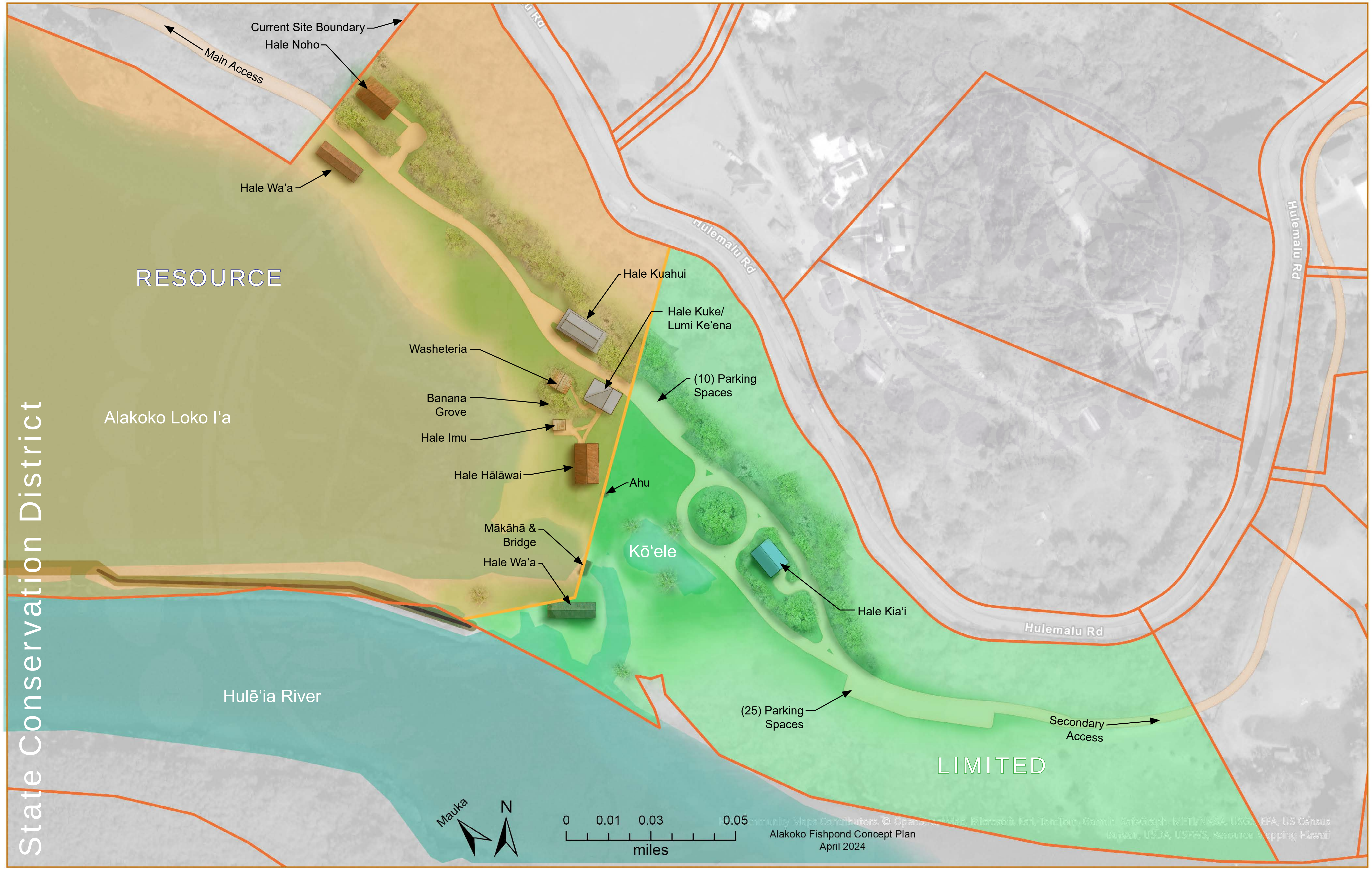
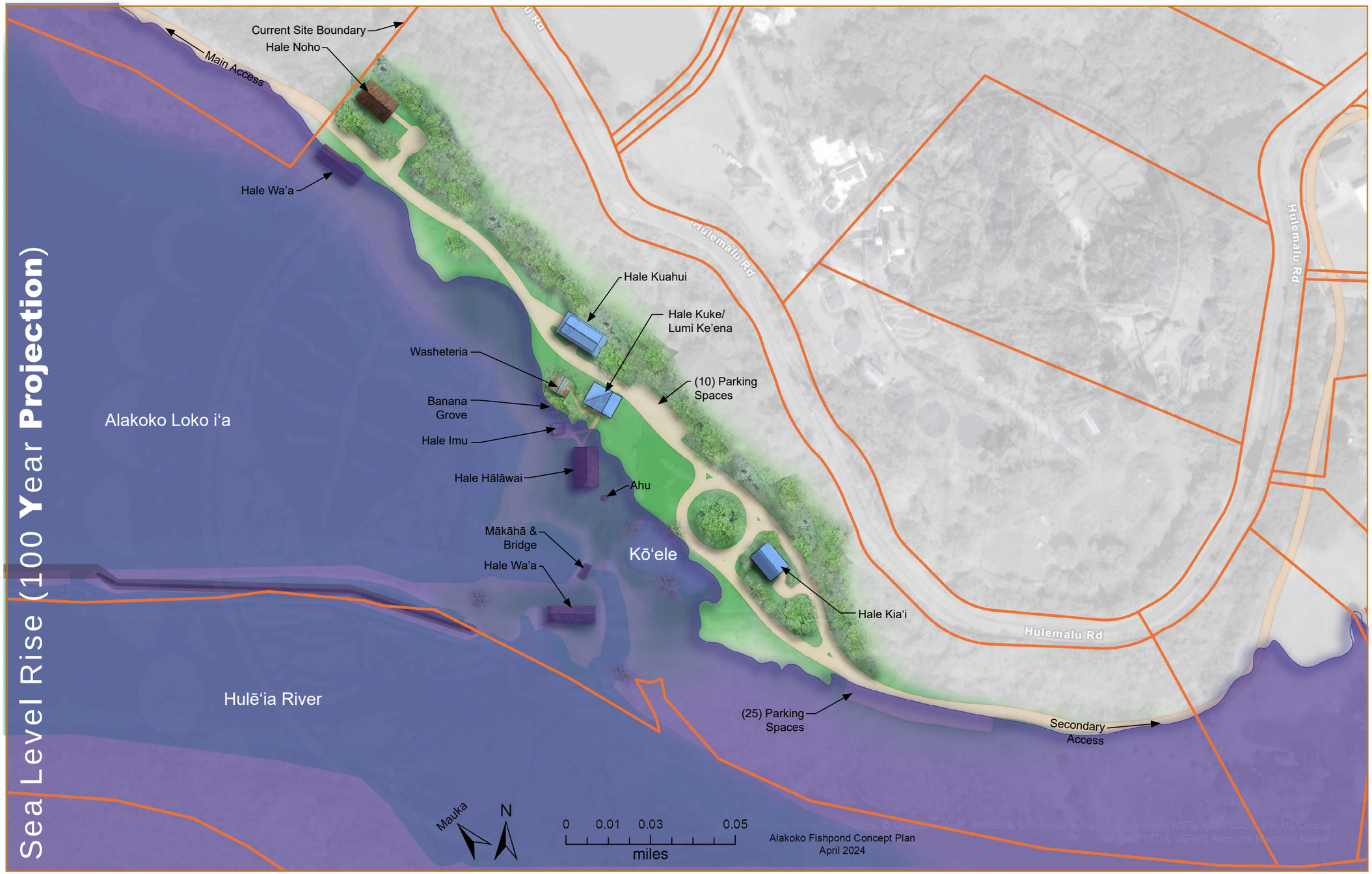


Figure 6-7. Siting of components in the Kuhikuhi Pu'uone relative to conservation district.



Alakoko Loko i'a Master Plan
Site Concept/Not for Construction
June 2025

Figure 6-8. Siting of components in the Kuhikuhi Pu'uone relative to sea level rise constraint district.

Tier 3

- Replace the Hale Waʻa on the banks of the Hulēʻia River.
- Build the Hale Waʻa on the shore of the pond.
- Build the Hale Noho near the western property line.

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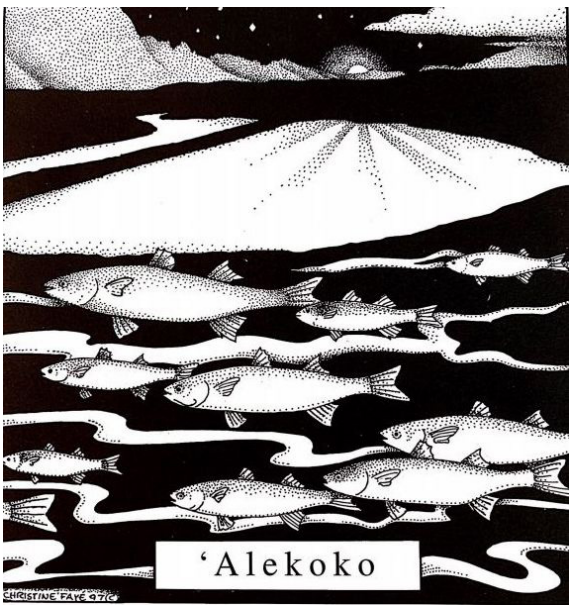
Appendix 1
The Name of Alakoko Loko I‘a

Alakoko loko i‘a is Mālama Hulē'ia‘s preferred name for this traditional Hawaiian fishpond. The site is also commonly known as Menehune Fishpond, which is how it is shown on U.S. Geological Survey topographical maps and in the U.S. Board on Geographic Names database (U.S. Board on Geographic Names 1981).

Alakoko is the spelling most commonly used in the earliest references from the 1800s. Mālama Hulē‘ia board member Jan TenBruggencate has researched the many names that have been applied to this historic site:

> *Most people today call it the Menehune Fishpond and many folks use the name ‘Alekoko. However, Hawaiian Land Court records and Hawaiian language newspapers dating to the 1800s, in the earliest references, mainly use the spelling Alakoko. An 1852 Land Court document about lands in Niumalu, by surveyor W.H. Pease, refers to ka loko o Alakoko (the Alakoko fishpond). Issues of the newspapers Ka Leo o Ka Lahui and Nupepa Ka Oiaio from 1895 use Alakoko. In his 1923 book, Hawaiian Legends, William Hyde Rice, who was born on Kaua‘i in 1846, uses Alakoko. In her book Koamalu, Ethel Damon, who was born in 1883, uses Alakoko.*
>
> *The alternate spelling Alekoko, without the addition of the diacritical ‘okina before the first letter, is seen, though rarely, before 1900. Not the first, but among the first to use the spelling Alekoko was Thomas Thrum, who was not Hawaiian-born and not from Kaua‘i, in a 1920 edition of the Journal of the Polynesian Society. The term with the Alekoko spelling appears in a story he wrote involving Menehune. Thrum, originally*



Australian, was a storyteller and publisher, and a powerful voice in the recording of Hawaiian stories— including a fair amount of bogus Hawaiian history. After Thrum's use of the spelling, Alekoko becomes an alternate spelling to Alakoko.

The big fishpond in the bend in the river has also gone by the names Pēpēʻawa and even Niumalu loko. Pēpēʻawa, while it sometimes has been used to refer to the pond, is apparently the name of the ili (a land division of an ahupuaʻa) in which it is found. Niumalu loko may simply be a term of reference rather than a valid name. It means "Niumalu pond" and may be used to refer to Alakoko in the way "city by the bay" refers to San Francisco.

The term Menehune Fishpond, which has gained popularity during the past century, is a reference to a complex story about either the entire construction or just the completion of the fishpond wall project by mythical Hawaiian forest dwellers.

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Appendix 2
National Coastal Wetland Conservation Grant Ranking Criteria

In 2017, Mālama Hulēʻia successfully applied to the National Coastal Wetlands Conservation Grants Program. This program provides annual grants up to $1 million to coastal and Great Lakes states, as well as U.S. territories to protect, restore and enhance coastal wetland ecosystems and associated uplands.

The ranking criteria presented in this appendix was part of the grant application. It provides the data and outlines the needs, commitment, and anticipated results of the Alakoko loko iʻa restoration project. Including it in this plan provides the projectʻs commitments, including the 20-year commitment of ongoing stewardship to maintain the restoration areas.

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Malāma Hulēʻia. 2017. Application to the National Coastal Wetlands Conservation Grants Program. Unpublished document.

Section I Summary Information for Ranking National Coastal Wetlands Conservation Program

1. Wetlands conservation. Will the project reverse coastal wetland loss or habitat degradation in decreasing or stable coastal wetland types?

Mālama Hulēʻia's goal is the eradication of invasive mangrove (*Rhizophora mangle*) from the entire Hulēʻia River watershed in a series of phased projects. This project proposal (Phase I) removes approximately 38% of the mangrove from the entire Hulēʻia river watershed. It will address key threats to sensitive coastal ecosystems and species by implementing specific restoration actions. Restoration work will be within Alekoko fishpond and surrounding estuarine wetlands, consisting of a total 26-acres of mangrove removal and re-planting native vegetation on 14.9-acres of regionally decreasing estuarine intertidal wetlands (NWI Code: E2FO3N). The project will restore the wetland by removing invasive, non-native plants and planting native Hawaiian coastal estuarine vegetation. The acres (11.1) identified for mangrove removal that are not included in the revegetation plan are either expected to return to estuarine deep water subtidal wetlands (NWI Code: E1UBLh), sand bar at the river edge, or are part of the historic fishpond structure (rock wall and historic nursery walls), see Map J3 in Section J. While these areas are not part of the vegetation plan, they are included in our long-term monitoring and maintenance plan and provide key habitat and foraging for endangered waterbirds and migratory seabirds. Ongoing monitoring and maintenance of the entire project area will ensure that mangrove does not reestablish. Those acres not initially included in the vegetation plan will be adaptively managed and if found that some areas are better suited for revegetation, they will be included in our planting efforts. See Section J (J-1 – J-6) for maps and images of the project area, specifically, Map J-3 and J-5, for project area details.

Nationally, estuarine intertidal wetlands are decreasing (T. E. Dahl, USFWS) and this trend is found within the Hawaiian Islands as well. Wetlands comprise a small percentage of the land mass on the Hawaiian Islands. In the State of Hawaii, estimates of wetland area ranges from 1.3 to 2.7% of the total land area (Hoffman 1991). Estimates of wetland loss in Hawaii have ranged from 12 to 31%, but detailed analysis of pre-historical and historical land use patterns are needed to accurately quantify the wetland loss. Published estimates likely underestimate the original extent of wetland habitats as large-scale land use changes occurred shortly after European contact before many historical records were maintained. Approximately 75% of the remaining 6,190 ha (15,474 ac) of wetlands throughout the state are degraded by non-native invasive plant species and altered hydrology due to urbanization and agriculture (HWJV Strategic Plan 2006).

While the current classification of the wetland within the project area is a nationally recognized wetland type, a healthy, thriving estuarine intertidal wetland in Kauai does not include the invasive red mangrove. Throughout the Pacific where native ecosystems have evolved with mangrove swamps, they play an important role for protecting coastal areas from storm and wave damage, and act as a land-building agent as suspended silt settles and accumulates around mangrove swamps (Stemmermann 1981). However, there are no mangrove species native to the Hawaiian Islands and two non-native invasive species of mangroves have become prevalent and have altered the ecological function of native coastal salt marshes, tidal flats, and ancient Hawaiian fishponds. Mangroves have caused increased siltation in natural and man-made connections between wetlands or between fresh and saline water sources, thereby further altering hydrological processes (USFWS Pearl Harbor NWR CCP, 2010). Multiple studies (Demopoulos and Smith 2010, Diorio et.al 2007, Allen 1998, Alongi and Sasekumar 1992, Smith et. al. 2000, Simberloff 1995) as well as management plans (see Tables 3 and 4 in Criterion 4 and 5) address the threats and impact that the mangrove has made within the natural wetland systems. The success and rapid proliferation of introduced mangroves over the last century has created many environmental concerns such as the loss of habitat for four endangered Hawaiian waterbirds, loss of fisheries nursey grounds, destruction of historic fishponds, and restructuring of the coastal wetland ecosystem (Allen 1998; Cox and Allen

1999). This project will remove the invasive plants, restore a native plant ecosystem, and restore an ancient and culturally significant fishpond, Alekoko.

Table 1 Wetlands Conservation.

Project Area	Acres	Percent of Project Site
Estuarine intertidal (E2FO3N)* **	**23.4**	**84%**
Estuarine and Marine Deepwater (E1UBLh)	2.6	9%
Upland Area	2.0	7%
Total	28	100%

***Declining Wetland: Estuarine intertidal (E2FO3N)

2. Maritime forests on coastal barriers. Will the application significantly benefit maritime forests on coastal barriers?

This project is not eligible. Maritime forests are defined, for the purposes of this regulation, as broad-leaved forests that occur on barrier islands and along the mainland coast from Delaware to Texas.

3. Long-term conservation. Will the project ensure long-term conservation of coastal wetland functions? The project must provide at least 20 years of conservation benefits to be eligible.

With a long term license in place, Mālama Hulēʻia will manage and maintain the project for a minimum of 20 years and provide long term conservation benefits to the site and the entire Hulēʻia river. Mālama Hulēʻia will continue to realize the ultimate vision of eradicating mangrove from the entire watershed, which will contribute to this project's success in the long term. Mālama Hulēʻia has a strong community-based mission that is committed to eradicating the mangrove and restoring a native, healthy, functioning ecosystem.

This project contributes to implementation of a comprehensive restoration plan for the Hulēʻia River watershed to eradicate invasive mangrove ensuring the project benefits will be sustained into the future. Project activities will be effective for more than 20 years. Once mangrove is removed and native Hawaiian coastal wetland vegetation planted, Mālama Hulēʻia is committed to managing the long-term benefits provided by this grant by implementing our adaptive management plans including vegetation monitoring and maintenance, wildlife monitoring, predator control and volunteer/stewardship program. Mālama Hulēʻia has formed a Technical Advisory Committee (TAC), Table 2, for the purpose of having the most relevant expertise and input to the development of our adaptive management plans. In addition, consultation with all relevant government agencies will be done to ensure that the adaptive management plans complement and contribute to the successful restoration of habitat for the native, migratory, and threatened and endangered species that will utilize the restored wetland.

Table 2 Mālama Hulēʻia Technical Advisory Committee

Name and Organization	Expertise
Dr. Carl J. Berg, Mālama Hulēʻia Board President, Surfrider Foundation Board	Water quality, bird surveys, stream habitat enhancement, ecology
Mike DeMotta, National Tropical Botanical Garden	Native Hawaiian Plants, Nursery Consultation
Thomas Kaiakapu, DOFAW Kauai District Biologist	Wetland Biology, Predator Control, Wildlife Monitoring
Bill Lucey, Manager Kauai Invasive Species Committee (KISC)	Invasive Species, Predator Control, Leveraging Funds
Michael Mitchell (or alternate depending on expertise), Deputy Project Leader, Kauai National Wildlife Refuge Complex	Wetland Management, Endangered Waterbirds, Permitting
Mary J. Naone, (past) Lead Archaeologist DLNR SHPD	Archaeological Inventory Study
Kimberly Peyton, Research Scientist, DLNR DAR	Fish Habitat, Fish Surveys

Mālama Hulēʻia has estimated that the cost for the long-term management to be $360,000 for the 20 year period with support from long term funders as well as through partnerships (see Section K, Mālama Hulēʻia letter attachment, Stewardship Fund Plan for details). With our past project experience at Pu`ali wetland we know that community volunteers play an enormous role in contributing to successful long-term restoration. Mālama Hulēʻia is dedicated to maintaining a staff person (Hired June 5, 2017) to implement these management plans with the help of dedicated volunteers, agency partners and internship positions.

In addition to the long term (20-years with the option to extend) license agreement, there are a number of existing protection measures on the property. The property is within a Special Management Area, protected from development by County and State through layers of conservation including County zoning designation of Conservation, designated as Conservation Lands within the State Conservation District, as well as under the State and National Registry of Historic Places. Long term preservation and continued conservation of the site is enhanced due to its historical designation and significance of the site. Protections under the Special Management Area (SMA) requires a SMA permit, under enactment of Act 176, known as the Shoreline Protection Act. The permit is necessary to provide "…special controls on developments within an area along the shoreline are necessary to avoid permanent losses of valuable resources and the foreclosure of management options, and to ensure that adequate access, by dedication or other means, to public owned or used beaches, recreation areas, and natural reserves is provided." It is state policy to preserve, protect, and where possible, to restore the natural resources of the coastal zone of Hawaiʻi.

In addition to the SMA designation, the land is in a Conservation District, subzone as a resource, and zoned conservation within the County of Kauai. Under the Hawaii State Land Use Commission, Conservation lands are defined as lands in existing forest or water reserve zones and include areas necessary for protecting watersheds and water sources, scenic and historic areas, parks, wilderness, open space, recreational areas, habitats of endemic plants, fish and wildlife and all submerged lands seaward of the shoreline. Conservation Districts are administered by the State Board of Land and Natural Resources and uses are governed by rules promulgated by the State Department of Land and Natural Resources.

Under the State of Hawaii Conservation District Administrative Rule, 13-5-13, Resource (R) subzone is designated for specific uses. The objective of this subzone is to ensure, with proper management, the sustainable use of the natural resources of those areas (Auth: HRS §183C-3) (Imp: HRS §183C-4). Any change to that designation requires extensive action. Administrative Rules[1] are regulations established by the department through an extensive public review and hearing process. The procedure for administrative rules is set by Hawaiʻi Revised Statutes (HRS) Chapter 91. Should any change to the use of the land be proposed (or amended), it must be drafted by the department, approved by the Board of Land and Natural Resources (BLNR) for public meetings/hearings, and reviewed by the Department of the Attorney General (AG). Then the draft is taken out to public meetings and/or hearings, where the public can give formal testimony on the draft rule. The rule is revised, if necessary, and then submitted to the Board of Land and Natural Resources for final approval. Then it is reviewed again by the AG, and after signing by the Governor and filing with the Lieutenant Governor, it has the effect of law. Thus, the conservation status provides an additional regulatory layer of protection for the project.

Alekoko Fishpond was listed on the National Register of Historic Places, authorized under the United States Department of the Interior, National Park Service in 1972 as well as on the Hawaii Register of Historic Places under the State of Hawaii Department of Land and Natural Resources. The property has a level of protection under the State and National Registry of Historic Places. The historic significance of the site under the federal and state registry, in addition to the conservation designation and willingness of the current land owners, Okada

[1] Referenced from: http://dlnr.hawaii.gov/occl/rules/

Trucking LLC. to lease the property for the purposes of long term restoration maintenance, environmental monitoring and education and perpetuation of traditional Hawaiian practices. Mālama Hulēʻia has secured a long term license of the property to ensure that Mālama Hulēʻia has the legal permissions necessary to conduct long term maintenance and has oversight of recreational access on the site. The larger term goal of mangrove removal from the entire watershed will continue to be pursued, which will also assist in the efforts to restore the functions and values of the wetlands and river to support wildlife as well as traditional stewardship of the river watershed.

4. Coastal watershed management. Will the completed project help accomplish the natural resource goals and objectives of one or more formal, ongoing coastal watershed management plan or effort?

The project is a key piece in coastal watershed management for the Nawiliwili watershed on Kauai. The Hulēʻia River comprises the largest portion of the Nawiliwili Bay watershed and has tidal saltwater influence for over two miles upstream from Nawiliwili Bay. The lower reach of the river and fishpond provide an important estuarine environment and nursery ground for many fish and crustacean species, and are crucial as endemic and migratory habitat. The Hulēʻia NWR abuts the Alekoko fishpond acreage in the lower reaches of the river (see Section J for map). The removal of the invasive red mangrove coupled with native wetland restoration within the Hulēʻia river is an essential management strategy for the recovery of Hawaii's endemic endangered water birds as well as efforts to restore the ecological function and water quality of the Nawiliwili watershed. This section identifies those plans and efforts that address the project need (Table 3).

A three-phase study was completed to assess the status of the Nawiliwili Watershed on Kauai and develop recommendations for restoration and protection (State Hawaii Department of Health, 2004). Strategies to improve functions and values of the watershed, as well as impacts were presented. This project supports the recommendations found in the report. It was found that mangrove contribute a significant amount of organic material to the streams, thereby increasing turbidity and nutrient concentrations and decreasing oxygen levels. Additionally, the extensive root system extending from these plants into the stream slows water flow and traps sediment. An anoxic environment, unsuitable for Hawaiian species, forms a degraded ecosystem among the roots. This leads to the filling in of the river and fishpond with sediment and its transformation from a tidal wetland to a supra-tidal mangrove forest ecosystem. This eliminates critical habitat used by native water birds and migratory shorebirds. The rock walls of the fishpond are being torn apart by the mangrove roots, and the estuary itself seems to be shrinking in size as the mangrove continues to spread into the fishpond open waters. It no longer provides suitable nursery grounds for native fishes and crustaceans.

The table below provides a summary of the other management plans that support the project. These management plans (Table 3) collectively recommend the restoration of native ecosystems that support the lifecycles of threatened, endangered, resident, and migrant species. Removal of invasive species is a key first step in that process. Together the management plans support the Nawiliwili Watershed studies and support efforts to continue the native habitat restoration of the entire Hulēʻia river.

Table 3 Project Benefits to Existing Management Plans

Management plan or effort	How this project helps implement plan goals
County and State Plans (*specifically mentions Hulēʻia River or Alekoko Fish Pond)	
*Assessment and Protection Pan for the Nawilwili Watershed: Phases 1-3 – Restoration and Protection Plan, 2014 State of Hawaii Department of Health Clean Water Branch	A three-phase study was completed to assess the status of the Nawiliwili Watershed on Kauai and develop recommendations for restoration and protection. Hulēʻia river is one of the rivers within the watershed, and the study looked at the nine elements the U.S. EPA requires for a watershed based plan to address Section 319 of Section 303(d) of the federal Clean Water Act for listed waters. The Plan recommends the removal of the red mangrove and restoration with native plants as a key strategy to address the nine elements required

	by the U.S. EPA.
**Pacific Coast Joint Venture Hawaii*, Strategic Plan for Wetland Conservation in Hawaii, January 2006	The Plan provides recommended actions for the Hulēʻia river and recommends that the stream should be managed as a complex of wetland habitats. To be able to do this, mangrove removal is recommended to open up habitat for endangered Hawaiian waterbirds and to restore the ancient cultural resources at "Menehune" (Alekoko) Fishpond.
USFWS Revised Recovery Plan for Hawaiian Waterbirds; second revision (2011)	Addresses four species of Hawaiian waterbirds: the Hawaiian duck or koloa maoli (*Anas wyvilliana)*, Hawaiian coot or ʻalae keʻokeʻo (*Fulica alai)*, Hawaiian common moorhen or ʻalae ʻula (*Gallinula chloropus sandvicensis*), and Hawaiian stilt or aeʻo (*Himantopus mexicanus knudseni)*, all listed as endangered. The project supports USFWS Waterbird Recovery Objective 1.3.2.2 - Control undesirable plant species. Undesirable plants, mainly introduced species such as…*Rhizophora mangle* (red mangrove), make wetlands less useful or unusable for waterbirds (Morin 1996, 1998; Rauzon and Drigot 2002; Chimner et al. 2006) These plants should be eliminated, where feasible, or controlled. Restored habitat will increase numbers by providing additional nesting, foraging and loafing areas and improving nesting success. Wetland restoration, including out-planting native species is listed as recovery objectives.
Hawaii's State Wildlife Action Plan (2015)	The Strategy calls for maintaining, protecting, and restoring native ecosystems and native species and combating introduced invasive species. The invasive mangrove is called out in numerous locations noting that it reduces open water, mudflats, or shallows, all key to the life cycle of Hawai'i's endangered waterbirds. Removing and controlling mangrove is a management strategy for State owned wetlands, and key to the recovery of the endangered waterbirds. The document lists Hawaiian goose, duck, moorhen, coot, and stilt as species of greatest conservation needs, and lists wetland restoration and conservation as important conservation actions for recovery of these species.
Hawaii Coastal and Estuarine Land Conservation Plan	Addresses the importance of estuarine systems and the need to protect and conserve. The proposed project is consistent with the goals and objectives. It recognizes that sheltered coastal wetlands in Hawaii support numerous unique plant and animal communities, and species dependent on Hawaiian estuaries are unusual in their ability to tolerate highly variable water quality conditions and significant sediment inputs
USFWS Multi-Island Plants Recovery Plan.	Lists alien animals and plants as one of the primary causes of the historical declines on the Multi-island cluster taxa, and the presence of these introduced species as the continued primary threats to their survival and recovery.
Hawaii Fish Habitat Partnership. 2010. Hawaii Fish Habitat Partnership Strategic Plan. Honolulu, HI. 24 pp.	Many of the important euryhaline species that are found in the Hulēʻia River/Alekoko Fishpond are transient and utilize the fishpond and nearby waters as primarily juveniles, these include: papio (blue trevally, white ulua), ʻamaʻama (striped mullet), Marquesan mullet (*Valamugil englei*), awa (milkfish), toau (blacktail snapper), and others (Table 2). These species generally avoid waters invaded by mangrove,

	and restoration of suitable habitat for these species will enhance community productivity within the Hulēʻia River/Alekoko Fishpond project area and, as these transient fish mature, will move on to repopulate nearby open coastal waters and coral reefs.
Regional and National Plans	
US Coastal Program Strategic Plan	The Plan identifies restoration of coastal wetlands for the benefit of endangered waterbirds, within the Hawaii Focus Area, as a high priority.
Ducks Unlimited Conservation Plan (2001)	Hawaiian wetlands are identified as a "High" priority for wetland conservation activities.
*North American Waterbird Conservation Plan (*2002)	Calls for restoration and protection of habitats that support the life cycle needs of water birds, including endangered waterbirds.
*Migratory Bird Program Strategic Plan (*2004)	Seeks to protect, restore, and manage migratory bird habitats such as the Hulēʻia watershed.
U.S. Pacific Islands Regional Shorebird Conservation Plan (2004)	Calls for high quality habitat to ensure that shorebirds in the region are not unduly limited by habitat availability and directs that efforts to provide habitat for shorebirds are integrated into multiple species habitat management initiatives.

5. Conservation of threatened and endangered species. Will the project benefit any federally listed endangered or threatened species, species proposed for Federal listing, recently delisted species or designated or proposed critical habitat in coastal wetlands? Will it benefit State-listed species?

The Hulēʻia River and associated estuarine and marine wetlands provide habitat for endemic waterbirds, migratory birds, and shorebirds. Removal of the mangrove and restoration 26-acres of native wetland habitat will benefit the state and federally listed endangered Hawaiian waterbirds including the Hawaiian duck (koloa maoli, *Anas wyvilliana),* Hawaiian coot (ʻalae keʻokeʻo, *Fulica alai),* Hawaiian morehen (ʻalae ʻula, *Gallinula chloropus sandvicensis)*, and the Hawaiian stilt (aeʻo, *Himantopus mexicanus knudseni)*." The Hawaiian goose (*Branta sandvicensis*) will also benefit as it frequents the adjacent lands on Hulēʻia NWR. The federally endangered Hawaiian hoary bat (*Lasiurus cinereus semotus)* is found within the Hulēʻia NWR and it is expected to benefit from the habitat restoration. Conservation of important lowland coastal habitat for foraging is essential for the recovery of the Hawaiian hoary bat (USFWS 1998).

Expanding foraging and nesting areas for the endangered species addresses the Draft Revised Recovery Plan for Hawaiian Waterbirds (USFWS 2011). See Table 4, below, for a summary of anticipated benefits. According to the U.S. Fish and Wildlife Service (2015-TA-0426 letter), the following species are known to occur or transit through the vicinity of the project area: Hawaiian stilt (aeʻo, *Himantopus mexicanus knudseni),* Hawaiian moorhen (ʻalae ʻula, *Gallinula chloropus sandvicensis)*, Hawaiian coot (ʻalae keʻokeʻo, *Fulica alai),* Hawaiian duck (koloa maoli, *Anas wyvilliana),* and the Hawaiian goose (*Branta sandvicensis*). The project site is located adjacent to Hulēʻia NWR (Map J2 in Section J), whose purpose is to "conserve (A) fish or wildlife which are listed as endangered species or threatened species." 16 U.S.C. § 1534 (Endangered Species Act of 1973). The focus of Refuge management is habitat restoration and creating infrastructure, primarily for water management, to expand wetland functions throughout the Refuge and support conservation and recovery of the listed species that occur there. A key requirement to restore functioning wetlands is to remove the invasive species, such as red mangrove, and replant with native wetland plants that improve water management, provide the wetland foraging and nesting habitat to support the endangered Hawaiian waterbirds. Approximately 30 acres of wetland are currently being managed at Hulēʻia NWR, which comprises 240 total acres of wetland. This project will increase the appropriate wetland habitat by 14.9 acres, and support conservation and recovery of the listed species that are known from this area. As the proposed site abuts Hulēʻia NWR, has no fenced boundaries with the refuge, is part of the same river system, and the endangered waterbirds, bat, and migratory birds are known

to be in the area, we expect the endemic waterbirds, migratory birds, shorebirds, and bat to greatly benefit from habitat expansion.

The 2015 Hawaii State Wildlife Action Plan (SWAP) identifies potential areas for enhanced conservation management. These are areas where additional efforts are needed for the long-term conservation of Kauai's native wildlife. Hulēʻia stream and associated watershed were called out as core or supporting wetlands for Hawaiian duck (koloa maoli, *Anas wyvilliana),* Hawaiian coot (ʻalae keʻokeʻo, *Fulica alai),* Hawaiian morehen (ʻalae ʻula, *Gallinula chloropus sandvicensis)*, and the Hawaiian stilt (aeʻo, *Himantopus mexicanus knudseni)*, the Hawaiian goose (*Branta sandvicensis*), Pacific golden plover (kolea*, Plusvialis fulva)*, ruddy turnstone (ʻakekeke *Arenaria interpres*), sanderling (hunakai *Calidris alba*), freshwater fishes, and freshwater invertebrates. They recognized that the implementation of the Waterbird Recovery Plan with the management of additional wetland habitat through coordination with private or public landowners, removal of invasive plants, and institution of predator control was needed. This project would be working to implement these recommendations. Mālama Hulēʻia will be removing the invasive red mangrove, restoring lost mud flats with native wetland plants, and is working with the private landowner as a long term conservation manager for the project site. Table 4 provides an overview of the endangered species and how the project supports their recovery.

Table 4 Alekoko Restoration Project T&E Species and Benefits Summary

Threatened and Endangered Species at Alekoko - Benefits Summary				
Common Name *Scientific Name*	**Status**	**Mangrove Removal/Wetland Restoration Benefits**	**Does the project support the Recovery Goal*?**	**Specific Recovery Objectives** Implemented**
Hawaiian stilt *Himantopus mexicanus knudseni* Hawaiian moorhen *Gallinula chloropus sandvicensis* Hawaiian coot *Fulica alai*	FE SE	This action supports USFWS Waterbird Recovery 1.3.2.2 Control undesirable plant species. Undesirable plants, mainly introduced species such as…*Rhizophora mangle* (red mangrove), make wetlands less useful or unusable for waterbirds (Morin 1996, 1998; Rauzon and Drigot 2002; Chimner et al. 2006) These plants should be eliminated, where feasible, or controlled. Restored habitat will increase numbers by providing additional nesting, foraging and loafing areas and improving nesting success. The Hawaii State Wildlife Action Plan identifies Hulēʻia stream and associated watershed restoration and protection as needed for the long-term conservation of the Hawaiian coot, moorhen, and stilt.	Yes, and supports the Hawaii State Wildlife Action Plan (2015) that specifically calls for the removal of red mangrove within the Hulēʻia river	2, 3, and 4
Hawaiian duck *Anas wyvilliana*	FE/SE	This action supports Recovery 1.3.2.2 Control undesirable plant species. Undesirable plants, mainly introduced species such as…*Rhizophora mangle* (red mangrove), make wetlands less useful or unusable for waterbirds (Morin 1996, 1998; Rauzon and Drigot 2002; Chimner et al. 2006). Restored habitat will provide food for	Yes	2, 3, and 4

		foraging areas. The Hawaii State Wildlife Action Plan identifies Hulēʻia stream and associated watershed restoration and protection as needed for the long-term conservation of the Hawaiian duck.		
Hawaiian hoary bat *Lasiurus cinereus semotus*	FE SE	Conservation of important lowland coastal habitat for foraging.	Yes	1998 Recovery Plan for the Hawaiian Hoary bat goal of protecting key foraging areas.
Hawaiian goose *Branta sandvicensis* nēnē	FE SE	The Hawaii State Wildlife Action Plan identifies Hulēʻia stream and associated watershed restoration and protection as needed for the long-term conservation of the Hawaiian goose.		

USFWS Recovery Plan for Hawaiian Waterbirds*Recovery Goal: The ultimate goal of the recovery program for Hawaiian waterbirds is to restore and maintain multiple self-sustaining populations within their respective historical ranges, which will allow them to be reclassified to threatened status (downlisted) and eventually removed from the Federal List of Endangered and Threatened Wildlife and Plants (delisted)

****Recovery Objectives**: Recovery of the four endangered waterbirds focuses on the following objectives:

1. Ensuring that population numbers are large enough to persist into the forseable future in the face of stochastic demographic variability;
2. Establishing multiple, self-sustaining breeding populations broadly distributed throughout each species' historical range to insure against population declines from localized demographic stresses;
3. Establishing and protecting a stable network of both core and supporting wetlands that are managed as habitat suitable for waterbirds, including the maintenance of appropriate hydrological conditions and control of invasive non-native plants;
4. Eliminating or controlling the threats posted by introduced predators, conditions that promote avian diseases, and contaminants to a sufficient degree for populations to be self-sustaining and
5. Specifically for the Hawaiian duck, removing the threat of hybridization with domestic mallards.

6. Benefits to fish. Will the project provide, restore or enhance important fisheries habitat?

Coastal wetlands adjacent to stream-mouth estuaries and historic fishponds in Hawaii have been severely degraded in recent decades as a result of encroachment of non-native woody vegetation, particularly red mangrove and hau bush. The prolific growth of these species results in altered hydrology and degraded water quality. In the case of Hulēʻia River/Alekoko Fishpond, waters that were historically open and circulating freely have become occluded by a thick overgrowth of mangrove. These reaches are now completely shaded by a dense canopy cover interspersed with trunks and prop roots. These areas lack water circulation and accumulate enormous amounts of leaf litter which create persistent anoxic conditions in the benthos and adjacent water column. All of these changes severely limit development of diverse and healthy fish and invertebrate communities.

This project will result in restoration and enhancement of estuarine and coastal wetland habitats that historically supported a variety of recreationally, commercially, and culturally important fish and invertebrates. Many of the important euryhaline species that are found in the Hulēʻia River/Alekoko Fishpond are transient and utilize the fishpond and nearby waters as primarily juveniles, these include: papio (blue trevally, white ulua), ʻamaʻama (striped mullet), Marquesan mullet (*Valamugil englei*), awa (milkfish), toau (blacktail snapper), and

others (Tables 6, 7). These species generally avoid waters invaded by mangrove, and restoration of suitable habitat for these species will enhance community productivity within the Hulēʻia River/Alekoko Fishpond project area and, as these transient fish mature, will move on to repopulate nearby open coastal waters and coral reefs. Table 5, below, provides a summary of the fish species likely to occur, and known to occur within the Hulēʻia River and Alekoko fishpond. References include personal communication and observation by aquatic biologists (Don Heacock, State DLNR DAR, and Dr. Carl Berg, consultant), surveys at the Hulēʻia NWR by USFWS staff, and the Atlas of Hawaiian Watersheds.

Table 5 – Fish and Invertebrates at Hulēʻia NWR and nearby waters

Scientific Name	Common Name	Hawaiian Name	Status
Fish			
Eleotris sandwicensis	Hawaiian sleeper	O'opu akupa	Endemic
Awaous stamineus	Stream goby	ʻOʻopu nākea	Endemic
Stenogobius hawaiiensis	Freshwater goby, naniha goby	O'opu naniha	Endemic
Kuhlia xenura	Hawaiian flagtail	ʻāholehole	Endemic
Kuhlia sandvicensis	Reticulated flagtail	ʻāholehole	Endemic
Mugil cephalus	Flathead mullet	ʻAma'ama	Indigenous
Chanos chanos	Milkfish	Awa	Indigenous
Sphyraena helleri	Barracuda	Kawele'a	Indigenous
Elops hawaiensis	Hawaiian tarpon		Indigenous
Caranx ignobilis	White ulua		Indigenous
Lutjanus fulvus	Toau (juv)		Introduced
Gambusia affinis	Mosquitofish		Introduced
Poecilia sphenops	Mexican molly		Introduced
Clarius fuscus	Chinese catfish		Introduced
Neomyxus leuciscus	Sharp-nosed mullet		Introduced
Oreochromis mossambicus	Mozambique tilapia		Introduced
Sarotherodon melanotheron	Black chin tilapia		Introduced
Tilapia zillii	Redbelly tilapia		Introduced
Invertebrates			
Atyoida bisulcata	Hawaiian prawn	`opae kala`ole	Endemic
Macrobrachium grandimanus	Hawaiian prawn	`opae `oeha`a	Indigenous
Gonodactylus spp	Mantis shrimp	Aloalo	Indigenous
Thalamita spp		Alei'eke	Indigenous
Charybdis hawaiiensis		Kuhonu	Indigenous
Thalamita crenata	Blue-pincher crab		Indigenous
Macrobrachium lar	Tahitian prawn		Introduced
Procambarus clarkii	Red swamp crawfish		Introduced
Metopograpsus thukuhar		Alamihi	Introduced
Scylla serrata	Samoan crab		Introduced

All of Hawaii's stream fish and larger invertebrates are diadromous and are dispersed downstream to seawater as larvae and then undertake an upstream migration to suitable river and stream habitat as returning juveniles. Populations of these stream fish and invertebrates are widely recognized as depleted. The restoration of natural flow conditions in the Hulēʻia River portion of the proposed project area will improve both adult resident habitat

and migratory pathways used by native freshwater and estuarine fish known from the Hulēʻia River and its tributaries. These include ʻoʻopu akupa (*Eleotris sandwicensis*) ʻoʻopu naniha (*Stenogobius hawaiiensis*),ʻoʻopu nakea (*Awaous stamineus*), ʻopae oehaa (*Macrobrachium grandimanus*), hapawai (*Neritina vespertina*).
The State of Hawaii Department of Land and Natural Resources (DLNR) Division of Aquatic Resources (DAR) is currently conducting a fisheries study on estuaries throughout the state, including the Puali Stream pilot project area, to determine the impact and benefits of mangrove removal and native habitat restoration for juvenile stages of important fish species. We continue to work closely with the DAR estuary team to utilize their study methodology and data collection at the proposed project site in order to measure the impact and benefits of our restoration efforts to the fishery resources.

Table 6 Fish Species, Habitat Type and Benefits

Fish Species	Habitat Types & Benefits
Mugil cephalus , *ʻamaʻama*, Striped Mullet	Indigenous herbivorous fish that prefers shallow estuarine habitat as juveniles and also utilizes these areas as adults for shelter and grazing. Open shallow habitat allows more growth of *limu*, or algae, which is a primary food source for this species; prized culturally and as a food fish in Hawaii.
Eleotris sandwicensis – ʻoʻopu akupa, Sandwich Island Sleeper	Endemic goby that is common throughout shallow open habitat in Hawaiian estuaries and stream mouths throughout Hawaii; targeted as a food fish and as bait
Caranx ignobilis, ulua aukea, Giant Trevally	Indigenous predatory fish that utilizes protected estuarine habitats primarily as juveniles; feeds on small fishes and crustaceans in these habitats; highly prized as a sport fish and food fish in Hawaii; open habitat in the fish pond would provide more foraging area for this species.
Caranx melampygus, omilu, Blue Trevally	Indigenous predatory fish that utilizes protected estuarine habitats primarily as juveniles; feeds on small fishes and crustaceans in these habitats; highly prized as a sport fish and food fish in Hawaii; open habitat in the fish pond would provide more foraging area for this species.
Kuhlia xenura, āholehole, Hawaiian Flagtail	Endemic fish, common in estuarine habitat as juveniles and adults; highly prized as a food fish; open shallow areas would provide more foraging area and habitat, especially for juveniles.
Chanos chanos, Awa, Milkfish	Indigenous fish, common in estuarine habitat as juveniles and adults; highly prized as a food fish; open shallow areas would provide more foraging area and habitat, especially for juveniles.
Scylla serrata, Samoan crab,	Large introduced crab common in estuarine habitat and comprising subsistence and recreational fishery in Hawaii. A top predator and scavenger it moves between estuary and reef flats in its natural habitat. It inhabits both mangrove and open areas in Hulēʻia estuary.
Thalamita crenata,. Blue-pincher crab	Large indigenous swimming crab common in estuaries. Forms a subsistence and recreational fishery in same areas as Samoan crab. Mangrove removal will increase suitable habitat in submerged wetlands.

7. Benefits to coastal-dependent or migratory birds. Will the project provide, restore, or enhance important habitat for coastal-dependent or migratory birds?

The project will provide benefits to coastal-dependent and migratory birds by restoring habitat and long term habitat protection and predator control. Table 7, below provides a summary of the bird species observed on the Hulēʻia NWR. Table 8 provides a list of bird species observed at Alekoko fishpond through the annual state bird surveys. Waterbirds and migratory shorebirds in Hawaii utilize coastal wetland habitat, with 80 percent of the state's koloa maoli (*Anas wylvilliana* [Hawaiian duck]) population, and 50 percent of the state's nēnē (*Branta sandvicensis* [Hawaiian goose]) population are found on Kauaʻi (SWAP 2015). The 2015 SWAP identifies Hulēʻia stream and associated watershed as core or supporting wetlands for Hawaiian duck (koloa maoli, *Anas wyvilliana),* Hawaiian coot (ʻalae keʻokeʻo, *Fulica alai),* Hawaiian morehen (ʻalae ʻula, *Gallinula chloropus sandvicensis)*, the Hawaiian stilt (aeʻo, *Himantopus mexicanus knudseni)*, the Hawaiian goose (*Branta sandvicensis*), Pacific golden plover (kolea*, Plusvialis fulva)*, ruddy turnstone (ʻakekeke *Arenaria interpres*), and sanderling (hunakai *Calidris alba*). Most of these species have been recorded at the restored Puali stream wetland. The implementation of the Waterbird Recovery Plan recommends the management of additional wetland habitat through coordination with private or public landowners, removal of invasive plants, and institution of predator control. The project will be working to implement these recommendations. We expect to see a similar list of species as Table 7 once the project restores native wetland habitat at Alekoko fishpond.

Table 7 Observed Birds at Hulēʻia NWR

Scientific Name	***Common Name***	***Hawaiian Name***	****Status***
Asio flammeus sandwichensis	*Hawaiian short-eared owl*	*pueo*	End
Branta sandvicensis	*Hawaiian goose*	*nēnē*	End, E
Anas wyvilliana	*Hawaiian duck*	*koloa maoli*	End, E
Gallinula chloropus sandvicensis	*Hawaiian moorhen*	*ʻalae ʻula*	End, E
Fulica alai	*Hawaiian coot*	*ʻalae keʻokeʻo*	End, E
Himantopus mexicanus knudseni	*Hawaiian stilt*	*aeʻo*	End, E
Nycticorax nycticorax	*Black-crowned night-heron*	*ʻaukuʻu*	Ind
Anas platyrhynchos	*Mallard*		Mig
Fregata minor	*Great frigatebird*	*ʻiwa*	Mig
Ardea alba	*Great egret*		Mig
Anser albifrons	*Greater white-fronted goose*		Mig
Branta bernicla	*Black brant*		Mig
Branta hutchinsii	*Cackling goose*		Mig
Branta canadensis	*Canada goose*		Mig
Anas strepera	*Gadwall*		Mig
Anas penelope	*Eurasian wigeon*		Mig
Anas americana	*American wigeon*		Mig
Anas discors	*Blue-winged teal*		Mig
Anas cyanoptera	*Cinnamon teal*		Mig
Anas clypeata	*Northern shoveler*	*koloa mohā*	Mig
Anas acuta	*Northern pintail*	*koloa māpu*	Mig
Anas carolinensis	*Green-winged teal*		Mig
Aythya valisineria	*Canvasback*		Mig
Aythya americana	*Redhead*		Mig
Aythya collaris	*Ring-necked duck*		Mig
Aythya marila	*Greater scaup*		Mig

Aythya affinis	*Lesser scaup*		Mig
Bucephala albeola	*Bufflehead*		Mig
Pluvialis squatarola	*Black-bellied plover*		Mig
Pluvialis fulva	*Pacific golden-plover*	*kōlea*	Mig
Tringa incana	*Wandering tattler*	*ʻūlilī*	Mig
Tringa flavipes	*Lesser yellowlegs*		Mig
Arenaria interpres	*Ruddy turnstone*	*ʻakekeke*	Mig
Calidris alba	*Sanderling*	*hunakai*	Mig
Calidris melanotos	*Pectoral sandpiper*	*upupā*	Mig
Calidris acuminata	*Sharp-tailed sandpiper*	*upupā*	Mig
Limnodromus scolopaceus	*Long-billed dowitcher*		Mig

* Status Definitions (from *Hulēʻia NWR)* End=endemic, E=endangered, Ind=indigenous Mig=Migratory

Table 8, below, provides a summary of the birds observed within Alekoko Fishpond from the State DLNR DOFAW's annual bird counts. These birds have been observed on the project site. It is anticipated that a restored, native ecosystem will support the species that are found adjacent, and are known in the area.

Table 8 – Species Observed During Hawaii DLNR Annual Bird Surveys

Taxon Name	Common Name
Bubulcus ibis	Cattle Egret
Gallinula galeata sandvicensis	*ʻAlae ʻula,* moorehen
Anas wyvilliana koloa	*Koloa,* (Hawaiian duck)
Nycticorax nycticorax,	*aukuʻu (*night heron)
Himantopus mexicanus knudseni	*Aeʻo,* Hawaiian stilt
Fulica alai	*ʻAlae ke ʻokeʻo,* Hawaiian coot

Mālama Hulēʻia will be removing the invasive red mangrove, restoring lost mud flats and native wetland plants, and is working with the private landowner on long term management. This will lead to habitat for various life stages and needs of migrant, migratory, and coastal dependent birds. Table 9, below, provides a summary of the benefits to each specific migratory bird. We anticipate that the restoration of native habitat will benefit the life cycles and recovery.

Table 9 Migratory Birds - species of greatest conservation need, Hawaii State Wildlife Action Plan

Migratory Birds	Species Status	Habitat/Life cycle benefit	
Kolea (Pacific golden plover) *Pluvialis fulva*	State recognized as Indigenous U.S. Shorebird Conservation Plan - High concern	Protect (or expand) habitat for wintering in Hawaii. Restored habitat will increase numbers by providing additional foraging and loafing areas.	M N U
ʻAkekeke (Ruddy turnstone) *Arenaria interpres*	State recognized as Indigenous U.S. Shorebird Conservation Plan—High Concern	Protection of coastal habitat. Restoration of additional coastal habitat, continued protection and management of wildlife refuges.	M N U
Koloa mapu (Northern pintail) *Anas acuta*	State recognized as Indigenous	Protection of current habitat. Restoration of additional wetland habitat, especially where it can be reclaimed from abandoned agricultural uses.	M N

Koloa moha (Northern shoveler) *Anas clypeata*	State recognized as Indigenous	Protect and restore habitat to include a preferred food availability koloa mōhā are adapted to a diet primarily of aquatic invertebrates such as water fleas (Daphnia spp.) and crustaceans (copepods and ostracods)	M N
Lesser scaup *Aythya affinis*	State recognized as Indigenous	Protection of current habitat. Restoration of additional wetland habitat, especially where it can be reclaimed from abandoned agricultural uses. Restored habitat will increase numbers by providing additional foraging and loafing areas.	M N
Huna kai (Sanderling) *Calidris alba*	State recognized as Indigenous	Protection of habitat. Huna kai will benefit from an increase in mudflats and river banks.	M N U
ʻUlili (Wandering tattler) *Heteroscelus incanus*	State recognized as Indigenous U.S. Shorebird Conservation Plan—Moderate concern	Protection of current habitat. Protection and restoration of additional wetland habitat. ʻUlili will benefit from an increase in mudflats and river banks.	M N U
American wigeon *Anas americana*	State recognized as Indigenous	Degradation of habitat due to pollution, hydrology alteration, or invasions by alien species is a major threat. Restoring wetlands and protecting habitat.	M N

Recovery Plan Key:

M: Migratory Bird Program Strategic Plan seeks to protect, restore and manage migratory bird habitats.

N: 2002 North American Water Bird Conservation Plan – Calls for restoration and protection of habitats that support the lifecycle needs of water birds, including endangered waterbirds.

U: U.S. Pacific Islands Regional Shorebird Conservation Plan (2004) – Calls for high quality habitat to ensure that shorebirds in the region are not unduly limited by habitat availability.

8. Prevent or reduce contamination. Will the project prevent or reduce input of contaminants to the coastal wetlands and associated coastal waters that are already contaminated?

The primary goal of the proposed project is the removal of highly invasive mangrove and rebuilding of a biologically diverse Hawaiian intertidal estuarine wetland ecosystem, with all of its ecological services and functions; but a valuable ancillary effect will be improving water quality and water flow in Alekoko fishpond and its waters discharging in to the Hulēʻia estuary.

Alekoko fishpond is in the lower reaches of the Hulēʻia River and is set off from the river itself by an ancient Hawaiian rock wall. There are no known outside sources of contaminants from the land surrounding the fishpond. Sugar agriculture, the only industry of note in the upper reaches of the watershed, stopped in 2000. The land abutting Alekoko fishpond upstream and inland from the river is the Hulēʻia NWR (Map 2). Land inland from the fishpond is steep fallow former sugar land. Land immediately downstream is light urban. The has been no wetland fill by major debris, only minor urban garbage (bottles and cans) that will be removed along with mangrove propagules, wood, and weeds after cutting of the mangrove. No agriculture or livestock will occur on property surrounding the fishpond, in Hulēʻia NWR, or the steep slopes going inland from the fishpond.

Hulēʻia River is a EPA 303(d) listed watershed within the 2016 State of Hawaii Water Quality Monitoring and Assessment Report. Hulēʻia river is listed for exceeding: NO3+NO2, TN, turbidity and enterococcus bacteria. A Total Maximum Daily Load (TMDL) report comprises Hulēʻia River and the other streams (2008). Although

polluted by state standards, the lower reach of the river and fishpond provide an important estuarine environment and nursery ground for many fish and crustacean species, and are crucial as waterbird habitat.

Demopoulos (2004) found that invasive mangrove in Hawaii export more organic matter (leaf, wood, flowers, propagules) than in their native habitats (Puerto Rico), with very little particulate organic carbon retained in the soil. With low flushing rates in the fishpond, mangroves contribute a significant amount of organic matter in to the water column, thereby increasing turbidity and nutrient concentrations and decreasing oxygen levels. Extensive root systems extending from these plants into the stream slows water flow and traps leaf litter and sediment. An anoxic environment, unsuitable for Hawaiian species, forms a degraded ecosystem among the roots (Demopoulos, 2004). This leads to the filling in of the river and fishpond with litter and sediment and its transformation from a tidal wetland to a supra-tidal mangrove forest ecosystem, which eliminates critical habitat used by native waterbirds and migratory shorebirds. Culturally important rock walls of the fishpond are being torn apart by mangrove roots, and the estuary itself seems to be shrinking in size as the mangrove continues to spread into the fishpond open waters.

Mangrove (26 acres) will be removed by cutting the roots below the mean high tide level, thus causing the roots to rot away without regeneration. Recruitment of new seedlings into the fishpond from upstream will be controlled by a floating boon and suspended mesh in the wall gate opening. Periodic (bi-monthly) manual picking of newly set seedlings will also keep mangrove from re-establishing. School groups have been shown to be especially effective at mangrove “weeding”.

A three-phase study was completed to assess the status of the Nawiliwili Watershed on Kauai and develop recommendations for restoration and protection (State Hawaii Department of Health, 2004). The study addressed the recommended steps needed to improve the water quality to de-list and meet TMDL standards. Restoration of the wetland is one of the key steps in this process. Strategy 5 within the Nawiliwili Watershed plan is to control invasive and non-native species. The study noted that red mangrove is an invasive species targeted for removal.

While removal of mangrove from the rock wall may have little impact on the entire Hulēʻia River water quality, mangrove removal and wetland restoration within the fishpond should have a demonstrable effect on water oxygen levels, turbidity and nutrients in the fishpond. Water enters the fishpond through the permeable rock wall and through an opening approximately mid-way along the length of the wall. Water exits through the wall, over a low portion of the downstream wall and through a channel at the most downstream portion of the fishpond. No hydrographic studies have yet been done to quantify flow and flushing rates of the fishpond. Measurements will be done throughout the project to quantify the effects of mangrove removal and wetland restoration on key water quality parameters.

Invasive animal species (e.g. feral pigs, dogs, cats, rats) are contaminants that could have a major impact on the wetland ecosystem and particularly target the waterbirds. In addition to being predators *per se*, such animal species carry parasitic diseases e.g. toxoplasmosis that is known to affect Hawaiian geese, ducks and coots. There are active predator control programs on Kauai by the State Department of Land and Natural Resources (DLNR)-Kauai Invasive Species Committee, DLNR-Division of Forestry and Wildlife, and by USFWS at the abutting Hulēʻia NWR. While the members of those groups will provide local specific expertise, we are asking them to include our project area in their ongoing predator control efforts. We are committed to long-term invasive species and predator control as an important aspect of project management and maintenance. Mālama Hulēʻia will develop the monitoring and predator control program with the members of the Technical Advisory Committee, made up of local State and Federal subject matter experts. Consultation with the agencies will also be done to ensure success.

Removal of the mangrove trees increases sunlight to water, water flow and oxygenation, and thus helps control invasive mosquito populations and the diseases they carry that are known to affect birds on Kauai e.g. avian malaria (Plasmodium relictum), and avian pox (avipoxvirus) but that rarely affect waterbirds. The prevalence of

avian botulism (Clostridium botulinum) which is devastating to Hawaiian ducks, coots and moorhens on Kauai, will also be reduced by better water flow.

While there are numerous invasive plant species on the dryland edges of the fishpond, it is the red mangrove that dominates the intertidal wetlands, with little else growing there. Sea hibiscus (Hibiscus tiliaceus, known as Hau in Hawaii) is an invasive Polynesian introduction that forms dense thickets on dry land adjacent to the mangrove. While it extends branches in to the water, it does not root in intertidal areas. While we may trim Hau as it occurs intertwined with mangrove, we will not be clearing the dryland areas. Invasive grasses and other weeds will be pulled up from the newly exposed mudflats.

9. Catalyst for future conservation. Will the project leverage other ongoing coastal wetlands conservation efforts in an area or provide additional impetus for conservation?

This project proposal is designed to leverage and expand upon ongoing coastal wetlands protection and management in the area including the efforts to conserve threatened flora and fauna at the Hulēʻia NWR. The proposed project will catalyze Mālama Hulēʻia's efforts of eradicating invasive mangrove along the Hulēʻia river by removing approximately 38% of the total watershed mangrove acres and continuing to expand and develop community conservation involvement in a place that is historically and culturally significant. Note: This project represents the first phase of a two or three phase effort for complete eradication of red mangrove in the remaining portions of the river corridor.

This project will contribute to efforts of improving water quality by the State Department Health under the TMDL action plan and will stimulate other groups such as the Nawiliwili Bay Watershed Council to initiate other watershed projects leveraging off of the work we do to improve ecosystem function with this grant. For example with this project there will be more of an impetus for the Hulēʻia NWR to expand their management units, enhance the wetland corridor connecting to Alekoko restoration site, resulting in a 2 mile contiguous wetland complex along the river.

Criterion 10: Partners in Conservation. Will the proposal receive financial support including in-kind match, from private, local, or other Federal interests?

Below is a table of partners in conservation who have made a financial commitment to the proposed project. Letters of support and commitment are included as Section K.

Table 10 Financial Partners in Conservation

Entity	Funding Amount	Commitment
Green Energy Team	$59,182	Hauling mangrove biomass
County of Kauai	$18,881	The County is very supportive of the project. Past support (not included as match) is $29,059 for planning and permitting support and $18,881 for archaeological study (included as match).
Kauai Invasive Species Council	$9,186	Predator control traps ($500), Drone surveys ($2000/yr * 2 years), KISC Crew labor (1-day $2343/yr * 2 years= $4,686)
Private Donor	$50,000 - $100,000	Unrestricted annual donation to support the MH mission of mangrove removal and watershed restoration
Carl J. Berg, Jr, Ph.D.	$12,000	Nursery manager (10 hrs/month @ $50/hr) = $12,000
Surfrider Foundation, Kauai Chapter	$24,000	Water Quality Monitoring: professional in-kind contribution of time and equipment will be:

		10 hrs/month @ $100/hr = $24,000
Malama Hule`ia	$560,597	Detailed in Budget (Section B, 8)

Partner involvement that is not directly connected to financial contributions comes from the Technical Advisory Committee as described in Criterion 3 and Table 2.The project does include State technical support from DLNR – DAR, DOFAW and DOBOR. Federal contributions include project and technical support from USFWS, Hulēʻia NWR and a technical assistance grant from National Park Service Rivers, Trails and Conservation Assistance Program (approximately $88,000).

11. Federal Share Reduced

Yes, Mālama Hulēʻia will contribute $270,701 non-federal cash match above the required base match. State Trust Fund – Hawaii State qualifies for the 25% non-federal match as it has recurring funds for habitat conservation purposes. These funds are provided through the State's Legacy Lands Program. The Legacy Land Conservation Program is authorized under Chapter 173A, Hawaii Revised Statues. This program provides funding from the Land Conservation Fund for the acquisition of lands, including easements, for watershed protection; parks; coastal areas; beaches; and ocean access; natural areas; habitat protection; agricultural production; cultural and historical sites; and open spaces and scenic resources. Eligibility has been previously approved and no change has occurred in the funds.

Total Project Cost	**$1,579,209**
Federal Share Requested	$999,731
Base Match (25%)	$333,244
Non-federal Cash Match	$270,701 CASH & $453,134 In-Kind

12. Education/outreach program or wildlife-oriented recreation. Is the project designed to increase environmental awareness and develop support for coastal wetlands conservation? Does it provide recreational opportunities that are consistent with the conservation goals of the site?

Hulēʻia River is a popular place for Hawaiian outrigger paddlers and for kayak tours for visitors to the island. Alekoko fishpond is a national and state historic property and thus has great significance for Hawaiian culture and for people to learn about Hawaiian fishponds. County of Kauai has made a scenic lookout on the road above the pond and has interpretive signage depicting the fishpond wall and cultural fishing practices of the fishpond. With collaboration of Hulēʻia NWR and the County, we will install interpretive signs depicting the endangered species of waterbirds present in, and the ecological functions of, the restored wetland. Mālama Hulēʻia's restoration efforts will be shared with recreational and educational groups with outreach materials about ecological functions and endangered species protection, that will enhance the experience for wildlife and culturally oriented recreation already taking place on the river.

Access to the coastal wetland restoration site will be limited to educational activities including traditional Hawaiian cultural activities and escorted volunteer and community groups who are providing service to the land. Primary focus for the first two years will be invasive species removal and planting of native plants. Our volunteer coordinator will continue existing programs with nearby primary and secondary schools, Kauai Community College, Rotary Clubs, and local businesses and restaurants looking for outdoor teambuilding experiences, as well as state vocational programs and landscape industry looking for training opportunities. Each group that volunteers with us will learn about the ecological importance of this coastal estuarine wetland and the wildlife that depend on it.

A gathering area will be set-up outside of the wetland restoration area, with guided access to the wetland for specific monitoring, maintenance and educational activities. Very limited fishing may be allowed in the future, based on fishery resource management and limited bird disturbance. With consultation from the agencies on

impacts to endangered species, we will review other fishpond restoration programs which offer a family fishing day each month with limited access by registration.

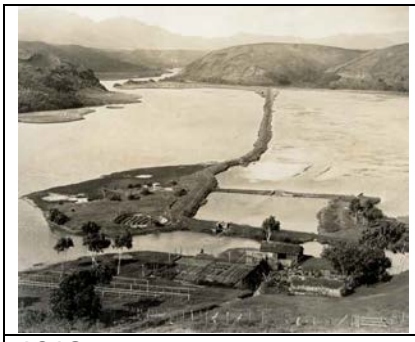
Mālama Hulēʻia staff will oversee volunteer and educational activities to allow the volunteer, educational, and recreational opportunities to be done in a managed way to ensure that the site is not loved to death. The goal of the education and outreach program is to protect natural and cultural heritage, and develop appreciation, understanding and *kuleana* (Hawaiian for responsibility) for the Alekoko fish pond and the entire watershed through education and interpretation. In addition, this program increases management capacity through volunteer programs and implements targeted educational and outreach efforts for the community, both residents and visitors.

13. Other factors. Do any other factors, not covered in the previous criteria, make this project or site particularly unique and valuable?

Other factors for consideration include the Hawaiian cultural benefits and sea level rise/climate change resiliency.

Hawaiian Cultural Benefits

Alekoko Fishpond, over the last 100-years

		
1912	197?	2017

Fishponds are considered valuable cultural and ecological resources that can positively impact coastal ecosystems and their adjacent communities. Hawaiian fishpond systems, loko iʻa, are some of Hawaii's most significant traditional cultural resources. They are biocultural articulations of Hawaiian innovation in the areas of engineering, education, hydrology, aquaculture and biology. Further, they demonstrate traditional Hawaii's excellence in sustainability, food sovereignty and natural resource management. Research shows that approximately 400 fishponds once functioned across the main Hawaiian Islands and provided a significant and sustainable food source to the Islands' population, estimated at 1,000,000 people. Many of those that remain are in disrepair. Many have been completely destroyed (DLNR 2013).

Alekoko (Menehune) fishpond, lies at a large bend in the Huleʻia River, from which it is separated by a wall 900 yards long. It is the best example of a loko ʻwai (inland fresh water fishpond) in the entire state, and is said to have been built by Menehune, suggesting that it was built during the earliest period of Hawaiian settlement. Alekoko Fishpond was listed on the National Register of Historic Places, authorized under the United States Department of the Interior, National Park Service (DOI, NPS) in 1972, as well as on the Hawaii Register of Historic Places under the State of Hawaii Department of Land and Natural Resources.

At the time of the national listing in 1972, the fishpond (as found in the official National register from 1972) was described as:

> Located near the mouth of the Hulēʻia River on the southeast coast of the "garden isle" of Kauai. This ancient fishpond, also known as Alekoko Pond, consists primarily of a stone faced dirt wall that runs for over 900 yards and cuts off a large bend in the river for use as a fishpond. There is 50 yards of shallow

> swamp land between the west end of the wall and the shore. A dirt wall runs for 145 yards whereupon the stone facing starts on the river side of the wall. The dirt wall is 5 feet above the water level, 4 feet wide on top and the dirt slants up on both sides. The facing wall begins with a single row of stones and then becomes of double thickness as it gets further out into the river and the current starts to become effective. The stones also become larger until the double layer is 2 feet thick. The stone facing on the outside is five feet high in most places and is quite perpendicular. The stones are very carefully fitted together; the stone facing runs for about two-thirds of the total length of the wall.

The 50 yards of "shallow swamp land" (wetland) have become thick stands of invasive mangrove, and the rock wall contains mangrove on either side, filling in both the Hulēʻia river and the inside of the fishpond itself. The statement of significance from the National Historic registry is as follows:

> Menehune Fishpond is the most significant fishpond on Kauai, both in Hawaiian legends and folklore and in the eyes of Kauai's people today. It is so old that its construction is attributed to the Menehunes, a mythical people inhabiting Hawaii before the Hawaiians arrived. Its antiquity makes it undoubtedly the oldest fishpond on Kauai and therefore it has an extremely high research potential. Additionally, it is the best example of an inland fishpond in the entire state. Close to the major urban center on Kauai, the pond has high public visibility because of a road that runs along the slopes of the hill behind the fishpond.

While the fishpond has a great viewing platform from above that is frequented by thousands of island visitors, the fishpond and the refuge from the road, the area is not open to the public. Access to the fishpond and coastal wetland restoration site will be limited to escorted volunteer and educational groups as described in detail for Criteria 12.

Sea Level Rise / Climate Change Resiliency

This project will result in a healthy native ecosystem that will be more resilient in the case of sea level rise and climate change. Under currently predicted future climate scenarios, the spread of invasive species will likely be increased, which will mimic the current situation that Hulēʻia watershed is experiencing (Root et al. 2003). With rising sea levels, it is expected that the invasive mangrove in the Hulēʻia River will further spread into existing functioning wetland habitats (at Hulēʻia NWR for example) and would be detrimental if not removed. The Hulēʻia NWR is currently one of the highest functioning habitat areas on Kauai and in the Hawaiian Islands, supporting listed, endemic and migratory waterbirds. Wetland systems are vulnerable and susceptible to changes. Some of the most pronounced effects on wetlands are seen through alterations in hydrological function; specifically, the nature and variability of the hydro-period and the number and severity of extreme events. Climate change will affect the hydrology of individual wetland ecosystems mostly through changes in precipitation and temperature regimes. In the Hulēʻia River, altered hydrologic function by invasive mangrove is changing the flow and quality of water through the watershed. With increased storm events and increased intensity of storms, a river system that is choked out by mangrove will not allow for the river to flow at the rate to sustain increased rain and storm events. However, a restored, native wetland ecosystem can better accommodate high flow and storm events. Maintaining hydrology, reducing pollution, controlling exotic vegetation, and protecting wetland biological diversity and integrity are important activities to maintain and improve the resiliency of wetland ecosystems so that they continue to provide important services under changed climatic conditions (Kusler et al. 1999; Ferrati et al. 2005)

b) Additional Considerations/Tie-breakers:

1) Is the habitat imminently threatened from pending sale?

No, the habitat associated with this project is not threatened from pending sale. However, Alekoko fishpond is imminently threatened by the invasive red mangrove. If not removed, it will continue to fill in the fish pond and

destroy its function. It will choke out native wetland species and not expand habitat needed to recover the endangered Hawaiian waterbirds.

2) Does the site have unique and significant biological diversity?

Yes the site, once this proposed project is implemented, will have unique and significant biological diversity, as the case was made in the earlier responses showing diverse species use in the area. Currently there are extreme limits to the biological diversity due to the monotypic mangrove.

3) What are the costs per acre?

Total project Cost of $1,723,566 over the total project area of 28-acres results in a cost of $61,556 per acre. This cost falls on the lower end of the range identified in our Invasive Species Action Plan prepared by UH SeaGrant in 2015. We expect other phases of the mangrove eradication project to have a higher per acre cost due to access, use of barge system and more extensive permitting.

4a Are there new sources of funds, lands, or services being applied to this project? (As opposed to lands already owned by the state or third party that are being offered as match.)

Access to the proposed coastal restoration project site is a new service to this project. The access is occurring by means of a newly donated long term license agreement by the landowner.

4b) What percentage of the funds, lands, or services is new?

100%. Mālama Hulēʻia has been reserving unrestricted funds to leverage grant match funds since 2015 and has been planning for this project during that time. However, this proposed project is new and no funds have been expended.

Appendix 3

Moʻolelo O Ka Laāhui Kaānaka I Kapaʻia Menehune, O Kauaʻi

After the removal of invasive mangroves at Alakoko loko iʻa, the fishpond reemerged as a powerful symbol of Hawaiian ingenuity and sustainability. It is once again a vital lifeline, and its restoration and revitalization has ignited a deep and profound connection with both the local community and those far beyond, sparking renewed interest, respect, and investment. The resultant increased demand for community outreach and educational programming offers an opportunity to honor and share the rich moʻolelo of this treasured place, breathing life once more into the stories that have long been woven into its shores. Mālama Hulēʻia is building a library rich with the moʻolelo of the area with continued research into traditional practices and sharing of knowledge.

In the late 1800s, James H. Kuhau Kaiwi, Esq., a distinguished community figure and kupa (resident, native) of Niumalu, compiled the history of Alakoko. Kaiwi's works were later translated into English and published by Thomas George Thrum in The Journal of the Polynesian Society (Thrum 1920) without being recognized as the original author. However, Thrum's translations contained several significant misinterpretations.

As an educational advocate for Hawaiian language, Mālama Hulēʻia deemed it necessary to revisit Kaiwi's original description of the role of Menehune in the creation of Alakoko loko iʻa (Kaiwi n.d.). The transcription project was undertaken with the intention to simplify access to Hawaiian language resources to enhance the educational experience at Alakoko loko iʻa.

Mālama Hulēʻia staff member Tiele-Lauren Doudtʻs new translation is presented below. It, along with further information is available at https://malamahuleia.org/wp-content/uploads/2021/07/kaiwi.pdf.

Moʻolelo O Ka Laāhui Kaānaka I Kapaʻia Menehune, O Kauaʻi

ʻO ka lāhui kānaka i kapa ʻia ka Menehune, he kanaka liʻiliʻi, ua ʻōlelo ʻia ma lalo iho o nā kuli o Nā-ipu-ʻālehu. Inā he ʻoiaʻiʻo ia ʻōlelo pēlā a kahiko, a laila, ua liʻiliʻi ʻiʻo nō; he ʻano peke, a pāhaʻa ma kahi ʻōlelo ʻana. He kino ʻano paʻakikī, he puʻipuʻi naʻe a ka lawakua; he ʻili ʻulaʻula, a he huluhulu ke kino, he mūkokikoki ka ihu, he muʻomuʻo ka lae me ka paʻa i ka huluhulu; he nunui nā maka i uhi ʻia aku e ka hulu o ke kuʻemaka, a he pupuka a kū i ka hoʻomakaʻu nā helehelena, e hoihoi ʻole ai ʻoe ke nānā aku iā lākou.

ʻO ko lākou noho ʻana aia ma nā kuahiwi o uka o Waimea lā, aia paha ma kahi e kokoke ana ia wahi i kapa ʻia ʻo Waineki, ma laila ka

Story of the Race of People Called the Menehune, of Kauaʻi

The race of people called Menehune were very small, and were said to be shorter than the knees of Nā-ipu-ʻālehu. If these words of the ancients are true, then that means that these people were indeed tiny; perhaps dwarf-like, short in stature. Yet they had strong bodies, sturdy with bulging muscles. Their skin was red, with lots of hair and snubbed-noses, and they had bulging foreheads that were covered in hair. Their large eyes were covered by their big eyebrows. They were said to be very frightening to gaze upon, something that was better off not looking at.

They lived in the uplands of Waimea,

ʻike nui ʻia ai kēia ʻano lāhui. ʻO ka lauhulu o ka maiʻa ʻoia kā ko lākou hale, ʻo kā lākou kamaʻilio ʻana he ʻano nunulu e like me ka nunulu ʻana a ka ʻīlio; ʻo kā lākou ʻakaʻaka ʻana he nunui ka leo; he poʻe like loa kēia ma kā lākou mea e hana ai. He ʻano lāhui ʻeʻepa nō kēia ma ko lākou ʻano, kā lākou hana a me ko lākou noho ʻana. Ko lākou ola ʻana, ka maiʻa, ka hinana me ka ʻōpae, ua māʻona nō kā ka Menehune inā ʻakahi a ʻelua maiʻa, a ʻo ka piha lima hoʻokahi ua māʻona ihola no ka mea hoʻokahi. ʻO ka hinana a me ka ʻōpae nā iʻa e lawe ai kēia poʻe, no ka nui maoli o kēia ʻano lāhui kanaka; pēlā i hiki ai iā lākou ke hana i kekahi hana nui, i hoʻokahi nō pō a ao, ua paʻa a pau ia hana i ka hana ʻia.

ʻO ka ʻauwai ʻo Kikī-a-Ola, mauka o ka muliwai o Waimea, na kēia lāhui Menehune i hana ia ʻauwai, i ʻeli a i nini i ka pōhaku a paʻa, a penei kā lākou hana ʻana. I ka pō paha ʻo Akua i hana ai lākou i ka ʻauwai ʻo Kikī-a-Ola, a paʻa nō i ka pō hoʻokahi. Ua ʻōlelo ʻia, ua kū laina lākou mai luna aku nei o ke poʻowai o ka ʻauwai ʻo Kikī-a-Ola a hiki i lalo o Polihale, a ma luna o ka lima o kēlā a me kēia Menehune pākahi i halihali ʻia mai ai ka pōhaku mai kēia lōʻihi mai ʻaneʻane paha e piha nā mile he ʻelima a ʻeono paha, eia naʻe, ua paʻa nā ʻauwai, ua komo ka wai a e kahe ana i ke kakahiaka ʻana aʻe i hana ʻia ai ua ʻauwai nei ʻo Kikī-a-Ola. Hauʻoli ke aliʻi nāna i hoʻolalelale i ua lāhui kānaka Menehune nei i ka lohe a ʻikemaka ʻana i ka paʻa o ua ʻauwai ʻo Kikī-a-Ola, a ola nō hoʻi nā makaʻāinana e noho ana ma Paliuli, a hala loa mai i kai i ke komo ʻana o ka wai, a ulu nā puʻepuʻe o nā loʻi kalo a nā kānaka, a manaʻo aʻe ke ola.

ʻO ka paʻa nō o ka ʻauwai ʻo Kikī-a-Ola. Mai ke hana ʻia ʻana a ka Menehune i kēia lā, ʻaʻohe mea nāna wāwahi aʻe i kēia paʻa o ka ʻauwai ʻo Kikīaola, he ʻano hoʻokalakupua nō ka hana a kēia ʻano kānaka liʻiliʻi. I ka paʻa ʻana o ka ʻauwai ʻo Kīkīaola, ua hiki ʻole e lawe ua lāhui Menehune nei i ka mea ʻai ʻole

perhaps close to the area that is called Waineki, for that is where these people were usually seen. Beneath banana leaves is indeed where they would reside, and sometimes their discussions were similar to the snarls of a dog. They would laugh very loud, which they often did while they were working. They were very peculiar people, in the way that they worked and in the way that they lived. Their livelihoods were based on maiʻa [banana], hinana [baby ʻoʻopu fish] and ʻōpae [shrimp]. They were usually full after the first or second maiʻa, so about one handful would be enough per person. The hinana and ʻōpae were the fishes that were preferred by most of these people, and that is often how they were paid for accomplishing their great feats. A project of theirs could be completed within a single night.

It was this race of Menehune that built the Kikī-a-Ola ditch, located uplands of the Waimea estuary. They dug and fenced the line of stones until it was completed. It is said that Kikī-a-Ola ditch was constructed within a single night beneath the Akua moon. It is said that they stood in a line from the poʻowai [main water inlet] of Kikī-a-Ola ditch all the way until Polihale, and the stones were hand-passed by Menehune over five to six miles. But when the ditch was completed, water was able to enter and flowed the next morning at this place that is now called the Kikī-a-Ola ditch. When the chief who had encouraged the Menehune to build the ditch had heard that the project had been completed, he was overjoyed. The commoners who were living at Paliuli had freshwater, and so they could live and thrive off of the mounds within their loʻi kalo [taro patches].

And that is how Kikī-a-Ola ditch was created. To this day, nothing has been able to destroy Kikī-a-Ola ditch. The feats of these small people are wondrous indeed. When the ditch

e ola ai lākou, no laila, i ka hiki ʻole ʻana e ola lākou ke noho aku no Waimea, ke ʻuʻuku a ke ʻemi maila ke kū ʻana o ka hinana iā Waimea, ua lohe ʻia aia he mau keiki aliʻi nō ke huli ma Puna, Kauaʻi, e noho ana i ke awāwa o ka muliwai o Kīpū mauka, a ʻo Niumalu makai. E noho ana he kaikunāne, ʻo ʻAlekoko a me ke kaikuahine, ʻo Kalālālehua, he mau aliʻi uʻi kēia o nā helehelena, hoʻoholo like lāua e ʻūhana i mau loko iʻa pākahi na lāua. I ka neʻe ʻana mai o ka Menehune e hana i kēia mau loko iʻa a kēia mau keiki aliʻi o Niumalu i ʻike ʻia aʻe nei ma mua.

I ka hana ʻia ʻana o ka loko iʻa a ua mau keiki aliʻi nei, hana ʻia nō hoʻi kā ke kaikunāne ma kekahi ʻaoʻao mai o ka muliwai o Niumalu, e hoʻolimalima ʻia nei i ka Pākē, a hana ʻia nō hoʻi ka loko iʻa a ke kaikuahine ma ka ʻaoʻao ʻo Kīpū, ka mea kupanaha ʻea, paʻa ke kuapā i nini ʻia me ka pōhaku ka loko iʻa hoʻi a ke kaikuāne, ʻo ʻAlekoko, a paʻa ʻole hoʻi ka loko iʻa a ke kaikuahine, ʻo Kalālālehua.

I ka ʻōlelo ʻia, hoʻokahi nō pō i hana ʻia ai kēia loko iʻa, ʻo ka pōhaku I hahau a nini ʻia ai kēia mau loko iʻa, mai lalo mai ia o kahakai ʻo Makaliʻi, me he lā he mile me hapa mai Niumalu mai, a i ʻōlelo ʻia he ʻelua paha mile a ʻoi aku ka mamao o ka pōhaku o kēia mau loko iʻa i kiʻi ʻia ai. E like nō me ka hana ʻia ʻana o ka ʻauwai ʻo Kikīaola, i ka pō a paʻa, pēlā nō kēia loko iʻa i hana ʻia, paʻa ka loko o ke kaikunāne a paʻa ʻole hoʻi ka loko iʻa a ke kaikuahine, ao ʻē kā, pau ka Menehune I ka hoʻi i uka o kuahiwi, no ka mea, he lāhui ʻeʻepa loa kēia i ka puka ka lā, he wahi iki wale nō koe a puni nō hoʻi ka loko iʻa a ke kaikuahine ao ʻē, lele aʻe kā ia Menehune, a lele aʻe a pēlā a pau loa nā Menehune i ka lele, a ao nō hoʻi. ʻIke ke kaikuahine ʻaʻole i paʻa kāna loko iʻa, kaumaha loa ʻo ia a ʻūwē no ka paʻa ʻole ʻana o kāna loko iʻa, a hauʻoli hoʻi ke kaikunāne i ka paʻa ʻana o ka loko iʻa, ʻo ia ʻo ʻAlekoko. ʻO ka pōhaku i nini ʻia ai kā ke kaikuahine eia nō ia ke paʻa nei i loko o ka muliwai a hiki i kēia lā.

was finished, the Menehune were not able to eat enough food to sustain themselves. The amount of hinana were decreasing in the river, so they could no longer make a substantial living in Waimea. They had heard that if they were to search in the Puna district of Kauaʻi, that there are two royal children who were living in the valley along the rivermouth, with Kīpū on the mountain side and Niumalu on the ocean side. The siblings lived there together as brother and sister, the brother named ʻAlekoko and the sister named Kalālālehua. Their chiefly features were quite beautiful, and it was for them whom the fishponds were built. The Menehune marched to build these fishponds for the royal children of Niumalu, as described above.

When the fishponds for the royal children were being built, the brothers' was built on the river mouth of Niumalu, which is now currently leased by the Chinese, and the sisters' was built on the Kīpū side, but something very strange was that the kuapā [fishpond wall] belonging to the brother ʻAlekoko was completed, but the same could not be said for the fishpond belonging to Kalālālehua.

It is said that his fishpond was built in a single night, and that the rocks that were laid for both of the fishponds came from the sea below of Makaliʻi, which is perhaps a mile or so away from Niumalu, but is also said that the distance away could be two miles or longer. Just like the construction of the Kikī-a-Ola ditch, the fishpond belonging to the brother was completed in a single night, but the sisters' was never completed—for when daylight came—all of the Menehune had returned to the uplands, since they were so ugly to gaze upon in the light. There was only a small portion remaining to complete the fishpond belonging to the sister, but daybreak arrived and the Menehune departed. The sister saw

ʻO kēia mau keiki aliʻi, ʻo ia ʻo ʻAlekoko, ke kaikunāne, a me Kalālālehua, ke kaikuahine, aia nō he wahi awāwa e pili ana ma ka muliwai, ʻo ia kahi i hānau ʻia ai kēia mau keiki aliʻi; na ke ānuenue e piʻo mau ana ma ia wahi a hiki nō i kēia lā. Ua ʻike a kamaʻāina nā kānaka o kēia wahi ke piʻo ānuenue ma ua wahi awāwa nei, e ʻōlelo ana lākou nō ua mau aliʻi nei, me ka ʻōlelo ʻia, "he mau aliʻi uʻi kā kēia."

Ma ka ʻōlelo a kamaʻāina o kēia awāwa ʻo Niumalu, he ʻano kupua nō kēia mau keiki, ʻo ke kaikuahine e loli ana i moʻo i kahi wā, a ʻo ke kaikunāne e kua manō ana i kahi wā. A aia ma lalo ponoʻī mai nō o ua wahi awāwa nei, he lua hohonu, i kahi wā wela ka wai o kēia wahi, i kahi wā koʻekoʻe ka wai. I kēlā wā paha ma mua hōʻike ʻia ia mau mea, i kēia wā nalowale loa.

Ma ka ʻōlelo o koʻu mau kūpuna i make, ua lohe nō lāua i ke ʻano o ka Menehune penei: aia lāua i uka o kēlā wahi ʻo Waineki, moe lāua ma laila, ma kahi a ka Menehune o ka wā kahiko. I ka pō ua hōʻā ʻia, a e puʻu ahi nui pūlehu maiʻa, ʻaʻole lākou i ʻai mua i ka maiʻa, e lilo mua ʻē ʻana i kēia poʻe Menehune me ka lāʻau loloa kā e kīʻoʻe mai ai i ka maiʻa i loko o ka puʻu ʻahi e ʻāʻā ʻana. ʻAʻole nō kā hoʻi o ka liʻiliʻi a kana mai o kēia ʻano lāhui, hoʻomakaʻukau nō hoʻi nā helehelena ke nānā aku ʻoe, a pupuka nō hoʻi a ke ʻino o nā maka, eia naʻe, ʻaʻole kēia he kānaka ʻano puni hulu a hoʻāla hakakā wahi a kuʻu mau kūpuna i lohe pono i ko lākou ʻano.

He kānaka liʻiliʻi ʻiʻo maoli nō, he poʻe makaʻu loa i ke ao, a inā i ka pō, ʻauwe, he hulu ʻāʻā ia nō kēia poʻe kānaka. He lōkahi loa lākou ma kā lākou mau hana ʻano nui, he ʻano oʻokalakupua maoli nō, nānā aku i ka ʻauwai ʻo Kikīaola a hiki mai i kēia lā, ʻaʻole he mea hiki e aa aʻe e hele e wāwahi i ka paʻa i hana ʻia e ka lāhui Menehune. I ka nānā pono ʻana i ke ʻano o ka pōhaku o ka nini ʻana he nunui maoli nō; a pēlā nō me ka loko iʻa o

that her fishpond was not completed and began to cry, but the brother ʻAlekoko was very happy that his was completed. The rocks that were stacked for the sister are still located within the rivermouth to this day.

As for these royal children, ʻAlekoko and Kalālālehua, they were born in a valley along the same rivermouth, in the area where the rainbow continues to be seen arching today. The people of this place that are familiar with this area where the rainbow arches would often say, "here indeed are the beautiful chiefs."

According to the people who were from Niumalu, these children were thought of as sometimes being supernatural. Sometimes the sister would change into a moʻo [lizard, water spirit], and the brother would appear at other times with a shark's back. Right beneath the valley there is a deep cavern, where sometimes the water would be hot, and other times it would be cold. This was perhaps in a time much before us, for today it is no longer in existence.

According to my ancestors who have passed on, they had heard the stories of the Menehune like this: one day they were resting in the uplands of Waineki, close to where the Menehune used to reside. When night came, they made a fire to roast maiʻa, but were never able to eat it because the Menehune would first scooped them up with long sticks from the burning fire. These people were so small that they were without comparison, and that their features were terrifying to behold, they were so very ugly to look upon, but nonetheless, these people were not covered in fur, and snarled and argued until the early mornings. My beloved ancestors justly understood what they were.

These people were indeed very small, and they were very afraid of daylight. The

ʻAlekoko a hiki mai i kēia lā, ʻoia paʻa nō a ka Menehune i hana ai ʻoia paʻa nō ia i kēia lā e ʻike ʻia nei, eia naʻe, ua ulu ʻia ʻē ka manienie ma waho mai o ke kuapā, ʻo ia kāu pōhaku e ʻike ʻana, akā, ʻo ka pōhaku ma luna iho ua nalowale i ka ulu nui ʻia o ka manienie. ʻO ka pōhaku helele'i iho i laila ʻo ia kā ka Pākē e hoʻokau aʻe i luna. I nā makahiki wai nui aku nei i hala, ʻaʻole i hoʻopōino iki ʻia kēia loko iʻa e ka wai kahe, ua piʻi nō ka wai a aʻe ma luna o kuapā, ʻaʻole naʻe i hiolo iki kekahi wahi o ka loko iʻa a hiki i kēia lā.

ʻO ke kumu o koʻu mau kūpuna i lohe ai i kēia ʻano poʻe kānaka, I uka o ia wahi ʻo Waineki, a ma luna pono aʻe o ke awāwa ʻo Wainiha e nānā pono iho ana kā i lalo. I piʻi hoʻi koʻu mau kūpuna i ka ʻohi lāʻau ala, na nā aliʻi, a moe i kuahiwi, a moe aku i kuahiwi, a pēlā ko lākou ʻike ʻana i ua wahi o ua lāhui ʻeʻepa nei, he poʻe maikaʻi, ʻaʻohe he hana wale mai, ma ka meaʻai kā lākou e kiʻi mai ai inā e pūlehu maiʻa kānaka i kuahiwi ia manawa o ke au kahiko iō kahiko loa. Ke paʻa nei kēia mau wahi a ka Menehune i hana ai, ʻoia paʻa nō ia lā ʻoia nō ia i kēia lā. Na kēia mau wahi kaulana a ka Menehune i hana ai i ʻike ʻia ai ka nani o ka Akua, i ka hana ʻana i nā ʻano kānaka o kēlā ʻano a me kēia ʻano, a ma nā hana naʻe i ʻike ʻia ai ka nani o ke Akua. Ma ka ʻōlelo a kahi poʻe he Mūʻaimaiʻa, akā, ma ka ʻōlelo a koʻu mau kūpuna, o ua lāhui Menehune nei nō ia.

Menehune worked together in their great feats, so much so that they are often considered supernatural. For example, if you look to Kikī-a-Ola ditch today, it is not something that is so easily taken apart and disassembled. If you look closely at the types of rocks that were stacked, there were very many—which is the same with ʻAlekoko—the work that the Menehune completed is long-lasting. Nevertheless, Mānienie grass has quickly grown on the exterior of the kuapā, but those are the same rocks, although the top layers of the rocks have disappeared due to the rampant growth of Mānienie. The crumbling rocks now above were placed by the Chinese. In past years with lots of water, the fishpond was not harmed. The water climbed until it reached the kuapā, but no part of the wall has fallen until today.

The reason why my ancestors know so much about these people is because they often went upland of Waineki, directly above the valley of Wainiha. They went there to harvest wood for the chiefs, and slept in the uplands, which is how they became acquainted with this forementioned race of people, a great people who never harmed them, who were known to roast maiʻa in the mountains a long, long time ago. But when things were completed by them, they were things that lasted well into our time. These famed places of the Menehune are known by the beauty of the Akua moon, and they were completed by such a different type of people, but their work was so great that God recognizes them for it. Some people call them the Mū-ʻai-maiʻa, but in the words of my ancestors, they were the Menehune.

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Appendix 4
The Heart of Restoration: Cultivating Community Stewards for a Resilient Ecosystem

Restoration and stewardship efforts at Alakoko loko iʻa are not only about ecological recovery; they also center on fostering a deep, lasting connection between the community and the land. Active participation of local communities, students, and educators in biocultural stewardship is integral to this process. Embedding the values of mālama ʻāina (care for the land) into educational curricula and hands-on restoration work ensures that future generations are equipped with the knowledge and skills to sustain Alakoko loko iʻa long-term. Integration of traditional ecological knowledge with contemporary scientific practices helps create a comprehensive and holistic model of stewardship.

This plan's education and stewardship efforts will involve people who use their culture, ecological knowledge, scientific observation, and ancestral practice to inform positive relationships with the environment. This approach will ultimately transform stewardship in Hawaiʻi in the future. Communities have a kuleana (right and responsibility) to care for Hawaiʻi. This includes not just a right to benefit from Hawaiʻi's environment (food, recreation, tourism, or otherwise), but a duty to both mālama (care for) Hawaiʻi and to ensure the people's concomitant right to do as much to assure abundance and well-being for future generations. Importantly, the education program addresses a goal of the U.S. Fish and Wildlife Service for Hulēʻia National Wildlife Refuge by providing experiential, place-based environmental education.

A stewardship program was developed based on traditional Hawaiian knowledge and practices coupled with Western science. From the practice of kilo (observation) to native plant propagation and water-quality testing, local community members and students are assisting with stewardship and monitoring activities of the restoration of a functioning loko iʻa and wetlands which will serve as a nursery for engendered wildlife.

Monitoring for waterbird populations at Alakoko loko iʻa.

A partnership with local schools was initiated to develop an biocultural education component that teaches Hawaiian practices and approaches as well as opportunities to learn about science, math, Hawaiian loko iʻa, and cultural practices.

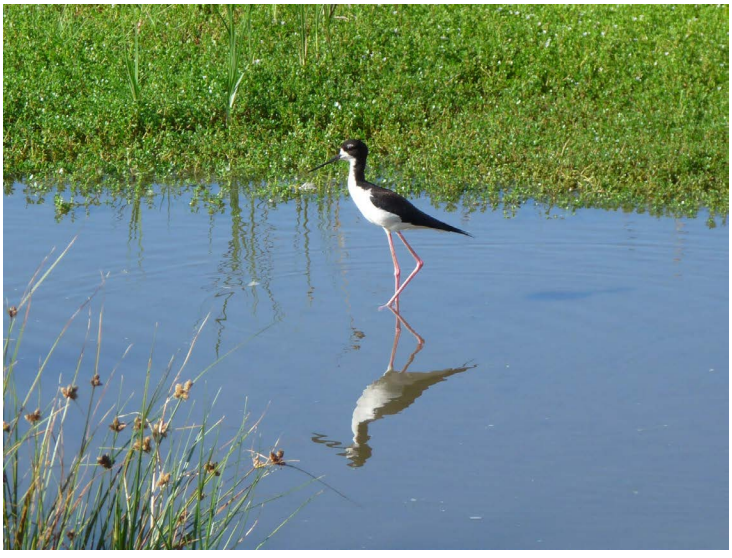
Mālama Hulēʻia will continue the data collection efforts at Alakoko loko iʻa for terrestrial and aquatic species and water quality. They will also continue predator-control efforts. This provides data that measure changes and help to inform practices that support the restoration.

Endangered Waterbirds and Migratory Birds

Alakoko loko iʻa provides important habitat for native waterbirds that are listed as endangered by both the U.S. Fish and Wildlife Service (USFWS) and State of Hawaiʻi (see next page). These endemic species are threatened by habitat loss and degradation, altered hydrology, invasive plants, predation by nonnative species (avian, aquatic, and terrestrial), and climate change, and in the case of koloa maoli (Hawaiian duck), hybridization.

The Alakoko loko iʻa property is also used by at least 30 species of migratory waterfowl and shorebirds. The habitat that the loko iʻa and surrounding wetlands provide is critical to their survival.

Restoration actions at Alakoko should improve the habitat available to these species in the Hulēʻia watershed. Mangrove removal around the loko iʻa and construction of the fish passage has restored the hydrology and opened up areas for native plants to become reestablished. Restoration of wetlands and the riparian systems associated with the punawai (freshwater springs) should also increase the habitat available to these species. Reestablishment of loʻi kalo (taro patches) and loʻi iʻa kalo (taro patch with fish) aquaculture and agriculture will also provide important resources for resident and migratory birds. Traditional Hawaiian loʻi and wetlands provide nesting, loafing, and foraging habitat for endemic waterbirds (Gee 2007; Opie 2022). Loʻi systems can also provide nesting habitat for Hawaiian waterbirds that could help compensate for the loss of natural wetlands due to sea level rise, demonstrating that Hawaiian biocultural techniques can address both food security and ecological needs (Harmon et al. 2021; Kurashima et al. 2019).



Aeʻo using habitat at the fish passage at Alakoko loko iʻa.

To contribute to the recovery of these highly endangered waterbirds, it is important to manage Indigenous agro-ecological spaces with waterbirds in mind. The USFWS has extensive best practice guidelines to maximize waterbird success. Additional habitat modifications to those already being planned include increasing the amount of saturated soils, providing banks with a low, gently sloping profiles to increase food availability, and the provision of safe nesting spaces such as kīpuka (floating islands) or habitat with some kind of predator exclusion option. Predator control is also a vital

Endangered Hawaiian Waterbirds

Ae‘o
Hawaiian stilt
Himantopus mexicanus knudseni

Found only in Hawai‘i
Population: 1,550

‘Alae ‘ula
Hawaiian moorhen (gallinule)
Gallinula chloropus sandvicensis

Found only on Kaua‘i and O‘ahu
Population: 700

‘Alae ke‘oke‘o
Hawaiian coot
Fulica alai

Found only in Hawai‘i
Population: 1,550

Koloa maoli
Hawaiian duck
Anas wyvilliana

Found only on Kaua‘i
(birds on other islands are hybrids)
Population: <700

Nēnē
Hawaiian goose
Branta sandvicensis

Found only in Hawai‘i
Population: 3,850

Alakoko hosts several culturally and ecologically important native Hawaiian birds that are unique to Hawai'i. Their presence is an indicator of ecological health.

These species are endangered so every bird counts!

Ae'o

Look out for ae'o in the mud flats and riverine areas at Alakoko – their pink legs are second only to the flamingo in relation to body size. They are great actors; if their nest is disturbed, they will perform a 'broken wing display', imitating an injured bird to lure predators away from their babies.

'Alae 'ula

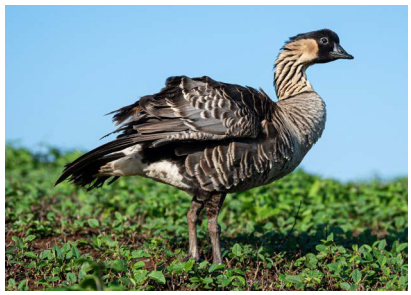
There are only around 700 'alae 'ula left in the world but at Alakoko, they are easy to see. They are the mythical 'firebringer'; in Hawaiian legend, the 'alae 'ula stole fire from the god Maui to give to humans and was branded with a red frontal shield in retribution! Like all these waterbirds, they are vulnerable to being killed by feral cats because they evolved without predators.

'Alae ke'oke'o

'Alae ke'oke'o are rare at Alakoko but the ongoing restoration work will provide the habitat that they need. They build floating nests and adults share nesting duties. These birds also kick box; in territorial battles, they balance upright to kick intruders! They will travel long distances, even between islands, to find food.

Koloa maoli

These birds are survivors! Several species of duck and geese went extinct in Hawai'i, but koloa maoli are still present and Alakoko provides good habitat for them. Their varied diet of wetland vegetation, snails, worms, and flying insects helped their survival. In legend, these ducks are said to have guided the ten spears of the blind warrior king Imaikalani to their target.



Nēnē

The nēnē is the state bird and the rarest goose in the world, but they have recovered from a low of less than 50 birds in the 1950s. They have evolved long toes and reduced webbing on their feet to navigate rocky volcanic ground. Nēnē can live for 30 years. They currently pass over Alakoko but could use the habitat in future.

Mālama Hulē`ia

Mālama Hulē'ia is a community-based mālama 'āina nonprofit organization leading the restoration of Alakoko loko i'a.

All photos credited to USFWS.

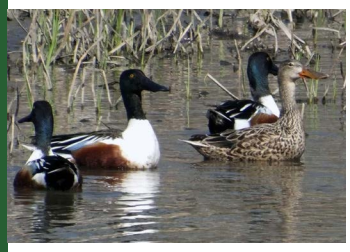
This page:
Dan Clark (ʻalae keʻokeʻo),
Gary Kramer (aeʻo, ʻalae ʻula),
Laurel Smith (koloa maoli, nēnē)

Opposite page:
Dan Clark (ʻalae keʻokeʻo),
Gary Kramer (aeʻo, ʻalae ʻula, nēnē),
Laurel Smith (koloa maoli)

Migratory Waterfowl

Mālama Hulē`ia

Bird migration across the vast Pacific to Hawai'i is one of the most impressive feats in the animal kingdom. Thirty species of migratory waterfowl and thirty migratory shorebirds rely on wetlands here. Making sure that habitat is available when the birds land is key to their survival.



Koloa mōhā
Northern shoveler
Spatula clypeata

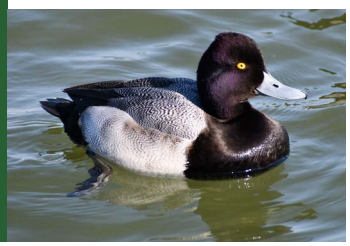
Credit: USFWS

Koloa māpu
Northern pintail
Anas acuta

Credit: USFWS, Tom Koerner

American wigeon
Mareca americana

Credit: USFWS, Steve Emmons



Lesser scaup
Aythya affinis

Credit: USFWS, Valerie Fellows

Migratory Shorebirds

Kōlea

Pacific golden-plover

Pluvialis fulva

Credit: USFWS, Laurel Smith

Kioea

Bristle-thighed curlew

Numenius tahitiensis

Credit: USFWS

ʻŪlili

Wandering tattler

Tringa incana

Credit: USFWS

ʻAkekeke

Ruddy turnstone

Arenaria interpres

Credit: USFWS, Kaleomanuiwa Wong

Hunakai

Sanderling

Calidris alba

Credit: USFWS, Peter Pearsall

Alakoko Resident Species

Flying pueo credit: Laura Wolf CC BY 2.0

ʻAukuʻu

Black-crowned night heron

Nycticorax nycticorax hoactli

Credit: USFWS, Laurel Smith

Koaʻe kea

White-tailed tropicbird

Phaethon lepturus

Credit: USFWS

Koaʻe ʻula

Red-tailed tropicbird

Phaethon rubricauda

Credit: USFWS, Dan Zimmerman

Pueo

Hawaiian short-eared owl

Asio flammeus sandwichensis

Credit: NRCS

ʻŌpeʻapeʻa

Hawaiian hoary bat

Lasiurus semotus

Credit: Forest & Kim Starr. CC BY 3.0.

component, because these birds evolved without predators and have no defences against them. High quality and consistent predator control will increase adult survival and breeding success.

The available bird habitat at Alakoko loko iʻa is currently in flux with the ongoing restoration actions. Much of the area around the pond still has exposed soil and only a few areas have been revegetated with native plants to date. The areas around the channel for the fish passageway already provides good habitat for ʻalae ʻula (Hawaiian moorhen) and koloa maoli and both species can be regularly found there.

ʻAlae ʻula with chick at Alakoko loko iʻa.

Bird Surveys

Mālama Hulēʻia has been working with ecological-consulting firm Archipelago Research and Conservation (ARC) to survey for endangered waterbirds and migratory waterfowl and shorebirds. Surveys are performed at least monthly by ARC biologists and/or Mālama Hulēʻia staff who have received training from ARC. Pacific Birds Habitat Joint Venture has also been instrumental in providing support with grant writing, technical advice and transfer of knowledge. Data collected during surveys include counts of native, migratory, and introduced predatory birds (e.g., cattle egret [*Bubulcus ibis*] and barn owl [*Tyto alba*]), bird behaviors, the presence of nests, and any observed mortalities or injuries, as well as weather and wetland conditions.

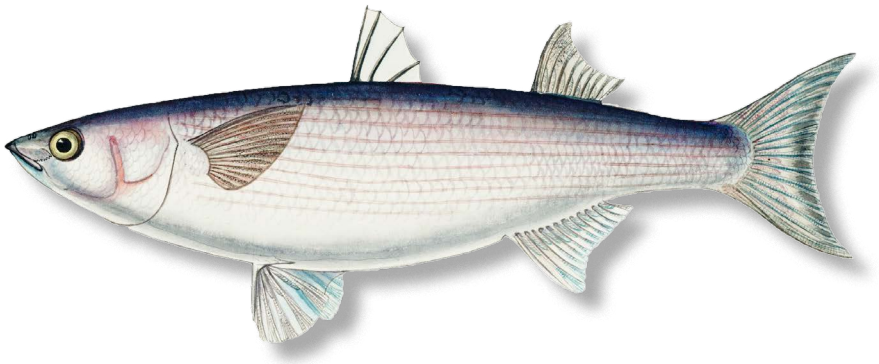
Aquatic Species

The presence of waterbirds is not the only indicator of a healthy ecosystem. The populations of native fish species other native aquatic organisms like crabs and shrimp as well as phytoplankton in Alakoko loko iʻa also are dependent on the health and productivity of the overall hydrologic system. Invertebrates and limu (aquatic vegetation including seaweed) are also part of the food web of Alakoko.

Input of wai (fresh water) from punawai and kahawai (freshwater streams) is essential for the productivity of Alakoko loko iʻa as many aquatic species depend on brackish water conditions. Alakoko loko iʻa will serve as a nursery for juvenile fish, increasing productivity and abundance of the fish population. This will impact the ecosystem of the Hulēʻia River, as well as Nāwiliwili Bay and nearshore environments. As a result, a loko iʻa like Alakoko also can impact fisheries not just in estuaries, but also in marine environments including the pelagic zone and coral reefs.

Native fish species found in Alakoko include herbivores such as ʻamaʻama (striped mullet), manini

(convict tang), and pualu (yellow-fin surgeonfish). Omnivorous fish include moi (Pacific threadfin) and āholehole (Hawaiian flagtail), and carnivorous species include kākū (barracuda) and pāpio (a juvenile in the trevally or jack family). The loko iʻa ecosystem also includes phytoplankton and crabs (ʻalamihi, kūhonu, ʻaʻama, moʻala).



ʻAmaʻama (striped mullet). 1875 illustration by Frank Edward Clarke (public domain).

In addition to mangrove removal, restoration projects at Alakoko have also included the construction of a fish passage into the loko iʻa, through funding from USFWS, and sediment removal from the pond itself (See Chapter 4). Future wetlands restoration as well as establishment of loʻi iʻa kalo and loʻi kalo terraces and kiʻo pua (a type of pond for raising juvenile fish [fry]) will continue to improve the habitat available for native fish and aquatic organisms at Alakoko.

The mangrove removal and the opening of the fish passage has already significantly changed the habitat in Alakoko loko iʻa due to reduced shade, lower nutrient input, and higher water flow. Species (especially nonnative ones) that had thrived in the mangrove-influenced pond may have migrated upstream to areas where mangroves remain (Goeke and Carstenn, 2017).

Aquatic Surveys

The State Department of Aquatic Resources surveyed fish population in Alakoko loko iʻa quarterly between 2020 and 2021, and again in November 2024. They utilized fyke net sampling in the pond near the fish passage to assess species composition and species abundance. This research provides an understanding of the impact of mangrove removal on the aquatic environment, as well as the impact of creating a fish passage between the loko iʻa and the river. It will help Mālama Hulēʻia to adaptively manage the aquatic habitat for fish species.

Preparing the netting prior to fish surveying.

The surveys began prior to mangrove removal from the full circumference of the pond and before restoration of the fish passage. During that time, a large

mud flat in the loko iʻa blocked the mākāhā (saltwater inlet/outlet) at low tide.

The first surveys reflect species composition prior to the opening of the fish passage and before mangrove removal was completed. High numbers of invasive fish species including mosquitofish, tilapia, and glass shrimp were captured in those surveys. Invasive species remained dominant until the fish passage project was completed. High capture rates during these early surveys probably resulted from the mudflat restricting movement between the interior of the loko iʻa and mākāhā.

Capture rates decreased once the fish passage was established as fish were no longer confined in a restricted area. The low catch rate continued into 2021, leading the DAR to pause sampling.

In November 2024, DAR resampled the loko iʻaʻs fish population to assess changes following extensive mangrove removal. Although only a few individuals were captured, āholehole, a species of both cultural and commercial importance, was recorded for the first time.

In the future, Mālama Hulēʻia will conduct fish population surveys using low-impact quadrat methods. Biannual environmental DNA (eDNA) sampling will help assess biodiversity and detect hard-to-see changes in microbial and aquatic species.

Water Quality and Quantity Monitoring

Mālama Hulēʻia is establishing a comprehensive water quality monitoring program to support the ongoing restoration of Alakoko loko iʻa and to help assess pond health over time. Standardized monitoring will include regular measurements of key water quality parameters—such as temperature, turbidity, pH, salinity, dissolved oxygen, and flow—at established sites throughout the pond. While initial implementation is led by Mālama Hulēʻia staff and educator Alex Nelson, the program is designed to grow into a collaborative effort involving educators, students, and community volunteers, all trained in consistent data collection protocols. These efforts aim to build both ecological understanding and community stewardship of this vital cultural and natural resource.

Predator Control Program

Predator control is an essential component of the Alakoko loko iʻa restoration to ensure that the area provides safe habitat for endangered waterbirds and other native wildlife. Invasive predators of concern include feral pigs, cats, rodents, and barn owls.

Since 2019, predator control at Alakoko has been actively implemented through a reciprocal partnership with Hallux Ecosystem Restoration. In exchange for use of the property for training and capacity building, Hallux contributes in-kind services to support predator control. This effort includes the use of Goodnature traps, Tomahawk live traps, and electric fencing that excludes pigs from sensitive restoration zones while allowing waterbirds free movement throughout the habitat. This innovative approach has already yielded positive results for native species and sets the foundation for long-term adaptive management.

Looking ahead, Mālama Hulēʻia will continue refining its adaptive management plan in collaboration with Hallux and other invasive species management partners. Staff and volunteers will play an active role in implementing best practices, monitoring effectiveness, and responding to emerging threats. For example, in late 2024 the coconut rhinoceros beetle (CRB) was identified at Alakoko.

In response, Mālama Hulēʻia began working with the Kauaʻi Invasive Species Council (KISC), along with additional partners, to develop and test appropriate control strategies, demonstrating the flexibility and responsiveness of the adaptive approach.

Ungulate-Proof Fencing

Fencing will be a part of the restoration of the larger Alakoko system as an important part of the predator control efforts to protect and restore native plant areas as well as native wildlife species including endangered waterbirds. Feral animals also may have negative impacts on soil condition, water quality, and overall plant health.

The exclusions will use a combination of pig/ungulate-proof fencing, and electrical fencing with the goal of keeping pigs from destroying the newly planted sites. Alignment of potential fencing on Mālama Hulēʻiaʻs Alakoko property is yet to be determined.

A pig captured on the Alakoko property during invasive predator control efforts.

Native Plant Restoration

In addition to removal of red mangrove other invasive plants, revegetation with native plants is a critical part of the restoration at Alakoko. Native land plants support both the aquatic ecosystem of the loko iʻa and terrestrial ecosystems. Native plants provide food and habitat for native fish and birds, contribute to the nutrient cycles throughout the watershed, help prevent the spread of invasive plants, and provide raw materials for traditional practices. Mālama Hulēʻia utilizes a variety of native species to meet specific restoration objectives.

At Alakoko loko iʻa, Mālama Hulēʻia is restoring wetlands and nahele (forests) with both native and culturally significant plants. Additionally, they will be establishing loʻi iʻa kalo and loʻi kalo plots as well as kīhāpai (small garden), māla ʻai (cultivated food garden), and māla lāʻau (medicine garden).

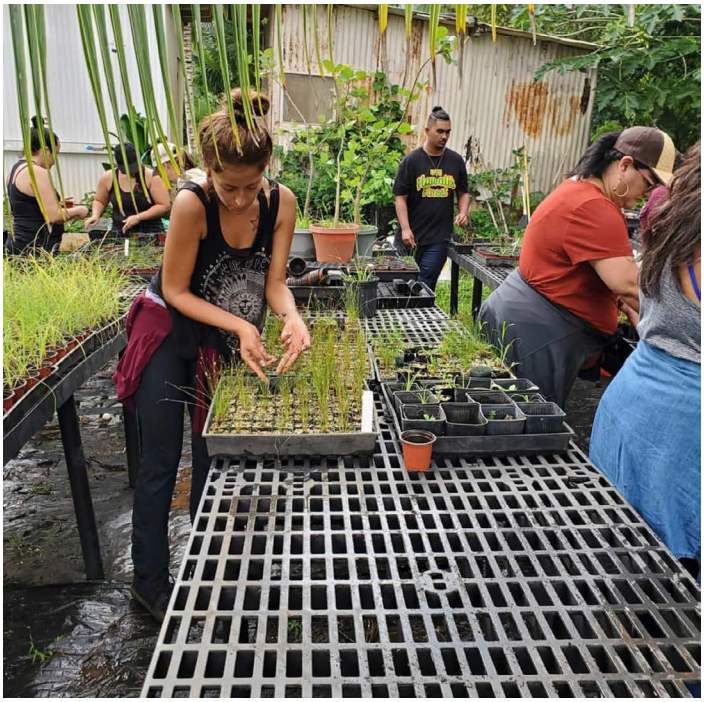
Native plant material collected from a test plot for use for weaving.

Aeʻae

Aeʻae is a hardy fast-growing water plant that is used to quickly provide ground cover around the loko iʻa where the ground is usually saturated. It prevents erosion, suppresses the growth of invasive plants, and provide habitat and shelter for fry and other juvenile fish.

Ahuʻawa

Ahuʻawa is a native wetland sedge that Mālama Hulēʻia plants to help provide diversity and habitat to the ecosystem. These plants have pale green leaves with sharp, finely serrated edges. Traditionally, the stems are pounded into fine strands which are used to strain ʻawa (beverage made from the root of the kava plant) for drinking during ceremonies, or for making light cordage.



Volunteers in the Mālama Hulēʻia nursery.

Makaloa

A once widely grown and utilized wetland plant, Makaloa is being replanted around Alakoko loko iʻa to increase diversity and habitat and to contribute to the revival of the traditional practice of weaving with dried makaloa strands. Makaloa mats are regarded as some of the finest mats found throughout the Pacific.

Aeʻae (left), ahuʻawa (center), and makaloa (right).

Kuapā Restoration

To rebuild the Alakoko kuapā (wall), Mālama Hulēʻia is relying on the knowledge, skill, and manaʻo (thought, belief) of native cultural practitioners. Cultural practitioners who work for Mālama Hulēʻia that excel in uhau humu pōhaku (traditional dry set masonry) and have hosted workshops to build local expertise and a cadre of uhau humu pōhaku practitioners who are dedicated to assisting Alakoko and other culturally important places across the islands. These practitioners are actively engaged in reconstructing the loko iʻa using traditional cultural knowledge gleaned from stories and writings of kūpuna and evolving the practice with modern techniques that will ensure success.

Native vegetation planted on the kuapā after mangrove removal.

The vision for Alakoko loko iʻa is not just shaped by the staff, board, technical experts, Hawaiian practitioners of loko iʻa and loʻi kalo, conservation professionals, scientists, and educators; it is also deeply rooted in the contributions of community volunteers, who are are also essential to the kuapā restoration. Their dedication, alongside the expertise of partners, underscores the significance of collective action, especially when guided by the wisdom of Hawaiian culture. This spirit of collaboration is informed by diverse ways of learning, including the Hawaiian practices of moʻolelo (stories), place names, oli (chants), and ʻike kūpuna (ancestral knowledge), and helps guide the restoration with wisdom passed down through generations.

The restoration of Alakoko is also central to the healing of the trauma experienced by the land and people of Hawaiʻi. With a cooperative spirit, Mālama Hulēʻia is moving forward to bind the community back to the land and water. Healing land and water is very straightforward, but healing a people's trauma is much more complicated. Events such as the E Kū Ana Ka Paia held in October 2023, where nearly 2,000 community members gathered to help repair the kuapā of Alakoko, is an example of collective action that benefits both people and place. The day started with a pledge to focus on positivity. Kūpuna provided wisdom and patience. Youth provided eagerness, strength, and continued hope moving forward. Laulima (cooperation)

Volunteers helping restore the Alakoko kuapā.

ensured that no pōhaku (stone) was too heavy to be put in place. Most of all, the unity that was achieved even for just a few hours gave everyone a stronger sense of hope and the feelings of success that occurs when people all work together for a greater good.

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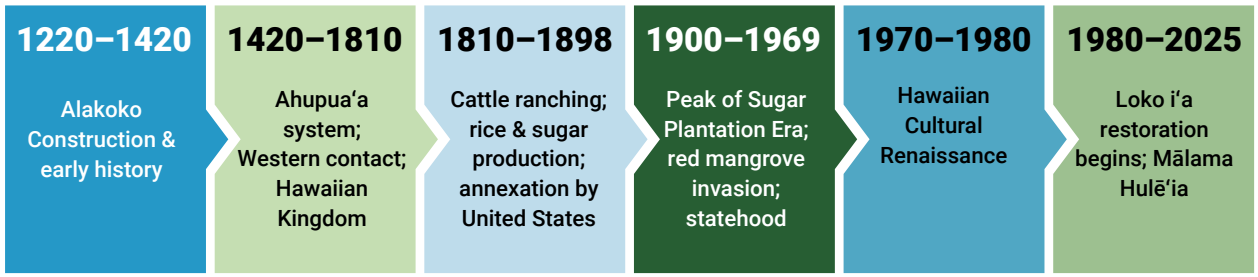
Appendix 5
Alakoko Loko I‘a Timeline & History

Alakoko Loko I‘a Timeline & History



1220–1420

According to radiocarbon dating, Alakoko was built approximately 600 to 800 years ago. Mo‘olelo suggests a kuapā was constructed in a single night by Menehune for the royal children of Niumalu, ‘Alekoko and Kalālālehua

Early 1400s

Around 1405 Kukonā, the 7th ali‘i (high chief or king) of Kaua‘i, was born in Kōloa, Kaua‘i. King Kalaunuiohua, the ambitious chief of Hawai‘i who had already conquered three other islands, tried to seize Kaua‘i. He was accompanied into battle by the combined armies and chiefs of Maui, Moloka‘i and O‘ahu. They landed ashore in Po‘ipū. The war is known as Ke Kaua ‘o Kawelewele, or ‘the War of the Clearing.’ The much smaller forces defending Kaua‘i, led by Kukonā and his son Manokalanipō, soundly defeated the invaders after leading them inland and then surrounding them at the shore. Kukona captured all four chiefs of Hawai‘i, O‘ahu, Maui and Moloka‘i. He had the opportunity to kill them all and assume leadership over the islands. However, he preferred peace and allowed them to return safely home with a promise that they never again make war on Kaua‘i. The peace that lasted since that time was called Ka La‘i Loa iā Kamaluohua, or ‘The Long Peace of Kamaluohua.’

1420–1810

Late 1400s

Kūkona’s son, Manokalanipō, organizes the ahupua‘a system on Kaua‘i. The island was divided into districts (moku) and sub-districts (ahupua‘a), each with their own land managers (ali‘i) who answered to the ali‘i ‘aimoku (paramount king). This system led to long lasting peace and advances in economy, engineering, architecture and culture.

Thriving Loko i‘a

Niumalu and Ha‘ikū are used extensively as a food production stronghold in the Puna district of Kaua‘i.

It is estimated that a 38-acre loko i‘a kuapā (walled fishpond) like Alakoko could provide 15,200–22,800 pounds of fish annually.

January 20, 1778

James Cook first arrives at Waimea, Kaua‘i.

1790s

Trade in ʻiliahi (Hawaiian sandalwood) begins. During this era, Kamehameha I had a near monopoly on the market. However, after his death, his son Kamehameha II (Liholiho) was unable to stop other chiefs from negotiating their own trade deals with foreign sandalwood traders. By 1830, the Hawaiian forests were exhausted and trade in sandalwood had completely collapsed.

1795

Kamehameha I, chief of Hawaiʻi Island, establishes the Hawaiian Kingdom after conquering the islands of Oʻahu, Maui, Molokaʻi, and Lānaʻi. Kauaʻi and Niʻihau remain independent.

1810–1898

1810

Cattle gifted to King Kaumualiʻi by early settlers are allowed to roam wild in Wailua and Hulēʻia.

1810–1824

King Kaumualiʻi peacefully cedes the islands of Kauaʻi and Niʻihau to Kamehameha I.

March 30, 1820

Missionaries first arrive at Kawaihae, Hawaiʻi.

1848

At the Māhele (land division/privatization) of 1848, Alakoko and the surrounding land was given to Princess Victoria Kamāmalu, who transferred to her father, Kekūanāoʻa and later to Princess Ruth Keʻelikōlani.

1850

Large amounts of loʻi kalo in Haʻikū are depredated by the wild herds belonging to the government. With increased regulation, cattle ranching continues to be used by community members.

1860

Loʻi kalo in Haʻikū transitions into rice production to create food for plantation workers.

1880

Princess Ruth Keʻelikōlani sold the property containing Alakoko loko iʻa to Paul Kanoa and for 106 years the land was owned by the Kanoa family and later the Kanoa Estate.

January 17, 1893

Queen Liliʻuokalani and the Hawaiian Kingdom are illegally overthrown on the island of Oʻahu by Hawaiian subjects of American descent, American citizens, and foreign residents residing in Honolulu.

July 4, 1898

Hawaiʻi is illegally annexed by the United States through a joint resolution of Congress.

1900–1969

Red mangrove was introduced to Hawai'i in 1902 by the American Sugar Company. It was brought first to Moloka'i to help with soil erosion. It has spread to almost all the island in Hawai'i. It is estimated that it first arrived in Kaua'i in the 1950s.

1930s

In the 1930s. Nāwiliwili Bay was filled in to build the harbor and breakwall. This caused significant changes to water circulation.

August 21, 1959

Hawai'i becomes the 50th state of the United States.

Nearly half of Kaua'i streams have diversions, Hulē'ia Stream has four different diversions.

In 1990, an average of 10 million gallons per day (MGD) were diverted from Kū'ia stream, a tributary of Hulē'ia, to Waita Reservoir through the Kōloa Tunnel.

Nāwiliwili Stream rated as one of the most polluted since 1978. Contamination incidents including gas, chemicals spils, sewage spills, and urban runoff from Līhu'e.

Pū'alì Stream is located below a sewage treatment plant and a retired landfill. Water testing from the area indicated fertilizer contamination from the plantations.

1970–1980

1970s

This period in Hawaiian history saw a renewed interest in 'Ōlelo Hawai'i, hula, traditional craft, Hawaiian Studies, and cultural identity. This time is referred to as the Hawaiian Cultural Renaissance.

1971

A hula competition is first held at the Merrie Monarch Festival in Hilo, Hawai'i.

1974

Researchers for the National Park Service begin to identify fishpond remnants throughout Hawai'i ideal for historic preservation. Alakoko is identified in their initial report.

1976

The Hōkūle'a successfully navigates from Hawai'i to Tahiti using only traditional navigation techniques.

1978

The Hawai'i State Constitutional Convention is held, laying the groundwork for the return of federal land such as the island of Kaho'olawe and creating the Office of Hawaiian Affairs in an effort to right the wrongs done towards Native Hawaiians since the overthrow of the Kingdom of Hawai'i. The Hawaiian language becomes the official state language of Hawai'i for the first time since 1893.

1980–2025

1986

The Kanoa Estate sold the Alakoko property to the Okada Trucking Company.

1987

The Hawai'i State Department of Education begins managing the Hawaiian Language Immersion Program (HLIP) in its public school system.

1989

Hui o Kuapā is established on Moloka'i to restore traditional fishponds.

November 23, 1993

The United States Congress adopts the Apology Resolution and "acknowledges that the overthrow of the Kingdom of Hawaii occurred with the active participation of agents and citizens of the United States and further acknowledges that the Native Hawaiian people never directly relinquished to the United States their claims to their inherent sovereignty as a people over their national lands..."

1996

Nā Kālai Wa'a o Kaua'i (NKWoK), or The Canoe Builders of Kaua'i, is founded.

2001

Paepae o He'eia, a private non-profit organization dedicated to caring for He'eia Fishpond, is established.

2004

Hui Mālama Loko I'a begins growing a network of fishpond practitioners and organizations from across ka pae'āina o Hawai'i.

2013–2014

Canoe paddlers with Kaiola Canoe Club began to notice changes along the river.

2015

Mālama Hulē'ia nonprofit corporation is formed.

2015–2017

Mālama Hulē'ia completed mangrove removal and wetland restoration pilot project at Pu'ali, on County of Kaua'i land.

2017

Mālama Hulē'ia began restoration efforts at Alakoko loko i'a. Between 2018 and 2021, Mālama Hulē'ia removed 26 acres of invasive red mangrove that surround the pond.

2021

Mālama Hulē'ia purchased the property containing Alakoko loko i'a, with support from the Trust for Public Lands.

2022–2025

Mālama Hulē'ia continues restoration efforts at Alakoko loko i'a and initiates conceptual master planning.

Appendix 6
At Loko Alakoko, What's Under the Wall?

By Jan TenBruggencate

The Alakoko fishpond wall has been described in detail many times over the years, often by people who apparently never actually inspected the wall itself.

It is a unique structure among Hawaiian fishponds, an inland pond wall structure that—for much of its length—combines an earthen berm with basalt boulders armoring on its outer river-side face, but not on the inner pond-side face. Kauaʻi archaeologist William "Pila" Kikuchi in 1973 said it was the first brackish-water fishpond built in the Hawaiian Islands. He said it was alternately called Alakoko, Alekoko and Pēpēawa. It is the largest fishpond on the island of Kauaʻi, according to a 2012 report prepared by Angela I. Faʻanunu, Margaret Magat, and Hallett H. Hammatt, of Cultural Surveys Hawaii.

In its combined mud and rock construction it is different from most known Hawaiian coastal pond walls. Those tend to be entirely made of large basalt boulders, or more commonly, basalt on both inner and outer walls, with an interior of porous ʻiliʻili, or small stones and pieces of coral. Figure A6-1 is from Kikuchi, 1973, is a cross-section view of a standard wall construction often used on the other islands, this one the Aliʻi Fishpond on Molokaʻi.

But the Alakoko wall uses a technique related to one that is common on Kauaʻi, where many Hawaiian old wall structures, whether for religious structures like heiau or for border walls, are constructed of earthen berms faced on the sides and top with basalt boulders. Some say that's because there are fewer rocks and more soil on Kaua`i, which is geologically much older than the other islands.

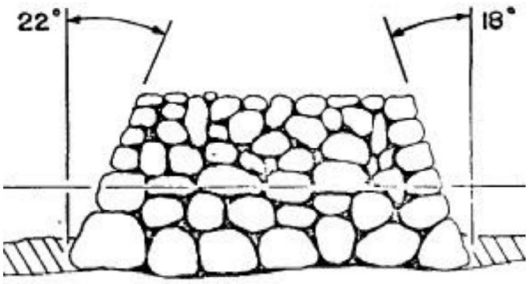


Figure A6-1

The east-west-running Alakoko pond wall disappears into the swamps and hillside at the west and touches the surrounding ponds and lowlands to the east.

Archaeologist Francis K.W. Ching in his 1973 “The Archaeology of Puna, Kaua‘i,” reports that the entire wall is underlain or bordered by an older basalt wall on the river floor, which is between 13 and 20 feet wide. Here is his rendering of his assumed cross-section (Figure A6-2).

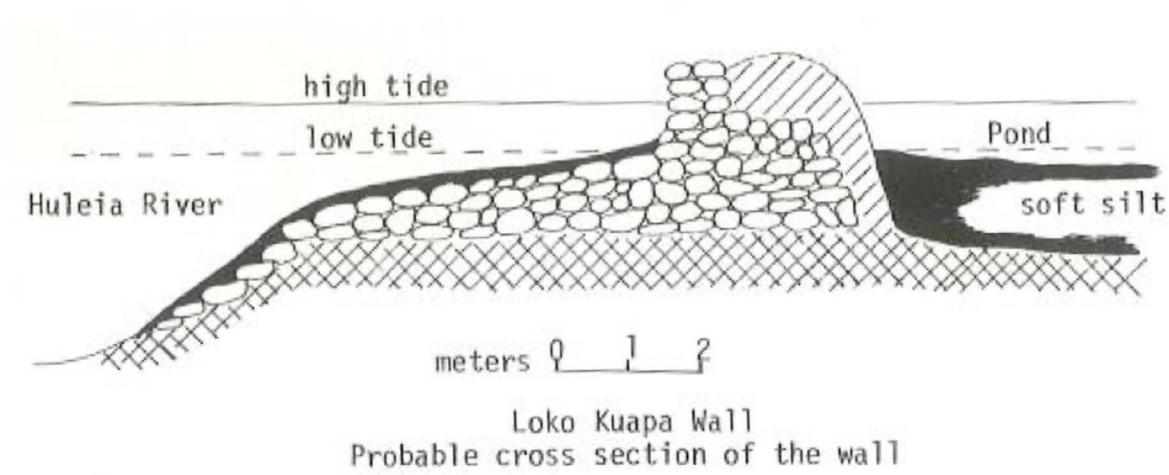


Figure A6-2

But it is not clear how Ching came to that assumed shape. He also envisions a wall that is earthen top to bottom, with a vertical rock wall on its river-facing side. Here are two of his views of that theoretical configuration (Figure A6-1):

What is clear from the surface is that the design in cross section changes, depending on where you are along the length of the wall. In the middle section, it has an earthen berm that is faced on the river side by a stone wall that is generally two boulders thick. But approaching the upstream or western end, the rock portion is only one rock thick. Ching measures the rock-faced portion at 1,764 feet in length. At the extreme western end, there appears to be no rock face; just a 435-foot earthen berm. That is also the case at the extreme eastern end, whose length depends on where you conclude the end is.

Figure A6-3

How long is the wall? Ching places the total wall length, confusingly at both 600 meters and 2,700 feet. Since 600 meters is no more than 1900 feet, that must be a typographical error. Faʻaunu, Magat and Hammatt put the wall at 825 meters, or about 2,560 feet. Mike Carson, in his 2005 paper, ʻAlekoko Fishpond, places the wall at 850 meters, or about 2,635. Bennett in 1931's "Archaeology of Kauai," says "over 900 yards." One common number used by others is 900 yards, which is the same as Ching's 2,700 feet. But when a team from Mālama Hulēʻia informally measured, starting where the western wall disappears into swamp and running to its eastern terminus, they came up with less than 2,000 feet.

This is not to suggests all these professionals didn't measure, but that it is difficult to decide where to measure. It is a challenge to designate the endpoints. In 2021, the western end of the wall seems to disappear into a swamp, while the eastern end connects to the walls of smaller ponds. Where does the Alakoko wall end and the next feature begin? That decision is up to the person doing the measuring.

Some tellers of tales have suggested that the Alakoko wall is made of cut stones, like those used in the prehistoric Kikiaola aqueduct at Waimea, Kauaʻi. Alakoko and Kikiaola have long been connected in legend, and Kikuchi suggests they were built in the same time period by some of the same masons. The cut-stone Alakoko theory seems to come from people who have never looked at the wall, since there is no evidence of that.

Other writers have argued that the Alakoko wall is entirely made of basalt rocks, like many other fishponds, without an earthen core.

When Mālama Hulēʻia began the arduous work of removing the invasive, destructive mangrove overgrowth, whose roots were tearing apart the wall, certain small truths became evident. And as we suggested above, neither the cut-stone theory nor the all-rock theory holds water.

At no point is the wall entirely made of rock if viewed in cross-section. In fact, much of the wall is indeed earthen berm with no evidence of rock. Certainly the ends are entirely made of piled mud and sand. In the central portion, for some of its distance, the mud/sand berm is faced with lava rocks. Thus far in Mālama Hulēʻia's work, none of those basalt rocks have shown evidence of shaping like the Kikiaola wall stones. All the rocks appear to be rough basalt stones, of a size appropriate for a human to carry.

Why is this particular fishpond wall so different from others?

Most Hawaiian pond walls were built on shallow reef flats, where builders could walk in knee or waist-deep seawater to set their stones. But parts of the Hulēʻia River nearby are 8-10 feet deep, although we don't know how deep the river was in about 1400, when it was built. Almost certainly,

builders would have had to work underwater. Were they lowering the first ranks of stones from canoes? Or perhaps were Hawaiian stonemasons walking on the river bottom, carrying basalt burdens as they held their breath? And after the fact, was this work of construction so heroic that storytellers invented the tale about magical Menehune doing the construction instead of their own inventive but human ancestors?

One thing that is clear in the appearance of the wall is that it has been touched by many hands, by people with different theories about construction, and with access to different materials. It is a living wall that has changed over time.

That bears out the known history, both from early Hawaiian legends and from the period after Western contact. Many of the early legends suggest that Hawaiians of the area started the wall, but were unable to finish. The legends say skilled craftsmen—some say they were Menehune spirit people from the forest—were called in to finish it. They would have had different construction methods. Also, during the 1800s and 1900s the pond wall was reconstructed at least twice, about 1900 and again after the 1946 tsunami. There would also have been repairs after other storms and wave events.

An 1890 photo attributed to Theodore P. Severin shows the wall in disrepair with its eastern end broken open (Figure A6-4).

A photo dated at 1900 shows the breach repaired (Figure A6-5). The provenance of this photo is not known.

By 1912, the photo shows that significant additional work had been done, adding new ponds at the eastern end of the wall (Figure A6-6). This photo by Ray Jerome Baker is courtesy of Bishop Museum.

So at a minimum, there are historical suggestions it was started by commoners of the region, completed by skilled masons, and rebuilt over the years by workers under early chiefs. Then in the more recent period, by Chinese farmer merchants who managed the pond from the late 1800s into the 1900s and by western operators in the 1940s. Each of them would have approached the pond challenge differently, and some, notably in the 1900 period, added features like two eastern ponds that may have been used as nurseries, harvest holding ponds, or for other aquaculture related purposes.

Ching suggests that the pond may have started its life as a fishtrap or pā, with a low wall whose top was between the low and high tides. That way fish would have traveled over the wall at high water, and would have been trapped inside at low water for easier catching. The subsequent traditional pond wall may have been built atop the pā wall, Ching says. But he also says it may simply have always been a regular enclosed pond, a loko kuapā.

The traditional Hawaiian mākahā, or control gates, which would have been built of basalt stones and wooden lattices, are gone. They have been replaced by more modern concrete structures. Mālama Hulēʻia is aware of three mākāhā. One is midway down the length of the wall. One in the surviving north-south wall at the eastern end of the pond (visible on the lower horizontal wall in the photo above.) And the foundations of a third have been located, buried in sediment west of the previous mākāhā and visible in the photo above midway on the upper horizontal wall. The construction of

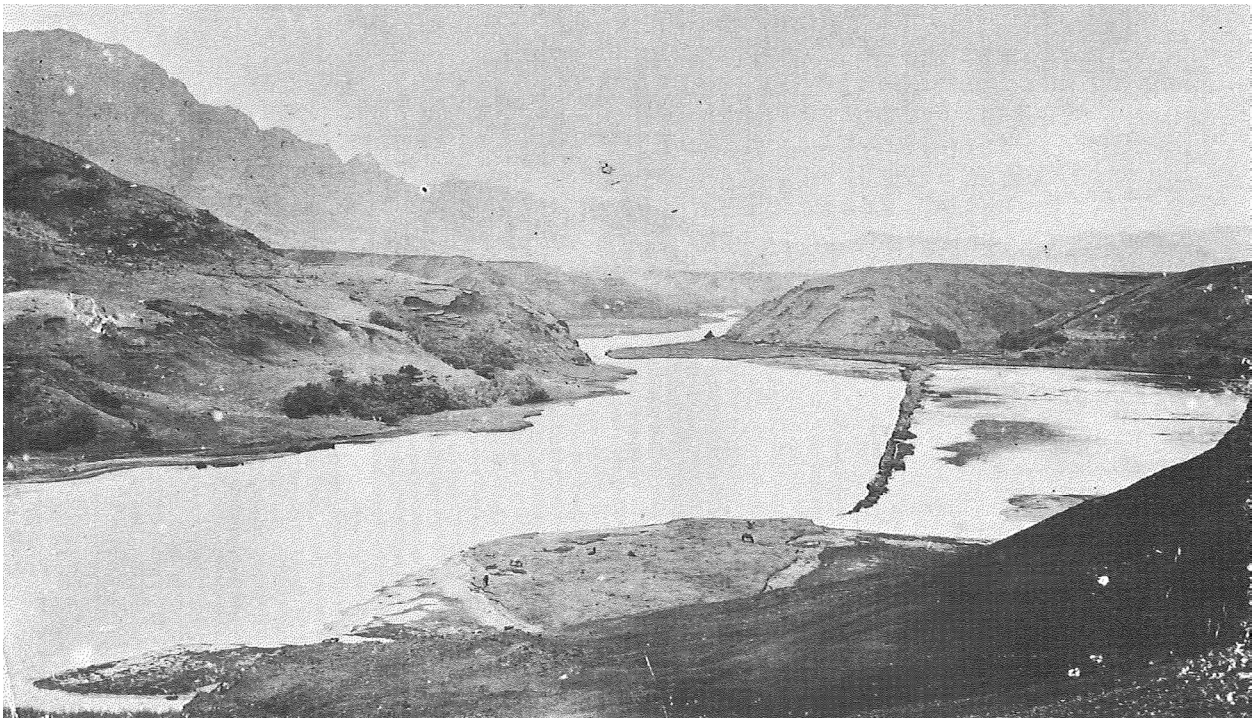


Figure A6-4

Figure A6-5

the different mākāhā is different, so they may not all have been built at the same time by the same people. Mālama Hulēʻia has not yet established dates of construction.

There are reports that sheets of roofing iron were inserted into the mud along the interior side of the wall, and still visible in the 1970s.

Figure A6-6

Bags of concrete were used to make repairs after the 1946 tsunami. Some of those bags are still visible on the top of the wall today, in the area near the main pond wall mākāhā.

Archaeologists have done isolated test pits and have probed through the water and mud to try to find answers about the wall's actual features, but their results were necessarily limited. Beneath the surface, lie mysteries yet to be revealed.

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This appendix was originally published on the Mālama Hulēʻia website. Available at https://malamahuleia.org/at-loko-alakoko-whats-under-the-wall-2/ (accessed 31 July 2025).