August 14, 2025

MEMO TO: KAʻĀ-1(7) File

F R O M: Keani N.W. Rawlins-Fernandez, Chair
Kōmike Aloha ʻĀina

SUBJECT: **TRANSMITTAL OF INFORMATIONAL DOCUMENT RELATING TO MOLOKAI CLIMATE CHANGE AND SEA LEVEL RISE ADAPTATION AND RESILIENCY MASTER PLAN** (KAʻĀ 1(7))

The attached informational document pertains to Item 1(7) on the Committee's agenda.

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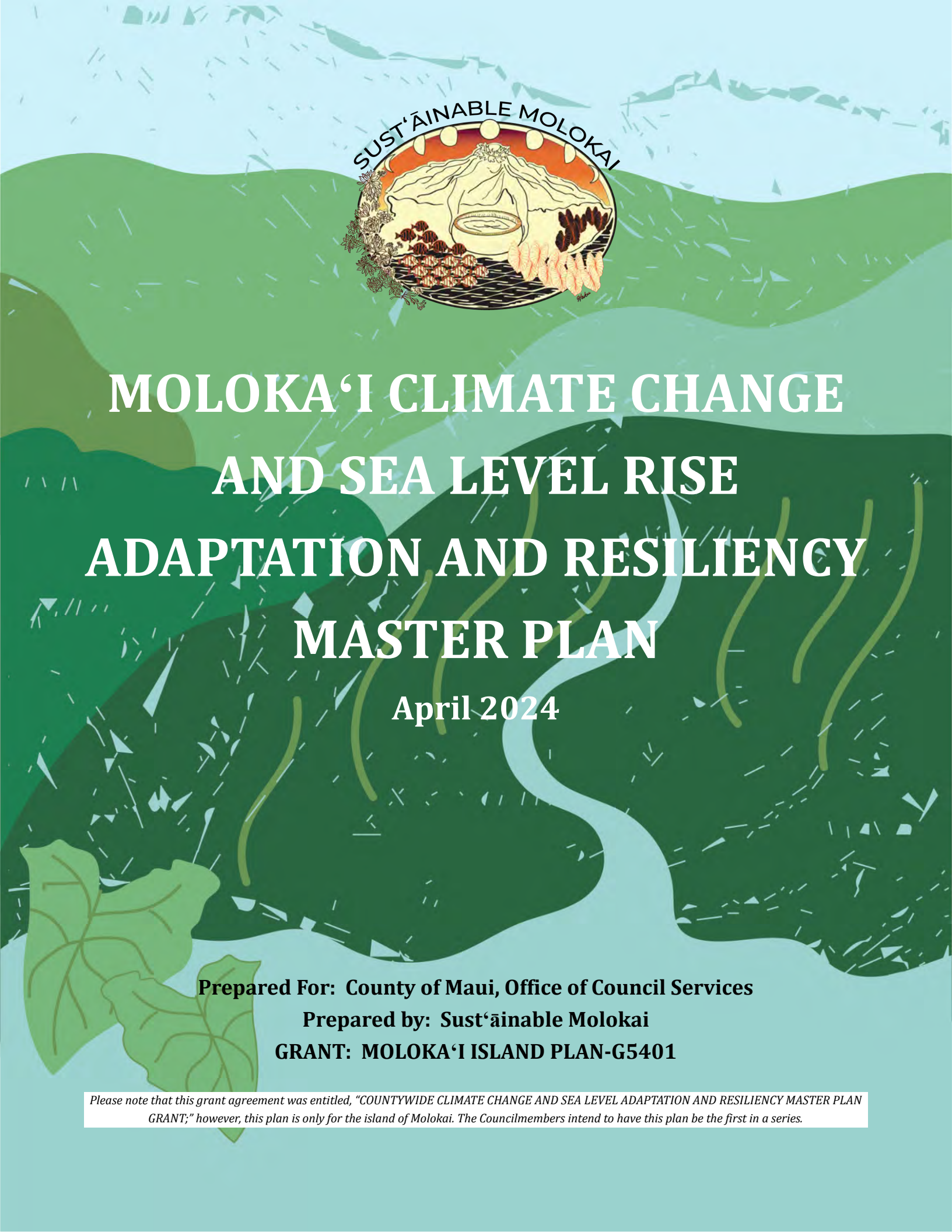
Attachment



MOLOKA'I CLIMATE CHANGE AND SEA LEVEL RISE ADAPTATION AND RESILIENCY MASTER PLAN

April 2024

Prepared For: County of Maui, Office of Council Services

Prepared by: Sust'āinable Molokai

GRANT: MOLOKA'I ISLAND PLAN-G5401

Please note that this grant agreement was entitled, "COUNTYWIDE CLIMATE CHANGE AND SEA LEVEL ADAPTATION AND RESILIENCY MASTER PLAN GRANT;" however, this plan is only for the island of Molokai. The Councilmembers intend to have this plan be the first in a series.

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LIST OF ACRONYMS:

AR6	6th Assessment Report
CARP	Maui County Climate Action & Resiliency Plan
CCSLAR	Molokaʻi Climate Change and Sea Level Rise Adaptation and Resiliency Master Plan
CEDS	County of Maui Comprehensive Economic Development Strategy
CERAP	Molokaʻi Clean Energy Resilience Action Plan
COM	County of Maui
CZMA	Coastal Zone Management Act
DHHL	Department of Hawaiian Homelands
DOE	Hawaiʻi State Department of Education
DOH	Hawaiʻi State Department of Health
EDA	Economic Development Administration of the U.S. Department of Commerce
FEMA	Federal Emergency Management Agency
HDOT	Hawaiʻi State Department of Transportation
IPCC	Intergovernmental Panel on Climate Change
KIM	Ka Ipu Makani Heritage Center
KWRF	Kaunakakai Wastewater Reclamation Facility
MCHC	Molokaʻi Community Health Center
MECO	Maui Electric Company
MHS	Molokaʻi High School
MMS	Molokaʻi Middle School
MWP	Molokaʻi Wetland Partnership
NCRF	DHHLʻs National Coastal Resilience Fund
NOAA	National Oceanic and Atmospheric Administration
OCS	County of Maui Office of Council Services
RFP	Request for Proposal
SEI	Sea Engineering, Inc.
SLR	Sea Level Rise
SM	Sustʻāinable Molokai
SM-SEMP	South Molokaʻi Shoreline Erosion Management Plan
SSP	Shared Socioeconomic Pathways
TLUs	Traditional Land Use Overlays
TSI	Townscape, Inc.
USGS	United States Geological Survey

Molokaʻi Community Values

Understanding what the Molokaʻi community values is the only way to understand the characteristics, expectations, and priorities that influence this community's decision making.

The Molokaʻi community's renowned advocacy is rooted in cultural values that are unwavering and consistently expressed and documented throughout history. The Molokaʻi community continues to clarify their values through the Molokaʻi CERAP process. Echoing the vision statement from the 2018 Molokaʻi Island Community Plan, Molokaʻi's values are captured here, not only as the translation of a Hawaiian word or concept, but as living, breathing, measurable functions that further define the Molokaʻi community, its collective purpose, and way of life.

Molokaʻi Community values courtesy of Molokaʻi CERAP

Molokaʻi's Community Values	Functional Definition/Action Oriented Translation
Aloha ʻĀina *(poʻe Hawaiʻi purpose of existence)* Lit. deep love of land or of one's country, that which feeds, land and people	Individual and collective actions that improve the physical health and advancement of Hawaiʻi's people and ʻāina (land) through the fierce protection of resources and unwavering prioritization of culturally based stewardship of ʻāina.
Ea: Self governance & Independence *(community-based decision making process)* Lit. sovereignty, independence	The Molokaʻi community's ability to lead their own decision making processes to achieve informed community consent with the ability to pull consent at will. Includes: research, solution design, implementation, maintenance/operation, ownership.
Pono *(evaluating/balancing system)* Lit. fair, equitable, righteous/moral, accurate, correct, necessary, successful, excellent	A community-led cultural value-based system of evaluating and adjusting decisions and actions to ensure they cultivate aloha ʻāina and achieve community consent.
Sustainability *(network of systems that support aloha ʻāina)* Lit. the quality of a state or process that allows it to be maintained indefinitely, the avoidance of the depletion of natural resources in order to maintain ecological balance	When an integrated network of systems, programs, and people that foster aloha ʻāina are established and maintained to ensure all essential needs are met in perpetuity.
Lōkahi *(community organizing)* Lit. unity, agreement, unanimous sentiment	A firm commitment to achieving a unified voice/community consensus based on community expertise that is informed by technical research and empirical data.
Kuleana *(community commitment)* Lit. right, privilege, responsibility, function	An understanding and commitment to the active responsibility each individual, group, peoples, etc. has to their community and ʻāina (land).
Community *(decision makers)*	Molokaʻi residents and ʻohana who work to understand and perpetuate Molokaʻi's cultural value based lifestyle.
Kahua *(framework for value based decision making)* Lit. foundation, base, groundwork, platform to stand/build upon	The framework for understanding community protocol, values, priorities, requirements and needs on Molokaʻi.
Pilina *(community engagement)* Lit. relationship, association, connection	A relationship or connection built on mutual respect, trust, and accountability.

Hyperlink to Table of Contents

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1. EXECUTIVE SUMMARY

1. EXECUTIVE SUMMARY

This Executive Summary includes an overview of the five primary chapters of the **Molokaʻi Climate Change and Sea Level Rise Adaptation and Resiliency Master Plan** (CCSLAR).

Chapter 2. Project Overview

Climate change is affecting the entire world, and Molokaʻi is no exception. As a small island in the middle of the Pacific Ocean, it is imperative that we adapt in order to survive. This **Molokaʻi Climate Change and Sea Level Rise Adaptation and Resiliency Master Plan** (CCSLAR) is a critical early-stage step in this essential adaptation process, which will be on-going for decades.

It should be noted that this plan is just one of numerous related processes. Thus, the authors have collaborated and coordinated with those other efforts - aiming to minimize redundancy and maximize efficiency. Specifically, the scope and purpose of this plan is to **work closely with the community to identify priority sites/areas where sea level rise - and related erosion and flooding - are considered most critical, and to recommend community-supported adaptation strategies to mitigate these impacts.** The goal is to identify adaptation strategies that will preserve natural and cultural resources as much as possible, while also being cost-effective. **Furthermore, Sustʻāinable Molokai is committed to continued efforts to see these strategies implemented.**

This section includes a brief overview of the primary climate change impacts our island has been experiencing, including sea level rise (SLR), which is the focus of this plan. It should be noted that the Molokaʻi Sea Level Rise Vulnerability Assessment prepared by Sea Engineering, Inc., specifically for this project, includes significant data on this topic, and provides the technical foundation for this planning process (included as Appendix A1). This section also provides an overview of the project purpose, approach, and the community engagement activities undertaken.

Overall, despite the daunting climate change and SLR trends and impacts described in this section, there is some good news: Molokaʻi has a low population density, a significant amount of open space, and a community that has a strong history of working together to protect our island from tourism, over-development, and other outside threats. Thus, with proper planning, we have an opportunity to prepare for these impending climate change impacts, and to be a model for other islands facing similar challenges.

Chapter 3. Existing Data, Maps, and Planning Efforts

Once the project officially got underway in July 2021, one of the initial steps taken was to identify existing data, research, and related studies/plans, both past and current. This chapter gives a high-level overview of those findings, including how this plan incorporates that information and intersects with those efforts. The end of this section explains how we compiled and presented that information to improve the community's collective understanding on the risks to infrastructure from flooding and inundation caused by climate change and sea level rise, as well as our plans to collaborate in future related efforts.

Sustʻāinable Molokai (SM) worked with Sea Engineering, Inc. (SEI) and Townscape, Inc. (TSI), to identify the most recent and relevant existing SLR scenarios, erosion data and methodologies to use for the most up-to-date mapping SLR for Molokaʻi. For a compilation of the relevant SLR scenarios, data, and methodologies, please see Molokaʻi Sea Level Rise Vulnerability Assessment, "Section 2. SEA LEVEL RISE," by SEI, in **Appendix A1.**

This Plan is a stand-alone document with the specific goal of identifying priority sites/areas where sea level rise - and related erosion and flooding - are considered most critical, and to recommend community-supported adaptation strategies to mitigate these impacts. However, in order to provide the best recommendations, we needed to also consider all existing regulations for our coastal areas, which include federal, state, and county regulations and policies. Furthermore, there are numerous related planning processes that are completed, in process, and planned for the future. Thus, we wanted to be sure to review, build off, and coordinate with all relevant planning efforts. This section summarizes those policies, plans, and related planning processes.

Chapter 4. Priority Sites - Sea Level Rise Adaptation & Mitigation Strategies

The following is a list of the 13 Priority Sites that were identified through our community and key stakeholders engagement process. It should be noted that we also took into consideration key factors such as community impact/need, site ownership (County sites prioritized), existing plans, etc. Based on this process, the following 13 Priority Sites were identified:

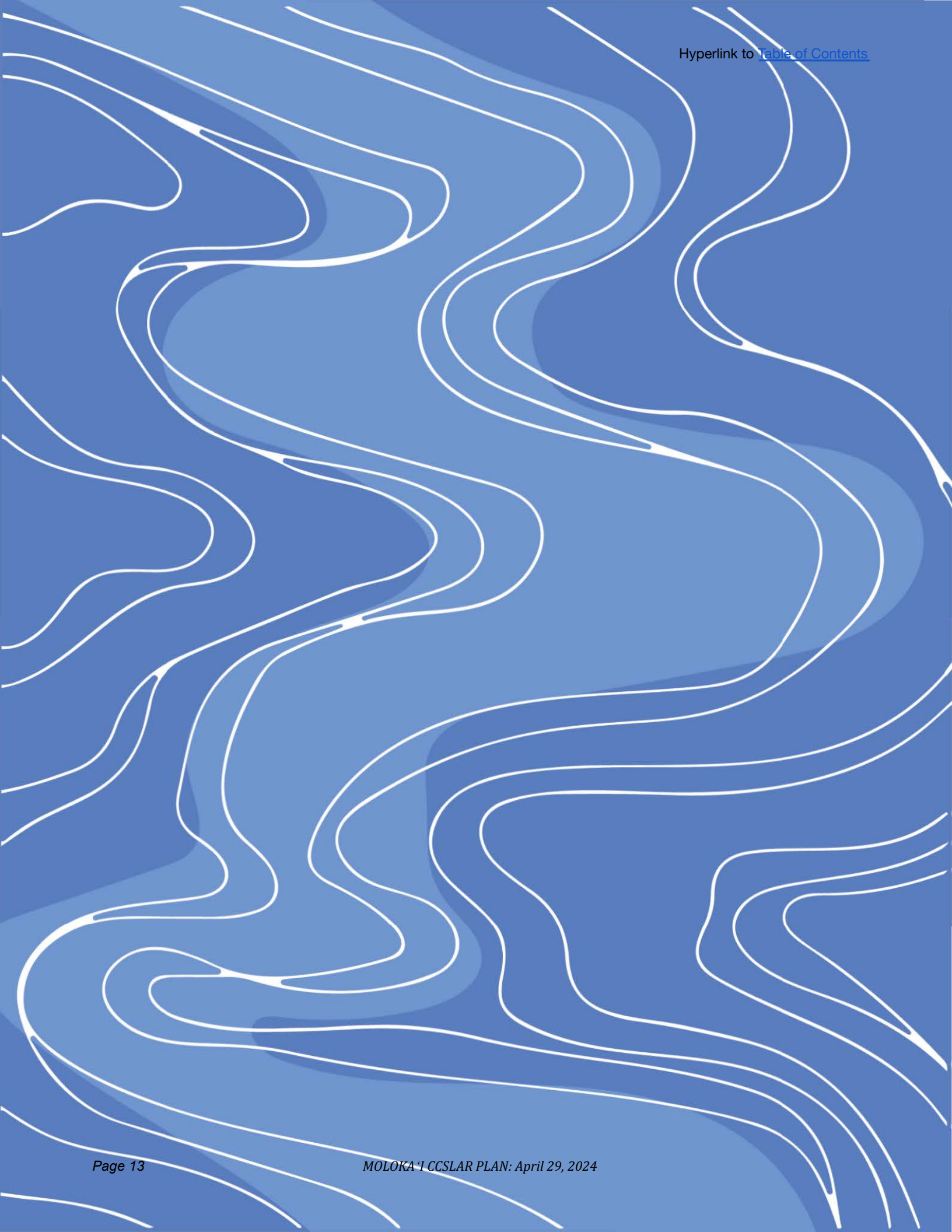
1. **Kaunakakai Wastewater Reclamation Facility: (CoM)**
2. **Kaunakakai Wharf**
3. **South Shore: Coastal Business Example**
4. **South Shore: Coastal Residential Example**
5. **Kākahaiʻa National Wildlife Refuge & Beach Park**
6. **Kamalō: Wharf, Roadway & Wetland Area**
7. **Keawanui Fishpond**
8. **East Shore: Residential & Business Example: Pūkoʻo**
9. **Roadway Section #1: Kaunakakai (Maunaloa Highway/Kamehameha V Highway**
10. **Roadway Section #2: Our Lady of Seven Sorrows Catholic Church/Niʻaupala Fishpond**
11. **Kapaʻakea Cemetery (CoM)**
12. **Kalamaʻula Landfill (CoM)**
13. **Brownfield (former MECO site; currently Ross)**

This chapter provides a summary of each site, including the history, current situation, and projected inundation/issue(s), vulnerability assessment, adaptation needs, conceptual adaptation strategies, and preliminary cost to implement - for the short-, mid-, and long-term. In general, short-term indicates 1-3 years (immediate actions); mid-term indicates 3-5 year actions; long-term indicates 5-20 year actions.

It should be noted that SLR adaptation methods fall into three general categories: protection, accommodation, and relocation. Protection can be further broken down into “hard” protection (engineered structures to armor the shoreline) and “soft” protection (more nature-based or “green” solutions). Protection prevents the effects of SLR from occurring (e.g., blocks the rise from moving inland). Accommodation reduces the SLR impacts (e.g., it happens but you can live with it). Relocation mitigates vulnerability by moving people and infrastructure outside of areas that are or may be impacted by regulatory requirements; however, the land that remains will continue to experience the impacts of SLR. All of these methods involve modifying or adopting new laws, policies, and regulatory requirements; social and economic considerations; assessing possible environmental impacts; and assuming varying degrees of financial costs. More detail of the priority sites is included in the SEI DRAFT Molokaʻi Sea Level Rise Vulnerability Assessment in **Appendix A1**. The section and page numbers are indicated for each site.

Chapter 5. Next Steps

This Chapter summarizes the next steps that are needed to implement the adaptation strategies and policies recommended. It includes short-, mid-, and long-term climate change response and action strategies; coupled with an identification of potential funding sources and key partners; and reflecting coordination and informing related ongoing plans and community initiatives. This chapter also identifies legal hurdles and proposes the adoption of new climate related laws and policies in order to implement some of these strategies.



2. PROJECT OVERVIEW

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Climate change is affecting the entire world, and Molokaʻi is no exception. As a small island in the middle of the Pacific Ocean, it is imperative that we adapt in order to survive. This **Molokaʻi Climate Change and Sea Level Rise Adaptation and Resiliency Master Plan** (CCSLAR) is a critical early-stage step in the adaptation process, which will be on-going for decades.

It should be noted that this plan is just one of numerous related processes. Thus, the authors have collaborated and coordinated with those other efforts - aiming to minimize redundancy and maximize efficiency. Specifically, the scope and purpose of this plan is to **work closely with the community to identify priority sites/areas where sea level rise - and related erosion and flooding - are considered most critical, and to recommend community-supported adaptation strategies to mitigate these impacts.** The goal is to identify adaptation strategies that will preserve natural and cultural resources as much as possible, while also being cost-effective. **Furthermore, Sustʻāinable Molokai is committed to continued efforts to see these strategies implemented.**

2.1. Climate Change on Molokaʻi

The island of Molokaʻi is the fifth largest of the Hawaiian islands, covering 261 square miles, with 88 miles of shoreline. With a population of approximately 7,000, no one lives farther than 5 miles from the coastline, and many live right along the southern and eastern shores. Kaunakakai, the island's main population and commercial center, is located near the center of the south coast. In addition, much of the infrastructure, including roads and utilities, run along the coast, as well as innumerable cultural and natural shoreline resources that are widely utilized by the community.

This section includes a brief overview of the primary climate change impacts our island has been experiencing, including sea level rise (SLR), which is the focus of this plan. It should be noted that the Molokaʻi Sea Level Rise Vulnerability Assessment prepared by Sea Engineering, Inc., specifically for this project, includes significant data on this topic, and provides the technical foundation for this planning process (included as Appendix A1).

Overall, climate change is creating a new norm of unpredictability. For example, Molokaʻi has been experiencing prolonged drought since the 1980s.[1] This is combined with a colonial history of poor land management, including deforestation, wild, non-native ungulates, and ranching, all of which have altered the watershed so that when heavy rains do come, there is nothing to hold the water - often resulting in severe flooding, run-off, and erosion.[2] The run-off accumulates on the reef, which in turn negatively impacts the ocean resources.[3] Furthermore, drought conditions have at times pushed our deer population to decimate agricultural crops.

All of this affects our community's ability to exercise traditional and customary practices, including subsistence fishing, farming, hunting, and gathering. This is critical since approximately 39% of the average Molokaʻi family diet comes from subsistence.[4] Specifically, fishing is an important traditional and cultural practice, with 24.1% of households engaging in fishing per 2-month period.[5] Activities and practices taking place along the shoreline would be negatively impacted by coastal erosion and beach loss.

Furthermore, sea level rise is already impacting numerous coastal homes, businesses, and cultural resources. As climate change continues to accelerate, sea levels will continue to rise. It is estimated that rising sea levels and high tides have already eroded 85% of Hawaiʻi's beaches.[6] By the end of the 21st century, scientists predict that sea levels will rise another 3.2 ft.[7]

With 3.2 ft of SLR, which is the State of Hawaiʻi planning target), several portions of Molokaʻi would become threatened. Specifically, 780 structures are estimated to be flooded resulting in an estimated $280 million in structure and land loss and 560 displaced residents.[8] Molokaʻi has one of the fewest numbers of total State facilities (69), but it has the highest percentage of vulnerable State facilities in the 3.2 ft SLR-XA (7.25%). Kaunakakai is the primary port of entry for ocean cargo into Molokaʻi and is vulnerable in all SLR scenarios.

[1] DLNR, Revised Hawaiʻi Drought Plan (2017 update). https://files.Hawaiʻi.gov/dlnr/cwrm/planning/HDP2017.pdf

[2] Dunbar-Co, PhD, "East Slope Watershed Start-Up Management Plan; East Molokai Watershed Partnership," (2013), pages 3; 15-16; OHA, "Traditional & Customary Practices Report for Manaʻe, Molokaʻi," (2016).

[3] USGS, "The coral reef of South Molokaʻi, Hawaiʻi— Portrait of a sediment-threatened fringing reef," (2008)

[4] Unpublished findings of the Molokaʻi Subsistence Study Update, (Afelin, 2024); Manaʻe TCP (2016); SM Ag Assessment (2011).

[5] McCoy, et. al., 2018 (from SEI report)

[6] Charles H. Fletcher et al., "National assessment of shoreline change: Historical shoreline change in the Hawaiian Islands," U.S. Geological Survey Open- File Report 1051 (2011): 55, quoted in County of Maui, "County of Maui, Hawai'i Climate and Community Trends Primer," (2022), 6.

[7] National Oceanic and Atmospheric Administration. "Coastal Erosion Line: Hawaiʻi 3.2 ft. Sea Level Rise Scenario," (2020), https://data.noaa.gov/dataset/dataset/coastal-erosion-line-Hawaiʻi-3-2-ft-sea-level-rise-scenario.

[8] Hawaiʻi Climate Change Mitigation and Adaptation Commission, Hawaiʻi Sea Level Rise Vulnerability and Adaptation Report (2017 & 2022) [hereinafter Hawaiʻi SLR Report 2017 or 2022].

King Tides have brought ocean water over roads and into our community. There are also increased impacts from wave inundation during tropical storms and hurricane events. Much of Molokaʻi's critical public infrastructure is concentrated in low-lying areas and is highly vulnerable to flooding. Approximately 2.2 miles of Molokaʻi's coastal roads, primarily Kamehameha V Highway, would become vulnerable to flooding, which could jeopardize critical ingress and egress to many communities. Chronically flooded roadways would result in regional impacts such as loss of commerce, loss of access to emergency services, and increased congestion on other roads and highways.

Septic tanks, cesspools, and other on-site sewage disposal systems, as well as hazardous materials storage and disposal sites, could become flooded with SLR resulting in the discharge of wastewater or contaminants into nearshore waters. Salt-water intrusion associated with SLR could also back-up cesspool systems and inundate homes with raw sewage, thereby posing a human and public health risk. On Molokaʻi, there are 131 on-site sewage disposal systems located within the SLR-XA with 3.2 ft of SLR.[9]

Saltwater infiltration is already impacting our community, including our wastewater facility, as well as certain agricultural crops, most prominently taro grown in loʻi.

In addition to Native Hawaiian communities themselves, many Native Hawaiian cultural and historical resources are located near the shoreline and are threatened by SLR. Coastal erosion already threatens areas that have served as burial grounds, home sites, fishponds, and other places of cultural significance.[10] The number of cultural sites on Molokaʻi that are located in the SLR-XA is projected to increase from 17 sites with 1.1 ft of SLR to 26 sites with 3.2 ft of SLR. Rising sea levels would also impact the many loko iʻa (fishponds) located on Molokaʻi.

In addition to coastal flooding, SLR can flood inland areas by raising ground water above surface levels in low-lying areas and by backing up storm drain systems. An example of an area that already experiences this type of flooding is Māpunapuna on Oʻahu, where high tides cause ground water inundation, affect the stormwater system to back up and flood low-lying streets with salt water, and prevent storm water from draining seaward during rains. King Tides, exceptionally high tides occurring during a new or full moon, exacerbate these conditions. While these conditions are considered "nuisance flooding" because they disrupt day-to-day activities only periodically (perhaps one or two times per month), these situations could occur more frequently with sea level rise, with flooding predicted to be mostly caused by such storm-drain backflow and groundwater inundation rather than by direct coastal flooding.

Overall, this is only the beginning. We know these trends will continue and will bring more severe impacts. This report includes the most up-to-date SLR data available, along with maps that demonstrate the current and impending impacts to our island. Modeling and maps of wave impacts using the most recent data, as well as historical coastal erosion, have been analyzed as part of this project and are included in subsequent sections. (Maps including these models and historical aerial photos are included in appendices).

Despite these daunting climate change and SLR trends and impacts, there is some good news: Molokaʻi has a low population density, a significant amount of open space, and a community that has a strong history of working together to protect our island from tourism, over-development, and other outside threats. Thus, with proper planning, we have an opportunity to prepare for these impending climate change impacts, and to be a model for other islands facing similar challenges.

[9] Hawaiʻi Sea Level Rise Vulnerability and Adaptation Report, 2017
[10] Kane et al., 2012 (from SEI)

2.2. Project Purpose

In response to these climate change impacts, in February 2020 the County of Maui's Office of Council Services put out a Request for Proposal (RFP No. 20-003OCS) to develop the Molokaʻi Climate Change and Sea-Level Rise Adaptation and Resiliency Master Plan (CCSLAR).

The RFP acknowledged that the Molokaʻi coastline is vulnerable to a variety of natural hazards, including coastal erosion and flooding, which are being exacerbated by SLR. Thus, the purpose of this project is to **work closely with the community to identify priority sites/areas where sea level rise - and related erosion and flooding - are considered most critical, and to recommend community-supported adaptation strategies to mitigate these impacts.** The aim is to identify adaptation strategies that will preserve natural and cultural resources as much as possible, while also being cost-effective.

CCSLAR Workshop Series #4-Manaʻe District, October 2023
(Photo credit: Quazifilms)

Specifically, the Scope of Work included the following primary outcomes:

A. Identify and compile all relevant existing research and studies on climate change and sea-level rise impacts on Molokaʻi, including conditions reports, vulnerability assessments, and plans that will identify the most vulnerable properties by screening existing vulnerability assessment information and summarizing existing sea-level rise scenarios, erosion data and methodologies;

B. Improve the community's collective understanding on the risks to all infrastructure from flooding and inundation caused by climate change and sea-level rise on Molokaʻi;

C. Identify vulnerable populations and the interests of affected landowners and stakeholders, including infrastructure; and

D. **Identify the priority projects and areas on Molokaʻi** and develop feasible strategies to protect vulnerable infrastructure that are compatible with adjacent land uses. Additionally, perform cost-benefit analyses for each proposed sea-level rise adaptation project in the Plan.

Sustʻāinable Molokai is a community-based non-profit organization that was formed specifically to address issues such as this, and to do so in collaboration with the community. For this reason, Sustʻāinable Molokai responded to the RFP and submitted a proposal, which was selected by the County of Maui. The following sections provide a summary of our approach to this project's scope of work, changes made to that scope and rationale, the activities we undertook, and the primary components of this plan.

2.3. Project Approach

Our overarching goal is to develop a Plan that best serves our community. Thus, this Plan strives to:

A. have an **indigenous place-based perspective—**meaning the planning process was led/driven by Molokaʻi kamaʻāina and long-time community leaders;

B. incorporate appropriate **technical land use planning and coastal engineering expertise,** including building off of previous planning processes and policies;

C. utilize this process as an opportunity to **engage and develop our next generation of local leaders**—since the effects of climate change adaptation will impact them the most and, ultimately, they are the ones who must be most prepared and engaged; and

D. result in an **action-oriented document** that identifies the key climate change issues, coastal inundation due to a significant rise in sea level, upcoming Molokaʻi projects that may need to be adapted, as well as new plans that should be adopted in order to build greater community adaptability, resilience, and capacity in the years ahead.

With these main values/pillars in mind, we undertook the following activities, in accordance with the RFP.

2.4. Project Planning Team & Community Engagement

This section provides an overview of the project planning team and community engagement activities undertaken. Details are included in the appendices. The original project was intended to start in July 2020. However, due to COVID-19 and the need to focus on immediate community relief efforts, the project start date was pushed back one year.

During that time, Sustʻāinable Molokai worked with the County of Maui Office of Council Services (OCS) to refine the scope of the project in preparation for the launch, and to make plans to adjust to COVID gathering regulations/restrictions.

2.4.1. Project Planning Team Coordination

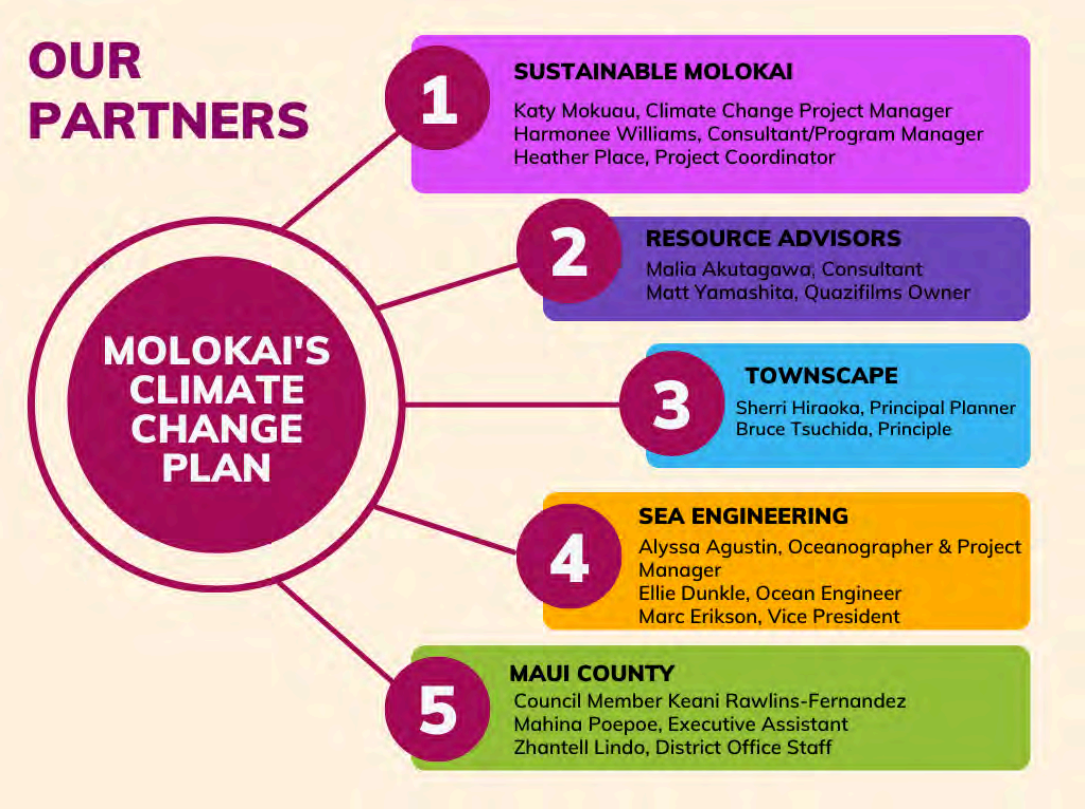
We initiated the project by meeting with our key project planning partners to plan overall project coordination. Our Project Team consisted of Sustʻāinable Molokai as the Prime Consultant, along with sub-contractors Townscape, Inc. and Sea Engineering, Inc. The **overarching strengths and project contributions** of each of these team members are summarized as follows:

- **Sustʻāinable Molokai (SM)** – Formed in 2010, SM was created with the intention of being a vehicle for the Molokaʻi community to proactively develop and implement strategies and programs that increase our island's overall resiliency. Since that time, the organization has developed and implemented numerous such projects. For this project, SM led community engagement, key partner collaboration, research, as well as overall project management and plan writing.

- **Townscape, Inc. (TSI)** – Established in 1991, TSI has extensive experience in community-based land use planning and mapping, including research and analysis of other social, economic and environmental factors that will impact the ability to deal with sea level rise and coastal impacts. For this plan, they took the lead on the creation of maps and graphics for community meetings and provided assistance to Sustʻāinable Molokai in integrating technical data, engineering analysis, and long-range climate change adaptation strategies into the Plan.

- **Sea Engineering, Inc. (SEI)** – Founded in 1973, SEI is well-known for their expertise in coastal engineering, geophysical surveys, and oceanographic and environmental studies. For this project, they took the lead in site reconnaissance of critical sea level rise (SLR) areas of Molokaʻi, coastal engineering design strategies and cost-benefit analysis, including analysis of critical SLR areas and development of conceptual plans for mitigating the impacts of SLR in those areas. Their Molokaʻi Sea Level Rise Vulnerability Assessment is included in Appendix A1.

In addition, the County of Maui OCS was regularly engaged throughout the project, including via community engagement activities, as well as team meetings - providing feedback and ensuring our implementation was in-line with the project intentions and expectations.



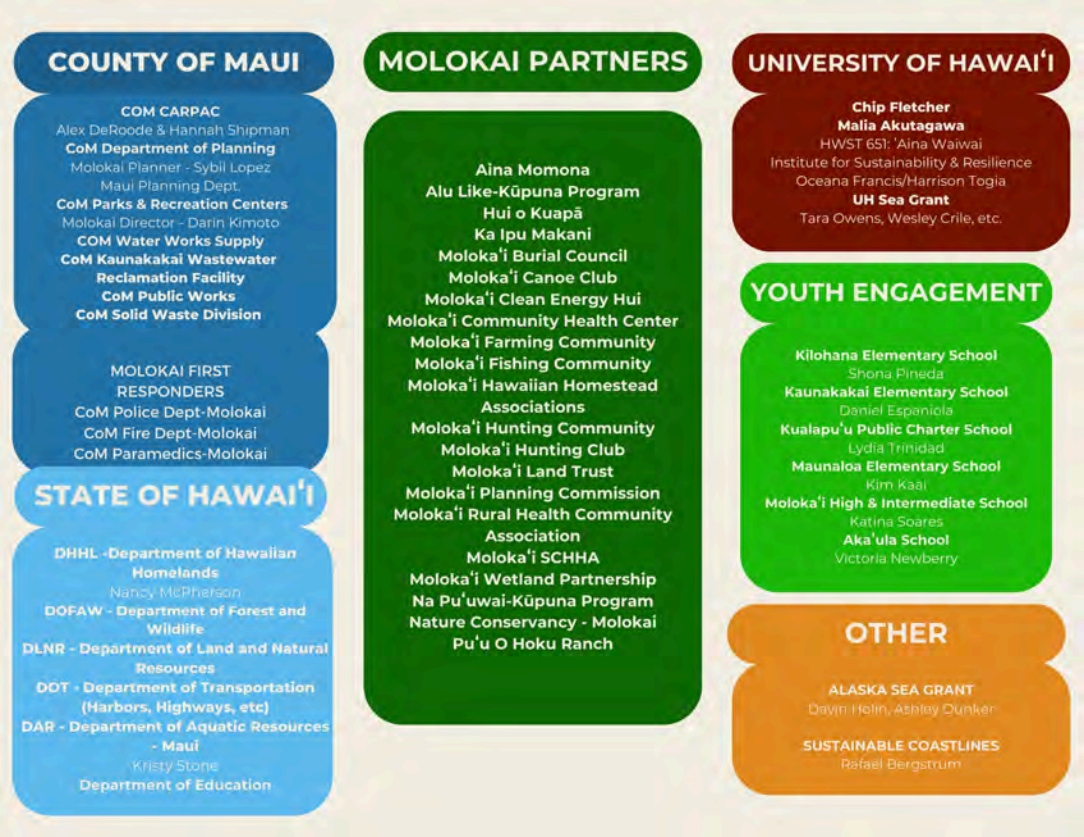
2.4.2. Community Engagement

One of the key aspects of this Plan is that it is community driven. To ensure this, we developed a place-based Community Engagement Strategy that included (a) creating a Key Stakeholder List, (b) preparing maps and other informative/educational materials for community, (c) hosting Community Workshops and conducting additional outreach efforts, (d) implementing a Sea-Level Rise Tour, (e) producing CCSLAR Awareness Videos, (f) creating online resources for residents to be able to access current/updated information on the planning process and give input online, and (g) sharing Plan Drafts and gathering Community Feedback.

This extensive community engagement ensured that this plan was community led and inclusive of an indigenous place-based perspective, as well as utilized multiple, simultaneous media advertising strategies. This planning process included various methods of Traditional Ecological Knowledge (TEK), Hoaʻāina traditional and present knowledge, Moku and Ahupuaʻa knowledge and community representation, the 8 realms Resource Realms and the Decision-Making Matrix under the ʻAha Councils, etc (more info in **Supplement**), and is partnered with technical knowledge and western-based science.

A. Key Stakeholder List

As stated above, our intent was to develop a plan that reflects community voices, including all residents interested in participating. Additionally, we wanted to ensure that key individuals and organizations with intimate knowledge of the island and its resources were engaged, specifically kamaʻāina from the areas most affected. In total, we received input from over 3,934 community sources (surveys, in-person input, etc.), from all of the four main districts of the island through workshops and focus groups (some people came to multiple sessions). In addition, these stakeholders included representatives from local businesses, agencies, and other entities. The figure below shows a list of people, organizations, and groups that we have met with multiple times throughout the process.



B. Maps and Materials

To prepare for our community engagement, the Project Team compiled data and created maps to facilitate community input/discussions - allowing participants to see the various locations/sites and the projected sea-level rise scenarios. The details of how those maps were created are included in Chapter 3, "Existing Data, Research, Maps, and Planning Efforts," and the maps themselves are included in Appendix A2.

We also created Molokaʻi specific information sheets to help the community easily read and understand the maps; explaining the basic technical aspects of the mapping methods utilized, including the "bathtub" approach, coastal flood zones, and the probabilities of each depth of sea-level rise. We made brochures that explained specific climate change effects that we are seeing here on Molokaʻi such as drought, higher temperatures, soil erosion, degrading landscapes and marine ecosystems due to introduced ungulates, etc. We printed out the timeline, description, and detailed steps of the planning process to ensure complete transparency.

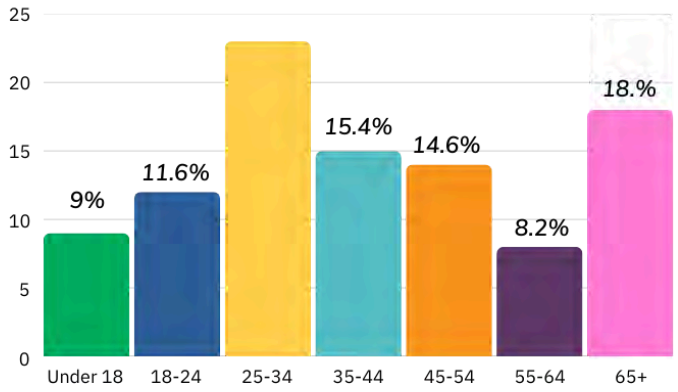
Data Collected

Description	Surveys Collected	People Reached
Phase I	506	747
Phase II	304	488
Phase III	0	1106
Phase IV	0	1593
Grand Total	**810**	**3934**

Note:
- *Some surveys were filled out by ʻohana or multiple people.*
- *After phase 2, no surveys were disseminated, as priority sites had already been identified.*

This figure exceeds more than half of Molokai's total population!

Demographics

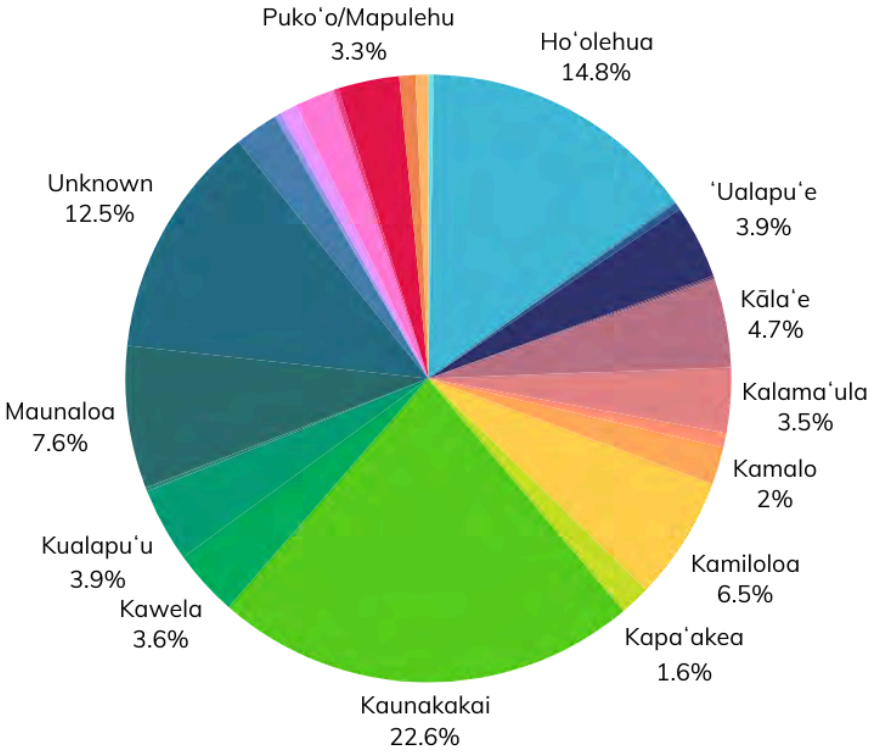


Demographics

WHERE DO YOU LIVE?

Total Population of Molokai: 7,000 people

Note: Results from the sign-in sheets of all 4 workshops.



Community Workshops & Outreach

Throughout the community engagement process, our main goal was to reach as much of the community as possible, including all ages, from our keiki (youth) to our kūpuna (elders), and community members from all areas of the island. The most important aspect of the community engagement process was the strategy to meet people where they are, aka place-based engagement. We were able to attend many community events to meet large numbers of people at community events that already had a large attendance, such as Kualapuʻu Elementary Schoolʻs ʻOhana Fun Fair, Earth Day, Resource Fairs, Keiki Fest, and also having a pop-up at the Molokai Little League games.

We accomplished this through various methods, including our Workshop series, which held workshops in each of the districts for multiple workshops (described in more detail below), small focus groups, individual meetings, as well as workshops at Molokaʻi High School and Molokaʻi Middle School and Akaʻula School. Our team was also able to repeatedly go to different kūpuna groups to present and get feedback from our elders on changes that they have seen in their lifetime. In addition, we attended other community meetings and events that were already planned, at locations where the community would already be at. Throughout the workshop series & alternative formats, there were a number of returning participants during each phase. Some attended in multiple districts or events across the island.

This is the format that works on Molokaʻi. It takes more effort than holding one or a few individualized community meetings in central Molokai. The talk-story, less formal, relaxed settings, where the community normally gathers are where we have found the most community engagement and feedback, which is evident in the Data collection stats. All workshops & community engagement events were advertised through a multitude of media simultaneously: Posting Flyers at all Community Bulletin Boards across the island, Molokai Dispatch Calendar, Social Media posts, including Awareness videos, MailChimp email lists, SimpleText, Mailers & Word of Mouth.

CCSLAR Workshop Series #1 in November 2021:
As this series was the launch of the project, these workshops focused on explaining the scope of the project, sharing the appropriate information with the community, and gathering their initial input. This consisted of place-based engagement at four workshops, one in each of the four districts: Manaʻe, Kaunakakai, Hoʻolehua/Kualapuʻu, and Maunaloa/West end. It was done in a drive-through style, created by our team, due to the COVID Pandemic and current regulations. Community members came to look at the first round of **Molokaʻi CCSLAR Maps 2021** (more information on maps below) and to give input on which areas are already experiencing SLR effects and which ones will be affected in the future. Information was gathered via surveys on priority areas in regards to infrastructure, roadways, and natural and cultural sites. *Approximately **400 people** participated in the workshops and around **750 surveys** were collected* - most families took the survey together. We also hosted additional workshops to target the ʻōpio (youth) and gathered input from Molokaʻi High School and Molokaʻi Middle School students.

Maunaloa community look at Molokai CCSLAR maps and indicate priority areas-Maunaloa CCSLAR Workshop Series #1 (November 2021)

CCSLAR Workshop Series #2 in March-April 2022:
This series focused on having the public give input on 10 priority sites that the community would like the plan to focus on. It also consisted of four workshops to include each district. COVID regulations were still taken into consideration, but at that time we were able to have more participants, by keeping in family pods. Some indoor meetings were also possible.

We also attended and presented at multiple community meetings (e.g. Townhalls, Homestead Association meetings, schools, informal neighborhood gatherings, with our ʻohanaʻs networks). *Approximately **400 people** participated in the CCSLAR Workshop Series #2 and around **500 surveys** were collected.*

This is the format that works on Molokaʻi. It takes more effort than holding individualized community meetings but the talk-story, informal, relaxed settings, where the community normally gathers are where we have found the most community engagement and feedback.

Community members discuss priority areas and some potential strategies." Kaunakakai CCSLAR Workshop Series #2 (March 2022)

CCSLAR Workshop Series #3 in December 2022-January 2023: For this series, we created an updated Molokaʻi CCSLAR **First Round of Priority Site Maps 2022** that indicated coastal flooding for the priority areas that were chosen. We had focus groups for stakeholders of each district to give their knowledge about certain areas and went over the mitigation strategies that our team and engineers have strategized. These were held over a few weeks to pinpoint the priority areas and the best way to mitigate. We found that having these small focus groups was more productive for gathering community input. For Hoʻolehua/Kualapuʻu Community Workshop #3, it was held at the Kualapuʻu School Fun Fair, a widely attended community event r. We were also able to get feedback on mitigation strategies for Kaunakakai at our Sustʻāinable Molokai Lā Pilina Event. *Approximately **1106 people** participated in this round of workshops.*

CCSLAR Workshop Series #4 in October 2023:
In this last phase of the Molokaʻi CCSLAR plan, we went back to the community (all 4 districts: Kaunakakai, Manaʻe, Hoʻolehua/Kualapuʻu, and Maunaloa/west end) to review new maps **Final Round of Priority Site Maps 2023** and **All Molokai Island-wide Maps 2023**: including priority site maps, agency maps, and flood risk maps panning over the whole south shore, east shore, Moʻomomi, and Papohaku beach. With the community reviewing these maps, they were also given a list of mitigation strategies (per priority location site) for short-, mid-, and long-term to respond to and provide insight and suggestions for specific areas. We were also able to visit the Alu Like group to get feedback from our kūpuna. The community workshops took place in October 2023 and were wrapped up in the beginning of November 2023. Our Kaunakakai community workshop was held at the Molokai Little League Baseball Park where the entire islands baseball games were held and people gather all morning from all the districts. These workshops were held strategically at *Approximately **1,593 community members participated** in this fourth series of CCSLAR Workshops.*

"Community members look at CCSLAR Priority SiteMaps and discuss mitigation strategies" CCSLAR Workshop Series #4: Kaunakakai District, October 2023 (Photo Credit: Quazifilms)

CCSLAR Workshop Series #5 in February 2024:
In the ending phase of our Molokai CCSLAR plan, we held the last workshop, a "Film Showcase," where we presented the Molokaʻi CCSLAR documentary and the plan summary. This documentary summarized the entire process, plan, the many community members and stakeholders, mitigation strategies and why this plan/project is so important for the entire island. For this particular showcase, we held the viewing at the Molokai Community Health Center (MCHC), with around ***100 people and dignitaries*** *that were instrumental in the process, in attendance.*

Molokaʻi CCSLAR Documentary Film Showcase at Molokai Community Health Center, February 2024
(Photo Credit: K. Rawlins-Fernandez)

Youth Engagement

Presentations at Molokai High & Intermediate School (Photo Credit: H. Place)

Engaging our younger generations was an imperative part of our process because they are the ones who will be the most directly affected by sea-level rise. Thus, educating these youth will help Molokaʻi prepare and move to a better and more resilient future.
Over 350 surveys and additional input were collected from MHIS. In January 2022, we presented to the Molokaʻi High School and Molokaʻi Middle School students and staff. During week-long workshop events, all grades of Middle School and High School students and staff attended at various times, and were able to look at the sea-level rise maps and indicate roadways, businesses, and areas that will be affected by sea-level rise. They also indicated what areas will affect their ʻohana in their day to day life whether it is for grocery shopping, being able to receive imported foods and goods by barge, utilizing existing roadways, and engaging in certain traditional subsistence practices such as fishing, hunting, etc. in certain areas. They were very adamant about the need to find solutions for priority areas to mitigate the negative repercussions from climate change.

At the end of 2022, our team was able to go back to Molokaʻi High School to visit some of the science classes to update students about the Molokaʻi CCSLAR plan. Some students focused their small in-class science projects on some of the priority sites that the community chose for the CCSLAR plan.

Molokai High School and Akaʻula School where students learn about SLR on Molokai, January 2022. (Photo credit: D. Mokuau, K. Mokuau, H.Place)

On January 26, 2022, we were able to present to Akaʻula School, a private school located on Molokaʻi that has both intermediate and high school students. Sea-level rise maps were presented, and students and staff were able to indicate areas that will affect their ʻohana and themselves in their day to day life. They indicated areas that would affect their hunting, fishing, and cultural practices and determined whether these areas would be affected by sea-level rise. Mitigation strategies were discussed and noted from students and staff. Around 50 surveys were collected from Akaʻula School. We were able to go back to Akaʻula School to update them about this plan. Some students were working on projects related to SLR on Molokaʻi.

C. Do It Yourself Sea-Level Rise (DIY SLR) Tour

This campaign was originally intended to be a walk through event where the community would walk from the existing shoreline to the potential new shoreline depicted on our SLR maps. However, due to the COVID-19 Pandemic & regulations we were unable to do an in-person community activity. Thus, we designed a "Do It Yourself Sea-Level Rise" (DIY SLR) Tour. **The CCSLAR DIY SLR** Tour started March 4, 2022 and ended April 18, 2022. The purpose of this campaign was to have the community visualize the SLR depths and levels that will be in certain areas, including roadways, businesses, cultural landscapes, etc. Sites with information were set up so that people could see them while walking through town, going to the store, and/or driving along our roadways. There were around 40 DIY SLR Tour signs placed around the island (from Kalamaʻula to Kūpeke Fishpond) in strategic locations such as grocery stores, fishing areas, recreational areas, residential areas, churches, and schools. Over 700 Molokaʻi residents participated in this campaign and over 2,000 residents saw signs and asked questions.

D. Awareness Videos

Social media was a highly impactful tool in getting the word out about this CCSLAR plan, especially during the COVID-19 Pandemic which was ongoing through Phases 1-2 of this planning process. County & State facilities were not open for use during these phases and our team creatively designed walk-through & drive-through workshops at alternative locations, using our community connections. In addition to utilizing social media to post flyers and information about the planning process and how to provide input, we worked closely with Quazifilms to create a total of five awareness videos. The description of each video is included.

Quazifilms was a crucial consultant on the project, providing filming, editing and storytelling expertise for the creation of awareness videos that are locally-based, including a kamaʻāina perspective with integral scientific information. These videos were broadcasted throughout all our social media platforms including YouTube, Instagram, Facebook, as well as our website and on Molokaʻi community Facebook pages such as 'What's the Happenings Molokaʻi.' The reach and advertisement of these videos into the community, especially during the COVID19 pandemic, was extremely successful. With all social media combined, we were able to reach over 8500 views/engagements and the count continues to rise.

Left Photo: Friendly Market Center, a local grocery store. Marking at 6' of SLR for the CCSLAR DIY SLR Tour, 2022
(Photo credit: H. Place)

Awareness Video 1 - Quazifilms produced a 2-minute video that was released on November 6, 2021. The video showcased short clips of areas on Molokaʻi that are affected by climate change, especially sea-level rise. Speakers talked about the effects of climate change they've seen and advised the community to prepare for future impacts through a series of 4 workshops. The goal of the video was to make the community aware of the workshops and to pique their interest in attending and providing input. The two community speakers that participated in this video were Aunty Kaui Kapuni Manera and Aunty Penny Martin, both long-time community advocates and leaders, as well as Councilmember Keani Rawlins-Fernandez. As of March 2024, social media statistics are as follows: Facebook - 747 people reached and 1040 engagements; Instagram - 2,152 views and 789 engagements.

Awareness Video 2 - A second video called "Molokaʻi CCSLAR Sea Level Rise - How to Share Your Manaʻo!" was developed by our Project Team. This video featured Sustʻāinable Molokai staff explaining how sea-level rise will affect Molokaʻi in the future and instructed viewers how to read and interpret our Molokaʻi Climate Change and Sea-Level Rise Adaptation and Resiliency Plan maps.. The video also encouraged participants to get involved in the project and plan. This video was released on March 17, 2022. As of March 2024, Social media statistics are as follows: Youtube - over 105 views; Facebook - over 364 views.

Awareness Video 3 - A third video called "About the Molokaʻi DIY Sea Level Tour" was developed by Quazifilms and featured Sustʻāinable Molokai staff explaining to Molokai residents how to participate in the Sea-Level Rise Tour; the importance of Molokaʻi residents getting involved; and the overall intent of the CCSLAR plan. The video detailed how to read and understand the signs/flags as they visualized what areas sea-level rise depths will affect over time.. This video was released on March 12, 2022. As of March 2024, social media statistics are as follows: Facebook - 3.9K people reached; Instagram - 860 views. The count continues to rise.

Awareness Video 4 - The fourth video is where we asked for the most participation from our community to provide last-call feedback on the priority sites mitigation strategies as we wrap up this plan and project. Video footage was taken during our last round of community workshops where each resident was able to give their thoughts and concerns about each location and priority site. This video was released on December 20, 2023

Awareness Video 5 - The final video was a 15-min documentary that summarizes the final plan, including giving backstory and context to the community-driven process. This documentary was used to educate policymakers and the broader community about the overarching issues surrounding sea-level rise on Molokaʻi; it tells the story of the planning process; and it provides an overview of key findings and recommendations that are detailed in the final plan.

E. Online Resources

Multiple online resources were made available for the community to stay informed and receive updates on the CCSLAR plan. We found these online resources to be successful in reaching additional community residents throughout this planning process.

CCSLAR Plan Website

- www.sustainablemolokai.org/environment-natural-resources/molokai-ccslar
- Main website for the Molokaʻi Climate Change and Sea-Level Rise Adaptation and Resiliency Plan where main updates, videos, surveys, and general information are housed.

YouTube Page

- www.youtube.com/@sustainablemolokai
- Sustʻāinable Molokaʻi's Youtube page contains all of the CCSLAR awareness videos - from an introduction to the plan, how to get involved, how to read maps, our DIY SLR Tour video, along with clips from the various district workshops held during this process.

CCSLAR Linktree

- https://linktr.ee/molokaiclimatechange
- This linktree website was created for community members to get updates on the CCSLAR plan, workshop information, take our surveys, find DIY tour stations, etc. We had a total of 430 online participants in the first round of SLR maps and workshops from late 2021 to beginning 2022. In the third round of SLR maps and workshops, in 2023, there were a total of 389 participants using this link tree.

CCSLAR DIY SLR Tour Linktree

- https://linktr.ee/mkkslrtour
- A Linktree was created for the community to find out where DIY Tour stations were on the island, to learn about the campaign, and to see how they could get involved in the project. It provided them with the SLR maps, the different SLR levels, a video on how to read the maps, a link to take our survey, and a way to receive updates on the project. We reached over 700 people through this online link during the DIY SLR Tour campaign. Additionally, there were many community members who read the signs and asked around about what this campaign was and how to get involved.

Sustʻāinable Molokai Facebook

- www.facebook.com/sustainablemolokai/
- Sustʻāinable Molokai's Facebook page also served as a hub to generate information on the CCSLAR plan and provide regular updates. Viewers were able to watch our videos, join our live free giveaways, and engage directly with us.. We reached over 3,700 people on this social media platform.

Sustʻāinable Molokai Instagram

- www.instagram.com/sustainable_molokai/
- Sustʻāinable Molokai's Instagram page proved an effective method for outreach and public engagement in the CCSLAR planning process. We were able to reach over 6,600 views from our informational videos that showcased our plan, how to read the maps, our workshop videos, our DIY SLR Tour campaign video, as well as ways in which the community could get involved with this project.

F. Write Plan Drafts and Gather Community Feedback

Lastly, the Project Team worked together to develop the CCSLAR Plan, making sure to get feedback from Maui County and the community through various public drafts and outreach events.

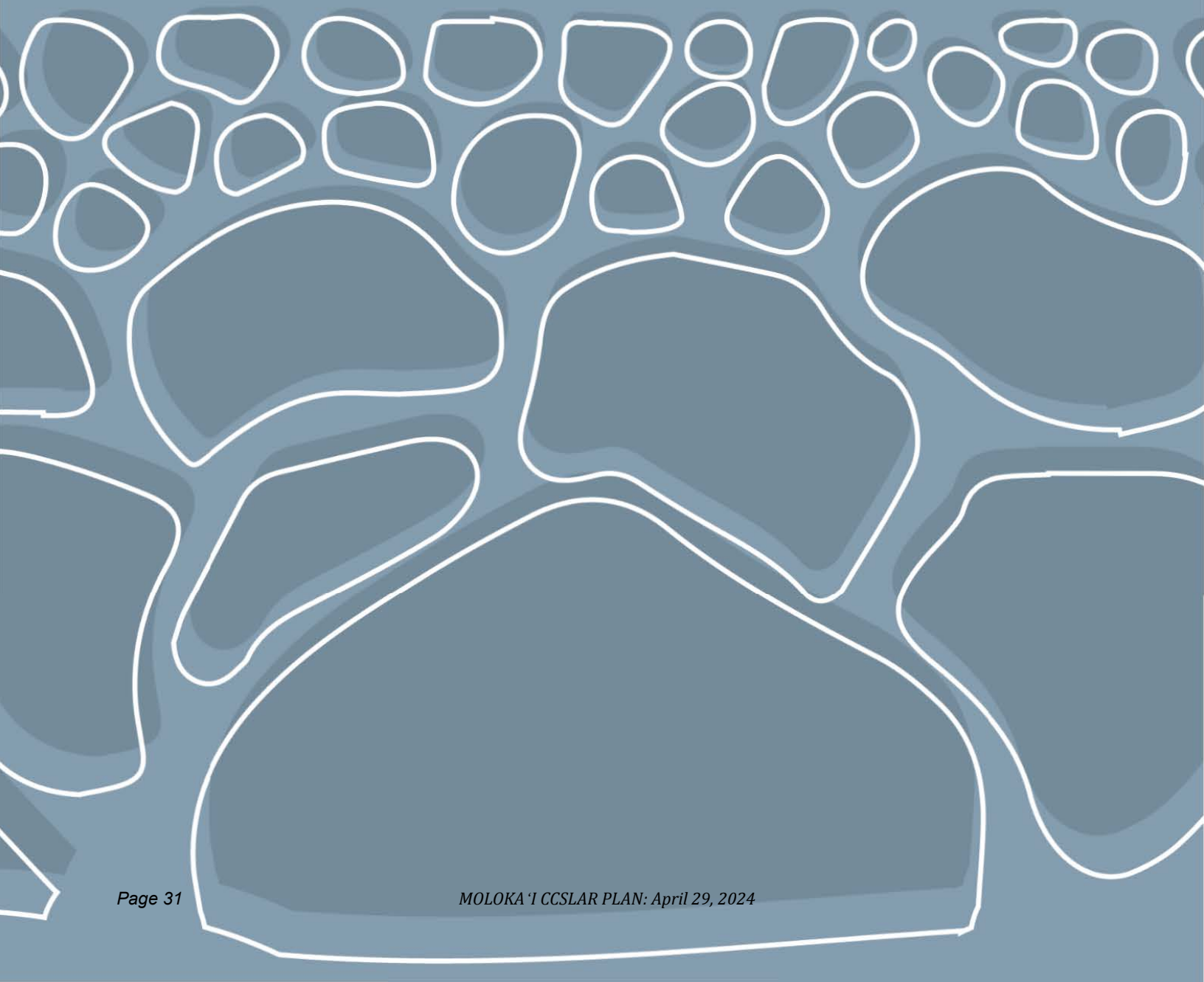
2.5. Primary Plan Components

As mentioned above, there are four primary outcomes addressed in this plan, as described in the following chapters:

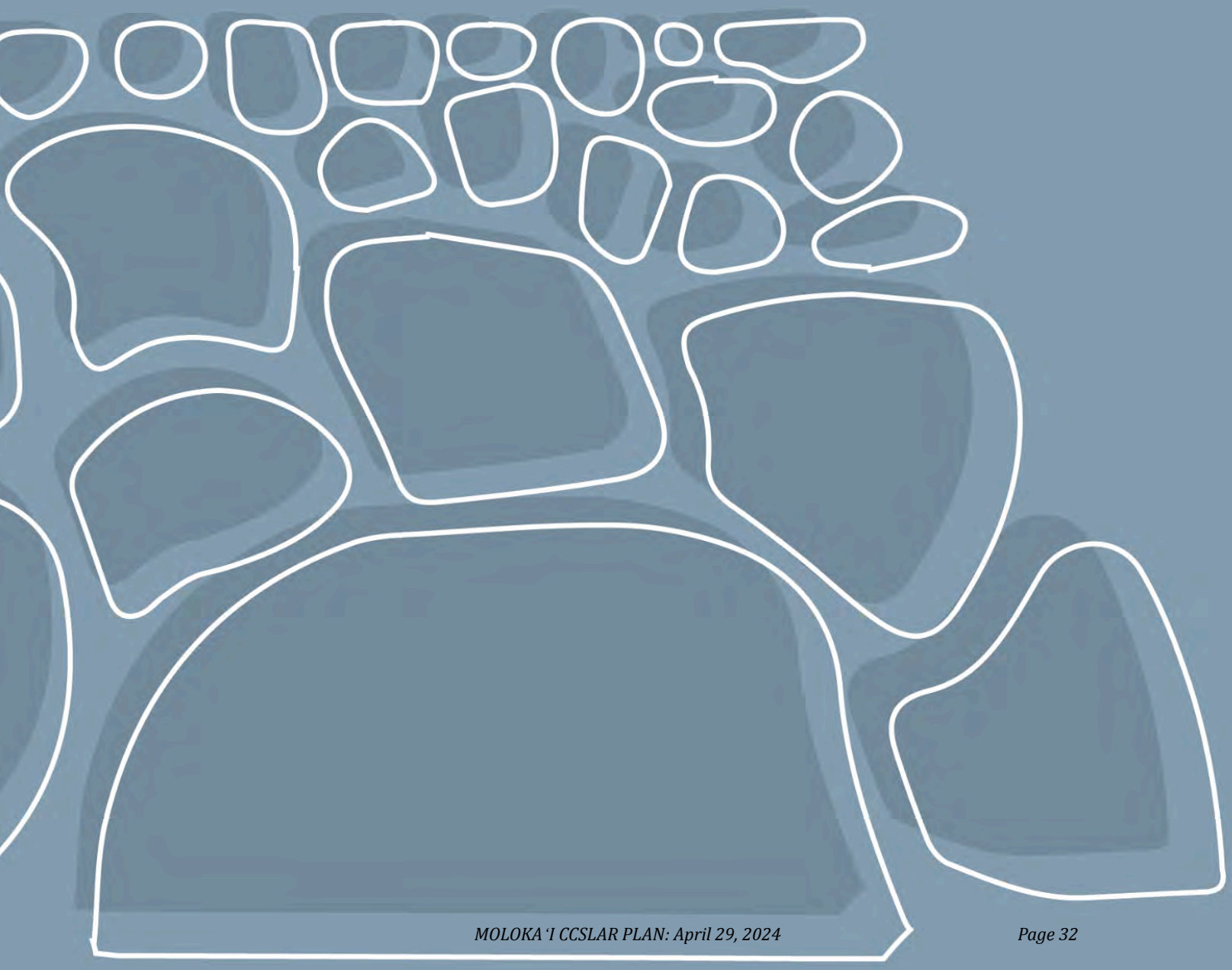
- **Chapter 3** identifies all relevant existing research and studies on climate change and sea-level rise impacts on Molokaʻi; compiles all relevant data on existing conditions; references prior reports, vulnerability assessments, and plans; and provides other useful information regarding risks to all infrastructure from flooding and inundation caused by climate change and sea-level rise on Molokaʻi. (Outcomes A & B)

- **Chapter 4** identifies Priority Projects, along with feasible strategies, to protect vulnerable populations, affected landowners and stakeholders, and critical infrastructure associated with current land uses. This chapter also provides a cost-benefit analysis for each proposed project. (Outcome C & D)

- **Chapter 5** summarizes the next steps required for implementation of the adaptation strategies and policies recommended throughout the Plan.



3. EXISTING DATA, MAPS, AND PLANNING EFFORTS



3. EXISTING DATA, MAPS, AND PLANNING EFFORTS

Once the project officially got underway in July 2021, one of the initial steps taken was to identify existing data, research, and related studies/plans, both past and current. This chapter gives a high-level overview of those findings, including how this plan incorporates that information and intersects with those efforts. The end of this section explains how we compiled and presented that information to improve the community's collective understanding on the risks to infrastructure from flooding and inundation caused by climate change and sea-level rise, as well as our plans to collaborate in future-related efforts.

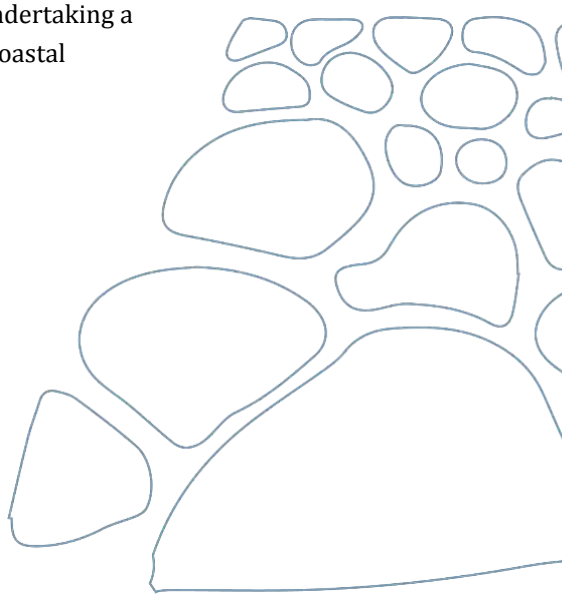
3.1. Existing Data and Maps

SM worked with Sea Engineering, Inc., and Townscape, Inc., to identify the most recent and relevant existing SLR scenarios, erosion data and methodologies to use for the most up-to-date Molokaʻi SLR maps. For a compilation of the relevant SLR scenarios, data, and methodologies, please see Molokaʻi Sea Level Rise Vulnerability Assessment, "Section 2. SEA LEVEL RISE," by SEI, in **Appendix A1.**

Identified and summarized existing SLR scenarios, erosion data & methodologies

Per Excerpt taken from Molokaʻi Sea Level Rise Vulnerability Assessment, "Section 2.2.3 State of Hawai'i," by SEI**:** Passive flooding includes marine flooding over the shoreline by still water flowing into the lands that lie below the water level. It also depicts low-lying areas indirectly flooded by SLR through water table rise. Passive flooding is exacerbated by rainfall as it prevents drainage and as such, runoff and marine waters combine to produce larger impacts. Passive flooding was modeled by UH using a modified "bathtub" approach that accounts for both regional tidal variability and hydrological connectivity (Cooper et al. 2013, Figure 2-6). The passive flooding model does not explicitly include flooding through storm drain systems and other underground infrastructure, which may contribute to flooding in many low-lying areas identified in the model. In many areas around the State, representing SLR from passive marine flooding alone may produce an underestimate of the area inundated or permanently submerged because the model does not account for waves and coastal erosion, which are important processes along Hawaiʻi's highly dynamic coastlines that increase the extent of potential hazards and damages along our shores.

However, the University of Hawaiʻi Coastal Resilience Collaborative is currently undertaking a statewide mapping update that will include modeling of high wave flooding and coastal erosion for Molokaʻi.



Per Excerpt taken from Molokaʻi Sea Level Rise Vulnerability Assessment, "Section 2.2.4 Island of Molokaʻi," by SEI. Estimates of Molokaʻi SLR scenarios based on the IPCC AR6 SSPs, taking into account the far-field effects, are presented in Table 2-4 and Figure 2-4 (IPCC, 2022). SLR impact areas for the 3.2, 4, and 6-ft scenarios are presented in Figure 3-35 through Figure 3-47. For this Molokaʻi Sea Level Rise Vulnerability Assessment, we will consider sea level projection elevations out to 2150, also aligning with the information provided by the 2021 IPCC AR6 report. Planning horizons are decadal spanning 2030 to 2150 with elevation benchmarks by foot. This data was included on the first round of 13 Molokaʻi SLR Maps used in the early community engagement and educational workshops, attached in Appendix A2.

In September 1, 2022, "Coastal Flood Zones with Sea-Level Rise of 3.2 feet" scenario was published by Tetra Tech, Inc. and Sobis, Inc., as the most recent projections to include coastal hazards. These projections will be used in all work of this project from September 2022 onward. The previous IPCC AR6 SSPs, projected 'passive flooding' (bathtub model) scenarios and did not include coastal flooding from storm-induced wave events, including storms, hurricanes, tsunamis, and other severe wave events with sea level rise. The '2022 CFZ with SLR 3.2' were included on the most recent maps generated for CCSLAR plan (dated October 2022), and utilized in Workshop #3 and public '1st Round of Priority Site Maps', attached in **Appendix A2**, and will be utilized in Final Priority Site Maps.

Molokaʻi has no GIS Coastal Erosion Data, unlike Oahu, Maui, and Kauaʻi Islands. This is a pressing need for Molokaʻi, in order to further efforts in SLR planning, adaptation and mitigation. These islands' Coastal Erosion Data from the Vegetation Line (Current) up to 3.2' in combination with SLR projections are available on the PacIOOS Hawaiʻi Sea Level Rise Viewer. Many of the strategies, mitigation, adaptation and resiliency measures and policies of these other islands rely heavily on the SLR models and existing erosion data. However, The University of Hawaiʻi Coastal Resilience Collaborative is currently undertaking a statewide mapping update that will include modeling of coastal erosion for Molokaʻi.

Past Reports/ Existing Data

In SEI's Moloka'i Sea Level Rise Vulnerability Assessment, "Section 2. SEA LEVEL RISE" (pages 2-20), SEI provides a detailed listing and explanation of past reports and data that exists.

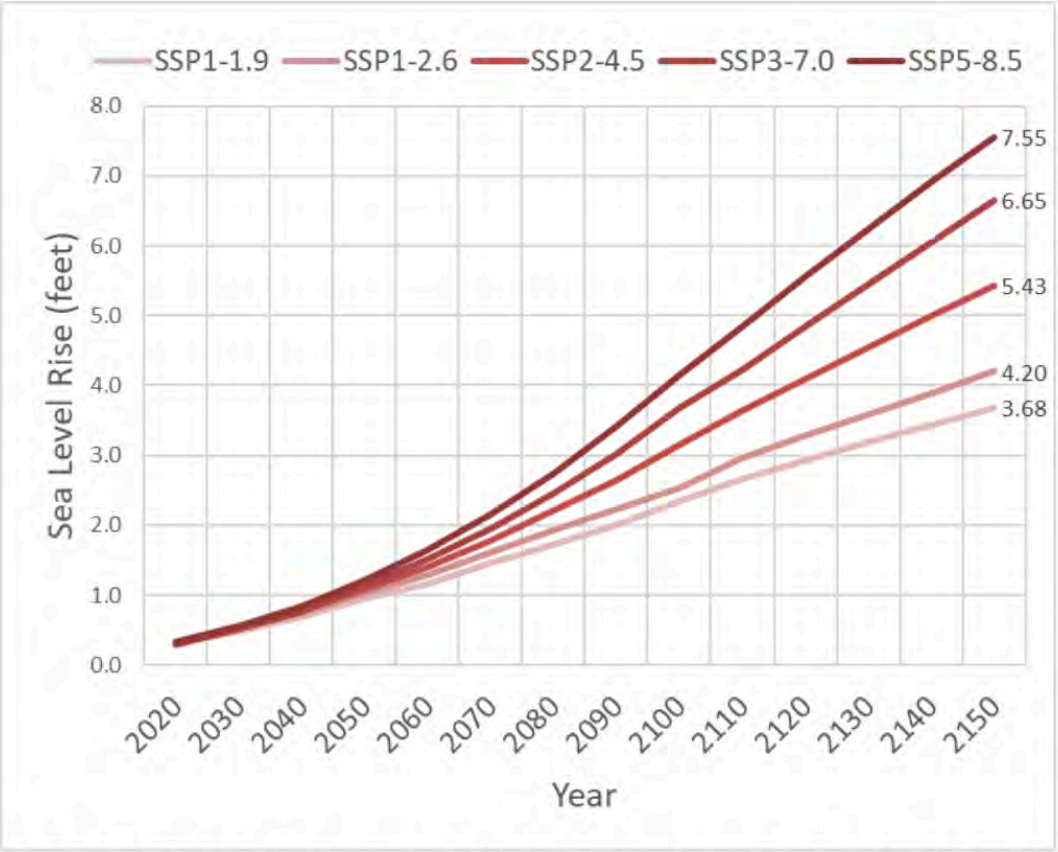


Figure 2-7 Moloka'i local mean sea level rise projections (adapted from the 2022 IPCC Sixth Assessment Report)

Image courtesy of SEI Molokai SLR Vulnerability Assessment V2-page 9

Table 2-5 Moloka'i Local Mean Sea Level Rise Scenarios (adapted from the 2022 IPCC Sixth Assessment Report, 83rd Percentile, 21°N, 157°W)

Scenario (feet)	2030	2040	2050	2060	2070	2080	2090	2100	2150
SSP1-1.9 Low	0.5	0.7	0.9	1.2	1.5	1.7	2.0	2.3	3.7
SSP1-2.6 Intermediate-Low	0.5	0.8	1.0	1.3	1.6	1.9	2.2	2.5	4.2
SSP2-4.5 Intermediate	0.5	0.8	1.1	1.4	1.8	2.2	2.6	3.1	5.4
SSP3-7.0 Intermediate-High	0.5	0.8	1.1	1.5	2.0	2.5	3.0	3.7	6.7
SSP5-8.5 High	0.6	0.8	1.2	1.6	2.2	2.7	3.4	4.2	7.6

Image courtesy of SEI Moloka'i SLR Vulnerability Assessment V3-page 10

Maps (summarized here; included in Appendices)

Three sets of maps were created:

- The first Molokaʻi Sea-Level Rise Adaptation and Resiliency Plan Maps, 2021, were created at the start of the project for education and community engagement during the Series #1 Workshops. These maps were based on the latest SLR passive flooding levels. They included:
  - 13 maps of the Molokaʻi shoreline depicting SLR 3.2 feet (Sea Level Rise Exposure Area), 4 feet (Year 2100, Intermediate Scenario), 6 feet (Year 2100, Intermediate-High Scenario predicted to be 6.4 feet), and 10 feet (Year 2100, Extreme Scenario predicted to be 10.9 feet) scenario layers for planning considerations. These maps covered multiple ahupuaʻa from Palaʻau/ Kalamaʻula to Hālawa and included Moʻomomi & Pāpōhaku.
  - Data from the Intergovernmental Panel on Climate Changeʻs (IPCC) 6th Assessment Report (AR6), along with the Shared Socioeconomic Pathways (SSPs), projecting 'passive flooding' (bathtub model), attached in **Appendix A2.**

- The second set of maps reflected the 1st Round of Priority Site Maps, 2022 which included the newly released Coastal Flood Zones with Sea-Level Rise of 3.2 feet scenario, for Workshop Series #2 and #3.
  - The 2022 Coastal Flood Zone with 3.2 ft. sea-level rise were included on the most recent maps generated for the CCSLAR Plan (dated October 2022), and utilized in Workshop #3 and public '1st Round of Priority Site Maps', attached in **Appendix A2.** Additionally, four "Mini Town" maps were created for Kaunakakai Town, Kualapuʻu, Maunaloa, and Kilohana. These maps prompted discussion on the need to relocate the main town of Kaunakakai. Decentralizing commerce through the creation of "Mini Towns" in each district will ensure greater resilience, food security, and accessibility to resources. Additionally, these Mini Towns should provide emergency response capability and essential medical services, education centers, shelters or centers for disaster response, etc.

- The third round of maps were created for the Final Priority Sites, as well as three additional sites. The maps reflected priorities identified by the community and also in consultation with several agencies such as DHHL, HDOT, County of Maui Parks and Recreation, and MWP A total of 29 maps were created for this final round, attached in **Appendix A2.**
  - 13 Priority Location maps included with the most recent 2022 Coastal Flood Zones + 3.2 SLR, along with additional land base marks and better overlaying for improved readability. These maps also indicate all flood hazard overlays within each location.
  - Another round of island-wide updated SLR maps were created for the public's use. These maps covered the island from West (Pāpōhaku), North (Moʻomomi), and from Kalamaʻula to Hālawa valley.
  - The remaining maps were island-wide key maps showing not only these CCSLAR Priority Locations but also indicating other related project locations for plans such as DHHL, County of Maui Parks & Recreations, MWP, HDOT, etc. These maps were created to show the community and planners the different projects and planning efforts on-island that are being affected by sea-level rise or other type of climate change phenomenon. These maps also demonstrate the overlap of multiple planning efforts within many of the Final Priority Sites and other projects.

3.2. Related Policies, Plans, and Planning Efforts

This Plan is a stand-alone document with the specific goal of identifying priority sites/areas where sea level rise - and related erosion and flooding - are considered most critical, and to recommend community-supported adaptation strategies to mitigate these impacts. However, in order to provide the best recommendations, we needed to also consider all existing regulations for our coastal areas, which include federal, state, and county regulations and policies. Furthermore, there are numerous related planning processes that are completed, in process, and planned for the future. Thus, we wanted to be sure to review, build off of, and coordinate with all relevant planning efforts. This section summarizes those policies, plans, and related planning processes.

A. Policy Related Plans

SEI's Molokaʻi Sea Level Rise Vulnerability Assessment includes a thorough overview of existing Sea Level Rise Guidance and Plans. Below is a summary:

Federal

In 1972, the Coastal Zone Management Act (CZMA) was passed to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone." Through the CZMA, the National Oceanic and Atmospheric Administration (NOAA) establishes a voluntary partnership with states and territories with approved programs and disburses funds to support its activities through a cooperative agreement. The CZMA requires that Federal actions that are likely to affect any land or water use or natural resource of the coastal zone be consistent with enforceable policies of a State's federally-approved coastal management program through a permitting process.

In 2022, NOAA released Global and Regional Sea Level Rise Scenarios to provide up-to-date SLR projections available for U.S. states and territories for every decade to 2050, and then every 50 years out to the year 2150. The national report includes information to help communities assess potential changes in average tide heights and height-specific threshold frequencies as they strive to adapt to SLR.

State of Hawaiʻi (*SEI's report - pages 12 - 20 summarizes all State regs/policies)*

In the State of Hawaiʻi the coastal zone is regulated by federal, state, and county agencies. The certified shoreline extending seaward three nautical miles is managed by the State of Hawaiʻi. Areas from the certified shoreline landward (mauka) are managed by the Counties. (This is depicted below, "Figure 2-8" in SEI's report).

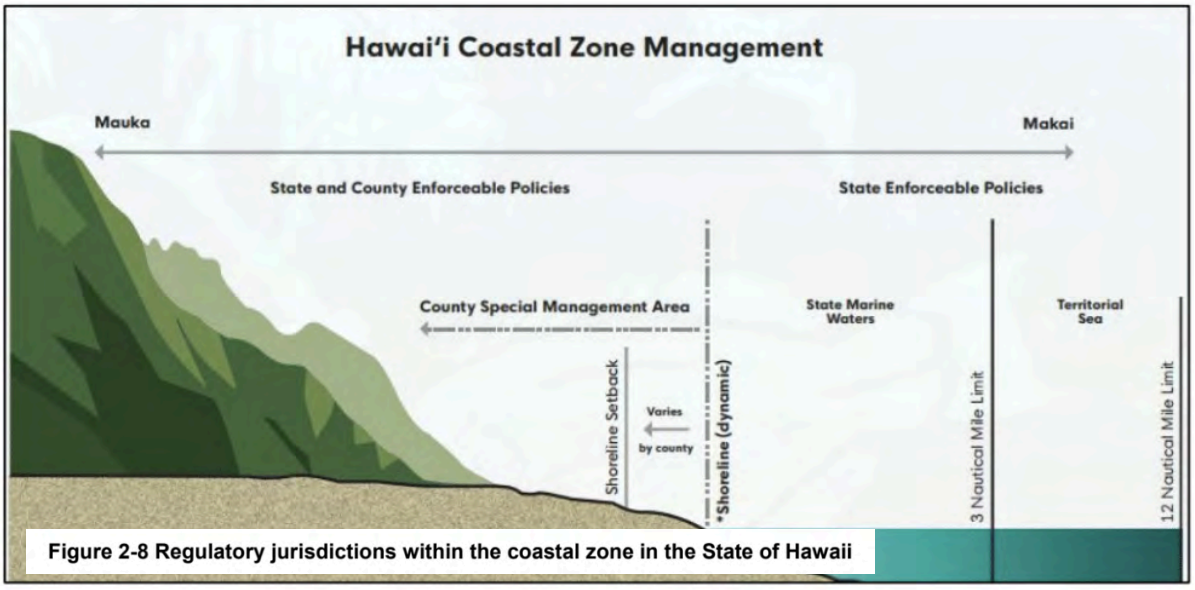


Figure 2-8 Regulatory jurisdictions within the coastal zone in the State of Hawaii

1977

Enabled by the CZMA, the State of Hawai'i created the Office of Planning Coastal Zone Management (OP-CZM) Program (Chapter 205A, Hawai'i Revised Statutes). The CZM federal-state partnership provides a basis for protecting, restoring, and responsibly developing diverse coastal communities and resources guiding the design and implementation of allowable land and water uses and activities throughout the state. The OP-CZM Program was approved by NOAA in 1978.

1984

Hawai'i began SLR planning after State Senate Resolution 137 requested a study on the worldwide greenhouse effect on Hawai'i's coastal development. The resulting report, Effects on Hawai'i of a Worldwide Rise in Sea Level Induced by the Greenhouse Effect, stated that the debate had shifted from questioning the possibility that the "Greenhouse Effect" would occur to whether the effect will be mild or severe as well as the timeframe for its imminent occurrence. The resolution recommended planning for 3.2 feet of SLR.

2006

OP-CZM updated the Hawai'i Ocean Resources Management Plan to include an ahupua'a approach to ecosystem management and began tracking metrics of partner agency efforts.

2008

The Hawai'i 2050 Sustainability Plan was published by a Sustainability Task Force The plan established goals, recommendations, and strategic actions to reduce Hawai'i's dependence on fossil fuels; conserve water and ensure an adequate water supply; conduct research to strengthen management initiatives to respond to rising sea levels, coastal hazards, erosion, and other natural hazards; and develop a comprehensive environmental mapping and measurement system to evaluate the overall health and status of Hawai'i's natural ecosystems.

2011

The Hawai'i State Planning Act was amended to include sustainability priority guidelines and principles to encourage collaboration needed to promote and implement sustainability through economic, social, community, and environmental priorities.

2011

ICAP published a report entitled Sea-Level Rise and Coastal Land Use in Hawai'i: A Policy Tool Kit for State and Local Governments. Discuss ...

2012

The Hawai'i State Planning Act was amended again to include climate change adaptation priority guidelines to encourage the collaboration needed to address climate change.

2013

OP-CZM updated the Hawai'i Ocean Resources Management Plan adding eleven (11) management priorities encouraging interagency collaboration.

2014

Concurrent Resolution 69 initiated the Aloha+ Challenge, which established sustainability as a State priority supporting the global U.N. Sustainable Development Goals. The goals of the Aloha+ Challenge are to achieve social, economic, and environmental goals relevant to SLR by 2030:

- Establish 30% of near-shore waters as marine-managed areas
- Increase invasive species control and native species restoration.
- Increase livability and resilience in the built environment through planning and implementation at the state and county levels.

In 2020 (Hawai'i Green Growth, 2020) the first Aloha+ progress report was released tracking Hawai'i's contribution to the 17 United Nations Sustainable Development Goals for 2030.

- Currently at 29.8% renewable energy and on track for efficiency.

- There was a 4% increase in the number of farms from 2012 to 2017. Improvements are needed to get Hawai‘i on track.
- 17.4% of native watershed forests now have high-level protection; only 6% of near- shore waters are now marine-managed areas; there has been an increase of 11 million gallons per day; 50% of Hawai‘i Interagency Biosecurity Plan’s recommended actions have been initiated.
- 50.12% of soil wastes have been diverted through source reduction, recycling, bioconversion, and landfill diversion methods.
- Disaster management and resilience and connection to place are on upward trends. Affordable housing, economic prosperity, and mobility need improvement to meet the sustainable development goal.
- Educational attainment, equitable access, and ‘āina based education are on upward trends. Unemployment, workforce development, and sustainable tourism need improvement to meet the sustainable development goal.

2014

Act 83 established the Hawai‘i Climate Adaptation Initiative to enable a coordinated approach among all agencies at all levels of government to plan for and address the effects of climate change to protect the State’s economy, health, environment, and way of life. Act 83 established a coordinating body to carry out this mission known as the Interagency Climate Adaptation Committee (ICAC) composed of State and County government representatives.

2017

Act 32 expanded the ICAC into the Hawai‘i Climate Change Mitigation and Adaptation Commission (Commission), which is responsible for driving greenhouse gas emission reduction and improving Hawai‘i’s resiliency to climate change. The Commission published the Hawai‘i Sea Level Rise Vulnerability and Adaptation Report (SLR-VA) providing the first state-wide assessment of Hawai‘i’s vulnerability to SLR and recommendations to reduce our exposure and sensitivity to SLR and increase our adaptive capacity. A key recommendation was that 3.2 ft of SLR should be adopted as a statewide vulnerability zone for planning purposes. With 3.2 ft of SLR, the Commission determined that chronic flooding would render over 25,800 acres of land, over 6,500 structures, nearly 550 cultural sites, and over 2,000 on- site sewage disposal systems in the State of Hawai‘i unusable valued at >$19 billion. Some of that land will have eroded into the ocean, some will become submerged by inches or feet of standing water, and some areas will be dry most of the year, but repeatedly washed over by seasonal high waves. State-wide, about 34% of that potentially lost land is designated for urban use, 25% is designated for agricultural use, and 40% is designated for conservation. The loss of urban land could put pressure on the development of inland areas, including those designated as agricultural and conservation lands.

The SLR-VA Report provided nine (9) recommendations to guide State and County agencies, communities, and other stakeholders in improving our capacity to adapt to SLR.

1. Support sustainable and resilient land use and community development.
2. Provide new opportunities to use land more sustainably by identifying and prioritizing areas for smart redevelopment within existing urban land boundaries and to minimize pressure on agriculture and conservation lands.
3. Incentivize improved flood risk management through support to a state-wide Community Rating System program, encouraging property owners outside currently regulated flood zones to purchase flood insurance, and incorporate SLR in hazard mitigation plan updates and disaster recovery frameworks.
4. A state-wide assessment of legacy beach conservation priorities for enabling beaches to persist with SLR.

5. An inventory, protocols, and processes are needed to preserve Native Hawaiian culture and communities with SLR.
6. A comprehensive review of environmental regulations that allow for the siting of environmental hazards, such as hazardous materials/waste storage facilities and onsite wastewater storage systems is needed to protect nearshore water quality with rising seas.
7. Develop funding sources and incentives for adaptation.
8. Support research, assessment, and monitoring of changing conditions fundamental to a learning approach to adaptation which involves conducting research, assessments, and monitoring needed to update the Report and other "living" outputs.
9. Promote collaboration and accountability for adaptation.

2018

The Hawai'i Sea Level Rise Viewer was released (DLNR et. al., 2018). The web-based maps illustrate where passive flooding, wave-induced flooding, and coastal erosion are modeled to occur based on SLR scenarios. The State of Hawai'i Hazard Mitigation Plan was released expanding considerations of climate change and SLR hazards for the State, incorporating data from the Hawai'i Sea Level Rise Viewer (Tetra Tech, 2018). The State of Hawai'i Hazard Mitigation Plan included mapping a 1% annual chance flood using FEMA methods plus SLR, resulting in the 1% Annual Chance Coastal Flood Zone (1%CFZ-3.2). This provided another layer on the Hawai'i Sea Level Rise Viewer for consideration in vulnerability assessments and adaptation planning. The Commission agreed to a statement that included support for the establishment of a State initiative, now called Climate Ready Hawai'i, to provide resources to assist in planning for SLR.

2019

OP-CZM published a report entitled, Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai'i, which provided an in-depth evaluation of potential strategies for shifting urban centers from vulnerable coastal areas in Hawai'i (OP-CZM., 2019). The report summarized the complexities of reshaping developed areas abutting shorelines, including the difficulties of relocating, demolishing, or restricting access to development in affected coastal areas. The report also articulated land use, planning, legal, financial, and community disruption issues that would need to be weighed carefully before managed retreat could be undertaken. The report provided examples of where managed retreat has been undertaken in Hawai'i and other states, most notably the town of Hilo on the Big Island, which was redeveloped after a series of devastating tsunamis. Guidance documents suggest following this example of redevelopment after disasters cause catastrophic shoreline damage creating open space in the damaged area, realigning roadways to the new shoreline, and accommodating growth outside of the hazardous areas (County of Maui, 2015, Courtney, et. al., 2020).

The State of Hawai'i Statewide Coastal Highway Program Report (Francis, 2019) was published. The report assessed Hawai'i's roads and highways in vulnerable coastal areas: A central focus of the report was the costs of coastal erosion and road degradation brought on by SLR impacts. The Coastal Road Erosion Susceptibility Index (CRESI) approach involves the characterization of coastal road locations by a single index that reflects the susceptibility of the road to erosion and structural collapse. CRESI is based on the concept that the width of land between the road and the ocean acts as a buffer to erosion and therefore controls how vulnerable a particular location is to structural road damage and collapse.

A road far inland would have a significant buffer protecting it from damage with a low CRESI score, whereas a road that is low and adjacent to the ocean is in much graver danger with a higher CRESI score. With this in mind, the following variables are used in the calculation of CRESI:

- Beach geomorphology
- Coast geomorphology
- Erodible volume
- Slope
- Coastal ground cover and existing structures above ground
- Road base and subgrade conditions
- Armoring
- Rate of sea level change
- Shoreline accretion or erosion rate
- Mean tidal change
- Significant wave height

No projections are included to assess how all the factors affecting CRESI might change because of the effects of climate change, SLR, intensifying ocean hazards, traffic patterns, and coastal development trends. On Molokaʻi, there were seven roadway sections identified as prioritized road sections under current conditions for planning and management ranked as follows:

1. Kālua‘aha at Milepost (MP) 14+0.7 with relocate or elevate identified as remediation alternatives.
2. Pūko’o at MP 16+0.27 with relocate or elevate identified as remediation alternatives.
3. Pauwalu southwest at MP 18+0.20 with hardening or relocation identified as remediation alternatives.
4. Pauwalu northeast at MP 18+0.71 with hardening or relocation identified as remediation alternatives.
5. Waialua at MP 19+0.62, 19+0.77, 19+0.91, and 20 with hardened or relocated identified as remediation alternatives.
6. Unnamed at MP 19+36 with relocate, elevate, or harden identified as remediation alternatives.
7. Unnamed at MP 20+0.51 and 20+0.55 with beach nourishment identified as the remediation alternative.

The State of Hawaiʻi requires all new projects undergoing environmental review under the Hawaiʻi Environmental Policy Act (Chapter 343, Hawaiʻi Revised Statutes) to consider whether a project is likely to have an adverse effect or be exposed to SLR using the information documented in the 2017 Hawaiʻi Sea Level Rise Vulnerability and Adaptation Report (HAR 11-200.1).

Through an NOAA Regional Coastal Resilience Grant, the Hawai‘i Sea Grant College Program together with the State of Hawai‘i Department of Land and Natural Resources (DLNR), Office of Planning, and Tetra Tech, Inc., developed statewide guidance documents and tools to improve community resilience to coastal hazards and SLR (Courtney, et.al., 2019). Recommendations are to capture opportunities to rebuild resiliently, such as through rebuilding to current flood damage prevention ordinance, building codes, and shoreline setbacks; utilizing regulatory base flood elevations that reflect future conditions; rethinking development patterns in vulnerable areas, such as SLR exposure areas; and considering nature-based solutions for risk reduction.

The U.S. Department of Transportation published a report on nature-based solutions tailored to coastal highway resilience (DOT, 2019). The guide is designed to help transportation practitioners understand how and where nature-based and hybrid solutions can be used to improve the resilience of coastal roads and bridges. Nature-based solutions use natural materials and processes to reduce erosion, wave damage, and flood risks,

serving as alternatives to, or ecological enhancements of, traditional shoreline stabilization and infrastructure protection techniques. Examples include the conservation, restoration, or construction of beaches, dunes, marshes, mangroves, maritime forests, and reefs to solve shoreline issues (Table 2-6). The report uses a case study on Maui to illustrate successful nature-based engineering. At the Wailuku-Kahului Wastewater Reclamation Facility, a combination of a buried revetment with beach nourishment, dune restoration, and vegetative plantings was used to protect the facility against coastal erosion and flooding (Boudreau et. al., 2018)

2020

Updates to the State Coastal Zone Management Act (CZMA, Hawai‘i Revised Statutes (HRS) 205A, through Act 16, SLH 2020) provide increased statutory support for integrating SLR considerations in planning and permit review. The statutory updates included the recognition that coastal hazards are increasing with SLR, strengthening prohibitions against coastal armoring, increasing scrutiny for shorefront development, and strengthening protections for beaches and other coastal environments.
Under Act 45, a statewide sustainability branch was established within the Office of Planning. The Act updated and reaffirmed the role of the office to coordinate among State agencies regarding climate change adaptation and sustainability. One of the reasons for this action was the fact that sustainability and climate change adaptation priority guidelines had been added to Part III of the Hawai‘i State Planning Act, chapter 226, Hawai‘i Revised Statutes. The Act specifically tasks the office with the responsibility for coordinating the management of SLR.

OP-CZM updated the Hawai‘i Ocean Resources Management Plan (CZM, 2020). The Plan identifies the need to inventory and analyze critical facility assets threatened by coastal hazards.
Funded by the CZM Program, Guidance for Addressing Sea Level Rise in Community Planning in Hawai‘i (Courtney, et. al., 2020). This guidance report assists local government planners to integrate SLR adaptation plans and policies into the state, county, and community plans. This document considers science-based information and adaptation actions to address coastal hazards with SLR to make coastal communities more resilient and sustainable. For planning decisions related to critical infrastructure with long expected lifespans or low-risk tolerance, the report suggests that counties may wish to also consider exposure to passive inundation with 6 ft of SLR.

2021

The Hawai‘i Climate Commission published the Nature-Based Resilience and Adaptation to Climate Change in Hawai‘i: A Climate Ready Hawai‘i Working Paper (CZM, 2021).

The Working Paper highlights actions in Hawai‘i that rely on nature-based strategies to adapt to and mitigate climate change. It identifies ongoing efforts in the state, and key action areas for the next steps that enhance climate readiness. Some examples they use for nature-based solutions in coastal erosion regions include:

- Agroforestry, lo‘i kalo (wetland taro), and loko i‘a (marine fishponds)
- Building coastal dunes, vegetation, and coral reefs
- Widening of floodways adjacent to rivers, temporary water detention, bank stabilization
- Small-scale beach nourishment
- Watershed restoration, ungulate fencing, invasive species control, green infrastructure
- Coral restoration nurseries

The Hawai‘i Department of Transportation (HDOT) developed two Climate Resilience Action Plans (HDOT, 2021) that outline the potential threats from climate change to Hawai‘i Highways. The Strategies for a More Resilient Future Plan promotes considering climate risk and long-term climate change resiliency in agency practices. The protection of transportation assets exposed to SLR hazards may not be cost-effective in the future. This means that exposed assets, and often adjacent assets, may need to be relocated or elevated. In extreme cases, where communities and their economic activities are relocated, roads may be decommissioned, and new roads may be needed. The Plans are a companion to the online mapping platform maintained on HDOT's website to enable the review of climate threats at a level of detail not possible in printed form. The Department of Health Hazard Evaluation and Emergency Response Office prepared a report on the Risks of Sea Level Rise and Increased Flooding on Known Chemical Contamination in Hawai‘i, which illustrated how State agencies have begun using SLR projections in Hawai‘i (Felton, 2021). The memorandum discusses potential environmental concerns posed by anticipated increased flooding, groundwater inundation, and disruption of contaminated lands in coastal areas due to climate change and rising sea levels.

Under Act 178, the Hawai‘i Office of Planning and Sustainable Development prepared an annual report Relating to Sea Level Rise Adaptation (Act 178, 2021). The report identified existing and planned facilities that are vulnerable to SLR, flooding impacts, and natural hazards and then assesses options to mitigate the impacts of hazards to those facilities.

County of Maui

On a county level, we examined the County of Maui 2030 General Plan (2010), the Moloka‘i Island Community Plan (2018), and the County of Maui Comprehensive Economic Development Strategy (CEDS, 2022). All three plans support the intent and strategies presented in this plan. Below are the key pieces that demonstrate that alignment.

It should also be noted that most counties in Hawai‘i, which are responsible for shoreline setbacks, Special Management Areas (SMAs), and building permits, are moving toward defining "no build" zones to prevent future improvements in areas exposed to SLR and coastal erosion. Maui County has already instituted shoreline setback rules, which use multiple criteria to determine appropriate setback distances.

Maui County General Plan (2010)

The Countywide Policy Plan provides broad goals, objectives, policies, and implementing actions that portray the desired direction of the County's future. Furthermore, this Countywide Policy Plan provides the policy framework for the development of the Maui Island Plan and the nine Community Plans.

Some of the specific language that supports this CCSLAR plan are in "Section IV. Goals, Objectives, Policies, and Actions," and include:

Sub-Section Heading	Policy	Page #
A. Protect the Natural Environment	e. Protect undeveloped beaches, dunes, and coastal ecosystems, and restore natural shoreline processes.	46
A. Protect the Natural Environment	f. Strengthen coastal-zone management, re-naturalization of shorelines, where possible and filtration or treatment of urban and agricultural runoff.	47
I. Improve Physical Infrastructure	f. Discourage the development of critical infrastructure systems within hazard zones and the tsunami-inundation zone to the extent practical.	73

J. Promote Sustainable Land Use and Growth Management	f. Discourage new entitlements for residential, resort, or commercial development along the shoreline.	74
J. Promote Sustainable Land Use and Growth Management	g. Restrict development in areas that are prone to natural hazards, disasters, or sea-level rise.	74

County of Maui Comprehensive Economic Development Strategy (CEDS, 2022)

The Comprehensive Economic Development Strategy (CEDS), mandated by the Economic Development Administration (EDA) of the U.S. Department of Commerce, is an economic roadmap to diversify and strengthen regional economies – in our case, Maui County. Usually conducted every 5 to 6 years, the purpose of the CEDS is to create a locally-based strategy for economic development and create an environment for economic prosperity and resilience. EDA and other Federal funding for projects, as well as some State and County funding, is informed by the CEDS and uses it as a criterion for decision making.

In the Molokaʻi SWOT (Strengths, Weaknesses, Opportunities, Threats) section, one of the Opportunities listed is, "Create a Molokaʻi-specific climate change plan" (page 156). Also, one of the top Threats listed is, "Sea level rise and flood risk" (page 157).

2009

Under the State Aloha+ Challenge, the County of Maui has its own Aloha+ Challenge. The Maui challenge site provides information to households on how to meet the goals of the Aloha+ Challenge:

- Be energy smart using tricks like insulating drapes and a smart thermostat to save energy and money.
- Have a clean energy home with renewable energy, efficient electric heat pump heating, and electric appliances.
- Shift your ride from a single-driver gasoline car to an electric or plug-in hybrid, carpool, bus, or biking.
- Eat lower-impact green foods and waste less.
- Be water wise lowering water consumption and upgrading water use systems to more efficient systems.
- Community involvement to talk about solutions and learn about climate solutions.
- Resilience by developing emergency plans, growing your food, learning first aid, or even adopting a storm drain to reduce water being trapped inland.

Most counties in Hawaiʻi, which are responsible for shoreline setbacks, Special Management Areas (SMAs), and building permits, are moving toward defining "no build" zones to prevent future improvements in areas exposed to SLR and coastal erosion. Both Maui and Kauaʻi Counties have already instituted shoreline setback rules, which use multiple criteria to determine appropriate setback distances.

2020

The County of Maui Public Works has received a grant from the federal Highway Administration for the University of Hawaiʻi to complete an assessment of the County of Maui Coastal Roads to the Effects of Climate Change, SLR, and shoreline erosion. UH developed a prioritized list of shoreline areas requiring mitigation work, and provided recommendations for short-term and long-term implementation (Francis, 2019).

Molokaʻi Island Community Plan (2018)

The Molokaʻi Island Community Plan identifies current and anticipated future conditions and needs on Molokaʻi. These conditions and needs are addressed throughout the Plan by identifying strategic planning goals, policies, and actions that will guide decision-making and implementation through 2035.

Section 1.2 outlines the problems and opportunities that Molokaʻi faces, not only issues that the county government must address, but also the top concerns expressed by the community through public outreach. One of the 10 top "Problems" listed is Climate Change, stating that "Climate change will become increasingly serious before the middle of the 21st century and will impact Molokaʻi's economy, built environment, historic and cultural resources, infrastructure systems, ecosystems, and natural resources."

In response, Section 2.3 discusses how climate change adaptation strategies and measures to develop a more sustainable island community are woven into the Plan. Major climate change effects forecasted for Molokaʻi are listed, and include "Sea level rise with resultant flooding, beach erosion, and damage to coastal property."

Furthermore, the Plan states "Climate change adaptation strategies, such as building on existing hazard mitigation principles and developing new ways of designing communities and infrastructure, will also be necessary for the health and safety of the people and the environment. This will be achieved by actions such as relocating critical structures out of hazard-prone areas, incremental adaptation of harbors, increasing water conservation and reuse, and managing aquifer recharge areas."

The following tables includes the actions identified by the Molokaʻi Island Community Plan that are most relevant to this Plan:

Community Plan Chapter	Action No.	Description	Priority	Timing	County Agency Lead	Est Cost ($1,000)	Funding Source(s)
Hazards (page 217)	4.05	Identify critical infrastructure, lifelines, roads, and structures that are vulnerable to coastal hazards, including SLR, and develop a more coordinated emergency response system of well-defined and mapped evacuation routes.	1	2018-2023	EMA	N/A	N/A
Hazards (page 218)	4.09	Complete an inventory of vulnerable critical facilities and infrastructure. Include this information in the Maui County HMP for future mitigation project funding.	1	2018-2023	EMA	TBD	Federal State
Hazards (page 218)	4.10	Map SLR projections for specific geographic areas on Molokaʻi, utilizing data from the NOAA Digital Coast SLR and Coastal Project Flooding Impacts Viewer. Map other climate-related coastal hazard areas.	2	2018-2023	PD	20	County
Hazards (page 219)	4.11	Continue work with FEMA to update FIRMs that incorporate best available information on climate change and SLR.	1	On-going	PD	N/A	N/A
Hazards (page 219)	4.12	Implement additional CRS activities to improve class ratings and discounts on flood insurance premiums.	2	On-going	PD	TBD	County
Hazards (page 219)	4.13	Conduct erosion analysis of Molokaʻi's shoreline to determine rate of erosion and use the results to determine setback calculations that also factor in incremental effects of SLR.	1	2018-2023	PD	100	County
Hazards (page 219)	4.14	Coordinate with Federal, State and County agencies to obtain current SLR information and maps. Plan phased relocation of critical structures and roadways. Plan long-term strategic retreat of buildings. Identify priority planning areas where resources and planning efforts should be focused. Identify how and where to use adaptation strategies such as retreat, accommodation.	2	2022-2035	PD	1,000	County State

Community Plan Chapter	Action No.	Description	Priority	Timing	County Agency Lead	Est Cost ($1,000)	Funding Source(s)
Land Use (page 226)	6.1.06	Study viable options for transitioning Molokaʻi's commercial and population center away from the threat of SLR and coastal inundation.	1	2018-2023	PD	TBD	County State Federal
Land Use (page 226)	6.1.07	Identify important subsistence use, lands, and resources.	1	2022-2035	OED	TBD	County State
Land Use (page 226)	6.1.08	Research and develop a climate change policy and adaptation plan to address rising sea levels and beachfront housing and development.	1	2018-2023	PD	TBD	County State Federal
Land Use (page 226)	6.1.09	Adopt a "Traditional Land Use" [TLU) Overlay into the Community Plan Designations. The County PD should look at existing Community Plan Designations and County Zoning in Mana'e and recommend zoning adjustments based on current land use suitability analysis methods, as recommendations included in the Mana'e GIS Mapping Project (COM, 2008) and the Traditional and Cultural Practices Report for Mana'e (OHA, 2016).			PD		ʻAha Kiole o Molokaʻi Molokaʻi Community
Wastewater (page 232)	8.2.01	Assess the feasibility of providing measures to protect the Kaunakakai WWTF against inundation threats or to relocate it out of the coastal floodplain.	1	2022-2035	DEM	200	County
Wastewater (page 232)	8.2.02	Conduct a wastewater reuse feasibility study that includes the identification of potential recycled water users, necessary wastewater facility upgrades, required infrastructure improvements, estimated costs, and funding sources.	2	2018-2023	DEM	50	County
Wastewater (page 232)	8.2.04	Explore options and necessary regulation changes to allow greywater reuse systems for 2018- 2023 irrigation and toilet flushing.	2	2018-2023	DEM	N/A	N/A

Molokaʻi Community Plan - Implementation Plan (page 217):

2018

The Molokaʻi Island Community Plan, updated in 2018, identifies erosion as an issue on Molokaʻi that is negatively impacting soils, streams, fishponds, wetlands, coastal waters, and reefs, as well as the cultural subsistence practices that rely on those resources. The Plan calls for performance indicators to monitor whether implementation is on schedule and whether policies are effective in reducing vulnerability to SLR. The Plan includes 39 core indicators, one of which is focused on SLR vulnerability by tracking the percent of building permits issued in tsunami inundation zone and SLR exposure areas (County of Maui, 2018).

2019

The Department of Hawaiian Home Lands (DHHL) developed the Molokaʻi Regional Plan to identify priority projects to implement in the next five years. The Plan identifies land, roadways, and infrastructure that are within the SLR-XA. In response to chronic and episodic erosion in homestead areas, DHHL prepared a South Molokaʻi Shoreline Erosion Management Plan for the coastal homestead communities of Kapaʻakea and Kamioloa-One Aliʻi. A similar erosion management plan for the shoreline areas along the coast in Kalamaʻula is also planned.

2022

DHHL developed a draft special area plan for Mālama Cultural Park (G70, 2022). The plan provides a conditions assessment of Malama Cultural Park and its resources, outlines specific management actions to ensure the natural and cultural resources within the DHHL property are properly cared for, and recommends management approaches that consider SLR projections.

With undeveloped land outside of the SLR-XA, Molokaʻi has opportunities to plan for SLR now by considering the County General Plan and Community Plan updates that recognize the SLR-XA with 3.2 ft of SLR as a vulnerability zone and to plan for future land use now. Revised and updated SMA policies, objectives, and requirements offer additional opportunities at the local level to prepare for SLR.

In addition to chronic coastal flooding from SLR, tropical storms, hurricanes, and tsunamis create waves that flood low-lying coastal areas. Communities should consider planning a new development to reduce exposure to severe events by recognizing that the coastal floodplain will migrate landward with increased sea levels.

For this Molokaʻi Sea Level Rise Vulnerability Assessment, we will consider sea level projection elevations out to 2150, aligning with the information provided by the 2021 IPCC AR6 report. Planning horizons are decadal spanning 2030 to 2150 with elevation benchmarks by foot.

B. Climate Change Plans

Maui County Climate Action & Resiliency Plan (CARP, 2022)

Released in 2022, this plan aims to reduce Maui County's contribution to climate change and to build resilience within the community in response to current and future climate change impacts. It was spearheaded by the County of Maui's Office of Climate Change, Resiliency, and Sustainability, which developed a partnership with the Climate Action and Resiliency Plan Advisory Committee. They are working on having support for a sustainable and climate-safe future for Maui County as a whole to provide the community with access to information to address their needs and concerns. https://www.resilientmauinui.org/

It should be noted that one of the 5 key strategies identified (Strategy 3) is to support necessary processes and planning for continued climate action and resilience. Specifically, the call to action is to "Develop guidance for capital planning, including resilient design standards for County of Maui infrastructure upgrades that consider climate change projections," which this CCSLAR Plan aims to do.

Maui County Countywide Wastewater Infrastructure Inundation Study (2021)

The County of Maui Wastewater Infrastructure Inundation Study evaluated potential impacts of storm surge and sea level rise of the wastewater systems in Maui County. Before this study, the County of Maui did not have any directives or formal policies to evaluate or plan for climate change.

Department of Hawaiian Homelands (DHHL) - South Molokaʻi Shoreline Erosion Management Plan (SM-SEMP)

Soil erosion has been a major issue on the island of Molokaʻi especially on our south shores. DHHL is preparing for the different impacts on their communities located on the south shore due to the effects of sea level rise and shoreline erosion. DHHLʻs communities from Kalamaʻula to Makakupa'ia (One Aliʻi) are in the major impact zones for sea level rise and especially shoreline erosion. Their planning process is broken down into 5 phases; Phase 1 is to do the research on the different areas and how SLR and soil erosion has affected the different areas, moʻolelos in areas along with the history, terrestrial environment, hotspots, etc. Phase 2 is to conduct field observations of shoreline conditions to gather valuable background data and photos of past floodings, shoreline conditions and change. Phase 3 is contacting and working with Hawaiian Homestead beneficiaries, lineal descendants, the government, and community stakeholders to identify shoreline erosion threats and management strategies and responses. Phase 4 is consulting with beneficiaries on draft recommendations, and Phase 5 is to bring the Draft and Final versions of the SM-SEMP to the Hawaiian Homes Commission for review and approval. The final SM-SEMP was approved in December 2022.

DHHL's National Coastal Resilience Fund (NCRF) - Building Community Resilience for Molokaʻi Coastal Homestead (estimated timeline 2023-2025)

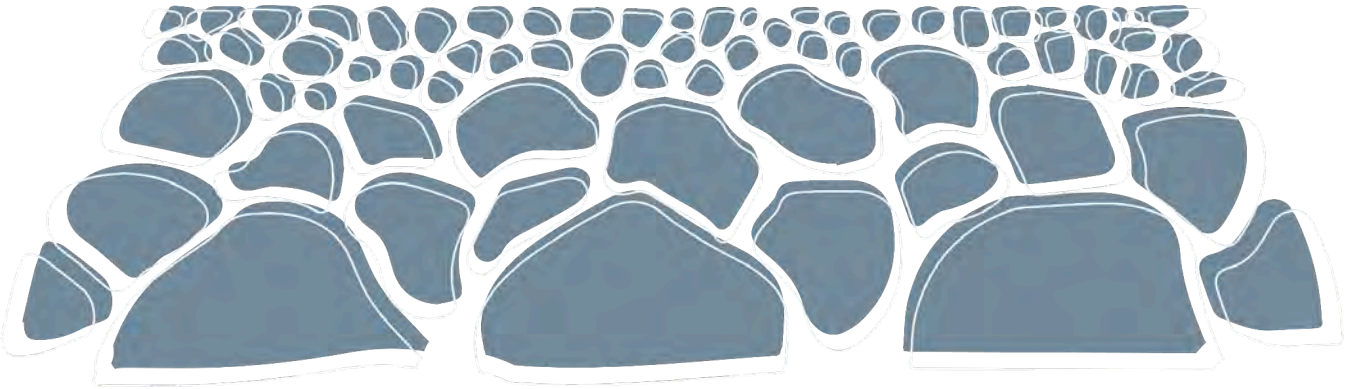
"The Project will utilize a hybrid approach, aligning Traditional Ecological Knowledge, social capital and indigenous assets of native Hawaiian beneficiaries on Hawaiian Home Lands along the southern shoreline of the island of Molokaʻi, Hawai'i with the most current scientific analyses and modeling of projected sea level rise, flooding, groundwater upwelling and other increasing coastal hazards, to develop a culturally appropriate, community- supported Homestead Community Resilience Plan. The planning process will engage all relevant stakeholders, including cultural practitioners, watershed restoration groups and soil and water conservation organizations, and will identify for project priorities that will stabilize and restore shorelines, mitigate coastal flooding and sedimentation, and emphasize culturally grounded, nature-based solutions."

Other Related Plans/Studies

In addition to the plans listed above, the Project Team identified these additional studies, plans, and ongoing planning processes that affect and intersect with this planning process:

- USGS and MWP: A prioritization protocol for coastal wetland restoration on Molokaʻi, Hawaiʻi
- DHHL: Mālama Cultural Special Area Plan (G70, Intl)
- County of Maui: Beach Parks Vulnerability and Adaptation Studies (Tetratech, Phase 1 - 2021) (Tetratech, Phase 2 - 2022) (Phase 3 TBA)
- County of Maui: Molokaʻi Water Plan (Ongoing, Townscape)
- County of Maui: Assessment of Stakeholder Perceptions of Ocean Hazard Risk for Coastal Infrastructure/Roadways (2022)
- County of Maui: Climate Action & Resiliency Plan (2022)
- Molokai Clean Energy Hui: Community Energy Resilience Action Plan (CERAP) 1.0 (SM, HNEI, completed in June 2023); CERAP 2.0 (2023)
- HDOT: Molokaʻi Shoreline Project Refined Priority List (2021), with reference to Statewide Coastal Highway Program Report (2019) and Hawaiʻi Highways Climate Adaptation Action Plan: Strategies for a More Resilient Future (May 2021)
- Coastal Geology Group in the School of Ocean and Earth Science and Technology at the University of Hawaiʻi: Hawaiʻi Shoreline Study (Ongoing)
- Molokaʻi Subsistence Study Task Force 1993-1994
- Molokai Subsistence Study Update (Unpublished, 2024)

In summary, the Project Team has made every effort to coordinate with all relevant planning efforts in order to minimize duplication of efforts, and to maximize the resources allocated to this project. In addition, we have aimed to share resources and to reinforce strategy recommendations where possible.



4. Priority Sites - Sea Level Rise Adaptation & Mitigation Strategies

4. PRIORITY SITES - SEA LEVEL RISE ADAPTATION & MITIGATION STRATEGIES

This chapter provides a summary of the 13 Priority Sites that were identified through our community engagement process. It should be noted that other key factors were taken into consideration, such as community impact/need, site ownership (County sites prioritized), existing plans, etc.

The sections for the Priority Sites include information on the history of this site, the current situation and projected inundation/issue(s), a vulnerability assessment, adaptation needs, and **Recommended Adaptation Strategies**, along with preliminary cost to implement (as available) - for the short-, mid-, and long-term. In general, short-term indicates immediate actions (1-3 years); mid-term indicates 3-5 year actions; long-term indicates 5-20 year actions.The process for determining the Recommended Adaptation Strategies was that SEI analyzed the 13 sites and then developed "Conceptual Adaptation Strategies." SM then presented those strategies to the community during workshop #4 series and the public comment period. We then included only those strategies that the community approved. Additional possible adaptation strategies are included in SEI's report, but we did not include strategies that were not supported or recommended by our community.

It is imperative to note that the project objective to "**Identify the priority projects and areas on Molokaʻi**" elicited strong pushback from the community. The general consensus was that when looking at the full impact of climate change and SLR, it was difficult to identify only 5-10 priority projects, since doing so would only be a short-term "band-aid" solution, and what we really need is a major overhaul in terms of what needs to be relocated, which includes all of Kaunakakai town, as well as the numerous roads, infrastructure, residences, and businesses along the coast from west of town, east to Manaʻe. Thus, we have included a **Supplement**, as an additional section that thoroughly documents big picture planning considerations that should be implemented in the long run. **We also included 13 Priority Sites, going beyond the scope of 5-10 sites, based on community input.**

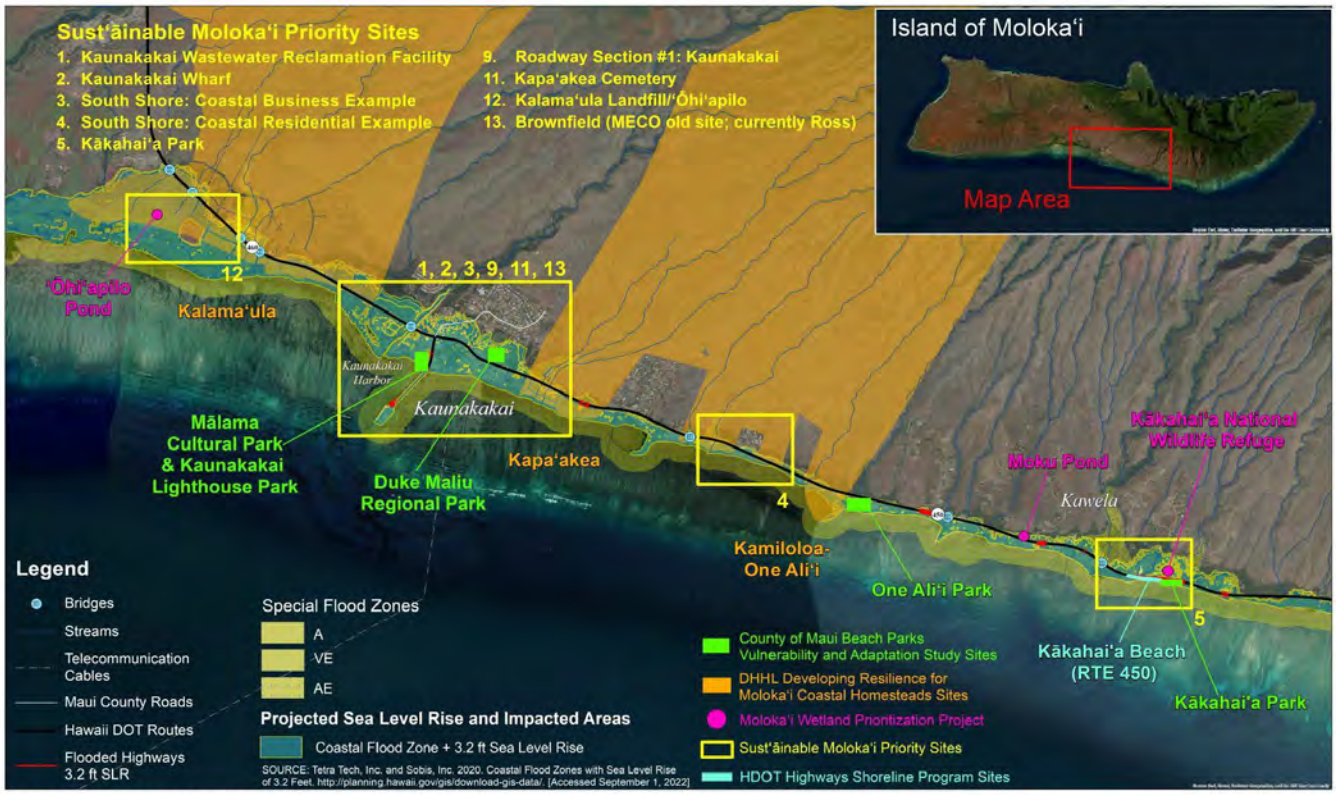
Overall, SLR adaptation methods fall into three general categories: **Protection, Accommodation,** and **Relocation.**

- **Protection** can be further broken down into "hard" protection (engineered structures to armor the shoreline), and "soft" protection (more nature-based or "green" solutions). Protection prevents the effects of SLR from occurring (e.g., blocks the rise from moving inland).
- **Accommodation** reduces the SLR impacts (e.g. it happens, but you can live with it).
- **Relocation** mitigates vulnerability by moving people and infrastructure outside of areas that are or may be impacted by SLR; however, the land that remains will continue to experience the impacts of SLR. All of these methods involve varying regulatory requirements, social and economic considerations, possible environmental impacts, and varying degrees of the financial cost.

More detail can be found in the SEI Molokaʻi Sea Level Rise Vulnerability Assessment in **Appendix A1**, which includes a detailed analysis of these sites. The section and page numbers are indicated for each site.

Furthermore, the **Supplement** includes information on:

- Community Engagement, Applying Place-Based Knowledge, Native Hawaiian Rights and Public Trust Protections for Access and Maintaining Traditional Subsistence Livelihoods
- Preservation and Restoration of Native Ecosystems and Ahupuaʻa, Regenerative Agriculture, and Resiliency Hubs
- Climate Proofing and Relocation of Coastal Residential and Businesses Properties, Roadways, and Critical Infrastructure
- Improving Sewage and Solid Waste Management Systems and Cleaning Contaminated Areas Through Bioremediation
- Reducing Molokaʻi's Carbon Footprint and Achieving Carbon Neutrality
- Considering Potential Impacts to Molokaʻi Due to Climate Migration.



MOLOKA'I CLIMATE CHANGE AND SEA LEVEL RISE ADAPTATION AND RESILIENCY MASTER PLAN

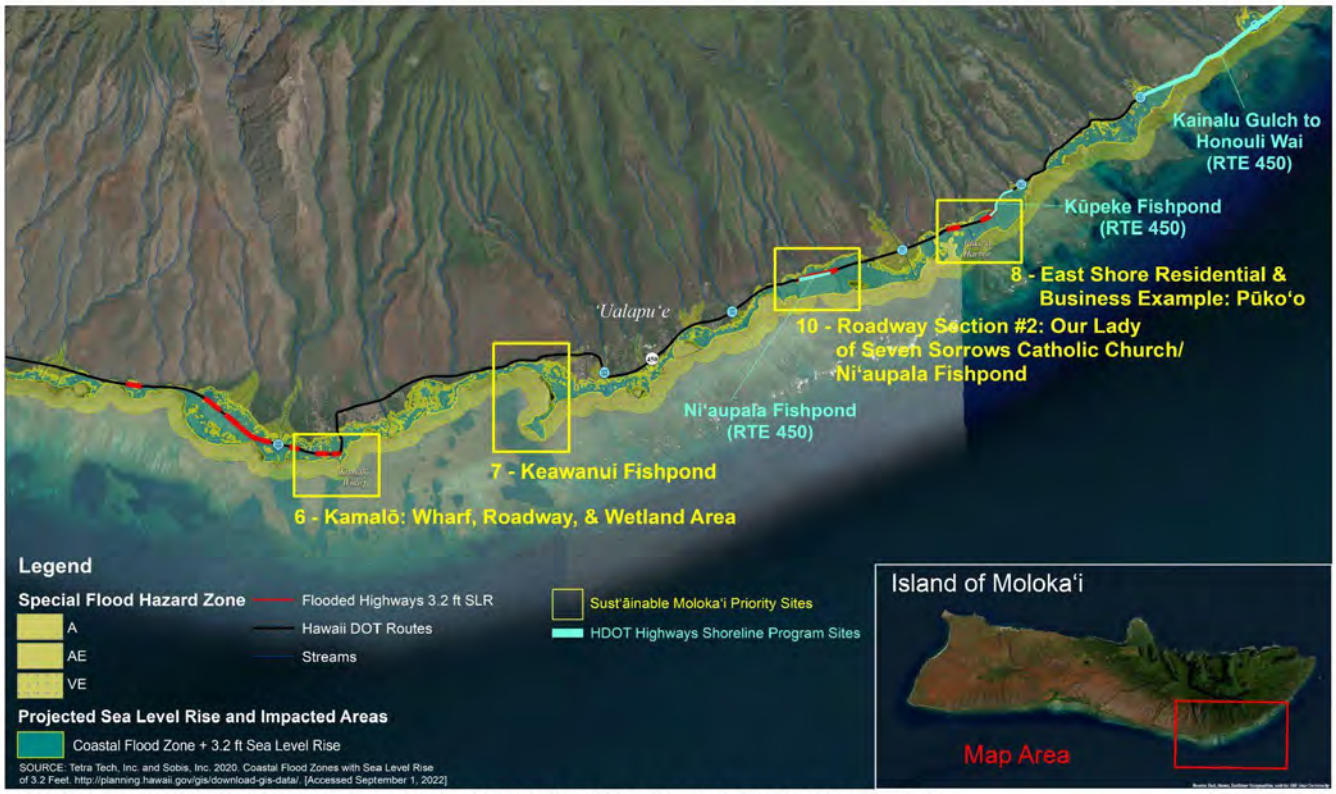
Sea Level Rise Mitigation Project Sites by Agency - South Shore

December 2023

0 2,500 5,000 10,000 Feet

0 0.25 0.5 1 1.5 2 Miles

N



MOLOKA'I CLIMATE CHANGE AND SEA LEVEL RISE ADAPTATION AND RESILIENCY MASTER PLAN

Sea Level Rise Sites by Agency - East Shore

December 2023

0 2,500 5,000 10,000 Feet

0 0.25 0.5 1 1.5 2 Miles

N

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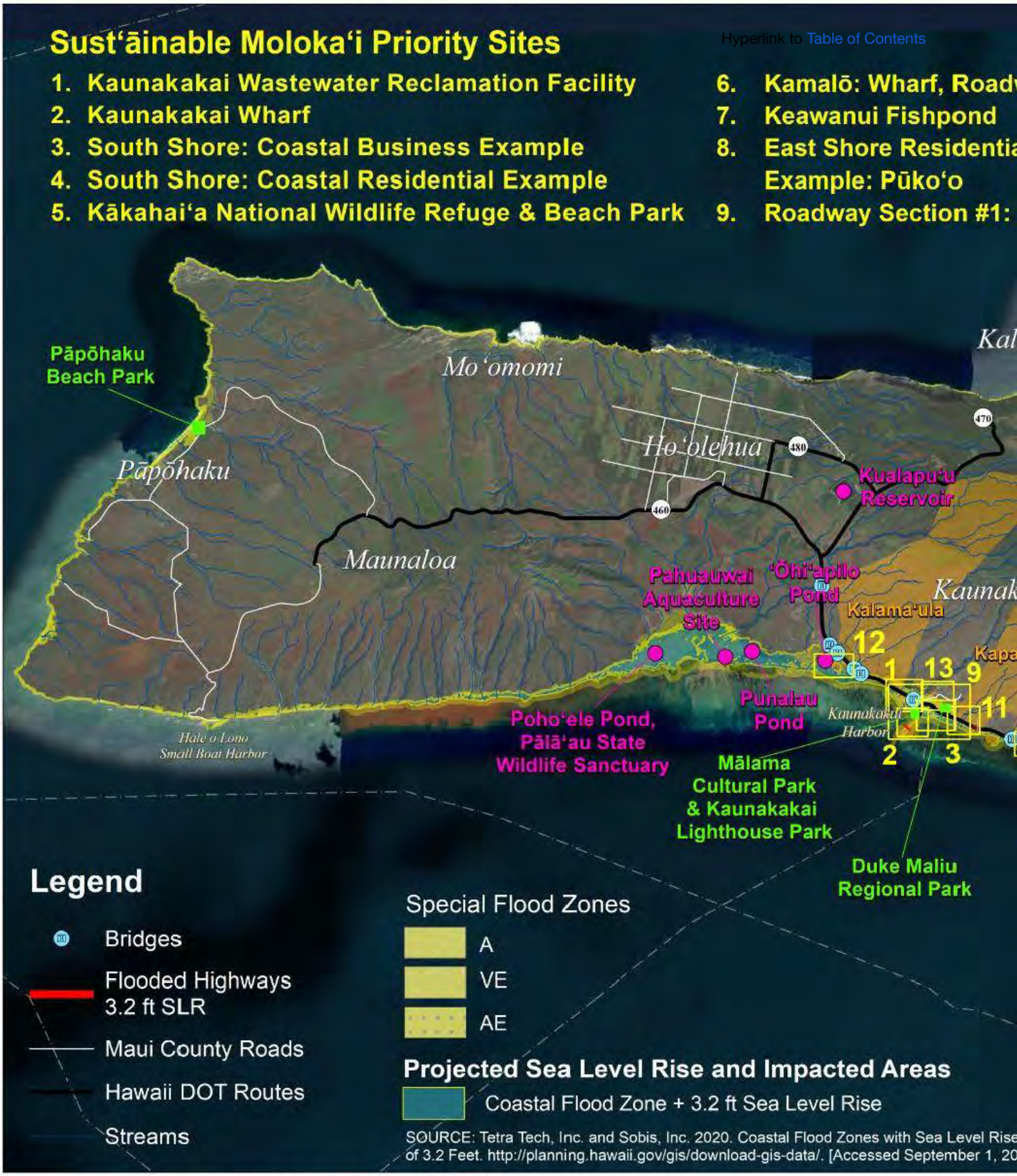

MOLOKA'I CLIMATE CHANGE AND SEA LEVEL RISE ADAPTATION AND

Sea Level Rise Project Sites by Agency

December 2023

Roadway, & Wetland Area
ond
dential & Business
)
n #1: Kaunakakai

10. Roadway Section #2: Our Lady of Seven Sorrows Catholic Church/Ni‘aupala Fishpond
11. Kapa‘akea Cemetery: County of Maui
12. Kalama‘ula Landfill: County of Maui/‘Ōhi‘apilo
13. Brownfield (MECO old site; currently Ross)

evel Rise
ber 1, 2022]

AND RESILIENCY MASTER PLAN

0 7,500 15,000 30,000 Feet

0 1 2 4 6 8 Miles

N

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4.1. Kaunakakai Wastewater Reclamation Facility

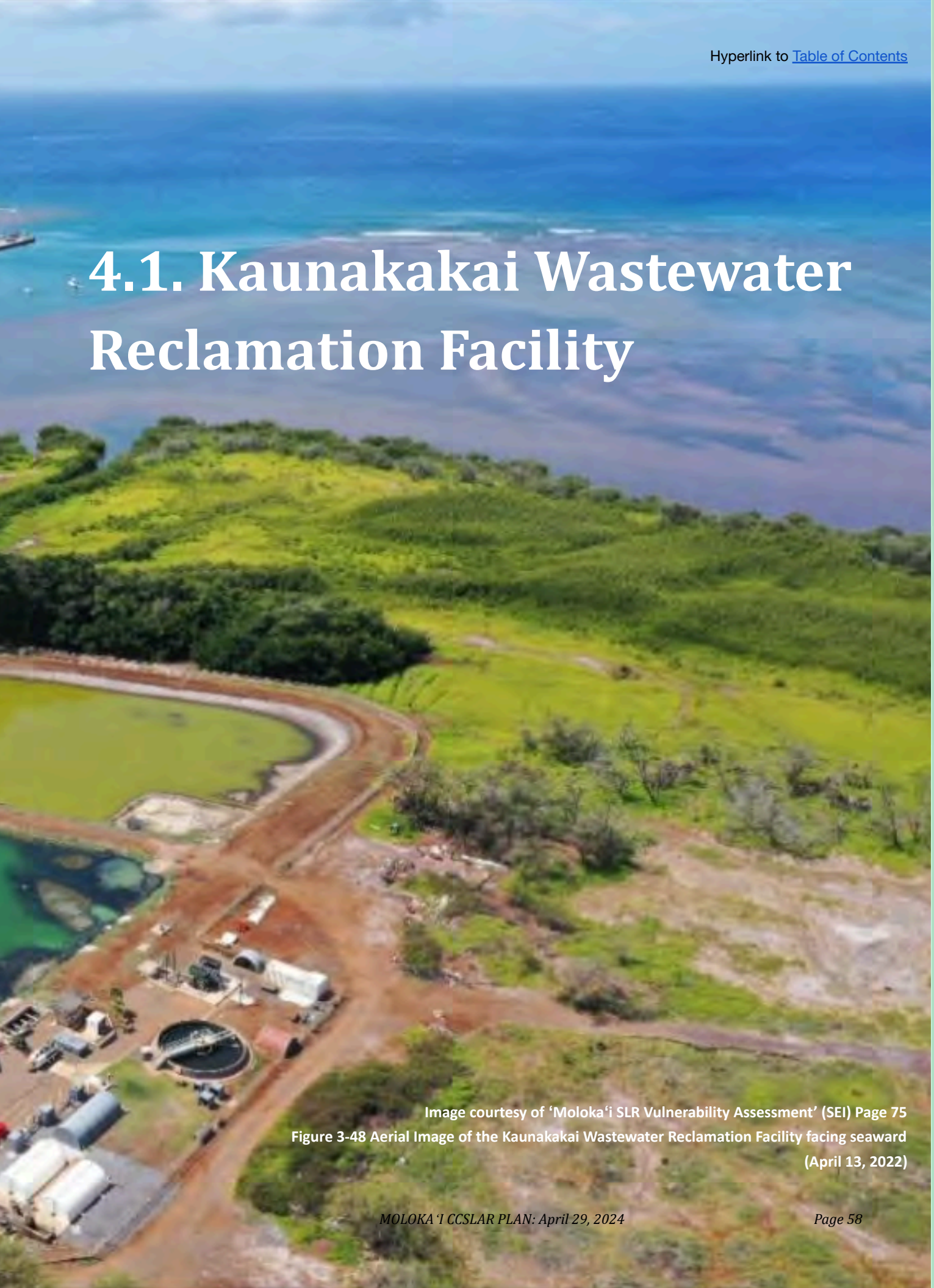
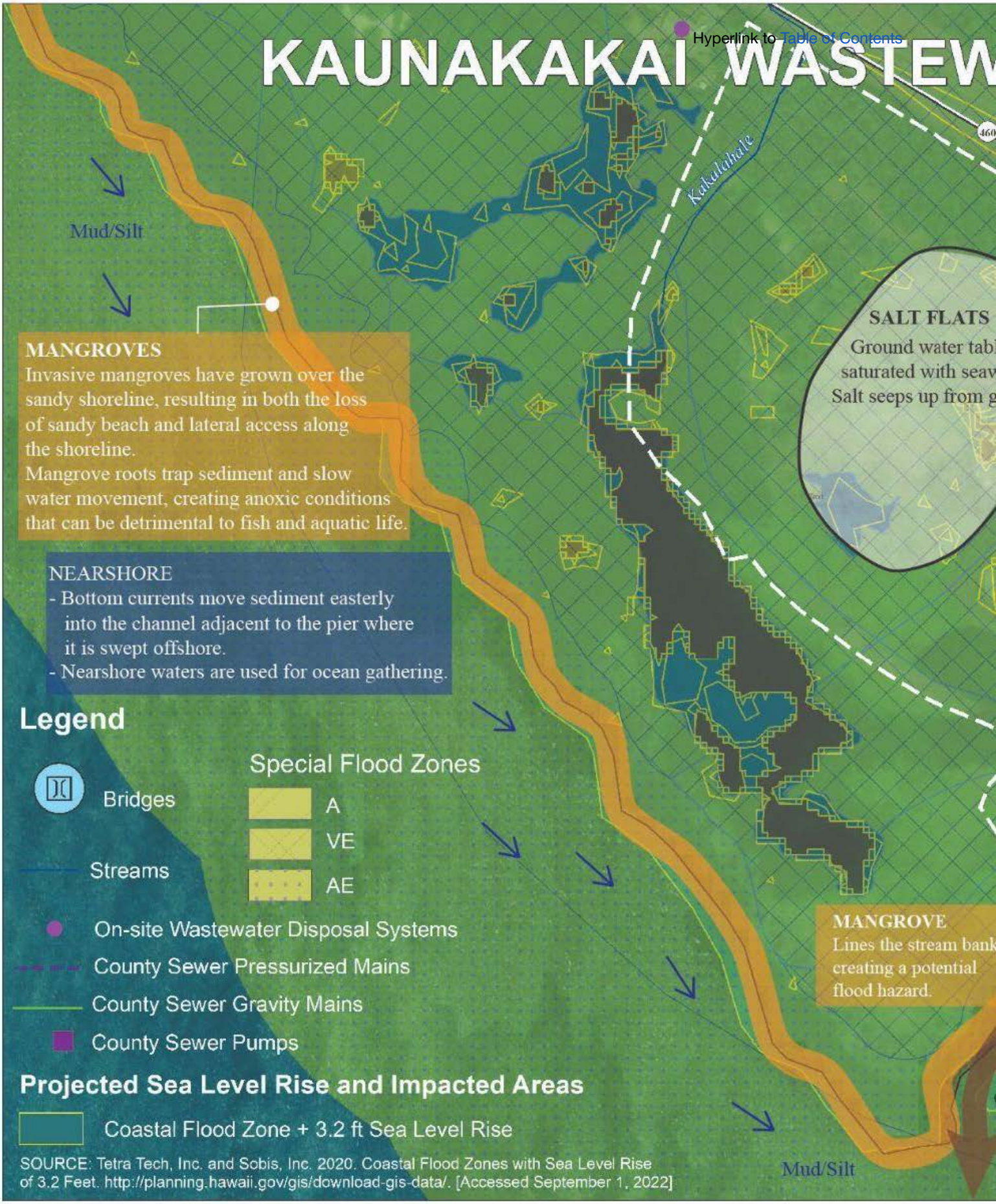


Image courtesy of 'Moloka'i SLR Vulnerability Assessment' (SEI) Page 75
Figure 3-48 Aerial Image of the Kaunakakai Wastewater Reclamation Facility facing seaward (April 13, 2022)


KAUNAKAKAI WASTEW
Kakaiahale
Mud/Silt
MANGROVES
Invasive mangroves have grown over the sandy shoreline, resulting in both the loss of sandy beach and lateral access along the shoreline.
Mangrove roots trap sediment and slow water movement, creating anoxic conditions that can be detrimental to fish and aquatic life.
SALT FLATS
Ground water tabl
saturated with seav
Salt seeps up from g
NEARSHORE
- Bottom currents move sediment easterly into the channel adjacent to the pier where it is swept offshore.
- Nearshore waters are used for ocean gathering.
Legend
Bridges
Streams
Special Flood Zones
A
VE
AE
On-site Wastewater Disposal Systems
County Sewer Pressurized Mains
County Sewer Gravity Mains
County Sewer Pumps
MANGROVE
Lines the stream bank creating a potential flood hazard.
Projected Sea Level Rise and Impacted Areas
Coastal Flood Zone + 3.2 ft Sea Level Rise
SOURCE: Tetra Tech, Inc. and Sobis, Inc. 2020. Coastal Flood Zones with Sea Level Rise of 3.2 Feet. http://planning.hawaii.gov/gis/download-gis-data/. [Accessed September 1, 2022]
Mud/Silt


ATER RECLAMATION FACILITY
Site 1
FLOOD HAZARD
- AE flood zone with Base Flood Elevation of 6 feet (1% annual chance of flooding)
- Tsunami evacuation zone
- Passive flooding area with 3.2 feet of SLR
- Entire facility to be flooded by SLR by 2100 in an *Intermediate* scenario.
- Mid-term SLR impacts: ponding in low-lying areas, soil softening, saltwater intrusion.
SITE ACCESS
via Mamalaoa Highway
KAUNAKAKAI WASTEWATER RECLAMATION FACILITY
KAUNAKAKAI WRF
- Treats up to 300,000 GPD
- Treats to R-2 standards
- 96% of effluent is disposed of in injection well north of Kaunakakai
- 4% of effluent is used to irrigate landscaping in and around WRF.
- When flooded, wastewater or contaminants may be released into nearshore waters.
SEDIMENT
Sediment flows from the Kaunakakai and Kalama'ula watersheds into nearshore coastal waters
Mālama Cultural Park
0 100 200 400 600 800 1,000
Feet
N

4.1. Kaunakakai Wastewater Reclamation Facility

See: Molokaʻi Sea Level Rise Vulnerability Assessment, Section 3.3.1, pages 74-80.

4.1.1 Location and General Description

- Ownership: County of Maui
- Land Zoning: Conservation and Class A waters
- Ahupuaʻa: Kaunakakai
- Geomorphological Classifications: Mud (NCCOS, 2007) and Very Stone Land and Rock Land (NCRS)
- Biological Classification: Estuarine and Marine Wetland (USFWS), Freshwater Emergent Water (USFWS), Uncolonized (NCCOS, 2007)

The Kaunakakai Wastewater Reclamation Facility (KWRF) was developed in 1969 on a shoreline property to meet the needs of Kaunakakai residents (Figure 3-49). The KWRF is capable of treating 0.3 million gallons of wastewater per day to R-2 standards (disinfected secondary treated recycled water with restrictions on uses and applications).

Approximately 10,000 gallons per day (4% of the total flow) is used to irrigate landscaping in the facility and roadway grasses areas. The remaining flow is disposed of by an injection well just north of town. **The Wastewater Division has indicated that the capacity of the KWRF is currently inadequate.**

To the east of the KWRF is Kaunakakai Stream. During storm events, water can overtop the stream banks lined with mangroves and have the potential to flood the KWRF facility (Figure 3-50). To the west of the KWRF is a flat coastal plain where the groundwater table has been saturated with seawater causing salt to seep up from the ground (Figure 3-51).

Image Source below: SEI, " Figure 3-49 Aerial Image of the Kaunakakai Wastewater Reclamation Facility facing landward", SEI Molokaʻi SLR Vulnerability Assessment V2, page 75

Figure 3-51 Salt flats west of the Kaunakakai Wastewater Reclamation Facility (April 13, 2022)

Image courtesy of SEI Molokaʻi SLR Vulnerability Assessment - page 76

The KWRF is approximately 700 feet from the low-lying shoreline, composed of mudflats formed from the continued deposition of terrigenous sediments. The shoreline is lined with Red Mangroves, which are an invasive species. The nearshore waters are downstream of Kaunakakai Wharf, which limits current velocities and allows sediment discharged from Kaunakakai Stream to remain nearby, impairing water quality (DHHL, 2022). Some sediment from the stream is carried by bottom ocean currents to the channel adjacent to Kaunakakai Wharf.

The mangroves along the shoreline have extensive root systems that dissipate wave energy near the shoreline. It provides shaded calm waters that are good for juvenile fish to avoid predators but can become anoxic resulting in fish kills when the tide or current subsides. The nearshore benthic biology is classified as macroalgae (10-50%) with mud geomorphology in Class– A waters (BAE, 2007). The coastal land area is classified as a wetland in the Special Management Area and the Conservation District.

The KWRF is the major infrastructure at this site. Access to the facility is available via Maunaloa Highway, which is serviced by the HDOT (Figure 3-52). Eight-inch sewer lines feed into the KWRF for treatment from the roadway (Figure 3-53)

Image courtesy of SEI Molokaʻi SLR Vulnerability Assessment - Figure 3-51, page 76,
"Mangroves along the banks of Kaunakakai Stream east of the Kaunakakai Wastewater Reclamation Facility (April 13, 2022)"

The KWRF is located within the passive flooding area with 3.2 ft of SLR. When flooded, this facility has the potential to release wastewater or contaminants into the nearshore waters. The facility is located in the AE flood zone with a Base Flood Elevation (BFE) of 6 feet. AE flood zones are areas that represent a 1% annual chance of flooding and a 26% chance over the life of a 30-year mortgage13. In 1946, a tsunami produced a runup that flooded all areas with an elevation of less than 2 feet. The KWRF is within the tsunami evacuation zone.

Image Source above: SEI, "Figure 3-52 Kaunakakai Wastewater Reclamation Facility Infrastructure (April 13, 2022)" SEI Molokai SLR Vulnerability Assessment, page 77

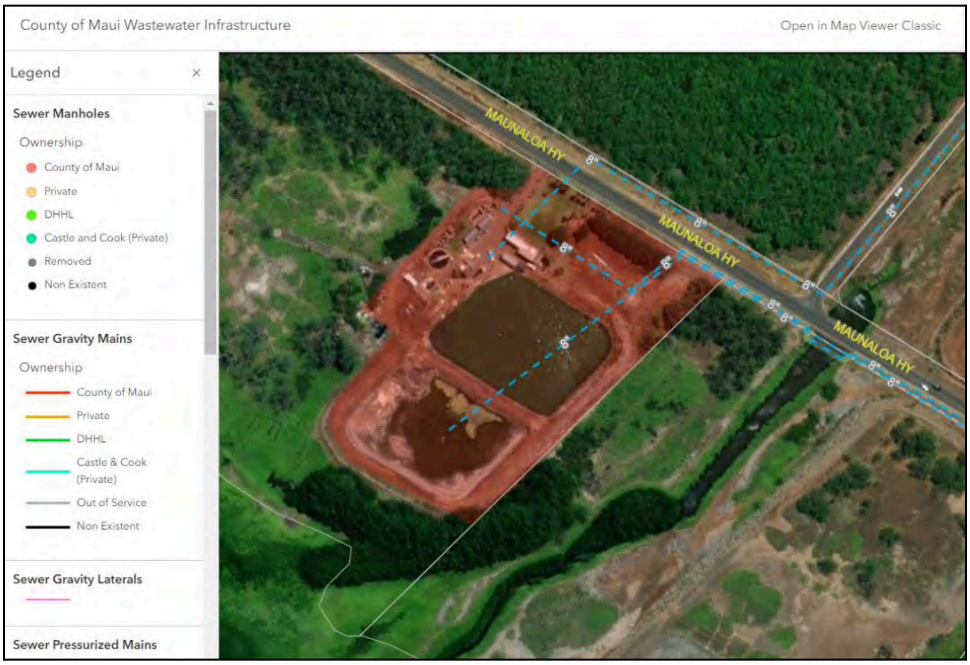


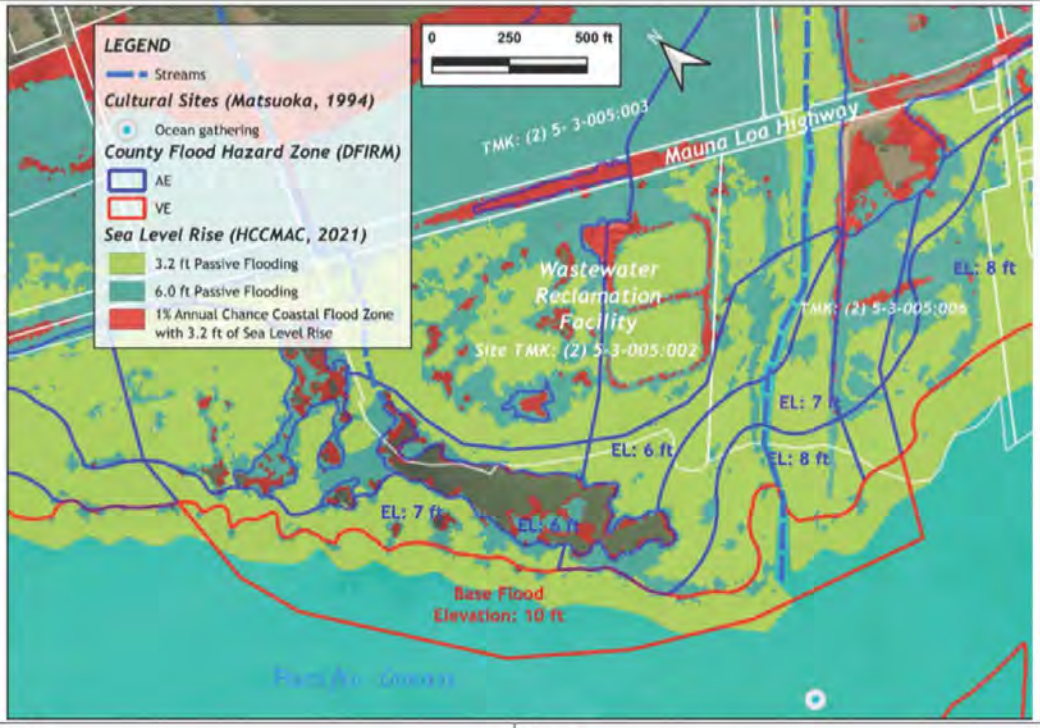
Image Source above: SEI Molokai SLR Vulnerability Assessment, page 77

Figure 3-53 Sewer lines that connect to the Kaunakakai Wastewater Reclamation Facility (County of Maui Wastewater GIS)

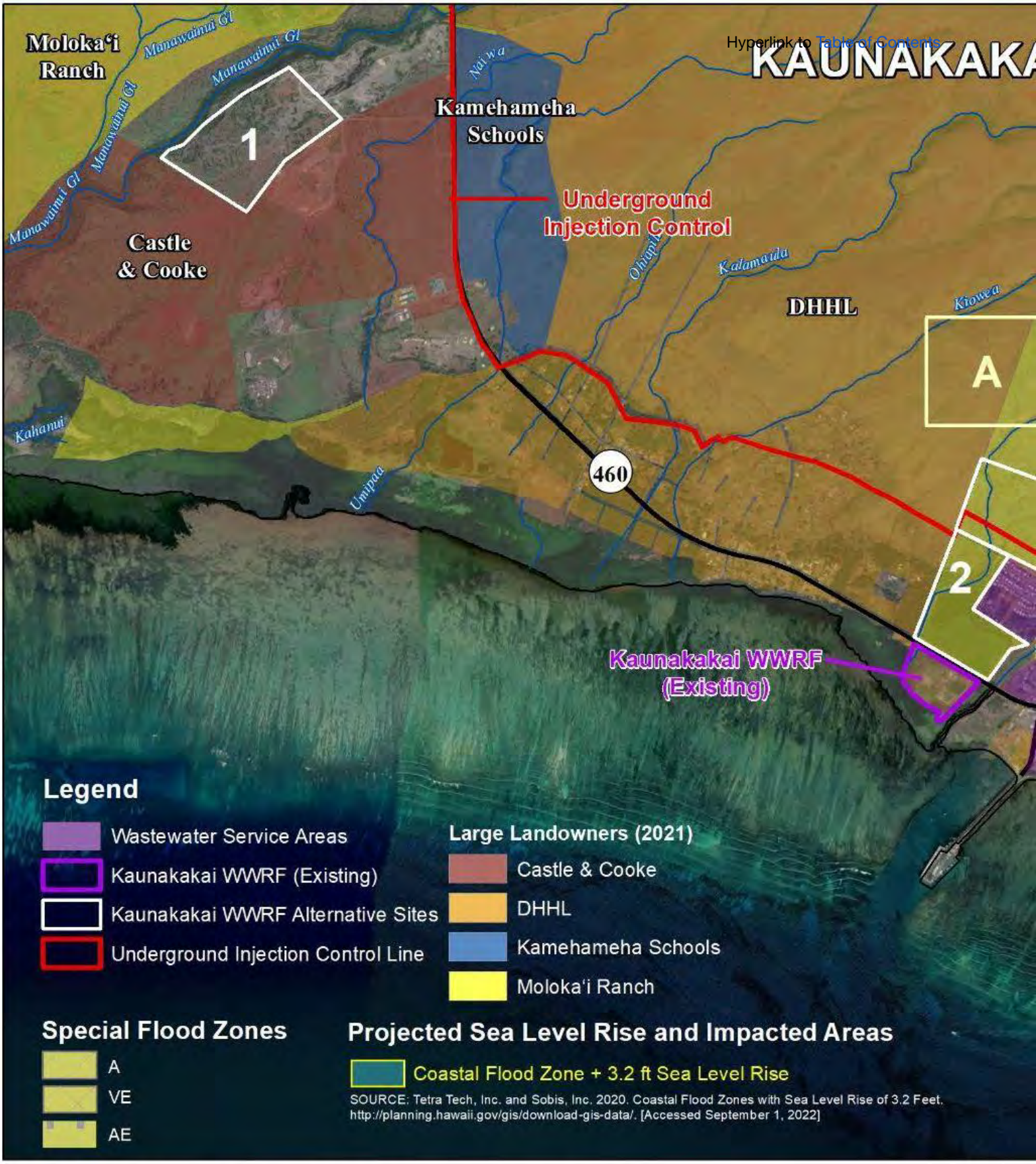
4.1.2 Vulnerability Assessment

The KWRF is already showing evidence of risk to SLR with saltwater infiltrating the groundwater causing salt to seep up and create a salt flat west of the facility. Projections show that most of the facility will be flooded with 3.2 feet of passive flooding (Table 3-3). This is a critical infrastructure facility that serves the town of Kaunakakai, the largest population on Moloka'i. It is expected that mid-term impacts will be of the nuisance variety. This includes water ponding in low-lying areas, soil softening, and saltwater intrusion.

Table 3-3 Kaunakakai Wastewater Reclamation Facility vulnerability assessment



Moku Kona	**Area** 26.4 acres, Length 1,000 feet
Ahupuaa Kaunakakai	**Ownership** County of Maui
Tax Map Key No(s) (2) 5-3-005:002	**Known Cultural Resources** Ocean gathering
Location 157.027493°W, 21.090977°N	**FEMA Flood Zone** AE, 6 to 10-foot Base Flood Elevation
Land Zoning Conservation Class A waters	**Tsunami Hazard** Evacuation Zone: shoreline to 0.5 miles inland 1946 Runup Elevation: 2.0 feet
Geomorphological Classifications Mud (NCCOS, 2007) Very Stony Land and Rock Land (NRCS)	**Setback from Vegetation Line** 700 feet (to the pond) 1,415 feet (to the highway)
Biological Classifications Estuarine and Marine Wetland (USFWS) Freshwater Emergent Wetland (USFWS) Uncolonized (NCCOS, 2007)	**Sea Level Rise Exposure** 3.2 feet = 835,077 square feet (sf, 73% of the site) 3.2 feet + 1% = 1,149,984 sf (100% of the site) 6.0 feet = 1,072,537 sf (93% of the site)
Existing Development Wastewater Reclamation Facility HI DOT State Road – Mauna Loa Highway	**Sea Level Rise Hazard Intensity** Medium – Low elevations



MOLOKA'I CLIMATE CHANGE AND SEA LEVEL RISE ADAPTATION AND RESILIENCY MASTER PLAN

December 2023

0 2,000 4,000 Feet

0 0.25 0.5 0.75 1 Miles

N

4.1.3 Adaptation Needs

The KWRF currently uses basins to treat wastewater. The facility could potentially use an alternative form of wastewater treatment that is elevated above the SLR projections or implementation of wastewater treatment at the waste source. The appropriate adaptation needs to be designed in conjunction with the CoM Environmental Management Team.

- Partner with UHMC Molokaʻi campus for workforce development with strategic planning courses for the operations crew of KWRF for future workforce development. Currently KWRF has 3 f/t employees, with one within retirement years, who are Molokaʻi'ss own local residents. Thus, creating workforce development to develop other local residents qualified for this work who are a part of the Molokaʻi community is of utmost importance for future alternative and technologically more advanced systems to be possible on Molokaʻi.
    - Per Scott Rollins, DEM Wastewater Reclamation Division, Division Chief: having a qualified workforce pool for Maui County DEM is always a need and will be more so as systems move toward more eco-friendly, technologically advanced systems .
- Incorporate possible new location siting in DHHL Developing Resilience for Molokaʻi Coastal Homesteads Sites plan.

4.1.4 Recommended Strategies

SHORT-TERM
● CoM-DEM: Prepare and implement a planned obsolescence strategy for infrastructure at risk of damage from SLR. ● Currently R-1, plan for Land Application & bioremediation of Alternative WWRF Sites: Site Option #2 ○ CoM Parks & Rec: Acquire site control and Application for Land option #2 to create a community park with bio retention ponds to help hold water in flooding months ○ MWP: Assessment of site for potential restoration with Molokaʻi Wetland Prioritization Project ● CoM-DEM: Start a Decentralized System Exploration Process within a new R&D position. ● CoM Admin or County Council: Create a new position under the Wastewater Reclamation Division for R&D (new systems development). For Molokaʻi, this position will focus on: R&D for a Decentralized System that will be large enough to accommodate the projected wastewater needs in the future with the increased capacity needs related to cesspool conversions. R&D to explore alternative options to residential septic systems, in accordance with the Statewide Cesspool Conversion by 2050 mandate. ○ R&D of a residential composting toilet system where bio separation occurs and solids only require removal quarterly or bi-annually. R&D for bio-waste management residential collection service & schedule options on Molokaʻi. ○ Design plans to include community engagement and reference to DHHL and other possible landowners identified in this plan.

MID-TERM

• Replace invasive vegetation with more suitable native coastal wetland species, dependent on wetland restoration potential.
  ○ HILT have been conducting trials at Nuʻu and Waiheʻe Wetland on Maui and can provide advice.
• Continued workforce development & UHMC Molokaʻi campus partnership
• Continued Land Application & bioremediation & wetland restoration, if deemed high potential per MWP Assessment (above).
  ○ Elevate access to infrastructure above the projected inundation levels, in the interim period.

LONG-TERM
• Relocate to a new parcel at a higher elevation. Design a facility that will be large enough to accommodate the projected wastewater needs in the future. • Develop a living shoreline by restoring the wetland.

4.1.5 Preliminary Cost Estimates

CoM Admin or County Council: Create a new position under the Wastewater Reclamation Division for R&D (new systems development). For Molokaʻi, this position will focus on: R&D for a Decentralized System that will be large enough to accommodate the projected wastewater needs in the future with the increased capacity needs related to cesspool to septic conversions.

- Include in FY 2025 or 2026 CoM County DEM Budget: Line Item for R&D Position.

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4.2 Kaunakakai Wharf

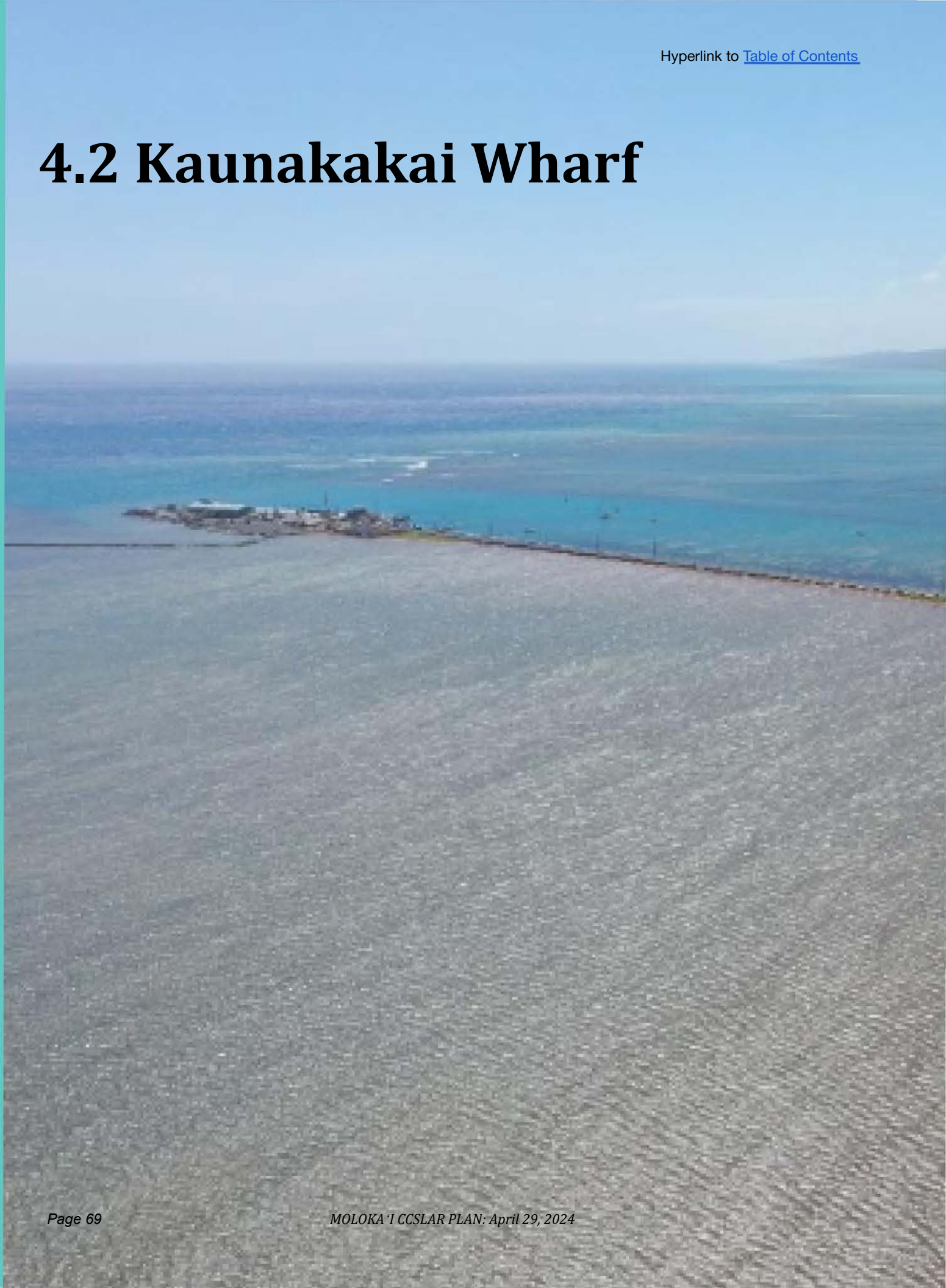
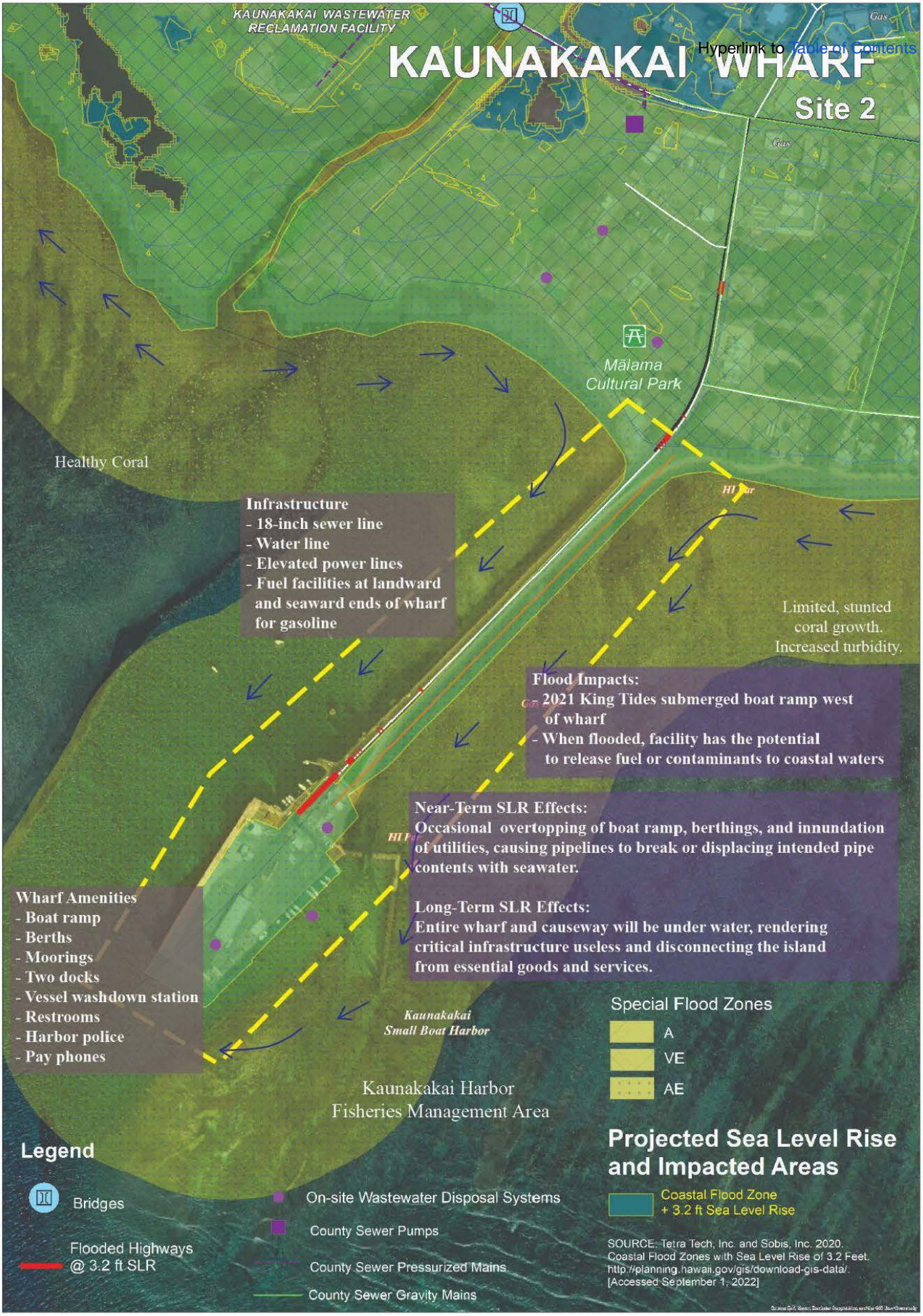


Image courtesy of SEI Molokaʻi SLR Vulnerability Assessment - page 84

Figure 3-56 Aerial image of Kaunakakai Wharf and causeway facing west illustrating increased turbidity where the causeway restricts alongshore circulation (April 13, 2022)



MOLOKA'I CLIMATE CHANGE AND SEA LEVEL RISE ADAPTATION AND RESILIENCY MASTER PLAN
December 2023

0 100200 400 600 800 1,000 Feet

N

4.2 Kaunakakai Wharf

See: Molokaʻi Sea Level Rise Vulnerability Assessment, Section 3.3.2, pages 81-93.

4.2.1 Location and General Description

- Ownership: State of Hawaiʻi and leased to several groups
- Land Zoning: Urban, Class A (west), AA (east) waters
- Ahupuaʻa: Kaunakakai
- Geomorphological Classifications: Mud, Pavement, and Sand (NCCOS, 2007), Very Stony Land and Rock Land (NCRS)
- Biological Classification: Estuarine and Marine Wetland (USFWS), Uncolonized, Macroalgae, Turf (NCCOS, 2007)

Kaunakakai Harbor and Wharf is the primary marine facility for the island of Molokaʻi. There are 2 berths, 29 moorings, 1 boat ramp, and 1 pier. The town of Kaunakakai is the largest town on Molokaʻi and sits adjacent to the largest and most important harbor on the island.

In the 1880s, the coastline between Kalamaʻula and the One Aliʻi fishpond was characterized by mudflats, sandy beaches, wetlands, salt pans, and a limited number of structures and habitation sites (DHHL, 2022). Jackson's 1882 survey of Kaunakakai Harbor (Figure 3-54) was prepared before the construction of the Kaunakakai Wharf.

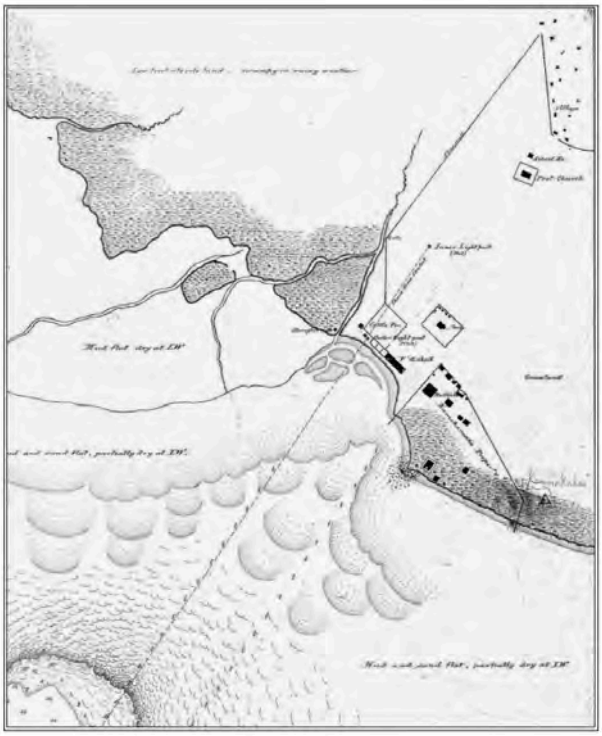


Figure 3-54 Kaunakakai Harbor, 1882 (Jackson)

The Jackson Survey documents a wide sandy beach and mud and sand flats that are partially dry at low water. Lands just west of the "village" of Kaunakakai are described as low-level "sterile land" that is swampy in rainy weather. Lands just to the east are described as "grasslands". The break in the reef fronting Mālama Park served as a natural entry to the shoreline for the transport of goods to and from Molokaʻi. Before the construction of the wharf, small boats would carry goods between the larger ships anchored offshore and the sandy beach. The 1882 Jackson Government Survey map illustrates a handful of structures along this beach to support the shipping activities.

Figure 3-55 Aerial image of Kaunakakai Wharf and causeway facing southeast (April 13, 2022)

Photo Source: SEI Molokai SLR Vulnerability Assessment, page 84

In 1889, a small stone-wharf was built fronting Mālama Park, near the opening in the reef. Eight years later a more substantial wharf was constructed next to the old one to serve the growth of plantation agriculture in Central Molokaʻi. The original wharf was built on piles, which allowed current and sediment to flow through the structure.

In 1934, the wharf at Kaunakakai was lengthened to nearly a half mile and was expanded and fortified so it could carry a two-lane road and handle additional shipping capacity (Kepler and Kepler, 1991). Modifications included filling the area and then building new facilities on top. The original causeway design included two culverts that would allow the flow of water to pass from one side to the other (Bottin, 2001). There is no indication that the culverts were included in the construction. The causeway in its present form creates an impermeable barrier inhibiting circulation in the area and trapping sediment east of the harbor.

Construction of the small boat harbor further restricted the circulation of water around the end of the harbor facilities due to the stub breakwater constructed parallel to the shore. Residents describe conditions in the area as having steadily deteriorated from one of clear water and an abundance of coral reefs and fish to its present state (Bottin, 2001).

The reef flat on both sides of the wharf is very broad and with muddy sediment and macroalgae. The reef is bisected by the Kaunakakai channel, a former stream channel remnant from a period of lower sea level. West of the Kaunakakai channel, the fore reef has a defined spur-and-groove morphology. East of the Kaunakakai channel, the bathymetry is flattened. This pattern reflects the active, healthy growth of coral west of the harbor and the limited, stunted growth that extends to the east for several kilometers.

The Kaunakakai Wharf used to be accessible via an elevated roadway over the water. As larger trucks and containers became necessary for supplying Molokaʻiʻs needs, a causeway was built that redirected and slowed the prevailing alongshore current leading to the deposition and accretion of silt and mud east of the causeway (Figure 3-59). On the eastern side of the wharf, a rock breakwater was built to protect the small boat harbor. The breakwater prevents sediment and current patterns to form an eddy that previously flushed sediments from nearshore waters into deeper ocean currents.

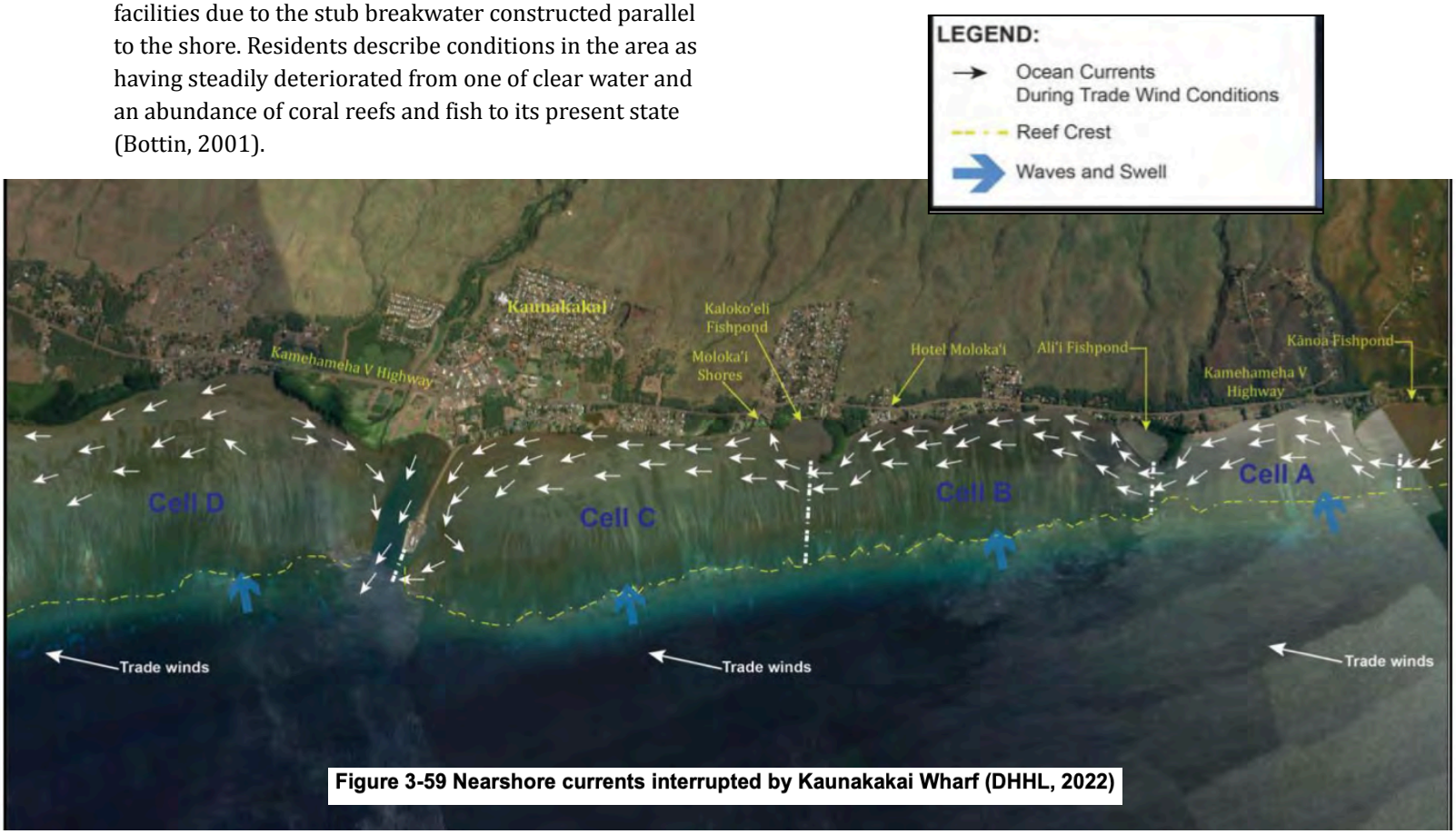


Figure 3-59 Nearshore currents interrupted by Kaunakakai Wharf (DHHL, 2022)

Kaunakakai Wharf is the main source of off-island goods such as food, medicine, vehicles, construction materials, and equipment. Occupying the wharf are several businesses as well as boat users who have slip leases. Commercial operators include: Young Brothers; Molokaʻi Ocean Tours: Whale watching, snorkeling, snuba; Molokaʻi Fish & Dive: Whale watching, sport fishing, snorkel tours, scuba diving, charters; Alyce C. Sport Fishing: Deep sea charters and whale watching; and Molokaʻi Ice House.

Young Brothers operate Monday through Thursday on the Wharf receiving cargo from Honolulu on Mondays and Thursdays. Perishable items in Honolulu are only accepted on Tuesday and Friday mornings and are available the next business day after barge arrival in Kaunakakai. This means that if perishable goods are loaded as cargo on Tuesday (Friday) morning, one can expect to receive goods on Friday (Tuesday). The 4-day time period for the shipping of fresh goods can restrict their availability on Molokaʻi.

Kaunakakai Wharf is also used for recreational activities primarily related to boating and fishing. The fisheries management area created by the State of Hawaiʻi Division of Aquatic Resources guides users to where each type of fishing activity is permitted (Figure 3-60).

The roadway that operates along the causeway, Kaunakakai Place, is a County of Maui road. Parallel to the road is an 18-in sewer line, water line, and elevated power lines (Figure 3-61).

There are fuel facilities at the landward and seaward ends of the wharf that bring gasoline to all vehicles on the island (Figure 3-62). At the wharf are several amenities including: Boat ramp, Berths, Moorings, Two docks, Vessel washdown station, Restrooms, Harbor office, Payphones.

Figure 3-62 Bathroom, payphones, fuel, and boat ramp infrastructure at Kaunakakai Wharf

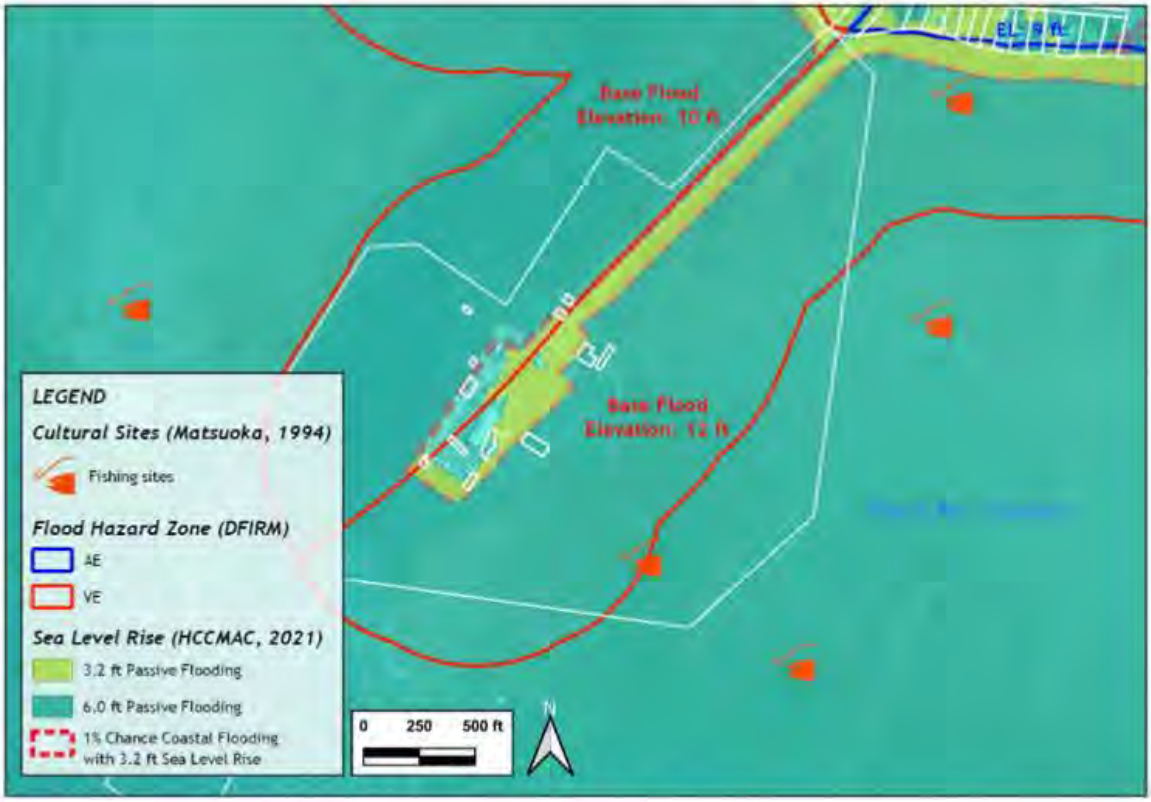
4.2.2 Vulnerability Assessment

Existing information about coastal hazards at Kaunakakai Wharf is presented in Table 3-4. The Wharf is located within the passive flooding area with 3.2 ft of SLR. When flooded, this facility has the potential to release fuel or contaminants to coastal waters. The facility is within flood zone VE with a base flood elevation of 10 to 12 ft. Zone VE classifies coastal areas with a 1% or greater chance of annual flooding with increased risk due to storm waves. The Wharf is within the tsunami evacuation zone. In 2021, King Tides submerged the boat ramp on the west side of the wharf (Figure 3-63).

It is expected that near-term impacts will consist of occasional overtopping of the boat ramp, berthings, and inundation of utilities. Inundation of utilities could potentially cause pipelines to break or displace the intended pipe content with seawater. As sea levels rise, the entire wharf and causeway will be underwater rendering the critical infrastructure useless and disconnecting the Island of Molokaʻi from maritime deliveries of essential goods and services.

Figure 3-63 King tide event that overtopped the Kaunakakai Wharf boat ramp (June 22, 2021, Photo Credit: Hawaii Sea Grant King Tides Project)

Table 3-4 Kaunakakai Wharf vulnerability assessment



Moku Kona	**Area** 8.91 acres
Ahupuaa Kaunakakai	**Ownership** State of Hawai'i and leased to several groups
Tax Map Key No(s) (2) 5-3-001:011	**Known Cultural Resources** Fishing Outrigger Canoe Paddling Area
Location 157.027832°W, 21.081777°N	**FEMA Flood Zone** VE, 10 to 12 foot Base Flood Elevation
Land Zoning Urban Class A (west), AA (east) waters	**Tsunami Hazard** Shoreline to 1.0 miles inland
Geomorphological Classifications Mud, Pavement, and Sand (NCCOS, 2007) Very Stony Land and Rock Land (NRCS)	**Setback from Vegetation Line** Not applicable
Biological Classifications Estuarine and Marine Wetland (USFWS) Uncolonized, Macroalgae, Turf (NCCOS, 2007)	**Sea Level Rise Exposure** 3.2' = 346,383 sf (75% of the site) 3.2' + 1% = 465,411 sf (100% of the site) 6.0' = 465,411 sf (100% of the site)
Existing Development Kaunakakai Fisheries Management Area Kaunakakai Wharf and Boat Ramp HI DOT State Road – Mauna Loa Highway	**Sea Level Rise Hazard Intensity** High – Low elevations, critical infrastructure

4.2.3 Adaptation Needs

The need is to have a facility that can receive goods from other islands to support the Molokaʻi community. The existing Kaunakakai Wharf could be altered so that it can continue to provide these services or an alternative facility could be constructed or altered to provide this need.

If the desired action is to keep Kaunakakai Wharf operating and functional as sea level rises, adaptations will be needed to suit future conditions. Relocation is not a realistic adaptation method for this site due to the need for vessel access and supply to the main urban center. Protection is also not practical, leaving adaptation as the most viable SLR mitigation option.

4.2.4 Recommended Strategies

SHORT-TERM

- Secure funding to create an "Inter-agency Kaunakakai Wharf Adaptation Plan" with appropriate Federal, State, and County agencies to explore the following:
  - Accommodation
    - The existing breakwaters, ramps, and piers could be reengineered and built to an elevation greater than sea level rise projections at a given time horizon. The pier and access causeway are solid fill structures, so raising their elevation is a relatively straightforward project. Utilities, fuel tanks, etc. may also have to be elevated above the projected sea level.
    - Altering the causeway to allow for the restoration of shoreline circulation, with options of culverts or renovation. This could be accomplished as part of the elevation increase project. (See SEI Report Page 91-93: See Figures below for 3-64 & 3-65, Bottin and Acuff, 2001), which references the 2001 U.S. Army Corps of Engineers modeling plan options.
      - None of the plans revealed any adverse impacts on conditions in the existing small-boat harbor or the deep-draft port. The 400-ft opening would produce similar current velocities to those existing along the shoreline east of the wharf (Figure 3-65). A 600-ft opening would result in greater velocities. Models of plan 6 show improved wave-induced current patterns and sediment patterns (e.g., eddies along the shoreline will be eliminated). Restoring along-shore flow would create stronger cross currents immediately west of the causeway where outrigger canoe paddling is popular.
    - Floating docks for small boats could be implemented to provide facilities that naturally adapt to rising sea levels.
- Create "Inter-agency Kaunakakai Wharf Adaptation Plan" with Federal, State, and County agencies, and community stakeholders.

LONG-TERM

- Implement "Inter-agency Kaunakakai Wharf Adaptation Plan".

4.2.5 Preliminary Cost Estimate:

Inter-agency Kaunakakai Wharf Adaptation Plan: Estimated $500k-$800k

- Dependent on Initial Scoping Meetings to determine Federal, State, and County Agency regulations & capacity requirements.

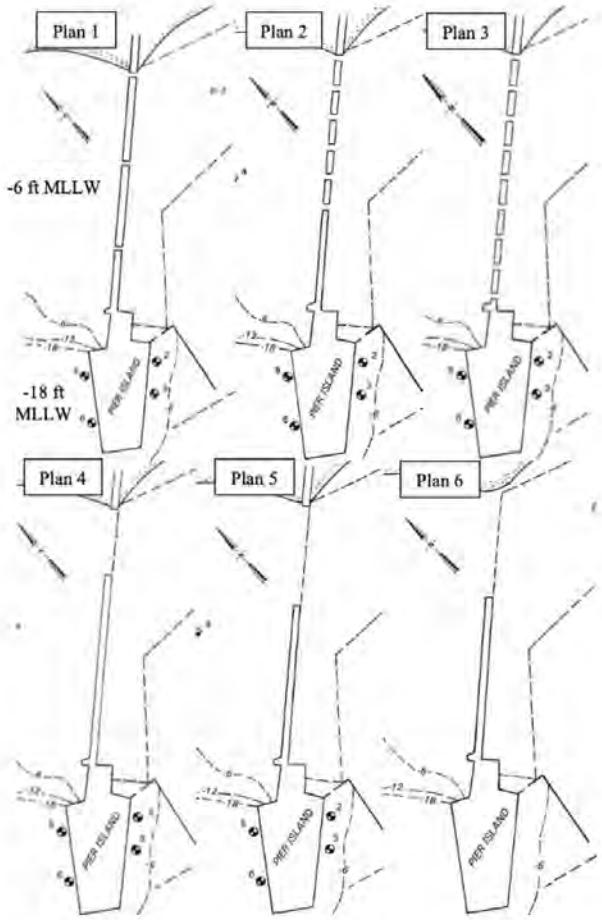


Figure 3-64 Kaunakakai causeway removal Concept Designs (Bottin, 2001)

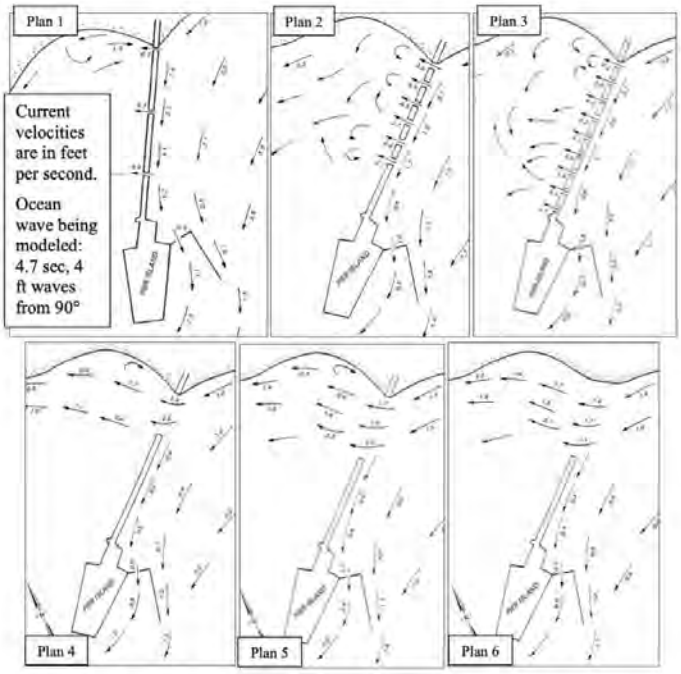


Figure 3-65 Kaunakakai Wharf concept designs current patterns and magnitudes (Bottin, 2001)

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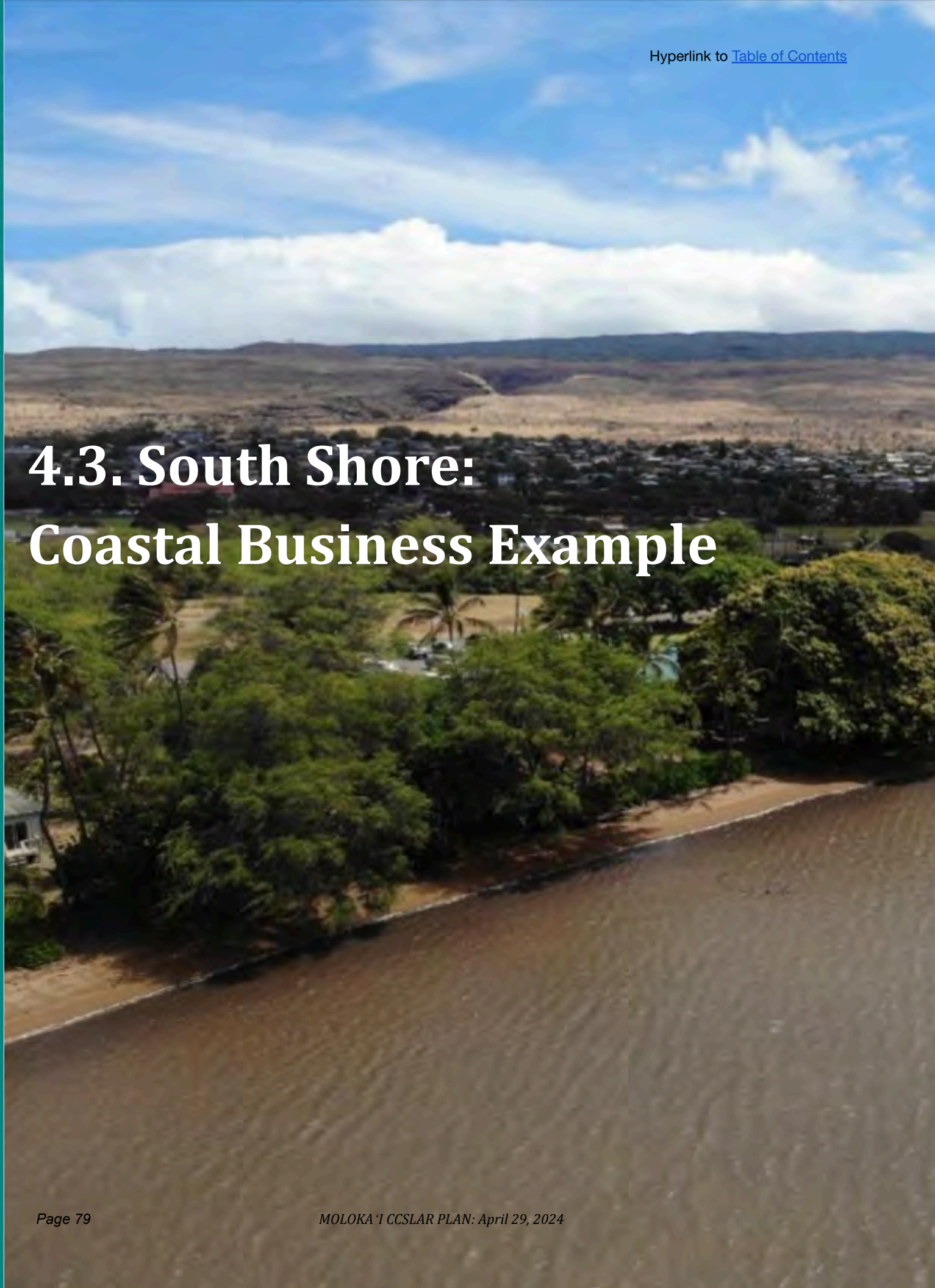
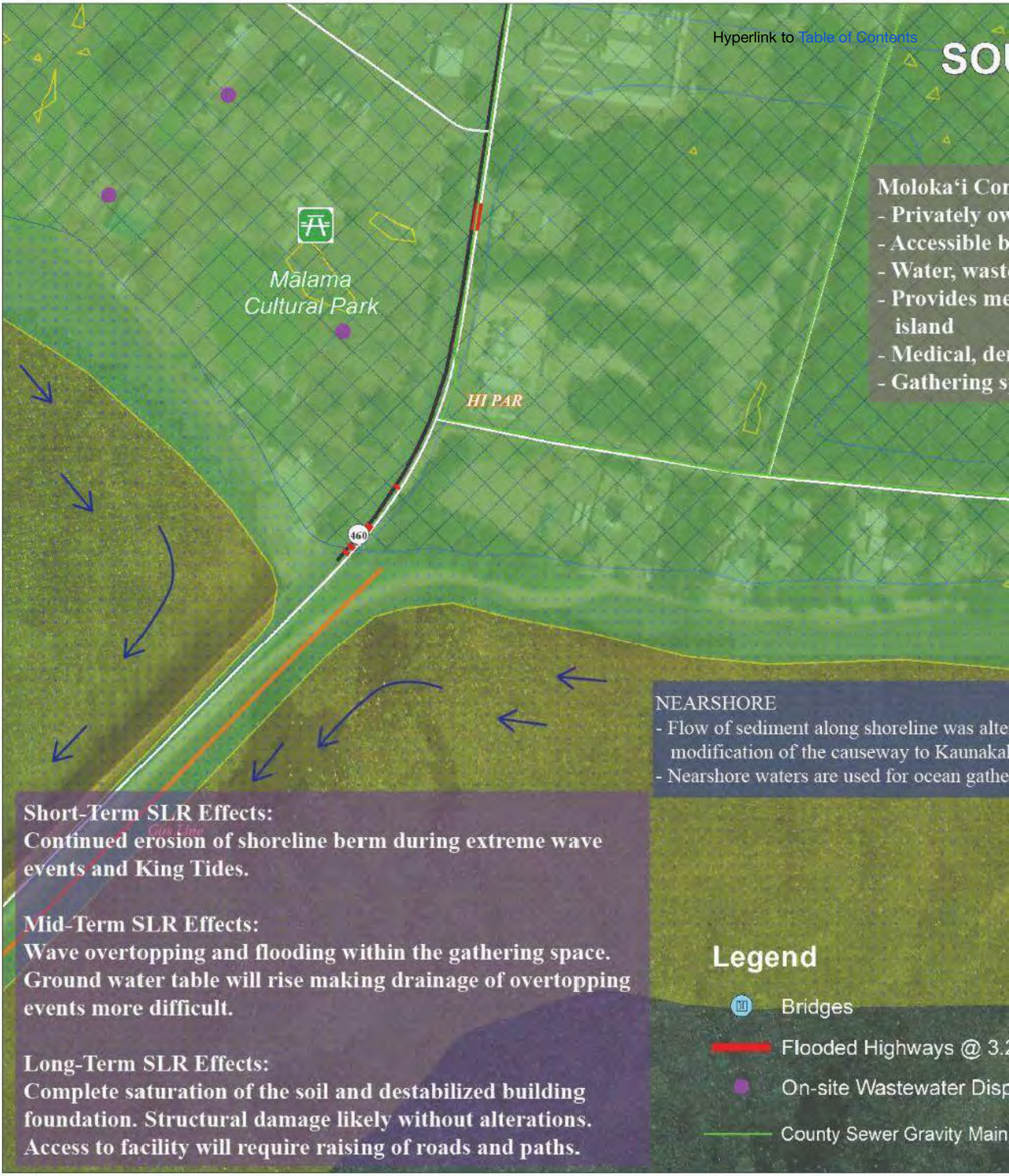


4.3. South Shore: Coastal Business Example

Image courtesy of SEI Molokaʻi SLR Vulnerability Assessment - page 95
Figure 3-68 Shoreline fronting the Molokaʻi Community Health Center



MOLOKA'I CLIMATE CHANGE AND SEA LEVEL RISE ADAPTATION AND RESILIENCY MASTER PLAN

December 2023

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4.3. South Shore: Coastal Business Example

See: Molokaʻi Sea Level Rise Vulnerability Assessment, Section 3.3.3, pages 94-101.

4.3.1 Location and General Description

- Ownership: Private
- Land Zoning: Urban and Class AA waters
- Ahupuaʻa: Kaunakakai
- Geomorphological Classifications: Mud (NCCOS, 2007) Very Stone Land and Rock Land (NCRS)
- Biological Classification: Estuarine and Marine Wetland (USFWS), Macroalgae, Turf (NCCOS, 2007)

Figure 3-67 Shoreline and nearshore waters west of the Molokaʻi Community Health Center

There are numerous businesses along the Molokaʻi coastline. For this report, we selected Molokaʻi Community Health Center as the Coastal Business example. The Molokaʻi Community Health Center (MCHC) is the only federally qualified health center on the island of Molokaʻi. It is located in Kaunakakai along the south shoreline. This Coastal Business Example is at a low elevation accessible by two County roads serviced by water, electric, and wastewater.

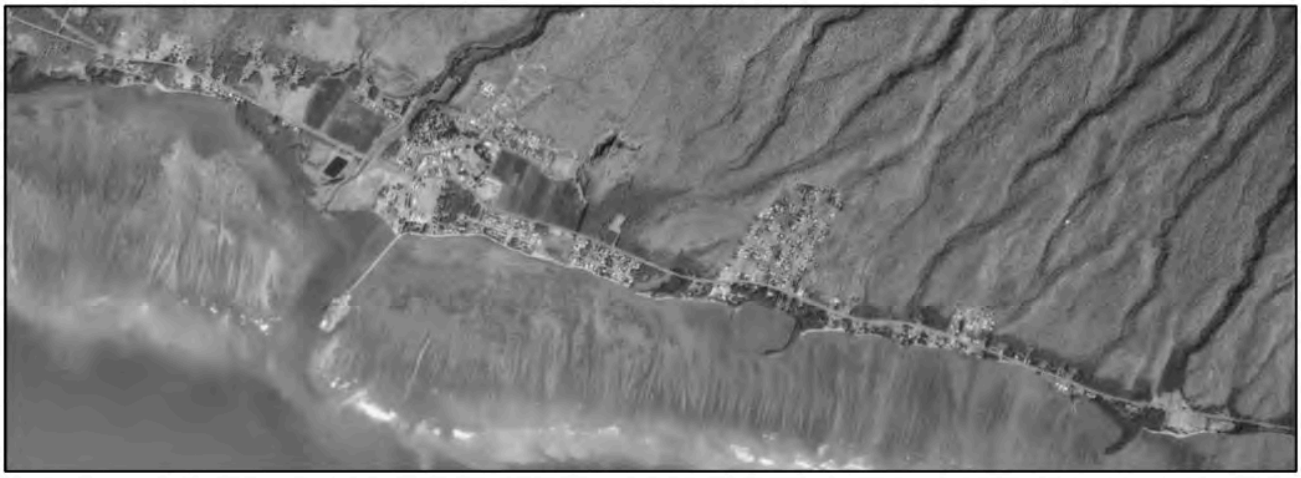


Figure 3-66 Southcentral Molokaʻi, January 6, 1977 (USGS)

As of 1977, the sandy shoreline fronting the MCHC was still visible (Figure 3-66). Today, there is a narrow sandy beach that terminates at the Kaunakakai causeway (Figure 3-67, Figure 3-68). Along the shoreline fronting the MCHC is a sandy berm fronted by a narrow beach with a low profile (Figure 3-69, Figure 3-70). The berm is stabilized by naupaka plants (Figure 3-71). In response to natural erosive forces, the naupaka has died near the MOHC outdoor stage revealing an erosion scarp that is 46 to 53 inches tall (Figure 3-72). Where naupaka ends at the east end of the property the ground is a gently sloping sandy beach. The sand at the landward edge of the beach face is fine-grained and reflective of wind-blown sediment transport (Figure 3-73). The sand on the beach face is more coarse and well-sorted by ocean currents (Figure 3-74). There is a gathering place on the seaward side of the facility with a stage and eating tables (Figure 3-75).

Figure 3-73 Fine sand at the landward edge of the naupaka

The flow of sediment along the shoreline was altered by the modification of the causeway to Kaunakakai Wharf. Originally, the roadway was elevated upon posts, but it was changed as fill was placed atop discharge pipes to form a causeway. The modification slowed the speed of the current and redirected flow offshore. This increased the deposition of sediment along the coastline and along the eastern edge of the causeway (DHHL, 2022).

Figure 3-74 Coarse sand on the beach face fronting the Moloka'i Community Health Center

4.3.2 Vulnerability Assessment

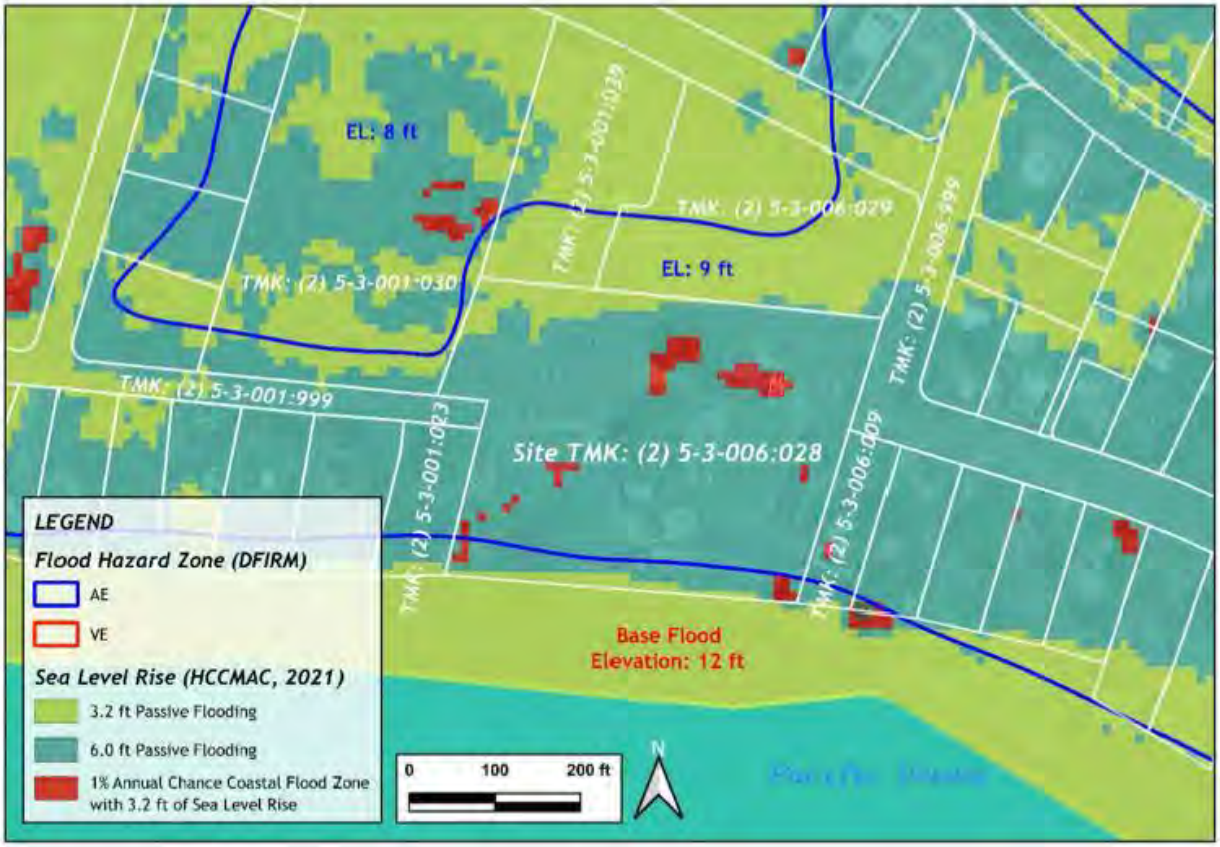
The Moloka'i Community Health Center is in flood zone AE with a base flood elevation of 9 feet. With 3.2 feet of SLR passive flooding, the water would be near the top of the shoreline berm. At 6.0 feet of SLR, the whole facility is inundated.

Short-term effects will likely include continued erosion of the shoreline berm during extreme wave events and King Tides. As the naupaka on the berm gets washed away, the roots will no longer hold the sand in place and the berm may begin destabilizing more quickly.

Mid-term effects will likely include wave overtopping and flooding within the gathering place. Over time, the ground will become saturated with seawater as the groundwater table rises, drainage of overtopping events will become more difficult.

Long-term effects include complete saturation of the soil and a destabilized foundation for the building. Structural damage is likely to occur unless alterations are made. Access to the facility will require roads and pathways to be raised to a higher elevation over the saturated or submerged ground.

Table 3-5: Moloka‘i Community Health Center vulnerability assessment



Moku Kona	**Area** 3.44 acres
Ahupuaa Kaunakakai	**Ownership** Moloka‘i Community Health Center
Tax Map Key No(s) (2) 5-3-006:028	**Known Cultural Resources** Fishing
Location 157.019488°W, 21.086123°N	**FEMA Flood Zone** AE, 9-foot Base Flood Elevation
Land Zoning Urban Class AA waters	**Tsunami Hazard** Evacuation Zone: shoreline to 0.5 miles inland
Geomorphological Classifications Mud (NCCOS, 2007) Very Stony Land and Rock Land (NRCS)	**Setback from Vegetation Line** 18 feet (to the building) 310 feet (to Pau Hana Road)
Biological Classifications Macroalgae, Turf (NCCOS, 2007) Estuarine and Marine Wetland (USFWS)	**Sea Level Rise Exposure** 3.2’ = 11,153 sf (8% of the site) 3.2’ + 1% = 151,555 sf (100% of the site) 6.0’ = 145,378 sf (96% of the site)
Existing Development Moloka‘i Community Health Center Gathering Place	**Sea Level Rise Hazard Intensity** High – Low elevations, critical infrastructure

4.3.3 Adaptation Needs

To adapt, this business example could be altered in the short- and mid-term to continue to provide services. In the long-term, managed retreat needs to be considered.

4.3.4 RECOMMENDED STRATEGIES

SHORT-TERM
● Plant and maintain several layers of native vegetation along the shoreline to create root systems to hold soils together as they become increasingly saturated. See the Hawai‘i Dune Restoration Manual for additional dune restoration guidance. ● Elevate walkways.

MID-TERM
● Elevate the infrastructure and access to infrastructure above the projected inundation levels.

LONG-TERM
● Relocate to a new parcel at a higher elevation. Design a facility that will be large enough to accommodate the projected medical needs in the future. ● Transform the parcel into a natural wetland to provide coastal hazard protection to landward facilities.

4.3.5 Preliminary Cost Estimate

Cost Estimates for planting and maintaining several layers of native vegetation along the shoreline, would be relatively low in cost. As this business currently has a landscape maintenance position, costs of native plants can range from $15-$100 and are readily available on Moloka‘i. Labor costs for the smaller species could be encompassed in regular landscaping maintenance fees. Plantings with larger species may require additional small scale heavy equipment or multiple labor sources.

All of these mid to long-term options would require a feasibility and cost-benefit analysis to determine the best option. A cost estimator should examine the cost of each adaptation strategy to determine how much funding is needed for implementation. If the cost of protecting a vulnerable structure from SLR exceeds the cost of relocating the structure out of harm’s way, a managed retreat can make economic and practical sense. These costs should also factor in the human costs of lost life, personal injury, and damage to property and possessions including repetitive losses.

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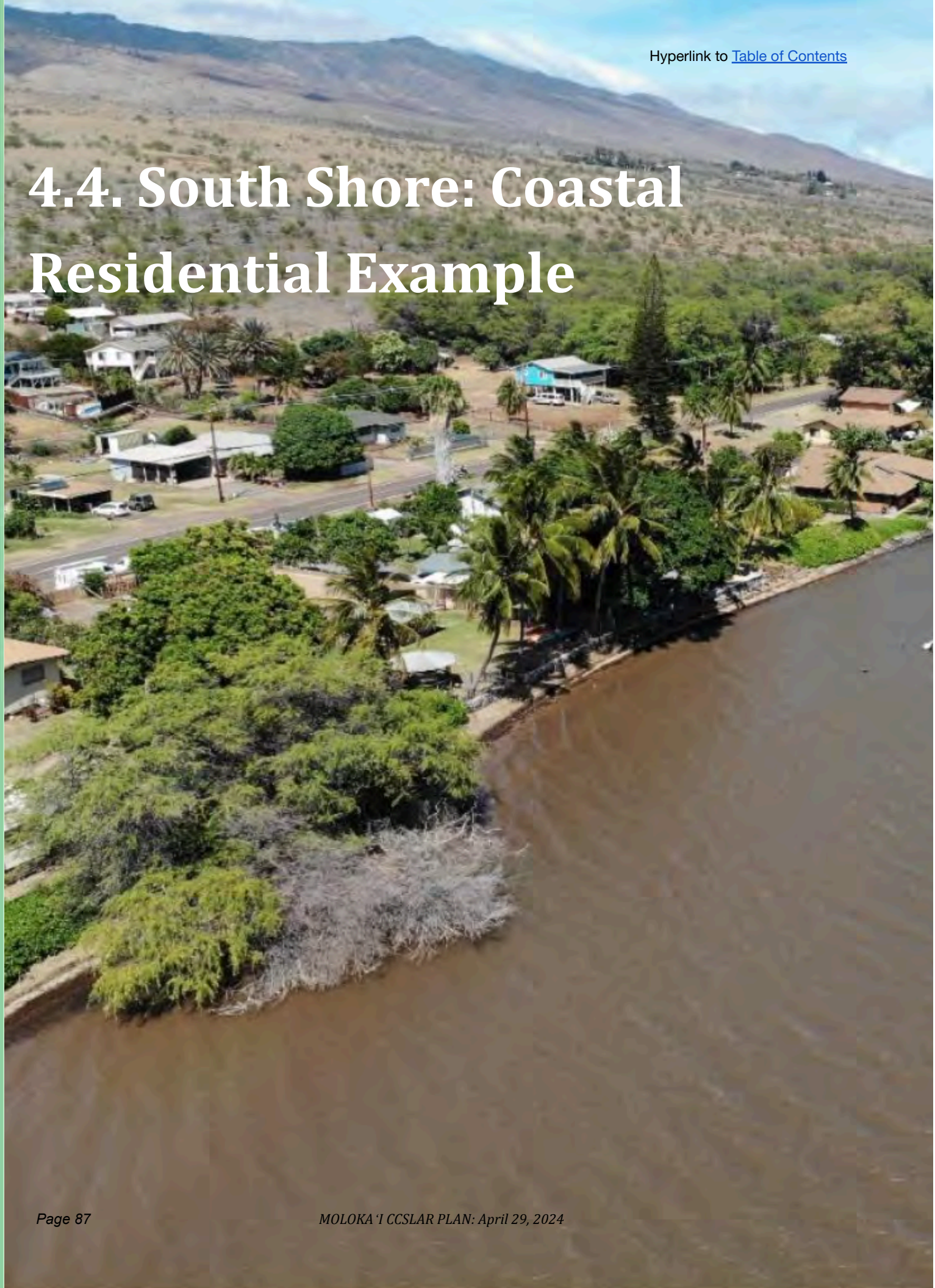
4.4. South Shore: Coastal Residential Example



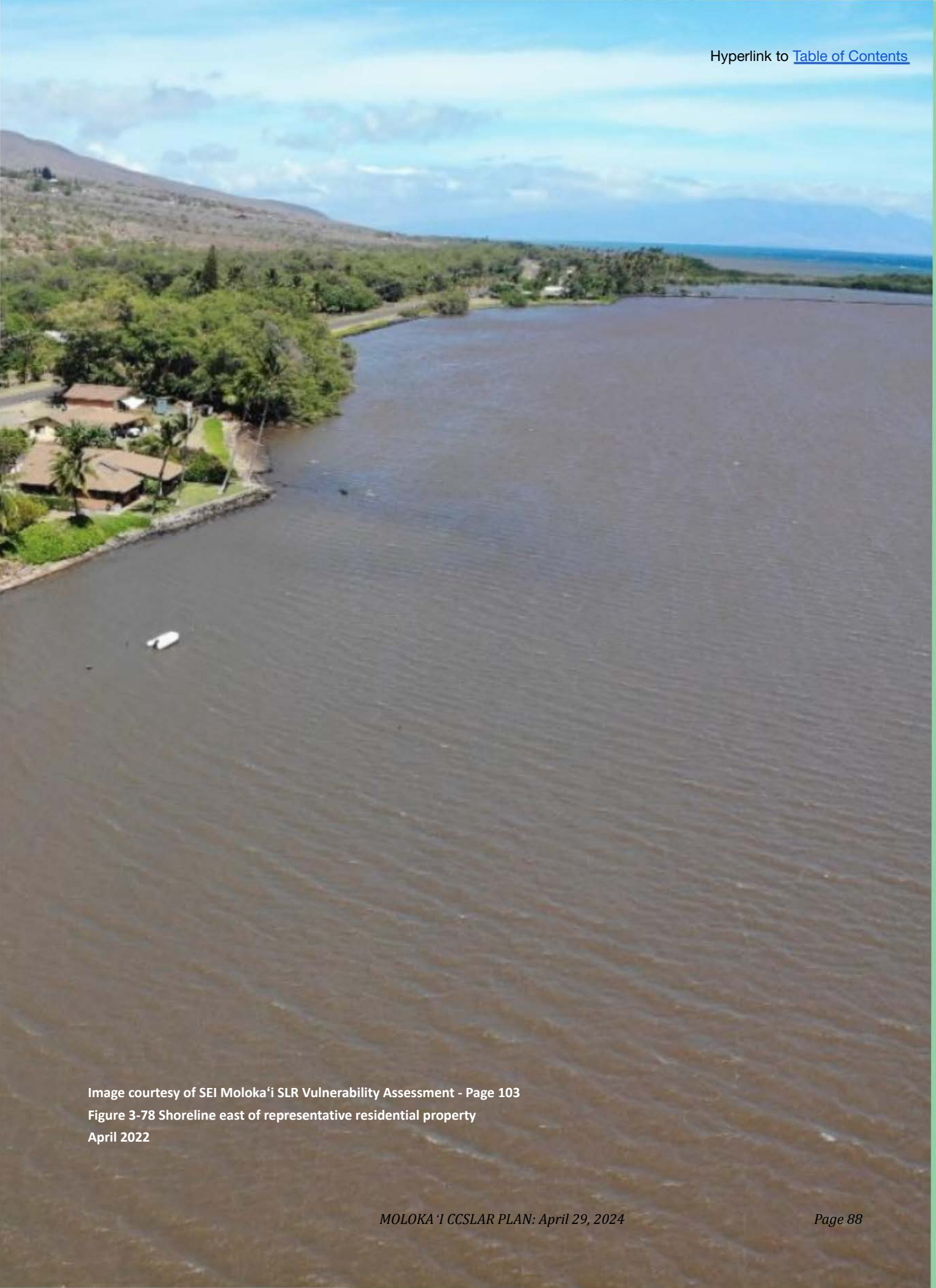


Image courtesy of SEI Molokaʻi SLR Vulnerability Assessment - Page 103
Figure 3-78 Shoreline east of representative residential property
April 2022


SOUTH SHORE: COA
Image courtesy of SEI Molokai SLR Vulnerability Assessment
SEDIMENT
Sediment flows into nearshore coastal waters
Makakiloia
Kaloko'eli
Kiawe
Invasive kiawe trees disrupt shoreline processes and impede lateral access along the shoreline
Mud/Silt
Longshore Movement of Sand
- Tradewinds and ocean currents move sand along the shore
- Kaloko'eli Fishpond disrupts sand movement. Shoreline accretion on easternside of the fishpond.
Shoreline Armoring
- Accelerates beach loss and hinders sand accumulation.
Mud/Silt
Invasive mangroves
Ali'i
FISHPONDS
- Fishponds cause tradewind currents to diffract, disrupting and impeding the western movement of sand along the shoreline.
- Ali'i and Kaloko'eli fishponds are filled with sediment and mangrove, changing the ecology of the ponds and impeding muliwai flow and ground water flow that may have previously helped transport sediment.
Legend
On-site Wastewater Disposal Systems
Bridges
Fishponds
Streams
Flooded Highways @ 3.2 ft SLR
Projected Sea Level Rise and Impacted Areas
Coastal Flood Zone + 3.2 ft Sea Level Rise
SOURCE: Tetra Tech, Inc. and Sobis, Inc. 2020. Coastal Flood Zones with Sea Level Rise of 3.2 Feet. http://planning.hawaii.gov/gis/download-gis-data/. [Accessed September 1, 2022]


DASTAL RESIDENTIAL EXAMPLE
Site 4
Kanoa
Kanoa
unnamed2
450
Kaonini or
Kanou
Kaweah Gl
d Impacts
en flooded, structures have the potential
release wastewater or contaminants to
arshore waters.
946 tsunami flooded all areas under the
o-foot elevation.
Near-Term SLR Effects:
Nuisance impacts. Water ponding in low-lying areas, soil softening, salt water intrusion. Sea water on roads due to wave overwash could damage vehicles and contribute toward ocean pollution. Continual inundation and flooding will weaken pavement, increasing road and drainage system maintenance.
Increased erosion due to SLR will occur over time. Beaches will be lost and roads will be undercut, leading to total loss of access.
Special Flood Zones
A
VE
AE
0 500 1,000 2,000 3,000 4,000 5,000
Feet
N

4.4. South Shore: Coastal Residential Example

See: Molokaʻi Sea Level Rise Vulnerability Assessment, Section 3.3.4, pages 102-110.

4.4.1 Location and General Description

- Ownership: Private
- Land Zoning: Urban, Class AA waters
- Ahupuaʻa: Kamiloloa
- Geomorphological Classifications: Mud (NCCOS, 2007), Mala Silty Clay, 0 to 3 percent slopes (USDA)
- Biological Classification: Uncolonized (NCCOS, 2007) Estuarine and Marine Wetland (USFWS)

There are numerous residences along the Molokaʻi coastline, under various ownerships.

For this report, we selected a populated example area between the ocean and Kamehameha V Highway - the Kamiloloa subdivision, just to the west of Aliʻi fishpond. Some of the lots have small erosion scarps and some have shoreline armoring (Figure 3-77 -Figure 3-81). The shoreline has dense thickets of invasive Kiawe trees. The beach is often submerged at high tide and during large wave events. Seawater regularly reaches the face of shore protection structures during high tide events. Coastal waters were observed to be murky as a result of poor along-shore circulation. Algae often washes up on the beach and can release a pungent odor as it sits there (Figure 3-82). There is an on-site septic system serving the residential property.

Figure 3-78 Shoreline east of representative residential property (April 2022)

4.4.2 Vulnerability Assessment

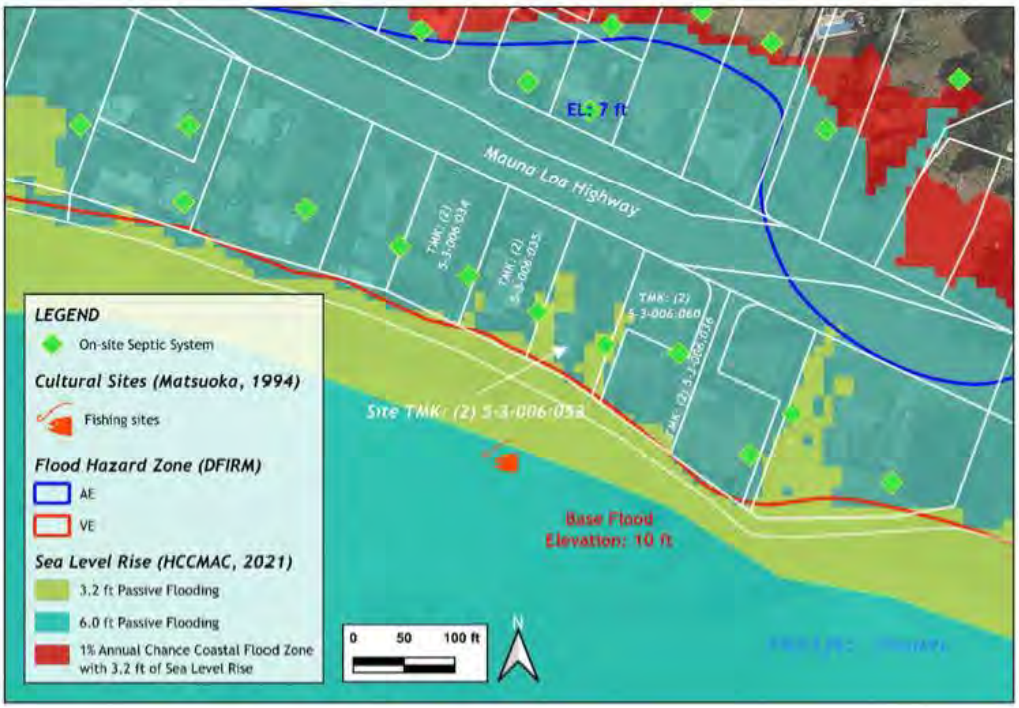
With 3.2 feet of SLR, the water level will be at the top of the residential property's existing seawall.

With waves and tidal anomalies on top of the water level, inundation of the lot would occur. The elevation of the lot is relatively uniform, so waters would eventually move across the lot and over the Kamehameha V roadway. There is an on-site septic system that would be flooded with rising water levels that could potentially release contaminants to nearshore waters and no longer provide the intended function. The residence is within flood zone AE with a base flood elevation of seven feet. AE flood zones are areas that present a 1% annual chance of flooding and a 26% chance over the life of a 30-year mortgage, according to FEMA.

It is expected that near-term impacts will be water splashing over the top of the seawall. Saltwater may kill any vegetation growing along the shoreline that is not salt -tolerant. As water levels rise, the frequency of overtopping will increase. If drainage on the landward side of the seawall is not sufficient, then ponding may occur. With rising ocean waters, the height of depth-limited waves reaching the shoreline will also increase putting more force on the seawall. Many of the residential shore protection structures in this area were not designed for large wave forces and may fail. Eventually, SLR passive flooding would submerge the entire parcel.

Figure 3-76 Aerial view of the representative residential property (April 2022)

Table 3-6: Representative residential vulnerability assessment



Moku Kona	**Area** 0.25 acres
Ahupuaa Kamiloloa	**Ownership** Private
Tax Map Key No(s) (2) 5-3-006:053	**Known Cultural Resources** Fishing
Location 156.988184 °W, 21.07659°N	**FEMA Flood Zone** AE, 7-foot Base Flood Elevation
Land Zoning Urban Class AA waters	**Tsunami Hazard** Evacuation Zone: shoreline to 0.125 miles inland
Geomorphological Classifications Mud (NCCOS, 2007) Mala silty clay, 0 to 3 percent slopes (USDA)	**Setback from Vegetation Line** 8.5 feet (to the home) 190 feet (to the highway)
Biological Classifications Uncolonized (NCCOS, 2007) Estuarine and Marine Wetland (USFWS)	**Sea Level Rise Exposure** 3.2' = 3,494 sf (32% of the site) 3.2' + 1% = 10,961 sf (100% of the site) 6.0' = 10,962 sf (100% of the site)
Existing Development Residential home On-site septic system	**Sea Level Rise Hazard Intensity** Medium – Low elevations

4.4.3 Adaptation Needs

Homes in the Kamiloloa subdivision provide housing, access to the ocean for fishing, and recreational use. Many of these homes have been in families for many generations. Houses can be rebuilt elsewhere to provide the housing need and fishing and recreation access points can be created, but the connection to the land and ancestors in each parcel is irreplaceable. Some SLR adaptation strategies can protect these parcels if the need to stay is great enough. Without protection, parcels will flood and the value to residents may diminish.

4.4.4 RECOMMENDED STRATEGIES

SHORT-TERM

- Remove existing seawalls/coastal obstructions and plant and maintain several layers of native vegetation along the shoreline to restore the Dynamic Dune shoreline. Reference the ʻDune Restoration Conceptual Plan for the South Shore of Molokaʻi (Residential Example)ʻ below.
    - Vegetated berms or coastal dunes can be restored through the planting of appropriate low growing vegetation along the shoreline. This vegetation should include native frontal dune plants that capture and accumulate wind or wave built sand over time, but do not lock up sand in dense root networks, impede coastal processes, or create barriers to access. Plants that are NOT recommended include hau, naupaka, sea grape or any large woody plants. Additionally, plants should not be overwatered. Dune plants only need irrigation for the first 1-3 months after planting in order to become established. Appropriate native plant species include; pohuehue, aki aki grass, akulikuli, nanea, and pohinahina.
    - Dunes build up sand over time, replenish the beach after storms, and then rebuild again over time. They shift and move around, plants are lost and then regrow.
- A 'green wall' of vegetation is not the preferred approach, but instead an assemblage of low frontal dune plants that build up sand over time. This still allows that sand to be accessible to the active beach during high wave events.
        - See the Hawaiʻi Dune Restoration Manual for additional dune restoration guidance.
    - Assessment of Existing Structures & Foundation Designs for protections and elevating structures (by Engineering Firm)
        - Including Permitting Processes such as: SMA Minor (includes Molokai Planning Commission Hearing), County Building Permits, Conservation Use District Permit
    - Evaluation of additional sites for wetland restoration to improve community resilience, in coordination with MWP. This will require additional funding as it is beyond the scale of the PI-CASC pilot project.
        - Seek long term funding for design, implementation and management for priority wetland restoration work.

MID-TERM

- The homes are slab on grade or post and beam, and for the short- to mid-term walkways and access could be raised above the projected water level. However, access to the homes could be difficult, if roadway is at SLR inundation zone also. As the site becomes inundated by water and flooded consistently, walkways and access to the homes itself would need to accommodate, and become difficult to maintain on a residential scale.
- Engineering Evaluations & Cost Estimates for elevating or relocating residential structures further on sites from SLR Inundation zones.
- It is not practical to elevate the existing septic systems thus wastewater disposal would become severely compromised. Alternate above-ground wastewater or composting toilets/ecosystems could be explored. Design and implementation would need to be approved by DOH (State & County) agencies and policies and municipal building codes will need to be updated to reflect these above-ground options.
- Site Design & Funding acquisition for wetland restoration, in potential areas

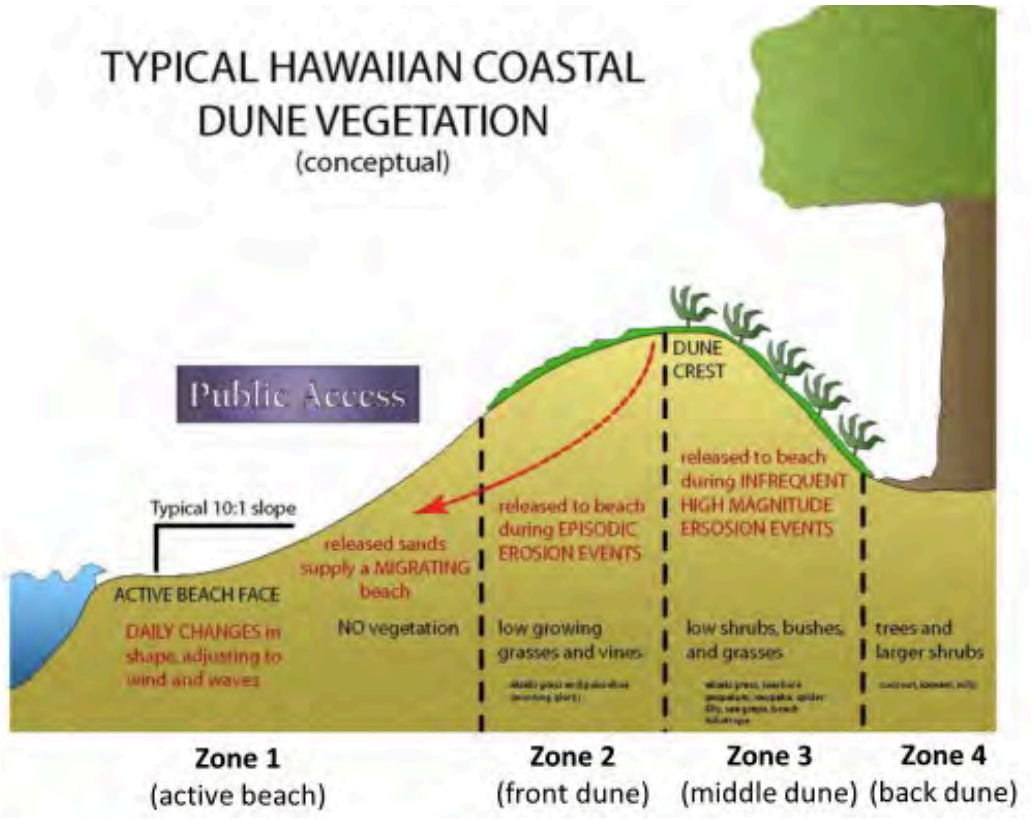
LONG-TERM
• Relocation of residential use to land at a higher elevation would escape the SLR hazard and is the most practical long term adaptation strategy. Future plans need to identify specific funding strategies and the process for decommissioning existing homes of long time residents. Removal of the existing shore protection and structures on the parcel would allow for the natural migration of the shoreline to adapt to changing sea level conditions. The undeveloped lot could be planted with native salt-tolerant species to slow down erosion until the land becomes submerged. The land could be converted to public access allowing residents who have a connection to the shoreline to continue to access the area.

Dune Restoration Conceptual Plan for the South Shore of Molokaʻi (Residential Example)
(Wes Crile, Hawaiʻi SeaGrant)

Dunes are an important part of the beach ecosystem, provide a number of ecosystem services, and protect infrastructure from high waves and storm events. Healthy dunes contribute to healthy beaches. Dune restoration areas will be established by:

- Creating dunes approximately 100 ft L x 6 ft W
- Roping off the active dune planting areas to prevent trampling
- Planting appropriate native plants like pohuihui and aki aki grass (see table below)

Plant list
Because the bulk of the site falls within the primary frontal dune, the recommended plant list consists of plants appropriate for this zone of the beach (zones 2 and 3) in the diagram below. The dunes should contain a mix of all of these plants, planted with an 18-inch staggered spacing between them.



Plant list (cont.)

Picture	Hawaiian Name	Scientific Name	Comment	Zone	Detailed Plant Profile	Spacing between plants
LOW GROWING (grasses, vines, and groundcovers)						
	ʻAkiʻaki	Sporobolus virginicus	A creeping perennial, grows on sandy coasts within reach of the ocean spray making it tolerant of both salt air and hot sun.	2	http://nativeplants.Hawaiʻi.edu/plant/view/Sporobolus_virginicus	18”
	Pōhuehue	Ipomoea pes-caprae	A perennial seashore vine, its 2-4 in leaves help trap sand with a pink or light purple flower.	2	http://nativeplants.Hawaiʻi.edu/plant/view/Ipomoea_pes-caprae_brasiliensis	18”
	ʻĀkulikuli	Sesuvium portulacastrum	A succulent herb that grows along the ground, it has trailing branches, and its leaves and stems are a fleshy red or green with a white or pale violet flower.	3	http://nativeplants.Hawaiʻi.edu/plant/view/Sesuvium_portulacastrum	18”
	Pōhinahina	Vitex rotundifolia	A low lying creeper shrub, it has light green, grayish, or silvery leaves with a blue or purplish flower.	3	http://nativeplants.Hawaiʻi.edu/plant/view/Vitex_rotundifolia	18”
	Nanea	Vigna marina	Sprawling vine that can grow to 1ft tall and 8ft wide. Small yellow flowers.	3	http://nativeplants.Hawaiʻi.edu/plant/view/Vigna_marina	18”

Irrigation and maintenance

Dune plants generally only need irrigation initially in order to get established. If planting was timed to coincide with the rainy part of the year, supplemental irrigation needs would be minimal or not needed at all. Maintenance consists of occasional weeding to control invasive species and replacing plants if needed.

4.4.5 Preliminary Cost Estimate

- Below is a budget estimate for establishing a **Dynamic Dune** 100 feet land by 6 feet wide. The budget assumes 18 inch spacing between the plants; 12 or 6 inch spacing can be used if a more finished look is desired sooner. See https://concalculator.com/plant-calculator/ to calculate plant numbers needed for different sizes and plant spacing. Native plant prices are highly variable and often require 8-10 weeks advanced notice so that they can be grown specifically for the project.

Item	Unit Cost	# needed	Total	Notes
3 in. treated posts	$ 12.00	9	$ 112.00	Spaced every 12 feet
drip irrigation line	$ 0.20	400	$ 80.00	18 inch spacing
irrigation line staples	$ 0.12	27	$ 3.20	
irrigation fittings	$ 50.00	1	$ 50.00	
pohinahina (4in. Pots)	$ 5.00	200	$ 1,000.00	Planted mauka of the fence
pohuehue (4in.)	$ 6.00	200	$ 1,200.00	evenly dispersed throughout
aki aki grass (2in.)	$ 3.00	200	$ 600.00	evenly dispersed throughout
akulekule (4in. Pots)	$ 5.00	200	$ 1,000.00	evenly dispersed throughout
TOTAL			**$ 4,045.20**	

- **Assessment of Existing Structures & Foundation Designs for protections and elevating structures (by Engineering Firm):** $30,000-100,000
  - Including Permitting Processes such as: SMA Minor (includes Molokai Planning Commission Hearing), County Building Permits, Conservation Use District Permit

- **Evaluation & Assessments of additional Wetland Sites by Moloka'i Wetland Partnership costs:** TBD
  - Based on the approximate costs of the previous wetland prioritization process through PI-CASC, a similar process would cost approximately $315,000 for 12 sites ($25, 250 per site) for initial assessment and prioritization analysis.
  - Following the prioritization, costs to take a site through the full design and permitting process so that the site is ready for restoration implementation, are approximately $460,000 per site as follows:

Budget Categories	Description	Cost
Personnel		$0
Civil Design	Investigation, research, concept design and development	$104,941
Environmental Assessment	Preparation of and submission through HEPA/NEPA	$104,586
Environmental Consulting Permitting	USACE, NDPES, SMA, CDUA, No Rise Certification, Plan Approval App, Grading & Stockpile, Sect. 104 etc.	$50,552
Surveys	Topographic, archaeological, hydrology	$132,848
Reimbursables	Soil sampling, travel, filing fees	$16,393
Community Non Profit	Outreach and engagement	$10,000
Contracts		$419,320
Travel		$0
Indirect	10%	$41,932
TOTAL PER SITE		$461,252

Mid-term Strategies Cost Estimates: Engineering Evaluations & Cost Estimates for elevating or relocating residential structures further on sites from SLR Inundation zones.

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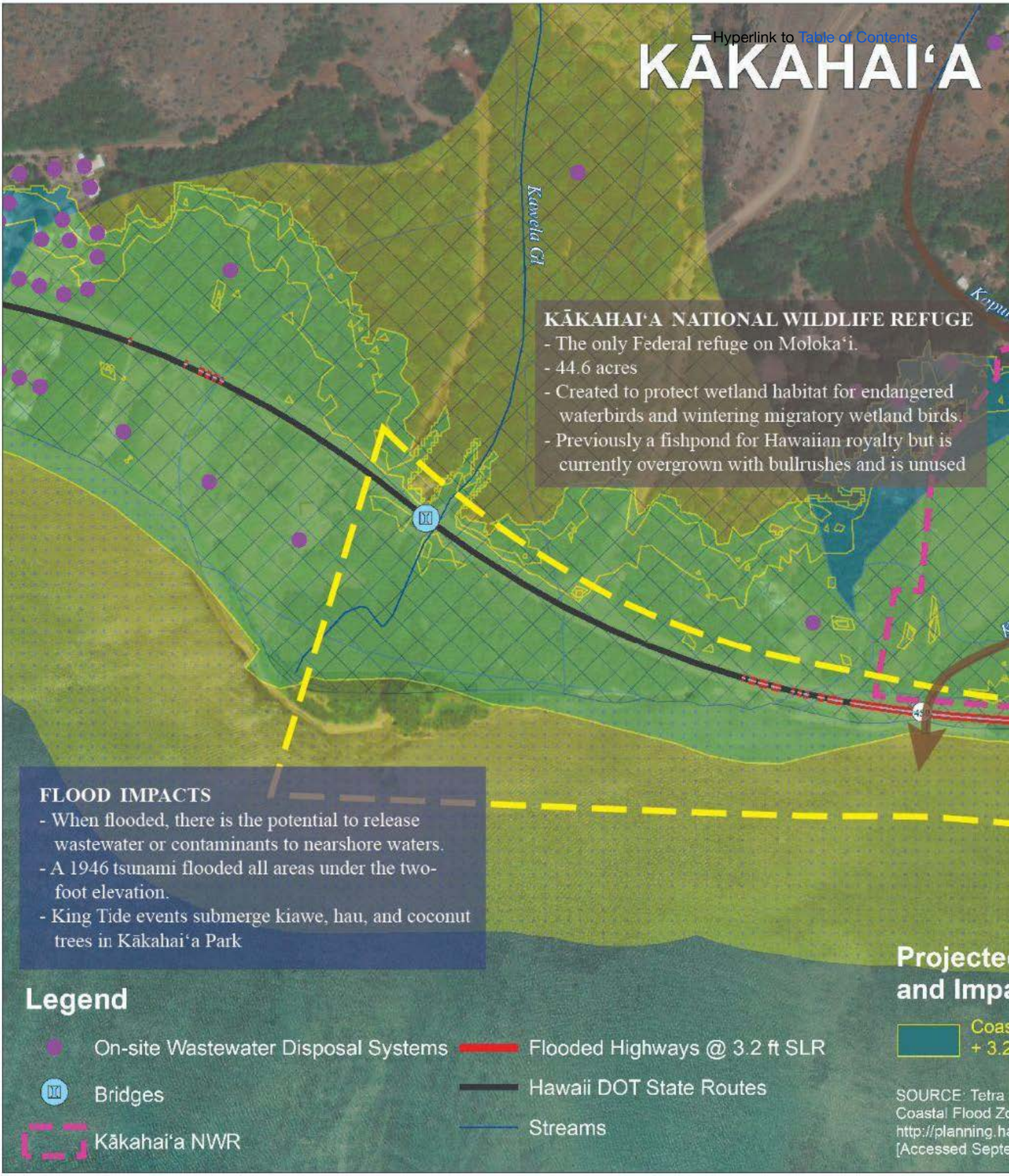
4.5. Kākahaiʻa National Wildlife Refuge (KNWR) & Beach Park

Image courtesy of SEI Molokaʻi SLR Vulnerability Assessment - Figure 3-87 Kakahaiʻa Park shoreline facing east



MOLOKAʻI CLIMATE CHANGE AND SEA LEVEL RISE ADAPTATION AND RESILIENCY MASTER PLAN

December 2023


A NATIONAL WILDLIFE REFUGE
& BEACH PARK
Site 5
SEDIMENT
Sediment flows into
nearshore coastal waters
Kapukaulua
Kakahaia
Kapukaulua
Kākahai'a
National Wildlife Refuge
KĀKAHAI'A PARK
- Shoreline area operated as a park through a cooperative agreement between USFWS and Maui County
- Limited facilities: picnic tables and one porta potty
- Erosion scarp reveals sediment layers
- Wave overwash through the trees has killed the grass at Kākahai'a Park and created a depression.
- Rocks have been placed around trees to protect them from erosion.
jected Sea Level Rise
Impacted Areas
Coastal Flood Zone
+ 3.2 ft Sea Level Rise
Special Flood Zones
A
VE
AE
CE: Tetra Tech, Inc. and Sobis, Inc. 2020.
Flood Zones with Sea Level Rise of 3.2 Feet.
lanning.hawaii.gov/gis/download-gis-data/.
sed September 1, 2022]
0 200 400 800 1,200 1,600 2,000
Feet
N

4.5. Kākahaiʻa National Wildlife Refuge (KNWR) & Beach Park

See: Molokaʻi Sea Level Rise Vulnerability Assessment, Section 3.3.5, pages 111-121.

4.5.1 Location and General Description

- Ownership: U.S. Fish and Wildlife Service, United States of America
- Land Zoning: Conservation, Class AA waters
- Ahupuaʻa: Kawela
- Geomorphological Classifications: Pavement (NCCOS, 2007), Kealia silt loam, 0 to 1 percent slopes (USDA)
- Biological Classification: Estuarine and Marine Wetland (USFWS), Macroalgae (NCCOS, 2007) The landward side of the road: Freshwater emergent wetland, freshwater forested/shrub wetland (USFWS)

The name Kākahaiʻa is comprised of two root words, "Kākaha" and "iʻa". The term Kākaha has two different literal translations including, "a shoal" or "a strip of land near the sea". Iʻa, literally translates to mean "fish" (Pukui and Elbert, 1986). When these two root words are compounded, the name "Kākahaiʻa" can be literally translated to mean, a shoal of fish or a strip of land near that sea that has fish (Lima, 2023).

The Kawela ahupuaʻa, situated on the Kona side of the island, was a vital contributor to various food sources. Documented in the Māhele Records, it stands out as one of the largest gulches in the region. Evidence of its historical importance lies in the presence of old terraced loʻi systems along the stream, showcasing its role in supporting agriculture, and the effective harnessing of water resources.

Figure 3-86 Delta west of Kakahaiʻa Park at Kawela Stream

Kākahaiʻa stands traditionally as Molokaʻi's most expansive Loko Puʻuone inland fishpond, with loʻi punawai adjacent, sourced by numerous natural springs along its inland edge and linked to the sea through a canal. Although its original expanse measured around 31 acres, the pond's surface area has diminished over time due to the gradual accumulation of upland sediments. Historical records trace the initial utilization of the pond back to AD 1500 (Weisler, National Register of Historic Places Inventory-Nomination Form). This area formally supported multiple food sources.

Kakahai'a Beach Park, 5.5 miles east of Kaunakakai near milepost 6, is a long stretch of public access over a narrow strip of land between the ocean and Kamehameha V Highway Hwy. 450.

Established in 1976, Kakahaiʻa National Wildlife Refuge (NWR) on the landward side of the road is the only Federal site on Moloka'i to permanently protect wetland habitat for endangered waterbirds, primarily Hawaiian stilt (aeʻo) and Hawaiian coot (ʻalae keʻokeʻo), and to provide habitat for wintering migratory wetland birds. Invasive mammals (feral cats, dogs, mongooses, and axis deer) are present on the refuge as well. Some of the areas in the park are restricted for conservation purposes and permission must be obtained before exploring the sanctuary.

Kakahaiʻa is currently ranked second on the MWP Assessment tool for restoration. Current efforts are in the planning stages and require extensive community outreach. Ka Ipu Makani Cultural Heritage Center (KIM) is the community engagement lead for the process. KIM is a local 501(c)(3) whose mission it is to foster an awareness of cultural and natural resource management and heritage preservation in Hawai'i, by encouraging community stewardship, practice, preservation, and restoration of cultural and historical sites, landscapes, and materials while promoting cultural and natural richness, diversity, arts, languages, sciences, history, and traditions of Molokaʻi.

Likely restoration needs are: replacement of the degraded fence with an ungulate proof or predator proof fence; removal of invasive species, particularly mangrove and pickleweed; a hydrological review to understand how to effective manage water; outplanting of native species; ongoing management to maintain the wetland interest and value for climate resilience and ecosystem service.

4.5.2 Vulnerability Assessment

Kamehameha V Highway on the landward side of this park is at risk with SLR. Without adaptation, the roadway is projected to be submerged with 3.2 feet of passive flooding. Recreational use and trees that support bird habitat would be reduced The park is within flood zone AE with a base flood elevation of seven feet. AE flood zones are areas that present a 1% annual chance of flooding and a 26% chance over the life of a 30-year mortgage, according to FEMA. The project site is within the tsunami evacuation zone.

4.5.3 Adaptation Needs

Uses in this area are primarily recreational viewing wildlife and fishing. Kamehameha V Highway is along the shoreline and is a critical access path connecting all of east Molokaʻi to Kaunakakai, the island's urban center that provides critical resources and emergency support services. To adapt to SLR, the roadway could be altered before it becomes submerged.

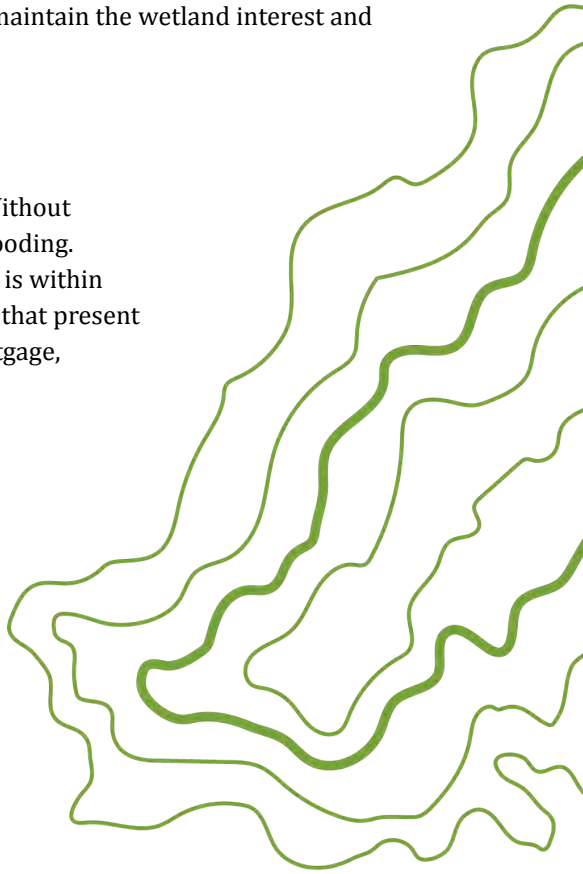
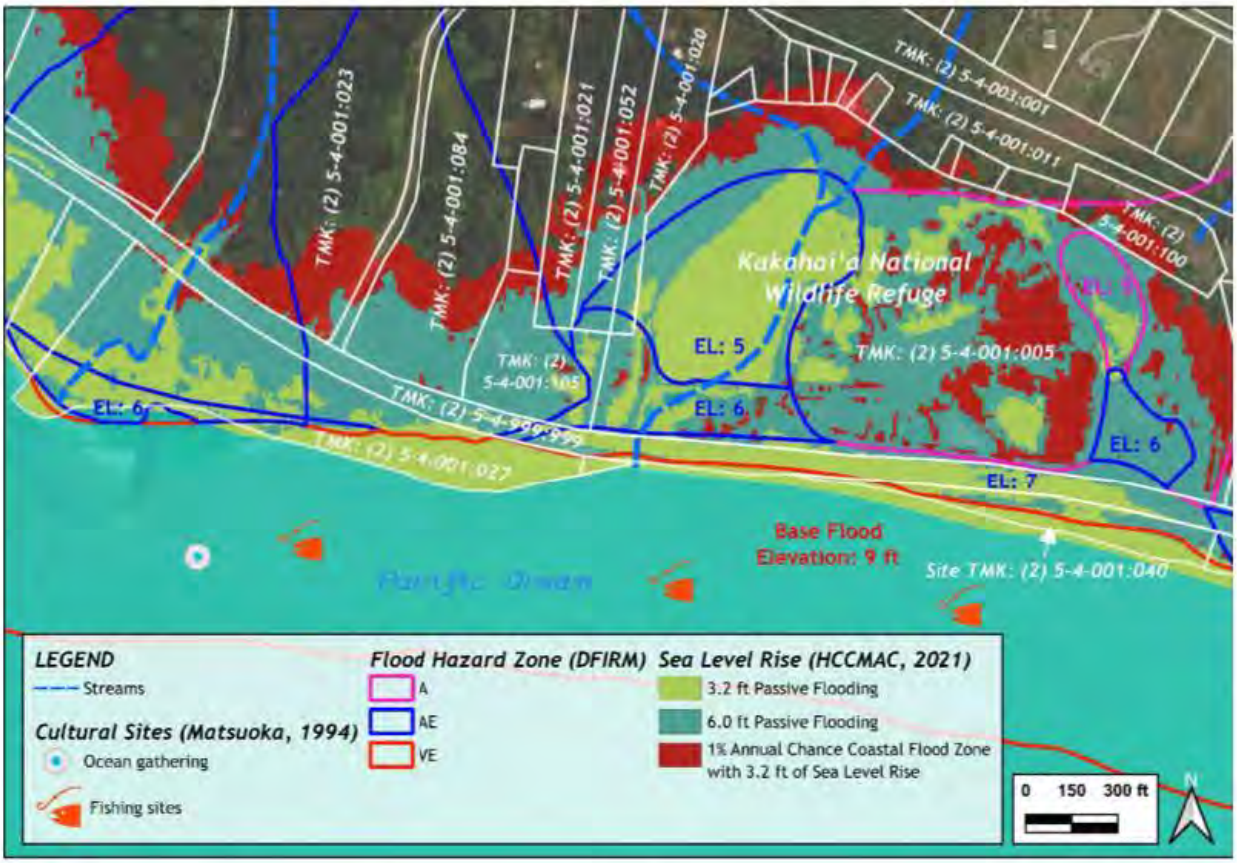


Table 3-7: Kakahai'a Park vulnerability assessment



Moku Kona	**Area** 1.86 acres
Ahupuaa Kawela	**Ownership** United States of America
Tax Map Key No(s) (2) 5-4-001:040	**Known Cultural Resources** Fishing, ocean gathering
Location 157.027493°W, 21.090977°N	**FEMA Flood Zone** AE, 6 to10 foot BFE
Land Zoning Conservation, Class AA waters	**Tsunami Hazard** Evacuation area: shoreline to 0.3 miles inland
Geomorphological Classifications Pavement (NCCOS, 2007) Kealia silt loam, 0 to 1 percent slopes (USDA)	**Setback from Vegetation Line** 40 feet (to the highway)
Biological Classifications Macroalgae (NCCOS, 2007) Estuarine and Marine Wetland (USFWS) The landward side of the road: Freshwater emergent wetland, freshwater forested/shrub wetland (USFWS)	**Sea Level Rise Exposure** 3.2' = 76,956 sf (71% of the site) 3.2' + 1% = 108,789 sf (100% of the site) 6.0' = 108,789 sf (100% of the site)
Existing Development Kamehameha V Highway	**Sea Level Rise Hazard Intensity** High – Low elevations, critical infrastructure

4.5.4 Recommended Adaptation Strategies

SHORT-TERM
● In partnership with the US Fish and Wildlife Services, Ka Ipu Makani Cultural Heritage Center is currently developing a Community Conceptual Plan for Restoration of Kākahaiʻa Loko Puʻuone. The Conceptual Plan will be informed by the Molokaʻi community, identifying appropriate restoration models. ○ Kākahaiʻa stands as Molokaʻi's most expansive inland fishpond, sourced by numerous natural springs along its inland edge and linked to the sea through a canal. Although its original expanse measured around 31 acres, the pond's surface area has diminished over time due to the gradual accumulation of upland sediments. Historical records trace the initial utilization of the pond back to AD 1500 (Weisler, National Register of Historic Places Inventory-Nomination Form). ● Coordination with MWP Wetland Restoration project (Kakahaiʻa projects have been identified and partially funded). Work includes. ○ A recently funded NFWF National Coastal Resilience Fund (NCRF) grant award to Molokaʻi Land Trust will carry out a hydrological study at Kakahaiʻa. Site is proposed as a possible site for 50% wetland restoration design in 2024. ○ Community and Stakeholder outreach and engagement ○ A NFWF NCRF grant application is planned to continue to 100% wetland restoration design in 2025, and implementation would be expected to occur from 2026 - 2029. ○ In the short-term, repair needed to existing fence to exclude ungulates ○ Restoration could occur for invasive species in the short-term, particularly for kiawe, followed by outplanting. ● Protection could be a short- to mid-term adaptation strategy at Kakahai'a Park. Wave energy across the reef here is low, so both soft and hard protection techniques could be considered to provide a buffer between the ocean and the roadway. Placement of protection however would reduce the land area available for recreational use. Protection would need to be installed along the entire length of the roadway that is at risk of being submerged with SLR to prevent water from creeping around the sides of the structure. Even with shore protection, sea levels will cause the groundwater table to rise and can damage the roadway. Any future potential protection needs to be coordinated with KIM, USFWS & MWP.

MID-TERM
● An accommodation strategy to lift the roadway allowing ocean waters to flow underneath may be a preferred option to provide long-lasting access to east Molokaʻi. There are a few uses on the mauka side of the road that would be visually impacted by an elevated roadway and a few properties that would need specially engineered access connections to the portion of the roadway that would be elevated. Any accommodation to an elevated roadway would need to work in conjunction with Wetland Restoration projects (Molokaʻi Wetland Partnership). A study would be needed to understand the impacts on the NWR. ● Outplanting of native species; coastal strand restoration; native bioshield border ● Continuing ridge to reef work to reduce sedimentation. ● Carry out hydrological and engineering surveys to understand how to re-engineer topography and hydrology to create variable water depths with edge. ● Install predator-proof fence (medium term) ● Develop and implement restoration plan

LONG-TERM
● Continued Relocation (see above)

4.5.5 Preliminary Cost Estimate

See above Section 5.4.5 for KIM & MWP funding secured $40k needed for Community Conceptual Plan for Restoration of Kākahaiʻa Loko Puʻuone. Future funding for compliance & regulatory will run $150,000-$200,000.

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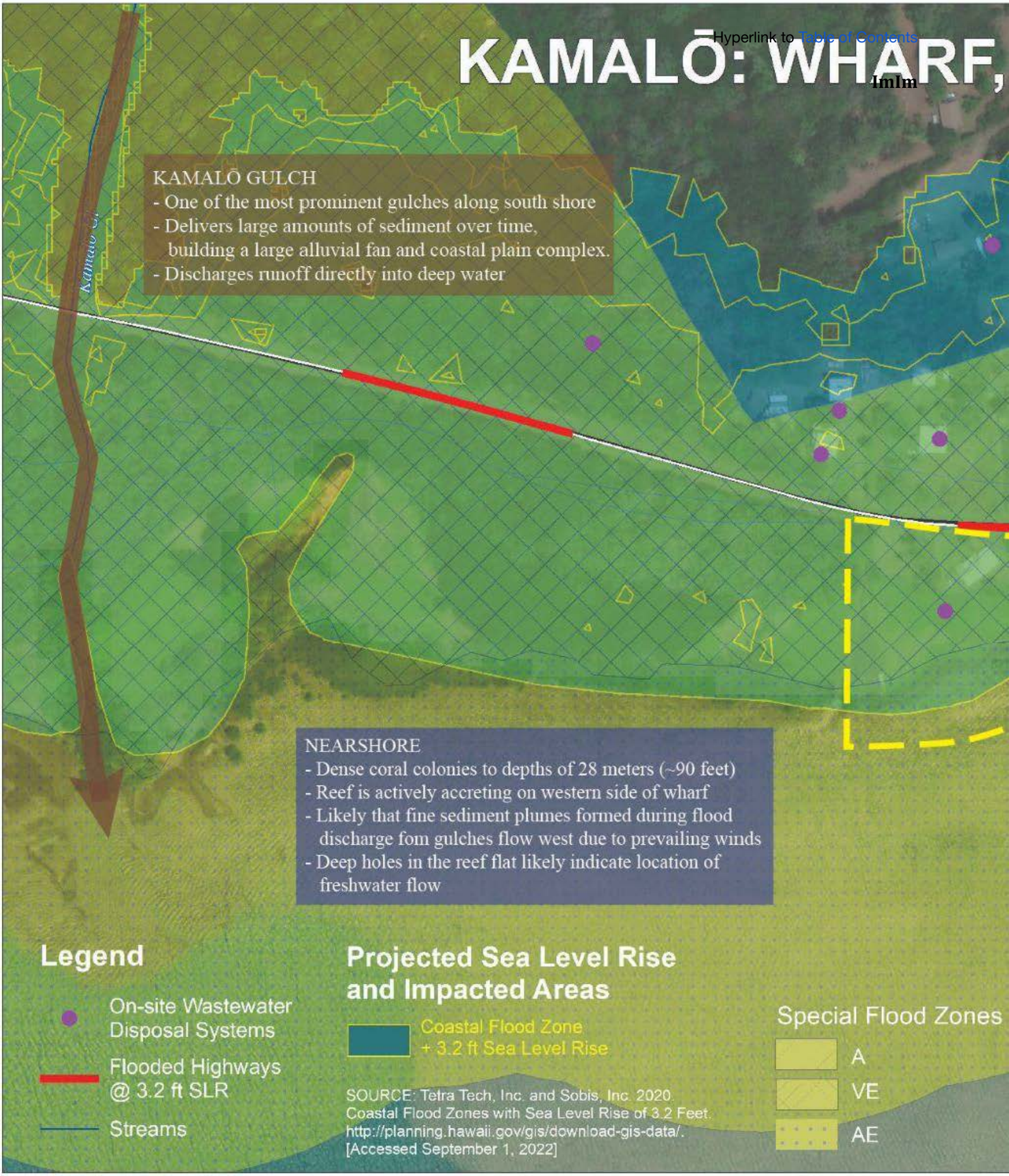
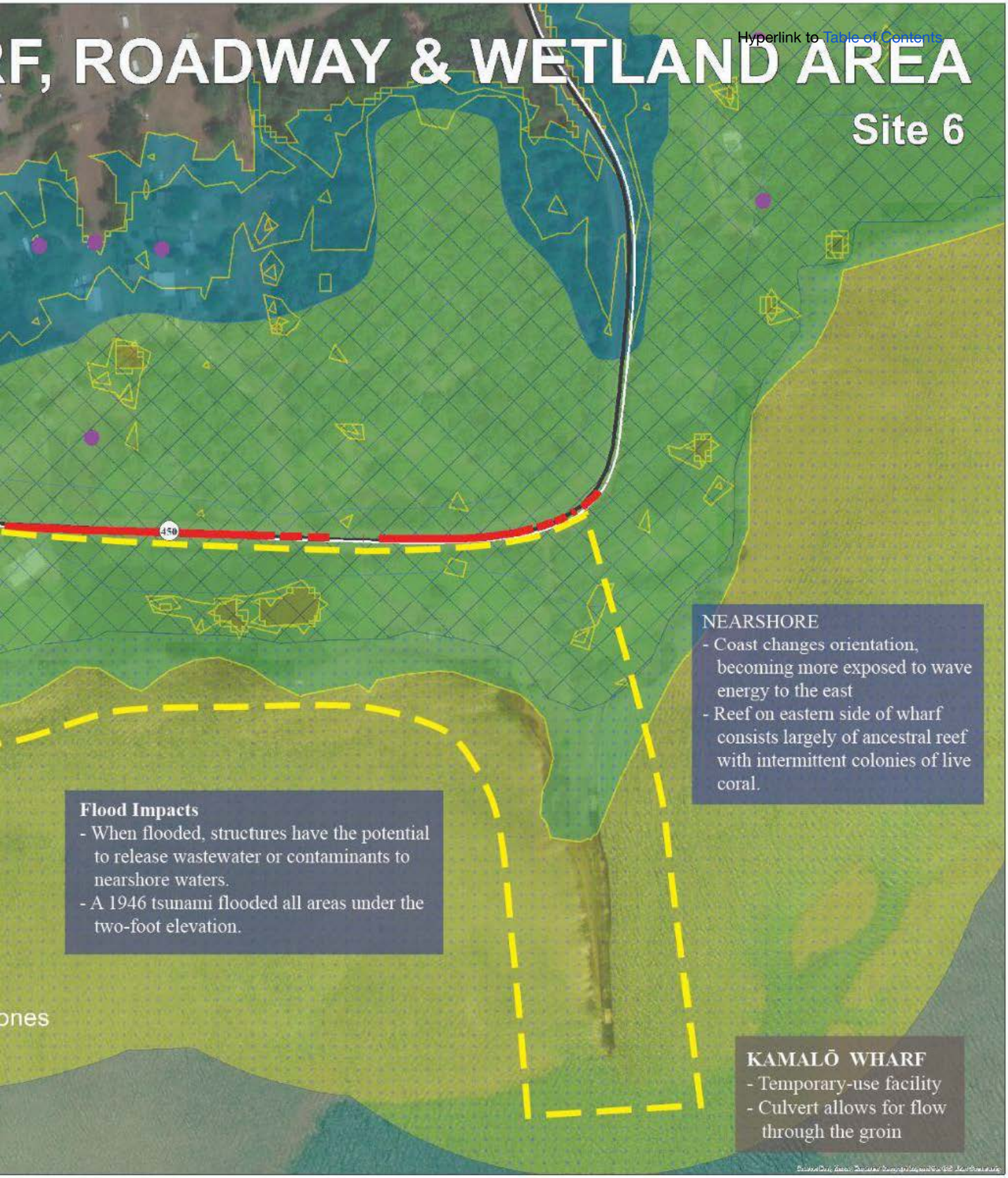
4.6. Kamalō Wharf, Roadway, and Wetland Area

Image courtesy of SEI Molokaʻi SLR Vulnerability Assessment
Figure 3-99 Kamalō Harbor facing landward (April 27, 2022)" page 124


KAMALŌ: WHARF,
KAMALŌ GULCH
- One of the most prominent gulches along south shore
- Delivers large amounts of sediment over time, building a large alluvial fan and coastal plain complex.
- Discharges runoff directly into deep water
NEARSHORE
- Dense coral colonies to depths of 28 meters (~90 feet)
- Reef is actively accreting on western side of wharf
- Likely that fine sediment plumes formed during flood discharge fom gulches flow west due to prevailing winds
- Deep holes in the reef flat likely indicate location of freshwater flow
Legend
On-site Wastewater Disposal Systems
Flooded Highways @ 3.2 ft SLR
Streams
Projected Sea Level Rise and Impacted Areas
Coastal Flood Zone + 3.2 ft Sea Level Rise
SOURCE: Tetra Tech, Inc. and Sobis, Inc. 2020. Coastal Flood Zones with Sea Level Rise of 3.2 Feet. http://planning.hawaii.gov/gis/download-gis-data/. [Accessed September 1, 2022]
Special Flood Zones
A
VE
AE


RF, ROADWAY & WETLAND AREA
Site 6
450
NEARSHORE
- Coast changes orientation, becoming more exposed to wave energy to the east
- Reef on eastern side of wharf consists largely of ancestral reef with intermittent colonies of live coral.
Flood Impacts
- When flooded, structures have the potential to release wastewater or contaminants to nearshore waters.
- A 1946 tsunami flooded all areas under the two-foot elevation.
ones
KAMALŌ WHARF
- Temporary-use facility
- Culvert allows for flow through the groin
0 100 200 400 600 800 1,000
Feet
N

4.6. Kamalō Wharf, Roadway, and Wetland Area

See: Moloka'i Sea Level Rise Vulnerability Assessment, Section 3.3.6, pages 122-135.

4.6.1 Location and General Description

- Ownership: Private, State of Hawai'i
- Land Zoning: Land Zoning, Class AA waters
- Ahupua'a: Kapualei
- Geomorphological Classifications: Mud (NCCOS, 2007), Kealia Silt loam, 0 to 1 percent slopes (USDA)
- Biological Classification: Estuarine and Marine Wetland (USFWS), Uncolonized (NCCOS, 2007)

Figure 3-102 Kamalō Harbor groin beach facing landward

Kamalo͞ is the point where the south Moloka'i coast changes orientation and becomes more exposed to wave energy and is the east end of the accreting reef (Figure 3-31 and Figure 3-33). The reef surface to the east consists largely of ancestral reef deposits intermittently colonized by live coral.

Kamalo͞ Gulch and its adjacent gulches are the most prominent gulches along the south shore. Running steeply down from the island's highest peak (Kamakou, 1,515 m or 4,970 ft), the gulches are wide and deeply entrenched. The large amounts of sediment that have been delivered through this system over time have built a large alluvial fan and coastal plain complex (Figure 3-98). Fine-grained sediment plumes from the gulch flow west along the shoreline with the alongshore current. Prominent blue holes, which are deeper and more abundant on the eastern end of the reef, are perhaps because of freshwater precipitation and water flow carving out the limestone (Field, 2008). At the landward end of the string of elongated blue holes is an artificially created pit formed by dredging in the 1970s to create a harbor.

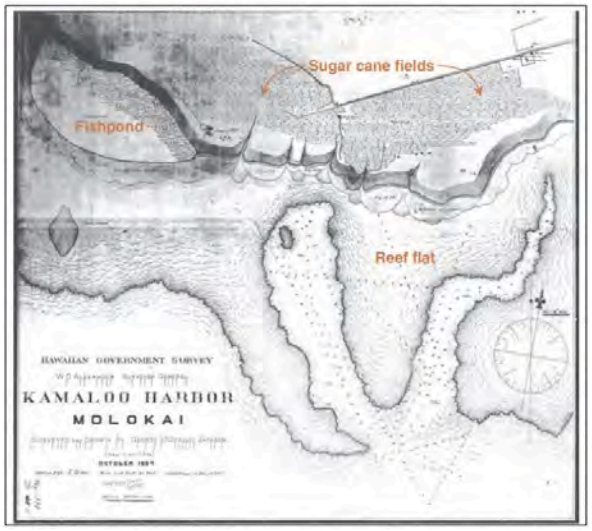


Figure 3-98 Kamalō Harbor in 1882 showing the shape of the coast and sugar cane fields (Jackson, 1882)

Today, Kamalo͞ Wharf is considered a temporary-use facility rather than a permanent mooring area. A groin extends seaward from the shoreline with three culvert openings that allow water to flow through the structure and improve alongshore circulation (Figure 3-99 -Figure 3-103). A narrow beach has formed on the downdrift side of the groin where water has carried sand through the openings. At low tide, water does not flow through the culvert openings, but as the tide rises the water gradually begins trickling through and eventually becomes a free-flowing alongshore stream (Figure 3-104, Figure 3-105).

Kamalo͞ is used for a variety of recreational activities. There is a shelter on the beach and a small boat ramp (Figure 3-106 - Figure 3-113). There is low-lying vegetation on relatively flat ground between the shoreline and the roadway. Water flows under Kamehameha V Highway and out through Kamalo͞. Mangroves are growing on part of the shoreline preventing lateral access between the beach and the boat ramp. A photo of a King Tide in July 2020 shows how elevated water levels quickly led to the flooding of the parking lot and ponding of water (Figure 3-114).

Kamahuʻehuʻe Fishpond and wetland resides on the western side of Kamalō Wharf. It is one of the biggest wetlands/fishpond in historical times on the island of Molokaʻi. Owned by the Bishop Estate, Kamahuʻehuʻe is a loko kuapā (walled fishpond) spanning 37 acres in size, with a wall that extends approximately 3,470 feet in length. Historically, this fishpond had two strategically placed makahā (entrances), one along the eastern shoreline and the other in the southwestern wall's central area (Summers 1971). According to Cobb's documentation from 1901 (1902:430), Kamahuehue was actively utilized for commercial purposes. However, as time passed, significant challenges emerged. By 1957, reports indicated that the pond had shrunk to 25% of its original size due to extensive siltation (Dunn, as cited in Summers 1971). The current pond area covers about 4.8hectares. Notably, mangrove growth now obscures the eastern end of the pond, while the southern section has suffered notable deterioration from wave action.

A former loko kuapa (seawater fishpond) with two makaha (sluice gates). The former fishpond(s) have filled with sediment, and provide large expanses of open mudflats that inundate during high tide or following heavy rainfall. Aeʻo, ʻalae keʻokeʻo and migratory waterfowl and shorebirds use the site regularly. The entire ahupuaʻa belongs to Kamehameha Schools, which provides potential for landscape level restoration.

Today, Kamahuʻehuʻe is filled with invasive species, has a large amount of sediment and has limited ungulate control. This reduces the ability of the wetland to provide ecosystem services such as flood and sediment control, leading to damage to the reef from sedimentation in high rainfall and flood events. The site scored well in the PI-CASC wetland prioritization process and would be a good candidate for restoration. Community engagement is vital for the success of any such project however.

“After heavy rains Kamehameha V Highway floods.” (Photo credit: H. Place, March 2023)

4.6.2 Vulnerability Assessment

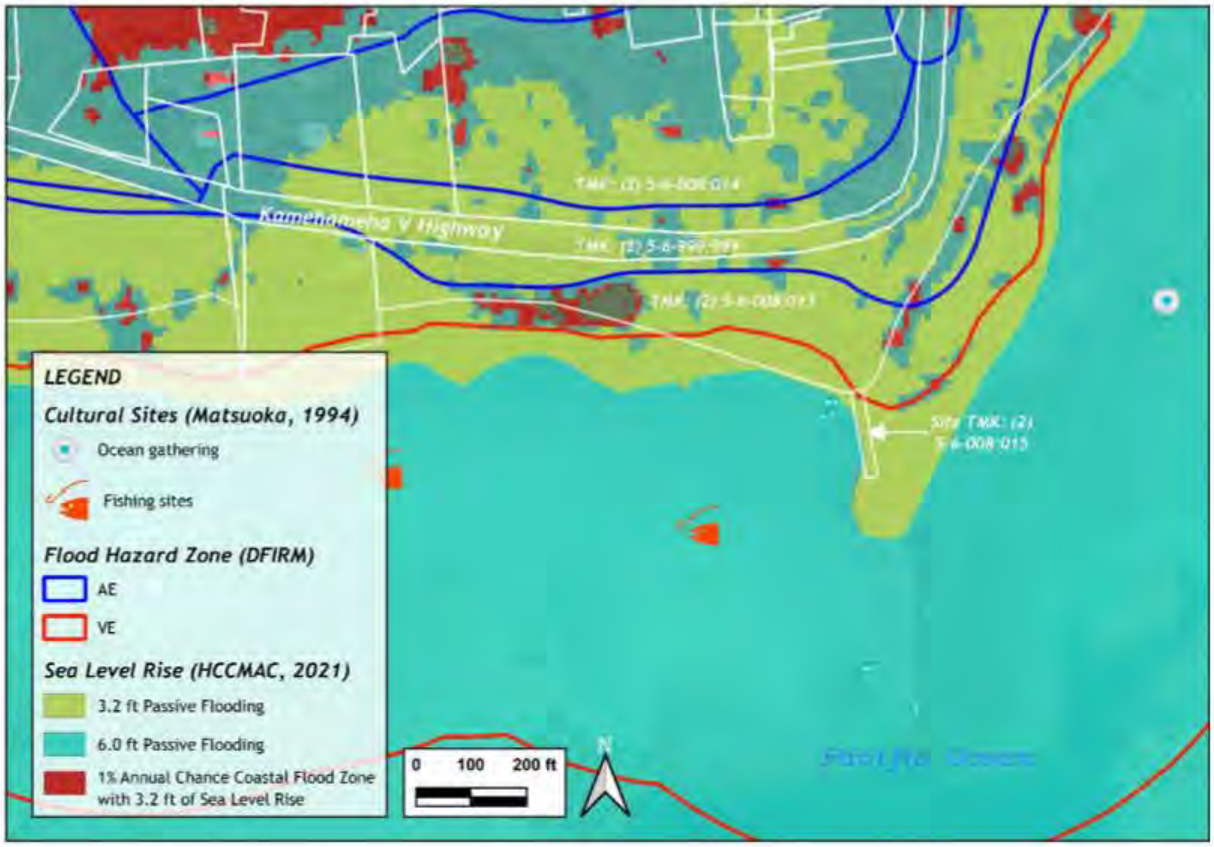
Kamehameha V Highway on the landward side of Kamalo Wharf is at risk with SLR. Without adaptation, the roadway is projected to be submerged with 3.2 feet of passive flooding. Recreational and boat use would be altered with a flooded coastline. Kamalo Wharf is within flood zone VE with a base flood elevation of ten feet. VE flood zones are areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage, according to FEMA.
The project site is within the tsunami evacuation zone.

4.6.3 Adaptation Needs

Kamalo Wharf provides facilities for local fishermen and fronts Kamemehaha V Highway, a critical access roadway connecting east Moloka'i to the Kaunakakai resource center. As sea levels rise, fishery amenities may need to adapt to be taller and closer to the new shoreline. The roadway will be flooded with 3.2 feet of SLR passive flooding. To continue to provide transportation services, the roadway will need to be adapted in advance.
Between the stream input running through the Kamalo Wharf shoreline and passive flooding from the ocean, the soils are growing increasingly saturated and the groundwater table will continue to rise.

Figure 3-114 King tide event at Kamalō Harbor flooding the parking lot (July 8, 2020, Photo Credit: Hawaii Sea Grant King Tides Project)

Table 3-9 Kamalō Wharf vulnerability assessment



Moku Kona	**Area** 20.3 acres
Ahupuaa Kapulei	**Ownership** Private, State of Hawaii
Tax Map Key No(s) (2) 5-6-008:015; (2) 5-6-008:013; (2) 5-6-008:016	**FEMA Flood Zone** AE, 7 to10 foot BFE
Location 156.874758°W, 21.047024°N	**Known Cultural Resources** Fishing, Ocean gathering
Land Zoning Conservation Class AA waters	**Tsunami Hazard** Evacuation zone: shoreline to 0.4 miles landward 1946 Runup Elevation: 6.0 feet
Geomorphological Classification Mud (NCCOS, 2007) Kealia silt loam, 0 to 1 percent slopes (USDA)	**Setback from Vegetation Line** 200 feet (to the highway)
Biological Classification Uncolonized (NCCOS, 2007) Estuarine and Marine Wetland (USFWS)	**Sea Level Rise Exposure** 3.2' = 3,474 sf (100 % of the site) 3.2' + 1% = 3,474 sf (100 % of the site) 6.0' = 3,474 sf (100 % of the site)
Existing Development Kamehameha V Highway	**Sea Level Rise Hazard Intensity** Low – Low elevations, adaptable infrastructure

4.6.4 Recommended Adaptation Strategies

SHORT-TERM
● Soft protection could be utilized in this area taking advantage of the space and the scenic attributes of the Wharf area. Soft protection will not stop SLR, but it can be used to live with it. Planting native salt-tolerant wetland plants can help retain soils and absorb excess water during flooding events. ● Collaborate on Kamahuʻehuʻe Wetland Planning (Fishpond inclusive) with MWP ○ Collaboration with MWP for the site and wetland integration with the roadway. Kamahuʻehuʻe Wetland (inc. fishpond) was amongst the wetlands evaluated for restoration in the MWP Prioritization Tool and ranked highly. The steps for this site is: ■ Develop relationship between landowner and Molokaʻi Wetland Partnership ■ Include the community in planning and restoration, especially with residents in the vicinity of the site to understand their vision for the area.; restoration must maintain appropriate community access; ■ Collaborate with DOT to put Kamalo on their vulnerable Shoreline Highways list ■ Seek funding to implement plan

MID-TERM
● An accommodation strategy to lift the roadway allowing ocean waters to flow underneath may be a preferred option to provide long-lasting access to east Molokaʻi. Stream waters flowing seaward would also be able to flow more freely if the roadway were raised. Fishery facilities could be rebuilt in new locations closer to the new shoreline at a higher elevation to maintain access for fishermen. New and improved waterfront structures designed for an elevated sea level could also be explored if the development of fishing and boating uses is desired. ● Collaborate on Kamahuʻehuʻe Wetland Restoration Planning (Fishpond inclusive) with MWP, incorporating community outreach results.

LONG-TERM
● Shoreline retreat may be possible for the roadway in this short portion that is at a vulnerable low elevation. Relocating the roadway further landward would escape the SLR hazard in this area, though land acquisition may be required. ● Restoration of Kamahuʻehuʻe Wetland

4.6.5 Preliminary Cost Estimate

- ***Short-term:*** Collaborate on Kamahuʻehuʻe Wetland Planning (Fishpond inclusive) with MWP
    - $5000: Contribution to cost of portion of Molokaʻi Wetland Coordinator position
    - $10,000-$20,000: Contribution to portion of community partner outreach for MWP
- ***Mid-term:*** Collaborate on Kamahuʻehuʻe Wetland Planning (Fishpond inclusive) with MWP
    - $440,000 for contract to take site to full design and permitting including; Investigation, research, concept design and development; Preparation of and submission through HEPA/NEPA; USACE, NDPES, SMA, CDUA, No Rise Certification, Plan Approval App, Grading & Stockpile, Sect. 104 etc; Topographic, archaeological, hydrology; Soil sampling, travel, filing fees; Molokaʻi Wetland Partnership project manager time)

Hyperlink to Table of Contents

4.7. Keawanui Fishpond

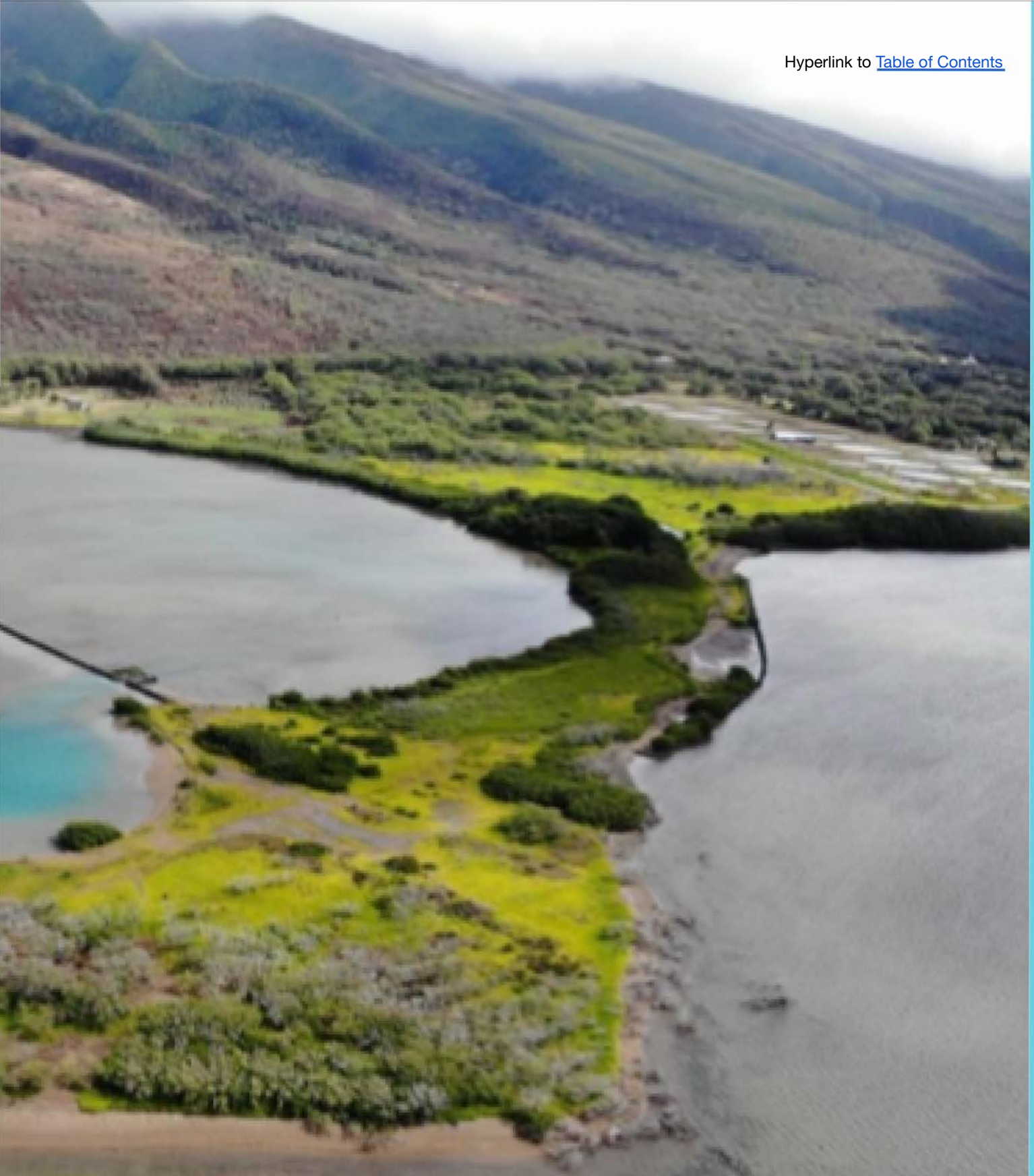
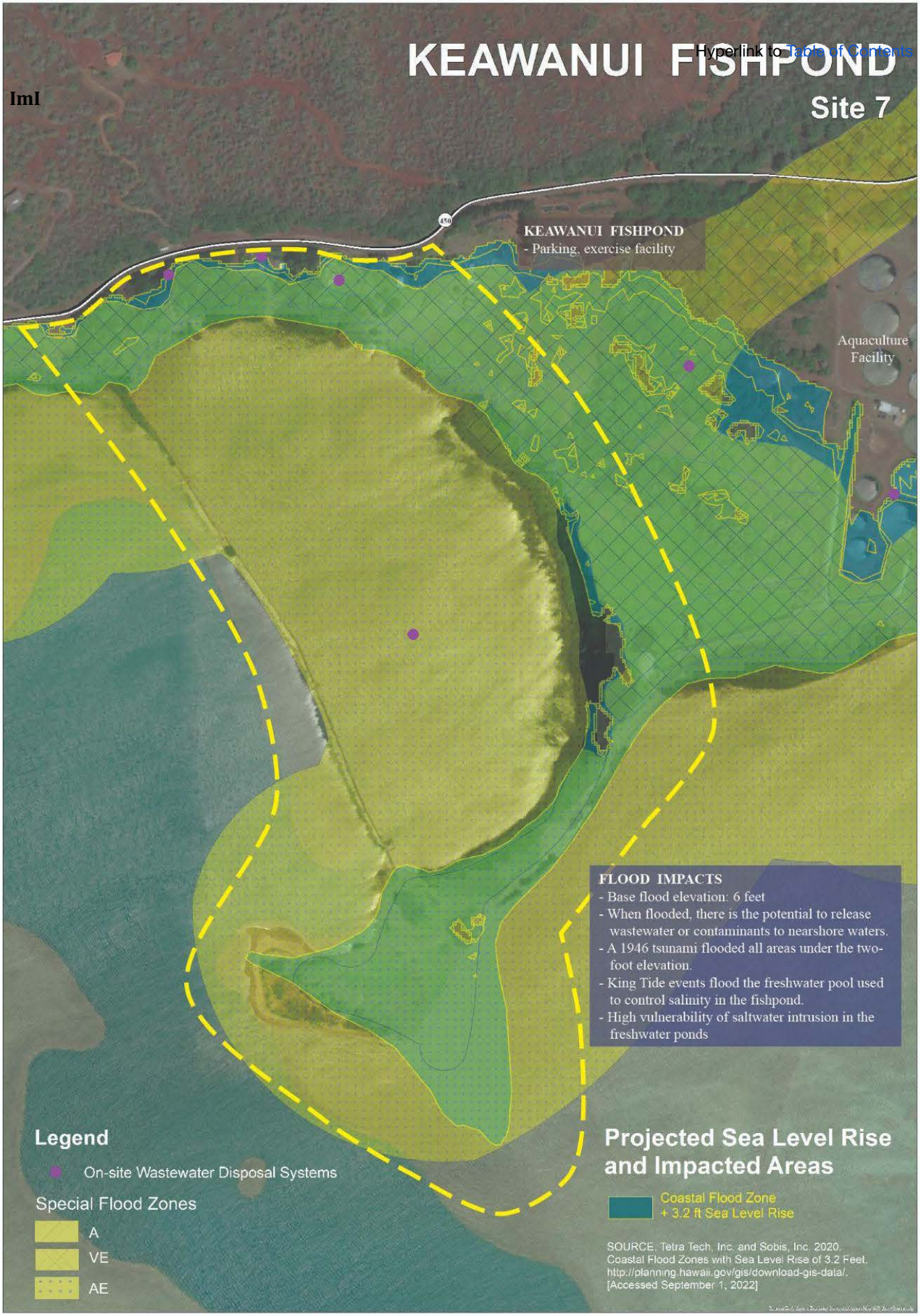


Image courtesy of SEI Molokaʻi SLR Vulnerability Assessment
"Figure 3-116 Keawanui Fishpond facing landward (April 27, 2022)" Page 136

ImI

KEAWANUI FISHPOND

Site 7



MOLOKA'I CLIMATE CHANGE AND SEA LEVEL RISE ADAPTATION AND RESILIENCY MASTER PLAN
December 2023

0 100200 400 600 800 1,000 Feet

N

4.7. Keawanui Fishpond

See: Molokaʻi Sea Level Rise Vulnerability Assessment, Section 3.3.7, pages 136-141.

4.7.1 Location and General Description

- Ownership: Private (Kamehameha Schools Bishop Estate)
- Land Zoning: Conservation & Agriculture, Class AA waters
- Ahupuaʻa: Kaʻamola
- Geomorphological Classifications: Mud and Sand (NCCOS, 2007), Kealia silt loam, 0 to 1 percent slopes (USDA)
- Biological Classification: Estuarine and Marine Wetland (USFWS), Uncolonized (NCCOS, 2007)

Figure 3-117 Keawanui Fishpond access point (April 27, 2022)

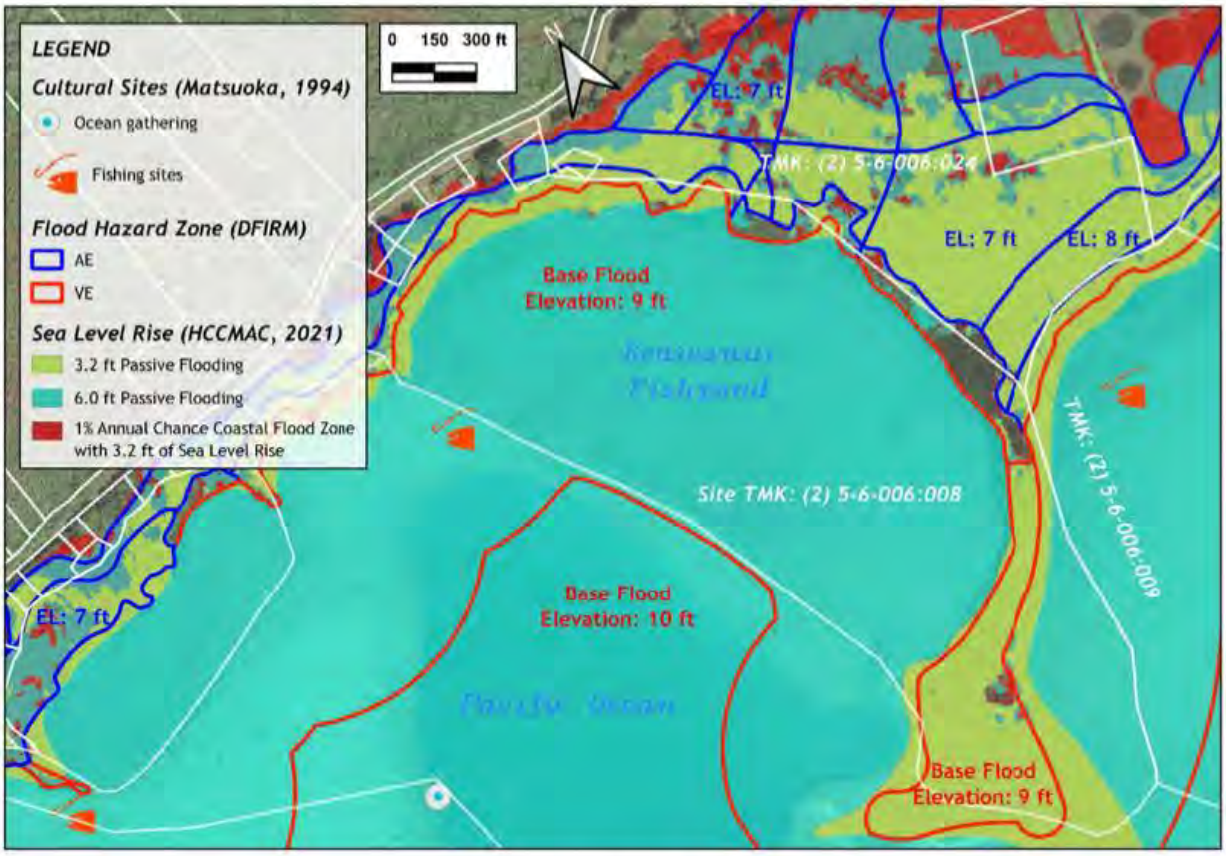
Native Hawaiians built numerous stone-walled fishponds on Molokaʻi's protective barrier reef before Western contact, and 64 of these ancient fishponds are still intact. These fishponds were highly valued for intensive food production. An average-sized 15-acre fishpond can yield 600 lbs of fish per acre annually (Molokaʻi, 2008). Keawanui Fishpond is an actively maintained fishpond perpetuating Native Hawaiian traditional knowledge and practices. The salinity, temperature, and nutrients in the pond are carefully monitored and managed to provide a healthy ecosystem for the food chain that lives within the Fishpond.

At present, Keawanui Fishpond is managed as a nursery for marine species to ensure the vitality of our subsistence resources outside of the pond. Photos of the existing conditions of the Fishpond and amenities are given in Figure 3-116 through Figure 3-119. When there are King Tide anomalies, ocean water levels rise and have caused flooding in the freshwater pool that is necessary to regulate the salinity in the Fishpond. These events can be difficult to recover from and will occur more and more as sea levels rise. The shortest distance from the fishpond to Kamehameha V Highway is approximately 260 ft. Ground elevations vary from about 5 to 16 ft.

4.7.2 Vulnerability Assessment

The shortest distance from the fishpond to Kamehameha V Highway is approximately 260 ft. Ground elevations vary from about 5 to 16 ft. Saltwater intrusion into the freshwater ponds puts the Keawanui Fishpond at high risk of no longer being able to function as sea levels rise. With 3.2 ft of SLR passive flooding, the fishpond as well as the expansive parking and office space would all be flooded. The roadway is at a higher elevation and would be safe from the SLR hazard, but it would only be providing access to flooded lands. The base flood elevation of the fishpond is 9 ft.

Table 3-9: Keawanui Fishpond vulnerability assessment



Moku Kona	**Area** 73.6 acres
Ahupuaa Ka'amola	**Ownership** Private
Tax Map Key No(s) (2) 5-6-006:008	**Known Cultural Resources** Hawaiian Fishpond, Fishing
Location 156.849833°W, 21.057665°N	**FEMA Flood Zone** AE, 6 to10 foot BFE
Land Zoning Conservation, Agriculture Class AA waters	**Tsunami Hazard** Evacuation zone: shoreline to 0.1 miles landward
Geomorphological Classification Mud, Sand (NCCOS, 2007) Kealia silt loam, 0 to 1 percent slopes (USDA)	**Setback from Vegetation Line** 265 feet (to buildings)
Biological Classification Uncolonized (NCCOS, 2007) Estuarine and Marine Wetland (USFWS)	**Sea Level Rise Exposure** 3.2' = 521,906 sf (62% of the site) 3.2' + 1% = 638,101 sf (76% of the site) 6.0' = 74,3576 sf (88% of the site)
Existing Development Keawanui Fishpond	**Sea Level Rise Hazard Intensity** Low – Low elevations

4.7.3 Adaptation Needs

To continue perpetuating Native Hawaiian traditional Fishpond knowledge and practices, innovative ideas on how to do so differently may need to be explored. The way this fishpond has worked in the past with an underground freshwater supply may not work in the future. Continued use of this fishpond may require using an alternate freshwater source and increasing the water quality monitoring within the pond to respond to changing ambient ocean chemistry.

To protect the Fishpond for restoration and adaptation, and maintain its isolation from surrounding ocean waters, the wall surrounding the pond could be elevated to a height greater than SLR projections. The wall strength would need to be greater to withstand the forces of greater wave heights.

4.7.4 Recommended Adaptation Strategies

SHORT-MID-TERM
● **For Fishpond (Loko Iʻa) Restoration & Adaptation,** these are the following needs: ○ Pōhaku (rocks) Survey, of pōhaku either from the specific ahupuaʻa as possible. ○ Survey and collect data on existing Kumuwai and start efforts on restoring Kumuwai. ○ Cost estimates on: pōhaku, size of pond, permits, and restoring of Kumuwai, Kuapa (wall), and shoreline ○ Permits for restoration ○ Soil Sampling: For pond caretakers that also care take the surrounding land, soil sampling studies will be needed to understand how to adapt to changing salinity levels in the soil. ○ Rigorous Water Quality Monitoring to study the ways in which salinity, turbidity, etc is changing to adapt pond structures to continue supporting life in the pond. ○ Permit support to import additional rocks to build wall height.

MID-TERM
● Accommodation by wetland restoration and planting of salt-tolerant vegetation can help hold soils landward of the pond together. Ground access to the fishpond will become increasingly saturated, and the use of something like a concrete block mat or slope stabilization may be desirable in portions of the facility. If saltwater intrusion prevents the use of the freshwater pool, the addition of freshwater tanks to the facility may be a way to maintain control of the salinity in the fishpond.

LONG-TERM
● Once protection and accommodation strategies no longer function due to inundation, the loko iʻa will not be able to function with its intended use. Alternative uses for the structure could be explored by the community. A continued perpetuation of knowledge may continue through alternative means at other fishponds or with educational centers. ○ Alternatively, shifting intent of the pond from a commercial focus to a nursery focus should be explored.

4.7.5 Preliminary Cost Estimate:

Based on interviews with local fishpond restoration project leaders, it is extremely difficult to estimate total costs of restoration due to numerous factors including changing conditions, such as SLR, water source and quality, the size of the fishpond, labor costs, availability of pōhaku, and other variables. In addition, these restoration efforts have been in process for decades and are still ongoing, and are still adjusting to changing SLR projections.

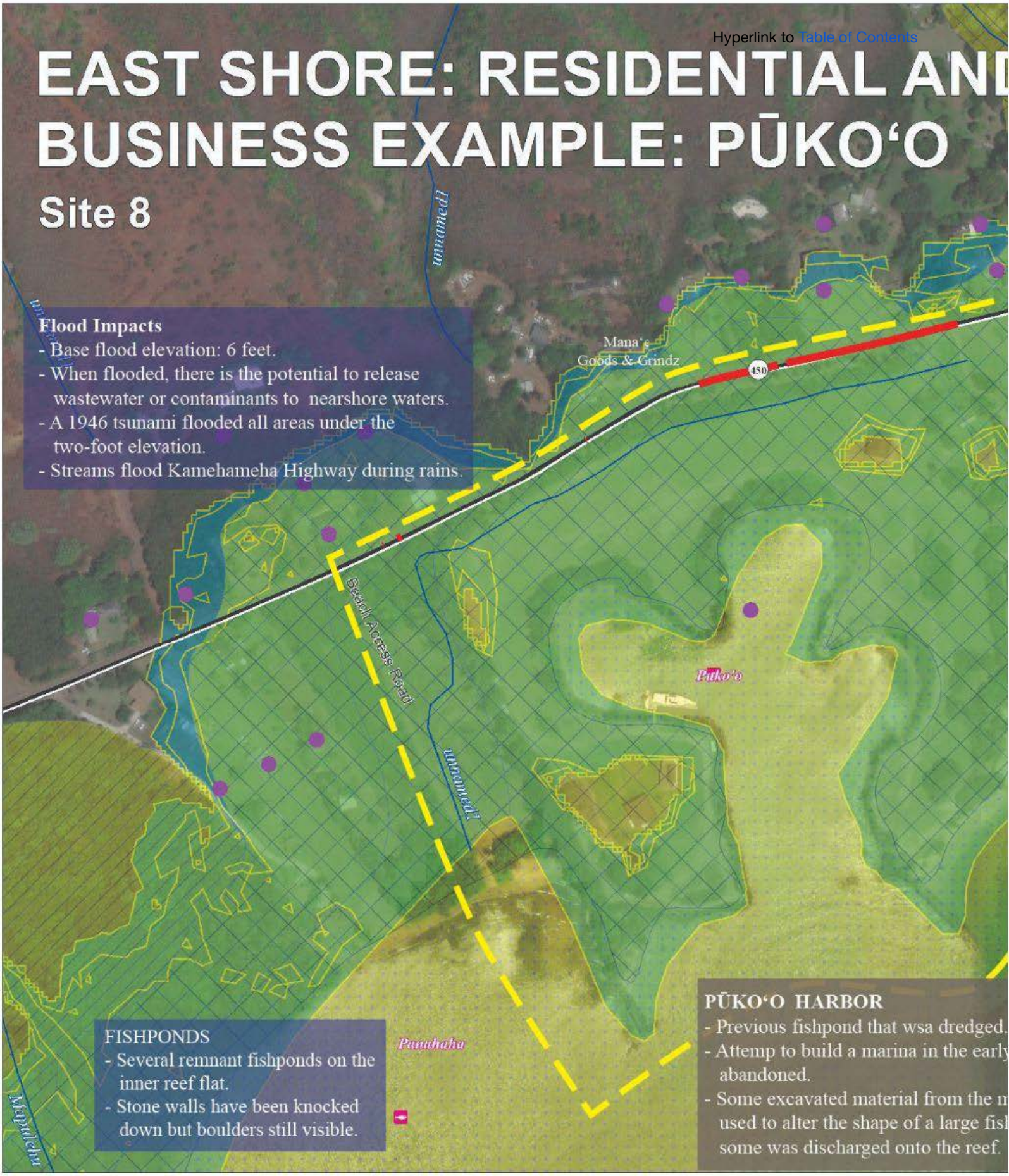
Hyperlink to Table of Contents

4.8. East Shore: Residential & Business Example: Pūkoʻo

Image courtesy of SEI Molokai SLR Vulnerability Assessment
"Figure 3-121 Pūkoʻo sandy shoreline facing east (April 21, 2022) page 143

EAST SHORE: RESIDENTIAL AND BUSINESS EXAMPLE: PŪKOʻO

Site 8




ND
Kupeke
Pūkoʻo Gl
NEARSHORE
- Fore reef in this area is smooth and lacks spur-and-groove patterns that characterizes the reef west of Kamalō.
- Rocks and pebbles protect the shoreline beach dunes.
- There is an erosion scarp along the shoreline between grassed areas and sand dunes.
Legend
On-site Wastewater Disposal Systems
Fishponds
Streams
Flooded Highways @ 3.2 ft SLR
Special Flood Zones
A
VE
AE
PŪKOʻO SHORELINE
- Shoreline is used for boat and canoe access
- A dirt/gravel roadway provides vehicular access to the shoreline.
- There are private access points along the shoreline
redged.
he early 1970s was
m the marina was
rge fishpond and
e reef.
Projected Sea Level Rise and Impacted Areas
Coastal Flood Zone + 3.2 ft Sea Level Rise
SOURCE: Tetra Tech, Inc. and Sobis, Inc. 2020. Coastal Flood Zones with Sea Level Rise of 3.2 Feet. http://planning.hawaii.gov/gis/download-gis-data/. [Accessed September 1, 2022]
0 100 200 400 600 800 1,000
Feet
N

4.8. East Shore: Residential & Business Example: Pūkoʻo

See: Molokaʻi Sea Level Rise Vulnerability Assessment, Section 3.3.8, pages 142-151.

4.8.1 Location and General Description

- Ownership: Private & State of Hawaiʻi
- Land Zoning: Conservation, Class AA Waters,
- Ahupuaʻa: Pūkoʻo
- Geomorphological Classification: Marsh, Jaucas sand, and Kawaihapai clay loam, moist, 0 to 2 percent sloped (USDA)
- Biological Classification: Uncolonized, Macroalgae (NCCOS, 2007), Estuarine and Marine Wetland (USFWS)

This site includes the low-lying Pūkoʻo area where there is an unfinished marina and a sandy coastline fronting several homes. This entire area is at low elevation, backed by a steep rise in topography, and is at risk of flooding with SLR in addition to the upland flood hazards.

In the early 1970s, sections of the reef flat at Kamalō and Pūkoʻo were dredged for marina development. The Pūkoʻo fishpond was also dredged with some of the excavated material used to alter the shape of the remains of a large fishpond, and some of it discharged onto the reef. However, after the completion of the dredging and accompanying reshaping of the coast in this area, the project was abandoned. Pūkoʻo is zoned by the State of Hawaiʻi as Rural and is within the Special Management Area.

Along the sandy shoreline, there are two placed rock groins. Between them is a pocket beach approximately 300 feet long fronting the privately owned marina (Pūkoʻo Fishpond) parcel. The pocket beach was observed during a site visit to have a crab population living in the beach face and an active dune system.

To the east between one of the groins and Kupeke fishpond is a beach approximately 1,900 feet long that fronts nine privately-owned parcels and an adjacent submerged fishpond. Several of the parcels have erosion scarps along their seaward boundary that vary in height and have been formed by a combination of beach deflation and backshore erosion.

Roots along the shoreline are exposed and trees are leaning seaward. Near where the Pūkoʻo Gulch reaches the shoreline, a pile of rocks has been placed along the shoreline. This beach is accessible by a public access road that leads from Kamehameha V Highway to the beach where there is a canoe hale. The beach and nearshore are used as a boat launch and temporary mooring area.

Figure 3-122: Pūkoʻo shoreline facing west

Upland is the Pūkoʻo Gulch. Rains flow down the hillside in the gulch where they eventually meet Kamehameha V Highway. Instead of a bridge where waters can flow under the highway, the roadway dips down at the Gulch mouth allowing water to flow over it and seaward. When water flows over the road, it may become impassable. Residents try to plan ahead when rain is coming to be on the side of the Gulch where their home is located, but it can be challenging to do so with commutes to and from workplaces, combined with the often sudden onset of heavy rains. Emergency services are cut off from portions of Molokaʻi east of the gulch when these storm events occur. Flow moves across the low-lying Pūkoʻo area seaward where it eventually gets discharged into the ocean.

Pukoʻo River Dip, Jan 29, 2023 (Photo Credit: H. Place)

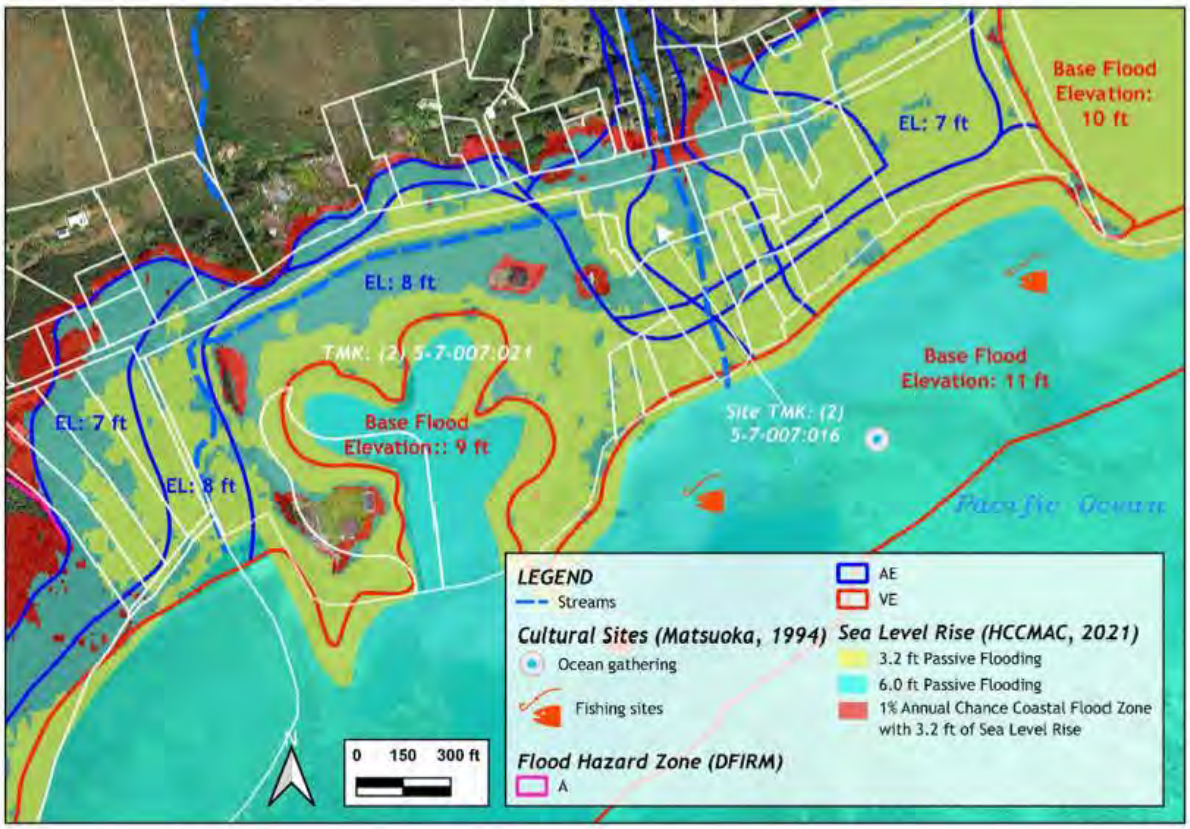
4.8.2 Vulnerability Assessment

Pūkoʻo, is located within the passive flooding area with 3.2 feet of SLR. Pūkoʻo is within flood zone AE with a base flood elevation of seven to nine feet. AE flood zones are areas that present a 1% annual chance of flooding and a 26% chance over the life of a 30-year mortgage, according to FEMA. In 1946, a tsunami produced runup that flooded all areas with an elevation of seven feet Pūkoʻo is within the tsunami evacuation zone.

There are many homes within the impact area that are vulnerable to passive flooding with SLR. In addition, the roadway is at risk of flooding with both SLR and storm rainfall events. The Pūkoʻo fire station is the only fire station east of Kaunakakai and is critical to reducing emergency response time.

As noted previously, this report includes sites such as this to be an example for similar sites. Thus, this site could be utilized for similar east-facing residential properties.

Table 3-10: Pūkoʻo Residential and Business area vulnerability assessment



Moku Kona	**Area** 1.67 acres
Ahupuaa Pūkoʻo	**Ownership** State of Hawaii
Tax Map Key No(s) (2) 5-7-007:016	**Known Cultural Resources** Fishing, ocean gathering, fishponds
Location 156.796251°W, 21.072644°N	**FEMA Flood Zone** AE, 6 to10 foot BFE
Land Zoning Conservation Class AA waters	**Tsunami Hazard** Evacuation zone: shoreline to 0.25 miles inland 1946 Runup Elevation: 7.0 feet
Geomorphological Classification Marsh, Jaucas sand, and Kawaihapai clay loam, moist, 0 to 2 percent slopes (USDA)	**Setback from Vegetation Line** 515 feet (to the fire station) 700 feet (to the highway)
Biological Classification Uncolonized, Macroalgae (NCCOS, 2007) Estuarine and Marine Wetland (USFWS)	**Sea Level Rise Exposure** 3.2' = 33,851 sf (46% of the site) 3.2' + 1% = 72,876 sf (100% of the site) 6.0' = 72,876 sf (100% of the site)
Existing Development Public Beach Access, Canoe Hale, On-site septic systems, Kamehameha V Highway	**Sea Level Rise Hazard Intensity** Medium – Widespread low elevations

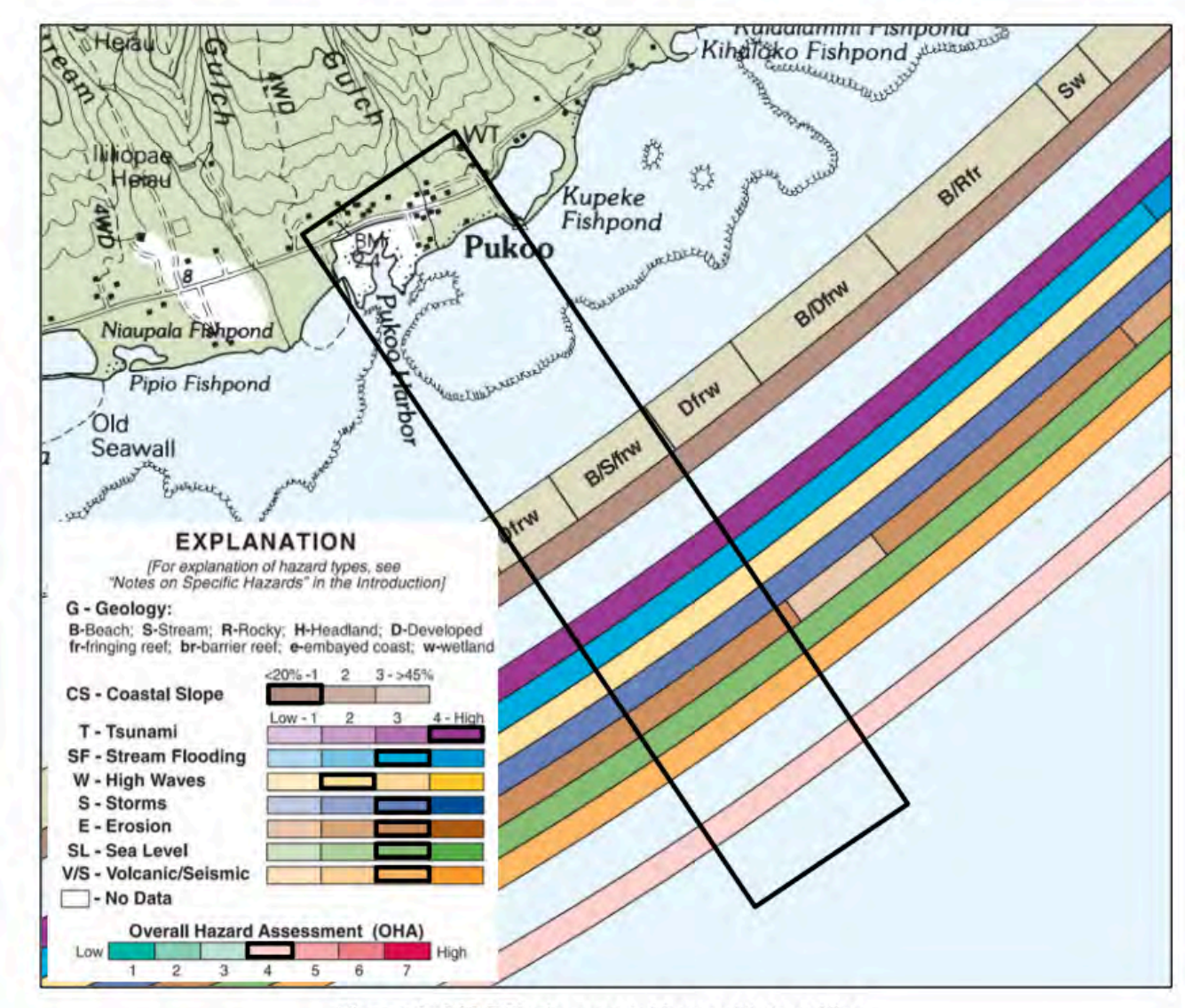


Figure 3-131: Pūkoʻo coastal hazard intensities

4.8.3 Adaptation Needs

The needs within the Pūkoʻo area are housing, emergency services, and transportation services to connect to other resources on Molokaʻi. These basic living needs are essential to support the population there and are difficult to adapt to.

4.8.4 Recommended Adaptation Strategies

SHORT-TERM
● Remove existing seawalls/coastal obstructions and plant and maintain several layers of native vegetation along the shoreline to restore the Dynamic Dune shoreline. Reference the '***Dune Restoration Conceptual Plan for the East Shore of Molokaʻi (Residential Example)***' below. ○ Vegetated berms or coastal dunes can be restored through the planting of appropriate low growing vegetation along the shoreline. This vegetation should include native frontal dune plants that capture and accumulate wind or wave built sand over time, but do not lock up sand in dense root networks, impede coastal processes, or create barriers to access. Plants that are NOT recommended include hau, naupaka, sea grape or any large woody plants. Additionally, plants should not be overwatered. Dune plants only need irrigation for the first 1-3 months after planting in order to become established. Appropriate native plant species include; pohuehue, aki aki grass, akulikuli, nanea, and pohinahina. ○ Dunes build up sand over time, replenish the beach after storms, and then rebuild again over time. They shift and move around, plants are lost and then regrow. ■ A 'green wall' of vegetation is not the preferred approach, but instead an assemblage of low frontal dune plants that build up sand over time. This still allows that sand to be accessible to the active beach during high wave events. ○ See the Hawaiʻi Dune Restoration Manual for additional dune restoration guidance. ● Evaluation of additional sites for wetland restoration to improve community resilience, in coordination with MWP. This will require additional funding as it is beyond the scale of the PI-CASC pilot project. ○ Seek long term funding for design, implementation and management for priority wetland restoration work. ● Public/Private Partnership to clear & maintain spring drainage tunnel out to the ocean front at Public Beach Right-of-way, under private ownership ● Assessment of Existing Structures & Foundation Designs for protections and elevating structures (by Engineering Firm) ○ Including Permitting Processes such as: SMA Minor (includes Molokai Planning Commission Hearing), County Building Permits, Conservation Use District Permit

MID-TERM
● CoM: Fund Engineering Assessment of current drainage & maintenance plan ● Multi agency redesign/maintenance plan(cost share with DOT/COM/Ke Kuaʻaina Hanauna Hou): DOT for along roadways, Ke Kuaʻaina Hanauna Hou for the beginning of the river by road to the tunnel, COM for drainage ● DOT: The road that allows Pūkoʻo Gulch to flow over it could be replaced with a bridge with drainage improvements so that stormwater flow would pass under the Highway and provide continued access to east Molokaʻi during storms for residents and emergency services. ● Restore Fishponds: Pūkoʻo, Pānāhāhā, Kūpeke Fishpond ● Structures and roads and walkways within Pūkoʻo could be elevated to a height that is greater than the projected sea levels to accommodate the rising water table. The ground between structures would become increasingly soggy. Elevated walkways could be used to traverse the inundation zone.

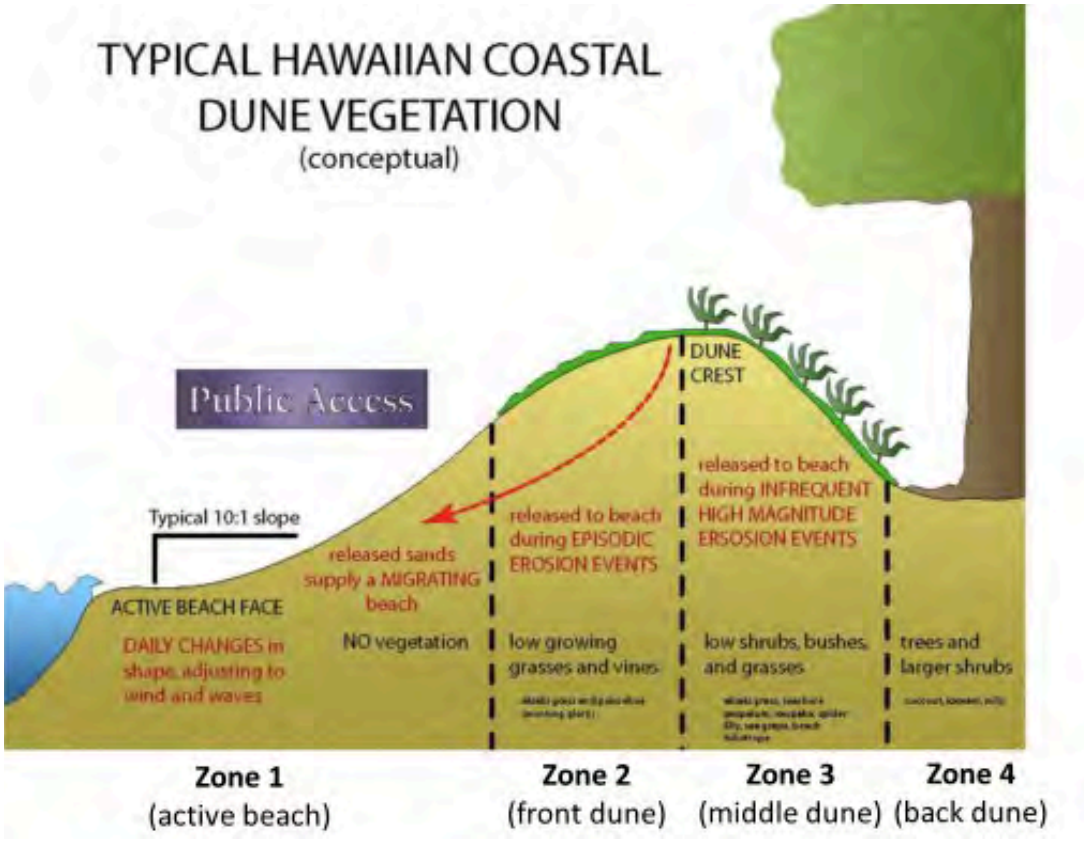
LONG-TERM
• Relocation of the Pūkoʻo community would escape the SLR and upland flooding hazards. Given the size of this neighborhood, finding and funding alternative housing may prove challenging. Chapter 5 on long-term planning discusses potential options for coastal planning and relocation. The following section provides details for a Dune Restoration Conceptual Plan.

Dune Restoration Conceptual Plan for the South Shore of Molokaʻi (Residential Example)
**Currently being updated for East Shore
(Cite: Wes Crile, Hawaiʻi SeaGrant)

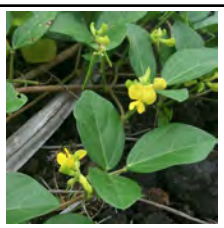
Dunes are an important part of the beach ecosystem, provide a number of ecosystem services, and protect infrastructure from high waves and storm events. Healthy dunes contribute to healthy beaches. Dune restoration areas will be established by:

- Creating dunes approximately 100 ft L x 6 ft W
- Roping off the active dune planting areas to prevent trampling
- Planting appropriate native plants like pōhuehue and ʻakiʻaki grass (see table below)

Plant list
Because the bulk of the site falls within the primary frontal dune, the recommended plant list consists of plants appropriate for this zone of the beach (zones 2 and 3) in the diagram below. The dunes should contain a mix of all of these plants, planted with an 18-inch staggered spacing between them.



Plant List

Picture	Hawaiian Name	Scientific Name	Comment	Zone	Detailed Plant Profile	Spacing between plants
LOW GROWING (grasses, vines, and groundcovers)						
	ʻAkiʻaki	Sporobolus virginicus	A creeping perennial, grows on sandy coasts within reach of the ocean spray making it tolerant of both salt air and hot sun	2	http://nativeplants.Hawaiʻi.edu/plant/view/Sporobolus_virginicus	18”
	Pōhuehue	Ipomoea pes-caprae	A perennial seashore vine, its 2-4 in leaves help trap sand with a pink or light purple flower	2	http://nativeplants.Hawaiʻi.edu/plant/view/Ipomoea_pes-caprae_brasiliensis	18”
	ʻĀkulikuli	Sesuvium portulacastrum	A succulent herb that grows along the ground, it has trailing branches, and its leaves and stems are a fleshy red or green with a white or pale violet flower	3	http://nativeplants.Hawaiʻi.edu/plant/view/Sesuvium_portulacastrum	18”
	Pōhinahina	Vitex rotundifolia	A low lying creeper shrub, it has light green, grayish, or silvery leaves with a blue or purplish flower	3	http://nativeplants.Hawaiʻi.edu/plant/view/Vitex_rotundifolia	18”
	Nanea	Vigna marina	Sprawling vine that can grow to 1ft tall and 8ft wide. Small yellow flowers.	3	http://nativeplants.Hawaiʻi.edu/plant/view/Vigna_marina	18”

Irrigation and maintenance

Dune plants generally only need irrigation initially in order to get established. If planting was timed to coincide with the rainy part of the year, supplemental irrigation needs would be minimal or not needed at all. Maintenance consists of occasional weeding to control invasive species and replacing plants if needed.

5.8.5 Preliminary Cost Estimate

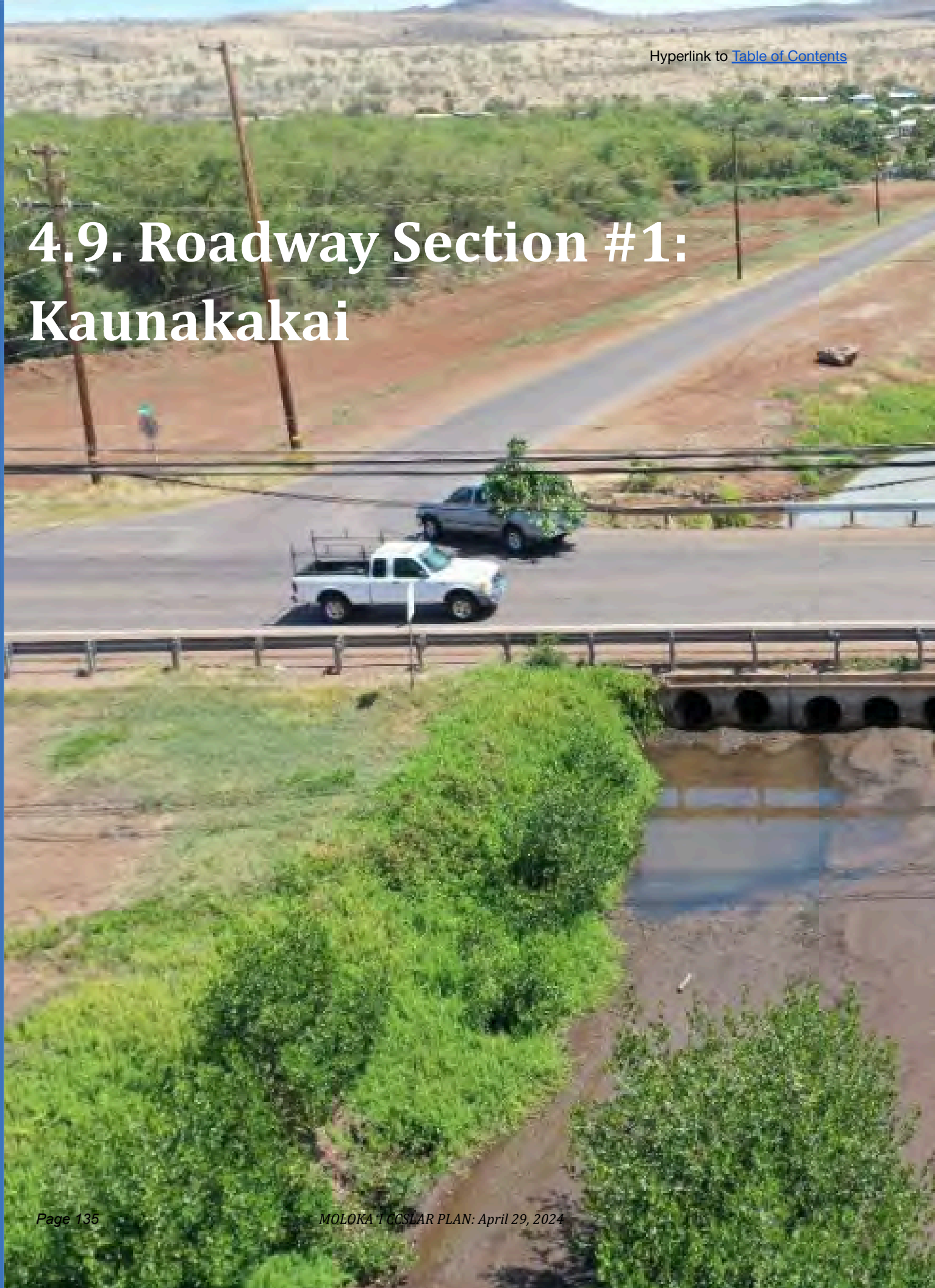
- Below is a budget estimate for establishing a **Dynamic Dune** 100 feet land by 6 feet wide. The budget assumes 18 inch spacing between the plants; 12 or 6 inch spacing can be used if a more finished look is desired sooner. See https://concalculator.com/plant-calculator/ to calculate plant numbers needed for different sizes and plant spacing. Native plant prices are highly variable and often require 8-10 weeks advance notice so that they can be grown specifically for the project.

Item	Unit Cost	# needed	Total	Notes
3 in. treated posts	$ 12.00	9	$ 112.00	Spaced every 12 feet
drip irrigation line	$ 0.20	400	$ 80.00	18 inch spacing
irrigation line staples	$ 0.12	27	$ 3.20	
irrigation fittings	$ 50.00	1	$ 50.00	
pohinahina (4in. Pots)	$ 5.00	200	$ 1,000.00	Planted mauka of the fence
pohuehue (4in.)	$ 6.00	200	$ 1,200.00	evenly dispersed throughout
aki aki grass (2in.)	$ 3.00	200	$ 600.00	evenly dispersed throughout
akulekule (4in. Pots)	$ 5.00	200	$ 1,000.00	evenly dispersed throughout
TOTAL			**$ 4,045.20**	

- **Assessment of Existing Structure & Foundation Designs (by Engineering Firm): $30,000-$100,000**
  - including Permitting Processes such as: SMA Minor (includes Molokai Planning Commission Hearing), County Building Permits, Conservation Use District Permit

Hyperlink to Table of Contents

4.9. Roadway Section #1: Kaunakakai



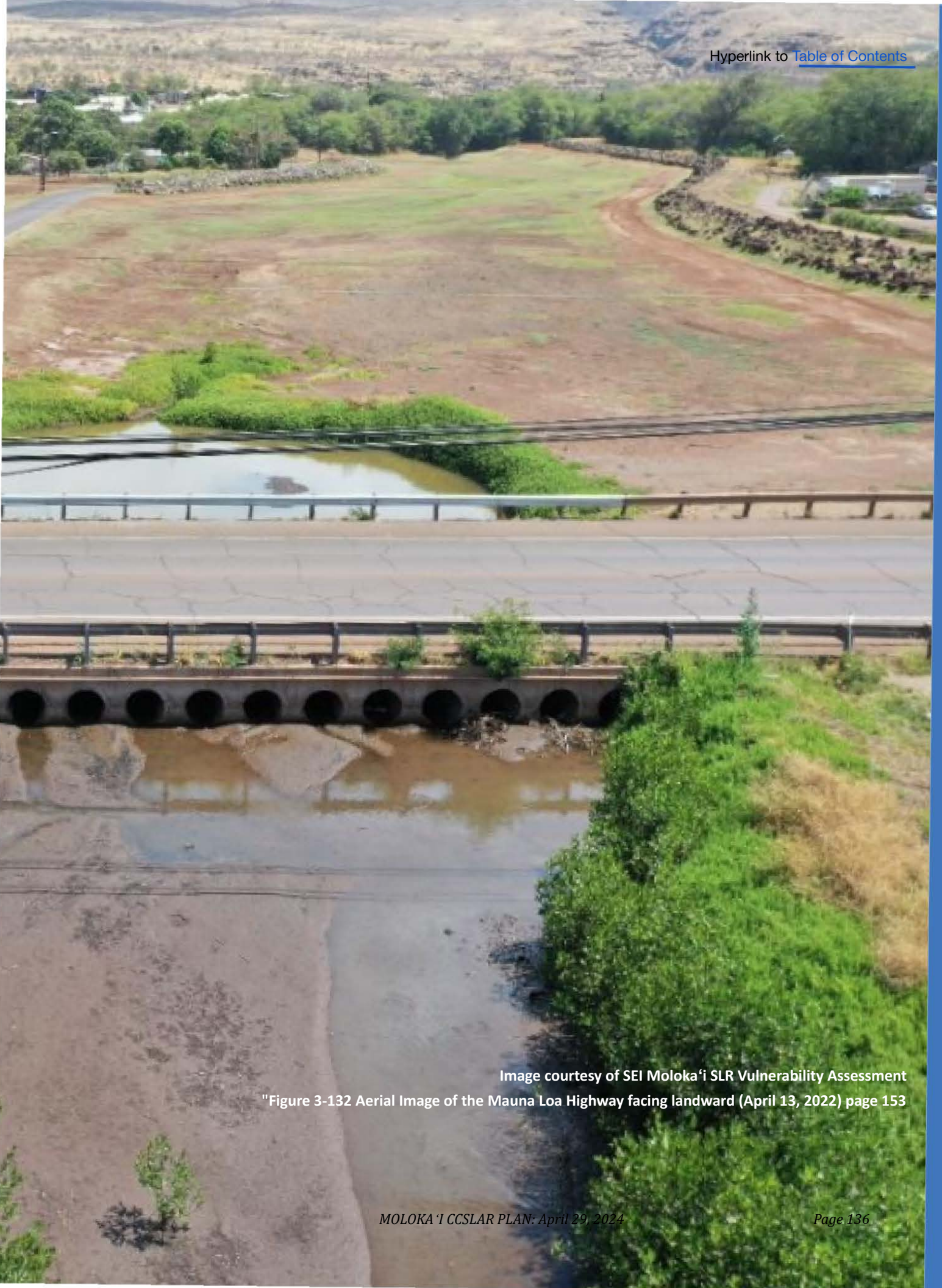
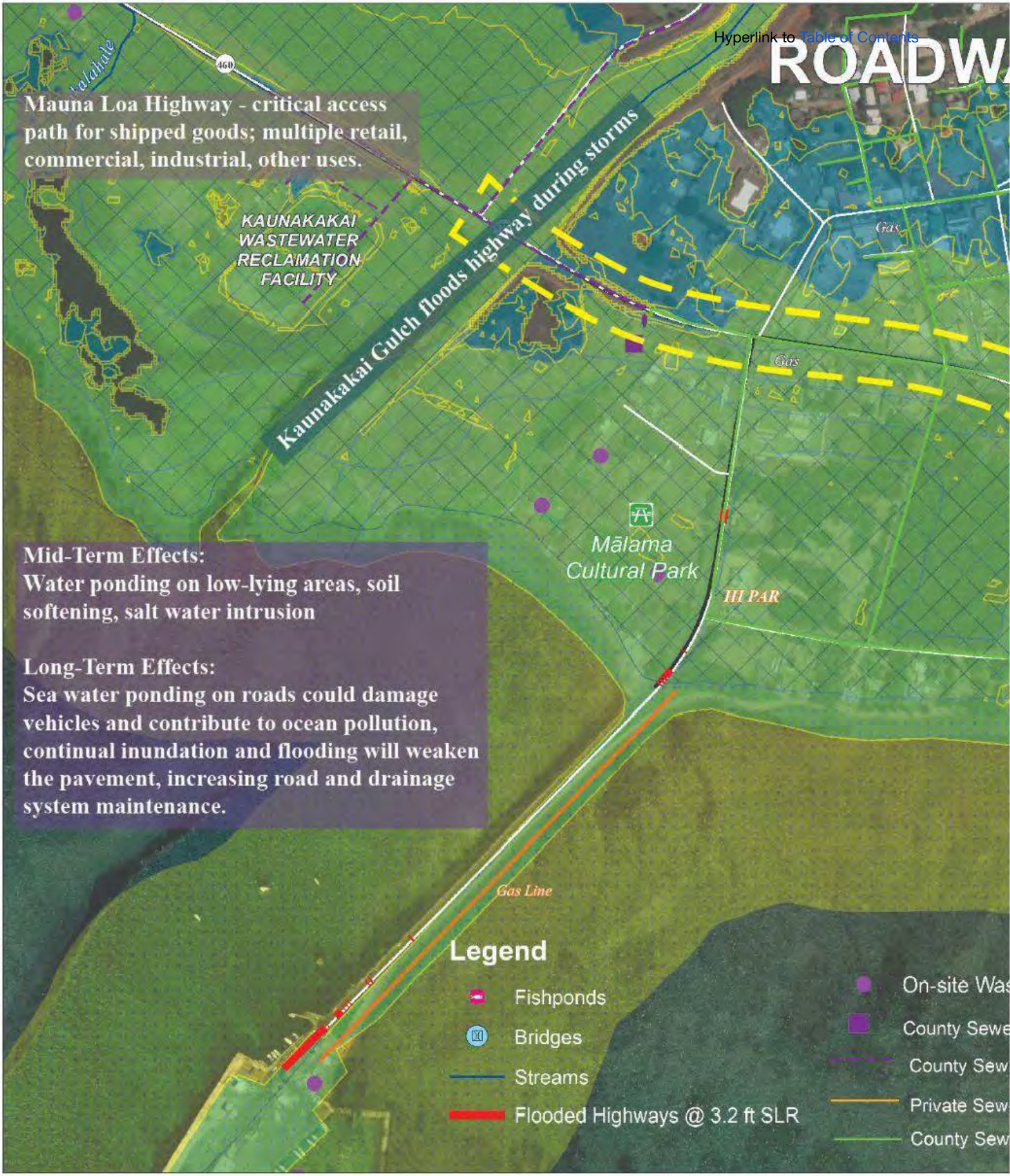


Image courtesy of SEI Molokaʻi SLR Vulnerability Assessment
"Figure 3-132 Aerial Image of the Mauna Loa Highway facing landward (April 13, 2022) page 153


ROADW
Mauna Loa Highway - critical access path for shipped goods; multiple retail, commercial, industrial, other uses.
KAUNAKAKAI WASTEWATER RECLAMATION FACILITY
Kaunakakai Gulch floods highway during storms
Gas
Gas
Mālama Cultural Park
HI PAR
Mid-Term Effects:
Water ponding on low-lying areas, soil softening, salt water intrusion
Long-Term Effects:
Sea water ponding on roads could damage vehicles and contribute to ocean pollution, continual inundation and flooding will weaken the pavement, increasing road and drainage system maintenance.
Gas Line
Legend
Fishponds
Bridges
Streams
Flooded Highways @ 3.2 ft SLR
On-site Was
County Sewe
County Sew
Private Sew
County Sew


WAY SECTION #1: KAUNAKAKAI
Site 9
POLICE STATION
Ho'omana Hou School
Kaunakakai Elementary School
Kaunakakai Headstart B
FIRE STATION
Along Highway: water, wastewater, and power lines, fire hydrants.
Moloka'i Education Center
450
Hawaii Department of Transportation
coastal hazard: LOW
CRESI Rating = 4
Kapu'akea
Kapuaiwa
Kamiloloa Gl
site Wastewater Disposal Systems
nty Sewer Pumps
unty Sewer Pressurized Mains
vate Sewer Gravity Mains
unty Sewer Gravity Mains
Special Flood Zones
A
VE
AE
Coastal Flood Zone
+ 3.2 ft Sea Level Rise
SOURCE: Tetra Tech, Inc. and Sobis, Inc. 2020. Coastal Flood Zones with Sea Level Rise of 3.2 Feet. http://planning.hawaii.gov/gis/download-gis-data/. [Accessed September 1, 2022]
0 200 400 800 1,200 1,600 2,000
Feet
N

4.9. Roadway Section #1: Kaunakakai (Maunaloa Highway/Kamehameha Highway)

See: Molokaʻi Sea Level Rise Vulnerability Assessment, Section 3.3.9, pages 152-160.

4.9.1 Location and General Description

- Ownership: State of Hawaiʻi
- Land Zoning: Urban, Agricultural
- Ahupuaʻa: Kaunakakai
- Geomorphological Classifications: Very Stony Land and Rock Land (NCRS)
- Biological Classification: Freshwater Emergent Wetland (USFWS)

Maunaloa Highway runs through Kaunakakai as the main artery. In 1886, the Hawaiian Government Survey prepared by M.D. Monsarrat shows a government road running east-to-west just mauka the coastline. Today, on the west side of town, the roadway is known as Maunaloa Highway, and on the east side of town, it becomes Kamehameha V Highway. The roadway grants access to many residential, public, and commercial uses that support the island of Molokaʻi.

The shoreline seaward of Maunaloa Highway is classified as an estuarine and marine wetland by the USFWS. The nearshore seafloor is dominated by macroalgae on mud. The waters are classified as Class A west of the wharf and Class AA east of the wharf. At the western end of the study area is Kaunakakai Gulch.

Maunaloa Highway is a critical access path in and out of Kaunakakai where shipped goods are received and the majority of businesses are located. Some uses adjacent to the roadway include Young Brothers shipping yard, Molokaʻi Burger restaurant, Hawaiian Telecom, Paddlers Restaurant, retail and food truck, NAPA auto parts, residences, the Community College, Duke Maliu Regional Park, Kaunakakai Elementary, Kaunakakai Baptist Church, Bank of Hawaiʻi, and a gas station (Figure 3-133; Figure 3-135).

Figure 3-133 Existing uses along Mauna Loa Highway

Maunaloa Highway (Kamehameha V Highway) is managed by the Hawai‘i Department of Transportation (HDOT). Adjacent to the roadway are private, State, County, and DHHL- managed lands. Any alteration to the roadway would require coordination with all of the adjacent landowners. Maunaloa Highway through Kaunakakai is zoned by the State of Hawai‘i as Urban and Agriculture.

The roadway is at a low elevation with water lines, power lines, fire hydrants, and wastewater lines. The HDOT did a coastal hazard analysis for this section of the roadway (Francis, 2019). For coastal hazards, this region ranked low (CRESI Rating of 4) due to the fringing reef providing protection and the amount of land separating the roadway from the shoreline.

All of Maunaloa Highway is within the 6 ft of passive SLR. Models that include the area to be flooded with conditions that occur once per 100 years show even more inundation within Kaunakakai. The coastal area is in the VE flood zone and the roadway is located in the AE flood zone. The area within approximately 0.5 mi of the shoreline is within the tsunami evacuation zone.

Storm events often cause heavy rainfall and an accumulation of water in the Kaunakakai Gulch that flows under the Maunaloa Highway on the west side of Kaunakakai. Water volumes are so great that the roadway becomes submerged and is impassable. Signs have been put up showing the typical waterline to indicate the flooding hazard.

DOT State workers working to clean Maunaloa Hwy, river was impassible: January 2023. (Photo Credit: K. Mokuau)

A coastal hazard atlas for Hawai‘i ranks Kaunakakai as a 3-4 (out of 7) overall hazard (Fletcher, 2002). The atlas is largely based on previous investigations by scientific and engineering researchers and county, state, and federal agencies. The Moloka‘i Island Community Plan includes the identification of 98 acres of land mauka of Kaunakakai as a potential location for relocation.

Heavy rains causes Mauna Loa Highway to be flooded & overtopping of bridge, exceeding culvert height of : January 2023. (Photo credit: K. Mokuau)

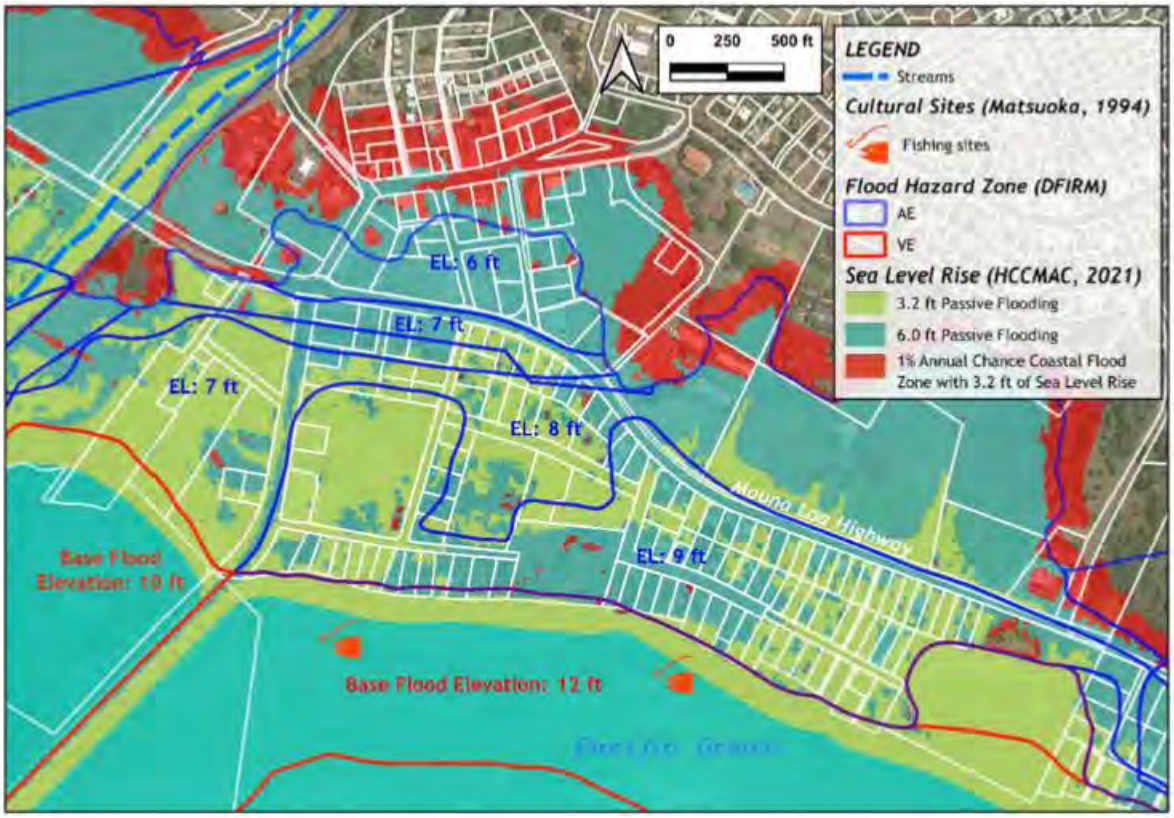
4.9.2 Vulnerability Assessment

Short and mid-term impacts include water ponding in low-lying areas, soil softening, and saltwater intrusion. Projections show that most of the roadway through Kaunakakai town will be flooded with 6.0 feet of passive flooding (Table 3-5).

In the long-term, sea water ponding on the roads could damage vehicles and contribute to ocean pollution. Continual inundation and flooding will make the pavement weak. This will increase road and drainage system maintenance.

It is imperative to note that Inundation Zones are already exceeding the current culvert height of drainage.

Table 3-11: Mauna Loa Highway vulnerability assessment



Moku Kona	**Length** 4,800 feet
Ahupuaa Kaunakakai	**Ownership** State of Hawai‘i
Tax Map Key No(s) (5) 3-005:002	**Known Cultural Resources** Fishing
Location 157.027493°W, 21.090977°N	**FEMA Flood Zone** AE, 7 to 9 foot Base Flood Elevation
Land Zoning Urban, Agriculture	**Tsunami Hazard** Evacuation zone: shoreline to 0.5 miles inland
Geomorphological Classifications Very Stony Land and Rock Land (NRCS)	**Setback from Vegetation Line** 700 feet (to the highway)
Biological Classifications Freshwater Emergent Wetland (USFWS)	**Sea Level Rise Hazard Intensity** Medium – Low elevations
Existing Development HI DOT State Road – Mauna Loa Highway Medical Centers Education Facilities Recreational Facilities	**Sea Level Rise Exposure** 3.2’ = 0 sf (0% of the site) 3.2’ + 1% = 235,050 sf (100% of the site) 6.0’ = 235,050 sf (100% of the site)

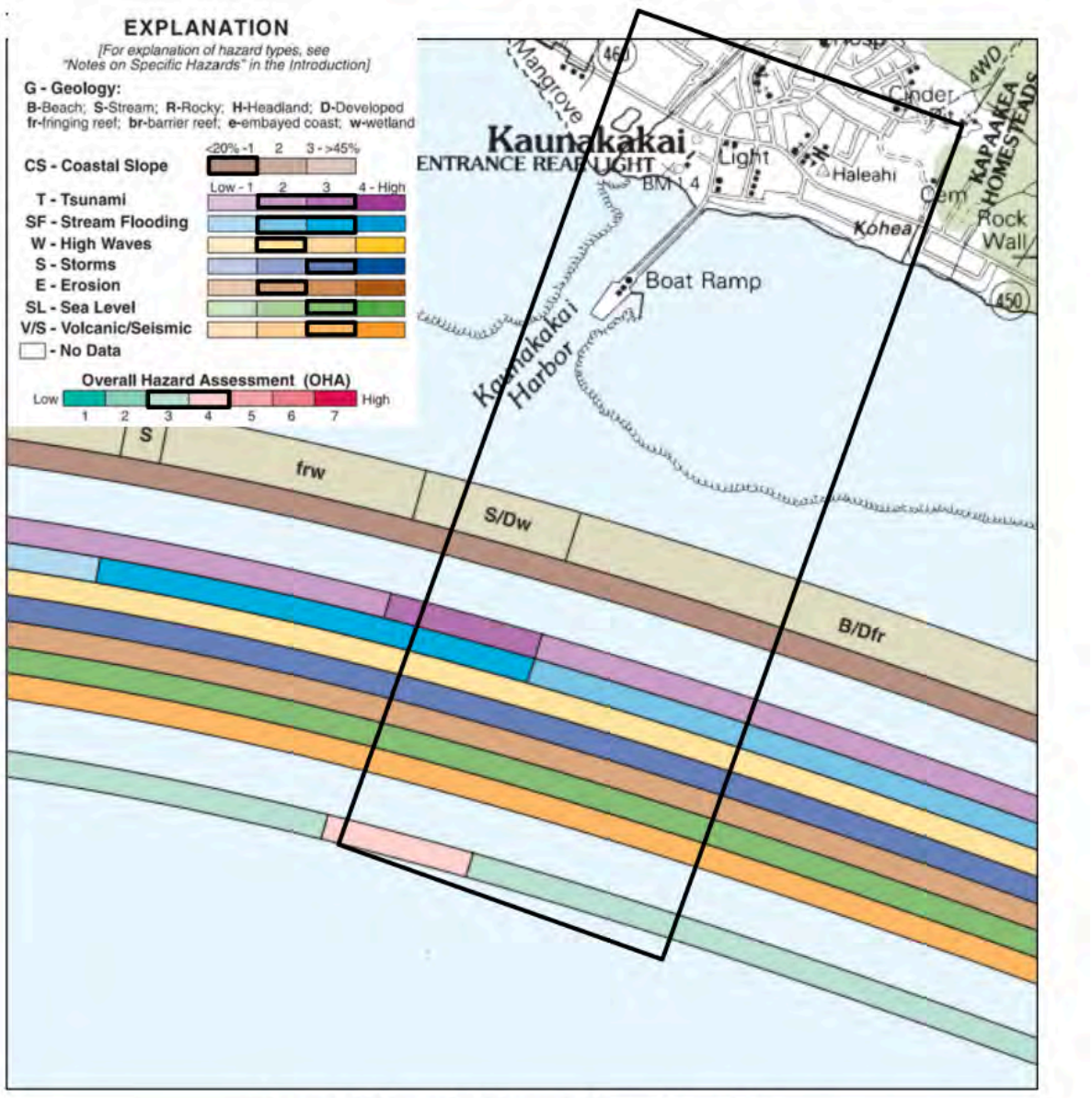


Figure 3-137 Kaunakakai coastal hazard intensities

4.9.3 Adaptation Needs

Roads are a critical link for homes, businesses, and neighborhoods in Kaunakakai. The need is to have transportation services to access the resources within Kaunakakai, provide emergency services, and receive incoming cargo from Kaunakakai Wharf. The existing road could be altered so that it can continue to provide these services, alternative transportation options could be utilized, or the resources within the impact area could follow a long-term managed retreat plan. To address water ponding on roads, the drainage system could be improved. Elevating the highway could be accomplished, but this may not be useful if the surrounding land use that accesses the roadway is not also elevated.

Better floodplain management, ditch management, and watershed management could all reduce the flood hazard at Kaunakakai Gulch that overtops the roadway. To provide an alternative evacuation route for the highway in case the highway or bridge is damaged. One option for evacuation in the short-term could be to improve the river ford crossing. It was also suggested that alternative mauka highway routes be studied including sites for bridge locations. Because there could be negative consequences economically if the highway is moved mauka, the highway through town could remain a 'main street' until maintenance is no longer feasible.

4.9.4 Recommended Adaptation Strategies

SHORT-TERM

• CoM:
  ○ Improve drainage culvert & infrastructure in CoM zone 20‘ to either side of State Highway (culvert) for better floodplain management, Kaunakakai gulch/ditch management
  ○ Development of Conceptual Design of Crossing,
• Wetland Restoration Evaluation, using MWP Online Tool

MID-TERM
• HDOT: Identify as a priority project to elevate the infrastructure and access to infrastructure above the projected inundation levels. • Mauka Restoration along waterway, to hold soil and create less feed.

LONG-TERM
• Watershed & flood management could all reduce the flood hazard at Kaunakakai Gulch that overtops the roadway. Incorporate wetland upper restoration evaluation (MWP).

4.9.5 Preliminary Cost Estimate

All of these options would require a feasibility and cost-benefit analysis to determine the best option. Maunaloa Highway is managed by the State-HDOT. A cost estimator should examine the cost of each adaptation strategy to determine how much funding is needed for implementation.

Rough Cost Estimates provided by: Okahara & Associates, Inc-Dec. 2023:

Conceptual Design (including outreach)

- 6-12 months
- $300,000 - $400,000

EA

- 18-36 months
- $800,000 - $900,000

Design & Permitting of Chosen Alternative

- 24-36 months
- $1,500,000 - $1,700,000

TOTAL

- 4 years - 7 years
- $2,600,000 - $3,000,000

(Detailed breakdown on next page)

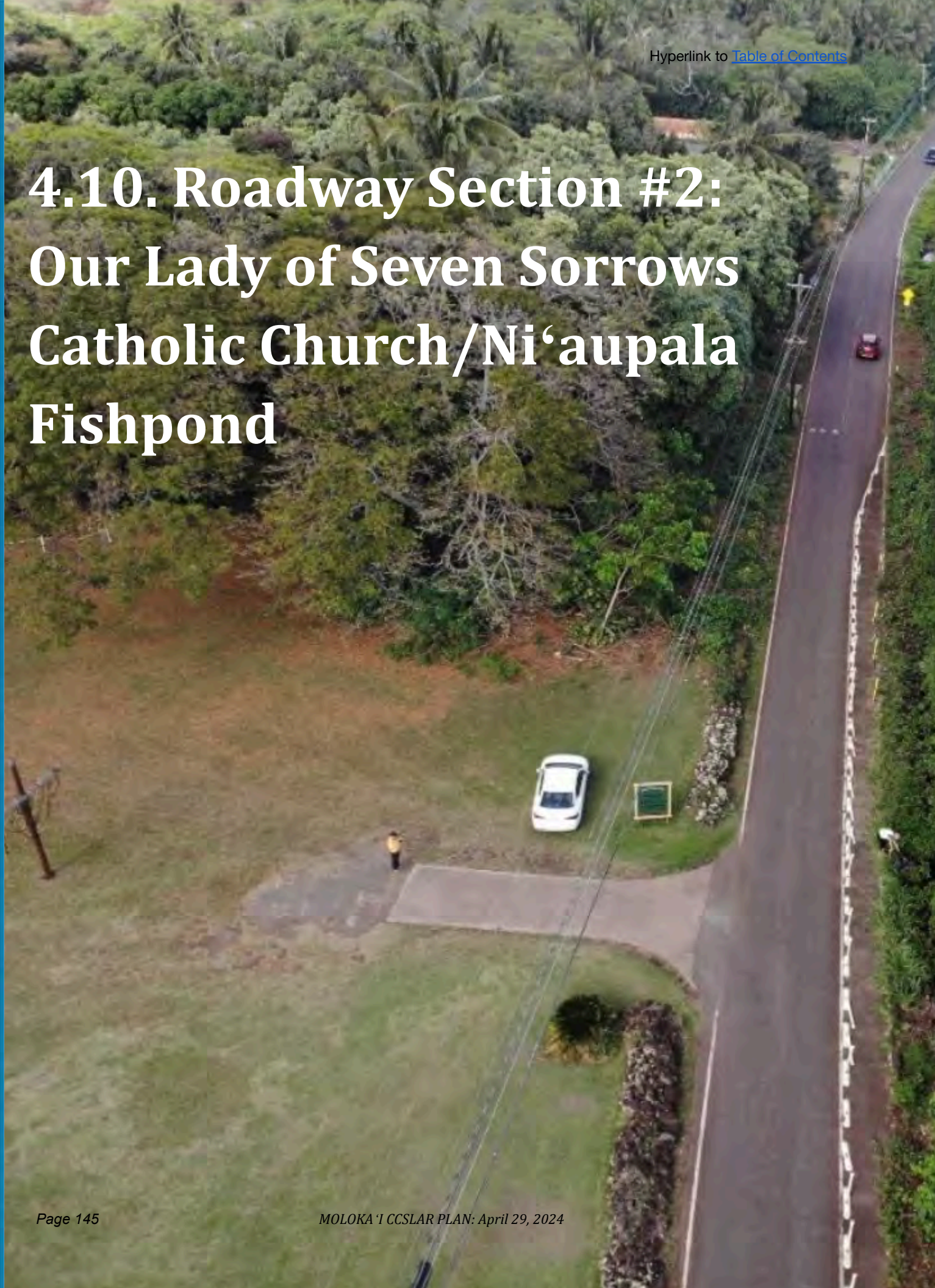
LONG-TERM CONSTRUCTION = $30M - $40M

Detailed Budget Estimate Breakdown:

Maunaloa Highway at Kaunakakai Stream Crossing		Low-range Estimate	High-range Estimate
	Conceptual Design of Crossing (6-12 months)	$300,000	$400,000
	Topographic Mapping		
	Site Reconnaissance		
	Alternative Crossing Concepts in Existing Alignment		
	Preliminary Hydrology and Hydraulic Studies (H&H)		
	Community Outreach		
	Environmental Assessment (1.5-3 years)	$800,000	$900,000
	Flora and Fauna		
	Wetlands		
	Traffic Study		
	Social Economic and Health		
	HAZMAT		
	Air Quality		
	Noise Environment		
	Risk Assessment		
	Public Meetings		
	Draft Publication and Address Comments		
	Obtain Finding of No Significant Impact (FONSI)		
	Design and Permitting of Chosen Alternative (2-3 years)	$1,500,000	$1,700,000
	Civil Design		
	Final H&H Studies		
	Highway Design		
	Reroute Wet Utilities		
	Permits and Approvals		
	Letter of Map Revision - FEMA		
	Corps 404		
	DOH Water Quality Certification		
	Stream Channel Alteration		
	Hawai‘i Department of Transportation Approval		
	SMA		
	Maui County Approvals / Permits		
	Geotechnical Engineering		
	Structural Design Criteria		
	Pavement Justification		
	Structural Design		
	Bridge or Culvert Crossing		
	Electrical Design		
	Reroute Electrical / Communications Utilities		
	Total	**$2,600,000**	**$3,000,000**

Hyperlink to Table of Contents

4.10. Roadway Section #2: Our Lady of Seven Sorrows Catholic Church/Ni'aupala Fishpond



Hyperlink to Table of Contents

4.10. ROADWAY SECTION #2: OUR LADY OF SEVEN SORROWS CATHOLIC CHURCH/NI'AUPALA FISHPOND

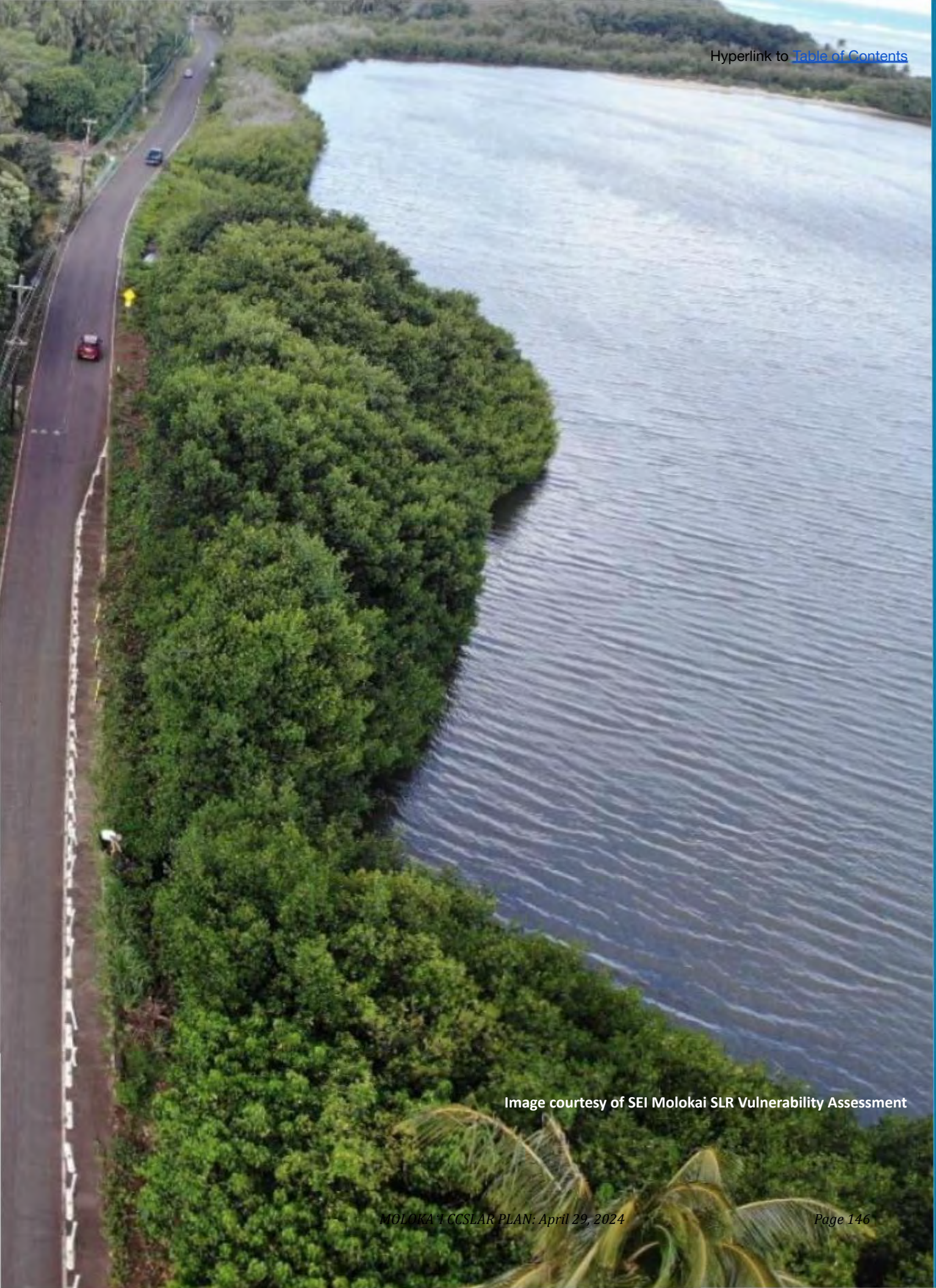
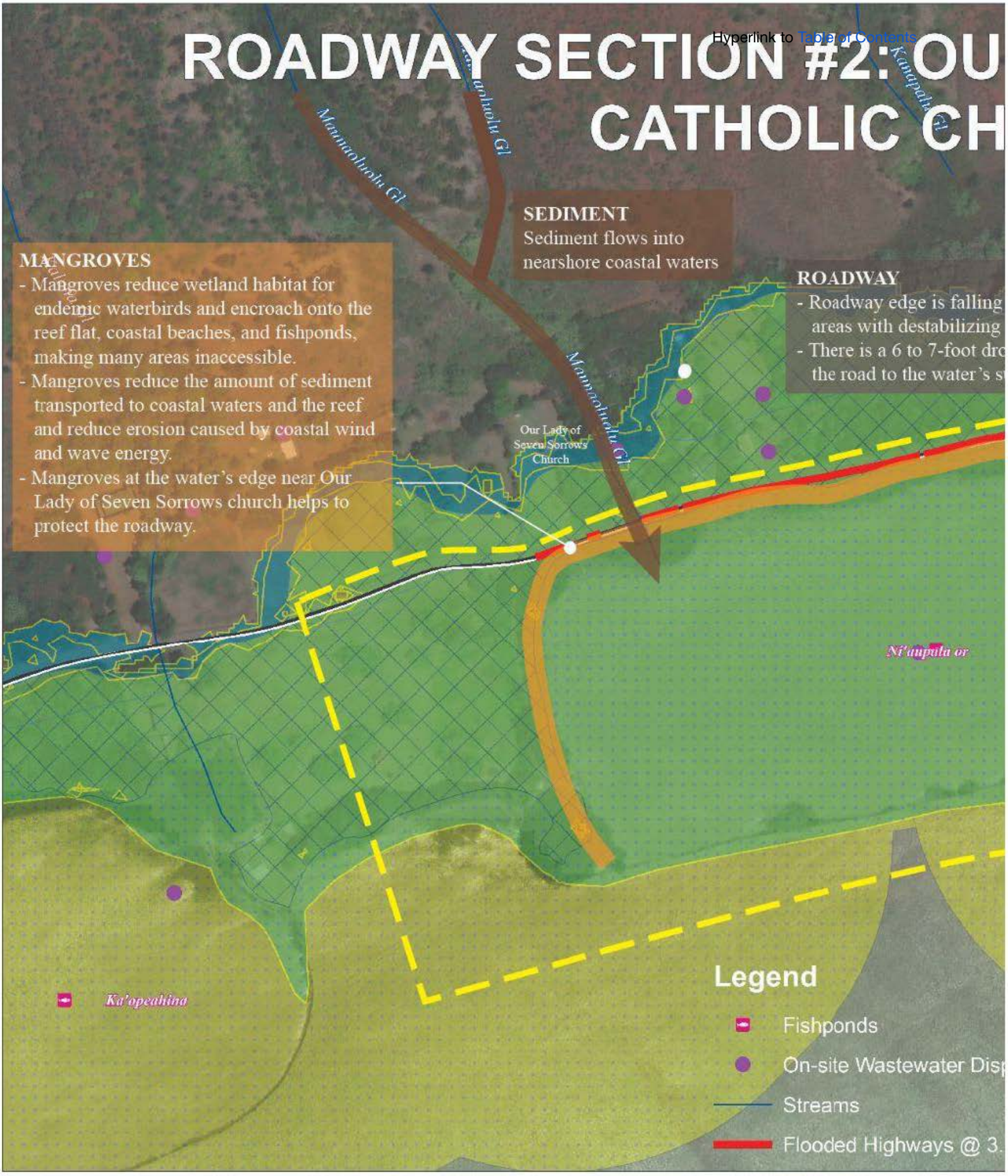
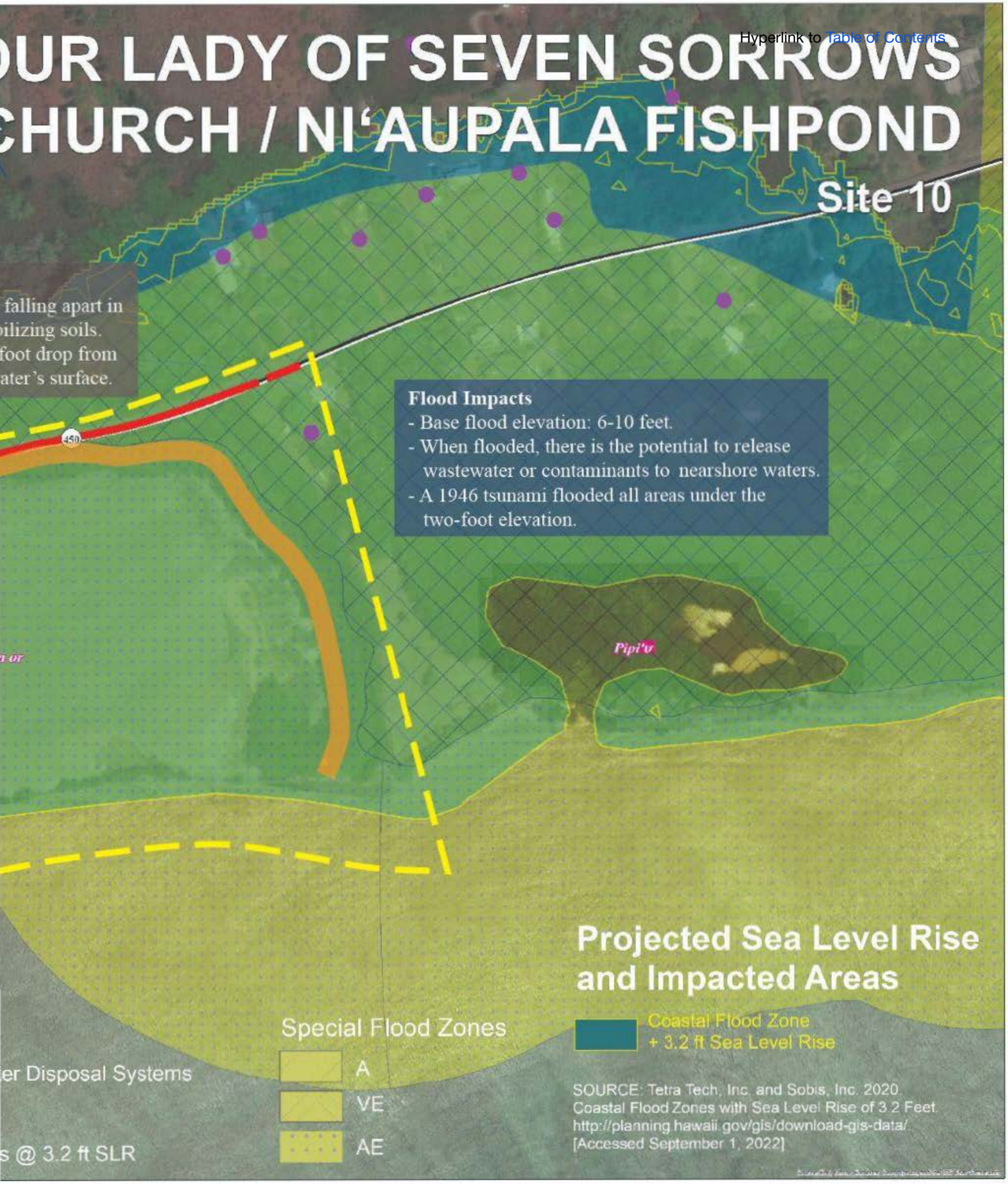


Image courtesy of SEI Molokai SLR Vulnerability Assessment


ROADWAY SECTION #2: OU
CATHOLIC CH
Mamaoholu Gl
Kanapaki Gl
SEDIMENT
Sediment flows into nearshore coastal waters
MANGROVES
- Mangroves reduce wetland habitat for endemic waterbirds and encroach onto the reef flat, coastal beaches, and fishponds, making many areas inaccessible.
- Mangroves reduce the amount of sediment transported to coastal waters and the reef and reduce erosion caused by coastal wind and wave energy.
- Mangroves at the water's edge near Our Lady of Seven Sorrows church helps to protect the roadway.
ROADWAY
- Roadway edge is falling
areas with destabilizing
- There is a 6 to 7-foot dro
the road to the water's s
Our Lady of Seven Sorrows Church
Ni'aupala or
Ka'opeahina
Legend
Fishponds
On-site Wastewater Disp
Streams
Flooded Highways @ 3.


OUR LADY OF SEVEN SORROWS
CHURCH / NI'AUPALA FISHPOND
Site 10
falling apart in
ilizing soils.
foot drop from
ater's surface.
Flood Impacts
- Base flood elevation: 6-10 feet.
- When flooded, there is the potential to release wastewater or contaminants to nearshore waters.
- A 1946 tsunami flooded all areas under the two-foot elevation.
450
Pipi'o
Projected Sea Level Rise and Impacted Areas
Coastal Flood Zone + 3.2 ft Sea Level Rise
Special Flood Zones
A
VE
AE
er Disposal Systems
s @ 3.2 ft SLR
SOURCE: Tetra Tech, Inc. and Sobis, Inc. 2020. Coastal Flood Zones with Sea Level Rise of 3.2 Feet. http://planning.hawaii.gov/gis/download-gis-data/ [Accessed September 1, 2022]
0 100 200 400 600 800 1,000
Feet
N

4.10. Roadway Section #2: Our Lady of Seven Sorrows Catholic Church/Niʻaupala Fishpond

See: Molokaʻi Sea Level Rise Vulnerability Assessment, Section 3.3.10, pages 161-168.

4.10.1 Location and General Description

- Ownership: Private (Roman Catholic Church)
- Land Zoning: Urban, Class AA waters, Conservation
- Ahupuaʻa: Kaluaʻaha, Mapulehu
- Geomorphological Classifications: Kawaihapai clay loam, moist, 0 to 2 percent slopes (USDA)
- Biological Classification: Estuarine and Marine Wetland (USFWS)

Our Lady of Seven Sorrows is a church, built in 1874 by Saint Damien landward of Niʻaupaia Fishpond. In the early 1960s, the church was rebuilt.

Today, the access road to the church is being undermined by coastal erosion. One portion of the roadway has been reduced to one lane (Figure3-138,Figure3-139).

There is a drop off from the edge of the road of approximately 5.75 to 7 feet to the water in a fishpond (Figure 3-140 - Figure 3-142). Much of the shoreline is lined with mangroves (Figure3-143). The soil under the road is muddy sand that erodes during extreme events. The USDA classifies the soil as Kawaihapai clay loam, moist, with 0 to 2 percent slopes (Figure 3-144)

Figure 3-141 Our Lady of Seven Sorrows water at the one-lane road edge with a 5.75-foot erosion scarp down to the water surface

In 1902, mangroves (*Rhizophora mangle*) were introduced by the American Sugar Company to stabilize the coastal mudflats in south-central Molokaʻi and hold back the soil washed down by heavy rains into the ocean (Allen, 1998). Mangroves are salt-tolerant, woody plants that grow on island shores and along low-relief coastlines. Regarded as land builders and known for their ability to promote sedimentation in coastal settings. Mangroves trap sediment being transported seaward, thereby reducing water turbidity and decreasing the amount of sediment flowing into adjacent coastal ecosystems.

Water flow is decreased in the vicinity of the extensive aerial root systems, allowing silt (fine-grained terrigenous sediment) to deposit. The high abundance of microbial communities within mangrove forests also plays an important role in trapping and binding sediment, as fine particles settling out from reduced water velocity are aggregated and mineralized by biological activity (Alongi and McKinnon, 2005). Increased water salinity, the presence of anaerobic substrates, high-energy wave action, and frequent tidal inundation are all factors that contribute to the severe nature of the mangrove environment.

Their ability to survive in these relatively adverse conditions sets mangroves apart from other plant species and allows them to occupy a niche within the coastal zone where they have little to no competition among other plants.

Since its introduction, the mangrove has migrated eastward taking over much of the South Moloka'i coastline. In doing so, it has reduced the area of wetland habitat important for endemic waterbirds, and it has also encroached onto the reef flat, coastal beaches, and fishponds inhibiting lateral access. Despite these negative outcomes, mangroves have reduced the amount of sediment that is transported from the watershed to coastal waters and the reef. It has also reduced erosion caused by coastal wind and wave energy (Roberts and Field, 2008).

The Our Lady of Seven Sorrows area is zoned by the State of Hawai'i as Rural and is fronted by a fishpond that is zoned as Conservation. The fishpond is within the Conservation District management area. The entire coastline is within the Special Management Area.

Figure 3-140 7-foot erosion scarp along roadway edge near Our Lady of Seven Sorrows

Figure 3-144 Kawaihapai clay loam the mangroves are growing in

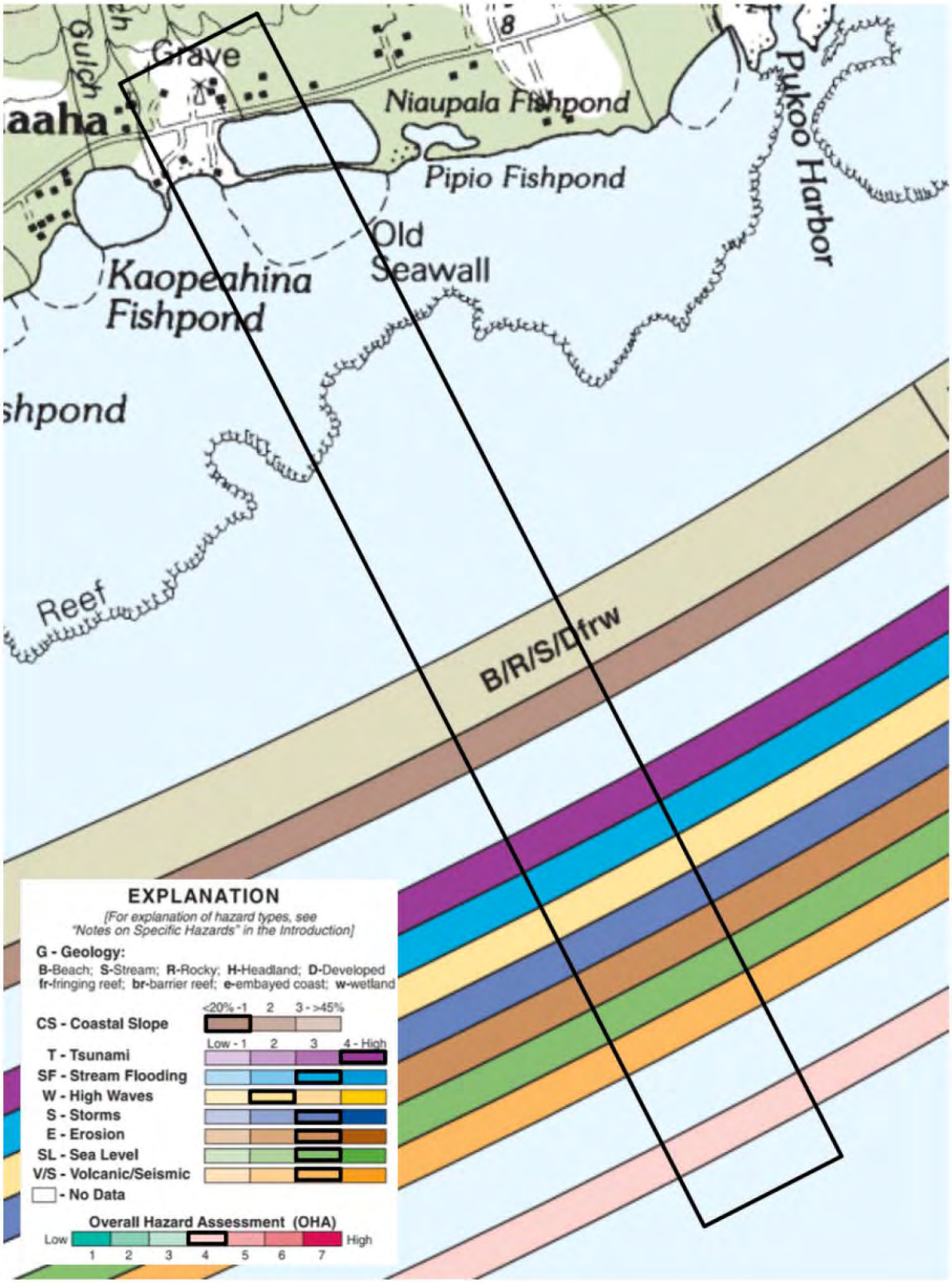
4.10.2 Vulnerability Assessment

With 3.2 feet of SLR, Kamehameha V Highway behind Niʻaupala Fishpond would be submerged under passive flooding. This highway is the only access road to east Molokaʻi and is therefore critical infrastructure. An erosion scarp along the edge of the Highway has already formed and the stability of the road is diminishing as evidenced by the reduction to a one-lane road. A DOT Highways roadway vulnerability study ranked this portion of the road as having one of the highest CRESI scores (37). The topography of the road increases sharply, reducing the availability of adaptation strategies.

"Heavy Rains causes flooding at Our Lady of Seven Sorrows Catholic Church"
January 2023. (Photo credit: H. Place)

Table 3-12 Our Lady of Seven Sorrows vulnerability assessment

Figure 3-145 Our Lady of Seven Sorrows coastal hazard intensities



4.10.3 Adaptation Needs

The need in this area is transportation services to east Molokaʻi. Currently, this need is satisfied with vehicle access across a paved roadway. Potential future methods are vehicle access along an altered roadway, ferry vehicle access across the hazardous area, or boat access. Adaptation strategies should consider response time by emergency services and other goods and services that east Molokaʻi may need access to.

4.10.4 Recommended Adaptation Strategies

A protection adaptation strategy in this area would need to be implemented on a large scale to be effective and perhaps coupled with other strategies. By hardening the edge of the roadway with a seawall, revetment, or structures for this low wave energy environment, the undermining of the road would cease. Protection could also be implemented further seaward by enhancing the Fishpond wall. If the wall elevation were raised and a closed system, water elevations within the pond could be controlled, like a levee. The Fishpond wall is exposed to ocean waves and currents so any hard protection would need to be built with durable materials.

An accommodation adaptation strategy within this narrow strip of coastline between the steep rise in elevation and the Fishpond could be raising the road over the SLR hazard. An elevated roadway would provide the freedom to relocate the road seaward, if desired, from its current position. An elevated roadway could be built wider if desired including bike lanes or pedestrian paths. In addition to the Our Lady of Seven Sorrows church, there are residences in this neighborhood. To continue to provide transportation access to these parcels, if they continue to be used, sloped driveways down from the new Highway would need to be considered. There would also need to be engineering design considerations to prevent the elevated roadway from acting like a dam during heavy rains, preventing water from draining seaward, and flooding the parcels mauka of the roadway that are not elevated.

Relocation as an adaptation strategy is limited in this area due to how narrow the strip of land is between the Fishpond and the steep incline backing the shoreline. The road could potentially move up the incline to a higher elevation with substantial construction costs. This would not solve the problem entirely as transportation access would still need to be provided to users along the shoreline.

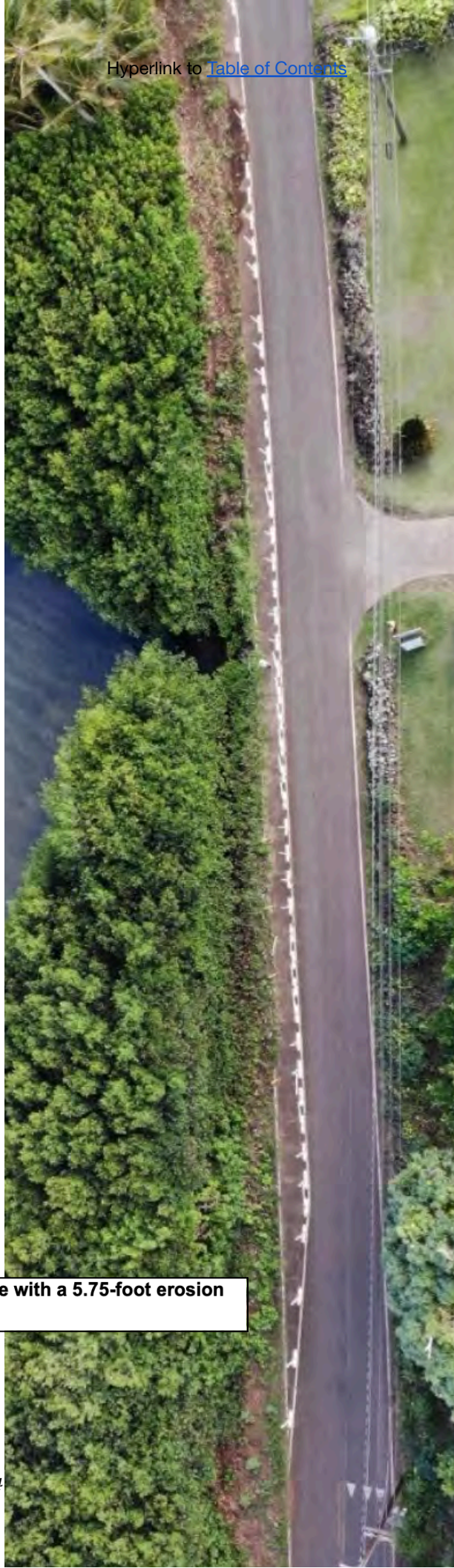


Figure 3-141 Our Lady of Seven Sorrows water at the one-lane road edge with a 5.75-foot erosion scarp down to the water surface

4.10.4 Recommended Adaptation Strategies

SHORT-TERM
● Relocation as an adaptation strategy is limited in this area due to how narrow the strip of land is between the Fishpond and the steep incline backing the shoreline. ● Under DOT Scope of Work: ○ Restoring the highway to a 2-lane highway. ■ Update of progress: ● October 27, 2023, Board of Land and Natural Resources Meeting: Request Authorization to Acquire Land for Temporary Use by the Department of Transportation, for Highway Purposes, Relating to Route 450 Kamehameha V Highway Shoreline Protection at Niaupala Fishpond Project No. HWY-L-CE19-01, PAO 7 at Kaluaaha, Molokaʻi, Maui, Hawaiʻi Tax Map Key No. (2) 5-7-011:002 ● Approved with the following questions: ○ Q: What impacts are anticipated to the fishpond? ○ A: HDOT does not want to touch the fishpond. This is a short-term road project. There will be a long-term project later. BLNR recommends HDOT do more consultations with the fishpond owners and users of the fishpond. ○ Q: What best management practices will be used to contain dust and debris from the project site to prevent impacts to the fishpond? ○ A: There will be something to filter any runoff to the fishpond. ○ Q: Has this been published in the local paper? ○ A: BLNR recommends publishing a map of the work area and give the community an opportunity to contact HDOT with any questions. ● Published in the Molokaʻi Dispatch for comments

LONG-TERM
● Relocation of the road up the incline to a higher elevation, with substantial construction costs and imminent domain acquisitions. This would not solve the problem entirely as transportation access would still need to be provided to users along the shoreline.

4.10.5 Preliminary Cost Estimate

A cost estimator should examine the cost of each adaptation strategy to determine how much funding is needed for implementation. Any cost incurred would be within State/DOT's jurisdiction.

Hyperlink to Table of Contents

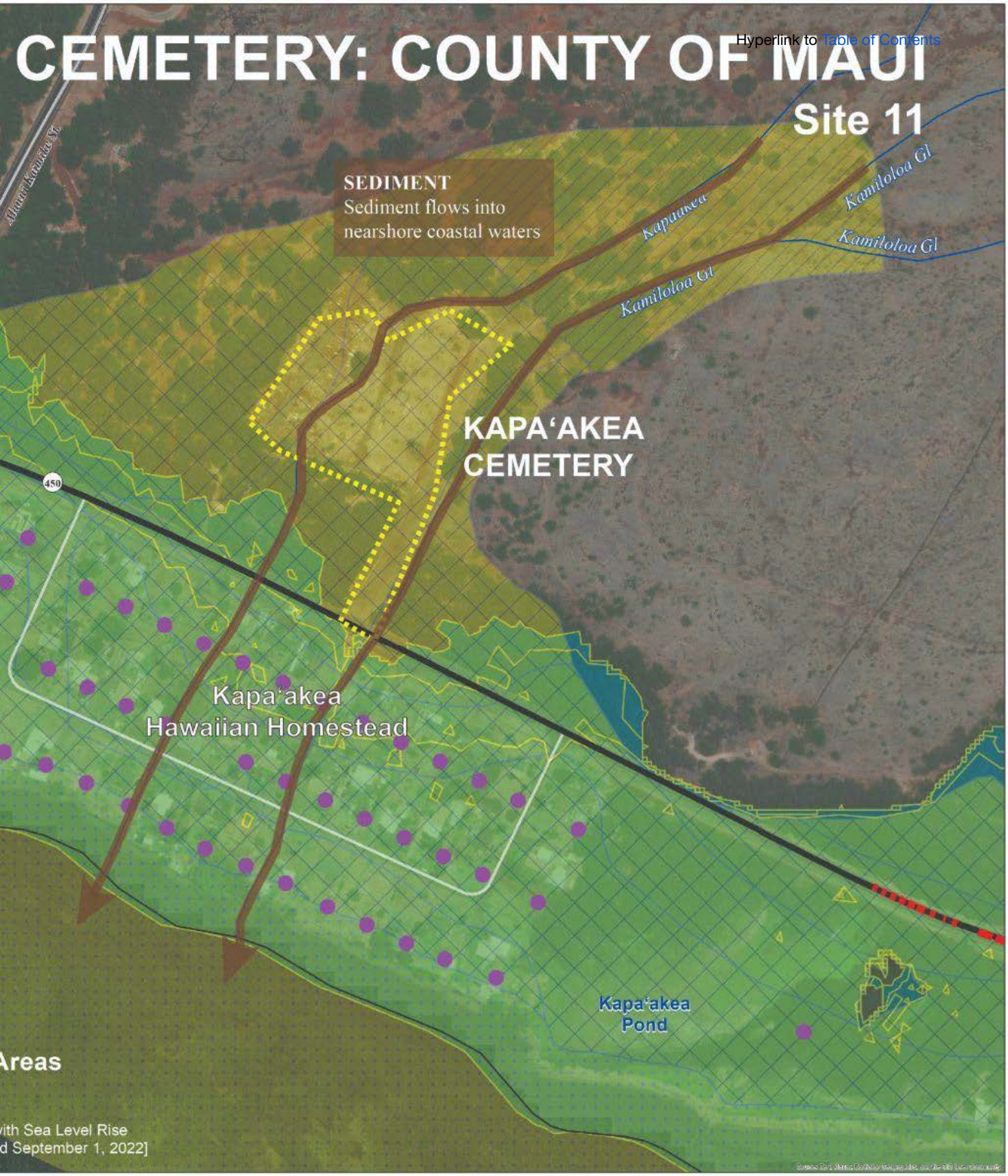
4.11. Kapa‘akea Cemetery: County of Maui

4.11. KAPAʻAKEA CEMETERY: COUNTY OF MAUI

Image courtesy of SEI Molokai SLR Vulnerability Assessment
"Figure 3-146 Kapaʻakea Cemetery facing southwest (july 7, 2023) page 169

MOLOKA'I CLIMATE CHANGE AND SEA LEVEL RISE ADAPTATION AND RESILIENCY MASTER PLAN

December 2023


CEMETERY: COUNTY OF MAUI
Site 11
SEDIMENT
Sediment flows into nearshore coastal waters
Kapaunea
Kamiloloa Gl
Kamiloloa Gl
Kamiloloa Gl
KAPA'AKEA CEMETERY
450
Kapa'akea Hawaiian Homestead
Kapa'akea Pond
Areas
ith Sea Level Rise
d September 1, 2022]
0 125 250 500 750 1,000
Feet
N

4.11. Kapaʻakea Cemetery: County of Maui

See: Molokaʻi Sea Level Rise Vulnerability Assessment, Section 3.3.11, pages 169-174

4.11.1 Location and General Description

- Ownership: County of Maui
- Land Zoning: Agriculture
- Ahupuaʻa: Kapaʻakea
- Geomorphological Classifications:
  Mala silty clay, 0 to 3 percent slopes (USDA)
- Biological Classification: N/A

Kapaʻakea Cemetery is located about 0.75 miles east of Kaunakakai Town on the mauka side of Kamehameha V Highway. The cemetery itself is approximately 300 feet from the highway, accessible by a gravel road, and spans an area of 4.1 acres. (Figure 3-146). More than 200 memorials are located at Kapaʻakea Cemetery, and water is accessible at or near each burial site to water flowers and plants.

The surrounding Kapa'akea ahupuaʻa up to the Forest Reserve line is owned by DHHL. To the east of Kapaʻakea Cemetery is Kamiloloa Gulch. Kapaʻakea Stream bisects the cemetery grounds on occasion. Three upland watersheds, including Kapaʻakea Stream, feed into Kamiloloa Gulch, which flows to the ocean. There are drainage pipes that allow flow from the Stream and Gulch to pass under Kamehameha V Highway to ditches that lead to the ocean. (Figure 3-150).

Near where Kamiloloa Gulch intersects with the Highway, there is a sign for a buried fiber optic cable.

Figure 3-146. Kapaʻakea Cemetery facing southwest (July 7, 2023)

Mauka of roadway: Kapa‘akea River, March 2023, B. Mowatt

Makai of roadway: Kapa‘akea River March 2023, B. Mowatt

The Kapa‘akea Cemetery was recently impacted by a flash flood event that ran through the cemetery and homestead properties at Kapa‘akea. Thus, the impact is not just sea level rise, but also storm event mauka flooding. The short-term mitigation strategy needs to include water diversion strategies and/or passive water harvesting to direct water away from cemetery and nearby residences. We then need to adopt a long-term strategy, which may involve relocation of burials.

Figure 3-150. Drainage pipes to carry flow under Kamehameha V Highway mauka to makai.

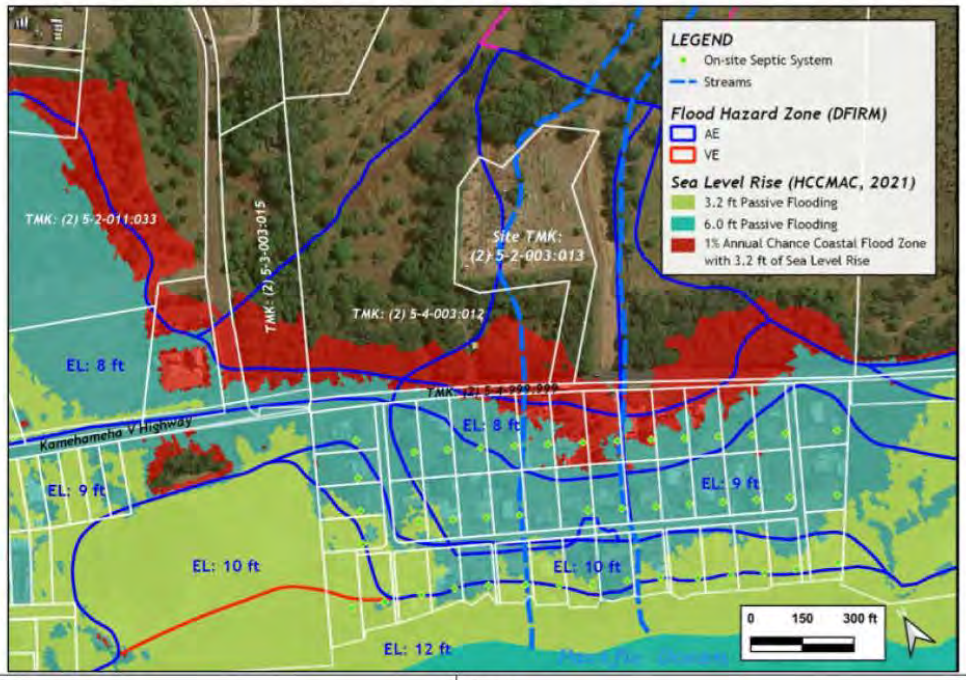
4.11.2 Vulnerability Assessment

The Kapa‘akea Cemetery is located within the AE FEMA Flood Hazard Zone (SE flood zones are areas that present a 1% annual chance of flooding and a 26% chance over the life of a 30-year mortgage). The roadway entrance to the cemetery is within 1% Annual Chance Coastal Flood Zone with 3.2 ft of SLR. There is a fiber optic cable near the roadway serving as critical infrastructure. If the roadway becomes submerged with sea level rise, the fiber optic cable may also become submerged. While the Kapa‘akea Cemetery may be set back from the shoreline and relatively removed from direct ocean-related SLR impacts, Kamiloloa Gulch to the west of the site is vulnerable to decreased drainage capacity as the ground becomes increasingly saturated with groundwater with sea level rise.

4.11.3 Adaptation Needs

The Kapa‘akea Cemetery is nearly at capacity and will stop being a destination for new burials. The cemetery is an important site to the Moloka’i community as it allows residents to honor community members who have passed away. Residents will need to maintain access to the site and may need to adapt the driveway entrance to the property as sea level rises.

Table 3-13 Kapa‘akea Cemetery vulnerability assessment



Moku Kona	**Area** 4.1 acres
Ahupua’a Kapa‘akea	**Ownership** State of Hawai‘i
Tax Map Key No(s) (2) 5-7-003:013	**Known Cultural Resources** Burial grounds
Location 157.0099720°W, 21.0854408°N	**FEMA Flood Zone** AE, uncharacterized BFE
Land Zoning Agriculture	**Tsunami Hazard** Evacuation zone: Kamehameha V Hwy to 0.15 miles inland 1946 Runup Elevation: 2.0 feet
Geomorphological Classification Mala silty clay, 0 to 3 percent slopes (USDA)	**Setback from Vegetation Line** 675 feet (to the Kamehameha V Hwy boundary of parcel)
Biological Classification N/A	**Sea Level Rise Exposure** 3.2’ = 0 sf (0% of the site) 3.2’ + 1% = 5,328 sf (3% of the site) 6.0’ = 0 sf (0% of the site)
Existing Development Waterline infrastructure, drainage pipe, culvert at Kamehameha V Hwy entrance	**Sea Level Rise Hazard Intensity** Low – Removed from vicinity of shoreline and projected SLR-induced hazards

4.11.4 Recommended Adaptation Strategies

SHORT-TERM
● CoM: Public Works, Office of Councilmember Rawlins-Fernandez, Parks & Recs & Mortuary Service (Buchannan‘s) Site Selection Study to identify a new county cemetery, relocate any unused plots to the new cemetery, as a gathering, community space so burials of current plots are redirected to a new location. ● CoM: Parcel Boundary should be re-surveyed, per the erosion. ● Site Incorporation into DHHL Coastal Homestead Resiliency Plan ○ Updated Soils & Drainage Engineering Study and Needs Assessment ■ To determine options, including possibly widening the Kamiloloa Gulch or increasing the elevation of the channel walls to accommodate water flow during storm events and evaluation of storm water runoff around the site from the 3 rivers above. ○ Flood Mitigation Mauka & in relationship to Cemetery, Homesteads and adjacent Wetland ○ Plantings for Revitalization of Soil & Build a vegetated, elevated berm along the perimeter of the cemetery to serve as a protective wall from the Kamiloloa Gulch flow. ■ Conduct removal of invasive species: Kiawe Trees, etc. ■ Replace with Native plants that help to hold soil, mitigate flooding and will lengthen the timeline for mid and long term strategies to be implemented

MID-TERM
● Conduct additional Cemetery Mapping & Updating Database to include inventory and Cultural Overlays, including ‘Ohana and contacts ○ Additional cemetery mapping of the cemetery and updating database to include cultural overlays and ‘ohana contacts is in alignment with KIM’s strategic priority to: Develop infrastructure to strengthen community preservation of heritage resources. ○ Mapping the cemetery and creating a database of ‘ohana contacts is a foundational element for future planning of Kapa‘akea Cemetery. The mapping will allow us to spatially identify boundaries that will be impacted by climate change. The contact database will further provide a baseline for stakeholder engagement and consultation. ○ Assessment of Kaunakakai by the Coastal Hydraulics Engineering Lab at the University of Hawai‘i at Manoa, as a part of the Maui County Coastal Roads Report ● Landowner (CoM) & ‘Ohana/Descendants create a Preservation & Design Plan together, utilizing the Cemetery Mapping Database and Inventory & Cultural Overlays ● Preservation & Design Plan contract with expert consultants.

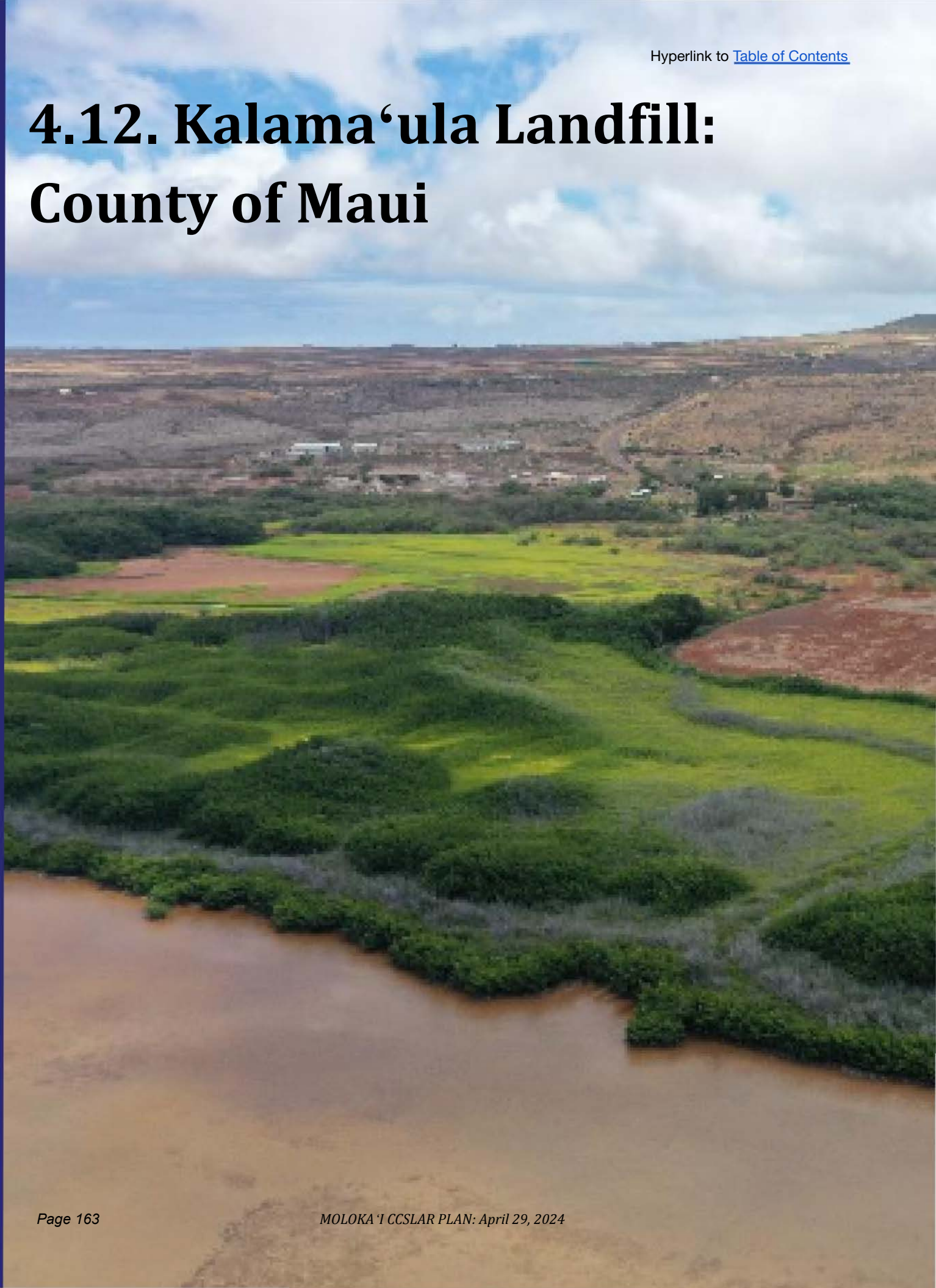
LONG-TERM
● Develop Burial Management Plan ● Relocate the access road to the mauka edge of the cemetery, raise the existing road, or alter the road type to accommodate sea level rise.

4.11.5 Preliminary Cost Estimate

- CoM Parcel Boundary: Re-survey: **$5,000**
- Updated Soils & Drainage Engineering Study and Needs Assessment: In process under DHHL
- Site incorporation into DHHL Coastal Resiliency Plan: n/a

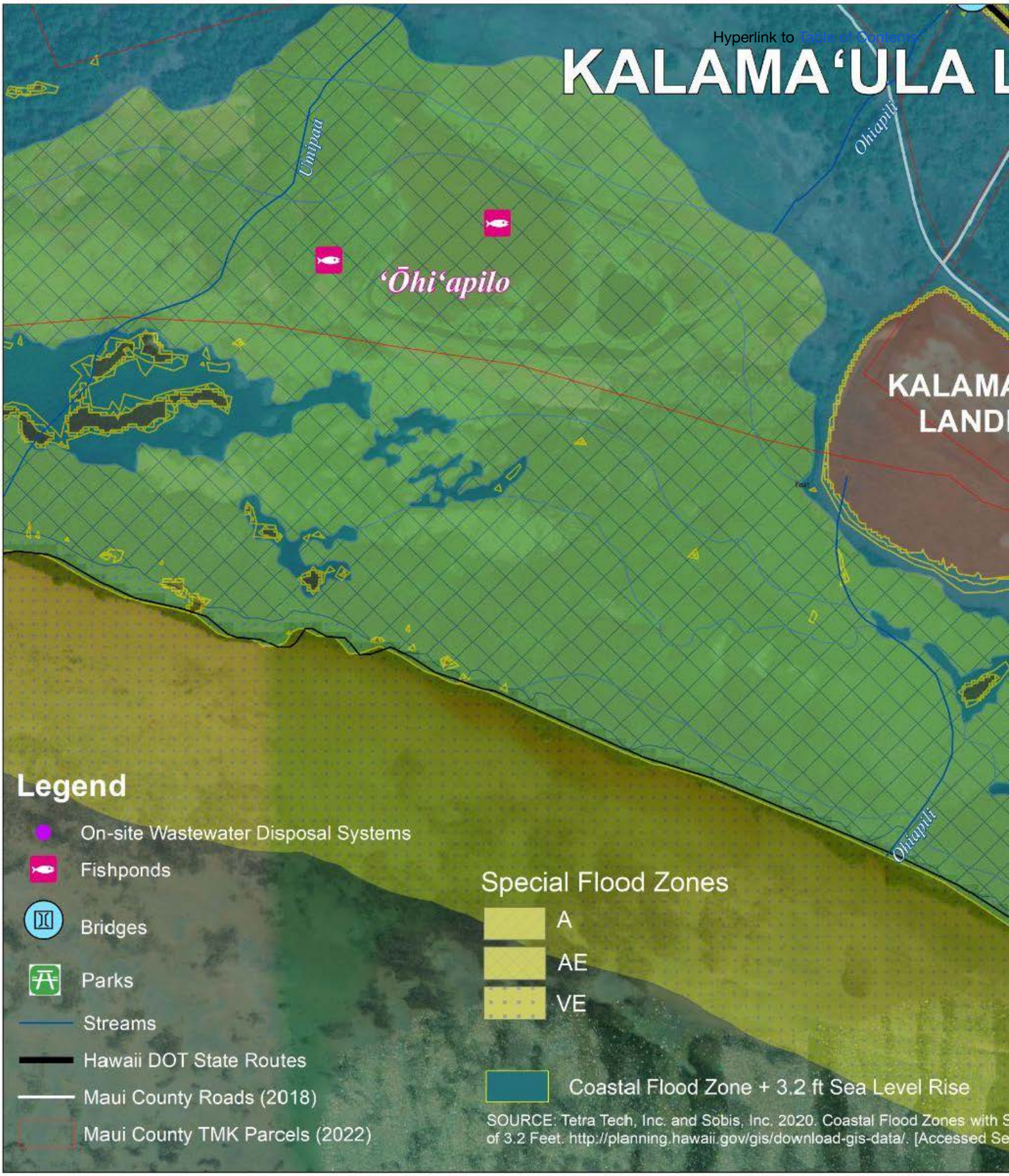
Hyperlink to Table of Contents

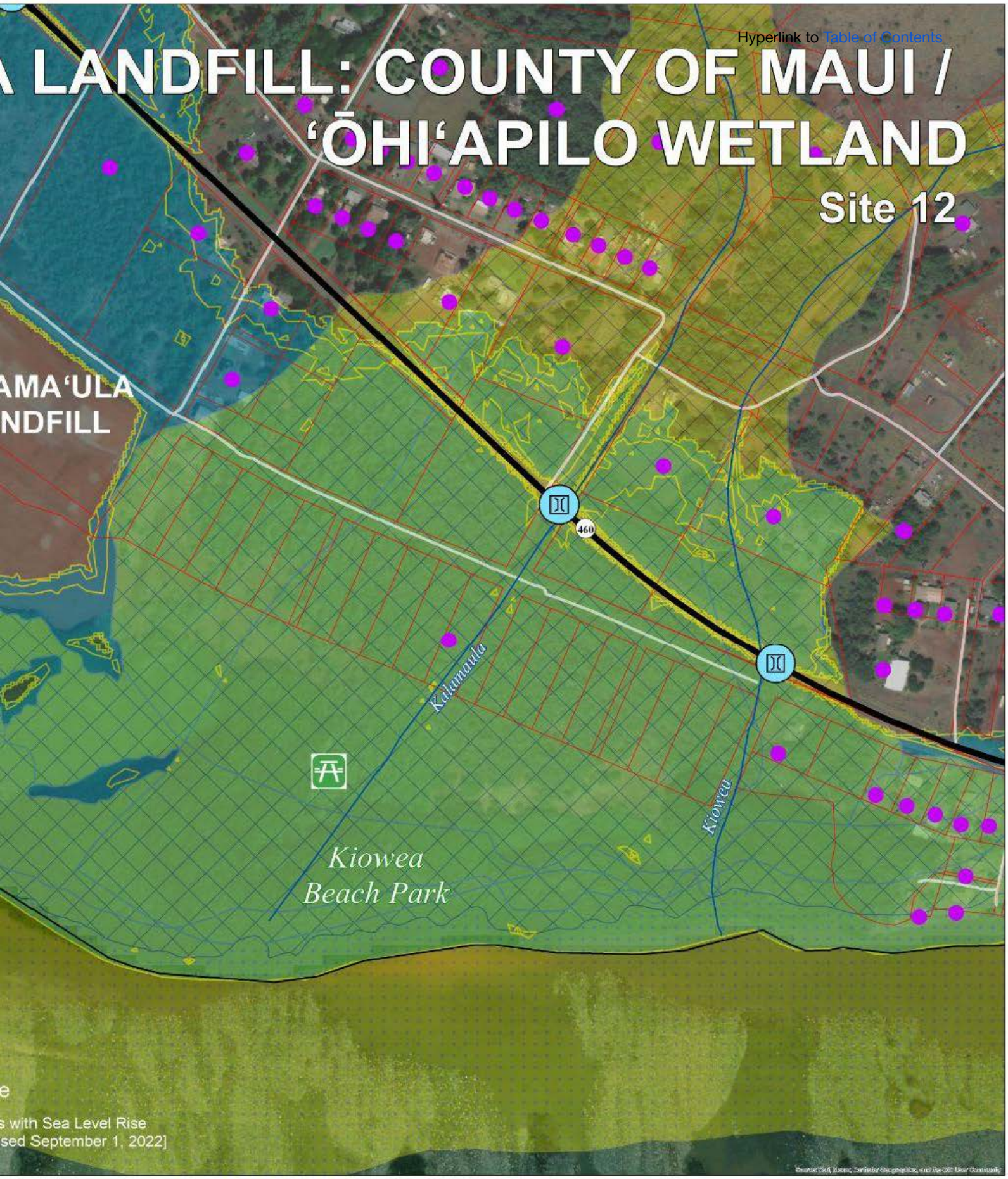
4.12. Kalama‘ula Landfill: County of Maui



4.12. KALAMAʻULA LANDFILL: COUNTY OF MAUI

Image courtesy of SEI Molokaʻi SLR Vulnerability Assessment
"Figure 3-153 Shoreline and nearshore area fronting the Kalamaʻula Landfill (July 6, 2023)" page 176


KALAMA‘ULA L
Umipaa
Ohiapilo
‘Ōhi‘apilo
KALAMA
LANDI
Ohiapilo
Legend
On-site Wastewater Disposal Systems
Fishponds
Bridges
Parks
Streams
Hawaii DOT State Routes
Maui County Roads (2018)
Maui County TMK Parcels (2022)
Special Flood Zones
A
AE
VE
Coastal Flood Zone + 3.2 ft Sea Level Rise
SOURCE: Tetra Tech, Inc. and Sobis, Inc. 2020. Coastal Flood Zones with S
of 3.2 Feet. http://planning.hawaii.gov/gis/download-gis-data/. [Accessed Se


LANDFILL: COUNTY OF MAUI /
ʻŌHIʻAPILO WETLAND
Site 12
AMAʻULA
NDFILL
460
Kalamaula
Kiowea
Kiowea
Beach Park
s with Sea Level Rise
sed September 1, 2022]
0
250
500
1,000
1,500
2,000
Feet
N

4.12. Kalamaʻula Landfill: County of Maui

See: Molokaʻi Sea Level Rise Vulnerability Assessment, Section 3.3.12, pages 175-180

4.12.1 Location and General Description

- Ownership: State - DHHL
- Land Zoning: Agriculture, Class A waters
- Ahupuaʻa: Kalamaʻula
- Geomorphological Classifications: Mud, Sand, Pavement (NCCOS, 2007) Kealia silt loam, 0 to 1 percent slopes; Marsh (USDA)
- Biological Classification: Uncolonized (NCCOS, 2007) Estuarine and Marine; Freshwater Forested/Shrub Wetland (USFWS)

Figure 3-152 Kalamaʻula Landfill facing southeast (July 6, 2023)

The Kalama'ula Landfill is a decommissioned landfill approximately 19 acres in size, located approximately 1.7 miles west of Kaunakakai town, south of Maunaloa Highway. It sits alongside the south shore of the Kalamaʻula moku (land division). The Kalamaʻula Landfill is located within the County Special Management Area and is owned by the State Department of Hawaiian Home Lands. The State of Hawaiʻi has zoned half the site as Agriculture and half as Conservation. A portion of the site is also zoned for Agriculture by the County of Maui. Much of the landfill is situated on and adjacent to the Ohi'apilo Wetlands, a major wetland system with significant and diverse ecological functions, such as providing habitat and foraging ground for various migratory shorebirds and waterfowl.

The landfill was opened in the early 1970s, stopped receiving waste in 1993, and has been closed since around 1998, and cannot be publicly accessed. In 1994, ordinance No. 2345, Bill No. 56 formed an agreement between Maui County and the Environmental Protection Agency to implement a Mitigation Plan.

The Mitigation Plan would remove materials from the wetland, enhance or create additional wetlands, preserve the mitigation site, and ensure the post-closure of the landfill does not adversely affect "waters of the United States". The landfill closure plan was in accordance with 40 CFR 258.60. In the process of closing, the landfill was graded, covered, monitored, and a drainage-control system was implemented. It is unknown what exact safeguards were implemented when the landfill was closed to prevent future leaking or leaching from the landfill into the adjacent groundwater. No records of waste type or volumes in the Kalamaʻula Landfill were available during this study.

Kalamaʻula Landfill, view facing west July 2023 (Photo credit: H. Place)

The landfill is at a raised elevation above sea level, and the majority is not in danger of flooding with SLR and other flood hazards. However, the landfill is surrounded by wetlands to the south, southeast, and west. In some low-lying areas of the landfill where saltwater may be intruding into the groundwater table, there is salt leaching through the surface of the soils. Also, currently ʻOhiʻapilo ponds fill predominately from nearshore ocean waters at high tides.

ʻOhiʻapilo Wetland, view toward ponds facing west July 2023(Photo credit: H. Place)

ʻOhiʻapilo Wetland is part of the USGS: A Prioritization Plan for Coastal Wetland Restoration on Molokaʻi, which is ongoing, being led by the Molokaʻi Wetland Partnership (MWP). We are aiming for the engineers to focus on dump remediation strategies and costs, and to coordinate with the MWP for long-term rehabilitation. Current MWP efforts are in the planning stages and require extensive community outreach. Likely restoration needs are: replacement of the degraded fence with an ungulate proof or predator proof fence; removal of invasive species, particularly mangrove and pickleweed; a hydrological review to understand how to reduce botulism risk to birds; outplanting of native species; ongoing management to maintain the wetland interest and value for climate resilience and ecosystem services.

Wetland restoration at ʻŌhiʻapilo would result in benefits to the near shore ocean water quality by ensuring that the wetland could provide ecosystem services such as trapping sediment and filtering contaminants. The adjacent reef will benefit substantially, leading to higher fishing yields and healthier coral that will be more able to withstand climate impacts in the longer term.

4.12.2 Vulnerability Assessment

The edges of the Kalama'ula Landfill are located within the passive flooding area with 6.0 feet of SLR. The Landfill itself is elevated above flood hazards within flood zone AE (zone with a 1% annual chance of flooding and a 26% chance over the life of a 30-year mortgage, according to FEMA). There are DHHL homes within the impact area to the east of the landfill that are vulnerable to passive flooding with SLR.

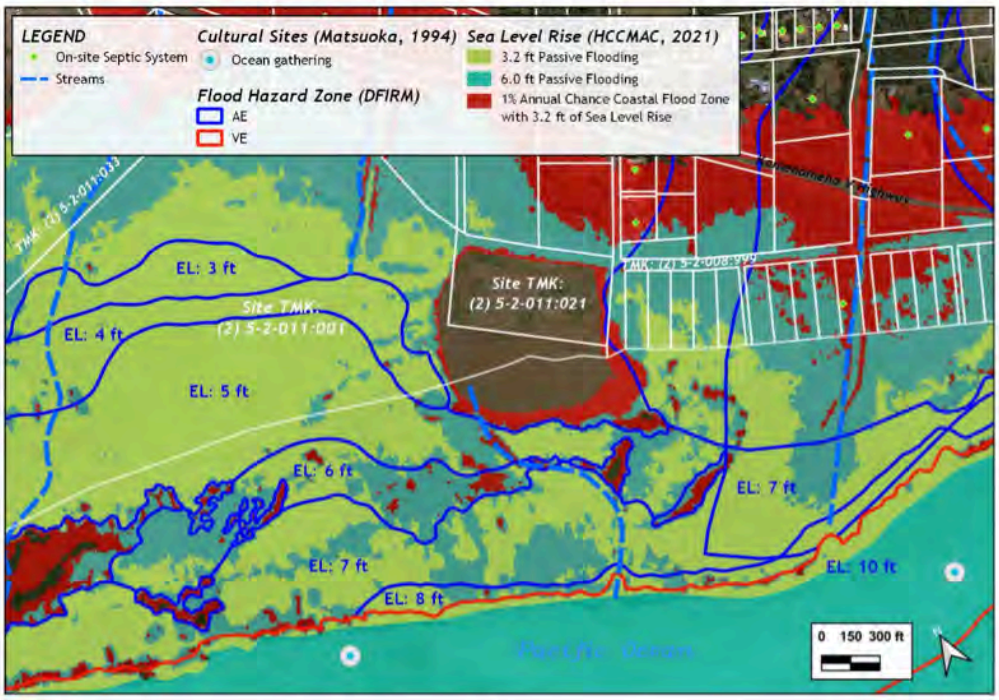
ʻOhiʻipilo Wetlands, with Kalamaʻula Landfill in the distance, facing east, July 2023 (Photo credit: H. Place)

4.12.3 Adaptation Needs

The Kalama‘ula Landfill is a decommissioned landfill that is not currently available for use to the public. An alternative, currently active landfill site has been developed, so the only needs remaining at the site are preservation of the environment. For example, there is a need to ensure the landfill does not leak waste into the surrounding environment due to sea level rise causing increased groundwater intrusion.

Liquid and solid wastes can leak from historic landfills due to site flooding and can be exacerbated by subsequent water table elevation rise (Nicholls et al., 2021). Such leakages pose a hazard for public health and the surrounding ecosystems. There are vents in the landfill area to allow gases from the decomposing waste to escape the ground that would need to continue.

Table 3-14 Kalama’ula Landfill vulnerability assessment



Moku Kona	**Area** 18.9 acres
Ahupua’a Kalama‘ula	**Ownership** State - DHHL
Tax Map Key No(s) (2) 5-2-011:021	**Known Cultural Resources** None
Location 157.049413°W, 21.100157°N	**FEMA Flood Zone** AE
Land Zoning Agriculture Class A waters	**Tsunami Hazard** Evacuation zone: shoreline to 0.6 miles landward
Geomorphological Classification Mud, Sand, Pavement (NCCOS, 2007) Kealia silt loam, 0 to 1 percent slopes; Marsh (USDA)	**Setback from Vegetation Line** 0.1 miles
Biological Classification Uncolonized (NCCOS, 2007) Estuarine and Marine Wetland; Freshwater Forested/Shrub Wetland (USFWS)	**Sea Level Rise Exposure** 3.2’ = 0 sf (0% of the site) 3.2’ + 1% = 150,176 sf (18% of the site) 6.0’ = 13,337 sf (2% of the site)
Existing Development Decommissioned landfill	**Sea Level Rise Hazard Intensity** Low – Low elevations

4.12.4 Recommended Adaptation Strategies

SHORT-TERM

- CoM & DHHL: Renegotiate contract for Mediation and continued responsibility of Landfill Site between DHHL & CoM, prior to 30 year county expiration
- CoM: Contract Engineer/Environmental Assessment Company to review and conduct testing below (such as Tetra Tech, etc.) and also with wetlands adjacency in mind.
  - Obtain & Review of the results of the original 5 years of post-closure sampling from CoM.
  - Obtain a groundwater sample from the leachate well to determine what is currently in the landfill leachate that may be migrating from the landfill.
  - If time is an issue, then samples from these four monitoring wells could be collected and analyzed at the same time as the leachate.
  - If contaminants are discovered in the four monitoring wells at concentrations which exceed the allowable criteria, then additional groundwater samples should be collected downgradient to determine the extent of the plume.
  - If cap regrading is undertaken to repair the settled area, the following steps are recommended:
    - Conduct a current topographical site survey to determine the areas where water ponding can occur on the cap.
    - Ensure that final grading or runoff channels do not exceed 6% slope without providing erosion protection.
    - After any drainage repairs are complete, hydroseed the cover and ensure growth is sustained to prevent further erosion. This may require ongoing maintenance and watering until vigorous growth can be established.[11]
- DAR & Partners: Partner with DAR for nearshore water and drainage testing, as part of regular water quality testing. While it does not appear that the landfill is significantly affecting the surrounding area, these steps would lessen the chance of future changes that could change the situation.
  - COM: Non Sealed, Removal Options Exploration and Remediation planning, with Lāhaina toxic removal process & remediation as a resource
  - DAR & Community Partners: Mangrove Management Planning
    - DAR Plans to assist other Molokaʻi community entities with Mangrove management
    - DAR is currently working on hiring Molokaʻi Staff that will be able to assist projects as on site management **(**in process of verifying with DAR for SOW**)**
    - Currently looking into wetland and watershed grant funds for future implementation
- Site Incorporation into DHHL Coastal Homestead Resiliency Plan
  - Flood Mitigation Mauka & in relationship to Homesteads and adjacent Wetland
- Support MWP Restoration Efforts as follows:
  - Coordination with MWP Wetland Restoration project (ʻOhiapilo projects have been identified and partially funded). Work includes:
    - A recently funded NFWF National Coastal Resilience Fund (NCRF) grant award to Molokaʻi Land Trust will carry out a hydrological review of the Management Plan at ʻOhiapilo. Site is proposed as a possible site for 50% wetland restoration design in 2024.
    - A NFWF NCRF grant application is planned to continue to 100% wetland restoration design in 2025, and implementation would be expected to occur from 2026 - 2029.
    - In the short-term, repair is urgently needed to the existing fence to exclude predators.
    - Restoration should occur in the short-term, particularly mangrove and pickleweed removal, followed by outplanting.

[11] Tetra Tech Memo on Next Steps for the Kalamaʻula Landfill (01/30/2024)

MID-TERM
• Conduct a Kalamaʻula Landfill Mitigation Assessment & Plan, with the inclusion of HHL Beneficiaries for long-term planning options to mitigate Landfill inundation and leaching into the near shore water.

LONG-TERM
• Implementation of Kalamaʻula Landfill Mitigation Assessment & Plan • Long term management and monitoring

4.12.5 Preliminary Cost Estimate (by **Tetra Tech, Jan 2024)**

Sampling and Analysis

These costs are based on previous work in the US Mainland and may need to be escalated for work on Molokaʻi.

Analytical costs are provided in **Table 1**. The labor associated with this includes purging the wells, taking samples and shipping them to the lab. This assumes that all existing wells are in good enough condition to purge and sample. Sampling Labor assumes one person.

Labor assumes purging and sampling of the leachate well and four monitor wells can occur in one day and assumes one person. Traveling from Oahu. Include 8 hours @ $160/hr=$1,280. Travel includes 4 hours round trip and $200 airfare and per diem=$960.

Total sampling and analysis=$5,155 + 20% contingency=$6,186 ($6,200).

Table 1 – Sampling / Analytical Costs

Analytical	Number	Rate	Total Cost
Equipment Rental and Supplies			
PINE Peri-Pump	1	$33	$33
Horiba U52-2 Water Quality	1	$124	$124
WLM- 100'- Solinst Model 101	1	$33	$33
PID-MiniRAE3000 10.6 120V D	1	$90	$90
Tubing Silicone 3/16 IDX3/8 OD	1	$4	$4
Tubing LDPE .17ID x 1/4OD-100'	1	$37	$37
	1	$2	$2
Total Equipment Cost			$327
Shipping (Fed Ex)			$350
Subtotal			**$677**
Leachate Well			
TCLP- extraction	1	$283	$283
TCLP- metals	1	$48	$48
TCLP- Hg	1	$25	$25
TCLP- VOCs	1	$62	$62
TCLP- pesticides	1	$98	$98
TCLP- herbicides	1	$130	$130
TCLP- PCBs	1	$60	$60
TCLP- SVOCs	1	$140	$140
Monitor Wells			
TOC	4	$50	$200
Total Metals*	4	$65	$260
VOCs	4	$75	$300
Subtotal			**$1,606**
Optional			
PCBs (8082A)	4	$60	$240
pesticides	4	$98	$392
Subtotal			**$632**
Total			**$2,915**

* Does not include mercury

4.12.5 Preliminary Cost Estimate (by **Tetra Tech, Jan 2024)**

Landfill Cap

Budgetary costs for drainage work would depend on what the survey indicates is damaged and need to be repaired (if anything). However, assuming only regrading the top of the landfill is required and the local contractor can provide the minimal design required to provide 3-percent slopes, the cost to survey, design and regrade the site is shown below in **Table 2**. This assumes an approximate area of 2 acres (based on the 2016 site visit) with an average required soil thickness of 2.5 feet (2 feet of clayey soil and 6 inches of topsoil for vegetative cover). This would provide a peak approximately 4.5 feet higher in this area than currently exists. The total as shown in **Table 2** is $353,798.

Table 2 – Regrading Costs

Item	Number	Unit	Unit rate	Total Cost
Survey	1	LS	$5,500.00	$5,500
Remove existing topsoil and stockpile 6"X 2 ac	1613	CY	$2.50	$4,033
Imported clayey soil	6453	CY	$30.00	$193,600
Place soil and compact	6453	CY	$6.50	$41,947
Replace exist topsoil	1613	CY	$2.50	$4,033
Hydroseed nd water	2	Ac	$1,800.00	$3,600
Subtotal	**1**			**$252,713**
Contractor mob / demob	1	10%		$25,271
Design	1	10%		$25,271
20% Contingency	1	20		$50,543
Total	**1**			**$353,798**

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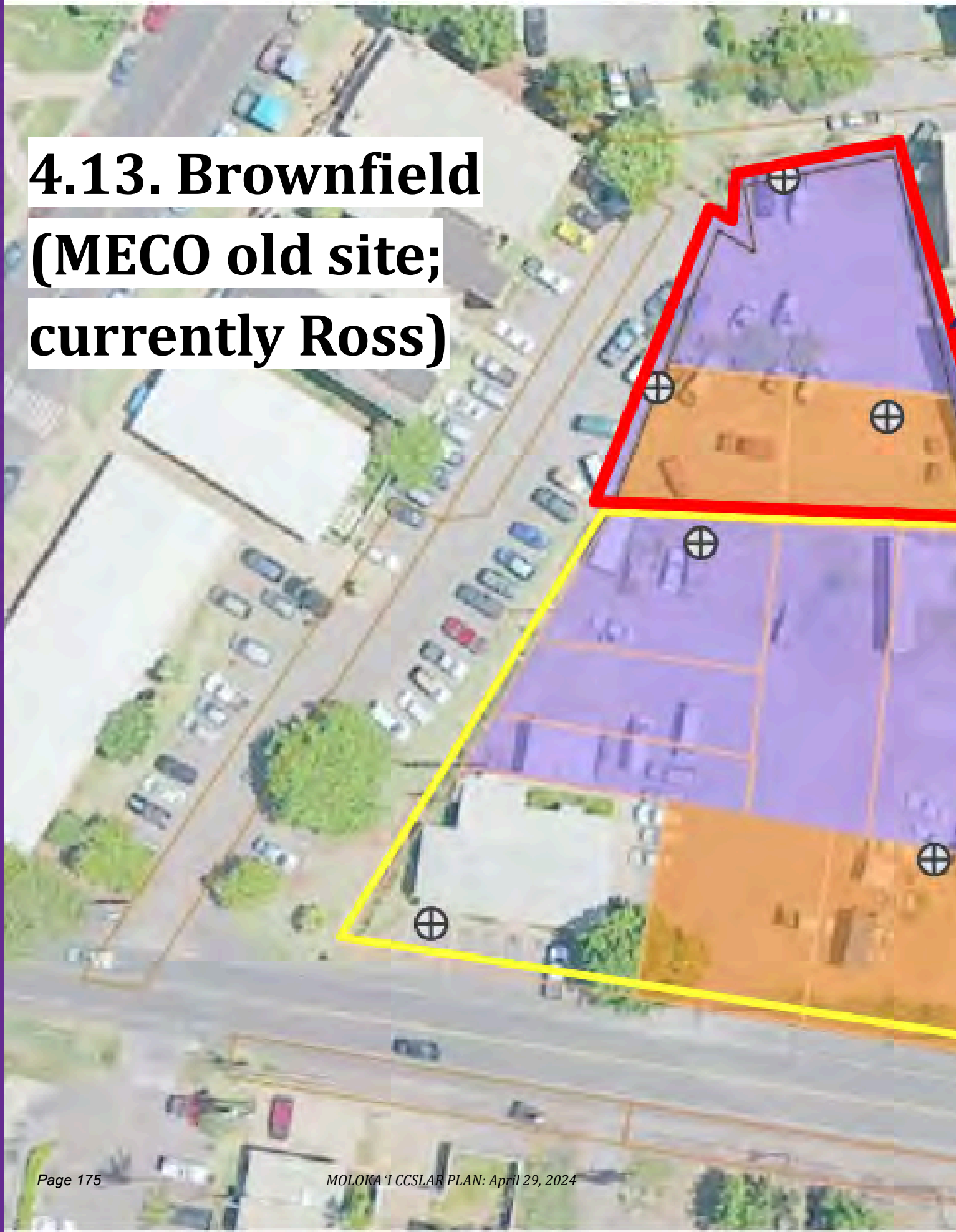
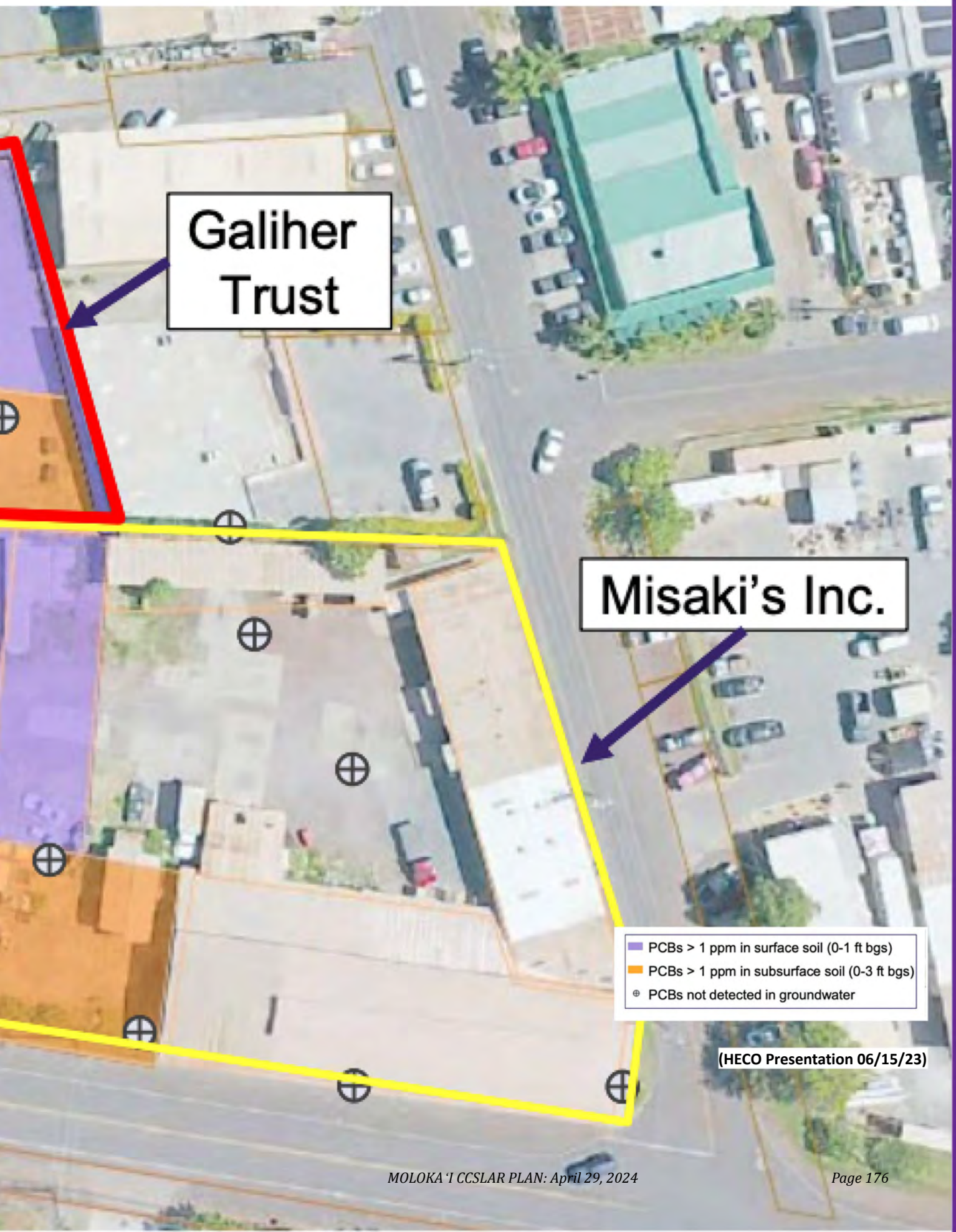
4.13. Brownfield (MECO old site; currently Ross)





(HECO Presentation 06/15/23)

Legend

- Police Stations
- State Building
- Schools
- Banks
- Bridges
- Streams
- Maui County Roads (2018)
- Hawaii DOT State Routes
- Flooded Highways @ 3.2 ft SLR
- On-site Wastewater Disposal Systems
- County Sewer Pumps
- County Sewer Pressurized Mains
- Private Sewer Gravity Mains
- County Sewer Gravity Mains

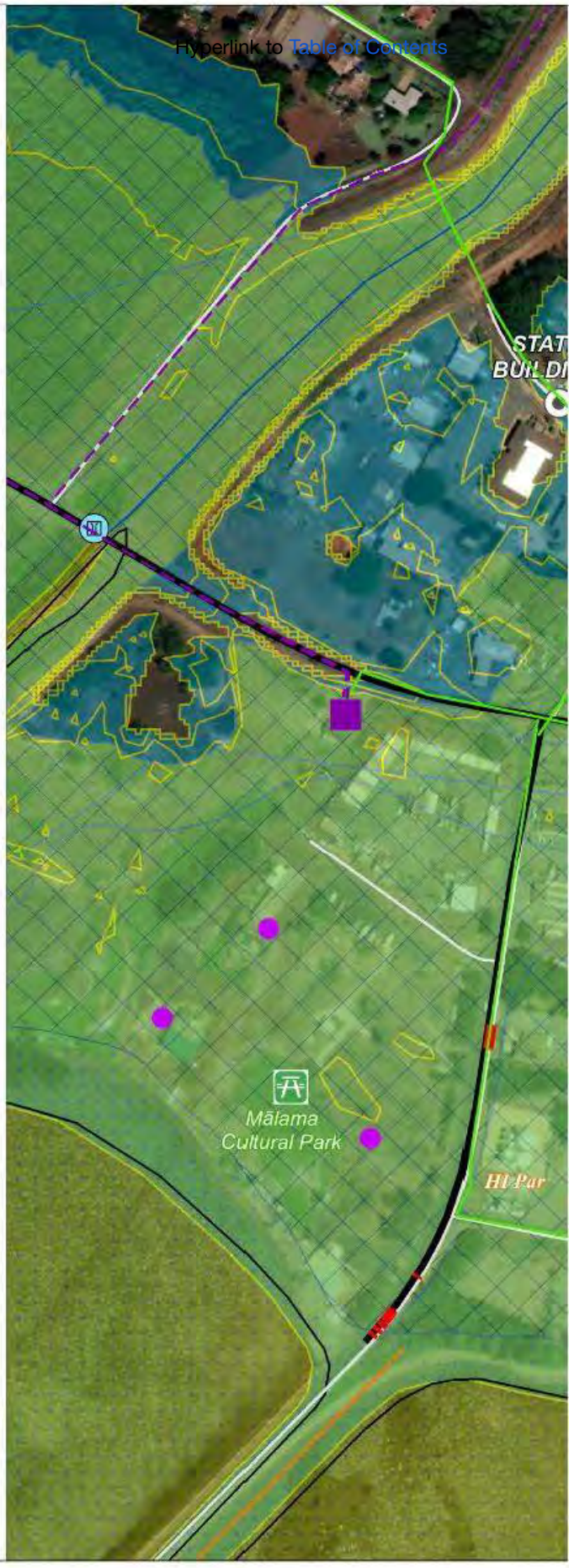
Special Flood Zones

- AE
- VE

Projected Sea Level Rise and Impacted Areas

- Coastal Flood Zone + 3.2 ft Sea Level Rise

SOURCE: Tetra Tech, Inc. and Sobis, Inc. 2020. Coastal Flood Zones with Sea Level Rise of 3.2 Feet. http://planning.hawaii.gov/gis/download-gis-data/. [Accessed September 1, 2022]



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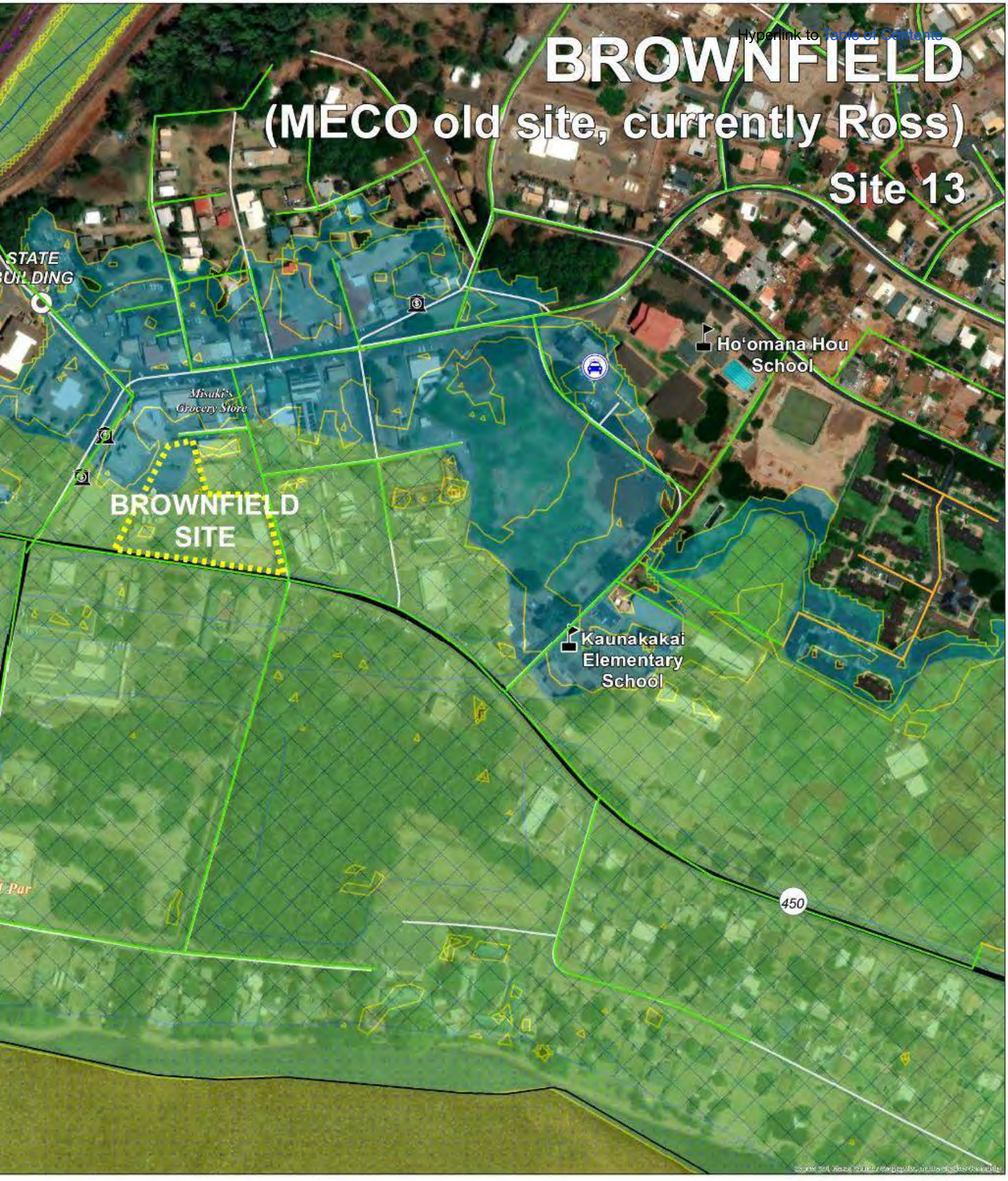
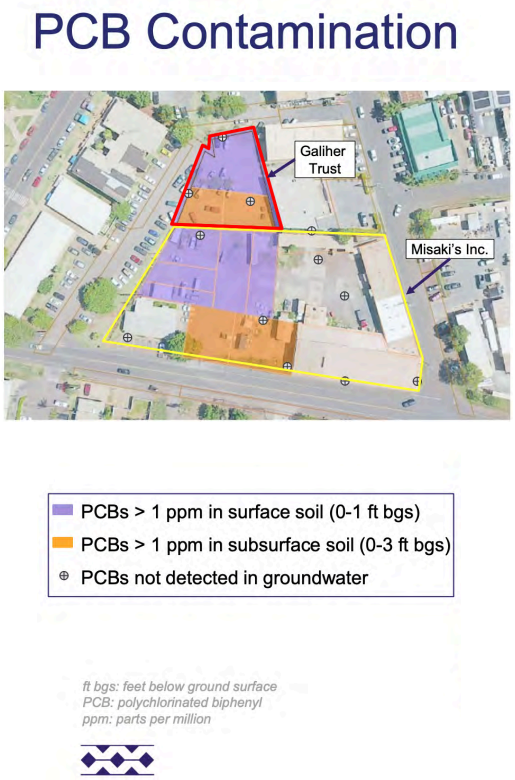


4.13. Brownfield (MECO old site; currently Ross)

This is the former Maui Electric Company site, and has a federal Brownfield designation. It is critical that a mitigation strategy be created for this site before it becomes inundated to protect our ocean resources.

4.13.1 Location and General Description

- Ownership: Private
- Ahupuaʻa: Kaunakakai
- Land Use Designation:
  - State Land Use District - Urban
  - Molokaʻi Island Community Plan - Business/Commercial
  - County Zoning - B-CT County Town Business District
  - Other - Special Management Area, Flood Zone (AE 8ʻ-9ʻ)
- Surrounding Uses
  - North: Misaki property is adjoined by the Galiher property with its parking lot Galiher property is adjoined with vacant lot
  - East: Misaki property is adjoined by Maluolu Street and a commercial property lies across the street. Galiher property is adjoined by the Misaki Property
  - South: Both properties are adjoined with Kamehameha V Highway.
  - West: Misaki property is adjoined by the Galiher property with its parking lot. Galiher property is adjoined by Ala Malama Avenue and the State building lies across the street.



4.13.2 Vulnerability Assessment

Two properties located in Kaunakakai Town (60 Maluolu Place known & 25 Kamehameha V Highway known as Galiher property) was the former Maui Electric Company site and has a federal Brownfield designation.

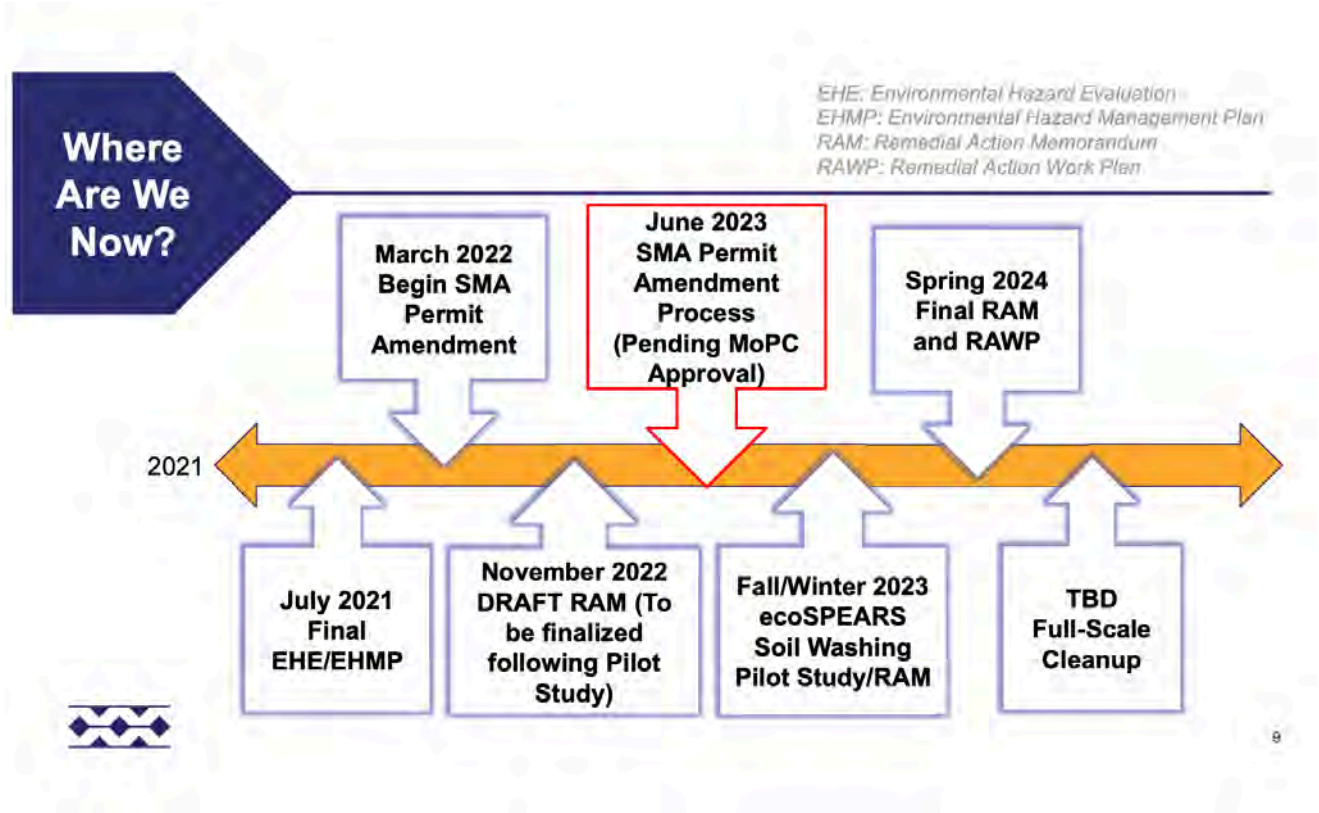
Both properties are currently a flat, asphalt-paved parking lot that was formerly used for transmission and distribution (T&D) warehouse, storage, and a motor pool for the adjacent former Molokaʻi Electric Company (MOECO) power plant. MOECO opened operations in 1932 and in 1983 MOECo sold the property and started to lease the place from the new owner.

This led to the utility to relocate its entire plant operations to Palaʻau in 1985 and terminated its lease with the landowner of the former site. In 1989, Maui Electric purchased Molokaʻi Electric Company.

For 50 years, MOECo operated a power plant and after closing left all contaminants in area that have seeped in the soil over the years. With SLR level predictions, this area will be susceptible to inundation and the contaminants leaking into our ocean. This will cause marine life to alter which is a major food source for the community of Molokaʻi.

4.13.3 Adaptation Needs

Hawaiian Electric Company is currently requesting a 3 year time extension for a Special Management Area (SMA) Use Permit to conduct an environmental site investigation (SI) on two properties identified as 25 Kamehameha V Highway, measuring approximately 1.4681 acres and located at Maui Tax Map Key (TMK), and 60 Maluolu Place, measuring approximately 12.282 sq ft. and located at Maui TMK, in Kaunakakai, island of Molokaʻi, Hawaiʻi. This extension includes the additional 3 years to complete the pilot study.



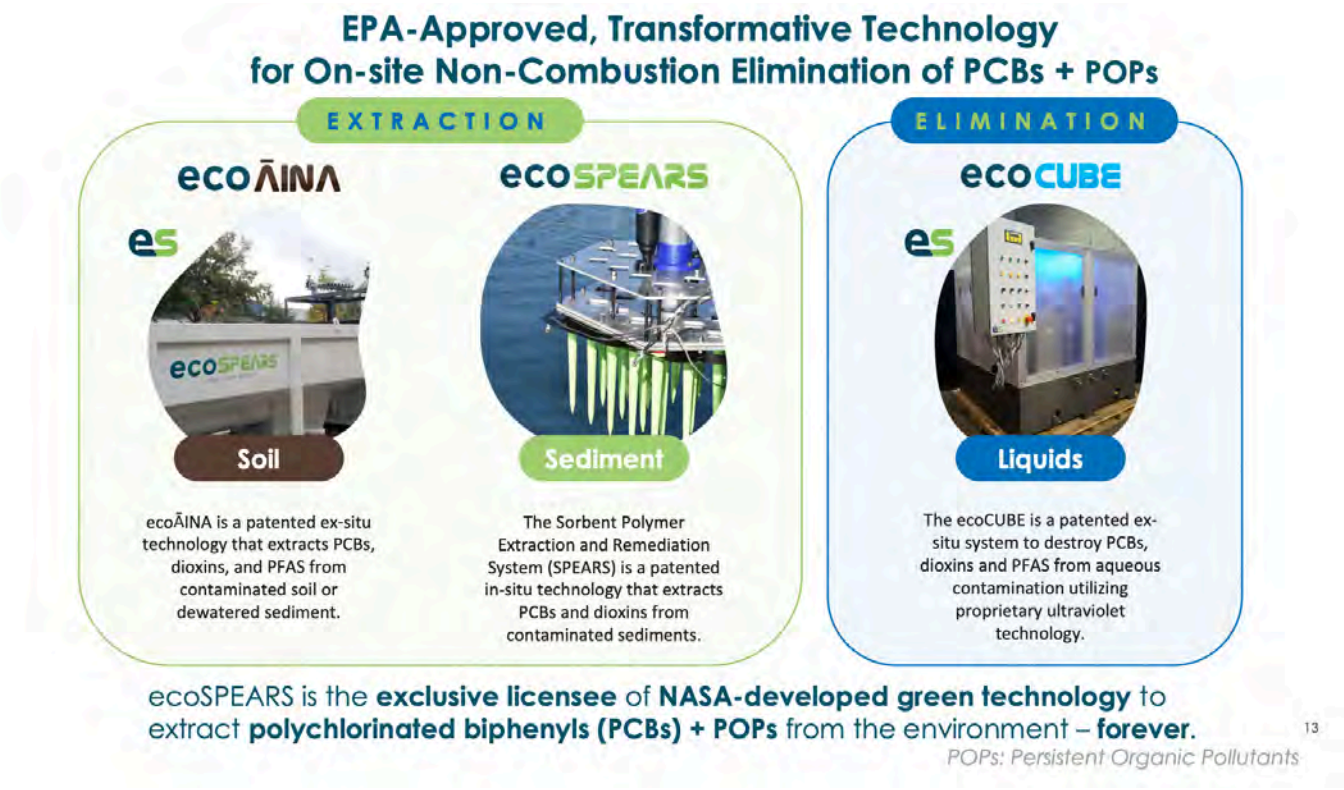
Estimated 3-Year Extension Timeline

Year 2023-2024	• ecoSPEARS Pilot Study • Final RAM & Public Meeting • Draft Remedial Action Work Plan (i.e., Cleanup WP)
Year 2025-2026	• Final Remedial Action Work Plan & Public Meeting • Obtain permits • Public Meeting • Implement selected remediation • Implement selected remediation
Year 2026-2027	• Develop long-term monitoring tasks (if applicable) • Final Cleanup Report / PCB closure • Public Meeting

Soil Treatment Method

One of the main studies is the soil treatment method, which is known as the Additive Desorption System (ADS), potentially enables the subsequent reuse of soil onsite or the soil to be transported off-island to a disposal facility. This treatment method consists of rinsing the contaminated soil with ethanol to extract the polychlorinated biphenyl (PCBs) from the soil (PCBs are attracted to ethanol from the soil) and then filtering the PCBs from the ethanol using activated carbon filter material.

For this proposed pilot project, they are focusing on ecoSPEARS Soil Washing Technology for the soil treatment in this specific area. "EcoSPEARS is the exclusive licensee of NASA-developed green technology to extract polychlorinated biphenyls (PCBs) + POPs from the environment - forever." (POPs:Persistent Organic Pollutants) The PCB "Soil Washing Technology" extracts PCBs from soils through a "washing" process where soil is mixed with an alcohol-based reagent and water that binds to the PCBs. It is a more environmentally friendly cleanup solution along with being able to reuse cleaned soil onsite. This technology is EPA-accepted in January 2020.



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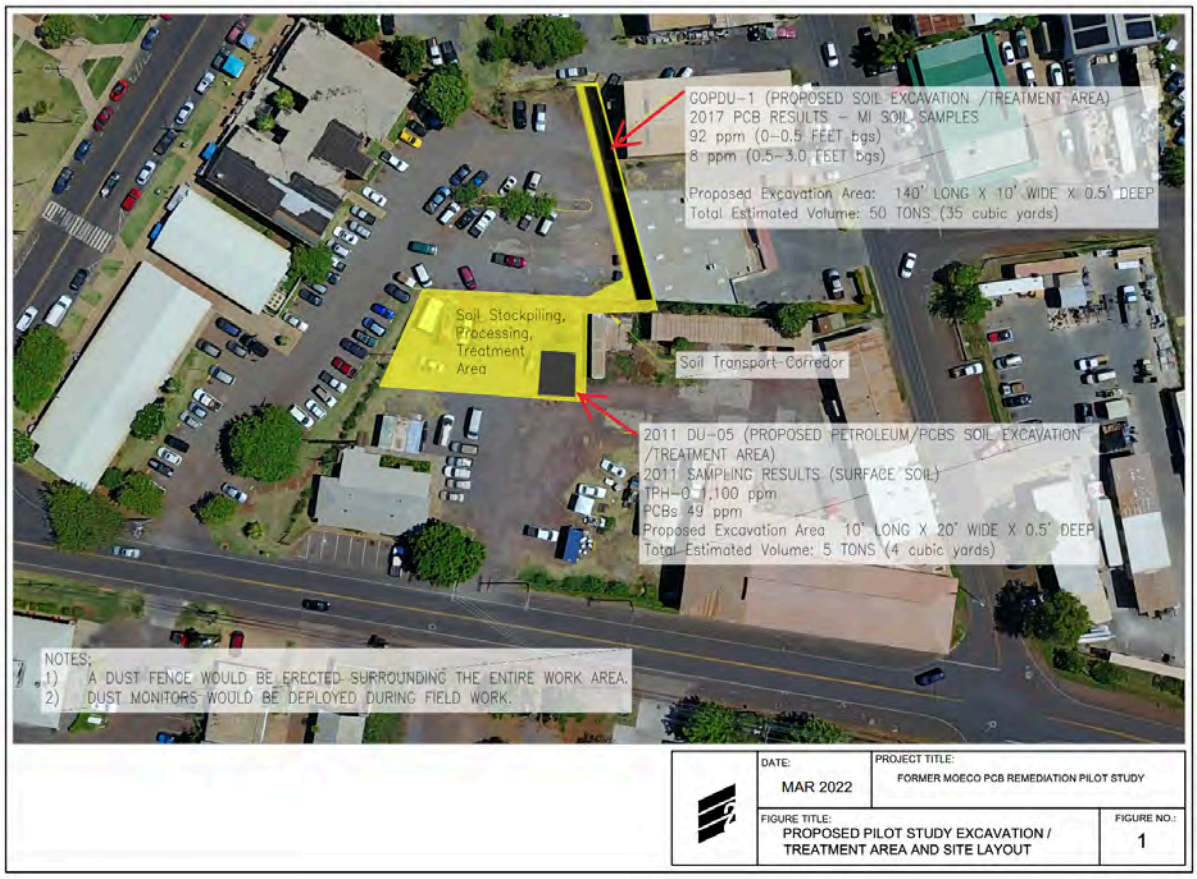
Proposed Pilot Study Excavation/Treatment Area and Site Layout & Deployment Process



EcoSPEARS Technology Deployment Process:

1. Soil pile contamination
2. Mixing with water
3. Phase separation
    a. Clean bulk sent for reuse
4. Separated contaminated dines
5. Mixing with reagent
6. Phase separation
    a. Separated clean fines
7. Granular Activated Carbon (GAC) filtration for water & reagent
8. Byproduct GAC filtration
9. Contaminated water & reagent treated for reuse

4.13.4 Recommended Adaptation Strategies

- ***Short-term***
    - Conduct the intended project in the current timeline.
    - Inclusion in contracted SOW, the method of removal of contaminated soil to a suitable contamination acceptance facility off of Molokaʻi to a suitable contamination facility (not in the middle of the ocean site).
    - Survey and Test the surrounding contamination areas, aside from the actual built site.

4.13.5 Preliminary Cost Estimate

- MECO is responsible for costs and timeline included in their project & SOW.

PRIORITIZATION OF NEEDS

Responses to SLR on Molokaʻi will need to be place-based, and larger regional issues should be considered, such as whether to armor in place or whether to relocate roads and other critical infrastructure inland. In the case of Kaunakakai where there may be opportunities to consider a managed retreat strategy as there are ample vacant lands immediately mauka (landward) and outside of the SLR-XA with 3.2 ft of SLR.

However, as with other populated coastal areas with adjacent vacant lands, large-scale boundary amendments should be predicated on appropriate state policies and guidelines (e.g., within Chapter 205, State Land Use Act) to provide the supportive legal basis for major land use changes. A summary of the sea level rise hazard intensities for each of the focus sites is given in Table 4-1.

Table 4-1 Summary of sea level rise vulnerability assessment

Focus Site Sea Level Rise	Hazard Intensity
Kaunakakai Wastewater Reclamation Facility	Medium
Kaunakakai Wharf	High
Maunaloa Highway (Kaunakakai)	Medium
Representative Residential Property	Medium
Kakahaiʻa Park	High
Kamalō Wharf	Low
Keawanui Fishpond	Low
Our Lady of Seven Sorrows	High
Pūkoʻo	Medium
Kalamaʻula Landfill	Low
Kapaʻakea Cemetery	Low

Table 4-2 summarizes how the three categories of SLR adaptation (Protection, Accommodation, and Relocation) intersect with the 13 Priority Sites.

Accommodation & Relocation Site Types	**Associated Priority Sites & Recommendations**
Kaunakakai & Population Centers	Comprehensive community-based planning process (recommended follow-up process described in the **Supplement**)
Public Buildings in town	Comprehensive community-based planning process (recommended follow-up process described in the **Supplement**)
Coastal Businesses & Residences	- Comprehensive community-based planning process (as part of recommended planning process noted above) The following Priority Sites can be used as examples for accommodation & relocation of businesses and residences with similar SLR and coastal exposure: - South Shore: Coastal Business Example (Priority Site #3) - South Shore: Coastal Residential Example (Priority Site #4) - East Shore Residential & Business Example: Pūkoʻo (Priority Site #5)
Infrastructure & Utilities	- Comprehensive community-based planning process (as part of recommended planning process noted above) The following Priority Sites can be used as examples for accommodation & relocation of infrastructure and utilities with similar SLR and coastal exposure: - Kaunakakai Wastewater Reclamation Facility (Priority Site #1) - Kaunakakai Wharf (Priority Site #2) - Kamalō: Wharf, Roadway & Wetland Area (Priority Site #6) - Roadway Section #1: Kaunakakai (Maunaloa Hwy/Kam V Hwy) (Priority Site #9) - Roadway Section #2: Our Lady of Seven Sorrows/Niʻaupala Fishpond (Priority Site #10)
Coastal/Nearshore	The following Priority Site can be used as an example for relocation & accommodation of natural and cultural resources, such as fishponds, with similar SLR and coastal exposure: - Keawanui Fishpond (Priority Site #7) Additional recommendations are included in the **Supplement**, including the implementation of TLUs.
Wetlands	The following Priority Sites can be used as examples for relocation and accommodation of natural and cultural resources, such as wetlands, with similar SLR and coastal exposure: - Kakahaiʻa National Wildlife Refuge & Beach Park (Priority Site #5) - Kamalō: Wharf, Roadway & Wetland Area (Priority Site #6) Additional recommendations are included in the **Supplement** for Ecosystem/ Ahupuaʻa Restoration, including the general wetlands recommendations below.
Watershed/Ahupuaʻa & Agricultural Lands	Comprehensive community-based planning process Additional recommendations are included in the **Supplement** for Ecosystem/ Ahupuaʻa Restoration, including the general wetlands recommendations below.
Integrated Approaches/Other	The following Priority Sites can be used as examples for relocation of other types of sites with similar SLR and coastal exposure. It may be not be feasible to relocate all of these sites, which is why Long-Term Planning for Ecosystem/Ahupuaʻa Restoration should also be incorporated: - Kapaʻakea Cemetery (Priority Site #11) - Kalamaʻula Landfill (CoM) - (Priority Site #12) - Brownfield (former MECO site; currently Ross) - (Priority Site #13)

Wetlands

Molokaʻi has some of the best wetland restoration potential in Hawaiʻi. Statewide, 15% of Hawaiʻi's original wetland acreage has been lost (44% in coastal areas) but Molokaʻi has avoided excessive coastal tourism and residential development, meaning that there is a unique opportunity to work at landscape-level scale to restore former coastal wetland habitat across the South Shore, restoring ecosystem services such as flood & sediment attenuation for water quality improvements and to protect infrastructure and community. Fulfilling this wetland restoration potential will take dedicated funding and capacity building and long term support, but is key to improving climate resilience on the island. Due to habitat degradation by big business and systematic failures in previous decades to include community in decision making processes, wetland habitats are highly degraded and traditional agro-ecology has been largely lost. Molokaʻi faces serious impacts from sea-level rise, climate induced storm surges and flooding, severe upland run-off and sedimentation from forest degradation, which affects water quality and reef health. Wetland restoration is urgently needed as a nature-based solution to the impacts of climate change, as the wetlands are the last line of defense in degraded ahupuaʻa (watershed land divisions).

The Molokaʻi Wetland Partnership, with the support of Judy Drexler (USGS) developed a system to evaluate and prioritize the value of wetland restoration on the island. This was trialed with 12 sites in 2023 and has subsequently been rolled out statewide as part of the Pacific Birds Strategic Plan for Hawaiʻi Wetlands (expected to be completed in early 2024). Any sites on Molokaʻi that were not included in the original prioritization process can be assessed using the same methodology, with appropriate funding. For more details on the methods used, which included assessing ʻcommunity acceptability' and Sea Level Rise impacts, see Drexer et al., 2023. Carrying out wetland restoration evaluations on Molokaʻi will allow the community and decision makers to assess where and when to best invest conservation dollars in the face of SLR, for the benefit of community and wildlife. It will also ensure that where wetland restoration is considered a strategy to improve climate resiliency, that the community vision of wetland restoration (namely, that it include sustainable food options - loʻi and loko iʻa - wherever possible) is honored in planning work. The partnership has been building capacity for wetland restoration on the island over the last 3 years and Molokaʻi Land Trust recently received funding to contract a Molokaʻi Wetland Co-ordinator. With additional, sustained funding for capacity and for on the ground planning and restoration work, wetland restoration for climate resiliency can be achieved.

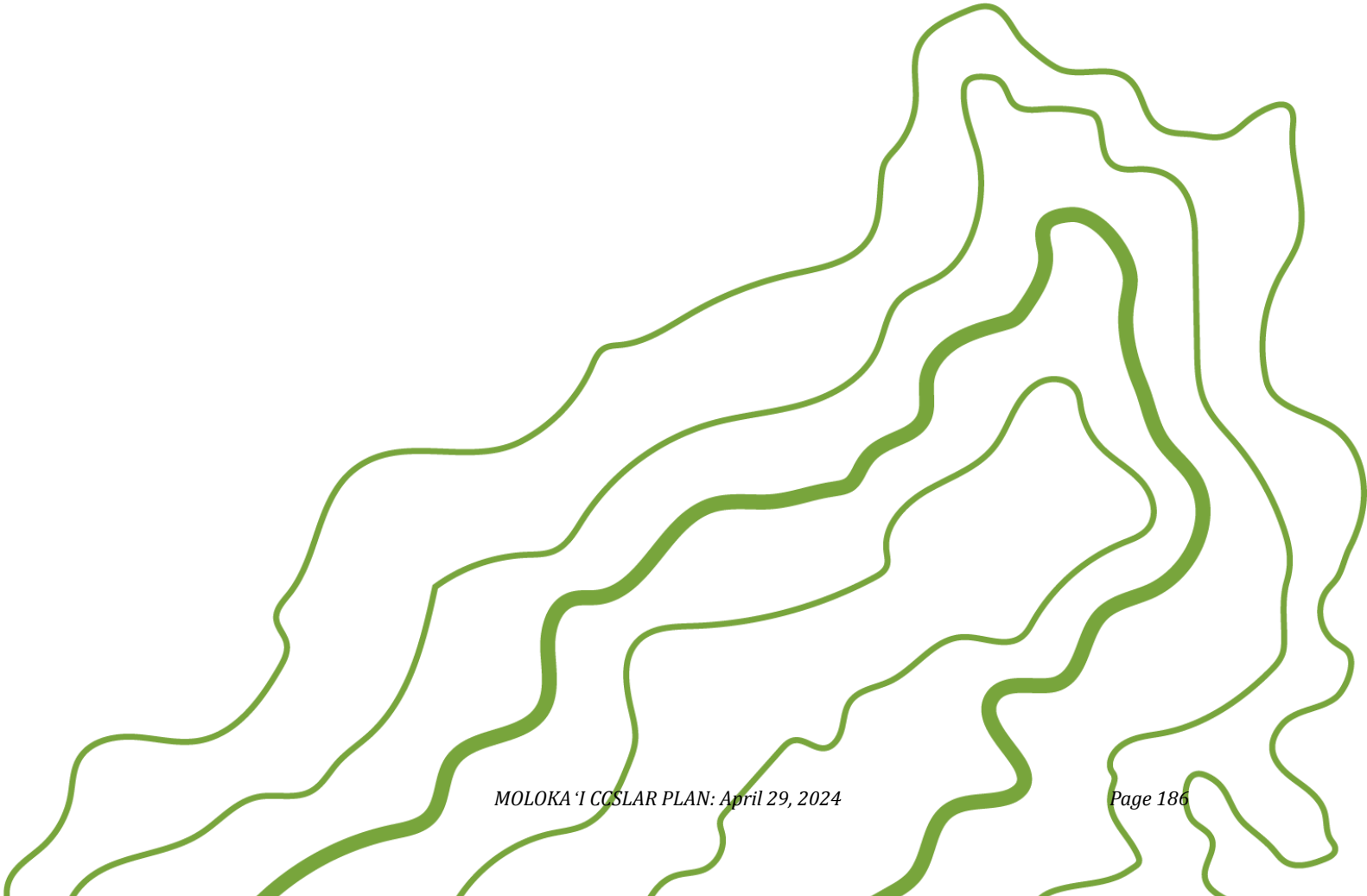
Agricultural Lands / Food Sovereignty

The importance of traditional subsistence activities on Molokaʻi is well-known, and has been well documented (Molokaʻi Subsistence Task Force, 1993; Updated 2024). Approximately 39% of the average Molokaʻi family diet comes from subsistence foods; and this percentage is even higher for Molokaʻi's predominantly native Hawaiian population. Associated with subsistence practices is the need to ensure native access to places that are important to subsistence.We know that SLR will alter the coastline. Access will need to be maintained and possibly re-configured to assist people in cultivating and maintaining pilina to a changing shoreline (e.g., via mauka-makai trails and lateral ahupuaʻa-to-ahupuaʻa trails). This may also mean adopting a stronger culture of travel and transport along the ocean (e.g., waʻa, shuttling people with small boats and water taxis). Updated data from the Subsistence Sustʻāinable Molokai has played a strong role in increasing food sovereignty on Molokaʻi, which needs to continue, along with other efforts. Furthermore, ahupuaʻa restoration projects (e.g., Kaʻamola/Keawanui) should be pursued to support additional agricultural projects.

Resiliency Hubs

There was also discussion around the need for at least four "resiliency hubs" across the island, that provide redundancy and critical support services in all four main districts - Manaʻe, Kaunakakai/central, Hoʻolehua/Kualapuʻu, and Maunaloa/west end - due to roads potentially being flooded/out of service, and access being limited. Additional "Emergency Preparedness Reefer and Storage Mobile Units," could be placed throughout the community for response to disasters and extreme weather events.

SM is currently in Phase I of planning for a Sustainability and Resiliency Hub, with projected locations within the Hoʻolehua/Kualapuʻu area, and out of SLR and inundation zones. This is the first of many phases, which includes feasibility study, site assessments, community assessment, conceptual and architectural design work. SM is also currently working on the first prototype of "Emergency Preparedness Reefer and Storage Mobile Units," that could be transported to various locations across the island, with all forms of power available (e.g. electrical hookup, generator backup and off-grid PV and battery system). The exact locations and services to be provided also need to be further planned for with the community(s). These planning efforts will move forward in collaboration with other Molokaʻi community partners.



5. NEXT STEPS

5. NEXT STEPS: SUMMARY TABLES FOR SHORT-TERM, MID-TERM, AND LONG-TERM CLIMATE STRATEGIES AND ACTIONS

This chapter includes short- and long-term climate change response and action strategies, coupled with an identification of potential funding sources and key partners, and reflecting coordination and informing related ongoing plans and community initiatives. This chapter also identifies legal hurdles and proposes the adoption of new climate related laws and policies in order to implement some of these strategies.

5.1. Implementation of Priority Sites' Recommended Strategies

Priority Sites' Recommended Strategies (for full details please refer to Chapter 4)

Section: 4.1. - KAUNAKAKAI WASTEWATER RECLAMATION FACILITY		
Recommended Strategies	**Timing**	**Preliminary Cost Estimate**
Prepare a planned obsolescence strategy.	1-3 yrs	Page 68
Replace invasive vegetation with more suitable coastal species such as ʻakiʻaki grass, pōhuehue, kaluhā, naupaka, and milo.	1-3 yrs	N/A
Start a Decentralized System Exploration Process. Create a new position under the Wastewater Reclamation Division for R&D (new systems development).	1-3 yrs	Page 68
Partner with UHMC Molokaʻi campus on workforce development with a focus on strategic planning courses that would, in this case, benefit the operations crew of KWRF.	1-3 yrs	N/A
Incorporate possible new sighting in DHHL Developing Resilience for Molokaʻi Coastal Homesteads Sites plan.	1-3 yrs	N/A
Replace invasive vegetation with more suitable native coastal wetland species, dependent on wetland restoration potential.	3-5 years	N/A
Continued workforce development & UHMC Molokaʻi campus partnership.	3-5 years	N/A
Continued Land Application & bioremediation & wetland restoration, if deemed high potential per MWP Assessment.	3-5 years	N/A
Elevate access to infrastructure above the projected inundation levels, in the interim period.	3-5 years	N/A
Relocate to a new parcel at a higher elevation. Design a facility that will be large enough to accommodate the projected wastewater needs in the future.	5-20 years	N/A
Develop a living shoreline by restoring the wetland.	5-20 years	N/A

Section: 4.2. - KAUNAKAKAI WHARF		
Recommended Strategies	**Timing**	**Preliminary Cost Estimate**
Secure funding to create "Inter-agency Kaunakakai Wharf Adaptation Plan," together with community and agency stakeholders.	1-3 years	Page 77
Create "Inter-agency Kaunakakai Wharf Adaptation Plan," together with community and agency stakeholders.	1-3 years	Page 77
Implement "Inter-agency Kaunakakai Wharf Adaptation Plan," together with community and agency stakeholders.	3-5 years	Page 77

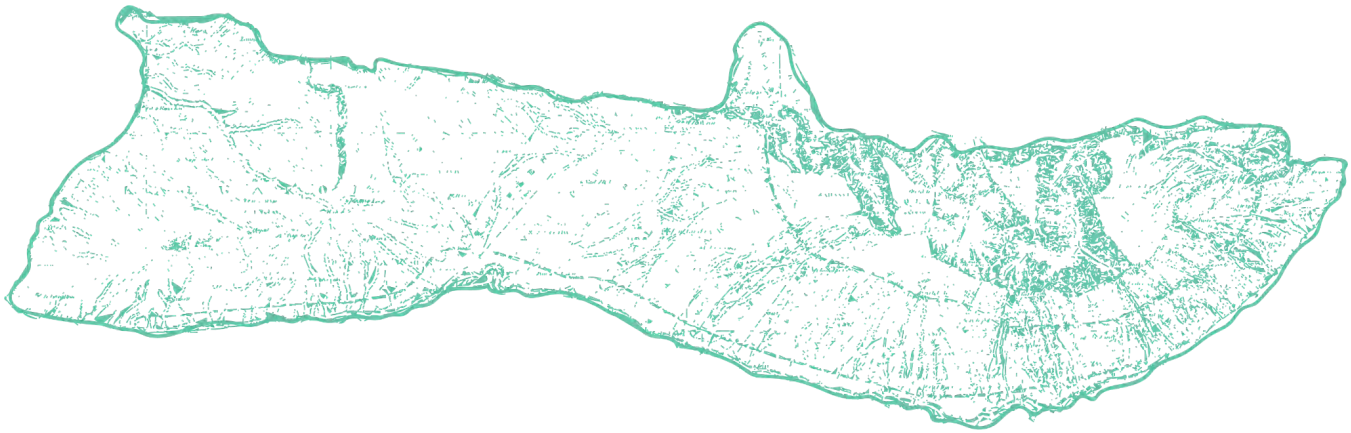
Section: 4.3. - SOUTH SHORE: COASTAL BUSINESS EXAMPLE		
Recommended Strategies	**Timing**	**Preliminary Cost Estimate**
Plant and maintain several layers of vegetation along the shoreline to create root systems to hold soils together as they become increasingly saturated.	1-3 years	Page 86
Elevate the infrastructure and access to infrastructure above the projected inundation levels.	5-20 years	Page 86
Relocate to a new parcel at a higher elevation. Design a facility that will be large enough to accommodate any projected medical needs in the future.	5-20 years	Page 86
Transform the parcel into a natural wetland to provide coastal hazard protection to landward facilities.	5-20 years	Page 86

Section: 4.4. - SOUTH SHORE: COASTAL RESIDENTIAL EXAMPLE		
Recommended Strategies	**Timing**	**Preliminary Cost Estimate**
Remove existing seawalls/coastal obstructions and plant and maintain several layers of native vegetation along the shoreline to restore the Dynamic Dune shoreline.	1-3 years	Page 97
Evaluation of additional sites for wetland restoration to improve community resilience, in coordination with MWP. This will require additional funding as it is beyond the scale of the PI-CASC pilot project.	1-3 years	Page 97
The homes are slab on grade or post and beam, and for the short- to mid-term walkways and access could be raised above the projected water level. However, access to the homes could be difficult, if roadway is at SLR inundation zone also. As the site becomes inundated by water and flooded consistently, walkways and access to the homes itself would need to accommodate, and become difficult to maintain on a residential scale.	3-5 years	N/A
Engineering Evaluations & Cost Estimates for elevating or relocating residential structures further on sites from SLR Inundation zones.	3-5 years	page 97
Design and implementation would need to be approved by DOH (State & County) agencies and policies and municipal building codes will need to be updated to reflect these above-ground options.	3-5 years	page 97
Site Design & Funding acquisition for wetland restoration, in potential areas.	3-5 years	page 97
Relocation of residential use to land at a higher elevation would escape the SLR hazard and is the most practical long term adaptation strategy.	5-20 years	page 97

Section: 4.5. - KĀKAHAIʻA NATIONAL WILDLIFE REFUGE & BEACH PARK		
Recommended Strategies	**Timing**	**Preliminary Cost Estimate**
In partnership with the US Fish and Wildlife Services, Ka Ipu Makani Cultural Heritage Center is currently developing a Community Conceptual Plan for Restoration of Kākahaiʻa Loko Puʻuone. The Conceptual Plan will be informed by the Molokaʻi community, identifying appropriate restoration models.	1-3 years	Page 106
Coordination with the MWP Wetland Restoration project (Kakahaiʻa projects have been identified and partially funded).	1-3 years	Page 106
Protection could be a short- to mid-term adaptation strategy at Kakahai'a Park. Wave energy across the reef here is low, so both soft and hard protection techniques could be considered to provide a buffer between the ocean and the roadway. Placement of protection however would reduce the land area available for recreational use. Protection would need to be installed along the entire length of the roadway that is at risk of being submerged with SLR to prevent water from creeping around the sides of the structure. Even with shore protection, sea levels will cause the groundwater table to rise and can damage the roadway. Any future potential protection needs to be coordinated with KIM, USFWS & MWP.	1-3 years	Page 106
An accommodation strategy to lift the roadway allowing ocean waters to flow underneath may be a preferred option to provide long-lasting access to east Molokaʻi. There are a few uses on the mauka side of the road that would be visually impacted by an elevated roadway and a few properties that would need specially engineered access connections to the portion of the roadway that would be elevated. Any accommodation to an elevated roadway would need to work in conjunction with Wetland Restoration projects (Molokaʻi Wetland Partnership). A study would be needed to understand the impacts on the NWR.	3-5 years	Page 106
Outplanting of native species; coastal strand restoration; native bioshield border.	3-5 years	Page 106
Continuing ridge to reef work to reduce sedimentation.	3-5 years	n/a
Carry out hydrological and engineering surveys to understand how to re-engineer topography and hydrology to create variable water depths with edge.	3-5 years	n/a
Install predator-proof fence (medium term).	3-5 years	n/a
Develop and implement a restoration plan.	3-5 years	n/a
Continued Relocation (see above).	5-20 years	n/a

Section: 4.6. - KAMALŌ WHARF, ROADWAY, AND WETLAND AREA		
Recommended Strategies	**Timing**	**Preliminary Cost Estimate**
Soft protection could be utilized in this area taking advantage of the space and the scenic attributes of the Wharf area. Soft protection will not stop SLR, but it can be used to live with it. Planting native salt-tolerant wetland plants can help retain soils and absorb excess water during flooding events.	1-3 years	Page 115
Collaborate on Kamahuʻehuʻe Wetland Planning (Fishpond inclusive) with MWP	1-3 years	Page 115
An accommodation strategy to lift the roadway allowing ocean waters to flow underneath may be a preferred option to provide long-lasting access to east Molokaʻi. Stream waters flowing seaward would also be able to flow more freely if the roadway were raised. Fishery facilities could be rebuilt in new locations closer to the new shoreline at a higher elevation to maintain access for fishermen. New and improved waterfront structures designed for an elevated sea level could also be explored if the development of fishing and boating uses is desired.	3-5 years	na
Collaborate on Kamahuʻehuʻe Wetland Restoration Planning (Fishpond inclusive) with MWP, incorporating community outreach results	3-5 years	Page 115
Shoreline retreat may be possible for the roadway in this short portion that is at a vulnerable low elevation. Relocating the roadway further landward would escape the SLR hazard in this area, though land acquisition may be required.	5-20 years	n/a
Restoration of Kamahuʻehuʻe Wetland	5-20 years	Page 115

Section: 4.7. - KEAWANUI FISHPOND		
Recommended Strategies	**Timing**	**Preliminary Cost Estimate**
To protect the Fishpond and maintain its isolation from surrounding ocean waters, the wall surrounding the pond could be elevated to a height greater than SLR. The wall strength would need to be greater to withstand the forces of greater wave heights.	1-3 years	N/A
Accommodation by wetland restoration and planting of salt-tolerant vegetation can help hold soils landward of the pond together. Ground access to the fishpond will become increasingly saturated, and the use of something like a concrete block mat or slope stabilization may be desirable in portions of the facility. If saltwater intrusion prevents the use of the freshwater pool, the addition of freshwater tanks to the facility may be a way to maintain control of the salinity in the fishpond.	3-5 years	N/A
Once protection and accommodation strategies no longer function, the pond will not be able to function with its current intended use. Alternative uses for the structure could be explored by the community. A continued perpetuation of knowledge may continue through alternative means at other fishponds or with educational centers.	5-20 years	N/A



Section: 4.8. - EAST SHORE: RESIDENTIAL & BUSINESS EXAMPLE: PŪKOʻO		
Recommended Strategies	**Timing**	**Preliminary Cost Estimate**
Remove existing seawalls/coastal obstructions and plant and maintain several layers of native vegetation along the shoreline to restore the Dynamic Dune shoreline. Reference the ʻ***Dune Restoration Conceptual Plan for the East Shore of Molokaʻi (Residential Example).***	1-3 years	Page 134
Evaluation of additional sites for wetland restoration to improve community resilience, in coordination with MWP. This will require additional funding as it is beyond the scale of the PI-CASC pilot project.	1-3 years	Page 134
Public/Private Partnership to clear & maintain spring drainage tunnel out to the ocean front at Public Beach Right-of-way, under private ownership.	1-3 years	N/A
CoM: Fund Engineering Assessment of current drainage & maintenance plan.	3-5 years	N/A
Multi agency redesign/maintenance plan(cost share with DOT/COM/Ke Kuaʻaina Hanauna Hou): DOT for along roadways, Ke Kuaʻaina Hanauna Hou for the beginning of the river by road to the tunnel, COM for drainage.	3-5 years	N/A
DOT: The road that allows Pūkoʻo Gulch to flow over it could be replaced with a bridge with drainage improvements so that stormwater flow would pass under the Highway and provide continued access to east Molokaʻi during storms for residents and emergency services.	3-5 years	N/A
Restore Fishponds: Pūkoʻo, Pānāhāhā, Kūpeke Fishpond.	3-5 years	N/A
Structures and roads and walkways within Pūkoʻo could be elevated to a height that is greater than the projected sea levels to accommodate the rising water table. The ground between structures would become increasingly soggy. Elevated walkways could be used to traverse the inundation zone.	3-5 years	N/A
Relocation of the Pūkoʻo community would escape the SLR and upland flooding hazards. Given the size of this neighborhood, finding and funding alternative housing may prove challenging.	5-20 years	N/A

Section: 4.9. - ROADWAY SECTION #1: KAUNAKAKAI (MAUNALOA HIGHWAY/KAMEHAMEHA HIGHWAY)		
Recommended Strategies	**Timing**	**Preliminary Cost Estimate**
Improve by increasing drainage capacity along the roadway moving water away from the infrastructure.	1-3 years	Page 143
Improve drainage culvert & infrastructure in CoM zone 20‘ to either side of State Highway (culvert) for Better floodplain management, Kaunakakai gulch/ditch management.	1-3 years	Page 143
Evaluation & Development for Accommodation of a longer bridge over the existing Kaunakakai Stream crossing.	1-3 years	Page 143
Wetland Restoration Evaluation, using MWP Online Tool and plantings within the current system.	1-3 years	Page 143
HDOT: Identify as a priority project to elevate the infrastructure and access to infrastructure above the projected inundation levels.	3-5 years	N/A
Mauka Restoration along the waterway to hold soil and create less feed.	3-5 years	N/A
Watershed & flood management could all reduce the flood hazard at Kaunakakai Gulch that overtops the roadway. Incorporate wetland upper restoration evaluation (MWP).	5-20 years	N/A

Section: 4.10 - ROADWAY SECTION #2: OUR LADY OF SEVEN SORROWS CATHOLIC CHURCH/NI‘AUPALA FISHPOND		
Recommended Strategies	**Timing**	**Preliminary Cost Estimate**
Relocation as an adaptation strategy is limited in this area due to how narrow the strip of land is between the Fishpond and the steep incline backing the shoreline.	1-3 years	Page 154
Restoring the highway to a 2-lane highway.	1-3 years	Page 154
Relocation of the road up the incline to a higher elevation, with substantial construction costs and imminent domain acquisitions. This would not solve the problem entirely as transportation access would still need to be provided to users along the shoreline.	5-20 years	N/A

Section: 4.11. - KAPA‘AKEA CEMETERY: COUNTY OF MAUI		
Recommended Strategies	**Timing**	**Preliminary Cost Estimate**
CoM: Public Works, Office of Councilmember Rawlins-Fernandez, Parks & Recs & Mortuary Service (Buchannan‘s) Site Selection Study to identify a new county cemetery, relocate any unused plots to the new cemetery, as a gathering, community space so burials of current plots are redirected to a new location.	1-3 years	N/A
CoM: Parcel Boundary should be re-surveyed, per the erosion.	1-3 years	Page 162
Conduct Cemetery Mapping Database, Inventory & Cultural Overlays, including ‘Ohana and contacts.	1-3 years	N/a
Site Incorporation into DHHL Coastal Homestead Resiliency Plan.	1-3 years	Page 162
Landowner (CoM) & ‘Ohana/Descendants create a Preservation & Design Plan together, utilizing the Cemetery Mapping Database and Inventory & Cultural Overlays.	3-5 years	N/A
Preservation & Design Plan contract with expert consultants.	3-5 years	N/A
Develop Burial Management Plan.	5-20 years	N/A
Relocate the access road to the mauka edge of the cemetery, raise the existing road, or alter the road type to accommodate sea level rise.	5-20 years	N/A

Section: 4.12. - KALAMA‘ULA LANDFILL: COUNTY OF MAUI		
Recommended Strategies	**Timing**	**Preliminary Cost Estimate**
CoM: Contract Environmental Assessment Company to conduct a current EPA Testing & Survey of the Landfill site, with wetlands adjacency.	1-3 years	Page 172
Re-negotiate contract between DHHL & CoM, upon the 30 year County expiration.	1-3 years	N/A
Site Incorporation into DHHL Coastal Homestead Resiliency Plan.	1-3 years	N/A
Support MWP Restoration Efforts.	1-3 years	N/A
Coordination with MWP Wetland Restoration project (‘Ohiapilo projects have been identified and partially funded).	1-3 years	N/A
Conduct a community driven assessment, with the inclusion of HHL Beneficiaries for long term planning options to mitigate landfill inundation and leaching into the near shore water.	1-3 years	N/A
Implementation of Site Design and Plan.	5-20 years	N/A
Long term management and monitoring.	5-20 years	N/A

Section: 4.13. - BROWNFIELD (MECO OLD SITE; CURRENTLY ROSS)		
Recommended Strategies	**Timing**	**Preliminary Cost Estimate**
Conduct the intended project in the current timeline.	1-3 years	N/A
Include in contracted SOW, the method of removal of contaminated soil to a suitable contamination acceptance facility off of Moloka‘i to a suitable contamination facility (not in the middle of the ocean site).	1-3 years	Page 182
Survey and test the surrounding contamination areas, aside from actual built site.	1-3 years	Page 182

APPENDICES

A1. Molokaʻi Sea Level Rise Vulnerability Assessment, (SEI, October 2023)

A2. Maps & Materials & Reports

- **A2.1.** Molokaʻi Sea-Level Rise Adaptation and Resiliency Plan Maps, 2021
- **A2.2.** 1st Round of Priority Site Maps, 2022
- **A2.3.** Final Round of Priority Sites Maps & All Molokaʻi Island Wide Maps
- **A2.4.** Handouts, Surveys, Flyers, Articles
- **A2.5** CCSLAR Videos

A3. Related Ongoing Plans

- **A3.1** Related Ongoing Plans

A4. Molokaʻi Climate Change Legal Primer