DEPARTMENT OF PLANNING AND PERMITTING
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January 15, 2021

2020/ED-12(ST)

Mr. Keith Kawaoka, Acting Director
Office of Environmental Quality Control
Department of Health, State of Hawaii
235 South Beretania Street, Room 702
Honolulu, Hawaii 96813-2437

Dear Mr. Kawaoka:

SUBJECT:	Chapter 343, Hawaii Revised Statutes Draft Environmental Assessment (DEA)
Project:	Krueger Residence Seawall Modification and Repair
Applicants:	David and Terri Krueger
Agent:	G70 (Jeff Overton)
Location:	1226A Mokulua Drive - Kailua
Tax Map Key:	4-3-005: 056
Request:	Shoreline Setback Variance and Special Management Area Use Permit Chapters 23 and 25, Revised Ordinances of Honolulu

With this letter, the Department of Planning and Permitting hereby transmits the DEA and anticipated finding of no significant impact (AFONSI) or the modification and repair of an existing nonconforming seawall within the 40-foot shoreline setback of the above-referenced parcel in the Koolaupoko District, on the island of Oahu, for publication in the next edition of "*The Environmental Notice*."

We have uploaded an electronic copy of this letter, the publication form, and the DEA to your online submittal site.

Should you have any questions, please contact Steve Tagawa, of our staff, at 768-8024, or by email at stagawa@honolulu.gov.

Very truly yours,

FOR Dean Uchida
Director Designate

21-105

From: webmaster@hawaii.gov
To: HI Office of Environmental Quality Control
Subject: New online submission for The Environmental Notice
Date: Friday, January 15, 2021 4:16:46 PM

Action Name

Kreuger Residence Seawall Modification and Repair

Type of Document/Determination

Draft environmental assessment and anticipated finding of no significant impact (DEA-AFNSI)

HRS §343-5(a) Trigger(s)

- (3) Propose any use within a shoreline area

Judicial district

Koʻolaupoko, Oʻahu

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

(1)4-3-005:056

Action type

Applicant

Other required permits and approvals

building, grading, grubbing, stockpiling and trenching permits

Discretionary consent required

Shoreline Setback Variance and Special Management Area Use Permit

Approving agency

Department of Planning and Permitting

Agency contact name

Steve Tagawa

Agency contact email (for info about the action)

stagawa@honolulu.gov

Email address or URL for receiving comments

stagawa@honolulu.gov

Agency contact phone

(808) 768-8024

Agency address

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650 South King Street
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United States
Map It

Applicant

David and Terri Krueger

Applicant contact name

Jeffrey Overton

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jeff@g70.design

Applicant contact phone

(808) 768-8024

Applicant address

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Map It

Was this submittal prepared by a consultant?

Yes

Consultant

G70

Consultant contact name

Jeffrey Overton

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jeff@g70.design

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(808) 768-8024

Consultant address

111 S. King Street, Suite 170
Honolulu, Hawaii 96813
United States
Map It

Action summary

The Applicant proposes to modify an existing nonconforming concrete seawall located at the makai boundary of the 18,376-square-foot shoreline parcel at 1226A Mokulua Drive in Lanikai. The project involves the insertion of sheet piles in back (mauka) of the dilapidated seawall that extends along the 105-foot boundary of the site. The sheet piles will be driven into the hard substrate 9 feet below the existing seawall. The sheet piles will be capped with a concrete cap secured to the seawall with dowels. The sheet pile cap will then be secured by 25-foot long steel tie rods spaced at 10 foot intervals anchored to the concrete deadman built further mauka and below the existing grade. The subject property and three adjacent parcels to the east (Waimanalo) are protected by a boulder rip-rap or "rock blanket" which was authorized by both the State and the City in 1968.

The project requires both a Shoreline Setback Variance and Major SMA permit.

Reasons supporting determination

The Project will not meet the significance requirement for the production of an EIS pursuant to Section 11-200.1-13. (see Chap. 6.2)

Attached documents (signed agency letter & EA/EIS)

- 1226aMokuluaDr_DEA_01152021.pdf
- DOC-313.pdf

Action location map

- ProjectParcel.zip

Authorized individual

Steve Tagawa

Authorization

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

REPAIR OF EXISTING SHORE PROTECTION FOR 1226A MOKULUA DRIVE

DRAFT ENVIRONMENTAL ASSESSMENT

KAILUA, ISLAND OF O‘AHU

APPLICANT:

DAVID AND TERRI KRUEGER

PREPARED BY:

G70

111 S. KING STREET, SUITE 170
HONOLULU, HI 96813

January 2021

REPAIR OF EXISTING SHORE PROTECTION FOR 1226A MOKULUA DRIVE

DRAFT ENVIRONMENTAL ASSESSMENT

KAILUA, ISLAND OF OʻAHU
TMK: (1) 4-3-005:056

APPLICANT:

DAVID AND TERRI KRUEGER
1226A MOKULUA DRIVE
KAILUA, OʻAHU, HAWAIʻI

PREPARED BY:

G70
111 S. KING STREET, SUITE 170
HONOLULU, HI 96813

APPROVING AGENCY:

CITY AND COUNTY OF HONOLULU
DEPARTMENT OF PLANNING AND PERMITTING
650 SOUTH KING STREET
HONOLULU, HAWAIʻI 96813

January 2021

Table of Contents

Section **Page**

List of Figures iii
List of Tables iv
List of Appendices iv
Abbreviations v

1.0 Introduction

1.1 Project Information Summary 1-1
1.2 Overview of the Planned Project 1-2
1.3 Project Background 1-2
1.4 Purpose of the Environmental Assessment 1-3
1.5 Permits and Approvals Required 1-3
1.6 Agencies, Organizations and Individuals Contacted During the Pre-Consultation Process 1-5

2.0 Project Description

2.1 Project Location 2-1
2.2 Site Characteristics 2-2
Existing Uses and Conditions 2-2
Adjacent Land Uses 2-5
Shoreline Characteristics 2-5
2.3 Purpose and Need for Action 2-6
2.4 Proposed Action 2-7
Design Characteristics 2-7
Construction Characteristics 2-9
2.5 Access, Utilities, and Infrastructure 2-9
2.6 Summary of Projected Costs 2-10

3.0 Environmental Setting, Potential Impacts, and Mitigation Measures

3.1 Topography 3-1
3.2 Soils and Erosion Conditions 3-4
3.3 Climate 3-8
3.4 Climate Change and Sea Level Rise 3-8
3.5 Natural Hazards 3-14
3.6 Oceanographic Setting 3-17

3.7 Marine Water Quality 3-19
3.8 Biological Resources 3-20
3.8.1 Terrestrial Biology 3-20
3.8.2 Marine Biology 3-22
3.9 Traffic and Roadways 3-23
3.10 Air Quality 3-24
3.11 Noise 3-25
3.12 Utilities and Infrastructure 3-25
3.13 Socio-Economic Characteristics 3-25
3.14 Public Facilities and Services 3-26
3.14.1 Educational Facilities 3-26
3.14.2 Recreational Facilities 3-27
3.14.3 Police 3-27
3.14.4 Fire 3-27
3.14.5 Emergency Medical Services 3-28
3.14.6 Solid Waste Management 3-28
3.15 Historic, Archaeological and Cultural Resources 3-28
3.15.1 Historic and Archaeological Resources 3-28
3.15.2 Cultural Resources 3-31
3.16 Visual Resources 3-33
3.17 Potential Cumulative and Secondary Effects 3-38

4.0 Alternatives to the Proposed Project

4.1 Alternative A – No Action 4-1
4.2 Alternative B – Managed Retreat 4-2
4.3 Alternative C – Beach Nourishment 4-4
4.4 Alternative D – Alternative Designs 4-6
4.4.1 Rock Revetment 4-6
4.4.2 Hybrid-Seawall-Revetment 4-10
4.4.3 Seawall Replacement 4-14
4.5 Alternative E – Seawall Removal 4-16
4.6 Preferred Alternative/Proposed Action – Seawall Repair 4-17

5.0 Conformance with Plans, Required Permits, and Approvals

5.1 Hawai‘i State Plan 5-1
5.2 Hawai‘i State Land Use District 5-3
5.3 Hawai‘i Coastal Zone Management 5-3
Part I. Coastal Zone Management 5-4
Part II. Special Management Area 5-9
Part III. Shoreline Setbacks 5-12

5.4 Hawaiʻi Water Quality Standards 5-14
5.5 City and County of Honolulu General Plan 5-15
5.6 City and County of Honolulu Koʻolau Poko Sustainable Communities Plan 5-16
5.7 City and County of Honolulu Land Use Ordinance 5-18
5.8 Shoreline Setback 5-18
5.9 Special Management Area 5-20
5.10 Ola: Oʻahu Resilience Strategy 5-21

6.0 Findings and Reasons Supporting Anticipated Determination

6.1 Anticipated Determination 6-1
6.2 Reasons Supporting the Anticipated Determination 6-1
6.3 Summary 6-4

7.0 Agencies, Organizations and Individuals Receiving Copies of the EA

8.0 References

List of Figures

Figure **Page**

1.1 Project Location and Tax Key Map Parcel 1-6
1.2 State Land Use District 1-7
1-3 FEMA Flood Zone 1-8
2-1 Project Site Photograph (SEI) 2-1
2-2 Existing Conditions – North End of Shoreline (SEI) 2-3
2-3 Existing Conditions – South End of Shoreline (SEI) 2-4
2-4 Project Site and Surrounding Shoreline Characteristics (SEI) 2-6
2-5 Conceptual Design for Seawall Repair (MKE) 2-8
3-1 Existing Shoreline Protection Profiles (SEI) 3-2
3-2 Existing Shoreline Protection Profiles (SEI) 3-3
3-3 Soils Map 3-5
3-4 Boring Samples (Shinsato) 3-7
3-5 Hawai‘i Sea Level Rise Projections (NOAA, 2017) 3-9
3-6 0.5-Foot Sea Level Rise Scenario 3-11
3-7 3.2-Foot Sea Level Rise Scenario 3-12
3-8 Tsunami Evacuation Zones 3-15
3-9 Previous Archaeological Investigations in Lanikai (Keala Pono 2020) 3-30
3-10 Site Photo Key (Source: Google Earth) 3-34
- 3-10A View 1 from Mokulua Drive Facing Makai Towards the Residence and Project Area 3-35
- 3-10B View 2 Middle Portion of the Yard Facing Makai 3-35
- 3-10C View 3 Backside of Seawall and Yard Facing North 3-36
- 3-10D View 4 Accessibility from Yard at Northern End of Property 3-36
- 3-10E View 5 Backside of Seawall and Yard Facing South 3-37
- 3-10F View 6 from Property, Rock Apron 3-37

4-1 Example of Beach Nourishment with T-Head Groins (Iroquois Point, O‘ahu, Hawai‘i) 4-4
4-2 Rock Revetment at Kahului Harbor (Kahului, Maui, Hawai‘i) 4-6
4-3 Conceptual View for Rock Revetment Landward of the Shoreline 4-8
4-4 Conceptual View for Rock Revetment Seaward of the Shoreline 4-9
4-5 Hybrid Seawall Revetment (Kapa‘a, Kaua‘i, Hawai‘i) 4-10
4-6 Conceptual View for Hybrid Seawall-Revetment Landward of the Shoreline 4-12
4-7 Conceptual View for Hybrid Seawall-Revetment Seaward of the Shoreline 4-13

4-8 Conceptual Design for Seawall Replacement 4-15

List of Tables

Table **Page**

1-1 List of Required Government Permits and Approvals 1-4

3-1 Water level data for Moku o Loʻe, Station 1612480 (NOAA, 2020) 3-18

7.1 Agencies, Organizations and Individuals Receiving Copies of the EA 7-1

Appendices

A. 1226a Mokulua Drive Legal Documents Nonconforming Status of the Seawall (DPP letter dated July 13, 1999, File No. 1999/CLOG-4318)

B. HDOT Shore Waters Construction Permit No. 1395

C. Variance Related to the Zone of Wave Action No. 1968/Z-124

D. Grant of Non-Exclusive Easement (S-6043)

E. Certified Shoreline Survey (November 13, 2020, File No. OA-1911)

F. *Coastal Assessment for Krueger Seawall Repairs.* Sea Engineering, Inc. October 2020.

G. *Marine Research Consultants, Inc. Baseline Assessment of the Marine Environment, 1226 Mokulua Dr, Krueger Seawall, Kailua, Oahu, Hawaii.* Prepared by Marine Research Consultants, Inc. September 6, 2020.

H. *Observations on Nesting Wedged-tailed Shearwaters on a Private Home Site in Lanikai.* Prepared by AECOS, Inc. September 14, 2020.

I. *Archaeological Assessment for the Repair of a Nonconforming Seawall at 1226a Mokulua Drive in Lanikai, Kailua Ahupuaʻa, Koʻolaupoko District, Island of Oʻahu.* Prepared by Keala Pono Archaeology Consulting, LLC. August 2020.

J. Early Consultation

Acronyms and Abbreviations

AIS	Archaeological Inventory Survey
BLNR	Board of Land and Natural Resources
BMPs	Best Management Practices
BWS	Board of Water Supply
CAB	Clean Air Branch
CDUP	Conservation District Use Permit
City	City and County of Honolulu
CRM	Concrete Rubber Masonry
CWA	Clean Water Act
CZM	Coastal Zone Management
DBEDT	Department of Business, Economic Development, and Tourism
DDC	Department of Design and Construction, City
DLNR	Department of Land and Natural Resources, State
DPP	Department of Planning and Permitting, City
DOE	Department of Education, State
DOH	Department of Health, State
DOT	Department of Transportation, State
EA	Environmental Assessment
EMS	Emergency Medical Services, City
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIRM	Floor Rate Insurance Map
FONSI	Finding of No Significant Impact

GHG	Greenhouse gas
HAR	Hawai‘i Administrative Rules
HDOT	Department of Transportation Harbors Division, State
HECO	Hawaiian Electric Company
HFD	Honolulu Fire Department
HPD	Honolulu Police Department
HRS	Hawai‘i Revised Statutes
IBC	International Building Code
IPCC	Intergovernmental Panel on Climate Change
LUC	Land Use Commission, State
LUO	Land Use Ordinance
MRCI	Marine Research Consultants, Inc.
msl	Mean Sea Level
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
OCCL	Office of Conservation and Coastal Lands, State
OCCSR	Office of Climate Change, Sustainability, and Resiliency
OEQC	Office of Environmental Quality Control, State
OHA	Office of Hawaiian Affairs
ORMP	Ocean Resource Management Plan
PacIOOS	Pacific Islands Ocean Observing System
ROH	Revised Ordinances of Honolulu
SAAQS	Station Ambient Air Quality Standards
SEI	Sea Engineering, Inc.
sf	Square feet

SHPD	State Historic Preservation Division
SLR	Sea level rise
SLRXA	SLR Exposure Area
SMA	Special Management Area
SSV	Shoreline Setback Variance
State	State of Hawai‘i
TMK	Tax Map Key
UH	University of Hawai‘i
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
XTEZ	Extreme Tsunami Evacuation Zone

Section 1

Introduction

Chapter 1

Introduction

This Environmental Assessment (EA) has been prepared in accordance with the requirements of Chapter 343, Hawai'i Revised Statutes (HRS), and Title 11, Chapter 200.1, Hawai'i Administrative Rules (HAR), Department of Health, which set forth the requirements for the preparation of environmental assessments. The property is located within the shoreline area and will require the approval of a Shoreline Setback Variance (SSV) pursuant to Revised Ordinances of Honolulu (ROH), Chapter 23, Shoreline Setbacks. Chapter 23 ROH requires the preparation of an EA consistent with Chapter 343 HRS and Chapter 11-200.1 HAR.

1.1 Project Information Summary

Type of Document:	Environmental Assessment (EA)
Project Name:	Repair of Existing Shore Protection for 1226a Mokulua Drive
Applicants:	David and Terri Krueger
Agent:	G70 111 S. King Street, Suite 170 Honolulu, HI 96813
Accepting Authority:	Department of Planning and Permitting 650 South King Street, 7th Floor Honolulu, HI 96813 Telephone: (808) 768-8049
EA Trigger:	HRS 343-5(a)(3) Use within a Shoreline Setback Area ROH Chapter 23, Shoreline Setbacks
Project Location:	1226a Mokulua Drive Kailua, O'ahu, Hawai'i *(Figure 1-1)*
Tax Map Keys (TMK) and Landowners:	(1) 4-3-005: 056 David and Terri Krueger *(Figure 1-1)*
Project Area:	Approximately 3,000 square feet (SF) (nearshore portion of 18,376 square-foot TMK)
State Land Use District:	Urban District
City & County of Honolulu Zoning:	R-10 (Residential District)
Ko'olau Poko Sustainable Communities Plan:	Low Density Residential
Special Management Area:	Within Special Management Area (SMA) *(Figure 1-2)*

Flood Zone: AE/X *(Figure 1-3)*

Anticipated Determination: Finding of No Significant Impact (FONSI)

1.2 Overview of the Planned Project

The project site consists of a single residential property located on Mokulua Drive in the community of Lanikai, Kailua, Koʻolaupoko District on the island of Oʻahu (*Figure 1-1*). The site is identified by TMK (1) 4-3-005: 056. The property is fronted by a seawall constructed of unreinforced concrete and a rock apron composed of basalt boulders that runs along the length of the seawall. The existing seawall is dilapidated and must be repaired pursuant to the requirements of a Grant of Non-Exclusive Easement S-6043 (hereinafter referred to as "the easement"). See the following *Section 1.3* for details about the easement. To maintain the seawall in a safe condition pursuant to the conditions of the easement, the property owner proposes to repair the seawall. Seawall repair involves the insertion of sheetpile into hard substrate landward of the seawall along its entire length to improve its structural integrity. The sheetpile wall will be structurally connected by the construction of a concrete width extension sheetpile cap dowelled into the existing wall. Further detail on the repair elements is provided in *Chapter 2.0*.

1.3 Project Background

In 1999, the previous owner inquired with the City and County of Honolulu (City) Department of Planning and Permitting (DPP) to consolidate accreted beach lands makai of the parcel prior to purchasing the property (1999/CLOG-3593(ST)). Although construction permits and other land use authorization permits could not be located for the existing shoreline protection system, affidavits filed for the property indicated that the wall was built prior to World War II and has been buried for the past 38 years. Additionally, although the older wall cannot be seen in 1967 aerial photos, the wall was possibly buried at that time (*Appendix A, DPP letter dated July 13, 1999, File Number 1999/CLOG-4318(ASK)*). The existing seawall structure is therefore considered nonconforming.

The rock apron was permitted on October 14, 1968 by the State of Hawaiʻi Department of Transportation (HDOT) Harbors Division for construction *(Appendix B, Shore Waters Construction Permit No. 1395*). On November 20, 1968, a variance was approved by the Zoning Board of Appeals for four properties along the Lanikai coastline, including the subject property, to construct a rock apron seaward of the nonconforming seawall and within the zone of wave action (*Appendix C, Variance Related to the Zone of Wave Action No. 1968/Z-124*).

In 2012, the Hawaiʻi Board of Land and Natural Resources (BLNR) approved disposition of a term, non-exclusive easement for seawall and revetment purposes. The easement was executed by the Hawaiʻi State Legislature on September 27, 2013. The easement confers unto the Grantee the "right, privilege, and authority to use, maintain, repair, replace and remove the existing seawall and steps over, under, and across State-owned land". The easement also requires that the Grantee "shall keep the easement area and the improvements thereon in a safe condition". The easement is valid for fifty-five (55) years and will expire on September 27, 2069 (*Appendix D, Amendment of Grant of Non-Exclusive Easement S-6043*). The project shoreline was certified by the State Department of Accounting and General Services, Survey Division on April 3, 2014. An updated shoreline survey was subsequently conducted, and the shoreline did not change. The shoreline certification was approved by DLNR on November 13, 2020 (*Appendix E, Shoreline Certification Map, File No. OA-1911*).

Documents detailing the regulatory status of the existing shoreline protection system are included within *Appendix A.*

In 2017, an investigation was performed by APTIM Environmental and Infrastructure, Inc. as a routine inspection to assess the general overall condition of the structures, assign condition assessment ratings, and identify recommended actions for future maintenance activities. Based on field observations and criteria established in the Waterfront Facilities Inspection and Assessment Manual (ASCE, 2015), the revetment was given a condition assessment rating of "Fair" as all primary structural elements are sound but minor to moderate defects were observed, and repairs were recommended. However, the seawall was given a condition assessment rating of "Serious" as advanced deterioration, overstressing, and breakage may significantly affect the load-bearing capacity of primary structural elements. Therefore, repairs to the seawall were determined to be carried out on a high-priority basis with urgency.

This EA demonstrates that repair to the existing shore protection system is an appropriate solution to meet the requirements of the easement. Repair is needed in order to protect the property from increased shoreline erosion and to maintain the existing shoreline protection system in a safe condition. Repairs to the seawall will be outside of the State Conservation District, starting mauka of the certified shoreline and extending landwards towards the existing residence. To support repairs to the existing system, the applicants will apply to the City for an SSV. This EA is being prepared in support of the SSV application in compliance with the Shoreline Setback and Special Management Area ordinances.

1.4 Purpose of the Environmental Assessment

Pursuant to Chapter 343 HRS and Chapter 11-200.1 HAR, development within the shoreline area is the trigger for preparation of the EA. DPP is the accepting authority. In the City and County of Honolulu, development within the shoreline area also requires an SSV pursuant to Chapter 23 ROH and SMA compliance pursuant to Chapter 25 ROH. Processing an SSV application by the DPP is a two-phase process. The first phase involves the acceptance of the Chapter 343 HRS EA. After the environmental review process, an SSV application will be processed by the DPP and include a public hearing. The SSV permit will require approval by the Honolulu City Council.

In accordance with Hawai'i's Environmental Review process, this Draft EA identifies the potential environmental impacts of the project, provides mitigation measures, and seeks agency and public comments. This Draft EA analyzes potential project impacts under 13 significance criteria listed in Chapter 11-200.1-13 HAR to provide a determination as to whether an Environmental Impact Statement shall be required. Pursuant to Chapter 11-200.1-20, the filing and publication of this Draft EA with the Office of Environmental Quality Control (OEQC) will be followed by a 30-day public comment period. All relevant public comments received during the comment period will be included in the preparation of the Final EA. This EA is expected to result in a FONSI.

1.5 Permits and Approvals Required

Several other approvals will be required from the State of Hawai'i (State) and City to implement the project, as outlined in *Table 1-1* below:

Table 1-1 List of Required Government Permits and Approvals

Permit or Approval	Approving Authority
Final Environmental Assessment / FONSI, Chapter 343 HRS	DPP
Special Management Area compliance, Chapter 25 ROH	DPP
Shoreline Setback Variance, Chapter 23 ROH	DPP
Minor Shoreline Structure	DPP
Certified Shoreline Survey	Department of Land and Natural Resources
Chapter 6E HRS Compliance Historic Resources	DLNR, State Historic Preservation Division (SHPD)
Grading, Grubbing, Trenching and Stockpiling Permits	DPP
Building Permits (Demolition, Buildings, Electrical, Plumbing)	DPP

The U.S. Army Corps of Engineers, Honolulu District was consulted in preparation of this EA. It is anticipated that Department of the Army permit authorization pursuant to the Clean Water Act (CWA), Section 404 (33 U.S. Code 1344) or Rivers and Harbors Act of 1899, Section 10 (33 U.S. Code 403) is not required because repairs to the seawall will not occur above, within, or below Waters of the U.S. Consequently, the project will not require a Water Quality Certification pursuant to the CWA, Section 401.

Notably, a Conservation District Use Permit (CDUP) from the DLNR-Office of Conservation and Coastal Lands (OCCL) is not required because the proposed repairs would be landward of the shoreline, outside of the Conservation District, which includes all lands makai of the certified shoreline. The shoreline fronting the subject property has been surveyed and the approved shoreline certification from the DLNR included in *Appendix E*.

The City regulatory review of the proposed action in the context of Act 16 (SB2060, SD2, HD2) adopted on September 15, 2020, requires confirmation of the exempt status of the existing seawall and its pending repair from a SMA permit.

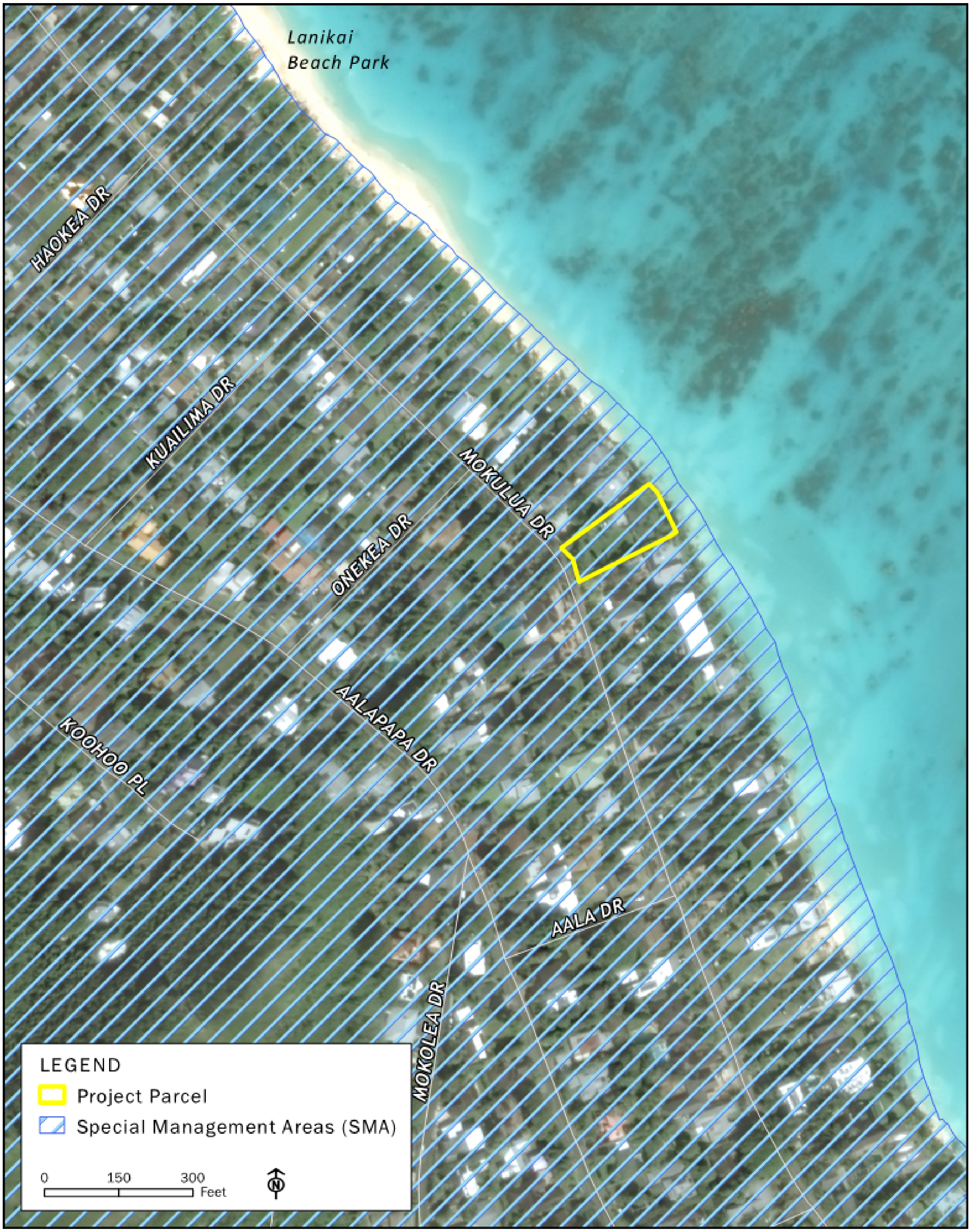
1.6 Agencies, Organizations and Individuals Contacted During the Pre-Consultation Process

To initiate the environmental review process pre-consultation communications were conducted with various Federal, State, and City agencies and the Lanikai Association in June 2020, listed below:

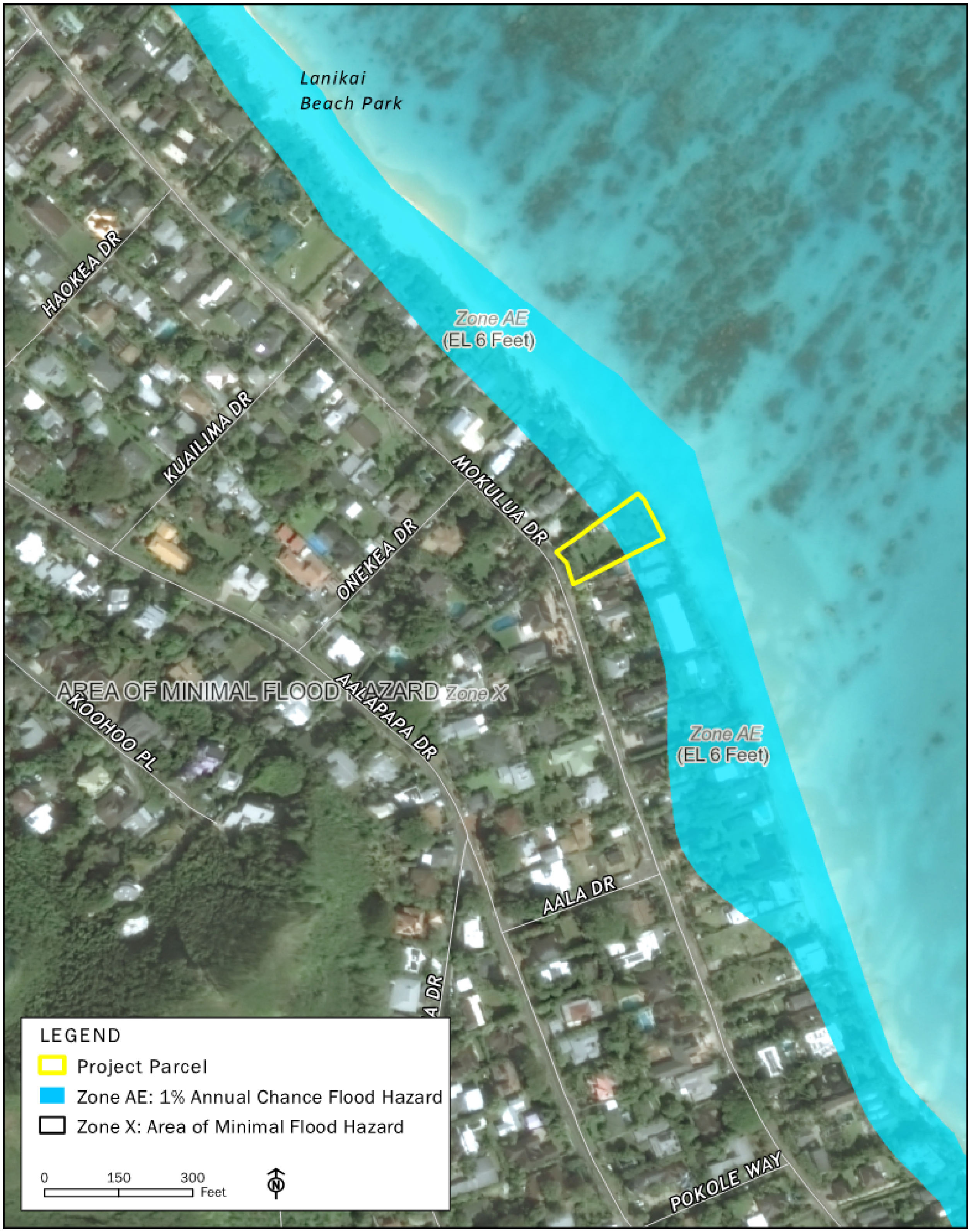
- U.S. Fish and Wildlife Service (USFWS), Pacific Islands Office
- U.S. Army Corps of Engineers (USACE), Honolulu District
- National Marine Fisheries Service (NMFS), Pacific Islands Regional Office
- State of Hawaii, Department of Business, Economic Development, and Tourism (DBEDT)
- State of Hawaii, DOH
- State of Hawaii, DLNR
- State of Hawaii, DLNR, SHPD
- State of Hawaii, DLNR, OCCL
- State of Hawaii, Office of Hawaiian Affairs (OHA)
- City and County of Honolulu, Department of Design and Construction (DDC)
- City and County of Honolulu, DPP
- Kailua Neighborhood Board No. 31
- Lanikai Association

A summary of comments received and list of agencies and other parties that will be provided an opportunity to review the Draft EA is provided in *Chapter 7.0* of this document.

Project Location and TMK Parcel **Figure 1-1**



Special Management Area **Figure 1-2**



Federal Emergency Management Agency (FEMA) Flood Zone **Figure 1-3**

Section 2

Project Description

Chapter 2

Project Description

2.1 Project Location

The project site consists of a single residential property identified by TMK (1) 4-3-005: 056 located on Mokulua Drive in the community of Lanikai, Kailua, Koʻolaupoko District on the island of Oʻahu (*Figure 1-1*). The property is located 0.70-mile southeast of Alala Point, and approximately 0.76 mile-northwest of Wailea Point. The project is situated on Low Density Residential zoned lands which are privately owned. The property is bound by the Pacific Ocean to east, Mokulua Drive to the west, and private residences to the north and south. The property is fronted by a seawall constructed of unreinforced concrete and a rock apron composed of basalt boulders that runs along the length of the seawall. The north and south adjacent properties are fronted by similar shore protection structures. See *Figure 2-1, Project Site Photograph (Sea Engineering, Inc. (SEI))*.

Project Site Photograph (SEI) **Figure 2-1**

2.2 Site Characteristics

Existing Uses and Conditions

The project site consists of a single residential parcel with a total land area of 18,376 square feet (0.42-acre) and a total shoreline frontage of 105 feet. The concrete driveway connects Mokulua Drive to the existing two-story single-family home, which is set back 40 feet from the existing shoreline. The home is currently being threatened by active shoreline erosion due to undermining of the seawall.

Terrestrial elevation ranges at the project site range from 7 to 11 feet above mean sea level (msl). The property is fronted by a shore protection system comprised of a seawall that is constructed of unreinforced concrete and a rock apron that is composed of basaltic boulders ranging from 9 to 18 inches in diameter. The rock apron is approximately 4 feet high, 10 feet wide, and runs along the length of the seawall. The current conditions of the shoreline are shown in *Figures 2-2 and 2-3*. The seawall is nonconforming, while the rock apron is permitted by HDOT Harbors (see *Section 1.3*).

SEI evaluated the existing shore protection system, and provided a detailed description in *Appendix F, Coastal Assessment for Krueger Seawall Repairs* (2020). The existing seawall is approximately 90 feet long and 6 to 8 feet tall, as referenced from the beach sand elevation at the time of inspection of the site in 2019. The top of the wall varies in elevation from about +5 feet to +7 feet msl. The top of the wall is approximately 16 to 17 inches wide with apparent front and rear batters of about 1H:12V to 1.5H:12V. Based on these batters and wall heights, the base of the wall is estimated to be approximately 2.4 feet wide. Two concrete counterforts are located on the landward side of the wall at approximately 43 feet and 70 feet from the north end, respectively (*Figure 2-4*). The seawall terminates approximately 20 feet from the northwest property corner. Wave action is causing erosion of the terrestrial soils in this area.

The seawall appears to have been constructed in six segments, or panels. Vertical joints are visible between each panel section. There is evidence of concrete repairs at several of the panel joints. An approximately 1 to 2-inch-wide gap was observed at the panel joint between the subject seawall and the south adjacent seawall

Settlement was observed along the northern portion of the seawall, which is likely due to the loss of subgrade support from erosion of the underlying substrate. In the areas where settlement was observed, outward rotation of the wall has also occurred. Most noticeable failure is at the return on the north end of the seawall which has disconnected from the main wall structure. The outward rotation of the wall may be attributed to a loss of bearing support fronting the wall and/or an increase in the active lateral forces due to saturated soil conditions. See *Appendix F* for additional photos depicting the existing conditions and deterioration of the seawall.

Further, the seawall appears to have been constructed on soft substrate that is highly susceptible to scour and erosion. Sinkholes are apparent along the entire length of the seawall. The sinkholes likely formed due to internal erosion of the sandy substrate from beneath and behind the seawall.

Existing Conditions – North End of Shoreline (SEI) **Figure 2-2**

Existing Conditions – South End of Shoreline (SEI) **Figure 2-3**

Adjacent Land Uses

Land uses adjacent to the project site include residential areas to the north and south, Mokulua Drive to the southwest, and the Pacific Ocean to the northeast. The project site is located along a predominantly armored shoreline characterized by a mix of seawalls, rock aprons, and revetments that extends approximately 4,000 linear feet from Wailea Point to the central portion of Lanikai Beach. The south adjacent property is fronted by a seawall that appears to be of similar construction, while the north adjacent property is fronted by a concrete rubble masonry (CRM) seawall and rock apron composed of loose basalt boulders.

Narrow sand beaches exist along portions of the Lanikai shoreline and there is some public access to these areas, but lateral shoreline access is limited between them. Shoreline public access is not available through or alongside the subject property. The closest beach access points are 350 feet northwest and 400 feet southeast of the property. Lanikai Beach, with wide fringing limestone reef flats protecting the coastline, is a recreational destination for snorkelers, swimmers, and spearfishermen. Large portions of the beach adjacent to the property are submerged at high tide, though the beach may be used by beachgoers during low tide. There are no notable surf breaks directly offshore of the project site. Surfing areas are located far offshore, outside of the reef crest for the wide, shallow, fringing reef. Very limited off-street vehicular parking is available for beachgoers along Mokulua Drive, and its side streets with the closest public restrooms and showers located at Kailua Beach Park.

Shoreline Characteristics

The project coastline is characterized by a wide fringing reef that extends over 3,000 feet offshore and along the Mokulua Islands. The fringing reef is incised with channels or depressions at numerous locations and has numerous sand patches. The shallow reef crest and reef flat dissipate wave energy as it approaches the shoreline. During typical conditions, significantly less wave energy reaches the shoreline than exists in deep water due to the shallow depths of the reef and subsequent wave breaking. However, wave energy still reaches the shoreline at higher water levels and cross-shore currents still occur.

The shoreline is shaped by the prevailing tradewind waves. These waves experience refraction and diffraction past the Mokulua Islands and over the shallow fringing reef, resulting in a very complex nearshore wave pattern.

Sand in Lanikai Beach and the nearshore sand fields is mobilized through active longshore and cross-shore transport. Typical patterns on windward Oʻahu beaches show sand being pushed offshore with winter swell events and a gradual transport back onshore during summer tradewind swell conditions. Longer term sand dynamics of Lanikai Beach have changed due to the extensive armoring of the shoreline, particularly along the southern portion of the shoreline, south of the project site.

Prior to the late 1970's, Lanikai Beach showed a trend of accretion. This trend reversed causing erosion along the shoreline and, in response, property owners constructed seawalls and other hardened shoreline protection structures (Romine and Fletcher, 2012). The project site is located at the north end of a predominantly armored shoreline that extends approximately 4,000 feet south to Wailea Point. The shoreline north of the project site transitions to a wider, dry beach with backshore dune formation and stable vegetation. Many of the properties in this area are fronted by shore protection structures that have been buried as the shoreline has accreted over time. The beach extends approximately 2,500 feet north of the project site. The remaining 1,200 feet of shoreline extending to Alāla Point is fronted by shore protection structures. See *Figure 2-4*.

.

Project Site and Surrounding Shoreline Characteristics (SEI) **Figure 2-4**

2.3 Purpose and Need for Action

The objective of the proposed action is to maintain the existing shore protection in a safe condition, pursuant to the conditions of the easement. The easement confers unto the Grantee the "right, privilege, and authority to use, maintain, repair, replace and remove the existing seawall and steps over, under, and across State-owned land". The easement also requires that the Grantee "shall keep the easement area and the improvements thereon in a safe condition". In order to adhere to the conditions of the easement, damage and structural deficiencies of the existing seawall must be addressed. The objective of the proposed action is also to provide long-term protection from increased coastal erosion. Shoreline erosion has encroached on properties in Lanikai with nearly all properties protected by shoreline protection structures (*Figure 2*-4). Coastal erosion has persisted, posing increased threats to the property and home.

The proposed action will involve activities within the shoreline area; therefore, preparation of an EA pursuant to Chapter 343 HRS is required. An EA is also requisite for submittal of the forthcoming SSV and compliance with the Shoreline Setback and Special Management Area ordinances. Activities in a shoreline area are defined and regulated in ROH Chapters 23 and 25. Per ROH 23-1.8 (b)(3), the director may grant a variance upon finding that the proposed activity meets the hardship standard. The proposed action meets the hardship criteria as listed in ROH 23-1.8 (b)(3) Hardship Standard. Please refer to *Chapter 5.8, Shoreline Setbacks* and *Chapter 5.9 Special Management Area* for further discussion.

2.4 Proposed Action

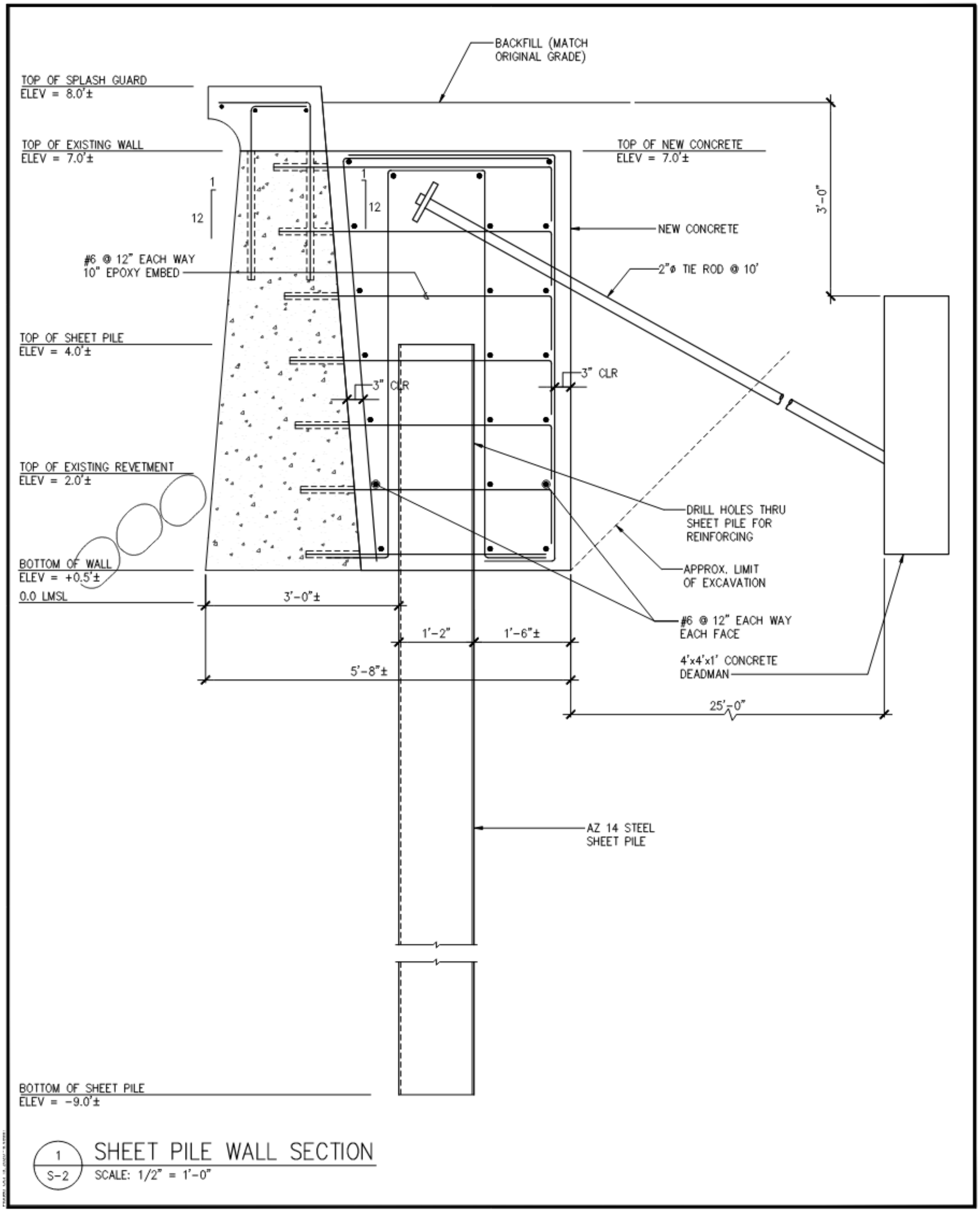
The existing seawall exhibits a variety of damage and structural deficiencies including settlement, outward rotation, cracking, undermining, and sinkholes. The most critical structural deficiency is the shallow depth of the existing foundation, which makes the wall vulnerable to scour and undermining. To address these issues, the Proposed Action was developed through an engineering alternatives analysis by SEI (2020) that evaluated eight alternatives (see *Appendix F*). The following discusses the Proposed Action, and a discussion of each alternative analyzed is provided in *Chapter 4.0*.

Design Characteristics

The Proposed Action is the "Seawall Repair" alternative, which was preferred because of its ability to meet the project objectives in a cost-effective manner, while minimizing potential impacts to the environment and adjacent shorelines. The Proposed Action retains the existing seawall and structurally connects a new sheetpile stabilization system landward of the existing seawall. The sheetpile would connect to the existing seawall by the construction of a concrete width extension and sheetpile cap dowelled to the existing wall. This would mitigate additional settling and rotation should undermining of the wall continue. See *Figure 2-5* for a conceptual plan provide by MKE Associates LLC.

The seawall repair option would retain the existing rock apron. An advantage of using a rock apron in a coastal environment is its capacity to disperse wave energy. This wave dispersion characteristic significantly reduces reflected wave energy while also preventing the downward motion of reflected wave energy that results in scour of the natural sediment. By dispersing wave energy as it impacts the shoreline, these installations improve the longevity of the backing structure and assist in protecting the backshore when paired with a seawall. The scope of the Proposed Action includes repair of the seawall, and does not include work on the rock apron.

In a study of shoreline structures in Lanikai and their relationship to coastal conditions, Lipp (1995) showed that measured beach profiles in Lanikai were of similar slope fronting beaches and dissipative seawalls (i.e., seawalls with rubblemound/scour aprons). Maintaining the existing rock apron will help to reduce scour with a significant reduction in reflected wave energy. This reduction in wave energy at the face of the seawall is expected to steepen the beach profile and allow sand to build up makai of the structure when there is available material. Lipp (1995) documented this effect in Lanikai and it has been corroborated with empirical evidence from the region.



Conceptual design for seawall repair (MKE) **Figure 2-5**

Repairing the seawall is preferable because it is less invasive and minimizes potential environmental impacts. A sheetpile stabilization system landward of the existing seawall would provide adequate resistance to design lateral forces and overturning moments produced by the retained soil and may extend the life of the structure for an undetermined amount of time. This repair approach is the most cost-effective alternative as it would require less excavation and would eliminate the costs to demolish and remove the existing seawall.

Construction Characteristics

Construction will require demolition and removal of the existing concrete counterforts. Construction will be accomplished from the upland areas with minimal disturbance to site topography. Vegetation clearing and grubbing will be very limited. Implementing the sheetpile stabilization system will require excavation in the yard area, landward of the seawall. Construction materials and equipment will be stored on the property. Construction work will be performed in accordance with the Federal, State, and City code and design standards.

Construction activity hours will be from 8:00 am to 6:00 pm. Construction will adhere to applicable noise regulations pursuant to HAR, Title 11, Chapter 46. Typical construction vehicles will be used on the jobsite for the project. These may include front-end loader, dump truck, and flatbed delivery trucks. As necessary, a permit will be obtained from Department of Transportation (DOT) Highways for transport of light trucks, backhoe, oversize equipment and overweight loads.

Nearshore ocean water quality in the project vicinity will be protected by the implementation of Best Management Practices (BMPs) during the construction period. To minimize temporary effects of suspended sediments in nearshore waters, mitigation such as a floating silt curtain will be deployed along the seaward edge of the construction segment, to contain the limited amount of suspended material along the immediate beach area during construction. Implementing the sheetpile stabilization system landward of the existing seawall will allow the seawall to serve as a functional barrier to protect the construction work area and be highly effective in maintaining runoff and suspended sediment from reaching the ocean.

The combined effects of multiple BMPs should result in improved protection for both nearshore water quality and the construction area. Work will be completed over a course of 90 to 120 days.

Several alternative designs are further discussed and evaluated in *Chapter 4.0.* Repairing the seawall falls within the conditions of the easement with the “right, privilege, and authority to use, maintain, repair, replace and remove the existing seawall.” The sheetpile stabilization system installed landwards of the existing seawall is the most feasible and least invasive alternative. This system will mitigate additional settling, rotation and undermining, and continue to protect the property from increasing shoreline erosion. The Proposed Action does not substantially or adversely impact existing lateral shoreline access or coastal processes, nor existing view planes to or along the shoreline.

2.5 Access, Utilities, and Infrastructure

Overall existing conditions, impacts, and mitigation measures for utilities are discussed in *Chapter 3.0* of this document. Existing vehicular access to the project site is from Mokulua Drive. The subject property has water supply (BWS), sewer, electricity (HECO), communications, and municipal solid waste collection services. The Proposed Action does not require construction of new infrastructure or alteration of existing utilities, and access to the site will continue to be on Mokulua Drive.

2.6 Summary of Project Cost

The projected cost for the repair of the existing shore protection system is anticipated to exceed $500,000.

Section 3

Description of the Environmental Setting, Potential Impacts and Mitigation Measures

Chapter 3

Description of the Environmental Setting, Potential Impacts, and Mitigation Measures

This section describes the existing environmental setting and identifies possible impacts of the planned repairs to the shoreline protection structure. Strategies to mitigate potential impacts are also identified.

3.1 Topography

Existing Conditions

The project site rests on a relatively flat coastal plain and gently slopes from approximately 5 feet above msl along the makai boundary to approximately 15 feet above msl on the mauka boundary along Mokulua Drive.

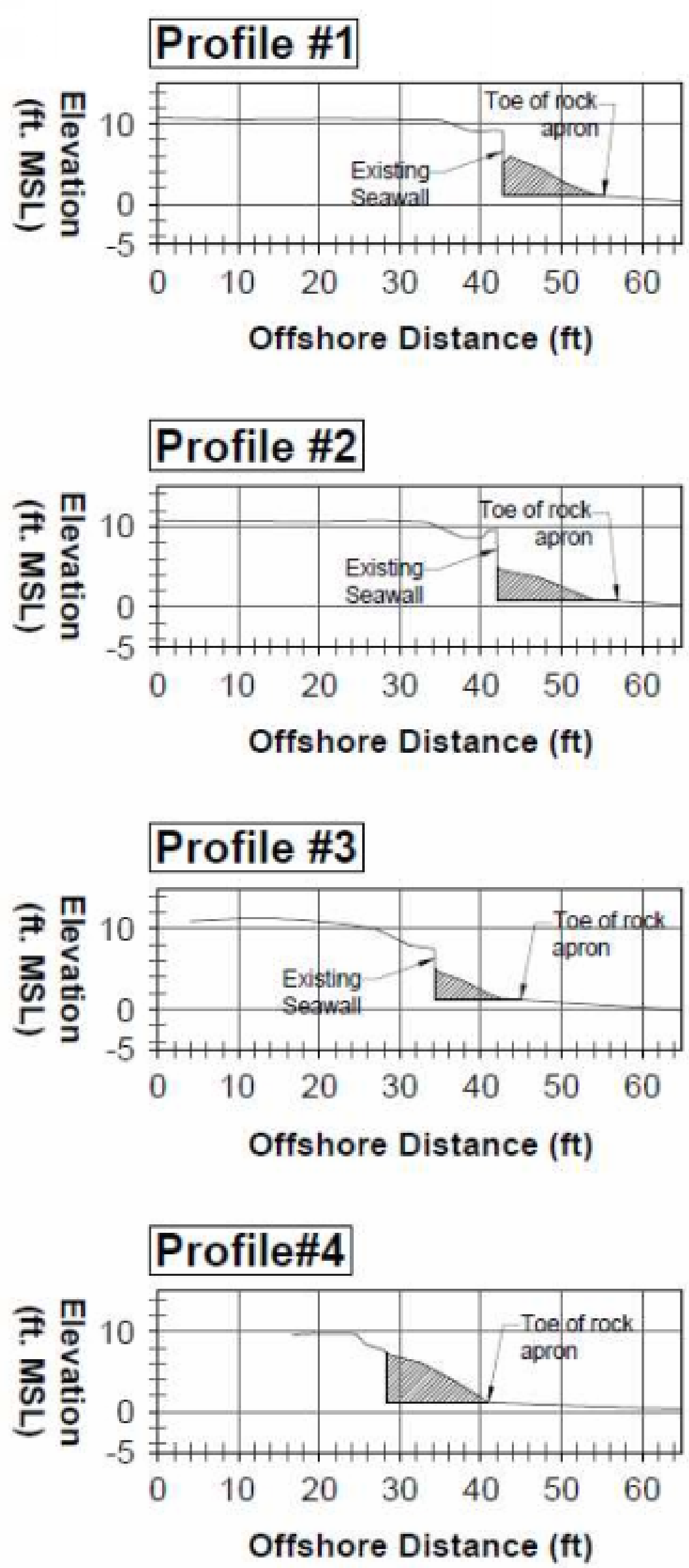
SEI conducted a topographic survey in July 2020 to collect elevation data of the backshore, foreshore, and nearshore waters fronting the project site (*Appendix E*). Shoreline profiles were generated through the topographic survey data to show the cross-shore profile of the seawall and rock apron *(Figure 3-1* and *Figure 3-2)*.

- **Profile 1:** Profile 1 is located on the southern portion of the parcel and extends from the southern edge of the existing residence to the toe of the rock apron.
- **Profile 2:** Profile 2 is located at the mid portion of the parcel and extends from the boundary of the concrete slab of the home to the toe of the rock apron.
- **Profile 3:** Profile 3 is located at the northern portion of the parcel and extends from the edge of concrete slab of the home to the toe of the rock apron.
- **Profile 4:** Profile 4 is located at the northern portion of the parcel and extends from the northern edge of the existing residence to the toe of the rock apron. There is no seawall present at this profile.

Anticipated Impacts and Mitigation Measures

The seawall repair will be accomplished landward of the existing seawall. Construction-related activity to repair the seawall is not anticipated to substantially alter the site's topography. Construction BMPs will be implemented pursuant to the required Grading Permit to mitigate potential impacts of soil erosion and fugitive dust during grading or excavation. Construction BMPs may include, but are not limited to, a stabilized construction entrance, stabilization of disturbed areas, and maintenance of equipment. Additional mitigation may include removal of unsuitable soils under foundations BMPs will also be deployed at exposed areas to minimize potential runoff.

Existing Shoreline Protection Profiles **Figure 3-1**



Exisiting Shoreline Protection Profiles **Figure 3-2**

3.2 Soils and Erosion Conditions

Existing Conditions

Soil types within the project site are identified in the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Web Soil Survey. The USDA NRCS system classifies soils by type and permeability characteristics, including run-off and erosion. The site consists of Beaches and Jaucus Sand, 0-15 percent slopes (JaC) (*Figure 3-3*). This type of soil is well drained, and runoff is low.

Geotechnical investigations were conducted by APTIM (February 2019) and Shinsato Engineering, Inc. (July 2020). The investigations included a total of three (3) test borings and a laboratory analysis on the soil samples to determine their engineering properties. The backfill soil and seawall subgrade appears to be a fine to medium grain calcareous sand. Bore #1 and Bore #2 of the APTIM (2019) investigation encountered what appeared to be a hard, nonerodable substrate approximately 15 to 20 feet below the backfill ground elevation. Bore #1 of the Shinsato (2020) investigation (*Figure 3-4)* encountered loose, light brown and tan, fine grained calcareous sand to a depth of 9 feet. Below 9 feet, the sand was found to be medium to coarse grained and medium dense in consistency. At 10.5 feet, the bore hole caved in. Proving below 10.5 feet disclosed medium dense to dense soil to a depth of 26.5 feet below grade then grading to very dense to the final depth of the boring at 28.33 feet where there was a refusal to further probing. Groundwater was encountered at a depth of 7'10" below the existing grade. SEI previously conducted water jet probing at several properties near the project site. Probe refusal was encountered at -6 to -8 feet msl.

The seawall was constructed on loose sandy substrate that has a high susceptibility to erosion. As a result, settlement was observed along the northern portion of the seawall. The settlement is likely due to the loss of subgrade support from erosion of underlying soil. Additionally, the loss of subgrade support from erosion of underlying soil and the loss of bearing support fronting the seawall due to soil saturation has contributed to the slight outwards rotation of the seawall's northern portion. The northern portion of the seawall has settled and rotated outwards, disconnecting the seawall return and the main seawall structure. Ongoing erosion exposed the bottom of the seawall on the northern end, where a sandy substrate is visually noticeable.

Sinkholes were observed behind the central and northern portions of the seawall. The sinkholes were likely formed due to internal erosion of the sandy backfill material from behind and beneath the seawall foundation. The sinkholes behind the central portion of the seawall were generally less than 24 inches deep and approximately 6 feet in width. Sinkholes behind the seawall's northern portion were previously backfilled with materials including concrete and boulders that appear to be from the rock apron. Although sinkholes were not observed along the southern portion of the seawall, undermining is likely occurring in this area as well.

The longer-term dynamics of Lanikai Beach's sands have changed with the gradual armoring of the shoreline. Prior to the late 1970s, Lanikai Beach showed accreting sands, which gradually reversed, causing erosion along the shoreline. In response, seawalls and other hardened shoreline structures were constructed by shoreline property owners. The project site is situated at a headland where the orientation of the shoreline transitions from approximately 160 degrees (to the south) to 135 degrees (to the north). The dominant shoreline change trend to the south has been erosion, whereas accretion has been the dominant trend to the north.

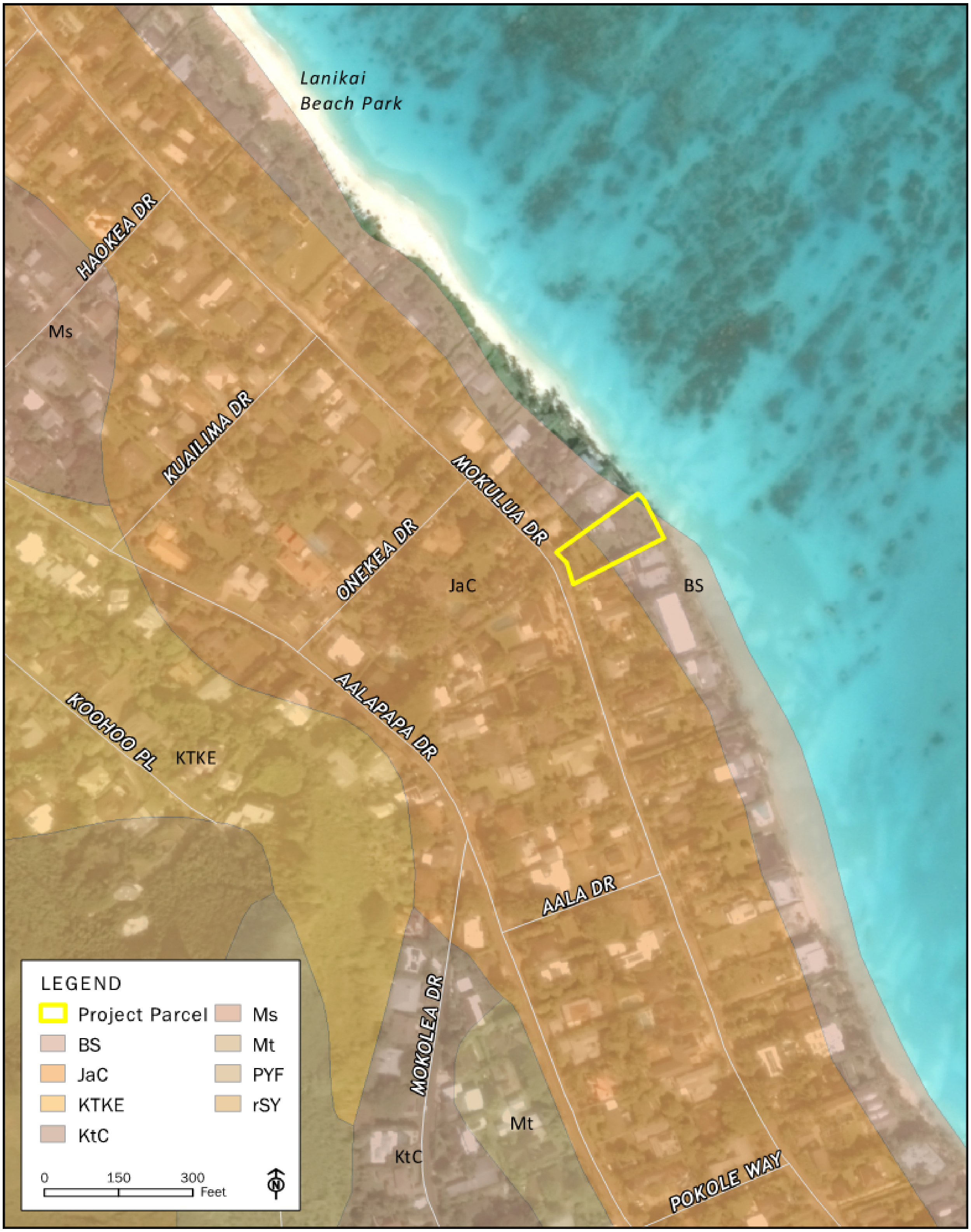
Datable ground photographs provide evidence that the Project site's shoreline have been experiencing ongoing erosion for many years as the seawall appears to be constructed before WWII (DPP Letter dated July 13, 1999). The project site is bounded by a CRM seawall and rock apron to the north and a vertical concrete seawall and rock apron to the south. Further north of the project site lays approximately 4,000 linear feet of armored shoreline. The project site's shoreline is characterized as a wet beach that moves with inflation and deflations.

Offshore, the Lanikai area is characterized by expansive fringing limestone reef flats over 3,000 feet offshore along the Mokulua Islands. There are channels or depressions at numerous locations along the reef. During typical conditions, significantly less wave energy reaches the shoreline. Wave energy still reaches the shore at high water levels and cross-shore currents still exist. Sands in the area are mobilized through active longshore transport. Typical patterns for East O'ahu show sand being pushed offshore with winter swells and gradual transport back onshore during summer trades.

Anticipated Impacts and Mitigation Measures

Construction of the seawall stabilization system will require excavation in the yard area. Erosion control practices will comply with County, State, and Federal regulations. BMPs will be implemented pursuant to the required Grading Permit to mitigate potential impacts of soil erosion and fugitive dust during excavation. BMPs may include a floating silt curtain to contain the limited amount of suspended material along the immediate beach area during construction. Construction-related activity will take place landward of the existing seawall, which will allow the seawall to serve as a functional barrier to protect the ocean from runoff and suspended sediment from construction-related activity.

The objective of the proposed repairs is to bring the shoreline protection structure into safe condition, pursuant to the conditions of the easement, and protect the property from increased coastal erosion. The soil composition will not change with the seawall repairs and will not cause any adverse effects to the shoreline of adjoining properties or public lateral access and sand flow.



Soils Map **Figure 3-3**

LOG OF BORING NO. 1

DRILLING METHOD: **Badger Drill Rig**
HAMMER WEIGHT (lbs): **140**
HAMMER DROP (in): **30**

ELEVATION (FT.): **Unknown**
DEPTH OF BORING (FT.): **28.33**
DEPTH TO GROUNDWATER (FT.): **7'-10"**
DATE DRILLED: **07/09/2020**

DEPTH (FT.)	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	BLOWS/FOOT	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)
0	SP-SM	SAND (calcareous), with fines, few roots		light brown	sl. moist	loose		
	SP	SAND (calcareous), fine grained, trace of fines		tan				
2			10				85.4	2.9
					moist			
4			7				89.5	6.0
6					very moist ▽			
			14				90.9	14.9
		--medium to coarse grain				medium dense		
10			19				95.8	15.6
		--hole caved in to 8' --probed from 10.5' with a 2-inch diameter probe tip attached to AW rods; driven with the 140-lb. hammer falling from a height of 30-incehs	14					
12			20					
			36			dense		
14			42					
			54					
16			41					
			36					
18			23			medium dense		
			22					
20			15					
			13					
22			16					
			11					
24			12					
			18					
26			20					
			51			very dense		
28		--refusal at 28'-4"	100/10"					
		END OF BORING						
30								

PENETROMETER (TSF) and TORVANE STRENGTH (TSF) columns: no entries.

Project: KRUEGER PROPERTY SEAWALL
1226 MOKULUA DRIVE
Project No.: 19-0067

SHINSATO ENGINEERING, INC.
CONSULTING GEOTECHNICAL ENGINEERS
98-747 KUAHAO PL. #E, PEARL CITY, HI 96782

PLATE 3

Boring Samples (Shintsato) **Figure 3-4**

3.3 Climate

Existing Conditions

According to the University of Hawai'i Geography Department *Climate of Hawai'i* interactive mapping tool, the windward and northern regions of the island are typically wetter than the western and southern regions. A typical year in Lanikai has approximately 31.4 inches of rainfall, and an average of 2.6 inches of rainfall per month. The wettest month of the year is December with an average of 4.9 inches of rainfall. The annual average air temperature in Lanikai is 73.8°F. The average monthly low temperature is around 70.1°F in January and the average monthly high temperature is around 77.3°F in August.

Anticipated Impacts and Proposed Mitigation

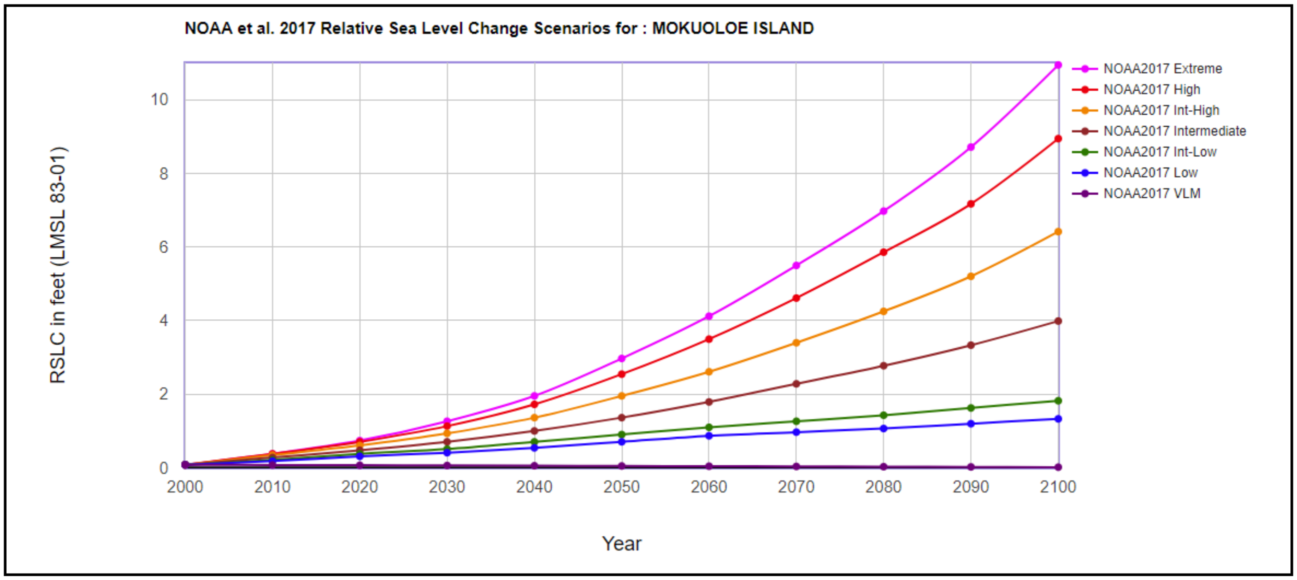
The project is not anticipated to result in nor constitute a source of impact to rainfall or climate of the project area or region. Therefore, no mitigation measures are required.

3.4 Climate Change and Sea Level Rise

Existing Conditions

Rapid anthropogenic climate change is a well-established fact within the scientific community. As a result of climate change, oceans are warming and acidifying, ice sheets and glaciers are melting, and sea levels are rising (NASA, 2018). Sea level rise (SLR) is negatively impacting beaches and shorelines in Hawai'i. Impacts may include beach narrowing and beach loss, loss of land due to erosion, and infrastructure damage due to inundation and flooding. The impacts from anomalous sea level events (e.g., king tides, mesoscale eddies, storm surge) are also likely to increase.

The National Oceanic and Atmospheric Administration (NOAA) recently revised their sea level change projections through 2100 considering up-to-date scientific research and measurements. Mean SLR scenarios for Hawai'i based on NOAA projections are depicted in *Figure 3-5*. An important conclusion of this regional climate assessment is that NOAA recommends the revised *Intermediate* rate for planning and design purposes in Hawai'i. The *Intermediate* rate projects that sea level in Hawai'i will rise 2.3 feet by 2070. Given the recent upwardly revised projections and the potential for future revisions, consideration may also be given to the *Intermediate-High* rate for planning and design purposes, which projects that sea level in Hawai'i will rise 3.4 feet by 2070.



Hawaiʻi Sea Level Rise Projections (adapted from NOAA, 2017) **Figure 3-5**

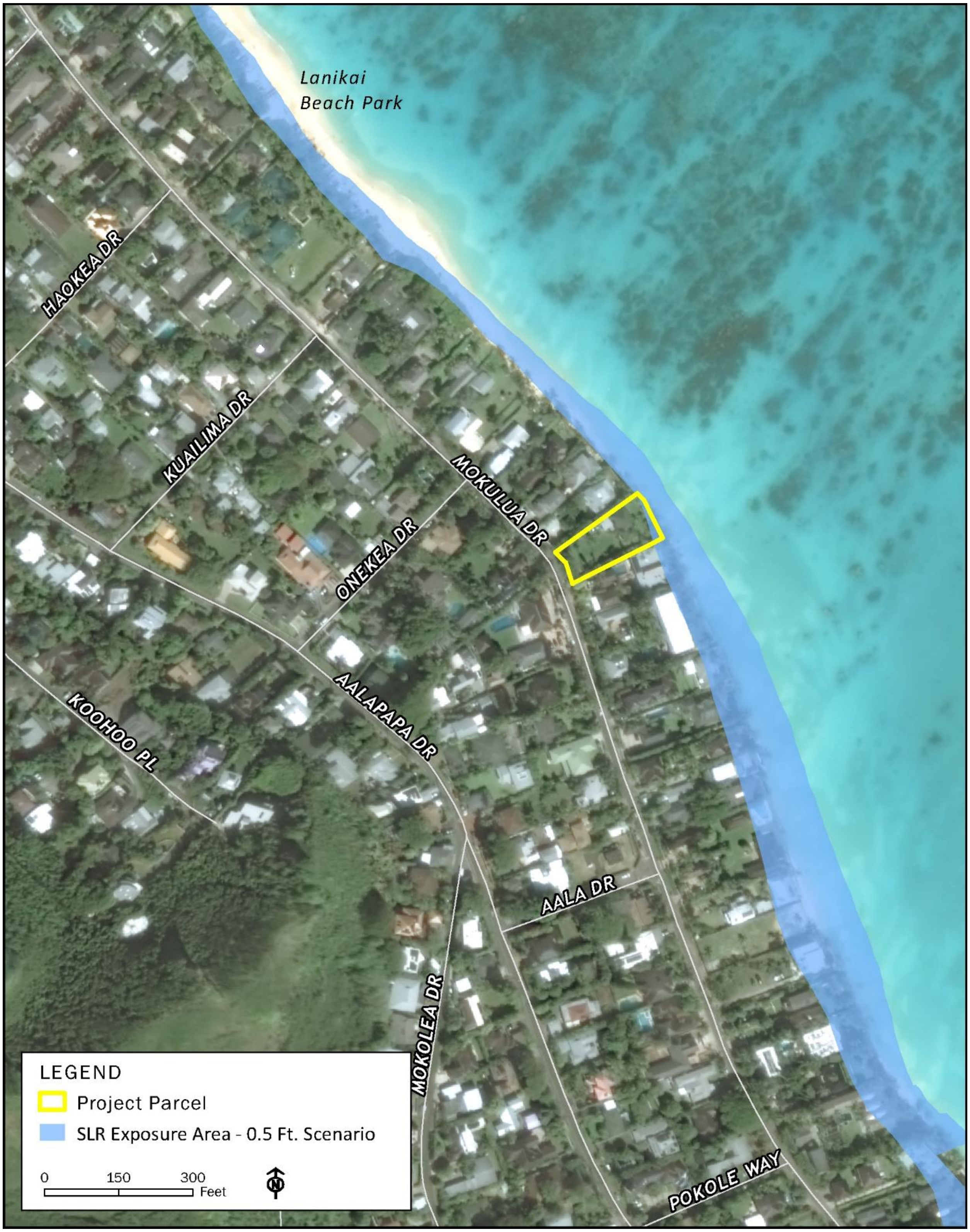
In 2017, the State published the *Sea Level Rise Vulnerability and Adaptation Report for Hawaiʻi*, which discusses the anticipated impacts of projected future SLR on coastal hazards, and the potential physical, economic, social, environmental, and cultural impacts of SLR in Hawaiʻi (Hawaiʻi Climate Change Commission, 2017). The report combines data from the Intergovernmental Panel on Climate Change (IPCC) Assessment Report 5 (IPCC 2014), NOAA, the National Aeronautics and Space Administration, and the best-available peer-reviewed scientific research articles. According to the report, "While the IPCC's "business as usual" scenario, where greenhouse gas (GHG) emissions continue at the current rate of increase, predicts up to 3.2 feet of global SLR by year 2100 (IPCC 2014), recent observations and projections suggest that this magnitude of SLR could occur as early as year 2060 under more recently published highest-end scenarios (Sweet et al. 2017). As such, questions remain around the exact timing of that rise due largely to uncertainties around future behavior of Earth's cryosphere and global GHG emission trajectories. For this reason, it is vital that the magnitude and rate of SLR is tracked as new projections emerge, plan for 3.2 feet of SLR now, and be ready to adjust that projection upward." The Hawaiʻi Sea Level Rise Viewer model developed by the University of Hawaiʻi (UH) Pacific Islands Ocean Observing System (PacIOOS) models the potential impacts that a 3.2-foot rise in sea level would have on coastal hazards include passive flooding, annual high wave flooding, and coastal erosion. The footprint of these three hazards were combined to define the project extent of chronic flooding due to SLR, referred to as the Sea Level Rise Exposure Area (SLRXA) (PacIOOS, 2018).

At the City level, Mayor Kirk Caldwell issued Directive 18-2 on climate change and SLR in July 2018 with the intention of establishing City policies to address climate change and SLR in accordance with the 2017 *Sea Level Rise Vulnerability and Adaptation Report for Hawaii*, and two publications from the Climate Change Commission: *Sea Level Rise Guidance* and the *Climate Change Brief*, both of which were adopted on June 5, 2018. The guidance issued through these publications echoed that a 3.2-foot SLR scenario by the end of the century was a reasonable benchmark for planning purposes (City Climate Change Commission, 2018). Directive 18-2 Section (V)(8) also stated, "Permitting permanent shoreline armoring is generally inconsistent with this directive and should only be considered as a last resort where it supports significant public benefits and will result in insignificant negative impacts to coastal resources and natural shoreline processes."

The property is located on along the shoreline, and a portion, including the seawall, is within the SLRXA, as indicated in the Hawaiʻi Sea Level Rise Viewer. See *Figure 3-6* for the 0.5-feet scenario and *Figure 3-7* for the 3.2 feet scenario. Data from the Hawaiʻi Sea Level Rise Viewer indicates that the project site will not be vulnerable to passive flooding or annual high wave flooding under both the 0.5-foot and 3.2-foot scenarios (SEI, 2020). However, the property could be exposed to erosion with 0.5 to 3.2 feet of SLR. The results of the erosion model represent the combined results of measured, historical erosion rates and the compounding impacts of projected higher water levels associated with projected SLR. The model results indicate that the project site will experience accretion with 3.2 feet of SLR (SEI, 2020).

Anticipated Impacts and Mitigation Measures

SLR is not expected to have short-term impacts on the project. Construction activity is anticipated to generate limited GHG emissions from combustion and exhaustion and will adhere to State DOH Air Quality Standards as discussed in *Section 3.10 Air Quality* to minimize short-term impacts. Repairing the seawall will have no long-term effect on climatic conditions, and therefore no mitigation measures are required.



0.5-Foot Sea Level Rise Scenario **Figure 3-6**

3.2-Foot Sea Level Rise Scenario **Figure 3-7**

The project site is situated at a headland where the orientation of the shoreline transitions from approximately 160 degrees (to the south) to 135 degrees (to the north). The dominant shoreline change trend to the south has been erosion, whereas accretion has been the dominant trend to the north. The SLRXA model projects that the shoreline south of the project site will experience increased erosion and flooding with SLR, whereas the shoreline to north will experience accretion and minimal flooding. The significant variability of the projected hazards over a small geographic area suggests that further study is required in order to quantify the potential impacts of SLR at the project site.

In the long term, a SLR of 2.3 feet was chosen by SEI for design purposes at the project site. The 2.3-foot SLR scenario projects that the shoreline south of the project site will experience increased erosion and flooding, whereas the shoreline to the north will experience accretion and minimal flooding. This corresponds to the Intermediate rate over a 50-year design life which is suitable for planning and design purposes for a project of this scale. The property is not affected by inundation in the more near term 0.5-foot SLR scenario.

The 2.3-foot SLR scenario was utilized as a basis for the design life for the various shoreline protection alternatives discussed in *Chapter 4.0*. While critical infrastructure such as roads, power plants, and hospitals may require the highest level of protection, it is reasonable to design coastal protection and stabilization structures for a lesser level, in this case a 50-year lifespan. Coastal structures require ongoing monitoring and maintenance due to their exposure to the degrading effects of marine processes. The basis of design parameters and consequent design life are based on typical functional use of similar coastal structures. Designing for conditions, such as significantly higher sea levels, that are predicted for time periods that well exceed the design life of the structure will produce more robust installations but will well exceed their functional performance requirements during their serviceable lifespans.

Although permanent armoring of the shoreline is inconsistent with the policies set forth in the City Directive 18-2 and the *Ola Oʻahu Resiliency Strategy*, there are multiple factors to consider when planning for SLR at the subject property including: site history and context, protecting the existing dwelling, protecting adjacent structures, preserving lateral access, and promotion of natural shoreline processes. Contextually, the owners of 1226a Mokulua Drive were granted an easement with the “Right, privilege, and authority to use, maintain, repair, replace and remove existing seawall and apron.” Declining the conditions pursuant to the easement, the seawall will continue to degrade, and the property would be subjected to severe erosion forces at the shoreline. Alternative shoreline protection pursuant to the conditions of the easement are discussed in *Chapter 4.0*.

Designing for a lesser SLR of 2.3 feet is still consistent with the City & County of Honolulu Mayor’s Directive 18-2, as the SLR that the coastal stabilization structures evaluated in by SEI (2020) (*Appendix F*) are expected to experience during their design lifetime would likely be less than the 3.2 feet presented in the directive. The property is not affected by inundation in the more near term 0.5 feet SLR scenario.

3.5 Natural Hazards

The following section summarizes the SEI (2020) report evaluating the property's exposure to natural hazards, with particular emphasis on coastal hazards, including tsunami, hurricanes, Kona storms, still water rise, and coastal flooding, in addition to seismic activity.

Existing Conditions

Hurricanes

Tropical cyclones originate over warm ocean waters, and they are considered hurricane strength when they generate sustained wind speeds over 64 knots (74 mph). Hurricanes that form near the equator, and in the central North Pacific usually move toward the west or northwest. During the primary hurricane season of July through September, hurricanes generally form off the west coast of Mexico and move westward across the Central Pacific. These storms typically pass south of the Hawaiian Islands and sometimes have a northward curvature near the islands. Late season hurricanes follow a somewhat different track, forming south of Hawaiʻi and moving north toward the islands. Three hurricanes have passed through the Hawaiian Islands in the past 25 years: Hurricanes ʻIwa in 1982 and Iniki in 1992, both passing near or over the island of Kauaʻi as well as Hurricane Iselle in 2014 passing over the island of Hawaiʻi. These storms caused high surf and wave damage on multiple shores of the islands. Although not a frequent or even likely event, hurricanes will be considered in the project design, particularly with regard to shoreline structures, both in the water and on land near the shore.

Kona Storms

Although somewhat protected by the southeast tip of Oʻahu, the study site is susceptible to damage from Kona storms, which occur during winter months, generally between October and April. Kona storms typically generate waves with significant heights of 9 to 16 feet and periods of 8 to 11 seconds. Occasional strong Kona storms have caused extensive damage to the south- and west-facing shorelines on Oʻahu. Deepwater wave heights during a severe Kona storm in January 1980 were about 17 feet with a period of 9 seconds.

Tsunami Inundation

Most tsunamis in Hawaiʻi originate from the tectonically active areas located around the Pacific Rim (e.g., Alaska, Japan, and Chile). Waves created by earthquakes in these areas take hours to reach Hawaiʻi, and the network of sensors that is part of the Pacific Tsunami Warning System can provide Hawaiʻi with several hours advance warning prior to the arrival of tsunami waves generated from these locations. Less commonly, tsunamis originate from seismic activity in the Hawaiian Islands, and there is less warning for these locally generated events. In 1946, a tsunami was generated in the Aleutian Islands and was one of the most destructive tsunamis to strike Hawaiʻi. The water level rise in Lanikai during the 1946 tsunami was 7 feet.

The City classifies tsunami evacuation zones into the following three designations: Tsunami Evacuation Zone, where evacuation is required for any tsunami warning; Extreme Tsunami Evacuation Zone (XTEZ), where additional areas must be evacuated only during an extreme tsunami event generated from earthquakes of Magnitude 9 or higher on the Richter scale; and, safe areas that are anticipated to be outside the inundated areas. The project site sits within an area designated as a Tsunami Evacuation Zone (*Figure 3-8*).

Tsunami Evacuation Zone **Figure 3-8**

Still Water Rise

Storms and large waves produce storm surge and wave setup that results in elevated water levels at the project site shoreline. During prevailing annual conditions this water level rise can be on the order of a foot above the tide level. However, during extreme events, the still water level rise can be significantly greater.

Coastal Flooding

The project site is relatively flat and level with an elevation ranging from approximately 5 to 15 feet above msl. Based on the FEMA Flood Insurance Rate Map (FIRM) map number 15003C0290H, effective November 5, 2014, the property is in Zone AE and Zone X (*Figure 1-3)*. The project site, where the repairs to the seawall will be accomplished is located in Zone AE. Zone AE is defined as, "areas subject to inundation by the 1-percent chance flood event by detailed methods." Zone X is defined as "areas of minimal flood hazard, which are the areas outside the Special Flood Hazard Area and higher than the elevation of the 0.2 percent-chance flood" (FEMA 2017). The property is not located within the VE zone which indicates wave velocity.

Seismic Activity

Per the 2006 International Building Code (IBC) seismic design maps, the entire City and County of Honolulu could experience seismic activity around 0.15 of the earth's gravitational acceleration (g-force) under a 1.0 second spectral response acceleration event. In comparison, the County of Hawaiʻi, with its ongoing volcanic activity, could experience ground motion anywhere from 0.30 up to 1.23 of the earth's g-force. In May 2018, the island of Hawaiʻi experienced a 6.9 magnitude earthquake due to volcanic activity at Kīlauea (USGS Earthquake Hazards Program).

Anticipated Impacts and Mitigation Measures

Short-term impacts of natural hazards to the project site are related to construction. If a hurricane, tropical storm, flooding, high winds, or seismic activity occur during repair of the seawall, construction activities would cease, and equipment will be secured in work and support areas. Essential equipment may also be located on higher elevations wherever feasible to avoid inundation from storm surges.

NASA research points to an increase in the severity and frequency of storms and SLR as a result of climate change (NASA, 2018). Effects of SLR on the project site are discussed in *Section 3.4*. The purpose of the project is to reduce the subject property's overall vulnerability to natural hazards that may contribute to shoreline erosion conditions. Repairing the seawall will bring the shoreline protection structure into safe condition, pursuant to the conditions of the easement, and protect the property from impacts during storm events.

3.6 Oceanographic Setting

SEI conducted a coastal assessment of the project site, included in *Appendix F*. The coastal assessment includes a description of the project site's oceanographic setting, is summarized below.

Existing Conditions

Winds

The prevailing winds throughout the year are the northeasterly tradewinds. The average frequency of tradewinds varies from more than 90% during the summer season to only 50% in January, with an overall annual frequency of 70%. Tradewinds are produced by the outflow of air from the Pacific Anticyclone high-pressure system, also known as the Pacific High. The center of this system is located well north and east of the Hawaiian Islands and moves to the north and south seasonally. In the summer months, the center moves to the north, causing the tradewinds to be at their strongest from May through September. In the winter, the center moves to the south, resulting in decreasing tradewind frequency from October through April. During these months, the tradewinds continue to blow; however, their average monthly frequency decreases to 50%. Westerly or Kona winds occur primarily during the winter months and are generated by low pressure or cold fronts that typically move from west to east past the Hawaiian Islands.

During the winter months, wind patterns of a more transient nature increase in prevalence. Winds from extra-tropical storms can be very strong from almost any direction, depending on the strength and position of the storm. The low-pressure systems associated with these storms typically track west to east across the North Pacific north of the Hawaiian Islands. At Honolulu International Airport, wind speeds resulting from these storms have on several occasions exceeded 60 mph. Kona winds are generally from a southerly to a southwesterly direction, usually associated with slow-moving low-pressure systems known as Kona lows situated to the west of the island chain. These storms are often accompanied by heavy rains.

Tides

Hawaiʻi tides are semi-diurnal with pronounced diurnal inequalities (i.e., two high and low tides each 24-hour period with different elevations). A modulation of the tidal range results from the relative position of the moon and the sun: when the moon is new or full, the moon and the sun act together to produce larger "spring" tides; when the moon is in its first or last quarter, smaller "neap" tides occur. The geometry of the oceans - the basin shape, local coastline, bays, and even harbor geometry - has a significant effect on the local behavior of the tides.

Tidal predictions and historical extreme water levels are given by the Center for Operational Oceanographic Products and Services, NOS, NOAA, website. A tide station is located at Moku O Loʻe (Coconut Island) in Kāneʻohe Bay. Water level data based on the 1983-2001 tidal epoch is shown in *Table 3-1*.

Table 3-1 Water level data for Moku o Loʻe, Station 1612480 (NOAA, 2020)		
Datum	**Elevation (feet, MLLW)**	**Elevation (feet, MSL)**
Mean Higher High Water	**+2.12**	**+1.07**
Mean High Water	**+1.80**	**+0.75**
Mean Sea Level	**+1.05**	**0.00**
Mean Low Water	**+0.31**	**-0.74**
Mean Lower Low Water	**0.00**	**-1.05**

Hawaiʻi is subject to periodic extreme tide levels due to large oceanic eddies and other oceanographic phenomena that have recently been recognized and that sometimes propagate through the islands. Mesoscale eddies produce tide levels that can be up to 0.5 to 1.0 ft higher than normal for periods up to several weeks (Firing and Merrifield, 2004). Temporary sea-level rise has also been associated with phenomena related to the El-Nino/Southern Oscillation (ENSO).

Waves

The wave climate in Hawaiʻi is dominated by long period swell generated by distant storm systems, relatively low amplitude, short period waves generated by more local winds, and occasional bursts of energy associated with intense local storms. Typically, Hawaiʻi receives five general surface gravity wave types: 1) northeast tradewind waves, 2) southeast tradewind waves 3) southern swell, 4) North Pacific swell, and 5) Kona wind waves.

Tradewind waves occur throughout the year and are the most persistent April through September when they usually dominate the local wave climate. These winds result from the strong and steady tradewinds blowing from the northeast quadrant over long fetches of open ocean. Tradewind deepwater waves are typically between 3 and 8 feet high with periods of 5 to 10 seconds, depending upon the strength of the tradewinds and how far the fetch extends east of the Hawaiian Islands. The direction of approach, like the tradewinds themselves, varies between north-northeast and east-southeast and is centered on the east-northeast direction. The project site is directly exposed to tradewind waves, which represent a significant source of wave energy reaching the shoreline.

During the winter months in the northern hemisphere, strong storms are frequent in the North Pacific in the mid-latitudes and near the Aleutian Islands. These storms generate large North Pacific swells that range in direction from west-northwest to northeast and arrive at the northern Hawaiian shores with little attenuation of wave energy. These are the waves that have made surfing beaches on the north shores of Oʻahu and Maui famous. Deepwater wave heights often reach 15 feet and in extreme cases can reach 30 feet. Periods vary between 12 and 20 seconds, depending on the location of the storm. The project site is directly exposed to North Pacific swell approach from the north and northeast directions and these waves represent a significant source of wave energy reaching the shoreline.

Southern swell is generated by storms in the southern hemisphere and is most prevalent during the summer months of April through September. Traveling distances of up to 5,000 miles, these waves arrive with relatively low deepwater wave heights of 1 to 4 feet and periods of 14 to 20 seconds. Depending on the positions and tracks of the southern hemisphere storms, southern swells approach between the southeasterly and southwesterly directions. The project site is well sheltered from the direct approach southern swell by the island itself, and only a portion of the wave energy refracting and diffracting around the southeast end of the island reaches the shoreline.

Kona storm waves also directly approach the project site; however, these waves are fairly infrequent, occurring only about 10 percent of the time during a typical year. Kona waves typically range in period from 6 to 10 seconds with heights of 5 to 10 feet and approach from the southwest. Deepwater wave heights during the severe Kona storm of January 1980 were about 17 feet. The project site is well sheltered from the direct approach of Kona storm waves by the island itself, and only a portion of the wave energy refracting and diffracting around the southeast end of the island may reach the site.

Severe tropical storms and hurricanes obviously have the potential to generate extremely large waves, which in turn could potentially result in large waves at the project site. As discussed in *Section 3.5*, recent hurricanes impacting the Hawaiian Islands include Hurricane Iwa in 1982 and Hurricane Iniki in 1992.

Further description on deepwater waves, extreme deepwater waves, numeric modeling of wave approach, and nearshore wave heights is provided by SEI (2020) in *Appendix F*.

Anticipated Impacts and Mitigation Measures

The proposed action to repair the existing seawall will not directly impact the oceanographic and coastal setting, nor will it affect the wind, wave, and tide conditions described above. However, these coastal conditions were considered in development of the project design. Winds, tides, waves, and other shoreline change trends were evaluated to assess the vulnerability of the property long-term coastal hazards. Existing conditions were also considered in developing appropriate alternatives and minimizing impacts to the coastal environment.

3.7 Marine Water Quality

An assessment of the existing condition of marine water chemistry in the offshore area of the project site that has the potential to be affected by the proposed seawall repairs was prepared by Marine Research Consultants, Inc (MRCI) (2020). The full report is included in *Appendix G.*

Existing Conditions

The PacIOOS Voyager mapping program displays the NOAA benthic habitat for the project area. The geomorphology and biology of benthic habitat for the area offshore of the project site is characterized by sand, scattered coral rock, pavement, and aggregate patch reef. Nearshore waters are classified by the USFWS as marine, intertidal, rocky shore that is regularly flooded. Offshore, coastal waters are classified as marine, subtidal, unconsolidated bottom (SEI, 2020)

Pursuant to HAR Chapter 11-54, DOH classifies the Pacific Ocean in the project area as a “Class A” marine water body, which are to be protected for recreational purposes and aesthetic enjoyment. These waters shall not act as receiving waters for any discharge which has not received the best degree of treatment or control compatible with the criteria established for this class.

Water chemistry field collection was conducted on May 15, 2020. Samples were collected at six locations along three study transects extending perpendicular to the shoreline approximately 50 m offshore. The results show elevated values of several nutrient constituents at the shoreline that decrease with distance from shore, a pattern evident on all three study transects. The most pronounced horizontal gradients were for dissolved silicate (Si) with elevated values at the shoreline. Salinity reflects this pattern with lower salinity levels near the shoreline. This pattern is indicative of freshwater entering the ocean at the shoreline and suggest that there may be two points of freshwater entry into the nearshore zone.

Similarly, turbidity, temperature, dissolved oxygen, and pH all display similar patterns, with peak values at the shoreline, and decreasing values with distance extending seawards. At the shoreline, all the values of all these constituents were slightly lower at the eastern boundary of the property.

The area within the scope of the project is within the specific criteria of the DOH-Water Quality Standards (DOH-WQS), with the caveat that this consideration is for a single sample set. As a result, it does not appear that there are any significant inputs of materials from land beyond the immediate shoreline that are affecting coastal ocean waters offshore of the project area.

Anticipated Impacts and Mitigation Measures

The repairs to the seawall are not anticipated to adversely affect the health of the nearshore marine environment. Repairs to the seawall will take place landward of the existing seawall which will minimize runoff during the construction period and reduce construction impacts on the nearshore marine environment. During the short-term construction period, erosion will further be minimized through compliance with the City and County's grading ordinance and the applicable provisions of the DOH's Water Quality Standards (Title 11, Chapter 54, HAR) and Water Pollution Control requirements (Title 11, Chapter 55, HAR). Standard BMPs will be employed to minimize impacts, as detailed in subsequent construction plans. No significant storm drainage runoff to coastal water is anticipated. Construction BMPs to protect nearshore waters may include a floating silt curtain to contain limited amounts of suspended material along the immediate beach area; utilization of a temporary cofferdam to contain loose material and suspended sediment during excavation; and potentially, limited dewatering to protect both nearshore quality and the construction area.

3.8 Biological Resources

3.8.1 Terrestrial Biology

Existing Conditions

The project site is situated within a coastal residential area of Kailua. Vegetation on the property includes coconut trees (*Cocos nucifera)* and naupaka (*Scaevola taccada),* and other ornamental plants. Patches of naupaka were removed in 2019 to investigate the backside of the seawall. No plant species found within the project site are known to be protected under State or Federal environmental laws.

It is likely that mammalian species commonly found in beach environments on the Windward side of the island, including rats (*Rattus sp.*), house mouse (*Mus musculus*), and Indian mongoose (*Herpestes a. auropunctatus*), may occasionally be present on the project site.

The Hawaiian Hoary bat (*Lasiurus cinereus semotus*), known in Hawaiian as ʻōpeʻapeʻa, is an endangered species endemic to the Hawaiian Islands. According to the Department of Land and Natural Resources, the Hawaiian Hoary Bat*,* roosts in native and non-native vegetation from one to nine meters (3 to 29 feet) above ground level (USFWS, n.d.). The bat is known to inhabit forested areas and is not commonly observed in coastal environments like the subject property.

Avian species common to Lanikai include the common mynah (*Acridotheres tristis*), Red-Crested Cardinal (*Paroaria coronate*), Northern Cardinal (*Cardinalis cardinalis*), Java Sparrow (*Padda oryzivora*), Spotted Dove (*Streptopelia chenensis*), Zebra Dove (*Geopelia striata*), and Japanese White-eye (*Zosterops japonicus*). In addition, indigenous Hawaiian seabirds may traverse the project area during Seabird Fallout Season (September 15 - December 15) when young seabirds and adults start their navigation out to sea (DOFAW Seabird Fallout Season).

The Mokulua Islets, located off the Lanikai coast, is a nesting site for the indigenous wedged-tailed shearwaters (*puffinus pacificus*), known in Hawaiian as ʻuaʻu kani, and other common shorebird species (DOFAW, Mokulua Islets State Wildlife Sanctuary). During the breeding season wedge-tailed shearwaters excavate burrows on low, flat islands, and sand splits with little or no vegetation. Most eggs are laid in June with most young fledging in November (DLNR, Seabirds ʻUaʻu kani or Wedge-tailed Shearwater).

The situation at 1226a Mokulua Drive is typical, presently ideal for burrows, because the sandy soil, recently exposed by cutting back of naupaka kahakai (*scaevola sericea*) shrubs. The exposed sandy scarp edge behind the seawall, along with the existing conditions at the project site with low levels of human traffic, noise and lights, have likely drawn attention from the wedged-tailed shearwaters, as three burrows were observed at the project site during a site visit on July 9, 2020. An additional site visit on July 31, 2020 was conducted with AECOS Inc. to confirm and assess impacts of the seawall repairs (*Appendix H*). Although initially three burrows were reported present, four burrows were observed on July 31. No sitting birds could be seen or heard during the site visits. Evidence surrounding each of the burrow sites indicated each was recently maintained, suggesting all four were recently active nests. Wedge-tailed shearwaters usually fledge after approximately 100 to 115 days of egg laying. So, in this case, fledging ought to occur sometime between late October through the end of November. As of November 2020, there was no evidence of current activity at the burrows which were formed by shearwaters during the summer. These burrows were either abandoned by the adults, or the burrow use for nesting has been completed and the young birds have fledged.

There are no known threatened or endangered terrestrial species present on the site or in the vicinity of the site.

<u>Anticipated Impacts and Mitigation Measures</u>

Repairing the seawall may require the removal of the existing naupaka and palm trees adjacent to the seawall. There are Federal or State-listed threatened, endangered, or candidate flora species on site. No threatened or endangered mammals will be affected by construction or implementation of the project.

Potential impacts to shearwater bird are related to construction activity during shearwater nesting and fledging season, which begins in June and runs through the end of November. Before construction begins, a visual survey for seabirds and burrow nests will be conducted. If a burrow nest is discovered, work will cease within a minimum radius of 200 feet of the nest for a minimum of 60 days; if a nest with chicks is discovered work will cease for 30 days. These standard guidelines are intended to protect chicks and may be shortened if monitoring is conducted often enough to note when chicks have fledged, which usually occurs five to nine weeks after hatching. Additionally, a construction fence will be staked down across the sand scarp edge to deter additional burrowing on the property.

3.8.2 Marine Biology

Existing Conditions

A *Base Assessment of the Marine Environment* was prepared by MRCI in September 2020 (*Appendix G*). MRCI conducted field assessments of the physical, chemical, and biological composition of the nearshore waters encompassing the areas that could be affected by the repairs to the seawall and restructuring of the rock apron.

The PacIOOS Voyager mapping program displays the NOAA benthic habitat for the project area. The geomorphology and biology of benthic habitat for the area offshore of the project site is characterized by sand, scattered coral rock, pavement, and aggregate patch reef. Nearshore waters are classified by the USFWS as marine, intertidal, rocky shore that is regularly flooded. Offshore, coastal waters are classified as marine, subtidal, unconsolidated bottom.

The base of the seawall consists of rocks and boulders that form a band extending approximately one meter offshore. Two juvenile convict tangs (*Acanthrus triostegus)* were observed in the shallow rocky area along the base of the seawall. The boulders provide a habitat for attached marine species including *Cellana* (opihi) and crustose coralline algae. No corals or filamentous algae were observed on the boulders forming the base of the seawall.

The composition of the seafloor includes patches of rubble partially covered with turf algae. No coral, seagrass, or fish were observed offshore of the project area. Beyond 50 meters of the shoreline, the marine habitat consists of a sand bottom interspersed with patch reefs composed of fossil reef structures colonized by living coral colonies. The most common coral observed were *Montipora capitate, Montipora patula,* and *Porites compressa.* Several fish species were identified in the patch reef zone, including the convict tang (*Acanthurus* triostegus), yellow tang (*Zebrasoma flavescens*), sailfin tang (*Zebrasoma veliferum*), ringtail surgeon fish (*Acanthurus blochii*), goldring surgeon fish (*Ctenochaetus strigosus*), bluespine unicornfish (*Naso unicornis*), threadfin butterflyfish (*Chaetodon auriga*), bullethead parrotfish (*Chlororus spilurus*), palenose parrotfish (*Scarus Psittacus*), saddle wrasse (*Thalassoma duperrey*), and yellowfin goatfish (*Mulloidichthys vanicolensis*). These species are common on Hawaiian reefs and are not rare or unique species assemblages. No large individuals that would be considered favorable for human consumption were observed.

Marine protected species that frequent Hawaiian waters include the indigenous populations of Hawksbill turtle (*eretmochelys imbricate*) and the Hawaiian green sea turtle (*Chelonia mydas*), listed as endangered and threatened under the Endangered Species Act (ESA), respectively. Each of these species shows fidelity to their natal beaches, returning to nest during their reproductive years. Hawksbill turtles are known to mainly nest on the islands of Maui, Molokai and Hawai‘i (NOAA, n.d.). The majority of the Hawaiian green sea turtle nesting (96%) occurs in the French Frigate Shoals located in the Northwestern Hawaiian Islands (NOAA, n.d.). Neither species of turtle was observed within the survey area over the course of the MRCI study, although they undoubtedly occur in the area. The shoreline at this property would not meet the criteria to support sea turtle nesting because it is not a natural sandy shoreline environment.

The humpback whale (*Megaptera novaeangliea*) is another ESA-listed species that are known to winter in the Hawaiian Island from December to April. Although the survey was conducted in May when most of the migrating population has left Hawaiʻi, the survey area is not conducive to whale habitation owing to shallow depth and lack of access across the outer reef.

The Hawaiian monk seal (*monachus schauinslandi)* is also an ESA-listed species that is endemic to the waters off the Hawaiian Islands. These endangered seals commonly haul out onto sandy beaches to rest. NOAA Fisheries has revised the ESA Critical Habitat for the Hawaiian monk seal in the main Hawaiian Islands to include terrestrial habitat that extends 5 meters inland from the shoreline between designated boundary points (NOAA, 2015). The shoreline at this property would not meet the criteria to support monk seal conservation because it is not a natural sandy shoreline environment. No seals were observed during the course of the survey, although the sand beaches northwest of the property could provide haul-out areas.

Anticipated Impacts and Mitigation Measures

The existing conditions of the beachfront at the project site include a lack of sand dune habitat and an extreme seasonal fluctuation in beach sand levels, which does not allow nor provide an adequate area for sea turtles to nest or forage. Although the beachfront is not a suitable location for sea turtle nesting, during the construction period, the marine construction company will evaluate the shoreline area prior to daily construction activity to ensure no turtles are present. If any turtles are found, all construction activity will cease within 100 feet until the animal voluntarily leaves the area. Further, any construction-related debris or beach equipment that may pose an entanglement threat to green sea turtles from the project site shall be removed if not actively being used at the conclusion of the project. Project-related materials will not be stockpiled in the intertidal zone and reef flats. Repairing the seawall and restructuring the rock apron will not alter the existing conditions at the beachfront to provide a nesting site for turtles, no mitigation is proposed.

The existing beachfront at the project site does not provide a monk seal habitat. Repairing the seawall will not alter the existing conditions at the beachfront, no mitigation is proposed.

Water quality best management practices will be incorporated during the construction period to minimize runoff in the marine environment. Repairing the seawall is designed to bring the shoreline protection structure into safe condition to further minimize erosion and sedimentation in the marine environment.

3.9 Traffic and Roadways

Existing Conditions

Mokulua Drive is the primary roadway serving the project site. Mokulua Drive is a one-way city street and provides the only vehicular access to the project site. A private driveway provides vehicular access into the property.

Bus service is provided to the project site by routes along Mokulua Drive, including Route 70. Traffic is typically busiest during weekday commuter periods and weekend afternoons. In addition to restricted parking on three-day weekends, the City reconfigured the intersection at Kailua Road and South Kalaheo Avenue into a roundabout in 2017, alleviating some of the area's traffic congestion due to the popularity of Kailua Beach Park and Lanikai Beach.

Anticipated Impacts and Mitigation Measures

The repairs to the seawall are not anticipated to adversely affect traffic along Mokulua Drive or the greater Kailua area. During the short-term construction period, all construction equipment and construction worker vehicles will be stored on the property and not along Mokulua Drive. Trucks delivering construction materials and disposing construction waste will be scheduled Monday through Friday during off hours throughout the day and respect to the Lanikai neighborhood. Upon completion, repairing the seawall will not affect traffic along Mokulua Drive, and no additional mitigation is proposed.

3.10 Air Quality

Existing Conditions

The State DOH Clean Air Branch (CAB) has established the State Ambient Air Quality Standards (SAAQS). The DOH-CAB regularly samples ambient air quality at monitoring stations throughout the State, and annually publishes this information. On O‘ahu, there are four monitoring stations. The closest station to the project site is located in Honolulu, which measures SO_2, CO, PM_{10}, and $PM_{2.5}$.

Air quality in the State of Hawai‘i continues to be one of the best in the nation, and criteria pollutant levels remain well below SAAQS. According to the *Annual Summary 2018 Hawai‘i Air Quality Data,* air quality monitoring data compiled by the DOH indicates that the established air quality standards for all monitored parameters are consistently met throughout the State and on the island of O‘ahu. O‘ahu has relatively clean air, low in pollution, due in part to prevailing northeasterly trade winds. The relative absence of stationary pollutant sources in the area presumably keeps air quality in the project area at levels considered good (i.e., well within the air quality standards). Present air quality in the project area is primarily affected by motor vehicles, with carbon monoxide being the most abundant of the pollutants emitted. Air quality data from the nearest monitoring stations suggest that all National and State air quality standards are currently being met, although occasional exceedances of the more stringent State standards for carbon monoxide may occur near congested roadway intersections.

Anticipated Impacts and Mitigation Measures

Short-term construction to repair the seawall will be consistent with general-related construction activity. Dust emissions from vehicle movement and soil excavation is anticipated with the repairs to the seawall. Construction related vehicles and construction crew members commuting to the site will also produce short-term emissions within the project area. Construction-related activity will adhere to DOH air quality standards.

The State of Hawai‘i Air Pollution Control regulations prohibit visible emissions of fugitive dust from construction activities at the property line. A dust control program will be implemented to control dust from construction activities. Fugitive dust emission will be controlled through the mitigation measures such as watering active upland work areas, using wind screens, keeping adjacent paved roads clean, covering open-bodied trucks, and limiting the area to be disturbed at any given time.

Upon completion, the repairs to the seawall will not adversely affect long-term air quality. No mitigation is proposed.

3.11 Noise

Existing Conditions

Noise in the project area is characterized by natural noises due to wind in the surrounding foliage and the ocean waves. Existing background ambient noise levels within the project area are largely attributed to motor vehicle traffic along Mokulua Drive mauka of the project site. The noise levels around the project site are consistent with noise levels found in residential areas.

Anticipated Impacts and Mitigation Measures

There will be short-term noise generated during the short-term construction period; however, noise levels are not expected to adversely affect residents near the project site. Construction activities will comply with the provisions of the regulations for community noise control articulated in HAR Chapter 11-46. The contractor will be required to obtain a noise permit if the noise levels from construction activities are expected to exceed allowable levels. Heavy vehicles traveling to and from project site will comply with the State's administrative rules for vehicular noise control. Over the long term, the project will not affect ambient noise levels.

3.12 Utilities and Infrastructure

Existing Conditions

According to City and County of Honolulu GIS data, there are no existing drainage facilities serving the project site. A sewer lateral located at the southwest corner of the property connects to the gravity sewer main along Mokulua Drive. Stormwater at the property currently infiltrates rapidly into the sandy soils, with peak period flow overland towards the shoreline.

Electrical services are provided to the properties by HECO's overhead distribution lines. Existing residential uses at the property generate a demand for electrical and communication services.

Anticipated Impacts and Mitigation Measures

The proposed action will not adversely affect public infrastructure such as roadways, water supplies, and electrical power. The repairs will not affect existing overhead service. No mitigation is proposed.

3.13 Socio-Economic Characteristics

Existing Conditions

The project site is located in Koʻolaupoko, Oʻahu within Census tract 112.02. In 2018, the Census tract had a residential population of approximately 1,500, which was approximately 0.1 percent of Oʻahu's total population. The population in this Census tract is slightly older in age compared to the overall age of Oʻahu's population as a whole. The racial mix of the area is comprised of proportionately more Caucasians, and fewer Native Hawaiians and Pacific Islanders than the island as a whole. The median household income in 2018 for Census tract 112.02 was $115,655. The area near the project site and throughout Lanikai consists primarily of single-family homes and the Lanikai Beach recreational area. The nearest commercial area is located about 2.3 miles to the northeast in Kailua.

Anticipated Impacts and Mitigation Measures

The proposed action will not result in adverse socio-economics impacts. The repairs will not increase population of Census Tract 112.02 or the greater Koʻolaupoko District. Short-term construction-related activity will generate economic benefits through the local civilian construction sector. Additionally, construction materials expenditures will be in support of locally owned businesses. Upon completion, repairing the seawall will have beneficial long-term impacts by providing the property with protection from increased coastal erosion.

3.14 Public Facilities and Services

This section discusses the potential for impacts to public facilities and services.

3.14.1 Educational Facilities

Existing Conditions

The project site is located within the State Department of Education's (DOE) Windward District, Kailua-Kalaheo Complex Area. The Kailua area currently contains 15 public schools operated under the State Department of Education. There are nine elementary schools, one intermediate school and two high schools. Educational facilities that serve the property include:

- Kailua Elementary School located at 315 Kuʻulei Road, is approximately 2.4 miles from the project site.
- Kaʻōhao Public Charter School located at 140 Alāla Road, is approximately 1.1 miles from the project site.
- Kailua Intermediate School located at 145 South Kainalu Drive, is approximately 2.1 miles from the project site.
- Kalaheo High School is located at 730 Iliiaina Street, is approximately 3.8 miles from the project site.

The public library in closest proximity to the property is the Kailua Public Library, located 1.87 miles northwest of the property.

Anticipated Impacts and Mitigation Measures

The proposed action is not expected to significantly affect regional educational facilities and will not increase the population in the Koʻolaupoko District. No mitigation is proposed.

3.14.2 Recreational Facilities

Existing Conditions

The primary recreational area located in the vicinity of the project site are Lanikai Beach, a recreational destination for snorkelers, swimmers, and spearfishermen. The nearest City Department of Parks and Recreation-managed recreation area is Kailua Beach Park, located approximately 1 mile northwest. The 35-acre beach park is divided by Ka‘elepulu Stream. The stream runs throughout Kailua and feeds into the beach. Kailua Beach Park includes covered and open picnic tables, food concession stands, barbeque grills, restroom facilities, beach showers, parking lots with free parking, kayak rentals, volleyball courts, and lifeguards on duty from 9:00AM to 5:30PM.

The public can easily gain access to the shoreline. Kailua Beach Park is heavily used by the public and has ongoing issues with shoreline erosion. High surf has taken out chunks of the shoreline reducing beach recreation areas and causing trees to lean or fall forcing the city to come and cut down trees. The City has tried to address the issue by spreading 1,500 cubic yards of sand along the shoreline, but eventually high surf caused areas that were filled with sand to become exposed again.

Anticipated Impacts and Mitigation Measures

The project will not adversely affect existing recreational facilities, include Lanikai Beach and Kailua Beach Park, therefore no mitigation is proposed. Beach access routes are located nearby to the site.

3.14.3 Police

Existing Conditions

The Lanikai area is served by Honolulu Police Department (HPD) District 4, which covers the area from Waimanalo to Kahuku. The Kailua Substation is located approximately 2.3 miles northwest of the project site.

Anticipated Impacts and Mitigation Measures

The repairs to the seawall will not impact the HPD’s operations or ability to provide adequate services to the surrounding community. No adverse impacts are anticipated, and no mitigation measures are proposed. Equipment mobilization and materials deliveries will be conducted following government requirements.

3.14.4 Fire

Existing Conditions

The Honolulu Fire Department (HFD) has 45 operating fire stations on the island of O’ahu. There are two fire stations serving the project site. Fire Station 18 Kailua is located approximately 2.2 miles north of the project site. Fire Station 19 ‘Aikahi is located approximately 3.8 miles north the project site. HFD will dispatch the closest fire engine in the case of an emergency.

HFD works with the Emergency Medical Services (EMS), who dispatches the closest available unit. During an emergency, this may be either an EMS ambulance or a fire engine depending on the type of emergency and location. Since there are only 20 EMS stations on Oʻahu, fire companies are frequently the first responder.

Anticipated Impacts and Mitigation Measures

The project will not impact the HFD's operations or ability to provide fire protection services to the project area and the surrounding residential neighborhood. No mitigation measures are proposed.

3.14.5 Emergency Medical Services

Existing Conditions

The nearest hospital to the project site is Adventist Health Castle, located approximately 3.9 miles northeast. The closest EMS ambulance is stationed at the Kailua Fire Station, which transports patients to Adventist Health Castle.

Anticipated Impacts and Mitigation Measures

The proposed action will not impact the handling of EMS or medical emergencies within the surrounding neighborhood and greater project area. Adventist Health Castle will be accessible should there be an accident or illness affecting workers at the project site. Upon completion, repairing seawall will not impact EMS operations, no mitigation is proposed.

3.14.6 Solid Waste Management

Existing Conditions

Solid waste collection for the project area is provided by the City. The project site is provided weekly refuse collection on Tuesdays and recycling collection on Fridays.

Anticipated Impacts and Mitigation Measures

Short-term construction-related activity will generate very limited amounts of construction waste. Waste material will be properly disposed and not left for weekly refuse collection provided by the City. Upon completion, the project will not adversely affect refuse services provided by the City. No mitigation is proposed.

3.15 Historic, Archaeological and Cultural Resources

3.15.1 Historic and Archaeological Resources

An Archaeological Inventory Survey (AIS) was conducted by Keala Pono Archaeological Consulting (August 2020). The survey was designed to identify historic properties within the greater project area and includes a 100% pedestrian survey, and subsurface test excavations. There were no archaeological resources identified in the survey of the subject properties. Due to findings, the AIS results were presented as an Archaeological Assessment *(Appendix I)*. The Archaeological Assessment report was submitted to DLNR SHPD for agency review in November 2020.

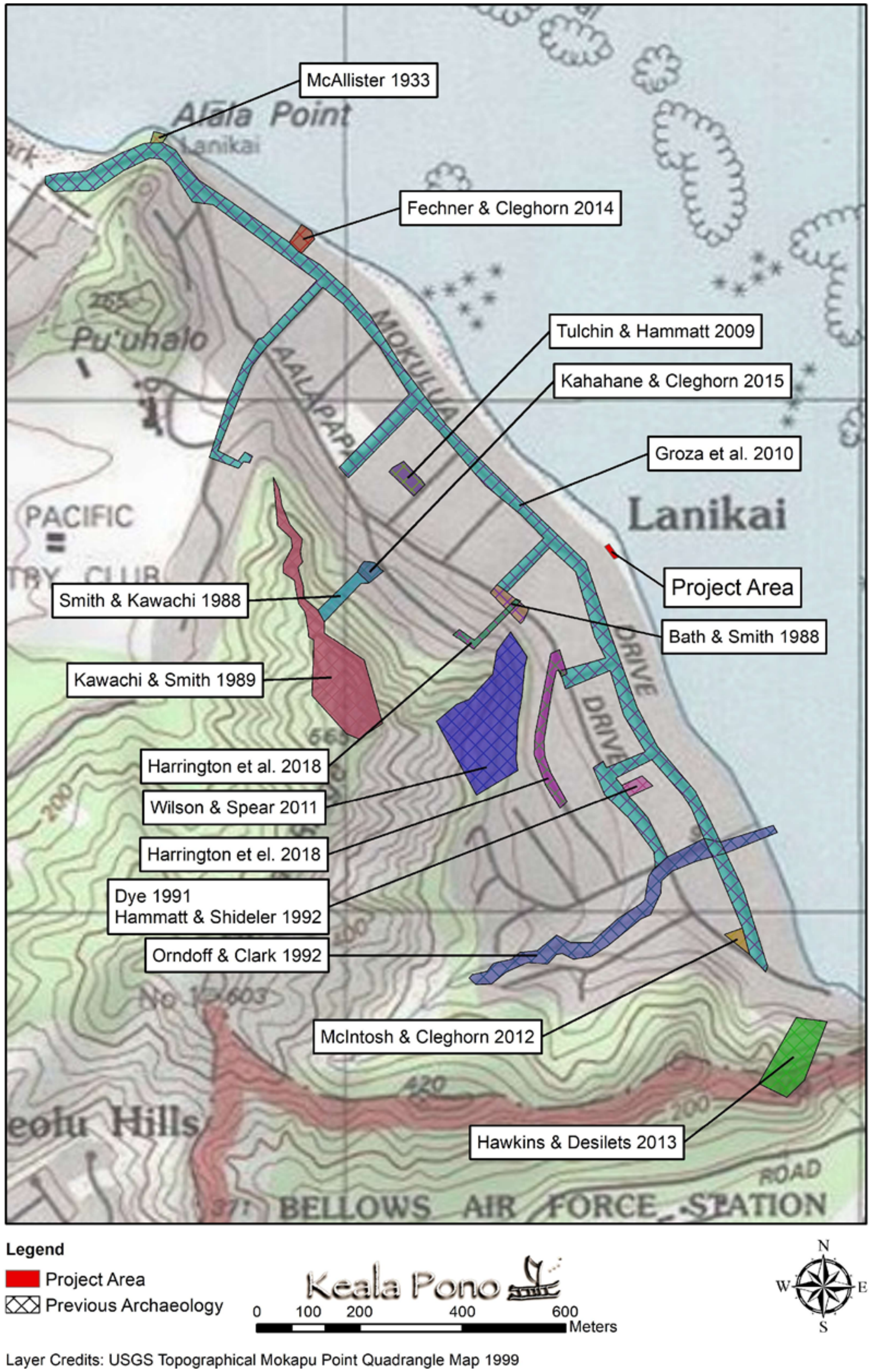
<u>Existing Conditions</u>

<u>History of the Project Area</u>

Historical maps of the broader Kailua area indicate that the property is located within the subdivision labeled as Alaapapa. Land use in the area consisted primarily of fisheries, and eventually coconut groves, cattle ranching, and dairies. As early as 1910, speculation of developing Kailua into a vacation destination and residential area began. Development of the area began in 1924, with Charles Frazier creating the 311-acre beachfront community called Lanikai in Kaʻōhao.

<u>Previous Archaeological Research in the Vicinity of the Project</u>

Information on known historic properties in the Lanikai area has been reported by numerous authors between 1933 and 2014. A heiau, WWII bunkers, human remains, and a pre-contact hearth have been identified or recovered from areas near the project parcel. The closest findings were documented by Dye (1991), Hammatt & Shideler (1992), and Groza et al. (2010), which identified human burials in beach lots north of the project site and a subsurface cultural layer to the west of the project area *(Figure 3-9)*.



Previous Archaeological Investigations in Lanikai (Keala Pono 2020) **Figure 3-9**

Results of the Archaeological Inventory

The pedestrian survey of 100% of the project area as well as subsurface testing of three trenches of the project area resulted in negative findings for subsurface archaeological deposits or material. No archaeological resources were found. The entire project area has been previously disturbed by modern activity, and subsurface testing did not yield evidence of subsurface archaeological features or deposits. Stratigraphy from the site consisted primarily of mostly topsoil above a natural beach deposit.

Anticipated Impacts and Mitigation Measures

The repair to the seawall is not expected to result in significant adverse impacts to historic properties of the site. Due to the presence of fill within the project site, there is a very low expectation for the occurrence of historic properties. No adverse effects on archaeological, or historical resources are anticipated as a result of the project. No further archaeological work is recommended. The report has been submitted to SHPD for review under HRS §6E-42.

3.15.2 Cultural Resources

Background

Historic Mo'olelo

Kailua is associated with Menehune and early settlement of O'ahu in pre-history. Menehune are the legendary race of people hailing from Kahiki who were known to be smaller in stature. They are known for having constructed things in Kailua and Pūowaina. In particular, the Mokulua Islands are said to have been built by the Menehune for protection. However, the construction was never completed after one night's work.

Traditional Land Use

O'ahu's windward coast was noted for its "many attractive bays, beaches, and stream-watered lowlands and valleys all the way from Kailua to La'ie" (Handy et al. 1991:268). Kailua itself was abundant in resources with fishponds, streams, and extensive wetlands which were converted into agriculture terraces. Kailua was a favorable place to live, especially for ruling chiefs. King Kamehameha lived and ruled from Kailua, where he was seen working in the fishponds. Upon the death of Kamehameha in 1819, windward lands under his rule were divided between his sons, Liholiho (Kamehameha II) and Kauikeaouli (Kamehameha III). The ahupua'a of Kailua went to Kauikeaouli.

After Kamehameha III's Māhele in 1848, land claims in windward O'ahu were awarded to commoners. In the Ko'olaupoko District, 199 awards were awarded in the Kailua and Waimānalo ahupua'a. Most of the lands in windward O'ahu went to Queen Kalama. She became the dominant landholder of those lands in Kailua, including claims in Kawainui and the ili of Mōkapu, Oneawa, and Keahupuaanui.

For commoners who sought individual land titles, the process required filing a claim with the Land Commission, having their land claim surveyed, testifying in person on behalf of their claim, and submitting a final Land Commission Award for a binding royal patent. Due to reasons such as an unfamiliarity with the process, distrust of the process, and/or the desire to cling to the traditional way of land tenure, the majority of the native population never received Land Commission Awards recognizing their land holdings.

There were a few Land Commission Awards granted in Lanikai, however one is located near the project area. Land Commission Award 2657:2 is 0.44 acres and was awarded to Mahuia. The LCA included two ʻāpana in Kailua with the first located in the ʻili of Kuailima and the second in Kaʻōhao adjacent to the project area to the north. The parcel is described in the Māhele Book as being located between the ocean to the east and the kula of the konohiki to the west.

Historic Land Use

In 1850 the Resident-Alien Act allowed foreigners to purchase lands in Hawaiʻi. After attempts to cultivate sugarcane and pineapple in Kailua, but never being productive, Chinese laborers moved off plantations to start rice farming in Kailua. By the end of the 1800s, the cattle industry also established a presence in the area, with operations near the Kailua flatlands by J.P. Mendonca and C. Bolte.

Historic maps show fisheries of Koʻolaupoko, naming Alaapapa Fishery and Kailua Fishery in the Lanikai area. Inland, Kaʻelepulu Fishpond is located where the subdivision of Enchanted Lakes is today.

In the beginning of the 20th century, the copra industry began in Kailua, with 10,000 coconut trees planted in 1908. The following year, an additional 130,000 trees were planted along 320 acres behind Kailua's shoreline, known today as Coconut Grove.

Around the same time, cattle ranching began expanding operations alongside existing dairy operations from Kaʻelepulu and Olomana down to Bellows Beach in Waimanalo. Raw milk was initially trucked from these operations to Meadow Gold (Dairymen's) in Honolulu for processing, but in 1950's the Campos, Moanalua, and Rico dairies united to form the Foremost Dairy based in Honolulu.

As early as 1910, speculation of turning Kailua into a vacation destination began. Beachfront properties along Kalaheo Road began being advertised for those who wish to build summer cottages. In 1917, following a decline in coconut oil demand, Arthur Rice of Hawaiian Copra Company initiated plans for residential subdivision development. More development followed, with upscale beachfront developments in Lanikai developed in 1924 by Charles R. Frazier. The name Lanikai was chosen by Frazier, thinking that it translated to 'heavenly sea,' although the literal Hawaiian translation is "sea heaven" or "marine heaven." The faux lighthouse of Lanikai was erected in 1926 as a monument, which has since been nominated to the National Register of Historic Places.

The Lanikai area was also historically used by the military during World War II. The "Lanikai Pillboxes" were constructed in the 1940s as observation bunkers for Battery Wailea and the nearby Bellows Field. Batter Wailea was armed with two guns and was operational between 1942 and 1945.

Existing Conditions

No known cultural practices currently occur on the project site. It is possible that cultural practices such as traditional fishing or throw new practices occur in the greater surrounding area.

Anticipated Impacts and Mitigation Measures

Background research indicate that there are no known cultural resources within the project site. Minimal to no impacts to Hawaiian cultural practices or resources are anticipated. Existing cultural practices, such as fishing, that occur in the greater surrounding area will not be impacted. With potential for inadvertent cultural finds, should cultural materials be discovered during construction activities, all work shall cease immediately and an archaeologist from SHPD shall be notified. Construction-related activity will be suspended until further recommendations are made for the appropriate treatment of archaeological and/or cultural materials.

3.16 Visual Resources

Existing Conditions

The project site is located in along the coast in the Lanikai neighborhood of Kailua, in the Koʻolaupoko District on the island of Oʻahu. The private residential property is developed with an existing home along with rock walls that demarcate the lot boundary. The project site is bounded by the Pacific Ocean, existing homes, and Mokulua Drive (*Figure 3-10A through 3-10F*).

Continuous views from Kailua Bay towards to shoreline are identified in the Koʻolau Poko Sustainable Communities Plan (SCP) as a scenic viewshed in Map A-1, Open Space. The existing seawall and rock apron is part of the 4,300 feet of armored shoreline that is visible from the ocean. *Figures 2-1* and *2-4* provide aerial perspectives of the Lanikai shoreline.

Anticipated Impacts and Mitigation Measures

The repairs to the seawall will be accomplished landward of the existing seawall and is not anticipated to affect coastal views. The repairs to the seawall will be accomplished by installing a sheetpile wall and cap, tie rods, and a concrete deadman beneath the surface, beginning at the surface elevation to a depth of 17 feet. The repairs will not adversely affect coastal views as the repairs will be accomplished beneath the surface and will not augment the current shoreline protection structure visible from the ocean. No significant adverse impacts to coastal views, scenic vistas or existing landscapes are anticipated. Ocean views will continue to be available.

Site Photo Key (Source: Google Earth) **Figure 3-10**

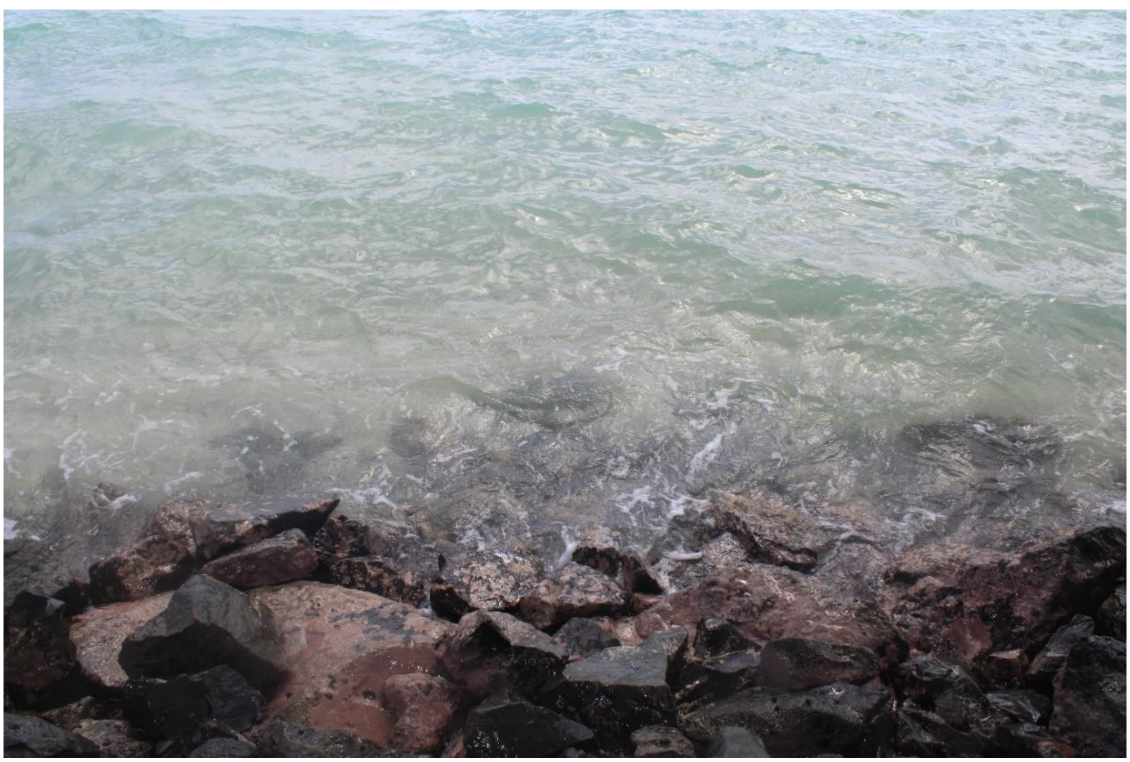
View 1 from Mokulua Drive Facing Makai Towards the Residence and Project Area   Figure 3-10A

View 2 Middle Portion of the Yard Facing Makai   Figure 3-10B

View 3 Backside of Seawall and Yard Facing North **Figure 3-10C**

View 4 Accessibility from Yard at the Northern End of Property **Figure 3-10D**

View 5 Backside of Seawall and Yard Facing South **Figure 3-10E**



View 6 from Property, Rock Apron **Figure 3-10F**

3.17 Potential Cumulative and Secondary Effects

Cumulative effects are impacts which result from the incremental effects of an activity when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertake such other actions. Erosion has occurred for decades along the Lanikai Shoreline. Since Lanikai is a chronically eroding shoreline, many homeowners opted to construct shoreline protection structures to stabilize the rapid recession of the shoreline. As discussed in *Section 1.3*, the existing seawall is considered nonconforming and the rock apron was permitted in 1968. Repairing the existing seawall will bring the shoreline protection structure into safe condition, pursuant to the conditions of the easement executed in 2013 and protect the property from increased coastal erosion. Repairs to the seawall will be accomplished landwards of the existing seawall and is not anticipated to adversely affect shoreline processes at other sections of the Lanikai shoreline. The proposed action is designed to properly bring the existing shoreline protection structure into safe condition without adversely affecting shoreline protection structures at neighboring properties and public lateral access along the shoreline. The applicant will seek a SSV and will adhere to the applicable terms and conditions of approval tied to the permit.

Secondary effects are impacts that are associated with an activity but do not result directly from the activity. The proposed action will not result in adverse secondary impacts.

Short-term construction-related impacts on the environment as described throughout this section will be generated by the project, and mitigation measures will be implemented to minimize these impacts. Federal, State, and County environmental regulations will be met throughout the construction and operation of the project. Construction activity during the proposed project will generate direct employment as well as indirect employment in construction-related industries.

Section 4

Alternatives to the Proposed Project

Chapter 4

Alternatives to the Proposed Project

The primary objectives of the project are to repair damage and structural deficiencies of the existing seawall, comply with the conditions of the easement to maintain the structures in a safe condition, and provide long-term protection for the property and existing single-family home.

To meet the objectives of the project, the following alternatives for shoreline protection at 1226a Mokulua Drive were evaluated:

A. No-Action
B. Managed Retreat
C. Beach Nourishment
D. Alternative Designs
   1. Rock Revetment
   2. Hybrid Seawall-Revetment
   3. Seawall Replacement
E. Seawall Removal
F. Preferred Alternative/Proposed Action – Seawall Repair

Each alternative was evaluated according to the project objectives and whether it met the following criteria:

- Effectiveness (i.e., likelihood of satisfying the project objectives)
- Design Considerations (i.e., suitability, design life, durability)
- Costs (i.e., initial costs, recurring costs, entitlement costs)
- Feasibility (i.e., regulatory support, community support)
- Potential Impacts (i.e., shoreline, coastal process, marine habitat, shoreline access, and neighboring property and shoreline structures)

The following sections summarize each alternative, with emphasis on the effectiveness, design, and potential impact evaluation criteria. Details of each alternative are described in-depth the SEI Coastal Assessment (*Appendix F*).

4.1 Alternative A – No-Action Alternative

The "No-Action" alternative is the baseline against which all other alternatives are measured, as it refers to the future site conditions that would result should the project not proceed. The No-Action alternative would involve leaving the seawall in its existing location and condition with no repairs or modifications.

The seawall has been protecting the project site and the adjacent properties from erosion and wave overtopping for nearly half a century. With time, the conditions of the seawall have deteriorated. If the seawall is not repaired, it can be expected to continue to deteriorate. If the seawall deteriorates to a point that it is no longer serviceable, the structure may fail, or removal may be required. The failure or removal of the seawall will not protect the terrestrial area and ultimately expose the property and existing single-family home to erosion and flooding. The project site and adjacent properties would further be exposed to increased hazard risk. The seawall is currently in serviceable condition and repairs are feasible.

No-Action Alternative Evaluation:

Advantages

- No cost

Disadvantages

- Does not address the damages and structural deficiencies of the existing seawall.
- Does not comply with the requirements of the easement.
- Does not provide long-term protection for the property and existing single-family home.
- Continued deterioration of the seawall could create a risk to public health and safety.

Although the No-Action alternative would have no immediate impacts to the project site, nearshore water, or adjacent properties, the likelihood of the seawall failing will increase over the long-term, as the seawall continues deteriorate throughout time. If no mitigative action is taken to repair the seawall, while repairs are still feasible, damage will continue and the level of deterioration of the seawall would eventually result in failure which would negatively affect the project site, adjacent properties and nearshore waters. The No-Action alternative would not satisfy the project objectives and is therefore not the preferred solution.

4.2 Alternative B – Managed Retreat

Managed Retreat, which is also referred to as “adaptive realignment”, is a coastal management strategy that is intended to allow the shoreline to naturally move inland, rather than fixing the shoreline with engineered shore protection structures. Retreat may be accomplished horizontally or vertically in nature. Horizontal retreat seeks to reduce hazards exposure by moving structures further inland, whereas vertical retreat strategies seek to reduce exposure by elevating structures above the hazard.

Managed Retreat is a concept that continues to be evaluated for applicability in Hawai‘i. The State Office of Planning (OP) published a report entitled, *Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai‘i.* The study found that retreat is one of three primary adaptation strategies, along with accommodation, and protection. The study also noted that prior to deciding upon retreat, accommodation and protection must be examined to determine which strategy is best for the area dealing with coastal hazards, climate change, and sea level rise.

Managed Retreat at the project site would potentially involve removal of the existing seawall and rock apron and the relocation of the existing single-family home further from the shoreline for the construction of a shore protection structure set back at a minimum of 40 feet from the shoreline. While removal of the seawall and rock apron would naturally allow the terrestrial area to erode and sand to migrate along the beach, the eroded sand would be unstable, mobilize, and spread throughout the littoral system during normal seasonal beach processes. Allowing the terrestrial area to erode naturally would expose adjacent neighbors to increased coastal hazards and sea level rise vulnerabilities. Additionally, relocating the single-family home would require demolition. The single-family home is 80 years old and the foundation is slab-on-grade. Moving the home from its current location is not a practical option. The project site is within the City "Residential" Zoning District with a height restriction of 25-30 feet, which significantly limits the opportunity for a vertical retreat strategy. While this alternative may reduce vulnerability of infrastructure to coastal hazards and sea level rise, complete redevelopment of the property is not a reasonable or economically practical alternative.

Managed Retreat Alternative Evaluation:

Advantages

- Reduces vulnerability of infrastructure to coastal hazards and sea level rise.
- Allows the shoreline to migrate naturally.

Disadvantages

- Does not address the damage and structural deficiencies of the existing seawall.
- Does not comply with the requirements of the State easement.
- Does not provide long-term protection for the property and existing single-family home.
- Would only be effective if implemented at the community-wide level.
- No existing rules, programs, or policies to manage or facilitate the retreat process.

Although Managed Retreat would reduce the vulnerability of infrastructure to coastal hazards and sea level rise and would allow the shoreline to migrate naturally, managed retreat would not be practical and necessary for the project site. The existing seawall is in serviceable condition for repair. Additionally, there are no rules, programs, and policies to manage the retreat process. This alternative would not meet the project objective of providing long-term protection of the property. Further, this alternative would not comply with the conditions of the easement. Managed retreat would not achieve the project's objectives and is therefore not the preferred solution.

4.3 Alternative C – Beach Nourishment

Beach nourishment typically involves placement of beach bill to specified profiles that are designed to augment the natural morphology of the beach to offset the effects of chronic, seasonal, or episodic erosion. Regulatory agencies and the public are generally supportive of beach nourishment because it has minimal environmental impacts and is consistent with State and County policies that seek to preserve and enhance beach resources and shoreline public access.

The shoreline fronting the seawall consists of a narrow sandy beach that is dynamic and ephemeral. The beach consists of a thin veneer of sand with no evidence of stable beach profile. When sand is present along the shoreline, the beach is generally exposed only during lower tides. At high tide, waves wash up to the seawall and the beach face is entirely submerged. Beach nourishment at the project site would consist of placing sand directly on the shoreline to increase the elevation and width of the beach.

One of the factors that limits the effectiveness of beach nourishment projects is the loss of sand due to natural littoral processes, such as longshore and cross-shore sediment transport. Sand placed only at the project site would be unstable and would be expected to mobilize and spread throughout the littoral system during normal seasonal beach processes. Engineered containment structures, such as T-head groins (*Figure 4-1)*, would be required to stabilize the sand and maintain a stable beach.

T-head groins decrease and reorient the amount of wave energy reaching the beach and create artificial littoral cells to stabilize the sand. Beach nourishment is effective when accompanied by the construction of groins to restore and maintain a stable beach.

Example of Beach Nourishment with T-Head Groins (Iroquois Point, O‘ahu, Hawai‘i) Figure 4-1

A disadvantage of beach nourishment with stabilizing groins is the potential for down drift effects that can negatively impact nearby shorelines. In order to avoid the potential for down drift effects, the scale of the project would need to be expanded as a regional effort to include a sufficient number of groins spanning a significant length of the shoreline.

In 2009, the U.S. Army Corps of Engineers and the Department of Land and Natural Resources evaluated options for large-scale beach nourishment in Lanikai. The first option is for the direct placement of sand with no stabilization. The design calls for approximately 182,000 cubic yards of sand producing a dry beach at width of approximately 30 feet. In 2009, the estimated cost was $33,000,000 with additional nourishment every 8.4 years costing approximately $109,000,000 over a span of 50 years. The second option is for the direct placement of sand with the construction of twelve T-head groins. The design calls for approximately 146,000 cubic yards of sand producing a dry beach at a width of approximately 30 feet. The initial estimated cost including the construction of the twelve T-head groins was $33,400,000 in 2009. Maintaining the beach and T-head groins over a span of 50 years is approximated to cost $41,600,000. The construction of the T-head groins would be located seawards of the shoreline, requiring easements from the State which would further increase costs.

Beach Nourishment Alternative Evaluation:

Advantages

- Improves lateral shoreline access.
- Provides some additional protection against erosion and flooding.

Disadvantages

- Does not address the damage and structural deficiencies of the existing seawall.
- Does not comply with the requirements of the easement.
- Does not provide long-term protection for the property and existing single-family home.
- Requires an adequate quantity of compatible beach quality sand.
- Requires discharge of fill material (sand) in waters of the United States.
- Groins and beach fill would have a very large structural footprint along the shoreline with environmental impacts exceeding the proposed action.
- Project would need to be a regional effort spanning multiple properties.
- Project would be cost-prohibitive for an individual landowner.
- Groins would require easements.

Beach nourishment at the project site, which would consist of placing sand directly on the shoreline to increase the elevation and width of the beach, would be ineffective in the long-term without the necessary stabilizing structures typical of a larger, regional-scale beach nourishment effort. Discharge of fill material into the water would have additional, potentially adverse, environmental impacts. Further, this alternative would not comply with the conditions of the easement. Beach nourishment is therefore not the preferred solution.

4.4 Alternative D – Alternative Designs

SEI proposed three alternative design strategies for the shoreline protection system at 1226a Mokulua Drive, including rock revetment, hybrid seawall-revetment, and seawall replacement, which are summarized and evaluated, below.

4.4.1 Rock Revetment

A revetment is a sloping, un-cemented structure constructed of wave-resistant material. The most common method of revetment construction is to place a layer of armor stone, sized according to the design wave height, over an underlayer of smaller rock that sits atop geotextile filter fabric. The underlayer is designed to distribute the weight of the armor layer and to prevent loss of fine material through voids in the revetment. An example of a rock revetment is shown in *Figure 4-2*.

Advantages of a revetment system is the rough, porous rock surface and sloping face of the structure, which will tend to absorb wave energy, reduce wave reflection, and may help to promote accretion of sand on a sandy beach when a sufficient volume of sand is available in the littoral system. Revetments are more effective in reducing wave reflection, runup, and overtopping, which increases the potential for sand accumulation seaward of the structure. Because of its durability, flexibility, and reduced wave reflection, a revetment is often considered the best erosion control/shore protection measure for sites where shoreline hardening is considered appropriate.

The design of a rock revetment is dependent on sea level elevation, design wave height, and scour depth. Additionally, it is preferred that the toe of the revetment be founded on hard, non-erodible substrate to prevent scour and undermining of the structure.

Rock Revetment at Kahului Harbor (Kahului, Maui, Hawai‘i) **Figure 4-2**

Based on its design criteria, SEI evaluated two options for a rock revetment at the project site. Both options would extend beyond the limits of the easement area and would require demolition and removal of the existing seawall and rock apron. Return walls would also be required to stabilize and protect the adjacent properties and existing shore protection structures. Both revetment designs incorporate a 2.3-foot higher than present sea level, with consequent increases in predicted wave exposure and scour depth. Utilizing 2.3 feet of sea level rise, which is currently projected for 50 years in the future, provides suitable design criteria within the effective life span of similar structures. Structure maintenance, improvements, or replacement would be appropriate at the end of the structure's projected life span or when environmental changes exceed design conditions. Adaptation to rising sea levels and their resulting impacts predicted at time frames beyond the structure's design life should be incorporated at that time.

The first revetment option would be to construct a rock revetment landward of the existing seawall (*Figure 4-3*). The crest of the structure would be placed at +10.5 feet msl to match the existing backshore topography with a slope of 1V:1.5H to ensure stability. The structure would be 40.2 feet wide with a total area of 3,880 square feet. The entire structure would be located within the Shoreline Setback of the existing property (City/County jurisdiction). The structure would occupy 100% of the yard area and would encroach 4 feet into the footprint of the existing single-family home.

To mitigate the need to modify or remove the existing single-family home, the second option would be to construct a rock revetment beginning at the seaward edge of the existing rock apron (*Figure 4-4*). The structure would be 40.2 feet wide with a total area of 3,970 square feet. The landward portion of the structure would be located within the Shoreline Setback Area. The seaward portion of the structure would extend into the State Conservation District. The structure would occupy approximately 70% of the yard area seaward of the existing single-family home.

Rock Revetment Alternative Evaluation:

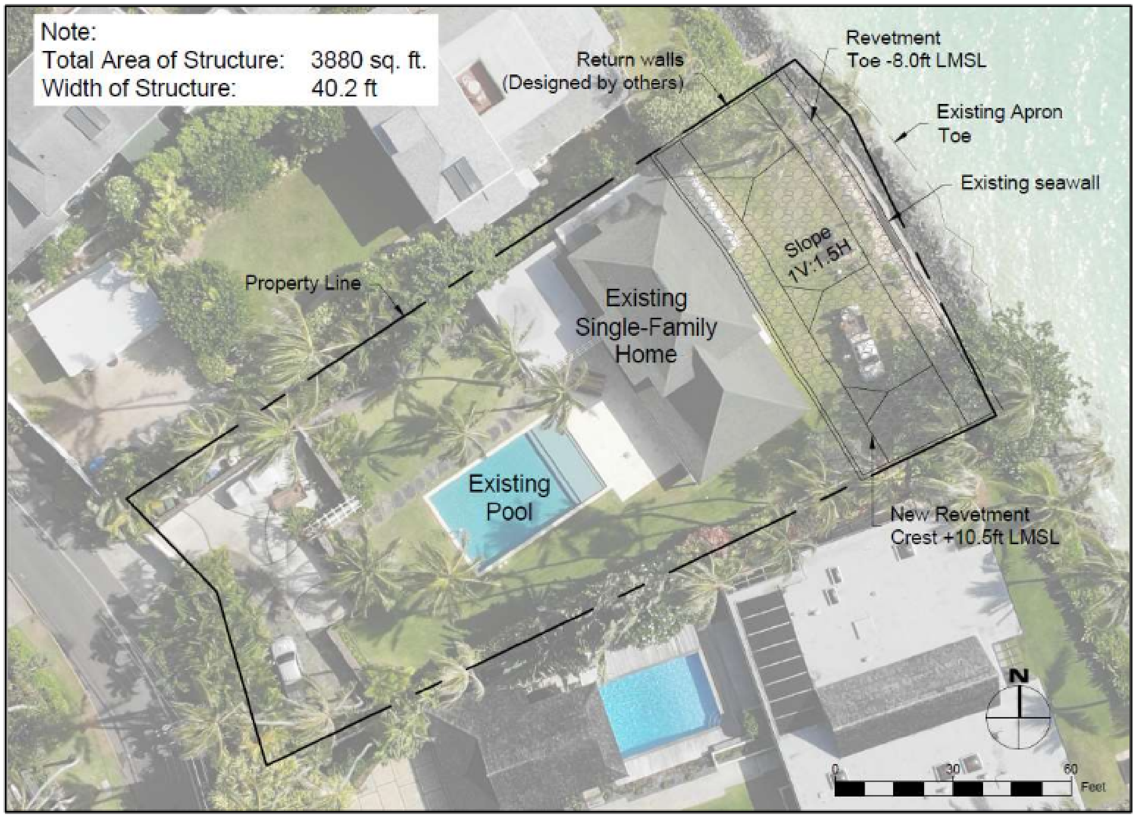
Advantages

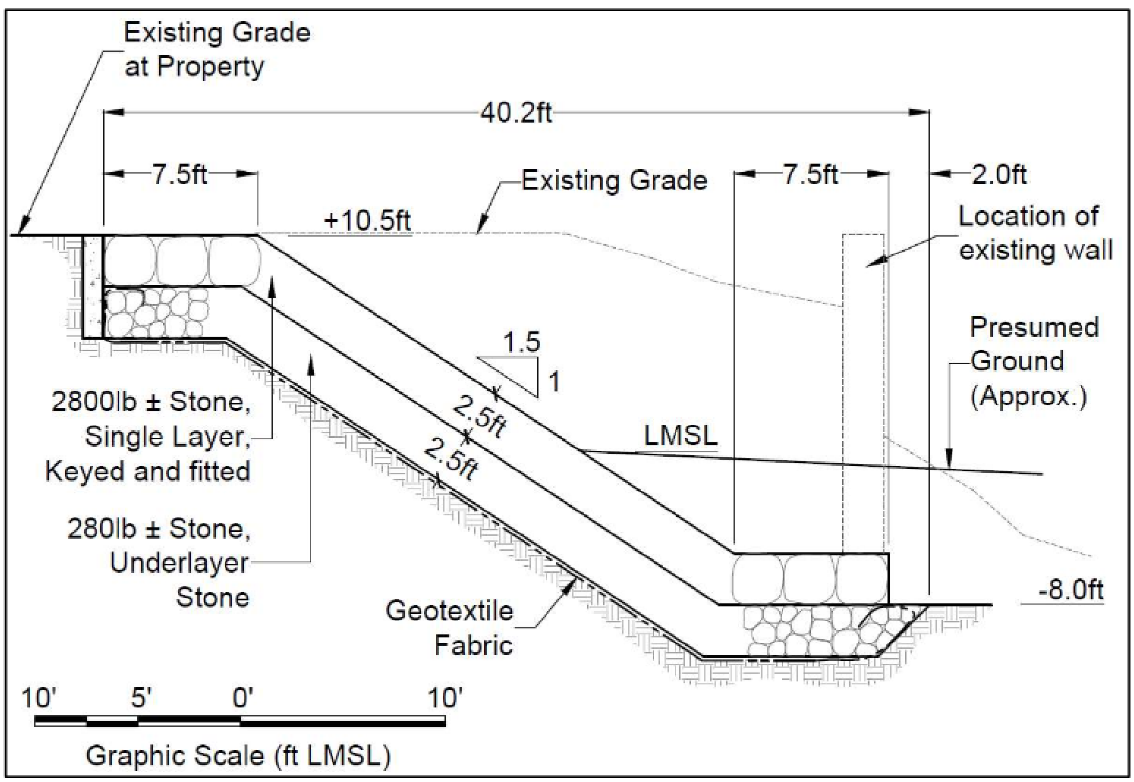
- Provides long-term protection for the property and existing single-family home.
- Better wave energy dissipation characteristics than a seawall.
- Less reflective than a seawall and may facilitate sand accretion seaward of the structure.

Disadvantages

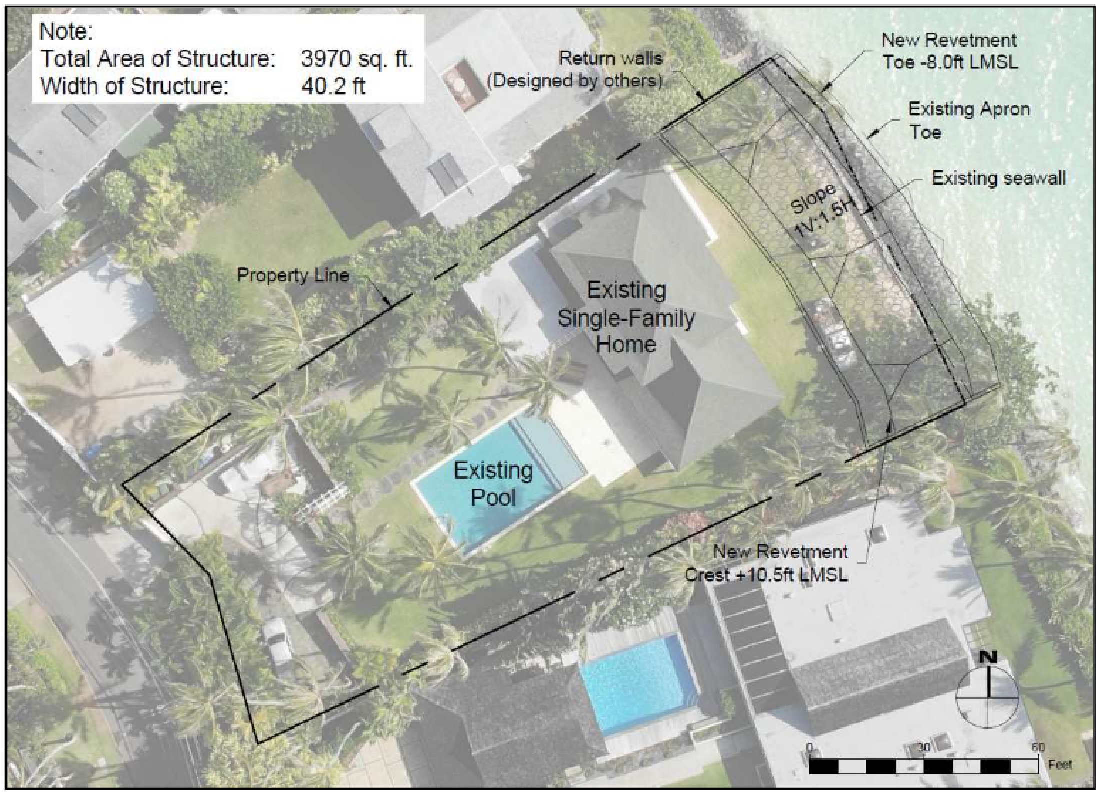
- Largest structural footprint of the options considered.
- Only feasible if a portion of the structure extends seaward of the shoreline.
- Requires demolition and removal of the existing seawall and rock apron.

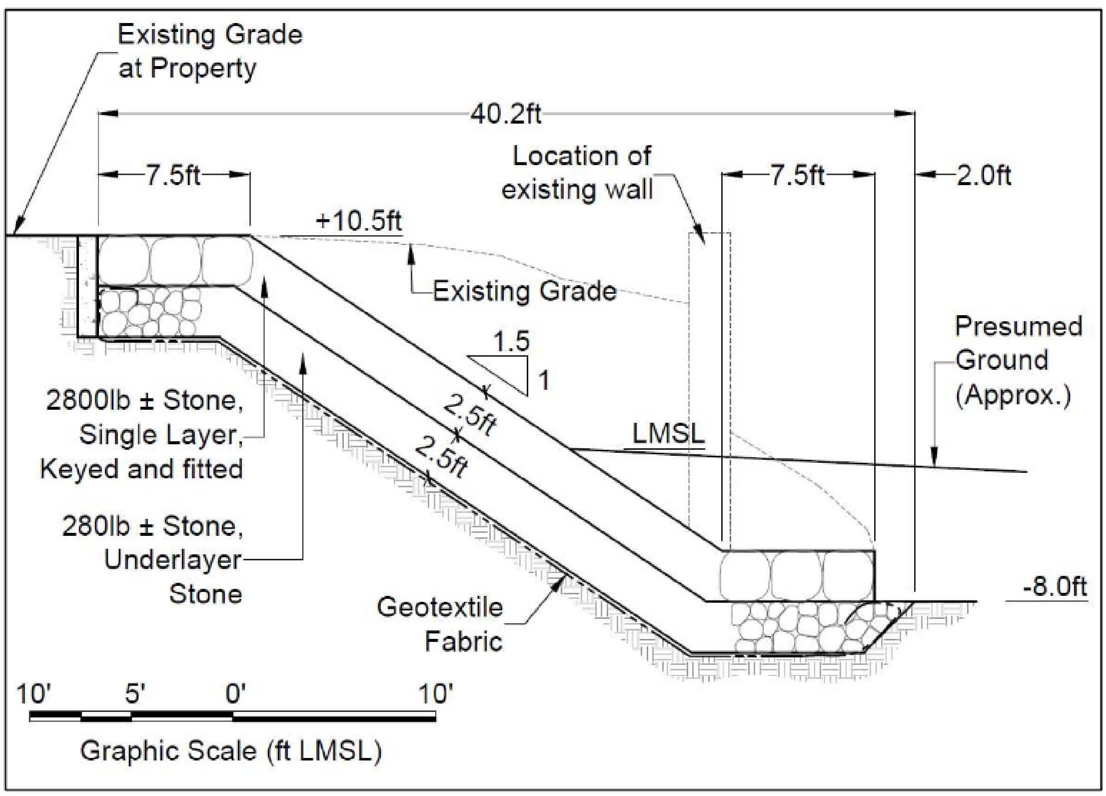
A rock revetment would be an appropriate engineering solution for the project site. However, the revetment would have a very large structural footprint, and significant environmental effects of demolition and removal of the existing seawall and rock apron. In addition, there would be the need for additional side yard retaining wall structures within the shoreline area to protect the adjacent properties and existing shore protection structures. Given these considerations, the development of a rock revetment is not the preferred alternative.





Conceptual View for Rock Revetment Landward of the Shoreline **Figure 4-3**


Note:
Total Area of Structure: 3970 sq. ft.
Width of Structure: 40.2 ft
Return walls (Designed by others)
New Revetment Toe -8.0ft LMSL
Existing Apron Toe
Existing seawall
Slope 1V:1.5H
Property Line
Existing Single-Family Home
Existing Pool
New Revetment Crest +10.5ft LMSL
N
0 30 60 Feet


Existing Grade at Property
40.2ft
7.5ft
Location of existing wall
7.5ft
2.0ft
+10.5ft
Existing Grade
1.5
1
2.5ft
2.5ft
LMSL
Presumed Ground (Approx.)
2800lb ± Stone, Single Layer, Keyed and fitted
280lb ± Stone, Underlayer Stone
Geotextile Fabric
-8.0ft
10' 5' 0' 10'
Graphic Scale (ft LMSL)

Conceptual View for Rock Revetment Seaward of the Shoreline **Figure 4-4**

4.4.2 Hybrid Seawall-Revetment

The hybrid seawall-revetment alternative would involve demolition and removal of the existing seawall and rock apron and construction of a hybrid structure composed of two primary elements: a seawall (i.e., vinyl sheet pile, reinforced concrete, or cemented rock masonry), and a uniform armor rock rubble mound revetment (*Figure 4-5*). Hybrid seawall-revetments have a slightly smaller structural footprint than a traditional rock revetment and would be designed to withstand changing design wave conditions as sea level rises. Properly designed and constructed hybrid seawall-revetments are durable, flexible, and highly resistant to wave damage.

SEI evaluated two options for a hybrid seawall-revetment at the project site. Both designs incorporate a 2.3-foot higher than present sea level, with consequent increases in predicted wave exposure and scour depth. Utilizing 2.3 feet of sea level rise, which is currently projected for 50 years in the future, provides suitable design criteria within the effective life span of similar structures. Structure maintenance, improvements, or replacement would be appropriate at the end of the structure's projected life span or when the environment changes beyond design conditions. Adaptation to rising sea levels and its resulting impacts predicted at time frames beyond the structure's design life should be incorporated at that time. The armor and underlayer stone size and placement would be the same as for the rock revetment options. Like the rock revetment option, a hybrid seawall-revetment would extend beyond the limits of the easement area and would require demolition and removal of the existing seawall and rock apron. Return walls within the shoreline setback area would also be required to stabilize and protect the adjacent properties and existing shore protection structures.

Hybrid Seawall-Revetment (Kapa'a, Kaua'i, Hawai'i) **Figure 4-5**

The first design option would be to construct a rock a hybrid seawall-revetment landward of the existing seawall (*Figure 4-6*). The crest of the structure would be placed at +10.5 feet msl to match the existing backshore topography with a slope of 1V:1.5H to ensure stability. The structure would be 32.9 feet wide with a total area of 3,145 square feet. The entire structure would be in the Special Management Area. The structure would occupy approximately 90% of the yard area seaward of the existing single-family home.

The second option would be to construct a hybrid seawall-revetment beginning at the seaward edge of the existing rock apron (*Figure 4-7)* The structure would be 32.9 feet wide with a total area of 3,225 square feet. The landward portion of the structure would be in the City/County jurisdiction. The seaward portion of the structure would be in the State Conservation District. The structure would occupy approximately 60% of the yard area seaward of the existing single-family home.

Hybrid Seawall-Revetment Alternative Evaluation:

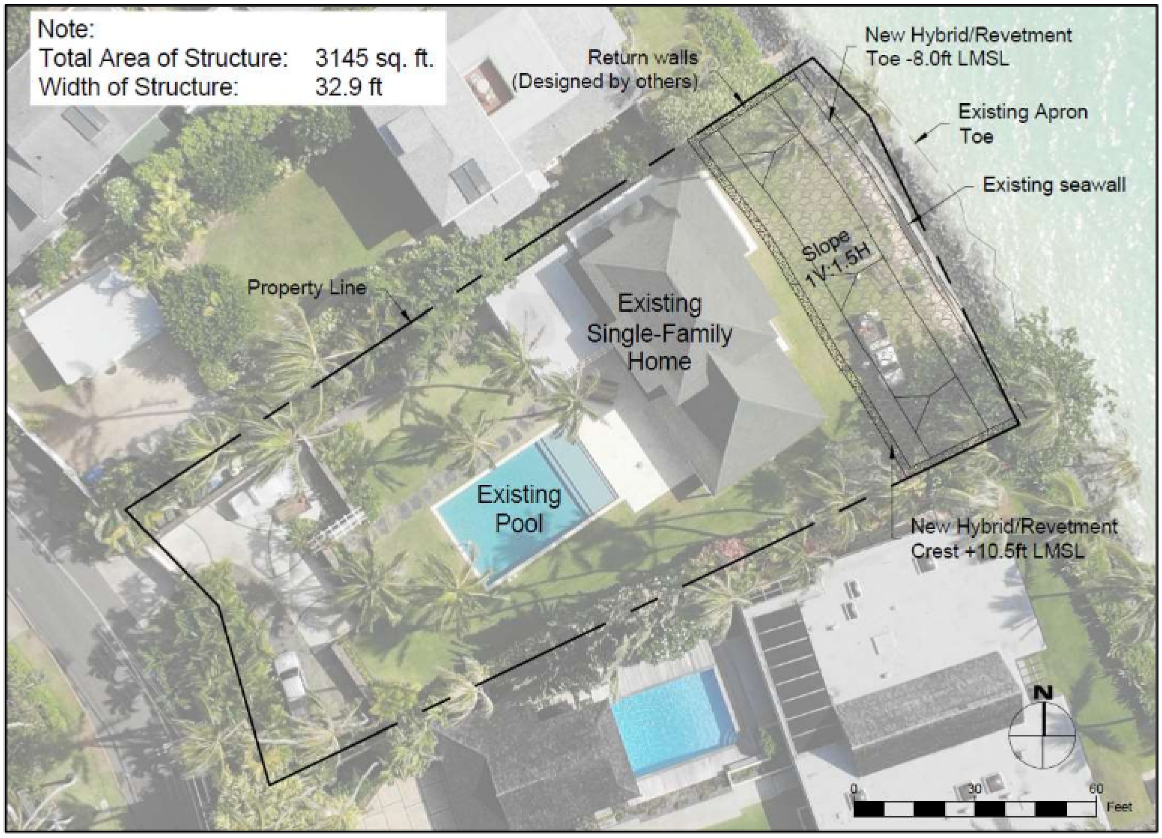
Advantages

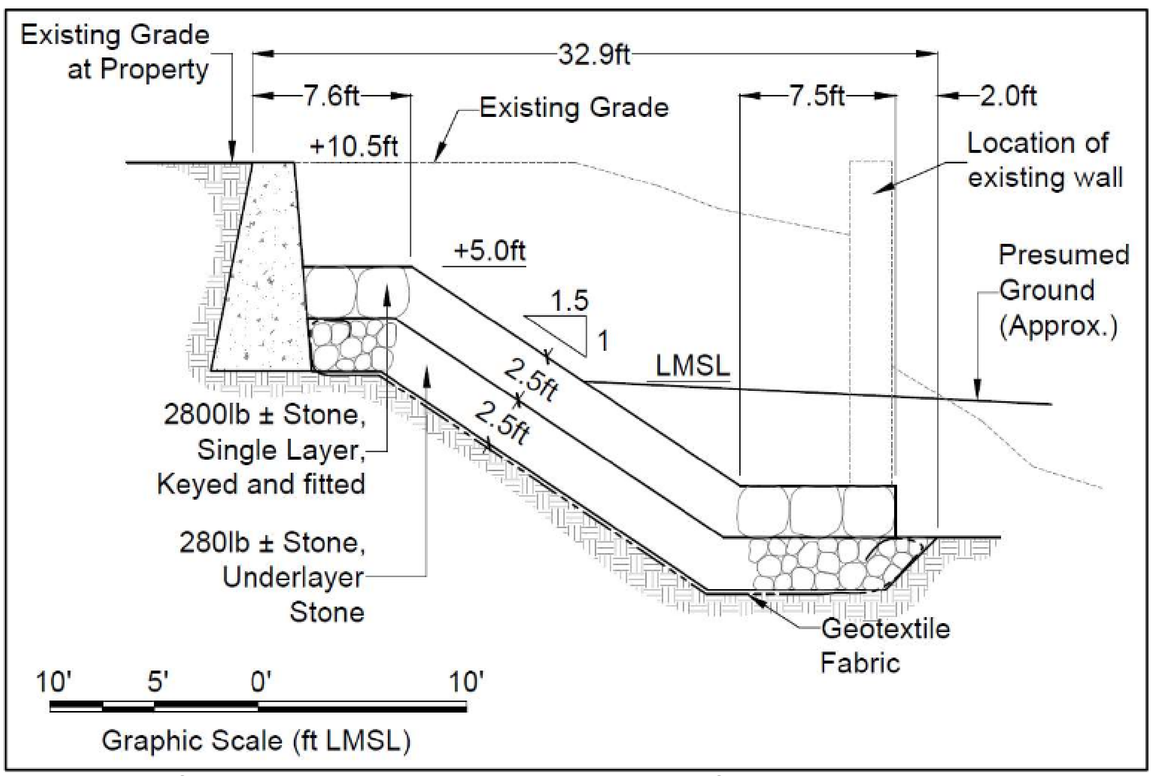
- Provides long-term protection for the property and existing single-family home.
- Better wave energy dissipation characteristics than a seawall.
- Less reflective than a seawall and may facilitate sand accretion seaward of the structure.
- Does not negatively impact lateral shoreline access.

Disadvantages

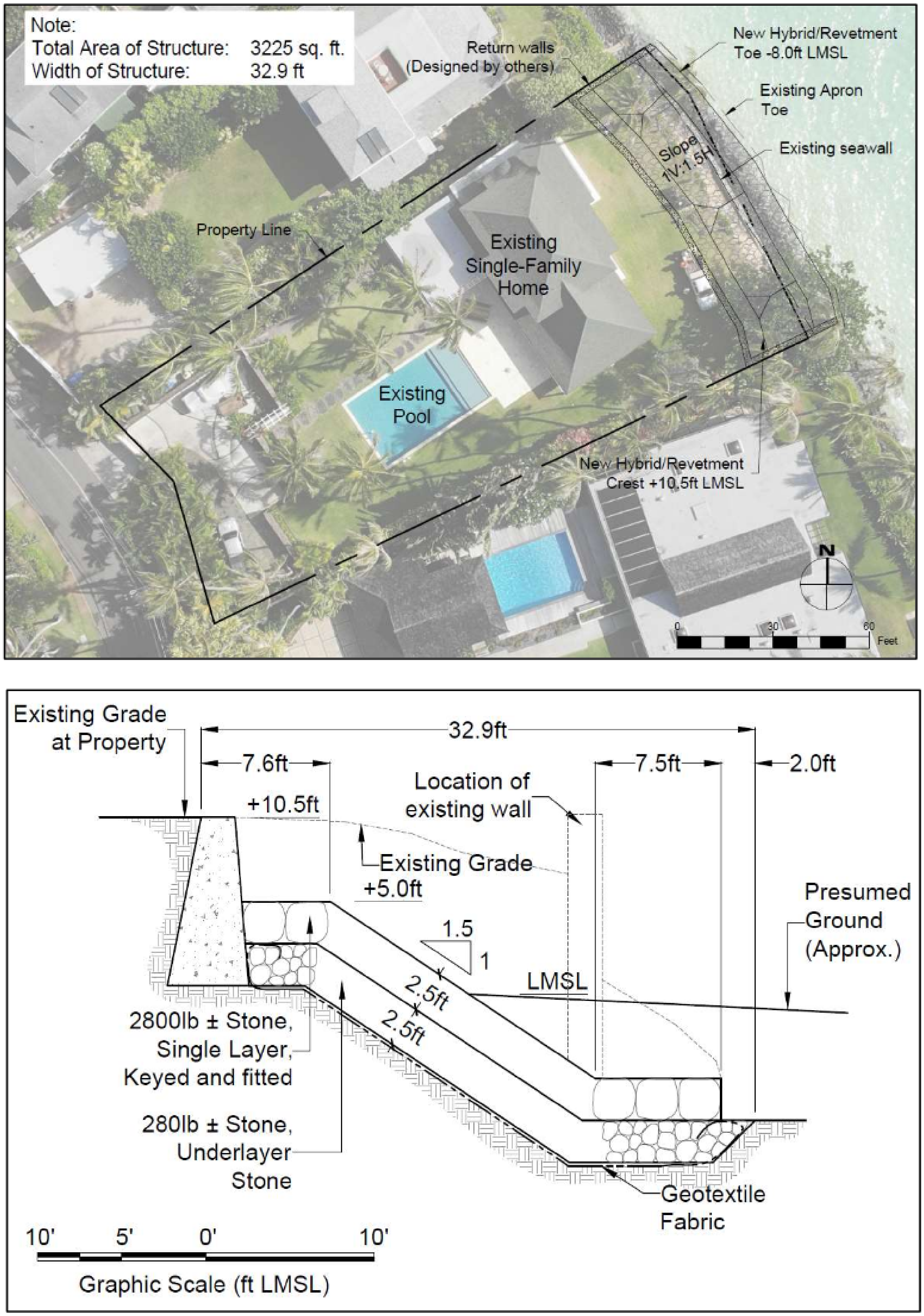
- Large structural footprint.
- Requires demolition and removal of the existing seawall and rock apron.

Although a hybrid seawall-revetment would be an appropriate engineering solution for the project site. However, given the large structural footprint which would occupy more than 50 percent of the yard, there would be significant environmental effects of demolition and removal of the existing seawall and rock apron. In addition, there would be the need for additional structures within the shoreline setback area to protect the adjacent properties and existing shore protection structures, therefore, a hybrid seawall-revetment is not the preferred solution.





Conceptual View for Hybrid Seawall-Revetment Landward of the Shoreline **Figure 4-6**



Conceptual Section View for Hybrid Seawall-Revetment Seaward of the Shoreline Figure 4-7

4.4.3 Seawall Replacement

Seawalls are vertical or sloping concrete, concrete rubble masonry (CRM), cement masonry unit (CMU), or sheet pile wall used to protect the land from wave damage and erosion. A seawall, if properly designed and constructed, is a proven, durable, and relatively low-maintenance shore protection method. Seawalls also have the advantage of having a relatively small footprint along the shoreline.

Seawalls are not flexible structures and their structural stability is dependent on the design and strength of their foundations. If the foundation of a seawall is breached, hydraulic action can erode the retained sediment inshore of the wall. With the loss of enough retained sediment, the ground surface behind the seawall will collapse and sinkholes will form. Sinkholes can compromise the structural integrity of a seawall and may result in failure of the structure. To avoid foundation problems, the seawall foundation should be well below the potential scour depth, which can require extensive excavation.

The impervious and vertical face of a seawall results in very little wave energy dissipation. Incident wave energy is deflected upward, downward, and seaward. Reflected wave energy can inhibit accretion of sand seaward of the wall. The downward energy component can cause scour at the base of the wall. Therefore, the foundation of a seawall is critical for its stability, particularly on sandy and eroding shorelines. Ideally, seawalls are constructed on hard, non-erodible substrate.

Replacing the existing seawall would require demolition and removal of the existing seawall and rock apron, and construction of a new deep foundation wall landward of the existing wall within the property. A conceptual design for a seawall replacement was prepared by MKE (*Figure 4-8).*

<u>Seawall Replacement Alternative Evaluation:</u>

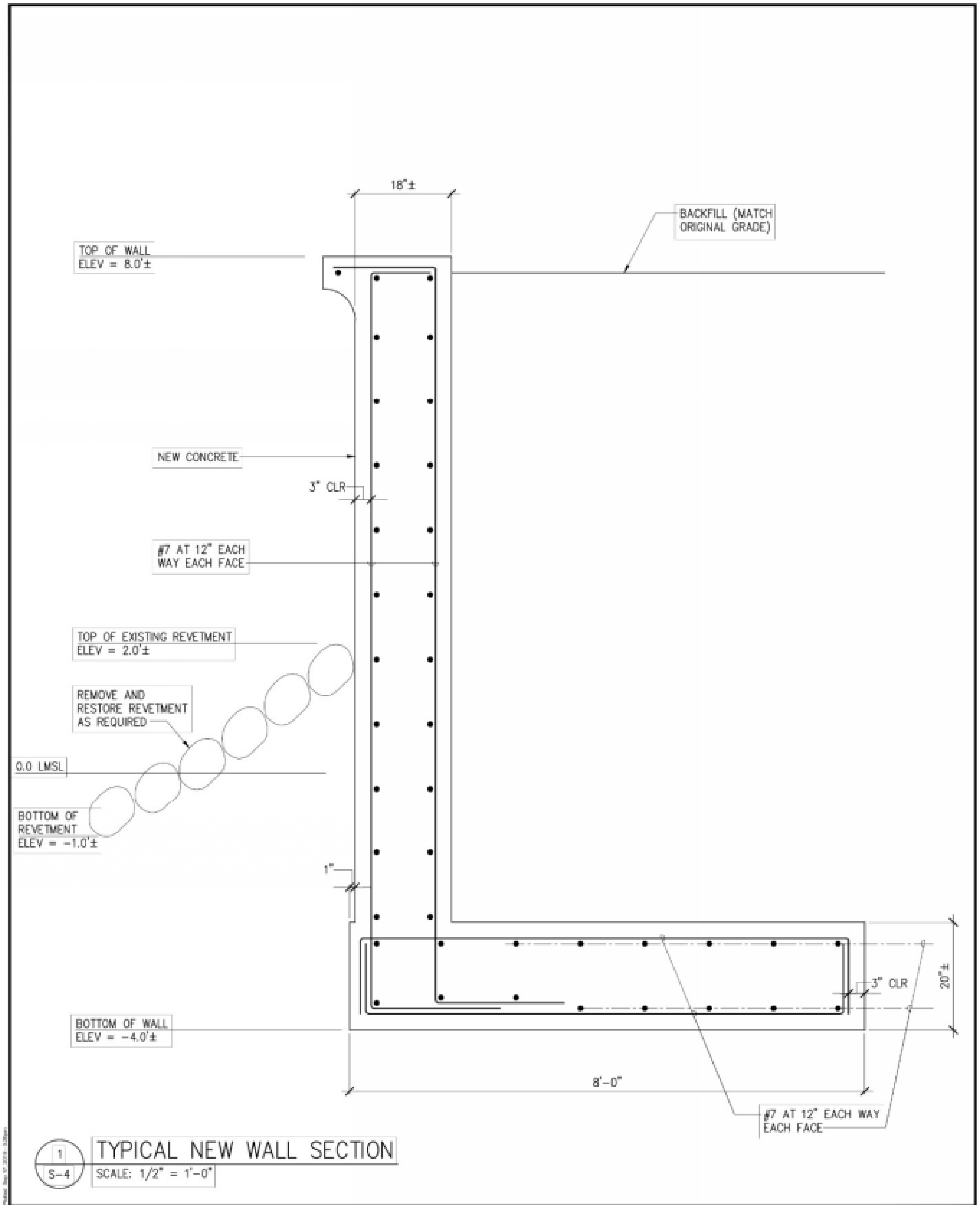
<u>Advantages</u>

- Provides long term protection against erosion and flooding.
- Provides more options to improve the seawall (e.g., appearance, size, ocean access).

<u>Disadvantages</u>

- Construction duration would be significantly longer than the repair option.
- Excavation to the depth required for scour resistance would be difficult and costly.
- Requires demolition and removal of the existing seawall and rock apron.

Replacing the seawall is an appropriate engineering solution for the project site and would achieve the project objective of providing long-term protection for the property and existing single-family home.



Conceptual Design for Seawall Replacement (MKE) **Figure 4-8**

4.5 Alternative E – Seawall Removal

The seawall removal alternative would involve removing the existing seawall and rock apron and allowing the shoreline to migrate naturally. The seawall protects the project site and the adjacent properties from erosion and wave overtopping. If the seawall were to be removed, the terrestrial area would be exposed to erosion, wave overtopping and flooding would occur more frequently, and property damage would be expected. Demolition and removal of the seawall would require extensive excavation, which would disturb a large volume of the existing soil in the terrestrial area making it more unconsolidated and prone to erosion. While erosion of the terrestrial sediment may result in a temporary increase in beach width, the eroded material would be unstable and would be expected to mobilize and spread throughout the littoral system during normal seasonal beach processes.

As sea levels continue to rise, this would likely result in significant erosion, flooding, and permanent loss of land. The seawall is over half a century old and is in a deteriorated, but repairable condition. The seawall is covered by an easement that confers unto the Grantee the “right, privilege, and authority to use, maintain, repair, replace and remove the existing seawall”. The easement also requires that the Grantee “shall keep the easement area and the improvements thereon in a safe condition”. Repairs are necessary in order to maintain the seawall in a safe condition and prevent it from being “substantially or completed destroyed”, which would result in termination of the easement. If the seawall is not repaired and continues to deteriorate to a point that it is no longer serviceable, the structure may eventually fail, or removal may be required.

<u>Seawall Removal Alternative Evaluation:</u>

<u>Advantages</u>

- Provides long term protection against erosion and flooding.
- Provides more options to improve the seawall (e.g., appearance, size, ocean access).

<u>Disadvantages</u>

- Construction duration would be significantly longer than the repair option.
- Excavation to the depth required for scour resistance would be difficult and costly.
- Requires demolition and removal of the existing seawall and rock apron.

Removing the seawall would not achieve the project objectives and would expose the project site and adjacent properties to increased hazard risk. The seawall is in a serviceable condition and repairs are feasible. Seawall removal is therefore not the preferred solution.

4.6 Preferred Alternative/Proposed Action – Seawall Repair

Seawall repair is the preferred alternative as described in *Section 2.3*. The alternative includes installation of sheetpile on the landward side of the existing seawall. The existing seawall and the sheetpile stabilization system will be structurally connected by a concrete sheetpile cap dowelled to the existing wall. This will mitigate additional settling and rotation should undermining continue. The existing rock apron will remain in its place (*Figure 2-5)*. An advantage of using a rock apron in a coastal environment is its capacity to disperse wave energy. This wave dispersion characteristic significantly reduces reflected wave energy while also preventing the downward motion of reflected wave energy that results in scour of natural sediment. By dispersing wave energy as it impacts the shoreline, these installations would improve the longevity of the backing structure and assist in protecting the backshore when paired with a seawall.

An alternative seawall repair design could be accomplished by driving sheetpile along the existing seawall. The sheetpile would be driven to hard substrate, minimizing any future soil erosion as well as providing adequate bearing, overturning, and sliding resistance. One option would be to install a steel sheetpile cutoff wall and associated tieback system seaward of the existing wall. This option would require existing voids beneath the seawall foundation to be filled to support the wall. This design is not preferred over the proposed action because installation of sheetpile seaward of the seawall may result in increased environmental impacts and reduce the design life of the seawall. The proposed action is more costly; however, the applicant seeks to establish a more long-term solution.

<u>Seawall Repair Evaluation:</u>

<u>Advantages</u>

- Improves structural integrity without having to construct a new seawall.
- Avoids costs for demolition and removal of the existing seawall and rock apron.
- May extend the life of the structure for an undetermined amount of time.
- Would have the least impact on the appearance of the shoreline.
- Concrete cap would provide additional protection from sea level rise.
- Construction costs would be significantly lower than the seawall replacement option.
- Construction would be significantly faster than the seawall replacement option.
- No substantial impacts on existing lateral shoreline access or coastal processes.
- No substantial impacts on existing viewplanes to or along the shoreline.
- Provides more options to improve the seawall (e.g., appearance, size, ocean access).

<u>Disadvantages</u>

- Requires demolition and removal of the existing concrete counterforts.
- More expensive than installing sheetpile seaward of the existing seawall.

Compared to all alternatives considered, repairing the seawall is the least invasive and minimizes potential environmental impacts. Additionally, repairing the seawall falls under the conditions of the easement with the "right, privilege, and authority to use, maintain, repair, replace and remove the existing seawall." A sheetpile stabilization system landward of the existing seawall would provide adequate resistance to design lateral forces and overturning moments produced by the retained soil and may extend the life of the structure for an undetermined amount of time. Seawall repair is therefore the preferred solution.

Section 5

Plans and Policies

Chapter 5

Plans and Policies

In this chapter, the project's consistency with applicable land use policies set forth in the Hawai‘i State Plan, State Land Use Law, State Coastal Zone Management Program, Hawai'i Water Quality Standards, City and County of Honolulu General Plan, City and County of Honolulu Ko‘olau Poko Sustainable Communities Plan, City and County of Honolulu Land Use Ordinance, Shoreline Setbacks, Special Management Area, and the *Ola: Resilience Strategy* are discussed.

5.1 Hawai‘i State Plan

The Hawai‘i State Plan establishes a statewide planning system that provides goals, objectives, and policies that detail priority directions and concerns of the State of Hawai‘i; these will be discussed as they relate to the project.

It is the goal of the State, under the Hawai‘i State Planning Act (Chapter 226 HRS), to achieve the following:

- A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawai‘i present and future generations.
- A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people.
- Physical, social, and economic well-being, for individuals and families in Hawai‘i, that nourishes a sense of community responsibility, of caring, and of participation in community life (Chapter 226-4 HRS).

Specific objectives and policies of the State Plan that pertain to the project are as follows:

Section 226-11 Objectives and policies for the physical environment--land-based, shoreline, and marine resources.

(a) Planning for the State's physical environment with regard to land-based, shoreline, and marine resources shall be directed towards achievement of the following objectives:

(1) Prudent use of Hawai‘i's land-based, shoreline, and marine resources.

(2) Effective protection of Hawai‘i's unique and fragile environmental resources.

(b) To achieve the land-based, shoreline, and marine resources objectives, it shall be the policy of this State to:

(1) Exercise an overall conservation ethic in the use of Hawai‘i's natural resources.

(3) Take into account the physical attributes of areas when planning and designing activities and facilities.

(4) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.

(6) *Encourage the protection of rare or endangered plant and animal species and habitats native to Hawai'i.*

(8) *Pursue compatible relationships among activities, facilities, and natural resources.*

Discussion: The project's use of the area is consistent with State and County land use districts and zoning designations. No endangered plant species, animal species, or habitats are known in the project area. The project is not anticipated to pose threats to Native Hawaiian endangered plant or animal species and habitats. However, as noted in *Section 3.8* of this document, the federally threatened sea turtle, may nest in the nearby shoreline area, and seabirds may overfly the project area.

Construction activities will be limited to daylight hours and will not use construction work lights to avoid attracting seabirds and/or disorienting sea turtles. The project is not anticipated to result in substantial impacts to environmental and marine resources.

Section 226-12 Objectives and policies for the physical environment—scenic, natural beauty, and historic resources.

(a) *Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawai'i's scenic assets, natural beauty, and multi-cultural/historical resources:*

(b) *To achieve the scenic, natural beauty, and historic resources objectives, it shall be the policy of this State to:*

(1) *Promote the preservation and restoration of significant natural and historic resources.*

(3) *Promote the preservation of views and vistas to enhance the landscapes, and other natural features.*

(5) *Encourage the design of developments and activities that complement the natural beauty of the islands.*

Discussion: The project will not pose adverse impacts to existing scenic assets or cultural/historical resources at the project site. As reviewed in *Section 3.16* of this EA, scenic viewsheds identified in the *Ko'olau Poko Sustainable Communities Plan* and the *Coastal View Study* include panoramic views of the coastline from the ocean. The project is located along Mokulua Drive surrounded by single-family homes which obscure views of the seawall from the roadway towards the ocean. Views toward the coast from the ocean would not be adversely impacted given that the shore protection system already exists, and surrounding properties also include shoreline protection structures. Repairs to the existing seawall would have a smaller footprint than alternatives discussed in *Section 4.0* and could be considered an aesthetic improvement to the shoreline.

As discussed in *Section 3.15*, an AIS was conducted for the project. The study indicated no effects to cultural, archaeological, or historical resources are anticipated to result from the project.

Section 226-13 Objectives and policies for the physical environment--land, air, and water quality.

(a) *Planning for the State's physical environment with regard to land, air, and water quality shall be directed towards achievement of the following objectives:*

(1) *Maintenance and pursuit of improved quality in Hawai'i's land, air, and water resources.*

(b) To achieve the land, air, and water quality objectives, it shall be the policy of this State to:

(2) Promote the proper management of Hawai'i's land and water resources.

(5) Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters.

(6) Encourage design and construction practices that enhance the physical qualities of Hawai'i's communities.

Discussion: The project is appropriately scaled and will maintain Hawai'i's natural and scenic resources. The project is not anticipated to adversely affect coastal resources. Protective measures will be carried out to address potential impacts to the physical environment (land, air, and water) that may occur during construction of the project.

5.2 Hawai'i State Land Use District

Under the Chapter 205 HRS, all lands of the State are to be classified in one of four categories: urban, rural, agricultural, and conservation lands. The State Land Use Commission (LUC), an agency of the DBEDT, is responsible for each district's standards and for determining the boundaries of each district (Chapter 205-2(a), HRS). The LUC is also responsible for administering all requests for district reclassifications and/or amendments to district boundaries, pursuant to Chapter 205-4, HRS, and the HAR, Title 15, Chapter 15 as amended. Under this Chapter, all lands in Hawai'i are classified into four land use districts: (1) Conservation, (2) Agricultural; (3) Urban, and (4) Rural.

The Urban District generally includes lands characterized by "city-like" concentrations of people, structures and services. This District also includes vacant areas for future development. Jurisdiction of this district lies primarily with the respective counties. Generally, lot sizes and uses permitted in the district area are established by the respective County through ordinances or rules.

Discussion: As classified by the State of Hawai'i LUC, the project site is situated within the State Urban District (*Figure 1-2*). The project is consistent with permitted uses for the Urban District with approval of a County Shoreline Setback Variance and SMA compliance and will not require district reclassification or boundary amendments to amend the existing land use designation.

5.3 Hawai'i Coastal Zone Management

The Coastal Zone Management Act of 1972 (16 USC Section 1451), as amended through Public Law 104-150, created the coastal management program and the National Estuarine Research Reserve system. The coastal states are authorized to develop and implement a state coastal zone management program. Hawai'i Coastal Zone Management (CZM) Program received federal approval in the late 1970's. The objectives of the State's CZM Program articulated in Chapter 205A-2 HRS are to protect valuable and vulnerable coastal resources such as coastal ecosystems, special scenic and cultural values, and recreational opportunities. The objectives of the program are also to reduce coastal hazards and to improve the review process for activities proposed within the coastal zone.

Most recently, amendments to Chapter 205A-2 HRS were adopted on September 15, 2020 through Act 16 (SB2060, SD2, HD2). The following subsections examine the project's conformance with the objectives of the Hawai'i CZM Law articulated in Parts I, II (Special Management Area), and III (Shoreline Setbacks) of Chapter 205A HRS, with adopted amendments presented below.

PART I. COASTAL ZONE MANAGEMENT

Section 205A-2 Coastal Zone Management Program; Objectives and Policies

(b) Objectives

(1) Recreational Resources

(A) Provide Coastal Recreational Opportunities Accessible to the Public.

(c) Policies

(1) Recreational Resources

(A) Improve coordination and funding of coastal recreation planning and management.

(B) Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:

(i) Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;

(ii) Requiring restoration of coastal resources that have significant recreational and ecosystem value, including but not limited to coral reefs, surfing sites sandy beaches, and coastal dunes when these resources will be unavoidable damaged by development; or requiring monetary compensation to the State for recreation when restoration is not feasible or desirable;

(iii) Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;

(iv) Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;

(v) Encouraging expanded public recreational use of county, state, and federally owned or controlled shoreline lands and waters having recreational value;

(vi) Adopting water quality standards and regulating point and non-point sources of pollution to protect and where feasible, restore the recreational value of coastal waters;

(vii) Developing new shoreline recreational opportunities, where appropriate, such as artificial lagoons, artificial beaches, artificial reefs for surfing and fishing; and

(viii) Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the land use Commissions, board of land and natural resources, county planning commissions, and crediting ~~such~~ <u>that</u> dedication against the requirements of Section 46-6.

<u>**Discussion:**</u> The project will not affect existing public access to coastal recreational resources. Narrow sand beaches exist sporadically along portions of the entire Lanikai coastline, with public beach access points throughout the area. The closest beach access points are 350 feet northwest and 400 feet southeast of the property. The proposed action to repair the existing seawall will not infringe on public ocean access to the shoreline for swimming, fishing, and other recreational activities.

Construction will be in accordance with State and federal water quality regulations. No storm water or sewer management systems are necessary.

(b) Objectives

(2) Historic Resources

(A) Protect, Preserve and, Where Desirable, Restore Those Natural and Man-Made Historic and Pre-Historic Resources in the Coastal Zone Management Area that are Significant in Hawaiʻi and American History and Culture.

(c) Policies

(2) Historic Resources

(A) Identify and analyze significant archaeological resources;

(B) Maximize information retention through preservation of remains and artifacts or salvage operations; and

(C) Support state goals for protection, restoration, interpretation and display of historic resources.

<u>Discussion:</u> An AIS was conducted for the project area to assess the potential for locating archaeological resources. The study did not identify evidence of archaeological or cultural resources at the site. The report determined no action was required due to negative findings.

(b) Objectives

(3) Scenic and Open Space Resources

(A) Protect, Preserve and Where Desirable, Restore or Improve the Quality of Coastal Scenic and Open Space Resources.

(c) Policies

(A) Identify valued scenic resources in the coastal zone management area;

(B) Ensure that new developments are compatible with their visual environment by designing and locating those developments to minimize the alteration of natural landforms and existing public views to and along the shoreline.

(C) Preserve, maintain and where desirable, improve and restore shoreline open space and scenic resources; and

(D) Encourage those developments which are not coastal dependent to locate in inland areas.

<u>Discussion:</u> As described in *Section 3.15,* the action will not adversely affect vistas or scenic resources in the surrounding area. The project is consistent with the City and County of Honolulu General Plan, Koʻolau Poko Sustainable Communities Plan, and Zoning regulations. Repairs to the seawall will raise the height to result in a uniform 8 feet above msl. The existing wall is 7 feet above msl. This additional height will not impede existing panoramic views of the Koʻolau mountains from the shore or change the physical characteristics of the shoreline.

(b) Objectives

(4) Coastal Ecosystems

(A) Protect valuable coastal ecosystems, including reefs, beaches, and coastal dunes, from disruption and minimize adverse impacts on all coastal ecosystems.

(c) Policies

(A) Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;

(B) Improve the technical basis for natural resource management;

(C) Preserve valuable coastal ecosystems, of significant biological or economic importance, including reefs, beaches, and dunes;

(D) Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs; and

(E) Promote water quantity and quality planning and management practices which reflect the tolerance of fresh water and marine ecosystems and prohibit land and water uses which violate state water quality standards.

Discussion: The proposed action to repair the existing seawall will protect the shoreline property from high wave action events and rapid erosion, which in turn prevents soil and vegetation from entering the ocean and polluting adjacent coastal waters. As discussed in *Section 3.8*, the project is not anticipated to pose adverse effects to biological species or coastal ecosystems. To mitigate for potential impacts during construction, BMPs to control pollutants and prevent the release of construction-related debris from entering coastal waters as discussed throughout this EA will be applied.

(b) Objectives

(5) Economic Uses

(A) Provide public or private facilities and improvements important to the State's economy in suitable locations.

(c) Policies

(A) Concentrate coastal dependent development in appropriate areas;

(B) Ensure that coastal dependent development, and coastal related development are located, designed, and constructed to minimize exposure to coastal hazards and adverse social, visual, and environmental impacts in the coastal zone management area; and

(C) Direct the location and expansion of coastal development to areas designated and used for that development and permit reasonable long-term growth at those areas, and permit coastal development outside of designated areas when:

i. Use of designated locations is not feasible;

ii. Adverse environmental effects and risks from coastal hazards are minimized; and

iii. The development is important to the State's economy

Discussion: The project is consistent with State and County plans and land use regulations and is seeking an SSV for construction of the shoreline stabilization system. The City's regulatory review of the proposed action in the context of Act 16 (SB2060, SD2, HD2) adopted on September 15, 2020 is forthcoming. The project is not anticipated to result in adverse social, visual, and environmental impacts in the coastal zone management area.

(b) Objectives

(6) Coastal Hazards

(A) Reduce hazard to life and property from coastal hazards.

(c) Policies

(A) Develop and communicate adequate information about the risks of coastal hazards;

(B) Control development, including planning and zoning control in areas subject to coastal hazards;

(C) Ensure that developments comply with requirements of the National Flood Insurance Program; and

(D) Prevent coastal flooding from inland projects.

Discussion: The purpose of the project is to prevent high wave action and flooding from further exacerbating coastal erosion issues fronting the residential property. The project supports the objectives and policies with regards to coastal hazards. See *Section 3.5* for discussion.

(b) Objectives

(7) Managing Development

(A) Improve the development review process, communication, and public participation in the management of coastal resources and hazards.

(c) Policies

(A) Use, implement, and enforce existing law effectively to the maximum extent possible in managing present and future coastal zone development;

(B) Facilitate timely processing of applications for development permits and resolve overlapping or conflicting permit requirements; and

(C) Communicate the potential short and long-term impacts of proposed significant coastal developments early in their life-cycle and in terms understandable to the public to facilitate public participation in the planning and review process.

Discussion: The project supports the objectives and policies with regards to managing development in coastal areas. This EA is prepared in accordance with HRS, Chapter 343 and complies with the requirements for assessing and communicating the potential short and long-term impacts of a coastal structure.

(b) Objectives

(8) Public Participation

(A) Stimulate public awareness, education, and participation in coastal management.

(c) Policies

(A) Promote public involvement in coastal zone management processes;

(B) Disseminate information on coastal management issues by means of educational materials, published reports, staff contact, and public workshops for persons and organizations concerned with coastal issues, developments, and government activities; and

(C) Organize workshops, policy dialogues, and site-specific mediations to respond to coastal issues and conflicts.

Discussion: Public participation is a requirement of the Chapter 343 HRS environmental review process. The OEQC is the governing agency of EA publications, and makes available all EAs for public review and comment. The public is provided 30 days to submit comments on the EA. Information regarding the coastal issues and processes is publicly provided in the EA, along with proposed mitigation measures for coastal concerns. Consulted parties in the process are also encouraged to provide input regarding the project during the Draft EA. Following the EA process, the public will have another opportunity to comment on the project during the SSV application process, which requires a public hearing.

(b) Objectives

(9) Beach and Coastal Dune Protection

(A) Protect beaches and coastal dunes for:

i. Public use and recreation

(c) Policies

(A) Locate new structures inland from the shoreline setback to conserve open space and to minimize loss of improvements due to erosion;

(B) Prohibit construction of private shoreline hardening structures including seawalls and revetments, at sites having sand beaches and at sites where shoreline hardening structures interfere with existing recreational and waterline activities;

(C) Minimize the construction of public shoreline hardening structures including seawalls and revetments, at sites having sand beaches and at sites where shoreline hardening structures interfere with existing recreational and waterline activities;

(D) Minimize grading of and damage to coastal dunes;

(E) Prohibit private property owners from creating a public nuisance by inducing or cultivating the private property owner's vegetation in a beach transit corridor; and

(F) Prohibit private property owners from creating a public nuisance by allowing the private property owner's unmaintained vegetation to interfere or encroach upon a beach transit corridor.

<u>Discussion:</u> The structural integrity of the existing seawall is deteriorating. Repairs to the seawall are located landward of the shoreline and will not interfere with existing surrounding recreational and waterline activities in Lanikai. Repairing and stabilizing the shore protection system will prevent failure of the existing shoreline protection structure and associated erosion, which in turn prevents soil and vegetation from entering the ocean and polluting adjacent coastal waters.

(b) Objectives

(10) Marine and coastal resources

(A) Implement the State's ocean resources management plan.

(c) Policies

- *(A) Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;*
- *(B) Assure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;*
- *(C) Coordinate the management of marine and coastal resources and activities management to improve effectiveness and efficiency;*
- *(D) Assert and articulate the interests of the State as a partner with federal agencies in the sound management of ocean resources within the United States exclusive economic zone;*
- *(E) Promote research, study, and understanding of ocean and coastal processes, impacts to climate change and sea level rise, marine life, and other ocean resources in order to acquire and inventory information necessary to understand how coastal development activities relate to and impact ocean and coastal resources; and*
- *(F) Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.*

<u>Discussion:</u> The project will not adversely affect marine resources. Appropriate BMPs as discussed throughout this EA will be used during construction to prevent the release of materials that have the potential to impact marine and coastal resources. A Coastal Assessment by SEI (2020) examined the alternatives to stabilize the Lanikai shoreline fronting the subject property and taking into consideration the marine resources of the area (*Appendix F)*. Repairs to the existing seawall is the preferred alternative, as discussed *Chapter 4.0*.

PART II. SPECIAL MANAGEMENT AREA

Each county is responsible for designating a SMA that extends inland from the shoreline. Development within the SMA is subject to County approval to ensure the proposal is consistent with the policies and objectives of the Hawai‘i CZM Program. Guidelines from Chapter 205A-26 are used to evaluate projects within the SMA.

Section 205A-22 Definitions

"Development" means any of the uses, activities, or operations on land or in or under water within a special management area that are included below:

(1) Placement or erection of any solid material or any gaseous, liquid, solid, or thermal waste;
(2) Grading, removing, dredging, mining, or extraction of any materials;

(3) Change in the density or intensity of use of land, including but not limited to the division or subdivision of land;
(4) Change in the intensity of use of water, ecology related thereto, or of access thereto; and
(5) Construction, reconstruction, [demolition,] or alteration of the size of any structure.

"Development" does not include the following:
(1) Construction or reconstruction of a single-family residence that is less than seven thousand five hundred square feet of floor area, is not situated on a shoreline parcel or a parcel that is impacted by waves, storm surges, high tide, or shoreline erosion, and is not part of a larger development;
(2) Repair or maintenance of roads and highways within existing rights-of-way;
(3) Routine maintenance dredging of existing streams, channels, and drainage ways;
(4) Repair and maintenance of underground utility lines, including but not limited to water, sewer, power, and telephone and minor appurtenant structures such as pad mounted transformers and sewer pump stations;
(5) Zoning variances, except for height, density, parking, and shoreline setback;
(6) Repair, maintenance, or interior alterations to existing structures;
(7) Demolition or removal of structures, except those structures located on any historic site as designated in national or state registers;
(8) Use of any land for the purpose of cultivating, planting, growing, and harvesting plants, crops, trees, and other agricultural, horticultural, or forestry products or animal husbandry, or aquaculture or mariculture of plants or animals, or other agricultural purposes;
(9) Transfer of title to land;
(10) Creation or termination of easements, covenants, or other rights in structures or land;
(11) Subdivision of land into lots greater than twenty acres in size;
(12) Subdivision of a parcel of land into four or fewer parcels when no associated construction activities are proposed; provided that any land that is so subdivided shall not thereafter qualify for this exception with respect to any subsequent subdivision of any of the resulting parcels;
(13) Installation of underground utility lines and appurtenant aboveground fixtures less than four feet in height along existing corridors;
(14) Structural and nonstructural improvements to existing single-family residences, where otherwise permissible;
(15) Nonstructural improvements to existing commercial or noncommercial structures; and
(16) Construction, installation, maintenance, repair, and replacement of emergency management warning or signal devices and sirens; provided that whenever the authority finds that any excluded use, activity, or operation may have a cumulative impact, or a significant environmental or ecological effect on a special management area, that use, activity, or operation shall be defined as "development" for the purpose of this part."

<u>Discussion:</u> The forthcoming City regulatory review of the proposed action will be made in the context of Act 16 (SB2060, SD2, HD2) adopted on September 15, 2020, as this shoreline structure repair project is regulated under the Special Management Area ordinance (ROH Chapter 25).

As discussed in *Section 3.4*, the project will not be vulnerable to passive flooding or annual high wave flooding under both the 0.5-foot and 3.2-foot scenarios (SEI, 2020). However, the property could be exposed to erosion with 0.5 to 3.2 feet of sea level rise. The results of the erosion model represent the combined results of measured, historical erosion rates and the compounding impacts of projected higher water levels associated with projected sea level rise.

Section 205A-26 Special Management Area Guidelines
(1) All development in the special management area shall be subject to reasonable terms and conditions set by the authority in order to ensure:

> *(A) Adequate access, by dedication or other means, to publicly owned or used beaches, recreation areas, and natural reserves is provided to the extent consistent with sound conservation principles;*
>
> *(B) Adequate and properly located public recreation areas and wildlife preserves are reserved;*
>
> *(C) Provisions are made for solid and liquid waste treatment, disposition, and management that will minimize adverse effects upon special management area resources; and*
>
> *(D) Alterations to existing land forms and vegetation, except crops, and construction of structures shall cause minimum adverse effect to water resources, beaches, coastal dunes, and scenic and recreational amenities and minimize impacts from floods, wind damage, storm surge, landslides, erosion, sea level rise, siltation, or failure in the event of earthquake.*

Discussion: The project will not adversely affect access to publicly owned or used beach, recreation, and natural areas. The closest beach access points are 350 feet northwest and 400 feet southeast of the property. Points of access will not be affected by the repairing of the seawall. During construction, potential effects to water quality of nearshore marine waters will be mitigated through employment of BMPs to control potential sediment and stormwater runoff.

The purpose of the project is to reduce the subject property's overall vulnerability to natural hazards that may contribute to shoreline erosion conditions. Repairing the seawall will bring the shoreline protection structure into safe condition, pursuant to the conditions of the easement, and protect the property from impacts of sea level rise and storm events. See *Sections 3.4 and 3.5.*

(2) No development shall be approved unless the authority has first found:

> *(A) That the development will not have any significant adverse environmental or ecological effect, except as any adverse effect is minimized to the extent practicable and clearly outweighed by public health, safety, or compelling public interests. Those adverse effects shall include but not be limited to the potential cumulative impact of individual developments, each of which taken by itself might not have a significant adverse effect, and the elimination of planning options;*
>
> *(B) That the development is consistent with the objectives, policies, and special management area guidelines of this chapter and any guidelines enacted by the legislature; and*
>
> *(C) That the development is consistent with the county general plan, community plan, and zoning; provided that a finding of consistency shall not preclude concurrent processing where a general plan, community plan, or zoning amendment may also be required.*

<u>Discussion:</u> Decades of erosion along the Lanikai shoreline resulted in the construction of various shoreline protection structures, including seawalls, to protect property. As discussed in *Section 3.4*, with 0.5 feet to 3.2 feet of SLR, the project could be exposed to further erosion. Several alternatives were evaluated to meet the objectives of the proposed action. Repair of the existing seawall would have the least environmental impact and is necessary to maintain the seawall in safe condition, pursuant to conditions of the easement. Allowing the seawall to continue to dilapidate or removing it altogether would affect adjacent properties. See *Chapter 4.0* for a discussion on all alternatives.

The entire project site is within the SMA as delineated by the City and County of Honolulu. Amendments to Chapter 205A HRS requires confirmation by DPP of the exempt status of the existing seawall and its pending repair from a SMA permit. Consistency of the project with various State and City plans and policies is discussed throughout this *Chapter 5.0*.

(3) The authority shall seek to minimize, where reasonable:

> *(A) Dredging, filling or otherwise altering any bay, estuary, salt marsh, river mouth, slough or lagoon;*
>
> *(B) Any development that would reduce the size of any beach or other area usable for public recreation;*
>
> *(C) Any development that would reduce or impose restrictions upon public access to tidal and submerged lands, beaches, portions of rivers and streams within the special management areas and the mean high tide line where there is no beach;*
>
> *(D) Any development that would substantially interfere with or detract from the line of sight toward the sea from the state highway nearest the coast; and*
>
> *(E) Any development that would adversely affect water quality, existing areas of open water free of visible structures, existing and potential fisheries and fishing grounds, wildlife habitats, or potential or existing agricultural uses of land."*

<u>Discussion:</u> The project does not involve dredging, filling, or alterations to surface waters, nor would it reduce the size of any beach or area usable for public recreation. Repair of the seawall would not affect views of the shoreline from the water, as discussed in *Section 3.16*. During construction BMPs as discussed in *Section 3.7* will be employed to minimize effects to water quality.

PART III. SHORELINE SETBACKS

An SSV is required when structures are planned within the shoreline area. Shoreline area is defined by Chapter 205A-41 HRS as,

> *"'Shoreline area' shall include all of the land area between the shoreline and the shoreline setback line and may include the area between mean sea level and the shoreline; provided that if the highest annual wash of the waves is fixed or significantly affected by a structure that has not received all permits and approvals required by law or if any part of any structure in violation of this part extends seaward of the shoreline, then the term 'shoreline area' shall include the entire structure."*

As with SMA permits, DPP is the granting authority for SSV approvals in the City and County of Honolulu. DPP's rules are adopted as Chapter 23 ROH.

Section 205A-42 Determination of the shoreline

(a) *The board of land and natural resources shall adopt rules pursuant to chapter 91 prescribing procedures for determining a shoreline and appeals of shoreline determinations that are consistent with subsection (b); provided that no determination of a shoreline shall be valid for a period longer than twelve months, except where the shoreline is fixed by artificial structures that have been approved by appropriate government agencies and for which engineering drawings exist to locate the interface between the shoreline and the structure.*

Discussion: The DLNR OCCL is the regulatory agency responsible for managing land uses on the State's submerged lands, which extend to the highest wash of the highest wave, as identified by the certified shoreline defined in HRS Chapter 205A. Permits for any development on the property are contingent upon a new approved certified shoreline from DLNR. The project shoreline was certified by the State on April 3, 2014. An updated shoreline survey was subsequently conducted, and the shoreline did not change. The shoreline certification was approved by DLNR on November 13, 2020 (*Appendix E, Shoreline Certification Map, File No. OA-1911*).

To pursue repair of the existing seawall located mauka of the certified shoreline, the applicant must obtain approvals from the City DPP for an SSV. The project qualifies for a variance under Chapter 205A-45(a)(9), as a private improvement that artificially fixes the shoreline.

Chapter 205A-46 Variances

(a) *A variance may be granted for a structure or activity otherwise prohibited in this part if the authority finds in writing based on the record presented that the proposed structure of activity is necessary or ancillary to:*

9. *Private facilities or improvements that may artificially fix the shoreline; provided that the authority may consider hardship to the applicant if the facilities or improvements are not allowed within the shoreline area; provided further that a variance to artificially fix the shoreline shall not be granted in areas with sand beaches or where artificially fixing the shoreline may interfere with existing recreational and waterline activities unless the granting of the variance is clearly demonstrated to be in the interest of the general public.*

Discussion: Criteria for granting a shoreline setback variance are provided in Part III of Chapter 205A-46 HRS and Chapter 23-1.8 ROH. The planned shoreline protection structure is anticipated to meet the criteria required for a SSV under both regulations. See *Section 5.8* for discussion.

Hawaiʻi Ocean Resources Management Plan

The Hawaiʻi Ocean Resources Management Plan (ORMP) Is a comprehensive plan spearheaded by the CZM with collaboration from Federal, State, County, and community members. The ORMP is a statewide plan seeking to address Hawaiʻi's resource management issues and encourages holistic stewardship from land to sea (ORMP, 2020) as defined in HRS Chapter 205A-62(1). The 2020 ORMP is the fifth version of the Plan which is built upon previous plans with its original publication in 1985. The 2020 ORMP is centered around three Focus Areas listed below.

Focus Area I: Development & Coastal Hazards

> Goal: Develop a statewide integrated shoreline management strategy to address the compounding impacts to Hawaiʻi's shorelines of coastal development, climate change and sea level rise, erosion, and other chronic coastal hazards.

Focus Area II: Land-Based Pollution

> Goal: Design management strategies and programs to recognize and incorporate the connection of land and sea, facilitating the broad adoption of green infrastructure practices to reduce polluted runoff from within watersheds.

Focus Area III: Marine Ecosystems

> Goal: Promote fishing practices that adopt the wisdom of both traditional ecological knowledge and scientific ecological knowledge to improve fish stocks.

> Goal: Effectively manage networks of healthy coral reefs while improving the health of reef ecosystems at priority sites identified by the State of Hawaiʻi Coral Program.

> Goal: Minimize the likelihood of aquatic alien species introduction and spread into and within Hawaiʻi from sources associated with vessels.

<u>Discussion:</u> Although the project falls within the focus area of Development & Coastal Hazards, the proposed action is to repair an existing seawall, and does not involve any new coastal development pursuant to the goals outlined within the Plan. Shoreline management for existing development including managed retreat and shifting development away from the shoreline remains a statewide challenge addressed in the CZM report, *Accessing the Feasibility and Implication of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawaiʻi*. Although shoreline management for existing development has been addressed, the existing seawall and rock apron is within an easement granted from the State. Pursuant to the conditions of the easement, the grantee maintains the "Right, privilege, and authority to use, maintain, repair, replace and remove existing seawall and revetment."

5.4 Hawai'i Water Quality Standards

The State of Hawaiʻi Department of Health, Clean Water Branch Hawaiʻi Water Quality Standards 11-54, HAR were most recently revised in 2014.

The project is consistent with the applicable objectives and policies for state water quality standards as described below.

General Policy of Water Quality Antidegradation

(a) Existing uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.

(b) *Where the quality of the waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the director finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the state's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the director shall assure water quality adequate to protect existing uses fully. Further, the director shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control.*

(c) *Where existing high-quality waters constitute an outstanding resource, such as waters of national and state parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.*

(d) *In those areas where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with section 316 of the Clean Water Act.*

<u>Discussion:</u> Construction of the shoreline protection structure may cause temporary elevated levels of suspended sediment. Construction BMPs will be implemented to control water quality fronting the project area. After the shoreline stabilization system is intact, long term water quality impacts are not anticipated.

5.5 City and County of Honolulu General Plan

Adopted by resolution in 1977, the 1992 revised edition of the General Plan for the City and County of Honolulu sets forth the long-range objectives for the general welfare and prosperity of the people of O'ahu and broad policies to attain those objectives. The Draft 2035 O'ahu General Plan Update was published in November 2012, and the Revised General Plan was submitted to the City Council in April 2018 for approval. A Final Revised General Plan Update is still pending as of October 2020. The General Plan Update provides objectives and policies intended to guide and coordinate City land use planning and regulation, and budgeting for operations and capital improvements.

The project is consistent with the applicable objectives and policies of the City and County of Honolulu Revised 2035 O'ahu General Plan described below.

<u>*Natural Environment*</u>

Objective A: To protect and preserve the natural environment.

- *Policy 1: Protect Oahu's natural environment, especially the shoreline, valleys, and ridges from incompatible development*
- *Policy 2: Seek the restoration of environmentally damaged areas and natural resources.*
- *Policy 4: Require development projects to give due consideration to natural features such as slope, flood and erosion hazards, water-recharge areas, distinctive landforms, and existing vegetation, as well as plan for coastal hazards that threaten life and property.*
- *Policy 7: Protect the natural environment from damaging levels of air, water, and noise pollution.*

- *Policy 8: Protect plants, birds, and other animals that are unique to the State of Hawai'i and the Island of O'ahu, and protect their habitats.*

Objective B: To preserve and enhance natural landmarks and scenic views of O'ahu for the benefit of both residents and visitors as well as future generations.

- *Policy 2: Protect O'ahu's scenic views, especially those seen from highly developed and heavily traveled areas.*
- *Policy 4: Promote public access to the natural environment for recreational, educational, and cultural purposes and the maintenance thereof in a way that does not damage natural or cultural resources.*

Public Safety and Community Resilience

Objective B: To protect residents and visitors and their property against natural disasters and other emergencies, traffic and fire hazards, and unsafe conditions.

- *Policy 2: Require all developments in areas subject to floods and tsunamis, and coastal erosion to be located and constructed in a manner that will not create any health or safety hazards or cause harm to natural and public resources.*

Culture and Recreation

Objective B: To protect, preserve and enhance O'ahu's cultural, historic, architectural, and archaeological resources.

- *Policy 2: Identify, and to the extent possible, preserve and restore buildings, sites, and areas of social, cultural, historic, architectural, and archaeological significance.*

Objective D: To provide a wide range of recreational facilities and services that are readily available to residents and visitors alike, and to balance access to natural areas with the protection of those areas.

- *Policy 7: Ensure and maintain convenient and safe access to beaches, ocean environments and mauka recreation areas in a manner that protects natural and cultural resources.*

Discussion: The project supports the objectives of the Revised General Plan Update. Development of the project will not pose significant adverse impacts to the natural environment and seeks to preserve the existing shoreline from accelerated erosion rates. As discussed in *Section 3.15,* an AIS was conducted for the project site which indicated no significant findings. Lastly, the recreational resources and public access points at Lanikai Beach will be unaffected by the project.

5.6 City and County of Honolulu Ko'olau Poko Sustainable Communities Plan

Complementing the General Plan are the eight regional plans, prepared by the City DPP. Two areas are identified as "development plans," which provide guidance for future growth and development, while the other six areas are identified as "sustainable communities plans" which aim to maintain the region's character and ensure modest development. Each regional plan implements the objectives and policies of the General Plan and provides direction on public policy, investment, and decision-making within each respective region. Together with the General Plan, they guide population and land use growth over a 20- to 25-year time span.

The project is within the Koʻolau Poko Sustainable Communities Plan area. The Koʻolau Poko Sustainable Communities Plan was first adopted by Ordinance 97-49 in 1997, and last revised in 2017 (Ordinance No. 17-42). The Koʻolau Poko Sustainable Communities Plan establishes policy to preserve the character and promote sustainable development in the Koʻolau Poko District, and projects essentially no growth over the 25-year planning horizon. This vision for Koʻolau Poko's future articulated in the plan is shaped around the following two principal concepts: first, the protection of the communities' natural, scenic, cultural, historic and agricultural resources, and, second, the need to improve and replace, as necessary, the region's aging infrastructure systems.

The Koʻolau Poko Sustainable Communities Plan establishes the region's role in Oʻahu's development pattern by establishing policies for the following land use types: Open Space Preservation; Parks and Recreation; Historic and Cultural Resources; Agricultural Use; Residential Use; Commercial and Industrial Uses; Institutional Uses; and Military Uses. The policies and/or guidelines applicable to the project area provided below:

3. Land Use Policies and Guidelines

3.1 Open Space Preservation

3.1.1 Policies

- *Protect endangered species and their habitats.*
- *Protect scenic beauty and scenic views and provide recreation.*

3.1.3.2 Shoreline Areas

- *Analyze the possible impact of sea level rise for new public and private projects in shoreline areas and incorporate, where appropriate and feasible, measures to reduce risks and increase resiliency to impacts of sea level rise.*

<u>Discussion:</u> The Koʻolau Poko Sustainable Communities Plan Urban Land Use Map identifies the property within the community growth boundary in an area designated as low-density residential. The project site is further identified in the Koʻolau Poko Sustainable Communities Plan Open Space Map, designated as a panoramic viewshed from the ocean looking towards the coastline. Repairs to the existing shore protection include installation of a splash guard on the top of the existing seawall and will increase the height of the wall by one foot from 7 feet above msl to 8 feet above msl, which will not adversely affect views identified in the plan. The project will protect scenic beauty and scenic views and will not alter the visual character of the shoreline, consistent with the Koʻolau Poko Sustainable Communities Plan.

The purpose of the project to maintain the existing shore protection in a safe condition, pursuant to the conditions of the easement. Therefore, it is consistent with the policies and guidelines relating to addressing coastal hazards, as the subject property has been under increased threat by coastal erosion and overwash from storm events. The repairs to the existing shore protection will protect the existing residential structure from rapid erosion threat, which has been exacerbated by climate change and sea level rise and ensure the continued habitability of the residence.

The project will also promote efforts to protect natural, cultural, and historic resources. No developed coral colonies or rare/unique marine communities were identified directly offshore from the property. Construction activities will employ BMPs as discussed throughout this EA to protect water quality and marine species.

5.7 City and County of Honolulu Land Use Ordinance

The purpose of the Land Use Ordinance (LUO) is to regulate land use in a manner that will encourage orderly development in accordance with adopted land use policies, including the County General Plan and development plans. The LUO is also intended to provide reasonable development and design standards. These standards are applicable to the location, height, bulk and size of structures, yard areas, off-street parking facilities, and open spaces, and the use of structures and land for agriculture, industry, business, residences or other purposes (ROH, Chapter 21).

Discussion: The subject property is designated as R-10 Residential by the City and County of Honolulu's LUO (*Figure 1-3*). According to Section 21-3.70(b) of the LUO, the intent of R-10 zoning district is to provide areas for large lot developments, typically located at the outskirts of urban development. Non-dwelling uses which support residential neighborhood activities are also permitted. Repairs to the existing shoreline protection system will protect adjacent properties from coastal hazards and is therefore consistent with the intent and use of the R-10 zoning designation. However, because the repair of the shore protection system is located within the shoreline setback area, the project is subject to approval of an SSV by the Honolulu City Council.

5.8 Shoreline Setbacks

To accomplish the objectives of Chapter 205A HRS discussed in *Section 5.3,* shoreline setback areas were established, and counties were authorized to develop and administer permitting systems to control development within the shoreline setback area. The shoreline setback area encompasses the land between the certified shoreline and the shoreline setback line, generally established 40 feet inland from the certified shoreline with exceptions that allow for adjustments. The proposed repairs to the existing shoreline protection system are located within the shoreline setback area.

City Shoreline Setback rules are defined in Chapter 23 ROH pursuant to Chapter 205A HRS and regulated by the City DPP. The purpose of the policy is to:

> *"(a) protect and preserve the natural shoreline, especially sandy beaches; to protect and preserve public pedestrian access laterally along the shoreline and to the sea; and to protect and preserve open space along the shoreline…[and to] reduce hazards to property from coastal floods."* (ROH Section 23-1.2)

Specifically, Chapter 23 ROH establishes standards that generally prohibit within the shoreline area any construction or activity which may adversely affect beach processes, public access along the shoreline, or shoreline open space. However, allowances are permitted for specific structures and circumstances with the approval of a variance. Notably, Act 16 (SB2060, SD2, HD2) adopted on September 15, 2020 amended HRS Chapter 205A . The City DPP is in the process of making revisions to Chapter 23 ROH, which must then be adopted by the Honolulu City Council. The following subsections analyze the project's consistency with the current regulations under Chapter 23 ROH.

Section 23-1.5(b). The following structures and activities are prohibited within the shoreline area, with the following exceptions:

(1) Minor structures and activities permitted under rules adopted by the department which do not affect beach processes or artificially fix the shoreline and do not interfere with public access, public views or open space along the shoreline. If, due to beach erosion or other cause, the director determines that a minor structure permitted under this section may affect beach processes or public access or has become located seaward of the shoreline, the director or other governmental agency having jurisdiction may order its removal;

(4) Nonconforming structures or structures that have received a shoreline setback variance;

<u>Discussion:</u> The existing seawall is a nonconforming structure, while the rock apron is permitted by HDOT Harbors. Proposed repairs to the existing seawall are located inland of the certified shoreline. Repairs are needed to maintain the deteriorating seawall in a safe condition in accordance with the conditions of the easement and will protect the existing residence from increased shoreline erosion. The applicant will obtain an SSV prior to construction activities.

Section 23-1.8 (b)(3) Hardship Standard

(A) A variance may be granted for an activity or structure that is necessary or ancillary to the following private facilities or improvements, if hardship will result to the applicant if the facilities or improvements are not allowed within the shoreline area:

(i) Private facilities or improvements which will neither adversely affect beach processes nor artificially fix the shoreline; and

(ii) Private facilities or improvements that may artificially fix the shoreline, but only if hardship is likely to be caused by shoreline erosion and conditions are imposed prohibiting any such structure seaward of the existing shoreline unless it is clearly in the public interest.

(B) For the purposes of this subsection, hardship may be found only if:

(i) The applicant would be deprived of reasonable use of the land if required to comply fully with the shoreline setback ordinance and the shoreline setback rules;

(ii) The applicant's proposal is due to unique circumstances and does not draw into question the reasonableness of this chapter and the shoreline setback rules; and

(iii) The proposal is the practicable alternative which best conforms to the purpose of this chapter and the shoreline setback rules.

(C) Before granting a hardship variance, the director must determine that the applicant's proposal is a reasonable use of the land. Because of the dynamic nature of the shoreline environment, inappropriate development may easily pose a risk to individuals or to the public health and safety. For this reason, the determination of the reasonableness of the use of land should properly consider factors such as shoreline conditions, erosion, surf and flood conditions and the geography of the lot.

(D) Hardship shall not be determined as a result of a zone change, plan review use approval, subdivision approval, cluster housing approval, planned development housing approval, conditional use permit, or any other discretionary land use permit granted after June 16, 1989.

Discussion: The project meets the prerequisite of a variance to be granted for private improvements that may artificially fix the shoreline. The existing shore protection system is an ancillary structure to a private residence. The use of the property for a private residence is considered a reasonable use of land. The existing residence is located 40 feet from the certified shoreline. Hardship will result to the applicant if the improvements are not allowed within the shoreline area because the existing seawall is deteriorating, affecting its integrity. If the applicant does not repair the seawall, conditions of the easement would not be met. Further deterioration to the seawall would occur, undermining its structural stability and threatening the existing residence. Loss of a private residence due to compliance with shoreline setback rules would deprive the owner of reasonable use of the land. No structures would be constructed seaward of the certified shoreline.

Alternatives were thoroughly evaluated in *Chapter 4.0*. Relocation of the applicant's residential structure using the remaining unbuilt areas is not possible since there is little open space remaining and the home is slab on grade construction. Removal of the existing shoreline protection without replacement would instantly result in active erosion. This action would release large quantities of earth material into the nearshore water while causing a significant landward movement of the shoreline. From site context and an engineering standpoint, repairs to the existing seawall was determined to be the best practicable alternative that best met the purpose of the shoreline setback rules.

Unique circumstances exist in the Lanikai shoreline setting, and as discussed in *Section 2.2*, there is a historical trend of erosion along the Lanikai shoreline. The shoreline makai of the existing shore protection is a wet beach that moves with inflation and deflation. There is no dry beach at the project site.

Additional analysis of the hardship criteria articulated in Chapter 23-1.8(b)(3)(B) ROH will be provided in a forthcoming SSV application to be submitted to DPP after completion of the EA process.

5.9 Special Management Area

Part II of Chapter 205A HRS outlines control, policies, and guidelines for development within an area along the shoreline referred to as the SMA. CZM policies are administered at the county level. The SMA is a regulated zone extending inland from the shoreline to a landward boundary typically delineated by the county. The purpose of the SMA is to preserve, protect, and where possible, to restore the natural resources of the coastal zone of Hawaiʻi. Special controls on development within the SMA are necessary to avoid permanent loss of valuable resources and foreclosure of management options. In the City and County of Honolulu, management of lands within the SMA is regulated through Chapter 25 ROH. Permit review guidelines in Chapter 25 ROH used by DPP and the City Council are derived from Section 205A-26 HRS.

Discussion: As shown in *Figure 1-5*, the project site is located entirely within the SMA. Under the existing regulations set forth in Chapter 25 ROH, the existing shore protection is considered accessory to the single-family home on the property. Pursuant to Section 25-1.3 ROH, "Development" does not include, "(O) Structural and nonstructural improvements to existing single family residences including additional dwelling units, where otherwise permissible".

Notably, Act 16 (SB2060, SD2, HD2), adopted on September 15, 2020 amended HRS Chapter 205A. DPP is in the process revising Chapter 25 ROH, and their approach to regulating the repair of this shoreline structure is forthcoming. The project's compliance with SMA Review Guidelines is discussed in *Section 5.3*.

The project will not interfere with existing public access, nor will it pose adverse impacts to public beaches or recreation areas. The project will not have adverse impacts on areas of open water, potential fisheries, fisheries, wildlife habitat, or agricultural land. Construction mitigation measures will be implemented as outlined in *Section 3.8* to prevent impacts to biological resources. As previously discussed, the project will not affect the line of sight to the ocean from Mokulua Drive or any State highway.

5.10 Ola: Oʻahu Resilience Strategy

The Office of Climate Change, Sustainability, and Resiliency (OCCSR) was established by the City Charter in 2016 and tasked with tracking climate change science and its potential impacts. As a part of this task, the office was responsible for developing Oʻahu's first resilience strategy. After 18 months of outreach with community stakeholders, government agencies, and the for- and non-profit sectors, OCCSR published *Ola: Resilience Strategy* on May 31, 2019. The strategy identifies 44 actions which directly address the challenge of long-term affordability and the impacts of climate change. Actions are organized in the following four pillars: 1) Remaining Rooted, 2) Bouncing Forward, 3) Climate Security, and 4) Community Cohesion. The strategy is consistent with the City's Multi-Hazard Pre-Disaster Mitigation Plan update (2018).

The 44 Actions includes a description, resilience co-benefits, lead City agency and partners involved, timeframe, measures of success, and a spotlight which offers a story of the action already implemented. Actions are described in relation to the Aloha+ Challenge sustainability goal(s) and the UN Sustainable Development Goal(s) that align with the action.

The proposed action is consistent with the following goals and actions items of the *Ola: Resilience Strategy* (2019):

PILLAR II. BOUNCING FORWARD
Goal 1: Pre-Disaster Preparation
Action 12. Launch Hurricane Retrofit Program for Vulnerable Homes
Action 14. Establish Future Conditions Climate Resilience Design Guidelines
Goal 2: Effective Disaster Response
Action 18. Increase Oʻahu's Preparedness Utilizing Scenario Modeling and Artificial Intelligence
PILLAR III. CLIMATE SECURITY
Goal 3: Climate Resilient Future
Action 29. Protect Beaches and Public Safety with Revised Shoreline Management Rules
Action 30. Protect Coastal Property and Beaches Through Innovation and Partnerships

Discussion: The project site is directly exposed to natural hazards approaching from the east. The proposed action is consistent with the Strategy's goals for pre-disaster preparation and disaster response: the proposed repairs will protect against shoreline erosion associated with natural hazards and will be designed to increase resilience to SLR based on the 2.3-foot SLR scenario. See *Sections 3.4* and *3.5* for further discussion.

Recently, Act 16 (SB2060, SD2, HD2) adopted on September 15, 2020 amended HRS Chapter 205A. The City DPP is currently making revisions to Chapters 23 and 25 ROH. Because the regulatory framework that supports climate security and a climate resilient future remains a work-in-progress, actions by individual landowners to invest in improvements that protect coastal property, beaches and public safety (such as the proposed action) should be encouraged.

Section 6

Findings Supporting the Anticipated Determination

Chapter 6

Findings Supporting the Anticipated Determination

6.1 Anticipated Determination

Based on a review of the significance criteria outlined in Chapter 343 HRS, and Chapter 11-200.1-13 HAR, the project has been determined to not result in significant adverse effects on the natural or human environment. A Finding of No Significant Impact (FONSI) is anticipated.

6.2 Reasons Supporting the Anticipated Determination

The potential impacts of the project have been fully examined and discussed in this EA. As stated earlier, there are no significant environmental impacts expected to result from the project. This determination is based on the assessments as presented below for criterion (1) to (13) (Chapter 11-200.1-13(b) HAR).

(1) Irrevocably commit a natural, cultural or historic resource.

The archaeological and cultural landscapes have been documented in studies conducted specifically for the project area. As detailed in *Section 3.15* of this report, the project does not involve any known loss or destruction of existing natural, cultural, archaeological or historical resources. Due to the presence of fill within the project site, there is a very low expectation for the occurrence of historic properties. If any cultural or archaeological resources are unearthed or ancestral remains are inadvertently discovered during construction, the DLNR, SHPD, the O‘ahu Island Burial Council representative and participating interests from lineal descendants and individuals will be notified. The treatment of these resources will be conducted in strict compliance with the applicable historic preservation and burial laws.

(2) Curtail the range of beneficial uses of the environment.

The project will not curtail the range of beneficial uses of the environment. Although HRS Chapter 91 generally prohibits construction activities within the shoreline area, the seawall is considered a nonconforming structure (present in 1953 and constructed before WWII) and the rock apron is permitted by HDOT. An easement was granted September 27, 2013 which provides the right, privilege, and authority to use, maintain, repair, replace, and remove the existing seawall and apron over, under, and across state-owned land. The project will bring the shoreline protection structure into safe condition, pursuant to the conditions of the easement, and provide a beneficial effect, by protecting the existing home and preventing erosion of the shoreline.

(3) *Conflict with the State's environmental policies or long-term environmental goals established by law.*

The project does not conflict with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 343 HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders. See *Chapter 5.0* for discussion of the project's consistency with State and City planning policies.

(4) *Have a substantial adverse effect on the economic welfare, social welfare, or cultural practices of the community and State.*

The project will result in short-term economic benefits during construction that includes direct, indirect, and induced employment opportunities and multiplier effects, but not at a level that would generate significant economic activity. The project will repair the existing shoreline protection structure into safe condition, pursuant to the conditions of the easement, and continue to protect the existing residence from erosion and property loss. No cultural practices are anticipated to be affected by the project.

(5) *Have a substantial adverse effect on public health.*

The project is consistent with existing land uses and is not expected to affect public health. There will be temporary construction-related impacts to air quality from possible dust emissions and temporary degradation of the acoustic environment in the immediate vicinity resulting from construction equipment operations. The project will comply with State and County regulations during the construction period and will implement BMPs to minimize temporary impacts.

(6) *Involve adverse secondary impacts, such as population changes or effects on public facilities.*

The project includes repair to the existing seawall to protect the property located in Lanikai, Kailua. The approval of the project will not incur secondary impacts, such as population changes or effects on public facilities. Although alternative designs have been proposed, repairing the seawall is the preferred alternative for minimizing potential impacts to neighboring shoreline structures.

(7) *Involve a substantial degradation of environmental quality.*

The project will not involve a substantial degradation of environmental quality. Long-term impacts to air and water quality, noise, and natural resources are not anticipated. The use of standard construction and erosion control BMPs will minimize the anticipated construction-related short-term impacts. Construction activity will be accomplished landward of the existing seawall, which will allow the seawall to provide further protection against runoff and sediment into nearshore marine waters. The proposed action is also to provide long-term protection from increased coastal erosion, which will protect the water quality of nearshore marine waters.

(8) *Is individually limited but cumulatively have substantial adverse effect upon the environment or involved a commitment for larger actions.*

Erosion is a widespread problem throughout the Lanikai coast. Repairing the seawall will not have substantial negative effects upon the environment and will not be a precursor for future actions.

(9) Have a substantial adverse effect on a rare, threatened or endangered species, or its habitat.

Although wedge-tailed shearwater bird burrows were observed at the project site, mitigation measures as outlined in *Section 3.5.1* will be employed prior to construction to mitigate potential impacts to the shearwater birds nesting on the property. The project site does not contain a habitat for the Hawaiian hoary bat. Due to the narrow or non-existent beachfront at the subject property, the beachfront is not suitable location for sea turtle nesting or foraging or a habitat for monk seals. No impacts are anticipated.

(10) Have a substantial adverse effect on air or water quality or ambient noise levels.

Temporary impacts associated with construction are identified throughout *Chapter 3.0* of this EA. Short-term effects on air, water quality, and ambient noise levels during construction will be mitigated through adherence with State and City regulations and mitigation measures as discussed throughout this EA. No detrimental long-term impacts to air, water, or acoustic quality are anticipated from the project.

(11) Have a substantial adverse effect on or be likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, sea level rise exposure area, beach, erosion-prone area, geologically hazardous land, estuary, freshwater, or coastal waters.

The property lies within Flood Zone AE and Zone X and within the designated tsunami zone. Zone AE is defined as, "areas subject to inundation by the 1-percent chance flood event by detailed methods." Zone X is defined as "areas of minimal flood hazard, which are the areas outside the Special Flood Hazard Area and higher than the elevation of the 0.2 percent- chance flood. The project site located along an erosion-prone shoreline area. The purpose of the project is to repair the seawall into safe condition pursuant to the easement and protect the property from ongoing shoreline erosion. The repairs to the existing shore protection will protect the existing residential structure from rapid erosion threat, which has been exacerbated by climate change and sea level rise and ensure the continued habitability of the residence. See *Chapters 3.4* and *3.5* for further discussion.

(12) Have a substantial adverse effect on scenic vistas and viewplanes, during day or night, identified in county or state plans or studies.

The project will be located on a privately-owned property at 1226a Mokulua Drive along the Lanikai coast of Oʻahu. Repairs to the seawall will be accomplished landward of the existing seawall and beneath the surface. Repairs to the seawall will not significantly hinder the views of the shoreline within the project vicinity. No adverse impacts are anticipated.

(13) Require substantial energy consumption or emit substantial greenhouse gases.

Construction of the project will not require substantial energy consumption when compared to other similar-sized projects. No long-term impacts to energy resources or increase in GHG emissions are anticipated.

6.3 Summary

Based on the above findings, further evaluation of the project's impacts through the preparation of an Environmental Impact Statement is not warranted. The EA recommends mitigation measures to alleviate impacts when such impacts are identified. A Finding of No Significant Impact (FONSI) is anticipated for this project. The project will have the beneficial effect of protecting not only the subject property but adjacent properties from ongoing erosion. Complying with the conditions of the easement by repairing the seawall and retaining the existing rock apron will provide a public benefit while resulting in minimal impacts to the surrounding environment.

Section 7

List of Agencies, Organizations and Individuals Receiving Copies of the EA

Chapter 7

List of Agencies, Organizations and Individuals Receiving Copies of the EA

Early consultation on the Project was carried out on June 9, 2020 with 13 total agencies and stakeholder groups as part of the scoping process for this project. Parties contacted during the early consultation process, comments received, and those that will be provided an opportunity to review the EA are identified in *Table 7.1* below. Written comments received during the early consultation comment period are located in *Appendix J.*

Table 7-1 Agencies, Organizations and Individuals Receiving Copies of the EA

Respondents and Distribution	Early Consultation	Received Early Consultation Comments	Receiving Draft EA	Comments Received	Receiving Final EA/ FONSI
Federal Agencies					
U.S. Army Corps of Engineers	X		X		
U.S. Fish and Wildlife Service	X		X		
U.S. National Marine Fisheries Service	X		X		
State of Hawai'i Agencies					
Department of Accounting and General Services			X		
Department of Business, Economic Development & Tourism (DBEDT) – Office of Planning	X	X	X		
Department of Health (DOH)	X		X		
Department of Land and Natural Resources (DLNR)	X		X		
DLNR, Division of Aquatic Resources			X		
DLNR, State Historic Preservation Division	X		X		
DLNR, Office of Conservation and Coastal Lands	X	X	X		
Office of Hawaiian Affairs	X		X		
City and County of Honolulu Agencies					
Department of Corporation Counsel			X		

Table 7-1 Agencies, Organizations and Individuals Receiving Copies of the EA					
Respondents and Distribution	**Early Consultation**	**Received Early Consultation Comments**	**Receiving Draft EA**	**Comments Received**	**Receiving Final EA/ FONSI**
Department of Design and Construction	X	X			
Department of Facility Maintenance			X		
Department of Planning and Permitting	X	X	X		
Department of Parks and Recreation			X		
Office of Climate Change, Sustainability and Resiliency			X		
State Senator Laura Thielen State Senate District 25			X		
State Representative Chris Lee State House District 51			X		
Council Member Alan Texeira Honolulu City Council District 3			X		
Chair Bill Hicks Kailua Neighborhood Board No. 31	X	X	X		
Libraries					
Hawai‘i State Library, Hawai‘i Documents Center			X		
Kailua Public Library			X		
Private Organizations					
Lanikai Association	X		X		
Individuals					
Phil and Mollie Foti	X		X		
Tom Cestare	X		X		

Section 8

References

Chapter 8

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Appendices

Appendix A

1226a Mokulua Drive Legal Documents Nonconforming Status of the Seawall

DEPARTMENT OF PLANNING AND PERMITTING

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET, 7TH FLOOR ! HONOLULU, HAWAII 96813
Phone: (808) 523-4414 ! Fax: (808) 527-6743

JEREMY HARRIS
MAYOR

JAN NAOE SULLIVAN
DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

1999/CLOG-4318(ASK)

Mr. Joel Cavasso
Century 21
Kailua Beach Realty
130 Kailua Road, Suite 110
Kailua, Hawaii 96734

Dear Mr. Cavasso:

Existing Seawall at 1226 Mokulua Drive
Tax Map Key: 4-3-5: 56

This responds to your inquiry regarding the seawall located at the above address. You have provided three affidavits, two stating that the wall was built before World War II and a third indicating that the wall has been buried under the sand for the past 38 years.

Although the wall cannot be seen in the 1967 aerial photos on file with our department, it is possible that the wall was buried at that time. We have no evidence that the wall is illegal. Based on the information currently available, we assume that the wall is non-conforming.

Should you have any questions regarding the above, you may contact Ardis Shaw-Kim of our staff at 527-5349.

Very truly yours,

JAN NAOE SULLIVAN
Director of Planning and Permitting

JNS:am

posse doc 5660
g:joel

Retrieve Update Insert Modify Delete Locate Print

Job Description:	fax transmittal fr Joel Cavasso/Century 21 Kailua Beach Realty of recap of mtg w/A. Challacombe re existing seawall

Job Type:	Correspondence log	Date Created:	Jul 01, 1999
Status:	Correspondence filed	Created By:	EKELLY
Parent Job:		Date Completed:	Jul 13, 1999
Specific Location:			

Details | Processes | Docs | Doc Sort | Notes | TMK | Customers | Warnings | Fees | Project

Process Type	Status	Assigned To	Outcome	Scheduled Start	Date Completed	Description
Open mail and provide desc	Complete	ELAINE KELLY (INAC	Opened	Jul 01, 1999	Jul 01, 1999	
Review and determine actio	Complete	ART CHALLACOMBI	Reviewed -	mmm dd, yyyy	Jul 02, 1999	
Designate to planner	Complete	ART CHALLACOMBI	Designated	mmm dd, yyyy	Jul 02, 1999	
Gather/review information	Complete	ANN ASAUMI; ARDIS	Gathered	mmm dd, yyyy	Jul 13, 1999	
Prepare response letter	Complete	ANN ASAUMI; ARDIS	Prepared	mmm dd, yyyy	Jul 13, 1999	
Review response	Complete	ART CHALLACOMBI	Reviewed	mmm dd, yyyy	Jul 13, 1999	
Sign response letter	Complete	ART CHALLACOMBI	Signed	mmm dd, yyyy	Jul 13, 1999	
Mail response letter	Complete	ANN ASAUMI	Mailed	mmm dd, yyyy	Jul 13, 1999	
File correspondence	Complete	ANN ASAUMI	Filed	mmm dd, yyyy	Jul 13, 1999	To SI TMK: 4-3-5: 56

Appendix B

HDOT Shore Waters Construction Permit No. 1395

PERMIT NO. 1395

DEPARTMENT OF TRANSPORTATION
HARBORS DIVISION
State of Hawaii

APPROVED BY DEPARTMENT OF TRANSPORTATION, HARBORS DIVISION

Work under this permit is approved as described in the foregoing application subject to the following CONDITIONS and must be completed prior to September 25, 1969, or permit will be considered null and void:

(1) Permittee shall indemnify and hold the State of Hawaii, its boards, commissions, agencies, officers, servants, employees, and agents free and harmless from any and all lawsuits or actions of every nature and kind which may be brought for or on account of any personal injury or death, or property damage, direct or indirect, arising or growing out of Permittee's exercise of the rights granted under this permit.

(2) Permittee shall obey and comply with all applicable ordinances, laws, rules and regulations of the City & County of Honolulu, the State, and of the United States of America, and of any political subdivision or agency, authority, or commission with respect to all phases of the construction, operation, and maintenance of any and all improvements authorized under this permit.

(3) Permittee shall take out and keep current all licenses and permits (whether county, state, or federal) required for the conduct of its operations and/or construction, maintenance, and repair of any and all improvements authorized under this permit, and shall pay promptly when due all fees therefor.

(4) The Department of Transperation hereby reserves the right to cancel this permit at any time and for any reason or to require the Permittee to suspend operations without being liable to the Permittee in any way whatsoever for damages.

(5) Permittee shall obtain approval, before construction, from the following agencies:

1. Department of Land and Natural Resources
2. U. S. Army Corps of Engineers
3. City and County of Honolulu's Planning Department

Date September 25, 1968

Acting Chief, Harbors Division

RECEIVED

'68 OCT 17 PM 2:25

[illegible] COUNTY
[illegible] HONOLULU

October 14, 1968

Mr. Elia A. Long
c/o Long & Melone, Ltd.
Suite 601, 333 Queen St.
Honolulu, Hawaii 96813

Dear Sir:

This is in reference to our letter of October 2, 1968 granting you, Mr. Fred F. Hedemann, Hawaiian Trust Co., Ltd. (Trustee) and Mr. John F. Rosa interim right-of-entry to construct a protective stone "blanket" immediately seaward of your respective properties at Lanikai, Kailua, Oahu in accordance with the conditions of Department of Transportation Harbors Division Shore Waters Construction Permit No. 1395.

At its meeting of October 11, 1968 under agenda Item F-11 (copy enclosed), the Board of Land and Natural Resources confirmed the above right-of-entry to construct the protective stone "blanket".

Should you have any questions, please feel free to contact us.

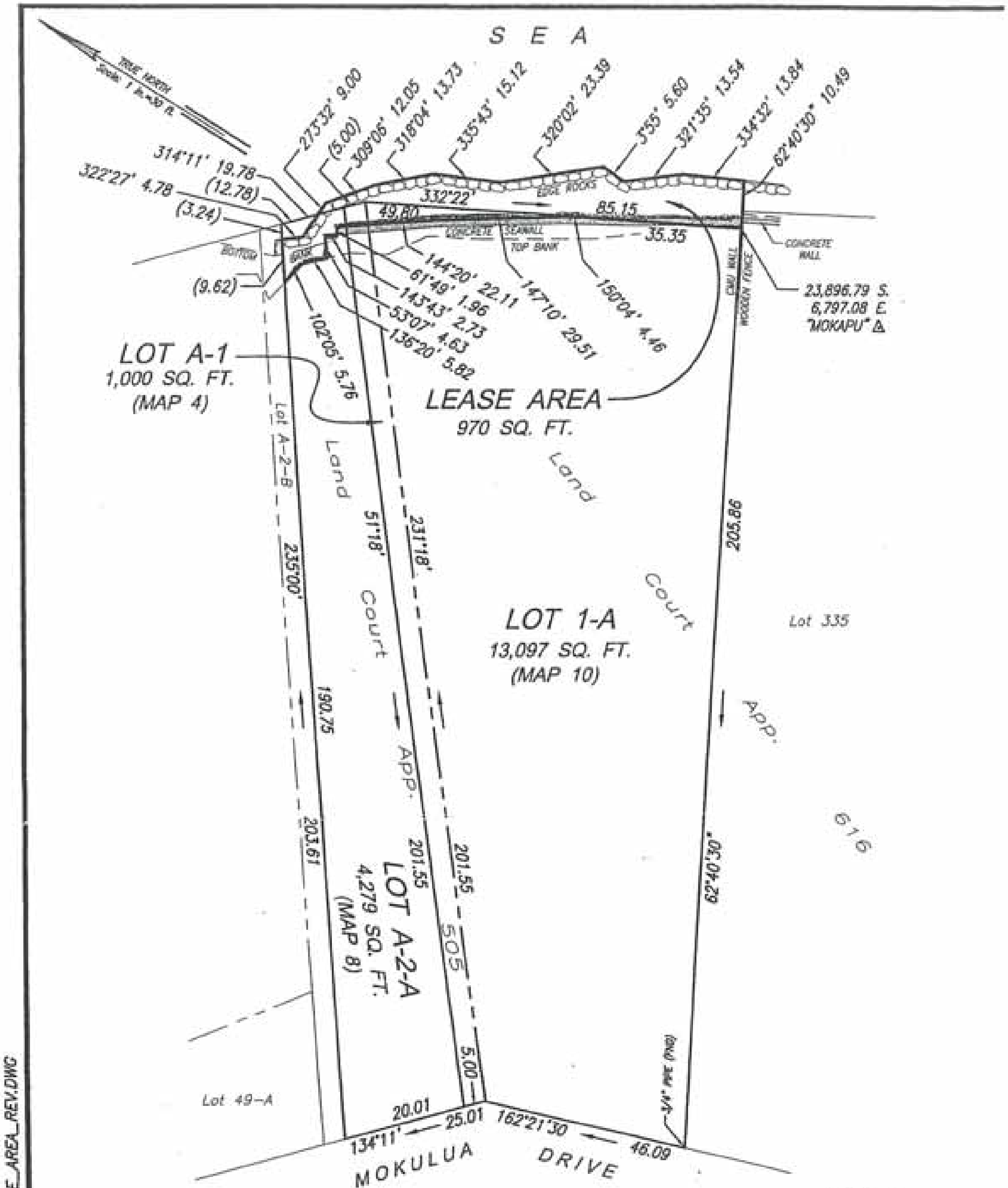
Very truly yours,

JAMES J. DETOR
Program Administrator
Division of Land Management

Enc.

cc: Harbors Div., Dept. of Transportation
U. S. Army Corps of Engineers, Hon.
City & County of Honolulu, Planning Dept
Mr. Fred F. Hedemann
Hawaiian Trust Co., Ltd.
Mr. John F. Rosa

EXHIBIT "D"



PLAN SHOWING LEASE AREA FRONTING LOTS A-1 (MAP 4) AND LOT A-2-A (MAP 8) OF LAND COURT APPLICATION 505 AND LOT 1-A (MAP 10) OF LAND COURT APPLICATION 616

AT KAILUA, KOOLAUPOKO, OAHU, HAWAII

TAX MAP KEY: (1) 4-3-005: 056

OWNERS: James H. and Barbara-Jeann Duncan

ADDRESS: 1226 Mokulua Drive
Kailua, Hawaii 96734

ROBERT K.Y. LEE
LICENSED PROFESSIONAL LAND SURVEYOR
No. 5075
HAWAII, U.S.A.

This work was prepared by me or under my direct supervision.

Robert K.Y. Lee

Robert K.Y. Lee
Licensed Professional Land Surveyor
Certificate Number 5075

MAY 27, 2008

JH_C:\SURVEY CAD FILES\2008\4675\DWG\4675_LEASE_AREA_REV.DWG

JOB NO.: 4675
FB. NO.: 1695
8.5" X 14" = 0.8 Sq. Ft.

TOWILL SHIGEOKA & ASSOCIATES, INC.
LAND SURVEYORS

2153 N. KING STREET
SUITE 308
HONOLULU, HAWAII 968

[E]HIBIT "E"

Exhibit "F"

Appendix C

Variance Related to the Zone of Wave Action No. 1968/Z-124

VARIANCE

NO. 1968/Z-124

November 20, 1968

68/Z-124

Mr. Elia A. Long
333 Queen Street, Suite 601
Honolulu, Hawaii 96813

Dear Mr. Long:

SUBJECT: Variance - Lanikai, 1226 to 1254-B
Mokulua Drive
Tax Map Key: 4-3-05: 56, 57, 76, and 88
Applicants: Elia A. Long, et al

The Zoning Board of Appeals at its meeting on November 7, 1968, held a duly authorized public hearing to consider your request for a variance from Ordinance No. 2837, relating to setback from zone of wave action, to permit the construction of a protective rock "blanket" extending seaward from the existing seawall within the 10-foot setback from zone of wave action for four (4) parcels of land situated at 1226 to 1254-B Mokulua Drive in Lanikai.

It was the decision of the Board to approve the variance and a copy of the Findings of Fact, Conclusions of Law, and Decision and Order is enclosed. Before proceeding with the protective rock "blanket" please be sure to obtain the necessary clearance from other governmental agencies who have jurisdiction along the waterfront.

Very truly yours,

ZONING BOARD OF APPEALS

By
Frank Skrivanek
Planning Director

Enclosure

:cmy

ZONING BOARD OF APPEALS OF THE CITY AND COUNTY OF HONOLULU

STATE OF HAWAII

IN THE MATTER OF THE APPLICATION OF ELIA A. LONG FRED F. HEDEMANN JOHN F. ROSA, AND HAWAIIAN TRUST CO., LTD., TRUSTEE FOR A VARIANCE	)

FINDINGS OF FACT, CONCLUSIONS OF LAW, AND DECISION AND ORDER

I. APPLICATION

The Zoning Board of Appeals at its meetings on October 24, and November 7, 1968, considered the application by Elia A. Long, Fred F. Hedemann, John F. Rosa, and Hawaiian Trust Company, Ltd., Trustee, for a variance from Ordinance No. 2837, relating to setback from zone of wave action to permit the construction of a protective rock "blanket" extending seaward from the existing seawall within the zone of wave action for four (4) parcels of land at 1226 to 1254-B Mokulua Drive in Lanikai.

A public hearing on this matter was held by the Zoning Board of Appeals on November 7, 1968, in accordance with Section 5-515(3) of the City Charter.

II. FINDINGS OF FACT

On the basis of the evidence presented, the Board hereby finds:

1. The four parcels in question are situated on the makai side of Mokulua Drive, between a point opposite Aala Drive

and Onekea Drive, at 1226 to 1254-B Mokulua Drive, identified by Tax Map Key 4-3-05: 56, 57, 76, and 88, in Lanikai, Koolaupoko, Oahu;

2. The lots front on Mokulua Drive and have depths of approximately 200 feet;

3. The existing seawall along the ocean frontage is 2 feet in width and approximately 5 feet in height and the seawall abuts a sandy shoreline;

4. The seawall is a nonconforming structure, constructed prior to the enactment of Ordinance No. 2837 which became effective August 19, 1966;

5. The zone of wave action line is the existing seawall inasmuch as it limits the advancement of waves inland. From inspection on the ground and from all indications, the entire seawall seems to be inside the property line. Therefore, any proposed construction within 5 to 6 feet on the ocean side of the wall would be contrary to Ordinance No. 2837 and thus requires a variance;

6. The applicant's proposal of construction of a protective stone "blanket" (seawall rock barrier) seaward from the existing seawall would necessitate variance from Section 1 (c) of Ordinance No. 2837, which prohibits any structure including but not limited to buildings, seawall, groin and revetment from being placed or erected within 10 feet of the zone of wave action as measured horizontally and landward from the inland boundary line of the zone of wave action, on any lot which is situated immediately adjacent to a sandy beach;

7. Waves are undermining the existing seawall which may create a hazardous condition and will eventually result in erosion of the properties under discussion;

8. The applicants have obtained permission to proceed with the rock barrier from the Corps of Engineers, Department of Army; Department of Land and Natural Resources, State of Hawaii; and Department of Transportation, Harbors Division; and

9. There were no protests filed in person or by letter during or prior to the public hearing.

III. CONCLUSIONS OF LAW

The Board made the following Conclusions of Law:

1. By reason of peculiar and unusual circumstances pertaining to the physical characteristics of the property, practical difficulty and unnecessary hardship would result from a strict enforcement of the existing zoning regulations;

2. The request is due to unique circumstances and not to the general conditions in the neighborhood which reflect the unreasonableness of the zoning ordinance; and

3. The use sought by the variance will not alter the essential character of the locality nor be contrary to the intent and purpose of the zoning ordinanse and will not adversely affect the adjoining property owners.

IV. DECISION AND ORDER

Pursuant to the foregoing Findings of Fact and Conclusions of Law, it was the decision of the Zoning Board of Appeals at its meeting on November 7, 1968, that the application for a variance from Ordinance No. 2837, relating to the Zone of Wave Action, be approved for the four (4) lots identified by Tax Map Key 4-3-05: Parcels 56, 57, 76, and 88, on the basis that it found sufficient evidence to meet the three conditions of hardship specified in the City Charter, and the construction of the protective rock "blanket" extending seaward from the existing seawall within the zone of wave action be subject to submission of a revised plan satisfactory to the Planning Director showing the utilization of larger rocks (approximately 400 lb. stones) for the rock "blanket" which shall be made a part of the variance.

Dated at Honolulu, Hawaii, this 7th day of November, 1968.

ZONING BOARD OF APPEALS OF THE
CITY AND COUNTY OF HONOLULU
STATE OF HAWAII

By______________________________
Jonah Ting, Chairman

___:cag

Appendix D

Grant of Non-Exclusive Easement (S-6043)

31 AM

STATE OF HAWAII
BUREAU OF CONVEYANCES
RECORDED
October 14, 2014 8:01 AM
Doc No(s) A-54000412

/s/ NICKI ANN THOMPSON
REGISTRAR

1 1/7 ZMA
B-32534026

LAND COURT SYSTEM | REGULAR SYSTEM

Return by Mail (✓) Pickup ( ) To:

State of Hawaii
DLNR
P.O. Box 621
Hon. HI 96809

TG: 201408164-S R 1
TGE: 14-040-067
Trish Furtado

Total Number of Pages:

Tax Map Key No. (1)4-3-005:seaward of 056

AMENDMENT OF GRANT OF NON-EXCLUSIVE EASEMENT NO. S-6043

THIS AGREEMENT, made and entered into this 22 day of August, 2014, by and between the State of Hawaii, by its Board of Land and Natural Resources, hereinafter referred to as the "Grantor," and JAMES HUGH DUNCAN and BARBARA-JEANN DUNCAN, husband and wife, as tenants in the entirety, whose address is 26908 Malibu Cove Colony, Malibu, California 90265, hereinafter referred to as the "Grantee";

WITNESSETH:

WHEREAS, Grant of Non-Exclusive Easement S-6043 dated September 27, 2013, recorded in the State of Hawaii, Bureau of Conveyances as Document No. A-51790561, was issued to Grantee; and

WHEREAS, the Grantee desires that Grant of Non-Exclusive Easement No. S-6043 be amended; and

WHEREAS, the Board of Land and Natural Resources, at its meeting held on June 13, 2014, has approved the amendment to Grant of Non-Exclusive Easement No. S-6043 for the purposes of:

558859_1.DOC

PRELIM. APPR'D.
Department of the
Attorney General

1. Revising the area to be 1,308 square feet due to a recent shoreline survey map which showed that the encroachment area is 1,308 square feet and not 1,268 square feet as previously determined; and

2. Stipulating the consideration for the difference between the old area and the new area to be TWO THOUSAND SIX HUNDRED EIGHTY AND NO/100 DOLLARS ($2,680.00).

NOW, THEREFORE, the Grantor and Grantee covenant and agree that:

1. At page 2, at line 3 to line 10, the following is hereby deleted being: "'Non-Exclusive Seawall and Revetment Easement,' containing an area of 1,268 square feet, more or less, more particularly described in Exhibit "A" and delineated on Exhibit "B," both of which are attached hereto and made parts hereof, said exhibits being respectively, a survey description and survey map prepared by the Survey Division, Department of Accounting and General Services, State of Hawaii, designated C.S.F. No. 25,194 and dated June 8, 2012," and in its place the following shall hereby replace said deletion: "(Revised-June 2014) Non-Exclusive Seawall and Revetment Easement," containing an area of 1,308 square feet, more or less, more particularly described in Exhibit "A-1" and delineated on Exhibit "B-1," both of which are attached hereto and made parts hereof, said exhibits being respectively, a survey description and survey map prepared by the Survey Division, Department of Accounting and General Services, State of Hawaii, designated C.S.F. No. 25,376 and dated June 19, 2014."

2. The consideration for the difference between the old area and the new area is TWO THOUSAND SIX HUNDRED EIGHTY AND NO/100 DOLLARS ($2,680.00).

IN CONSIDERATION THEREOF, the Grantor and Grantee further agree that this Amendment of Grant of Non-Exclusive Easement No. S-6043 is subject to all the covenants and conditions in the Grant of Non-Exclusive Easement No. S-6043, except as herein provided.

This Amendment, read in conjunction with the Grant of Non-Exclusive Easement No. S-6043 sets forth the entire agreement between the Grantor and Grantee; and the Grant of Non-Exclusive Easement No. S-6043 as amended and modified hereby shall not be altered or modified in any particular except by a memorandum in writing signed by the Grantor and Grantee.

PRELIM. APPR'D.
Department of the
Attorney General

IN WITNESS WHEREOF, the STATE OF HAWAII, by its Board of Land and Natural Resources, has caused the seal of the Department of Land and Natural Resources to be hereunto affixed and the parties hereto have caused these presents to be executed the day, month, and year first above written.

STATE OF HAWAII

Approved by the Board of Land and Natural Resources at its meeting held on June 13, 2014.

By ______________________
WILLIAM J. AILA, JR.
Chairperson
Board of Land and
Natural Resources

GRANTOR

APPROVED AS TO FORM:

____
PAMELA K. MATSUKAWA
Deputy Attorney General

Dated: 8/7/2014

____
JAMES HUGH DUNCAN

____
BARBARA-JEANN DUNCAN

GRANTEE

558859_1.DOC

PRELIM. APPR'D.
Department of the
Attorney General

STATE OF HAWAI'I
SURVEY DIVISION
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
HONOLULU

C.S.F. No. 25,376 June 19, 2014

(REVISED-JUNE 2014)
NON-EXCLUSIVE
SEAWALL AND REVETMENT EASEMENT
Affecting Lots A-1 and A-2-A of Land Court Application 505
and Lot 1-A of Land Court Application 616

Kailua, Koolaupoko, Oahu, Hawaii

Being a portion of the submerged land of Kailua Bay and the submerged land within Lots A-1 and A-2-A of Land Court Application 505 and Lot 1-A of Land Court Application 616.

Beginning at the south corner of this easement, at the southeast corner of Lot 1-A as shown on Map 10 of Land Court Application 616 and on the north boundary of Lot 335 as shown on Map 56 of Land Court Application 616, the coordinates of said point of beginning referred to Government Survey Triangulation Station "MOKAPU" being 23,896.79 feet South and 6797.08 feet East, thence running by azimuths measured clockwise from True South:-

1. 152° 22' 41.74 feet along Lot 1-A as shown on Map 10 of Land Court Application 616;

2. 146° 26' 27.60 feet along the remainder of Lot 1-A as shown on Map 10 of Land Court Application 616;

PRELIM. APPR'D. Department of the Attorney General

EXHIBIT "A-1"

3.	144° 20'	22.11	feet along the remainder of Lot 1-A as shown on Map 10 of Land Court Application 616, remainder of Lot A-1 as shown on Map 4 of Land Court Application 505 and remainder of Lot A-2-A as shown on Map 8 of Land Court Application 505;
4.	61° 49'	10.14	feet along the remainder of Lot A-2-A as shown on Map 8 of Land Court Application 505;
5.	132° 02'	11.88	feet along the remainder of Lot A-2-A as shown on Map 8 of Land Court Application 505;
6.	235° 00'	14.16	feet along Lot A-2-B as shown on Map 8 of Land Court Application 505;
7.	235° 00'	4.34	feet;
8.	298° 59'	1.41	feet;
9.	313° 27'	18.58	feet;
10.	320° 52'	16.49	feet;
11.	319° 06'	13.47	feet;
12.	345° 52'	7.94	feet;
13.	303° 37'	8.61	feet;
14.	0° 19'	6.37	feet;
15.	308° 25'	5.41	feet;
16.	349° 07'	8.82	feet;
17.	311° 51'	12.44	feet;
18.	344° 24'	10.84	feet;
19.	62° 40' 30"	8.82	feet;

PRELIM. APPR'D.
Department of the
Attorney General

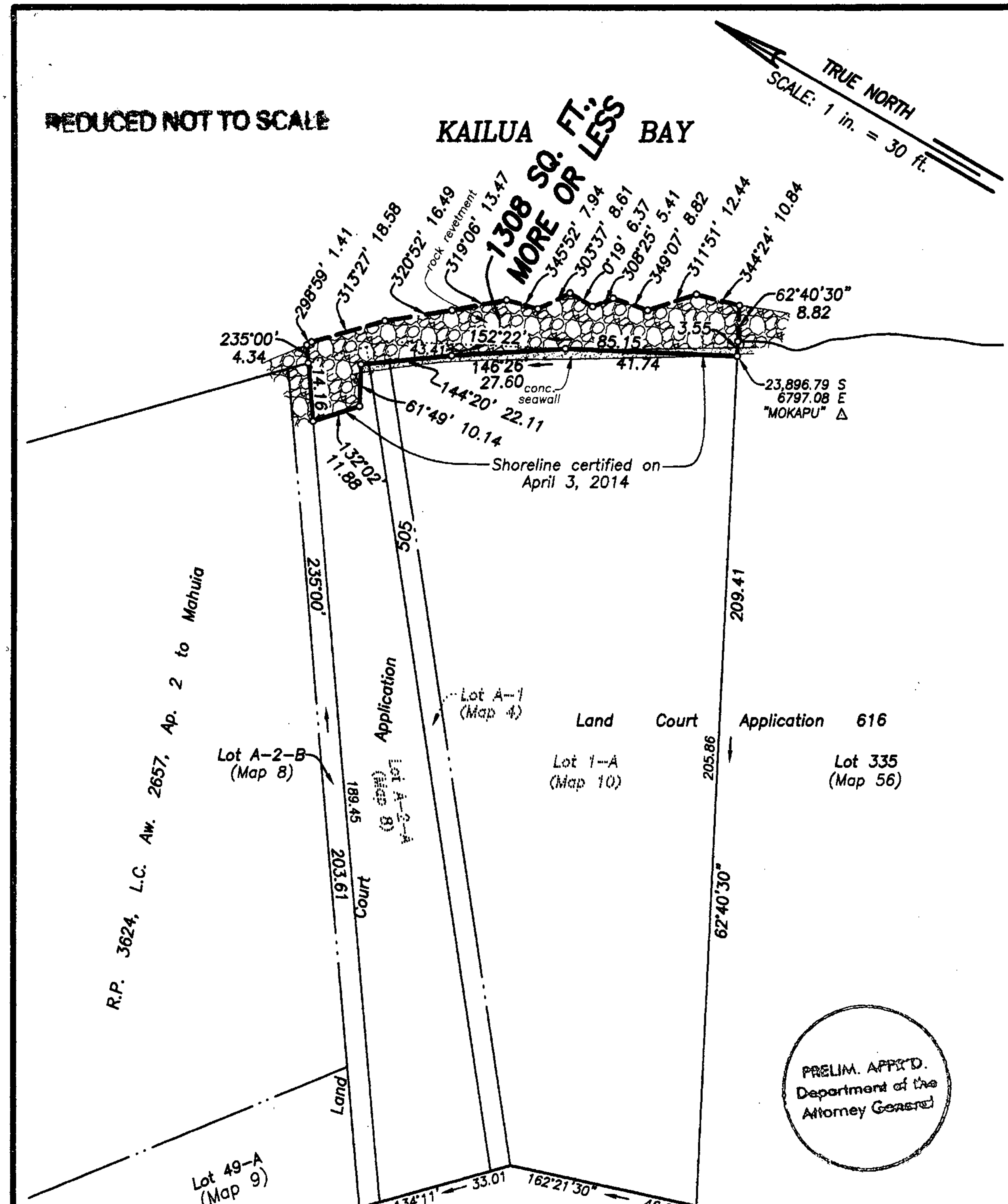
20. 62° 40' 30" 3.55 feet along Lot 335 as shown on Map 56 of Land Court Application 616 to the point of beginning and containing an AREA OF 1308 SQUARE FEET, MORE OR LESS.

SURVEY DIVISION
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
STATE OF HAWAII

By: ____________________
Gerald Z. Yonashiro
Land Surveyor tkt

Compiled map and desc. furn. by Towill Shigeoka & Assoc., Inc. Said map and desc. have been examined and checked as to form and mathematical correctness but not on the ground by the Survey Division.

PRELIM. APPR'D.
Department of the
Attorney General



(REVISED–JUNE 2014)
NON–EXCLUSIVE
SEAWALL AND REVETMENT EASEMENT

Affecting Lots A–1 and A–2–A of Land Court Application 505
and Lot 1–A of Land Court Application 616

Kailua, Koolaupoko, Oahu, Hawaii

Scale: 1 inch = 30 feet

Job 0–119(14)
C. BK.

EXHIBIT "B-1"

Fronting Parcel 56 of TMK: 4–3–05

SURVEY DIVISION
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
STATE OF HAWAII

C.S.F. NO.	*25,376*	
RDM	*June 19, 2014*	

Appendix E

Certified Shoreline (November 13, 2020)

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

RECEIVED
NOV 19 2020
AUSTIN, TSUTSUMI & ASSOCIATES, INC.
Honolulu, Hawaii 96817-5031

November 13, 2020

File No.: OA-1911

Austin, Tsutsumi & Associates, Inc.
501 Sumner Street, Suite 521
Honolulu, Hawaii 96817

Dear Applicant:

Subject: Transmittal of Signed Shoreline Certification Maps
Owner(s): Krueger Trust
Tax Map Key: (1) 4-3-005:056

Enclosed please find three (3) copies of the certified shoreline survey maps for the subject property.

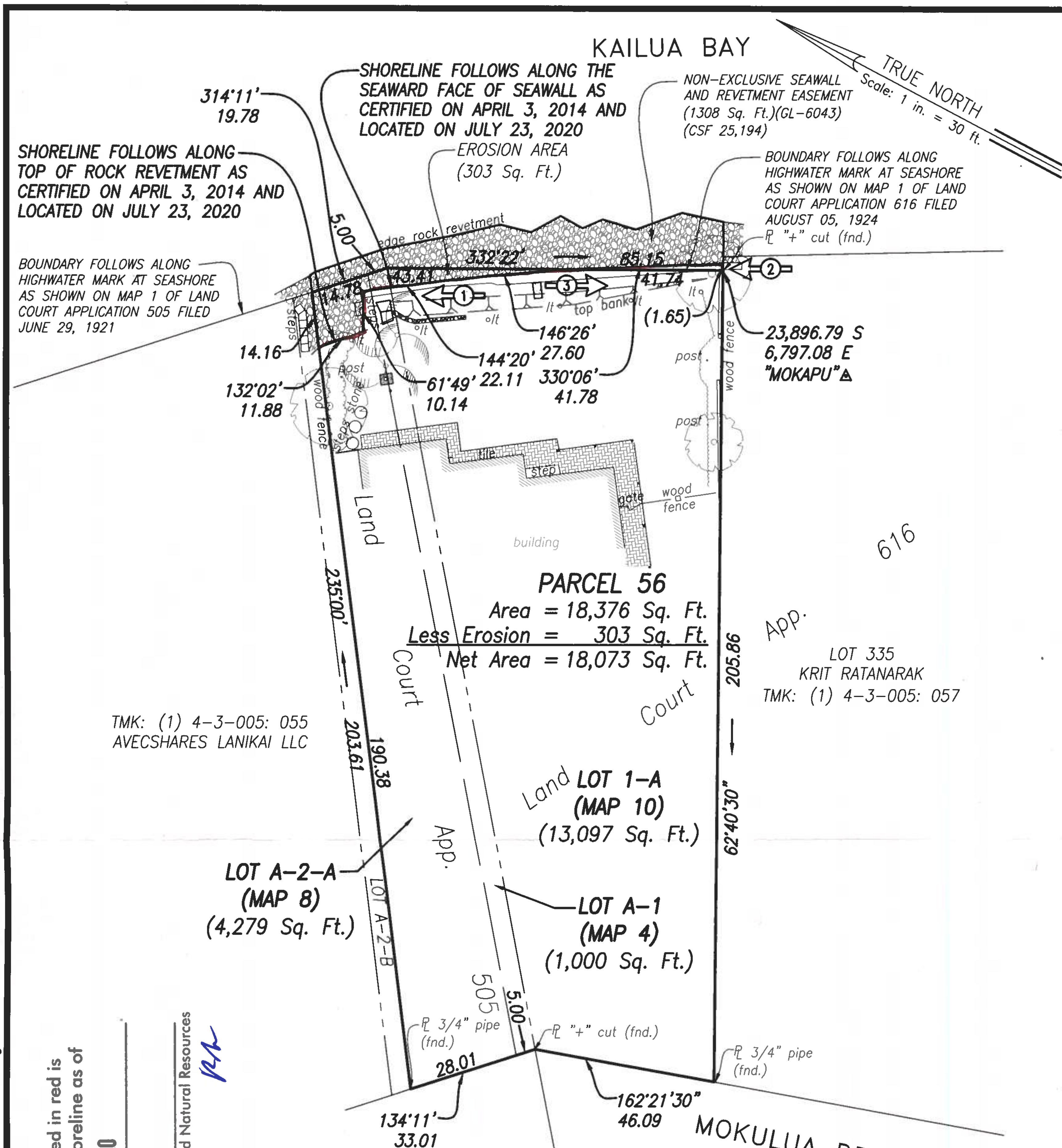
If you have any questions, please feel free to call us at (808) 587-0424. Thank you.

Sincerely,

Cal Miyahara
Shoreline Disposition Specialist

Enclosures

cc: DAGS



The shoreline as delineated in red is hereby certified as the shoreline as of

NOV 13 2020

Chairperson, Board of Land and Natural Resources

SHORELINE SURVEY OF

LOTS A-1 AND A-2-A OF LAND COURT APPLICATION 505 AND LOT 1-A OF LAND COURT APPLICATION 616

AT KAILUA, KOOLAUPOKO, OAHU, HAWAII

TAX MAP KEY: (1) 4-3-005: 056

OWNERS: Krueger Trust

ADDRESS: 1226A Mokulua Drive
Kailua, Hawaii 96734

ERIK S. KANESHIRO
LICENSED PROFESSIONAL LAND SURVEYOR
No. 9826
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

LICENSED PROFESSIONAL LAND SURVEYOR
CERTIFICATE No. 9826
EXP. 04/22

October 19, 2020

LEGEND:

fnd found
TMK tax map key

NOTES:

1. Azimuths and Coordinates are referred to Government Survey Triangulation Station "MOKAPU" △.
2. =①=> Denotes approximate position and direction of Shoreline Photographs.

Y:\2020\20-323 1226a Mokulua Drive Shoreline\DWG\20-323 SHORELINE MAP.dwg

JOB NO.: 20-323
FB. NO.:
10" X 15"

Appendix F

Sea Engineering, Inc. Coastal Assessment Krueger Seawall Repairs (August 2020)

Coastal Assessment for Krueger Seawall Repairs

Lanikai, Oahu, Hawaii

October 2020

Prepared for:
David & Terri Krueger
1226A Mokulua Drive
Kailua, HI 96734
Tax Map Key No. (1) 4-3-005:056

Prepared by:
Sea Engineering, Inc.
Makai Research Pier
41-305 Kalanianaole Hwy
Waimanalo, HI 96795

Job No. 25751

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TABLE OF CONTENTS

1. INTRODUCTION 1

1.1 BACKGROUND 1
1.2 LOCATION 1
1.3 OBJECTIVES 1

2. PROJECT SITE DESCRIPTION 4

2.1 REGIONAL SETTING 4
2.2 EXISTING CONDITIONS 4
2.3 GEOTECHNICAL ASSESSMENT 13
2.4 CERTIFIED SHORELINE 15
2.5 SHORELINE PROFILES 15
2.6 HISTORICAL SHORELINE CHANGE 19

3. PHYSICAL SETTING 2

3.1 GEOLOGY & SOILS 2
3.2 BATHYMETRY 2
3.3 BENTHIC HABITAT 2
3.4 COASTAL USES 3
3.5 ZONING & LAND USES 3

4. OCEANOGRAPHIC SETTING 6

4.1 WINDS 6
4.2 WATER LEVELS 7
4.2.1 Tides 7
4.2.2 Sea Level Rise 8
4.3 WAVES 11
4.3.1 General Wave Climate 11
4.3.2 Prevailing Deepwater Waves 12
4.3.3 Extreme Deepwater Waves 15
4.4 NUMERICAL MODELING OF WAVE APPROACH 17
4.5 STILL WATER LEVELS AND NEARSHORE WAVE HEIGHTS 19

5. COASTAL HAZARDS 20

5.1 HURRICANES 20
5.2 KONA STORMS 20
5.3 TSUNAMI 20
5.4 STILL WATER RISE 22
5.5 COASTAL FLOODING 22
5.6 PROJECTED IMPACTS OF SEA LEVEL RISE 23

6. ALTERNATIVES ANALYSIS 27

6.1 INTRODUCTION 27
6.2 NO ACTION 27
6.3 MANAGED RETREAT 28
6.4 BEACH NOURISHMENT 30

6.5 ROCK REVETMENT 32
6.6 HYBRID SEAWALL-REVETMENT 37
6.7 SEAWALL REMOVAL 41
6.8 SEAWALL REPLACEMENT 42
6.9 SEAWALL REPAIR 44

7. REFERENCES 47

LIST OF FIGURES

FIGURE 1-1 PROJECT SITE LOCATION ON OAHU, HAWAII (GOOGLE EARTH) 2
FIGURE 1-2 PROJECT SITE LOCATION IN LANIKAI, OAHU (GOOGLE EARTH) 2
FIGURE 1-3 OBLIQUE AERIAL PHOTOGRAPHS OF THE PROJECT SITE (JULY 2020) 3
FIGURE 2-1 EXISTING CONDITIONS (JULY 2020) 6
FIGURE 2-2 EXISTING CONDITIONS – NORTH END OF SHORELINE (JULY 2020) 7
FIGURE 2-3 EXISTING CONDITIONS – SOUTH END OF SHORELINE (JULY 2020) 8
FIGURE 2-4 COUNTERFORT ON INSHORE SIDE OF SEAWALL (JULY 2020) 9
FIGURE 2-5 BACKSHORE EROSION ALONG NORTH END OF SHORELINE (JULY 2020) 9
FIGURE 2-6 CONCRETE REPAIRS AT PANEL JOINT (JULY 2020) 10
FIGURE 2-7 GAP BETWEEN SUBJECT SEAWALL AND SOUTH ADJACENT SEAWALL (JULY 2020) 10
FIGURE 2-8 SETTLEMENT ALONG NORTHERN PORTION OF SEAWALL (JULY 2020) 11
FIGURE 2-9 OUTWARD ROTATION ALONG NORTHERN PORTION OF SEAWALL (JULY 2020) 11
FIGURE 2-10 DISCONNECTED RETURN AT NORTH END OF SEAWALL (JULY 2020) 12
FIGURE 2-11 SINKHOLES INSHORE OF EXISTING SEAWALL (JULY 2020) 12
FIGURE 2-12 BORING LOG FROM PROJECT SITE (SHINSATO, 2020) 14
FIGURE 2-13 SHORELINE AS CERTIFIED BY THE STATE OF HAWAII APRIL 3, 2014 16
FIGURE 2-14 PROFILE TRANSECT LOCATIONS 17
FIGURE 2-15 PROFILES FROM TOPOGRAPHIC SURVEY (JULY 2020) 18
FIGURE 2-16 HISTORICAL SHORELINE CHANGE RATES FOR THE PROJECT SITE (CGG, 2019) 20
FIGURE 2-17 LANIKAI SHORELINE CHANGE AND SEDIMENT BUDGET, 1996-2005 (USACE, 2009) . 1
FIGURE 3-1 SOIL TYPES WITHIN THE PROJECT SITE (USDA) 3
FIGURE 3-2 BATHYMETRY FOR THE PROJECT SITE, IN METERS (NOAA LIDAR) 4
FIGURE 3-3 BENTHIC HABITAT BIOLOGY FOR THE PROJECT SITE (PACIOOS, 2020) 4
FIGURE 3-4 BENTHIC HABITAT GEOGRAPHY FOR THE PROJECT SITE (PACIOOS, 2020) 5
FIGURE 3-5 BENTHIC HABITAT GEOMORPHOLOGY FOR THE PROJECT SITE (PACIOOS, 2020) 5
FIGURE 4-1 WIND ROSE KANEOHE MCBH (JULY 2016 TO JULY 2018) 7
FIGURE 4-2 RELATIVE SEA LEVEL TREND, MOKU O LOE, HAWAII, 1957 TO 2019 (NOAA, 2020) 10
FIGURE 4-3 HAWAII LOCAL MEAN SEA LEVEL RISE PROJECTIONS, IN FEET (ADAPTED FROM NOAA, 2017) 10
FIGURE 4-4 HAWAII DOMINANT SWELL REGIMES 11
FIGURE 4-5 PROJECT SITE AND VIRTUAL BUOY LOCATIONS 13
FIGURE 4-6 STATION 51202 VIRTUAL BUOY WAVE HEIGHT ROSE FROM JAN 1979 TO JAN 2010 14
FIGURE 4-7 STATION 51202 VIRTUAL BUOY WAVE PERIOD ROSE FROM JAN 1979 TO JAN 2010 14
FIGURE 4-8 LOCATION OF CDIP BUOY 098 IN RELATION TO THE PROJECT SITE 15
FIGURE 4-9 CDIP 098 RETURN PERIOD 17-YR (AUG 2000 TO MAR 2018) 16
FIGURE 4-10 LAYOUT OF SWAN NESTED GRIDS 18

FIGURE 4-11 NEARSHORE SIGNIFICANT WAVE HEIGHT TRANSFORMATION FROM THE DESIGN 50-YR NORTHEAST SWELL EVENT 18
FIGURE 5-1 COMPOSITE HAZARD MAP WITH PROJECT SITE SHOWN IN RED (USGS, 2002) 21
FIGURE 5-2 FLOOD HAZARD ZONES FOR THE PROJECT SITE (FEMA) 22
FIGURE 5-3 PASSIVE FLOODING WITH 3.2 FEET OF SEA LEVEL RISE (PACIOOS, 2020) 24
FIGURE 5-4 ANNUAL HIGH WAVE FLOODING WITH 3.2 FEET OF SEA LEVEL RISE (PACIOOS, 2020) 24
FIGURE 5-5 COASTAL EROSION WITH 0.5 TO 3.2 FEET OF SEA LEVEL RISE (PACIOOS, 2020) 25
FIGURE 5-6 COMBINED HAZARD EXPOSURE WITH 3.2 FEET OF SEA LEVEL RISE (PACIOOS, 2020) 25
FIGURE 6-1 EXAMPLE OF BEACH NOURISHMENT WITH T-HEAD GROINS (IROQUOIS POINT, OAHU) 30
FIGURE 6-2 ROCK REVETMENT AT KAHULUI HARBOR (KAHULUI, MAUI, HAWAII) 32
FIGURE 6-3 CONCEPTUAL PLAN VIEW FOR ROCK REVETMENT LANDWARD OF THE SHORELINE 35
FIGURE 6-4 CONCEPTUAL SECTION VIEW FOR ROCK REVETMENT LANDWARD OF THE SHORELINE 35
FIGURE 6-5 CONCEPTUAL PLAN VIEW FOR ROCK REVETMENT SEAWARD OF THE SHORELINE 36
FIGURE 6-6 CONCEPTUAL SECTION VIEW FOR ROCK REVETMENT SEAWARD OF THE SHORELINE ... 36
FIGURE 6-7 HYBRID SEAWALL-REVETMENT (KAPAA, KAUAI, HAWAII) 37
FIGURE 6-8 CONCEPTUAL PLAN VIEW FOR HYBRID SEAWALL-REVETMENT LANDWARD OF THE SHORELINE 39
FIGURE 6-9 CONCEPTUAL SECTION VIEW FOR HYBRID SEAWALL-REVETMENT LANDWARD OF THE SHORELINE 39
FIGURE 6-10 CONCEPTUAL PLAN VIEW FOR HYBRID SEAWALL-REVETMENT SEAWARD OF THE SHORELINE 40
FIGURE 6-11 CONCEPTUAL SECTION VIEW FOR HYBRID SEAWALL-REVETMENT SEAWARD OF THE SHORELINE 40
FIGURE 6-12 CONCEPTUAL DESIGN FOR SEAWALL REPLACEMENT (MKE) 43
FIGURE 6-13 CONCEPTUAL PLAN FOR SEAWALL REPAIR (MKE) 46

LIST OF TABLES

TABLE 4-1 WATER LEVEL DATA FOR MOKU O LOE, STATION 1612480 (NOAA, 2020) 8
TABLE 4-2 HAWAII LOCAL MEAN SEA LEVEL RISE SCENARIOS, IN FEET (ADAPTED FROM NOAA, 2017) 10
TABLE 4-3 RETURN PERIOD SIGNIFICANT WAVE HEIGHTS AT CDIP 098 16
TABLE 4-4 TOP 10 NE WAVE EVENTS RECORDED AT CDIP 098 16

1. INTRODUCTION

1.1 Background

Sea Engineering, Inc. (SEI) was hired to prepare a Coastal Assessment for the project site, which is located at 1226a Mokulua Drive, Kailua, Oahu, Hawaii, 96734; Tax Map Key No. (1) 4-3-005:056. The project site is fronted by a seawall and rock apron that that are in a deteriorated condition. The property owners are evaluating potential options to repair or replace the existing shore protection.

The purpose of this Coastal Assessment is to collect the data and information necessary to understand the problem and inform the development of conceptual engineering solutions that are appropriate for the site conditions. The objective of this Coastal Assessment is to assess current conditions, evaluate potential engineering alternatives, present conceptual alternatives, and identify the preferred alternative.

The Coastal Assessment is an important component of the environmental review and regulatory permitting process. This Coastal Assessment complies with the Office of Environmental Quality Control (OEQC) guidelines for assessing shoreline alteration projects, including a detailed description of the existing shoreline and coastal processes; historical shoreline erosion rates; site maps; oceanographic setting; coastal hazards; description of improvements; and review of alternatives.

1.2 Location

The project site consists of a single residential property located in the community of Lanikai, approximately 0.70 miles southeast of Alala Point, and approximately 0.76 miles northwest of Wailea Point. The project site is bounded by Mokulua Drive to the west and the Pacific Ocean to the east. The location of the project site is shown in Figure 1-1 and Figure 1-2. Oblique aerial photographs of the project site are shown in Figure 1-3. The project site is located along a predominantly armored shoreline that extends approximately 4,000 feet from Wailea Point to the central portion of Lanikai. The project site is fronted by a seawall that is constructed of unreinforced concrete and a rock apron that is composed of basalt boulders that runs along the length of the seawall. The north and south adjacent properties are fronted by similar shore protection structures. (Figure 1-3).

1.3 Objectives

The existing seawall and rock apron are covered by a term, non-exclusive easement from the State of Hawaii (Easement S-6043). The easement confers unto the Grantee the "right, privilege, and authority to use, maintain, repair, replace and remove the existing seawall and steps over, under, and across State-owned land". The easement also requires that the Grantee "shall keep the easement area and the improvements thereon in a safe condition".

The objectives of the proposed repairs are to:

- Repair damage and structural deficiencies of the existing seawall.
- Comply with the conditions of the easement to maintain the structures in a safe condition.
- Provide long-term protection for the property and existing single-family home.

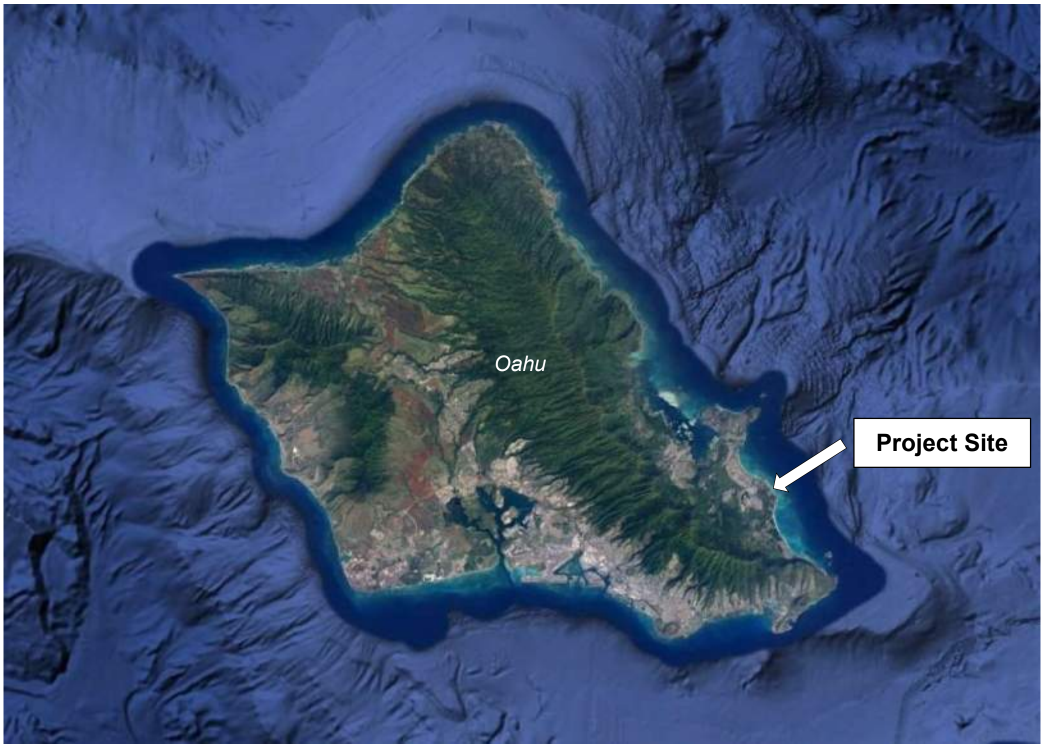

Figure 1-1 Project site location on Oahu, Hawaii (Google Earth)

Figure 1-2 Project site location in Lanikai, Oahu (Google Earth)

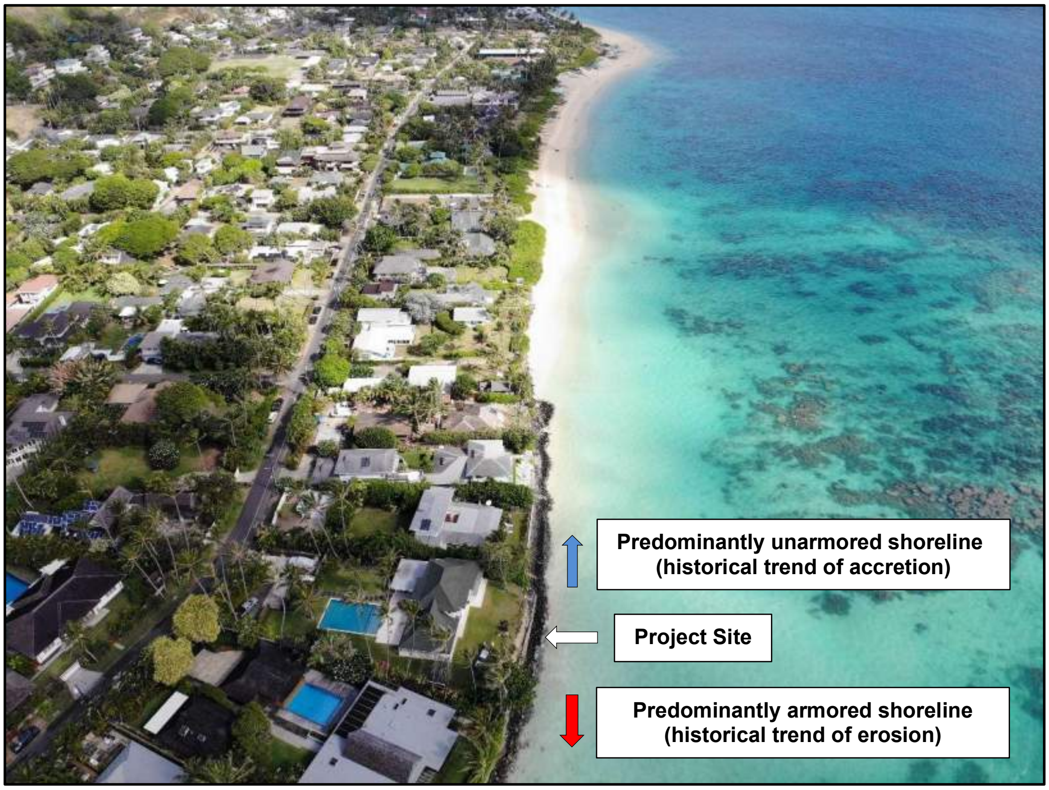

Figure 1-3 Oblique aerial photographs of the project site (July 2020)

2. PROJECT SITE DESCRIPTION

2.1 Regional Setting

The project site is located along Mokulua Drive at the seaward edge of a relatively flat coastal plain in the community of Lanikai on the southeast coast of Oahu. The coastline is dominated by narrow beaches, discontinuous coastal dunes, and broad shallow fringing reefs. The region is intensely developed, and many beaches suffer from chronic and episodic erosion. The backshore area at the project site consists of a single residential parcel. Lateral shoreline access is limited due to the extensive shoreline armoring and lack of beach width in the Lanikai area.

The project coastline is characterized by a wide fringing reef that extends over 3,000 feet offshore and along the Mokulua Islands. The fringing reef is incised with channels or depressions at numerous locations and has numerous sand patches. The shallow reef crest and reef flat dissipate wave energy as it approaches the shoreline. During typical conditions, significantly less wave energy reaches the shoreline than exists in deep water due to the shallow depths of the reef and subsequent wave breaking. However, wave energy still reaches the shoreline at higher water levels and cross-shore currents still occur. Sand in Lanikai Beach and the nearshore sand fields is mobilized through active longshore and cross-shore transport. Typical patterns on windward Oahu beaches show sand being pushed offshore with winter swell events and a gradual transport back onshore during summer tradewind swell conditions. Longer term sand dynamics of Lanikai Beach have changed due to the extensive armoring of the shoreline, particularly along the southern portion of the shoreline, south of the project site.

Prior to the late 1970's, Lanikai Beach showed a trend of accretion. This trend reversed causing erosion along the shoreline and, in response, property owners constructed seawalls and other hardened shoreline structures (Romine and Fletcher, 2012). The project site is located at the north end of a predominantly armored shoreline that extends approximately 4,000 feet south to Wailea Point. The shoreline north of the project site transitions to a wider, dry beach with backshore dune formation and stable vegetation. Many of the properties in this area are fronted by shore protection structures that have been buried as the shoreline has accreted over time. The beach extends approximately 2,500 feet north of the project site. The remaining 1,200 feet of shoreline extending to Alala Point is fronted by shore protection structures.

2.2 Existing Conditions

The project site consists of a single residential parcel with a total land area of 18,376 square feet (0.42 acres) and a total shoreline frontage of 105 feet. Terrestrial elevation ranges from 7 to 11 feet above mean sea level (msl). The project site is fronted by a seawall that is constructed of unreinforced concrete and a rock apron that is composed of basaltic boulders that are 9 to 18 inches in diameter. The rock apron is approximately 4 feet high, 10 feet wide, and runs along the length of the seawall. Aerial and ground photographs showing the current condition of the shoreline are shown in Figure 2-1 through Figure 2-3

There are no construction permits or other land use authorizations for the seawall. However, datable ground photographs have shown that the seawall existed in its current shape and location in 1953. The rock apron was permitted in 1968 by the Hawaii Department of Transportation Harbors Division (Shore Waters Construction Permit No. 1395) and Hawaii Board of Land and Natural

Resource. In 2012, the Hawaii Board of Land and Natural Resources approved disposition of a term, non-exclusive easement for seawall and revetment purposes. The easement was executed by the Hawaii State Legislature on September 27, 2013 (Grant of Non-Exclusive Easement S-6043). The easement confers unto the Grantee the "right, privilege, and authority to use, maintain, repair, replace and remove the existing seawall and steps over, under, and across State-owned land". The easement also requires that the Grantee "shall keep the easement area and the improvements thereon in a safe condition". The easement is valid for fifty-five (55) years and will expire in September 27, 2069.

The seawall is approximately 90 feet long and 6 to 8 feet tall, as referenced from the beach sand elevation at the time of the inspection. The top of the wall varies in elevation from about +5 feet to +7 feet mean sea level (msl). The top of the wall is approximately 16 to 17 inches wide with apparent front and rear batters of about 1H:12V to 1.5H:12V. Based on these batters and wall heights, the base of the wall is estimated to be approximately 2.4 feet wide. Two concrete counterforts are located on the landward side of the wall at approximately 43 feet and 70 feet from the north end, respectively (Figure 2-4). The seawall terminates approximately 20 feet from the northwest property corner. Wave action is causing erosion of the terrestrial soils in this area (Figure 2-5).

The seawall appears to have been constructed in six (6) segments, or panels. Vertical joints are visible between each panel section. There is evidence of concrete repairs at several of the panel joints (Figure 2-6). An approximately 1 to 2-inch-wide gap was observed at the panel joint between the subject seawall and the south adjacent seawall (Figure 2-7).

Settlement was observed along the northern portion of the seawall. The settlement was approximately 24 inches relative to the southern portion of the wall (Figure 2-8). The settlement is likely due to loss of subgrade support from erosion of the underlying substrate. Outward rotation of the wall has also occurred in these areas (Figure 2-9) and the return at the north end of the seawall has disconnected from the main wall structure (Figure 2-10). The outward rotation of the wall may be attributed to a loss of bearing support fronting the wall and/or an increase in the active lateral forces due to saturated soil conditions.

The seawall appears to have been constructed on loose sand that is highly susceptible to scour and erosion. At a portion of the wall about 30 feet from the north end, where the bottom of the wall was visible, sandy substrate was visible under the wall. Sinkholes are apparent along the entire length of the seawall (Figure 2-11). The sinkholes likely formed due to internal erosion of the sandy substrate from beneath and behind the seawall foundation.

Figure 2-1 Existing conditions (July 2020)

Figure 2-2 Existing conditions – north end of shoreline (July 2020)

Figure 2-3 Existing conditions – south end of shoreline (July 2020)

Figure 2-4 Counterfort on inshore side of seawall (July 2020)

Figure 2-5 Backshore erosion along north end of shoreline (July 2020)

Figure 2-6 Concrete repairs at panel joint (July 2020)

Figure 2-7 Gap between subject seawall and south adjacent seawall (July 2020)

Figure 2-8 Settlement along northern portion of seawall (July 2020)

Figure 2-9 Outward rotation along northern portion of seawall (July 2020)

Figure 2-10 Disconnected return at north end of seawall (July 2020)

Figure 2-11 Sinkholes inshore of existing seawall (July 2020)

2.3 Geotechnical Assessment

Geotechnical investigations were conducted by APTIM (February 2019) and Shinsato Engineering, Inc. (July 2020). The investigations included a total of three (3) test borings and a laboratory analysis on the soil samples to determine their engineering properties. The backfill soil and seawall subgrade appears to be a fine to medium grain calcareous sand. Bore #1 and Bore #2 of the APTIM (2019) investigation encountered what appeared to be a hard, nonerodable substrate approximately 15 to 20 feet below the backfill ground elevation. Bore #1 of the Shinsato (2020) investigation (Figure 2-12) encountered loose, light brown and tan, fine grained calcareous sand to a depth of 9 feet. Below 9 feet, the sand was found to be medium to coarse grained and medium dense in consistency. At 10.5 feet, the bore hole caved in. Probing below 10.5 feet disclosed medium dense to dense soil to a depth of 26.5 feet below grade then grading to very dense to the final depth of the boring at 28.33 feet where there was refusal to further probing. Groundwater was encountered at a depth of 7'10" below the existing grade. SEI previously conducted water jet probing at several properties near the project site. Probe refusal was encountered at -6 to -8 feet msl. For the structural evaluation of the wall including preliminary repair design, the recommended soil parameters are as follows:

1. <u>Ultimate soil bearing value for evaluation of the existing wall:</u>
   The ultimate soil bearing pressure may be assumed as 1,500 psf for each foot of width plus 2,000 psf for each foot of embedment. For example, a 4-foot wide footing bearing directly on the soil (no embedment), the ultimate soil bearing capacity would be 6,000 psf. With 1 foot of embedment, the ultimate bearing capacity for the 4-foot wide footing would increase to 8,000 psf. Note: the above assumes positive contact between the bottom of the footing and the subgrade soil.

2. <u>Allowable soil bearing value:</u>
   Apply a minimum factor of safety of 3.0 to the ultimate soil bearing value to obtain the allowable soil bearing value. The recommended maximum allowable soil bearing value is 4,000 psf in order to limit the anticipated foundation settlement to less than 1-inch. Higher bearing values will result in an increase in the foundation settlement. The bearing value may be increased by one-third (1/3) for momentary loads due to wind or seismic forces. The maximum edge pressure shall not exceed the maximum allowable soil bearing pressure. The minimum footing embedment 12 inches below the anticipated depth of soil scour or bearing on a nonerodable substrate.

3. <u>Lateral earth pressure coefficients:</u>

* Passive Earth Coefficient	Kp = 4.55
* Active Earth Coefficient	Ka = 0.22 (unrestrained condition)
	Ko = 0.33 (restrained condition)
Coefficient of friction	0.83 x DL
Soil Unit Weight	110 pcf (moist)
	60 pcf (submerged)

The passive and active earth pressures may be determined by multiplying the respective earth coefficient by the soil unit weight (either above water - moist, or under water - submerged). Apply an appropriate factor of safety for allowable design values.

LOG OF BORING NO. 1

DRILLING METHOD: **Badger Drill Rig**
HAMMER WEIGHT (lbs): **140**
HAMMER DROP (in): **30**

ELEVATION (FT.): **Unknown**
DEPTH OF BORING (FT.): **28.33**
DEPTH TO GROUNDWATER (FT.): **7'-10"**
DATE DRILLED: **07/09/2020**

DEPTH (FT.)	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	BLOWS/FOOT	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0	SP-SM	SAND (calcareous), with fines, few roots		light brown	sl. moist	loose				
	SP	SAND (calcareous), fine grained, trace of fines		tan						
2			10				85.4	2.9		
					moist					
4			7				89.5	6.0		
6					very moist					
			14		▼		90.9	14.9		
8										
		–medium to coarse grain				medium dense				
10			19				95.8	15.6		
		–hole caved in to 8' –probed from 10.5' with a 2-inch diameter probe tip attached to AW rods; driven with the 140-lb. hammer falling from a height of 30-incehs	14							
12			20							
			36			dense				
14			42							
			54							
16			41							
			36							
18			23			medium dense				
			22							
20			15							
			13							
22			16							
			11							
24			12							
			18							
26			20							
			51			very dense				
28		–refusal at 28'-4"	100/10"							
		END OF BORING								
30										

Project: KRUEGER PROPERTY SEAWALL
1226 MOKULUA DRIVE
Project No.: 19-0067

SHINSATO ENGINEERING, INC.
CONSULTING GEOTECHNICAL ENGINEERS
98-747 KUAHAO PL. #E, PEARL CITY, HI 96782

PLATE 3

Figure 2-12 Boring log from project site (Shinsato, 2020)

2.4 Certified Shoreline

In Hawaii, the shoreline boundary of property may be subject to change because of the action of the waves in adding to (accretion) or taking away (erosion) land along the shoreline and is subject to redetermination according to the laws of the State of Hawaii. Shoreline boundaries are typically determined by a certified shoreline. The "shoreline" in Hawaii is defined as:

> *"the upper reaches of the wash of the waves, other than storm or seismic waves, at high tide during the season of the year in which the highest wash of the waves occurs,, usually evidenced by the edge of vegetation growth, or the upper limit of debris left by the wash of the waves (Hawaii Administrative Rules §13-222)."*

The shoreline plays an important role in establishing jurisdictional boundaries for coastal land uses in Hawaii. Lands seaward of the shoreline are deemed to be in the Conservation District and come under the administrative jurisdiction of the Hawaii Department of Land and Natural Resources (DLNR). Lands inland of the shoreline are in the Special Management Area and Shoreline Setback Area and come under the administrative jurisdiction of the counties. A certified shoreline is typically a prerequisite for obtaining approvals for land uses in the Conservation District and Special Management Area. The certified shoreline also establishes the landward limits of the *beach transit corridor*, which is intended to provide lateral public access seaward of the shoreline.

The project site shoreline was certified by the State of Hawaii on April 3, 2014 (Figure 2-13). The certified shoreline confirmed that the shoreline is located along the seaward face of seawall and top of the rock apron.

2.5 Shoreline Profiles

SEI conducted a topographic survey in July 2020 to collect elevation data of the backshore, foreshore, and nearshore waters fronting the project site. Four (4) shoreline profiles were generated through the topographic survey data to show the cross-shore profile of the seawall and rock apron (Figure 2-14 and Figure 2-15). Elevations are relative to mean sea level (msl). There is no seawall present at Profile 4.

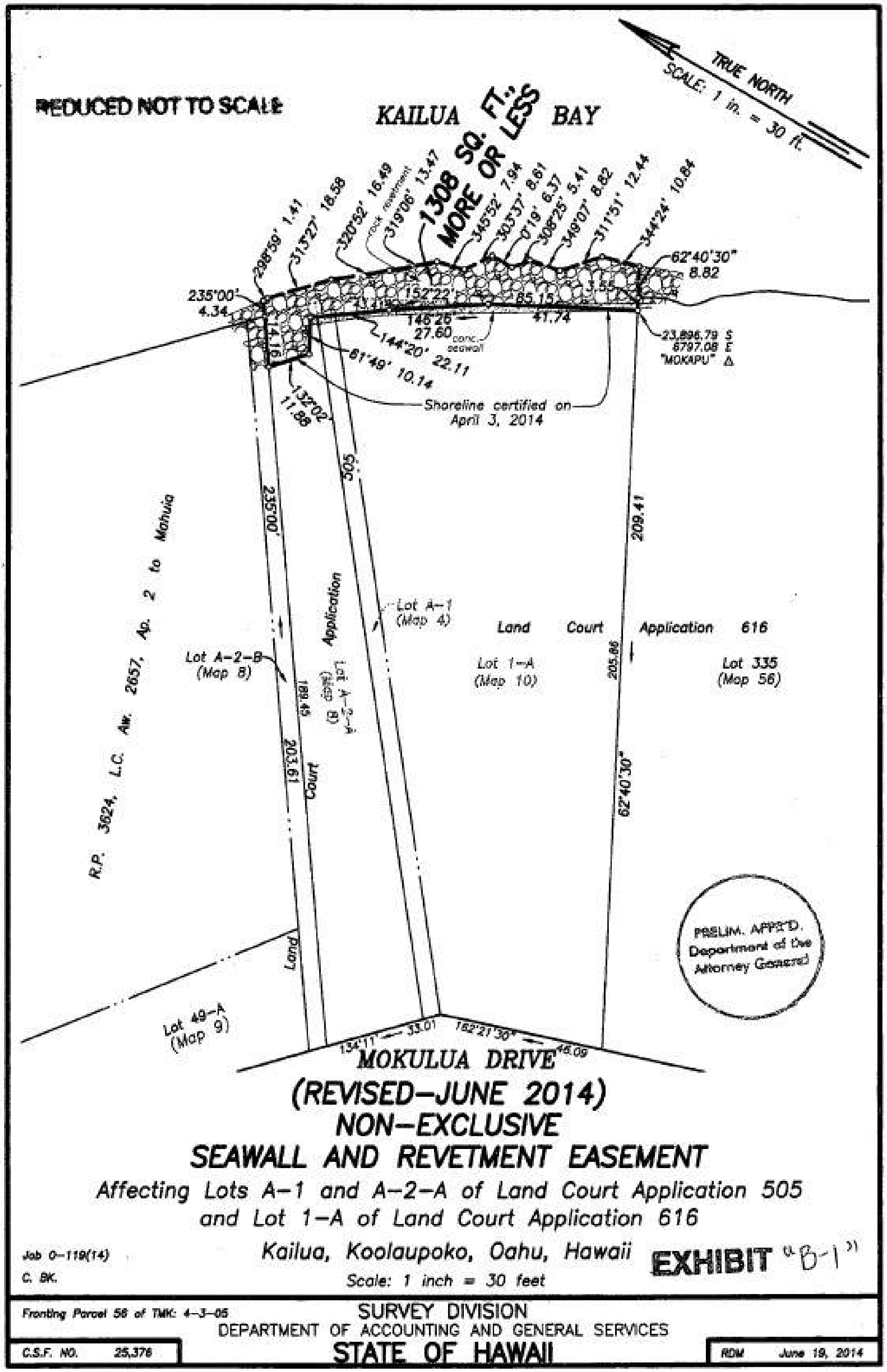

Figure 2-13 Shoreline as certified by the State of Hawaii April 3, 2014

Figure 2-14 Profile transect locations

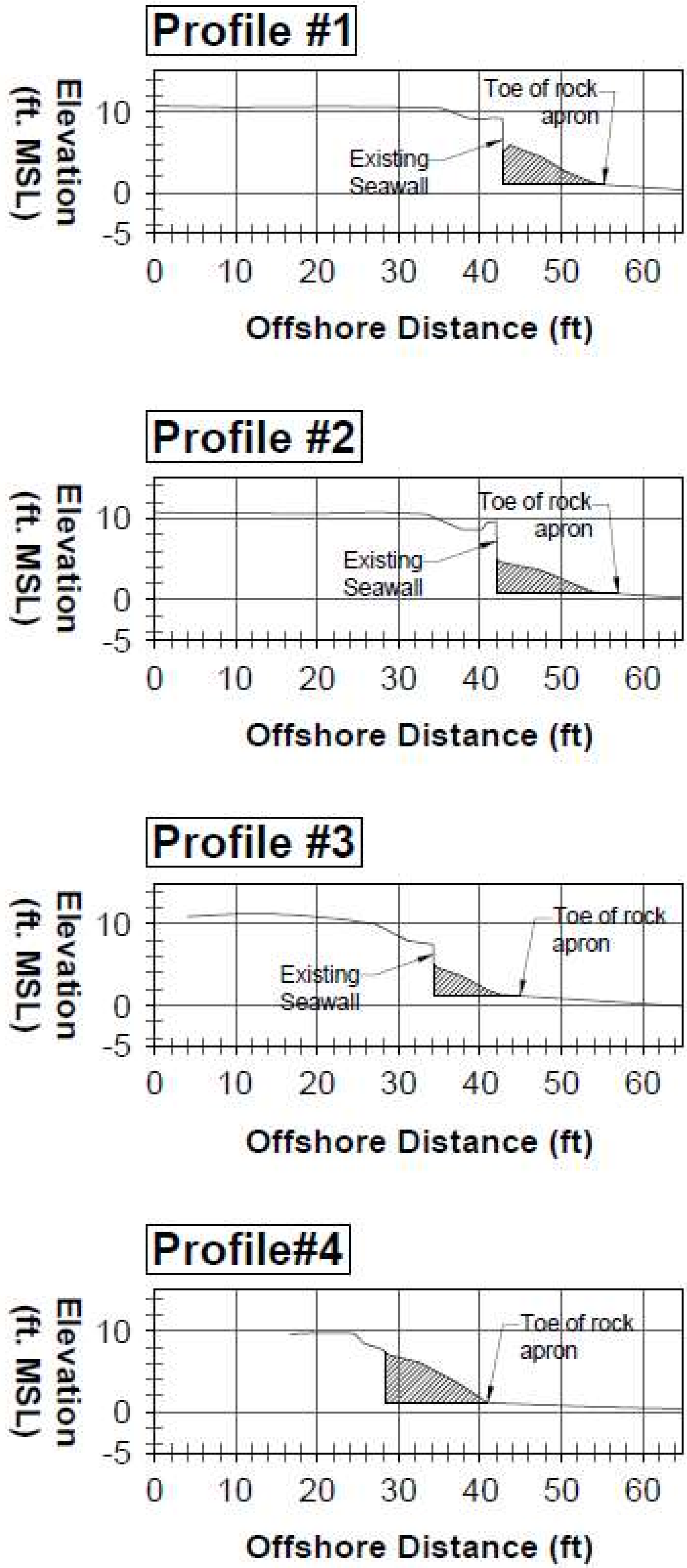

Figure 2-15 Profiles from topographic survey (July 2020)

2.6 Historical Shoreline Change

Historical shoreline change for Lanikai has been analyzed with aerial photographs by the University of Hawaii Coastal Geology Group (CGG, 2019). The CGG compared the low water mark digitized from National Ocean Survey topographic survey charts (T-sheets) from 1911 and 1928, and eleven (11) aerial photographs between 1949 and 2015.

The project site shoreline corresponds with Transect 66 of the CGG study (Figure 2-16). The CGG analysis determined that the dominant shoreline change trend for the project site has been accretion at an average rate of 0.2 feet/year. While this rate is representative of the average, smoothed, long-term trend for the shoreline from 1911 to 2015, it does not account for fluctuations in beach width that have occurred since the study was completed. It should also be noted that the historical trend has an uncertainty of 0.9 feet/year, which is nearly five times the historical rate of 0.2 feet/year.

Figure 2-16 shows the historical shoreline positions and uncertainty levels for Transect 66. The project site shoreline was relatively stable from 1949 to 1971. Accretion was the dominant trend from 1975 to 1988. However, erosion has been the dominant trend since 1996. From 1996 to 2015, the shoreline has retreated approximately 95 feet.

Romine and Fletcher (2012) found that, prior to the late 1970's, a pattern of accretion was present in southern Lanikai. After this time, a pattern of erosion began and increased in severity with the installation of additional hardened structures throughout the neighboring shoreline. Fletcher et al. (1997) found that changes in beach volume along the Lanikai coastline tend to be related to chronic fluctuations in alongshore sand transport and sediment deficiencies, rather than event-based erosion because the offshore reef platform diminishes incoming swell. Boccichio (2009) found that Lanikai has experienced a series of decadal-scale erosion and accretion events producing > 50 m changes in beach width over a 60-year period, and that shoreline behavior is governed by a significant southeast to northwest trend in net sand transport.

The U.S. Army Corps of Engineers (2009) analyzed historical shoreline change and sediment transport in Lanikai from 1996 to 2005 (Figure 2-17). The project site is located at an inflection point where the dominant long-term shoreline change trend transitions from accretion (north of the project site) to erosion (south of the project site). The shoreline north of the project site is predominantly sandy beach, whereas the shoreline to the south is predominantly armored. Given the lack of beach to the south, and the dominant direction of sand transport being southeast to northwest, there does not appear to be a natural mechanism for accretion at the project site.

Anderson et al. (2015) found that, due to increasing sea level rise, average shoreline recession (erosion) in Hawaii is expected to be nearly twice the historical extrapolation by the year 2050, and nearly 2.5 times the historical extrapolation by the year 2100. In the absence of the existing shore protection, the project site would likely experience significant erosion with rising sea levels.

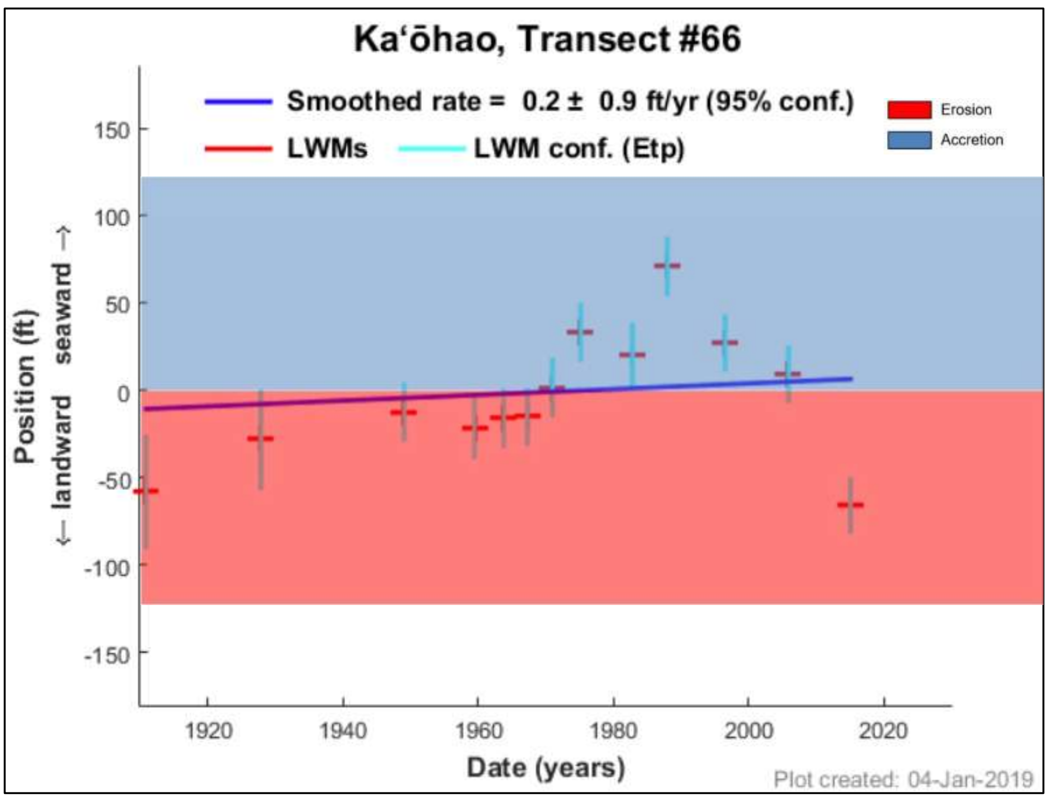

Figure 2-16 Historical shoreline change rates for the project site (CGG, 2019)

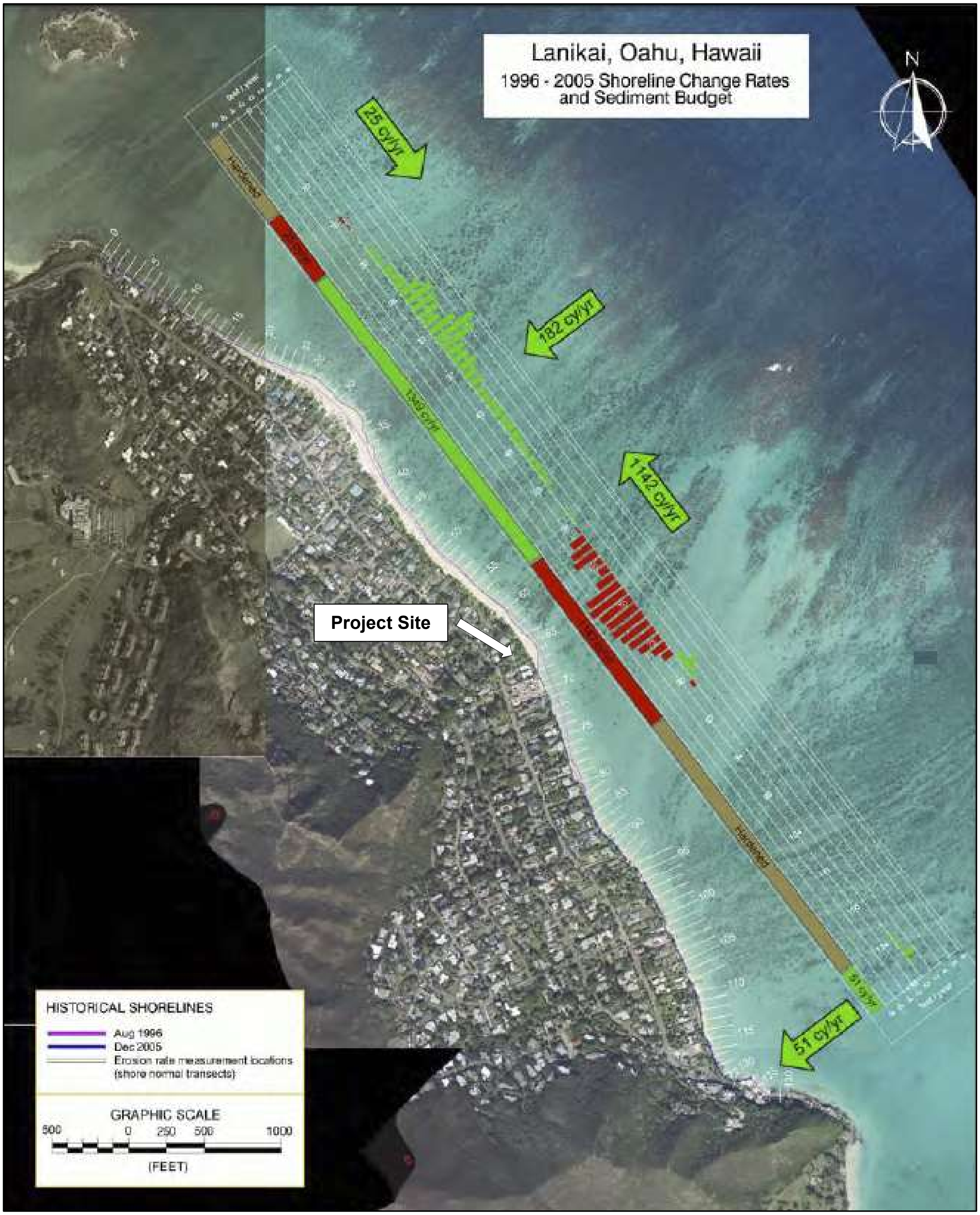

Figure 2-17 Lanikai shoreline change and sediment budget, 1996-2005 (USACE, 2009)

3. PHYSICAL SETTING

3.1 Geology & Soils

The surficial geology of the low-lying Lanikai coastal plain is primarily Holocene beach deposits (Sherrod et al., 2007) windward of the Koʻolau Volcano. The Koʻolau lavas are found within the watershed mauka of the project site. They are divided into the Koʻolau Basalt and the Honolulu Volcanics.

The Ko'olau Basalt primarily consists of Pliocene aged shield stage tholeiitic basalt, which plays an important role in the Ka'elepulu watershed. Koʻolau Basalt rocks can be divided into three groups; lava flows (aʻa and pahoehoe), pyroclastic deposits, and dikes. Lava flows associated with Koʻolau basalt are usually thinly bedded. Each bed is a unique flow, composed of aʻa and pahoehoe flows. Interspersed with these flows are pyroclastic deposits. Aʻa flows contains a solid central core between two gravely clinker layers. Pahoehoe flows are usually characterized by a smooth ropy texture. Pyroclastic deposits originate from explosive volcanism and are composed of friable sand-like ash and indurated tuff deposits. Dikes are thin near planar sheets of rock that intruded or squeezed into existing lava flows or pyroclastic deposits.

The shoreline is characterized by an extensive fringing reef complex associated with a broad, shallow, and generally smooth reef flat. The fringing reef parallels most of the coastline. The Lanikai shoreline consists of carbonate sand beaches with varying widths. The foreshore (beach) soils are classified as "beaches" (Figure 3-1). Landward of the subject property, soils are classified as Jaucus Sand (JaC) with 0 to 15% slopes (USDA, 2018).

3.2 Bathymetry

Figure 3-2 shows water depths (in meters) relative to mean sea level (msl) offshore of the project site. Water depths range from 0 to 5 meters on the inner reef flat, which extends approximately 3,700 feet offshore. Water depths along the reef crest range from 1 to 3 meters. Water depths on the outer reef range from 3 to 10 meters before dropping off into deeper waters offshore.

3.3 Benthic Habitat

The Pacific Island Ocean Observing System's (PacIOOS) Voyager web-based mapping program displays the National Oceanographic and Atmospheric Administration's (NOAA) benthic habitat data for the project site. These maps show the biology (Figure 3-3), geography (Figure 3-4), and geomorphology (Figure 3-5) of benthic habitat offshore of the project site, which is characterized by sand, scattered coral rock, and aggregate patch reef that is uncolonized or has live coral. The U.S. Fish and Wildlife Service classifies the nearshore waters as marine, intertidal, rocky shore that is regularly flooded. Offshore, the coastal waters are classified as marine, subtidal, unconsolidated bottom. The Hawaii Department of Health (DOH) classifies the nearshore waters as Class A Marine Waters.

3.4 Coastal Uses

Lanikai (originally referred to as *Ka'ōhao*) was developed as a subdivision in 1924. The majority of properties in Lanikai are zoned for residential purposes and the first residential structures were constructed around 1926 (Lanikai Association, 2020). Narrow sandy beaches exist along portions of Lanikai, particularly the northern and central portions of the shoreline (north of the project site). Lanikai Beach is bordered by a wide fringing limestone reef flats and is a recreational destination for paddlers, snorkelers, swimmers, and spearfishermen. There are no notable surf breaks in the vicinity of the project site. Surfing areas are located well offshore, outside of the crest of the wide, shallow, fringing reef. There are eleven (11) beach rights-of-way in Lanikai that provide perpendicular access to the shoreline. Eight (8) of the rights-of-way are owned by the Lanikai Association, and the remaining three (3) are owned by the City & County of Honolulu (Lanikai Association, 2020). The public beach rights-of-way closest to the project site are approximately 655 feet (0.1 miles) to the northwest, and 400 feet (0.075 miles) to the southeast. Lateral shoreline access is abundant along the northern and central portions of Lanikai but limited along the southern portion of the shoreline where the beach is chronically eroding. There is typically no beach present along the shoreline fronting the project site. When sand is present, it is typically completely submerged at high tide.

3.5 Zoning & Land Uses

The project site is zoned R-10 Residential. The area landward of the shoreline is located in the Special Management Area (SMA) and Urban Land Use District. The area seaward of the shoreline is located in the Resource Subzone of the Conservation District.

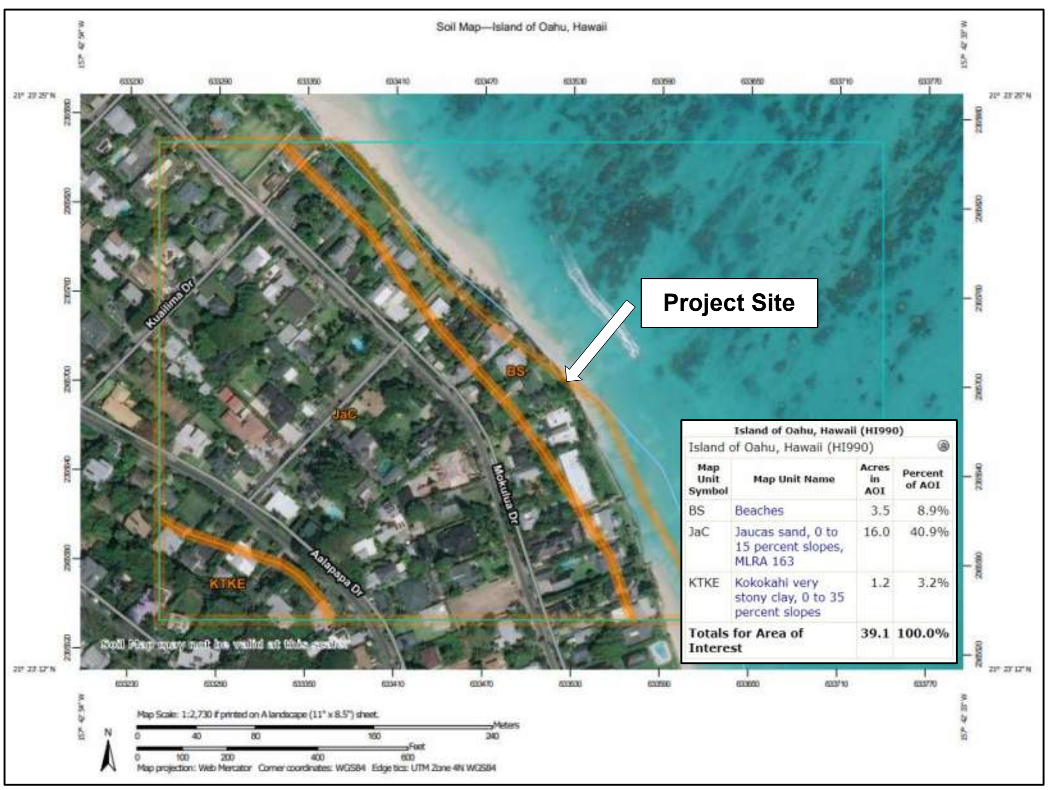

Figure 3-1 Soil types within the project site (USDA)

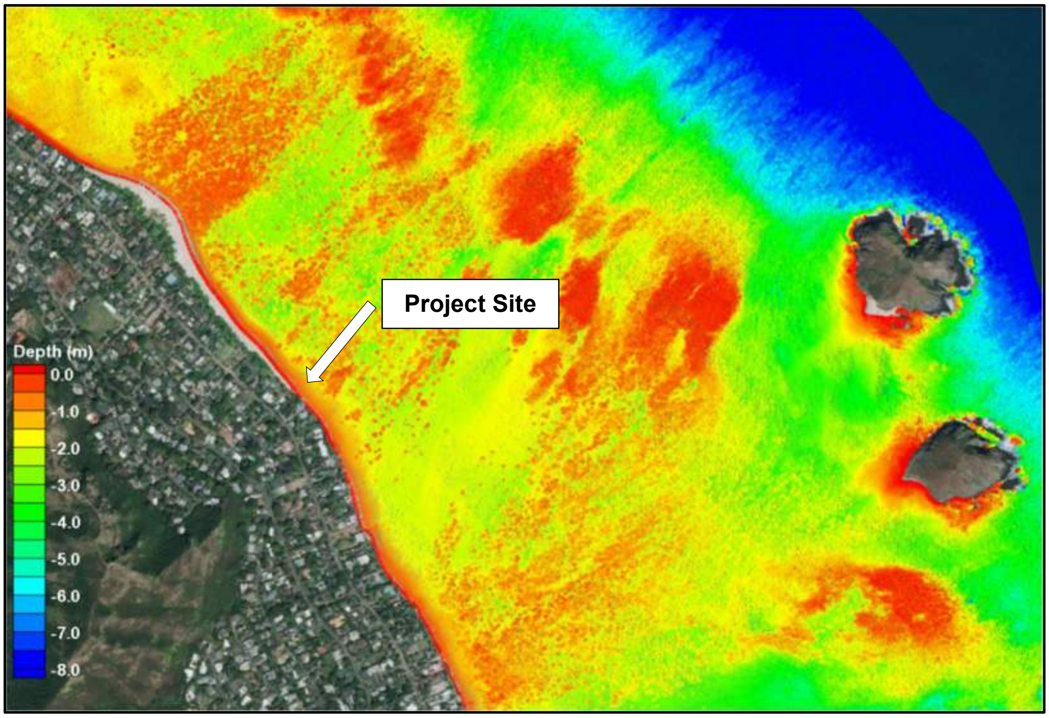

Figure 3-2 Bathymetry for the project site, in meters (NOAA LiDAR)

Figure 3-3 Benthic habitat biology for the project site (PacIOOS, 2020)

Figure 3-4 Benthic habitat geography for the project site (PacIOOS, 2020)

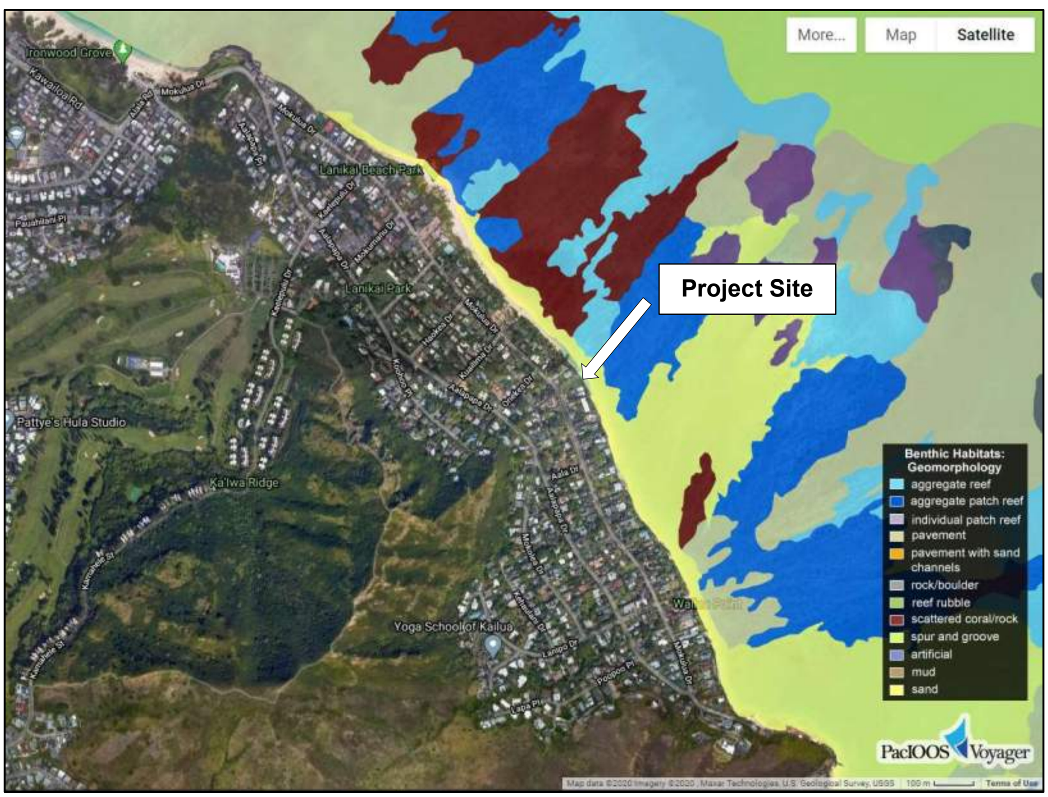

Figure 3-5 Benthic habitat geomorphology for the project site (PacIOOS, 2020)

4. OCEANOGRAPHIC SETTING

The neighborhood of Lanikai is nestled between the mountains and the ocean on the windward side of Oahu. The 1.5-mile long shoreline lies between the rocky headlands of Alala Point (to the north) and Wailea Point (to the south). By 1959, the Lanikai coastline was intensely developed and a series of seawalls and revetments had been constructed to protect properties from the effects of coastal erosion. The north and south portions of the Lanikai coastline have experienced extensive beach loss and those seawalls and revetments are presently exposed to wave attack.

The reef flat offshore of Lanikai is primarily a fossilized reef. Portions of the reef are emergent at low tide and the deeper areas are covered with a veneer of sand. The Mokulua Islands, large basaltic outcrops from the sea floor, are located about 4,000 feet offshore and rise approximately 200 feet above sea level. The water becomes increasingly deeper offshore of the islands.

The shoreline is shaped by the prevailing tradewind waves. These waves experience refraction and diffraction past the Mokulua Islands and over the shallow fringing reef, resulting in a very complex nearshore wave pattern. Bulges in the sandy shoreline are centered 1,900 feet and 3,800 feet south of Alala Point. These bulges are produced by convergent wave patterns caused by refraction and diffraction past the Mokulua Islands and the reef. A third bulge, centered opposite Lanipo Drive, has been armored.

4.1 Winds

The prevailing winds throughout the year are the northeasterly tradewinds. The average frequency of tradewinds varies from more than 90% during the summer season to only 50% in January, with an overall annual frequency of 70%. Tradewinds are produced by the outflow of air from the Pacific Anticyclone high-pressure system, also known as the Pacific High. The center of this system is located well north and east of the Hawaiian Islands and moves to the north and south seasonally. In the summer months, the center moves to the north, causing the tradewinds to be at their strongest from May through September. In the winter, the center moves to the south, resulting in decreasing tradewind frequency from October through April. During these months, the tradewinds continue to blow; however, their average monthly frequency decreases to 50%. Westerly or Kona winds occur primarily during the winter months and are generated by low pressure or cold fronts that typically move from west to east past the Hawaiian Islands. Figure 4-1 shows a wind rose diagram applicable to the project site based on wind data recorded daily at the Kaneohe Marine Corps Base Hawaii (MCBH).

During the winter months, wind patterns of a more transient nature increase in prevalence. Winds from extra-tropical storms can be very strong from almost any direction, depending on the strength and position of the storm. The low-pressure systems associated with these storms typically track west to east across the North Pacific north of the Hawaiian Islands. At Honolulu International Airport, wind speeds resulting from these storms have on several occasions exceeded 60 mph. Kona winds are generally from a southerly to a southwesterly direction, usually associated with slow-moving low-pressure systems known as Kona lows situated to the west of the island chain. These storms are often accompanied by heavy rains.

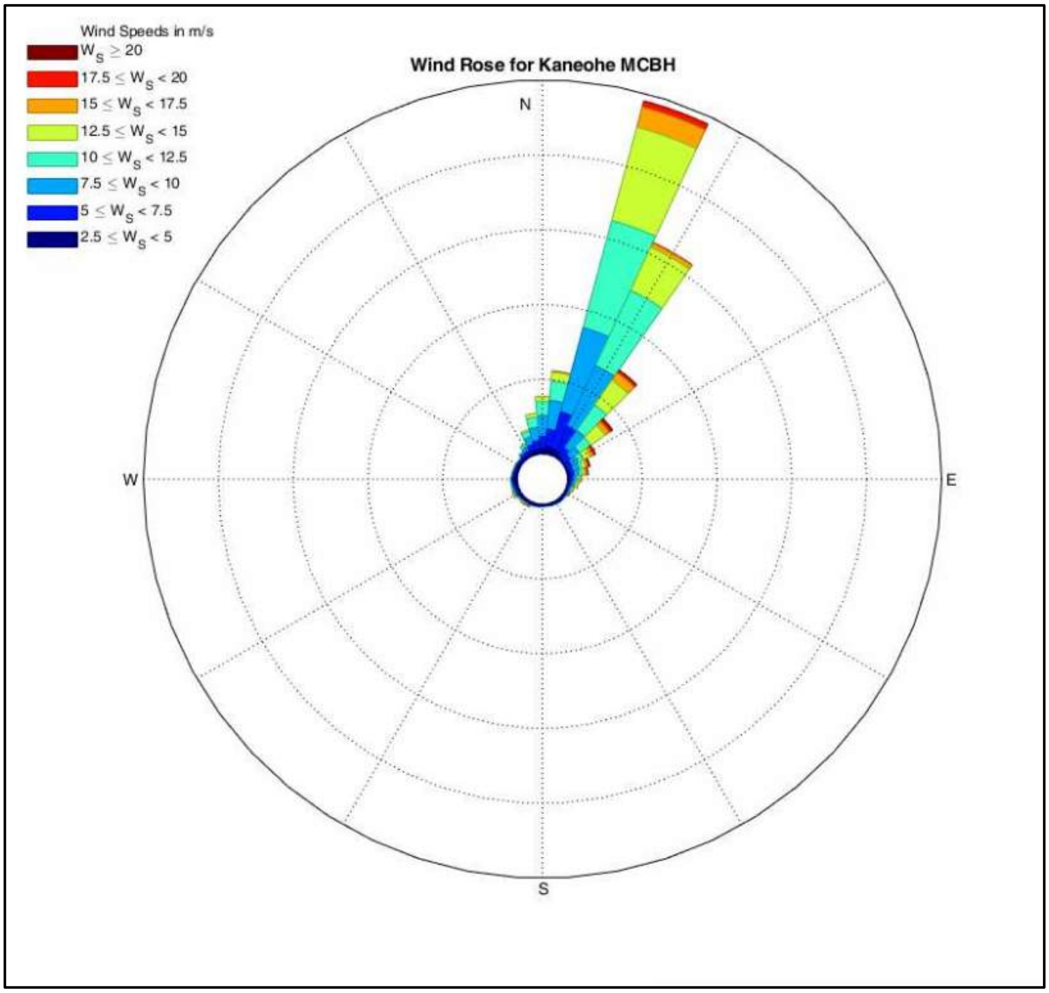

Figure 4-1 Wind Rose Kaneohe MCBH (July 2016 to July 2018)

4.2 Water Levels

4.2.1 Tides

Hawaii tides are semi-diurnal with pronounced diurnal inequalities (i.e., two high and low tides each 24-hour period with different elevations). A modulation of the tidal range results from the relative position of the moon and the sun: when the moon is new or full, the moon and the sun act together to produce larger "spring" tides; when the moon is in its first or last quarter, smaller "neap" tides occur (Rapaport, 2013). The cycle of spring to neap tides and back is half the 27-day period of the moon's revolution around the earth and is known as the fortnightly cycle. The combination of diurnal, semi-diurnal and fortnightly cycles dominates variations in sea level throughout the Hawaiian Islands.

The geometry of the oceans - the basin shape, local coastline, bays, and even harbor geometry - has a significant effect on the local behavior of the tides. On scales of oceanic basins, tides exist as very long waves propagating in patterns determined by their period and the geometry of the basin. Lines along which high tide occurs at the same time (referred to as "phase lines") converge to several points where the tidal range is zero. There are four of these points, called "amphidromes" in the Pacific: one in the North Pacific near the dateline, one near the equator in the eastern North Pacific, one in the central South Pacific near Tahiti, and one east of New Zealand. Phase lines rotate counterclockwise around the amphidromes in the North Pacific and clockwise around those in the South Pacific. For example, in the Hawaiian Islands, the offshore diurnal tide reaches Hawaii Island first, then sweeps across the islands of Maui, Oahu, and finally Kauai. Tidal currents result from tidal variations of sea level, and near the shore are often stronger than the large-scale circulation (Rapaport, 2013).

Tidal predictions and historical extreme water levels are given by the Center for Operational Oceanographic Products and Services, NOS, NOAA, website. A tide station is located at Moku O Loe (Coconut Island) in Kaneohe Bay. Water level data based on the 1983-2001 tidal epoch is shown in Table 4-1.

Table 4-1 Water level data for Moku O Loe, Station 1612480 (NOAA, 2020)

Datum	Elevation (feet, MLLW)	Elevation (feet, MSL)
Mean Higher High Water	+2.12	+1.07
Mean High Water	+1.80	+0.75
Mean Sea Level	+1.05	0.00
Mean Low Water	+0.31	-0.74
Mean Lower Low Water	0.00	-1.05

Hawaii is also subject to periodic extreme tide levels due to large oceanic eddies and other oceanographic phenomena that have recently been recognized and that sometimes propagate through the islands. *Mesoscale eddies* produce tide levels that can be up to 0.5 to 1.0 ft higher than normal for periods up to several weeks (Firing and Merrifield, 2004). Temporary sea-level rise has also been associated with phenomena related to the El-Nino/Southern Oscillation (ENSO).

4.2.2 Sea Level Rise

The present rate of global mean sea-level change (SLC) is +3.4 ± 0.4 mm/year (Sweet, 2017), where a positive number represents a rising sea level. SLC appears to be accelerating compared to the mean of the 20th Century. Factors contributing to the measured rise in sea level include decreasing global ice volume and warming of the ocean. Sea level, however, is highly variable. The historical sea level trend for Moku O Loe, Station 1612480, is shown in Figure 4-2 (NOAA, 2020). The mean historical rate of sea level change (RSLC) is +1.55 ± 0.52 mm/yr based on monthly data for the period 1957 to 2019, which is equivalent to a change of 0.51 feet in 100 years. The tide gauge data also show interannual anomalies exceeding 0.5 feet (15 cm) at Moku O Loe that are likely mesoscale eddies.

The National Oceanic and Atmospheric Administration (NOAA) recently revised their sea level change projections through 2100 taking into account up-to-date scientific research and measurements. NOAA is projecting that global sea level rise, as shown by their “Extreme” scenario, could be as high as about 11 feet by 2100. NOAA’s recent report also identifies specific regions that are susceptible to a higher than average rise in sea level. Hawaii has thus far experienced a rate of sea level rise that is less than the global average; however, this is expected to change. Hawaii is in the "far field" of the effects of melting land ice. This means that those effects have been significantly less in Hawaii compared to areas closer to the ice melt. Over the next few decades, this effect is predicted to spread to Hawaii, which will then experience sea level rise greater than the global average.

Figure 4-3 and Table 4-2 presents mean sea level rise scenarios for Hawaii based on the revised NOAA projections, taking into account the far-field effects. While the projections are based on the most current scientific models and measurements, discretion is necessary for selecting the appropriate scenario. Selecting the appropriate sea level change projection is a function of many parameters, including topography, coastal setting, criticality of infrastructure, the potential for resilience, budget, and function.

An important conclusion of the regional climate assessment is that NOAA's revised *Intermediate* rate is recommended for planning and design purposes in Hawaii. The *Intermediate* rate projects that sea level in Hawaii will rise 2.3 feet by 2070 (Table 4-2). Given the recent upwardly revised projections and the potential for future revisions, consideration may also be given to the *Intermediate-High* rate for planning and design purposes, which projects that sea level in Hawaii will rise 3.4 feet by 2070.

In 2017, the Hawaii Climate Commission published the Hawaii Sea Level Rise Vulnerability and Adaptation Report, which discusses the anticipated impacts of projected future sea level rise on coastal hazards, and the potential physical, economic, social, environmental, and cultural impacts of sea level rise in Hawaii (Hawaii Climate Commission, 2017). A key recommendation of the report was that 3.2 feet of sea level rise should be adopted as a statewide vulnerability zone for planning purposes. The planning horizon for the project site is 50 years, which corresponds with the NOAA Intermediate-High scenario projection of 3.2 feet of sea level rise by 2070. Planning for 3.2 feet of sea level is consistent with the recommendations from the 4th National Climate Assessment (2018) and the Hawaii Sea Level Rise Vulnerability and Adaptation Report (2017).

A sea level rise of 2.3 feet was chosen for design purposes at the project site. This corresponds to the Intermediate rate over a 50-year design life which is suitable for planning and design purposes for a project of this scale. While critical infrastructure such as roads, power plants, and hospitals may require the highest level of protection, it is reasonable to design coastal protection and stabilization structures for a lesser level, in this case a 50-year lifespan. Coastal structures require ongoing monitoring and maintenance due to their exposure to the degrading effects of marine processes. The basis of design parameters and consequent design life are based on typical functional use of similar coastal structures. Designing for conditions, such as significantly higher sea levels, that are predicted for time periods that well exceed the design life of the structure will produce more robust installations but will well exceed their functional performance requirements during their serviceable lifespans. Designing for a lesser sea level rise is still consistent with the City & County of Honolulu Mayor's Directive 18-2, as the sea level rise that the coastal stabilization structures evaluated in this report are expected to experience during their design lifetime would likely be less than the 3.2 feet presented in the directive.

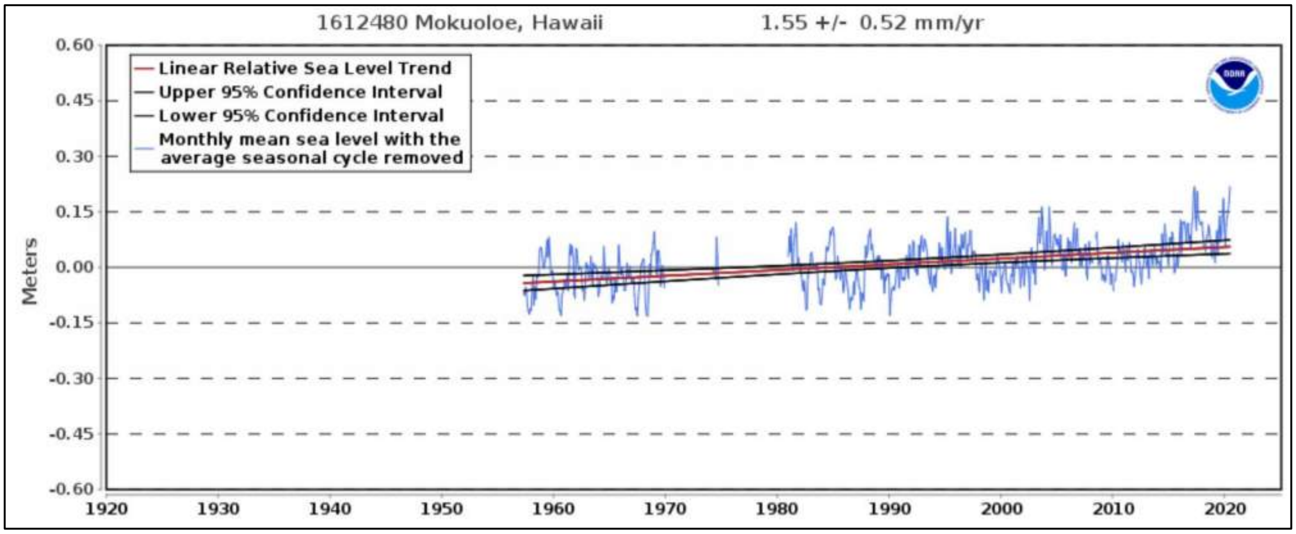

Figure 4-2 Relative sea level trend, Moku O Loe, Hawaii, 1957 to 2019 (NOAA, 2020)

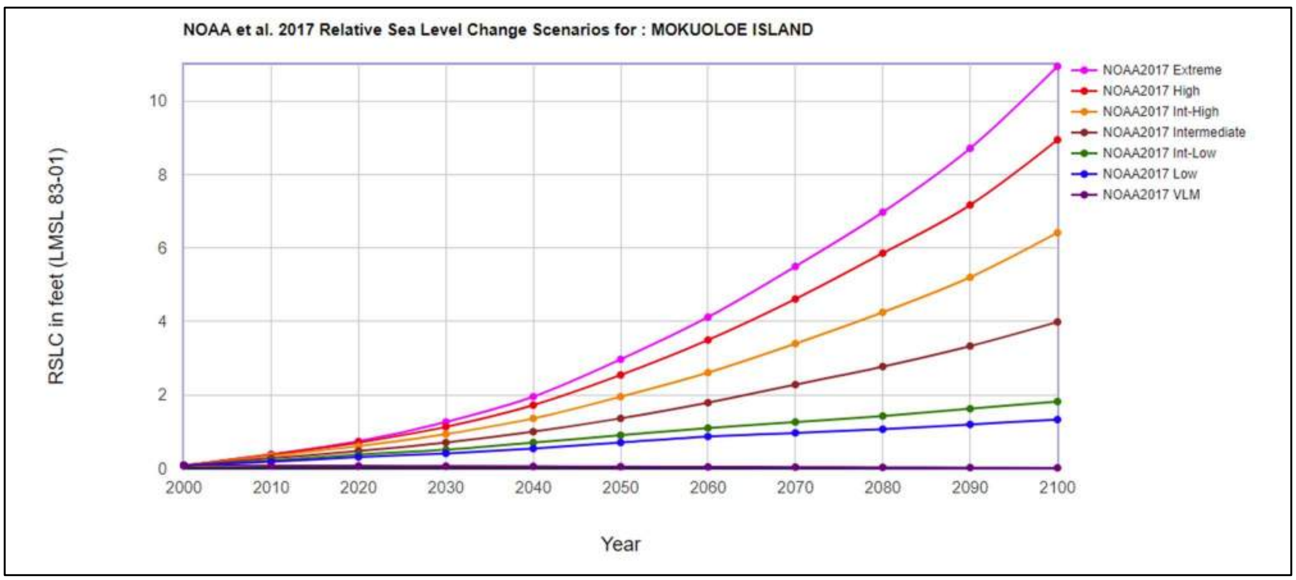

Figure 4-3 Hawaii local mean sea level rise projections, in feet (adapted from NOAA, 2017)

Table 4-2 Hawaii local mean sea level rise scenarios, in feet (adapted from NOAA, 2017)

Scenario	2020	2030	2040	2050	2060	2070	2080	2090	2100
Extreme	0.7	1.3	2.0	3.0	4.1	5.5	7.0	8.7	10.9
High	0.7	1.1	1.7	2.5	3.5	4.6	5.9	7.2	8.9
Intermediate-High	0.6	0.9	1.4	2.0	2.6	3.4	4.3	5.2	6.4
Intermediate	0.5	0.7	1.0	1.4	1.8	2.3	2.8	3.3	4.0
Intermediate-Low	0.4	0.5	0.7	0.9	1.1	1.3	1.4	1.6	1.8
Low	0.3	0.4	0.5	0.7	0.9	1.0	1.1	1.2	1.3

4.3 Waves

4.3.1 General Wave Climate

The wave climate in Hawaii is dominated by long period swell generated by distant storm systems, relatively low amplitude, short period waves generated by more local winds, and occasional bursts of energy associated with intense local storms. Typically, Hawaii receives five general surface gravity wave types: 1) northeast tradewind waves, 2) southeast tradewind waves 3) southern swell, 4) North Pacific swell, and 5) Kona wind waves. The dominant swell regimes for Hawaii are shown in Figure 4-4 .

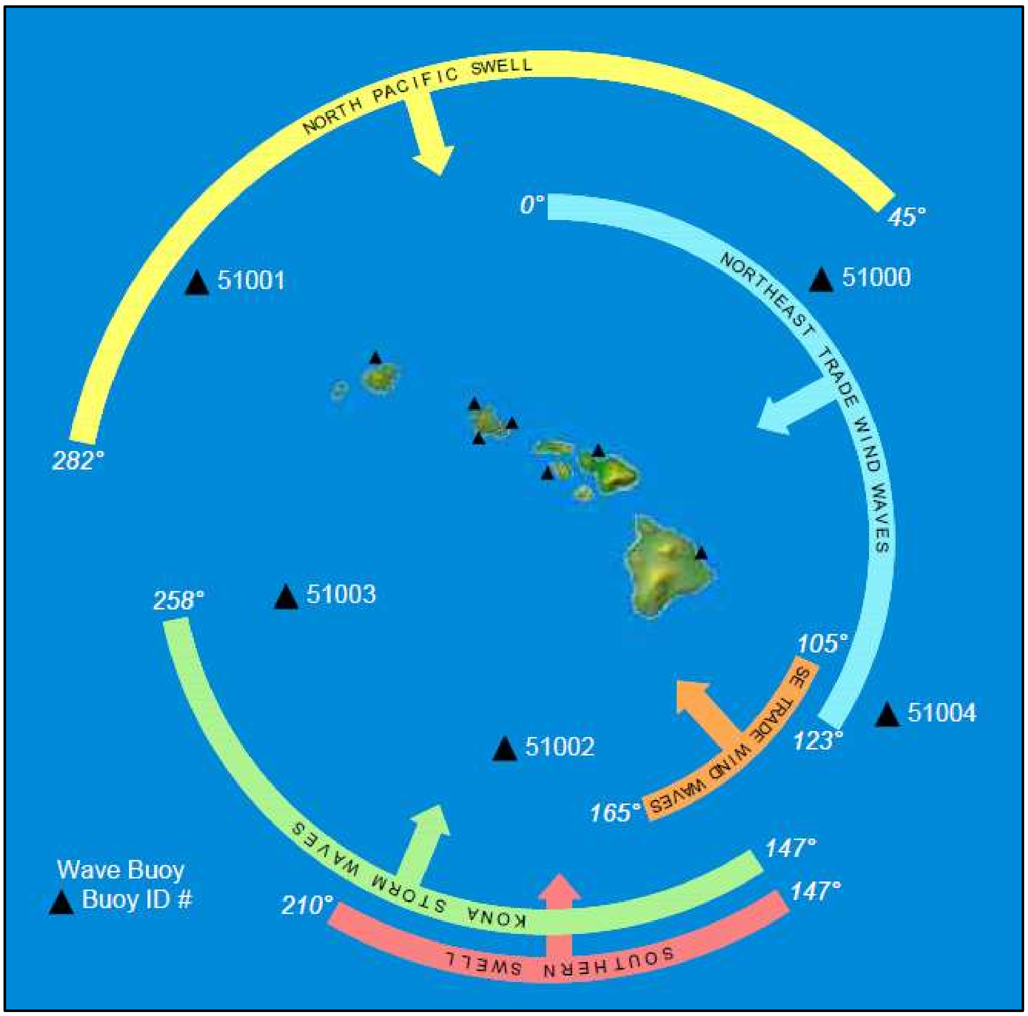

Figure 4-4 Hawaii dominant swell regimes

Tradewind waves occur throughout the year and are the most persistent April through September when they usually dominate the local wave climate. These winds result from the strong and steady tradewinds blowing from the northeast quadrant over long fetches of open ocean. Tradewind deepwater waves are typically between 3 and 8 feet high with periods of 5 to 10 seconds, depending upon the strength of the tradewinds and how far the fetch extends east of the Hawaiian Islands. The direction of approach, like the tradewinds themselves, varies between north-northeast and east-southeast and is centered on the east-northeast direction. The project site is directly exposed to tradewind waves, which represent a significant source of wave energy reaching the shoreline.

During the winter months in the northern hemisphere, strong storms are frequent in the North Pacific in the mid-latitudes and near the Aleutian Islands. These storms generate large North Pacific swells that range in direction from west-northwest to northeast and arrive at the northern Hawaiian shores with little attenuation of wave energy. These are the waves that have made surfing beaches on the north shores of Oahu and Maui famous. Deepwater wave heights often reach 15 feet and in extreme cases can reach 30 feet. Periods vary between 12 and 20 seconds, depending on the location of the storm. The project site is directly exposed to North Pacific swell approach from the north and northeast directions and these waves represent a significant source of wave energy reaching the shoreline.

Southern swell is generated by storms in the southern hemisphere and is most prevalent during the summer months of April through September. Traveling distances of up to 5,000 miles, these waves arrive with relatively low deepwater wave heights of 1 to 4 feet and periods of 14 to 20 seconds. Depending on the positions and tracks of the southern hemisphere storms, southern swells approach between the southeasterly and southwesterly directions. The project site is well sheltered from the direct approach southern swell by the island itself, and only a portion of the wave energy refracting and diffracting around the southeast end of the island reaches the shoreline.

Kona storm waves also directly approach the project site; however, these waves are fairly infrequent, occurring only about 10 percent of the time during a typical year. Kona waves typically range in period from 6 to 10 seconds with heights of 5 to 10 feet and approach from the southwest. Deepwater wave heights during the severe Kona storm of January 1980 were about 17 feet. The project site is well sheltered from the direct approach of Kona storm waves by the island itself, and only a portion of the wave energy refracting and diffracting around the southeast end of the island may reach the site.

Severe tropical storms and hurricanes obviously have the potential to generate extremely large waves, which in turn could potentially result in large waves at the project site. Recent hurricanes impacting the Hawaiian Islands include Hurricane Iwa in 1982 and Hurricane Iniki in 1992. Iniki directly hit the island of Kauai and resulted in large waves along the southern shores of all the Hawaiian Islands. Damage from these hurricanes was extensive. Although not a frequent or even likely event, they should be considered in the project design, particularly with regard to shoreline structures, both in the water and on land near the shore.

4.3.2 Prevailing Deepwater Waves

Wave data available from the National Oceanographic and Atmospheric Administration (NOAA) was compiled and analyzed to identify the primary components of the wave climate affecting the project site. These data provide a 31-year wave record and were statistically analyzed to determine the frequency of occurrence of different wave heights, periods, and directions along the coast. Coastal processes in this region are dominated by wave energy, as this coastline is exposed to both Tradewind waves and North Pacific swell. Understanding the magnitude and frequency of these events at the stream mouths and along the entire region’s coastline is a key aspect of evaluating stream flow impacts to the marine ecosystem.

Wave hindcasting is a tool used to calculate past wave events based on weather models and historical data (Hubertz, 1992). With the proper inputs, wave hindcast models can calculate historical wave climates anywhere in the world. Hindcast model outputs are often recorded for a single location, known as a "virtual buoy". WaveWatch III (WWIII) is a numerical wave model used to forecast and hindcast waves. Hindcast data for a 31-year period (1979-2010) are available around the Hawaiian Islands from the NOAA National Centers for Environmental Prediction (NCEP). For this study, hindcast data were obtained from virtual buoy Station 51202, located approximately 3 miles offshore of the project site (Figure 4-5).

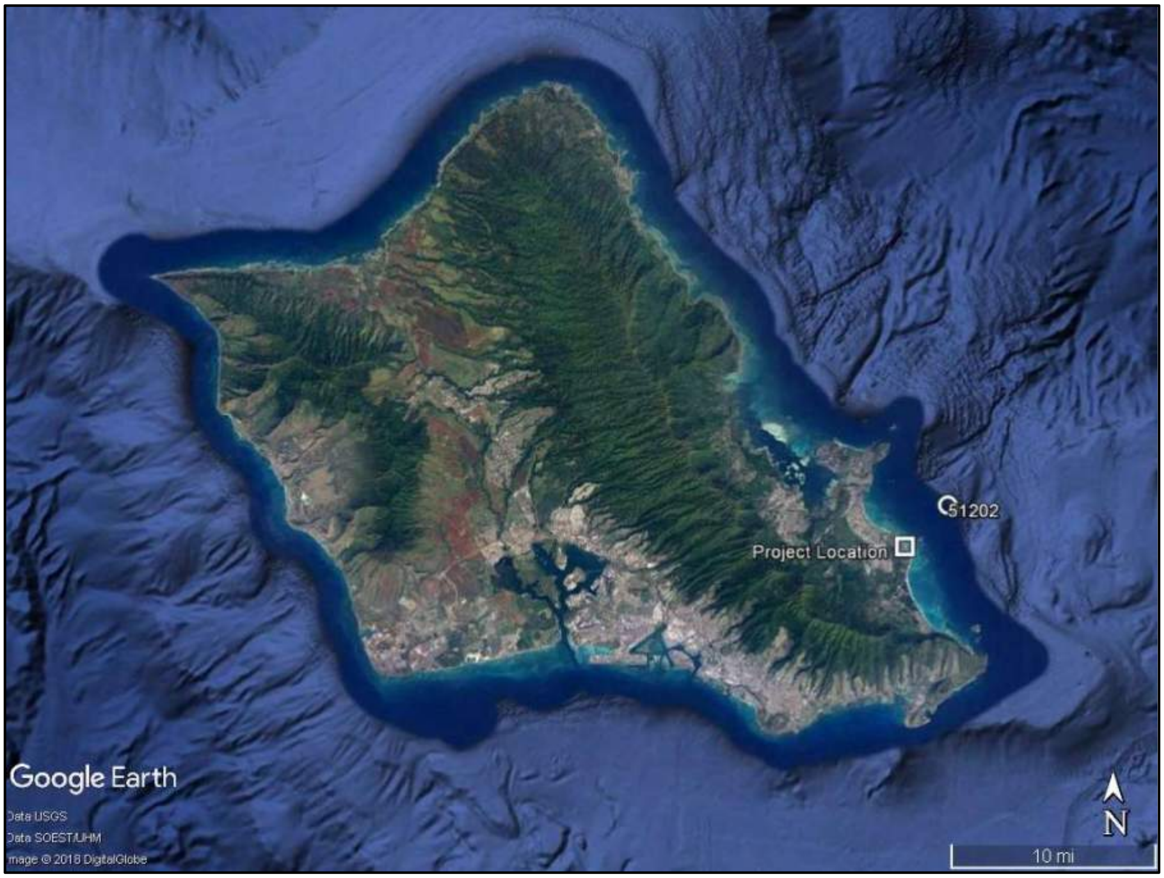

Figure 4-5 Project site and virtual buoy locations

It is rare for the sea state to consist of a singular wave condition. Wave events are described by wave height, peak period, and peak direction. The wave parameters from the hindcast model are calculated from a modeled wave spectrum. The spectrum shows the distribution of wave energy relative to wave direction and wave frequency (wave frequency is the inverse of wave period). This methodology allows multiple wave conditions to be accounted for at the same time for a more accurate description of the sea state. Figure 4-6 is a wave height rose diagram that shows the percent occurrence of wave height and direction for waves as measured at virtual buoy Station 51202. Figure 4-7 is a wave period rose diagram that shows the percent occurrence of wave period and direction for waves as measured at virtual buoy Station 51202.

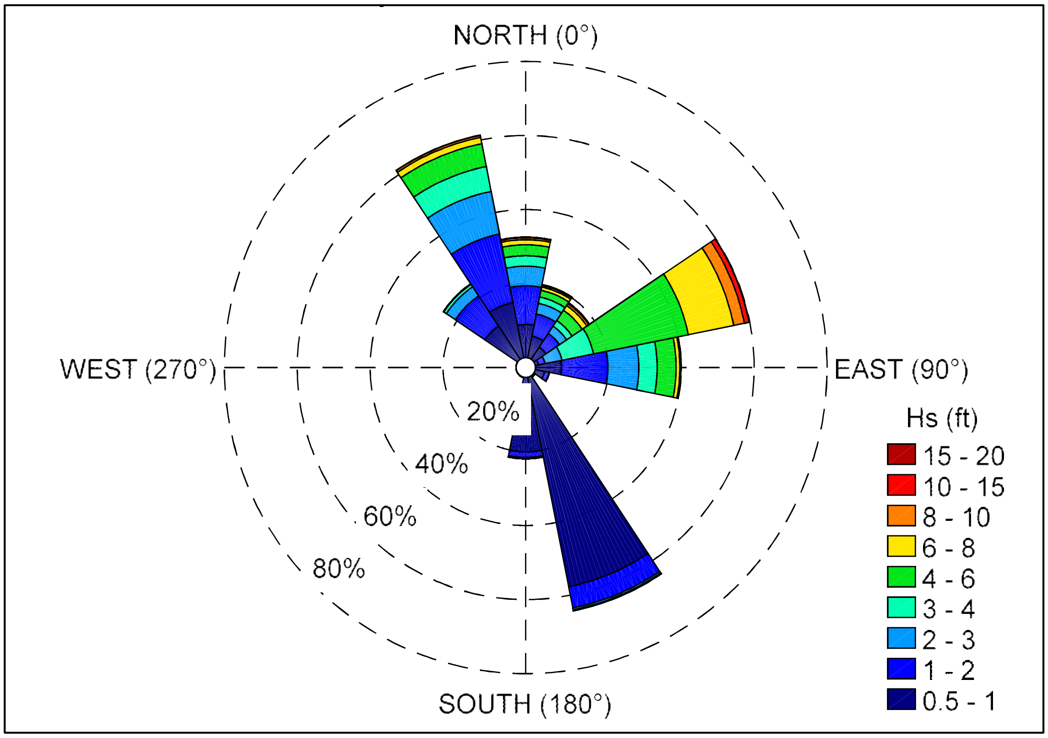

Figure 4-6 Station 51202 virtual buoy wave height rose from Jan 1979 to Jan 2010

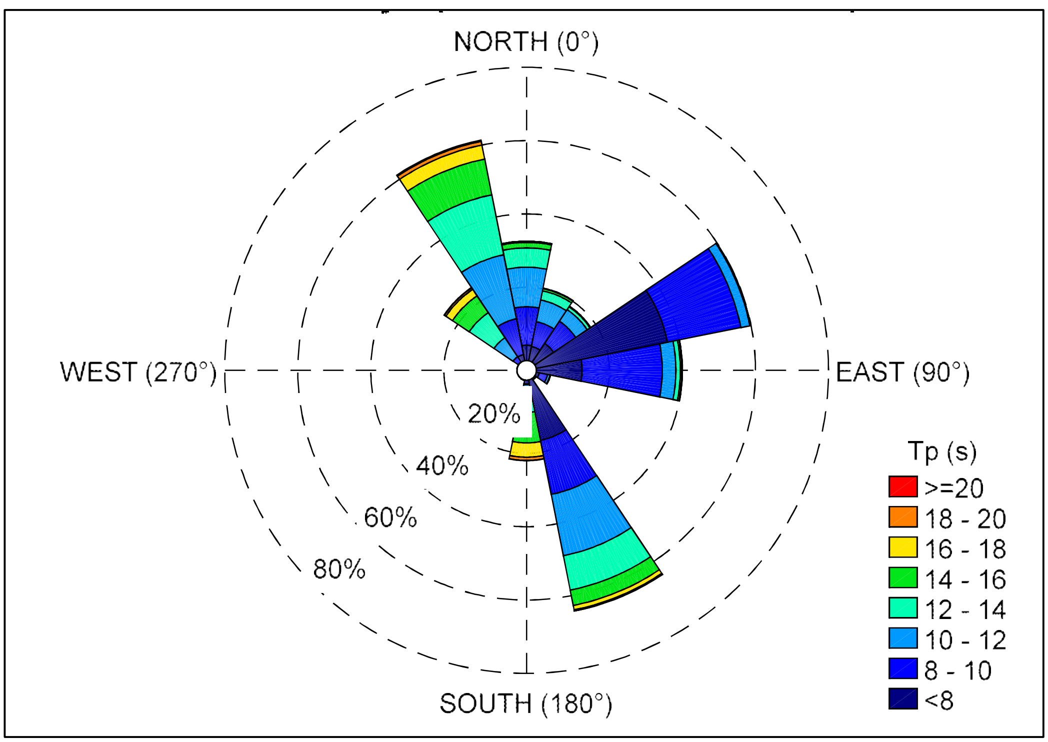

Figure 4-7 Station 51202 virtual buoy wave period rose from Jan 1979 to Jan 2010

4.3.3 Extreme Deepwater Waves

Historical wave buoy data allows the prediction of extreme wave events. These are infrequent, large, powerful, low probability wave events that are typically used for design purposes. For example, a 50-year return period wave event is an extreme event with a 1/50 (i.e., 2%) chance of occurring in any given year. Wave buoy data was compiled from the Coastal Data Information Program (CDIP) buoy station 098 located approximately 3 miles northeast of the project site (Figure 4-8). Wave data for this buoy spans over a 17-year period between August 2000 to March 2018. Extreme wave heights were investigated by filtering the buoy data by direction and period for waves within the project site's direct exposure window, between 0˚ and 45˚ (NE swell), with periods of 12 seconds or greater.

The extreme wave height data were used to generate a Weibull extreme value distribution for return period wave heights. The Weibull Distribution is a tool for looking at the relationship between the size of waves and how frequently they occur at a given location. Analysis requires a long-term data set with well-documented wave events. These events are sorted by size, and frequency of occurrence can be assessed by how often these events occur in the record. The relationship is logarithmic, and a linear fit can be established with a best fit linear regression of the data. Though not all wave events will be co-located on the line, its general trend represents the nature of the size and frequency relationship of wave events at a specific location. Wave height versus return period is shown on Figure 4-9 and Table 4-3. The ten largest wave events from directions south to west (180º to 270º TN) during the period of record are shown on Table 4-4.

Figure 4-8 Location of CDIP buoy 098 in relation to the project site

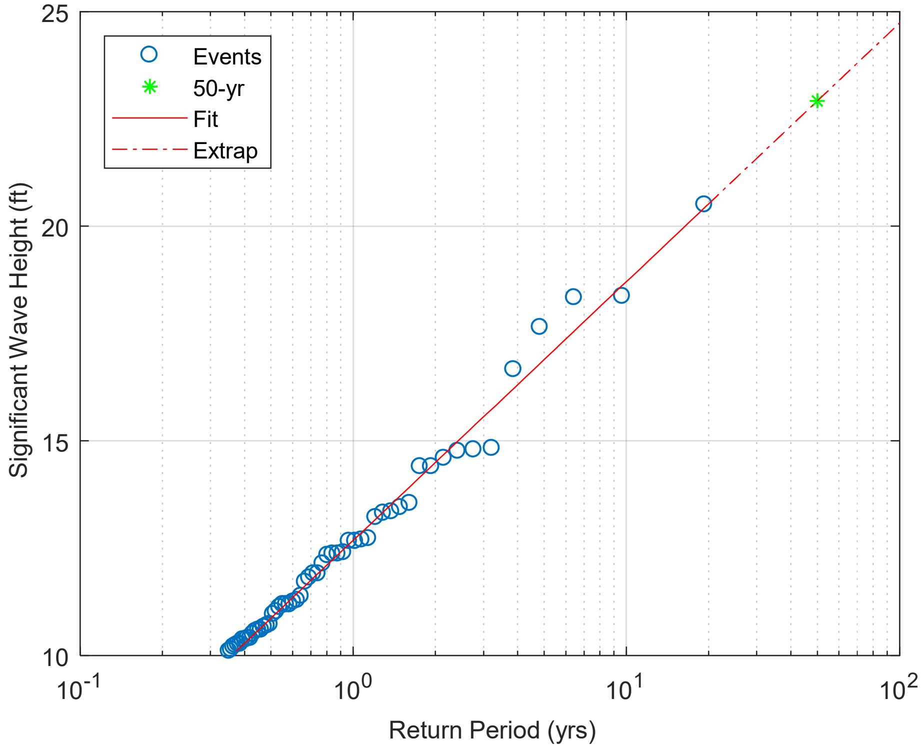

Figure 4-9 CDIP 098 Return period 17-yr (Aug 2000 to Mar 2018)

Table 4-3 Return period significant wave heights at CDIP 098

Return Period (yrs)	Hs (ft)
1	12.7
2	14.5
5	16.9
10	18.7
25	21.1
50	22.9

Table 4-4 Top 10 NE wave events recorded at CDIP 098

Date	Hs (ft)	Tp	Dp
Nov 21, 2003	20.5	17	37
Feb 22, 2016	18.4	18	1
Mar 14, 2009	18.3	14	10
Nov 12, 2009	17.6	13	28
Nov 29, 2003	16.7	13	7
Dec 01, 2002	14.8	17	7
Nov 23, 2017	14.8	15	5
Jan 27, 2008	14.8	13	44
Mar 18, 2016	14.6	15	13
Dec 04, 2007	14.4	18	2

4.4 Numerical Modeling of Wave Approach

As deepwater waves propagate toward shore, they begin to encounter and be transformed by the ocean bottom. In shallow water, the wave speed becomes related to the water depth. As waves slow down with decreasing depth, the process of wave shoaling steepens the wave and increases the wave height. Wave breaking occurs when the wave profile shape becomes too steep to be maintained. This typically occurs when the ratio of wave height to water depth is about 0.78 and is a mechanism for dissipating the wave energy. Wave energy is also dissipated due to bottom friction. The phenomenon of wave refraction is caused by differential wave speed along a wave crest as the wave passes over varying bottom contours and can cause wave crests to converge or diverge and may locally increase or decrease wave heights. Not strictly a shallow water phenomenon, wave diffraction is the lateral transmission of wave energy along the wave crest and would cause the spreading of waves in a shadow zone, such as occurs behind a breakwater or other barrier.

Simulating Waves Nearshore (SWAN) is a third-generation wave model developed by Delft University of Technology that computes random, short-crested wind-generated waves in coastal regions and inland waters (Booij, et al, 1999). The SWAN model can be applied as a steady state or non-steady state model and is fully spectral (over the total range of wave frequencies). Wave propagation is based on linear wave theory, including the effect of wave generated currents. SWAN provides many output quantities, including two-dimensional spectra, significant wave height and mean wave period, and average wave direction and directional spreading. For this project, the SWAN model was used to transform waves from deep water to the project site.

A nested 4-grid setup in the SWAN wave model was used to propagate the extreme deepwater design waves to the project site. The wave conditions are applied along all boundaries of the largest grid, which has a resolution of 1,640 feet and nests intermediate grids down to a nearshore grid with a resolution of 66 feet. The SWAN nesting grid layout is shown in Figure 4-10. Figure 4-11 shows the nearshore transformation of the 50-year northeast swell (22.9 ft significant wave height, 12 second period, and 35° direction) to the project site.

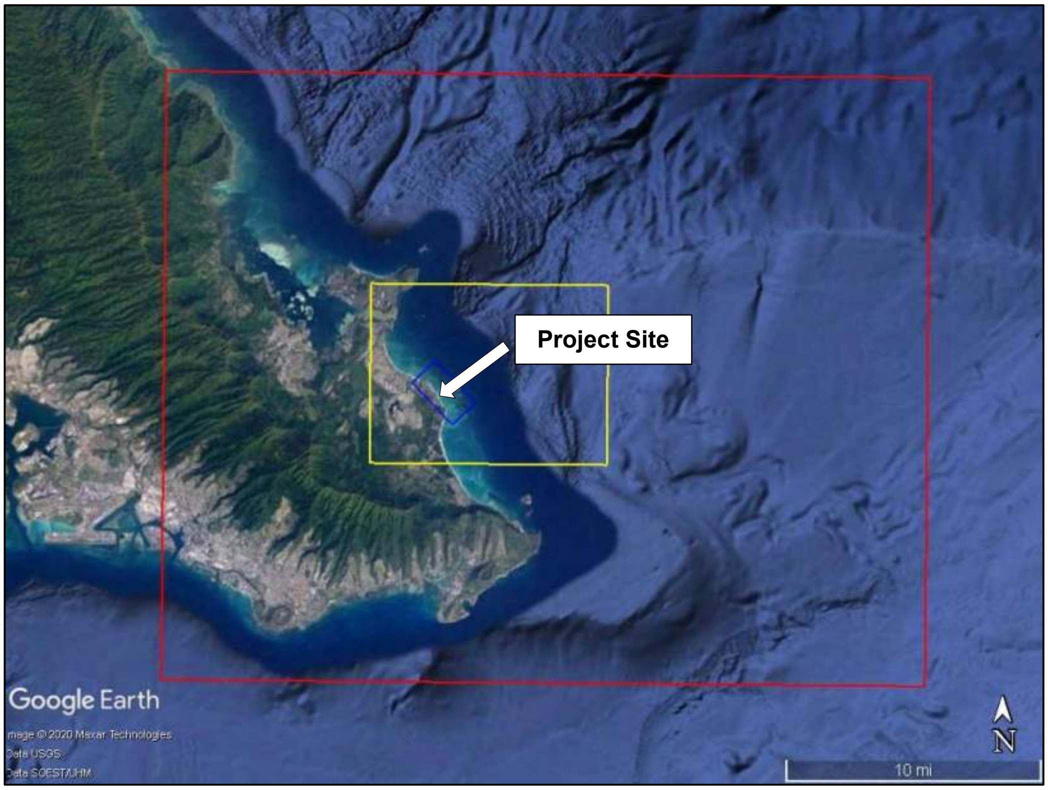

Figure 4-10 Layout of SWAN nested grids

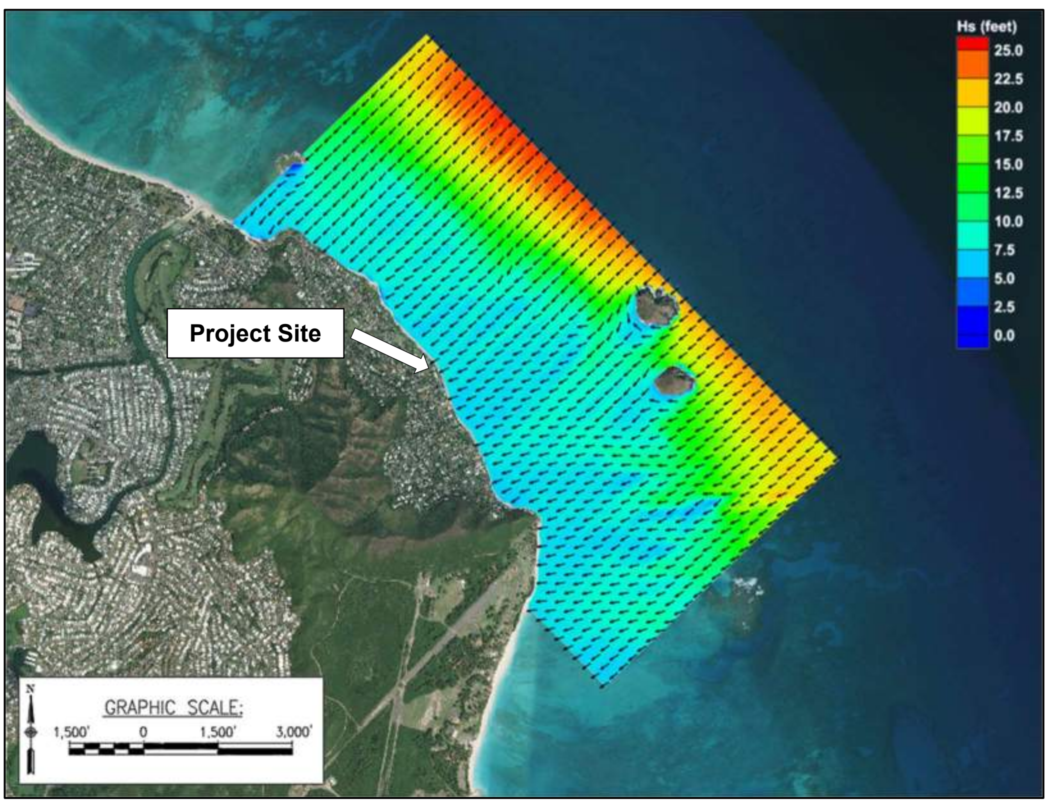

Figure 4-11 Nearshore significant wave height transformation from the design 50-yr Northeast swell event

4.5 Still Water Levels and Nearshore Wave Heights

During high wave conditions, the nearshore water level may be elevated above the tide level by the action of breaking waves. This water level rise, termed wave setup, could be as much as 1 to 2 feet during severe storm wave conditions. During hurricane conditions, an additional water level rise due to wind stress and reduced atmospheric pressure can occur. Collectively termed "storm surge," this can potentially add another 1 to 2 feet to the still water level.

During a storm or large wave conditions, there may be multiple zones of wave breaking. Wave heights are said to be *depth-limited* because once the water depth becomes shallow enough the wave breaks, losing size and energy. The wave, however, may reform before it reaches the shoreline and break again when the depth-limited ratio is again attained. The still water level rise during storm events is an important design consideration because it allows larger wave heights to reach the shoreline than during lower water levels. Estimation of still water level rise for a specific design wave event may be accomplished by a traditional analytical methodology which uses bathymetry and wave heights as inputs. Still-water level rise at the shoreline is a combination of astronomical tide, storm surge, and wave setup.

Wave setup is a function of the breaking wave height, period, and bottom topography. The mass transport of water due to breaking waves produces wave setup—the increase in water depth shoreward of the breaker zone. The available analytical methods for calculating wave setup have been simplified and assume long, straight, parallel bathymetric contours, continuous breaking waves, and breaker zones relatively near shore; these methods are presented in the U.S. Army Corps of Engineers Shore Protection Manual (1984) and Coastal Engineering Manual (2006). Experience has shown that these methods tend to overpredict wave setup because the natural environment has discontinuous breaking zones, irregular bathymetry, channels, and gaps in the reef that allow for a relief of wave setup.

5. COASTAL HAZARDS

5.1 Hurricanes

Tropical cyclones originate over warm ocean waters, and they are considered hurricane strength when they generate sustained wind speeds over 64 knots (74 mph). Hurricanes that form near the equator, and in the central North Pacific usually move toward the west or northwest. During the primary hurricane season of July through September, hurricanes generally form off the west coast of Mexico and move westward across the Central Pacific. These storms typically pass south of the Hawaiian Islands and sometimes have a northward curvature near the islands. Late season hurricanes follow a somewhat different track, forming south of Hawaii and moving north toward the islands. Three hurricanes have passed through the Hawaiian Islands in the past 25 years: Hurricanes Iwa in 1982 and Iniki in 1992, both passing near or over the island of Kauai as well as Hurricane Iselle in 2014 passing over the island of Hawaii. These storms caused high surf and wave damage on multiple shores of the islands. The *Windward Oahu Hurricane Vulnerability Study* (Sea Engineering, 1990) indicates that a theoretical model hurricane passing over the island from the south/southwest could result in deep-water waves 44.2 feet high with periods of 14.6 seconds for Oahu's north and east shores.

5.2 Kona Storms

Although somewhat protected by the southeast tip of Oahu, the study site is susceptible to damage from Kona storms, which occur during winter months, generally between October and April. Kona storms typically generate waves with significant heights of 9 to 16 feet and periods of 8 to 11 seconds. Occasional strong Kona storms have caused extensive damage to the south- and west-facing shorelines on Oahu. Deepwater wave heights during a severe Kona storm in January 1980 were about 17 feet with a period of 9 seconds.

5.3 Tsunami

Tsunami are waves that result from large-scale displacements of the seafloor. They are most commonly caused by large magnitude earthquakes (typically magnitude 7.0 or greater). If the earthquake involves a large segment of land that displaces a large volume of water, the water will travel outwards in a series of waves, each of which extends from the ocean surface to the seafloor where the earthquake originated. Tsunami waves typically have small wave heights in deep water but can have wavelengths of hundreds of miles and travel at speeds up to 500 miles per hour. A tsunami can travel from one side of the Pacific to the other in less than a day. The speed decreases rapidly as the water shoals. The waves increase greatly in height as they shoal and can push further inland. The water then recedes, also at considerable speed, and the recession often causes as much damage as the original wavefront itself. Most tsunamis in Hawaii originate from the tectonically active areas located around the Pacific Rim (e.g., Alaska, Japan, and Chile). Waves created by earthquakes in these areas take hours to reach Hawaii, and the network of sensors that is part of the Pacific Tsunami Warning System can provide Hawaii with several hours advance warning prior to the arrival of tsunami waves generated from these locations. Less commonly, tsunamis originate from seismic activity in the Hawaiian Islands, and there is less warning for these locally generated events. In 1946, a tsunami was generated in the Aleutian Islands and was one of the most destructive tsunamis to strike Hawaii. The water level rise in Lanikai during the 1946 tsunami was 7 feet. The U.S. Geological Survey (Fletcher et al., 2002) has given the project site a tsunami hazard rating of 3 out of 4 **(**Figure 5-1**).**

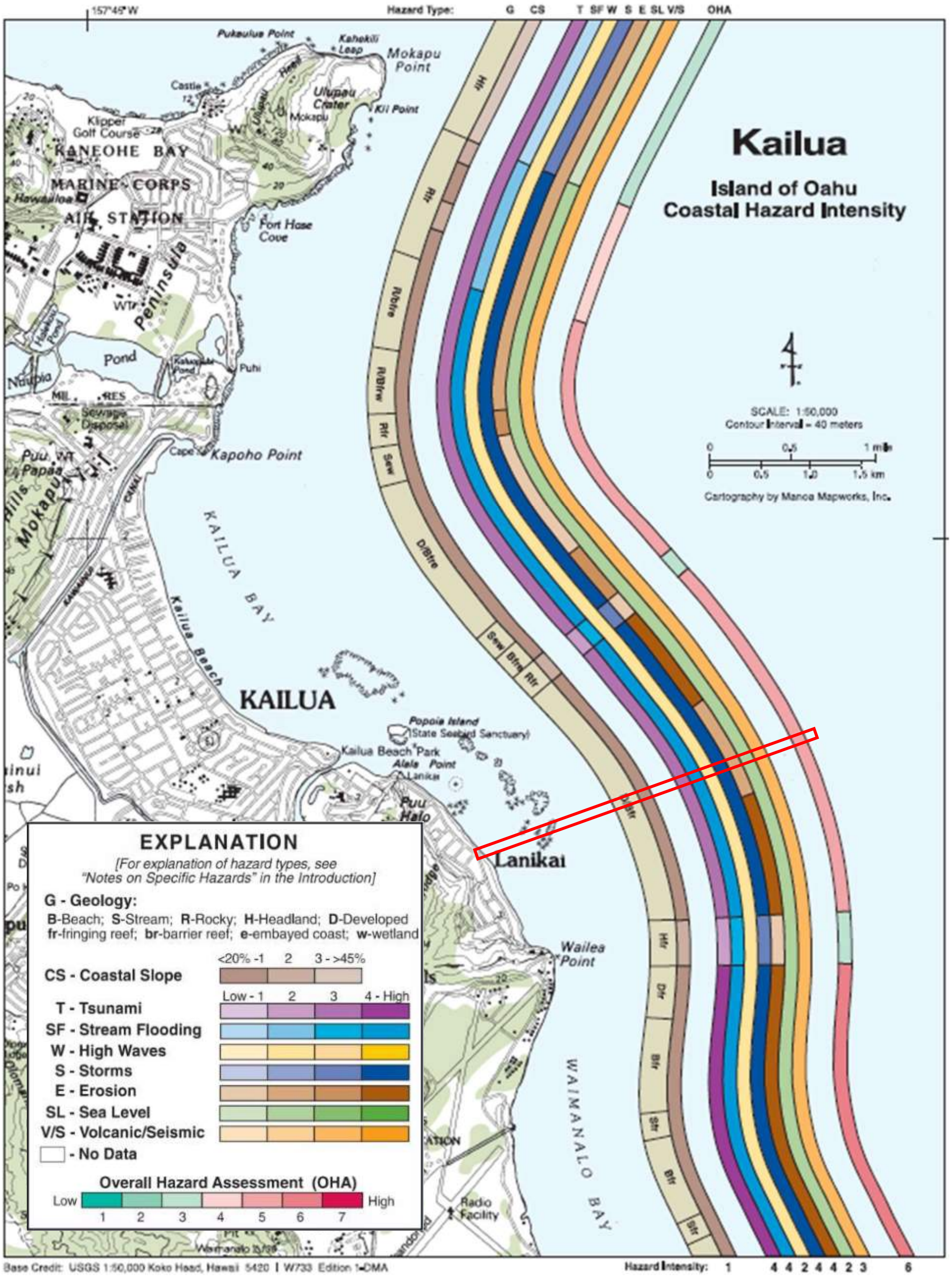

Figure 5-1 Composite hazard map with project site shown in red (USGS, 2002)

5.4 Still Water Rise

Storms and large waves produce storm surge and wave setup that results in elevated water levels at the project site shoreline. During prevailing annual conditions this water level rise can be on the order of a foot above the tide level. However, during extreme events, the still water level rise can be significantly greater.

5.5 Coastal Flooding

The National Flood Insurance Program, administered by the Federal Emergency Management Agency (FEMA), produces maps identifying flood hazards and risks. Figure 5-2 shows the flood hazard map for the project site. The map indicates that the seaward portion of the property is in Flood Zone AE, which designates areas subject to inundation by the 1% annual chance flood event. The Base Flood Elevation (BFE) is 6 feet. The map also indicates that the inland portion of the project site is in Flood Zone X, which designates areas determined to be outside the 0.2% annual chance floodplain.

Figure 5-2 Flood hazard zones for the project site (FEMA)

5.6 Projected Impacts of Sea Level Rise

Sea level rise is negatively impacting beaches and shorelines in Hawaii. Impacts include beach narrowing and beach loss, loss of land due to erosion, and infrastructure damage due to inundation and flooding. The impacts from anomalous sea level events (e.g., king tides, mesoscale eddies, storm surge) are also increasing. A 2015 study found that, due to increasing sea level rise, average shoreline recession (erosion) in Hawaii is expected to be nearly twice the historical extrapolation by 2050, and nearly 2.5 times the historical extrapolation by 2100 (Anderson et al., 2015).

The *Hawaii Sea Level Rise Vulnerability and Adaptation Report* (Hawaii Climate Change Commission, 2017) discusses the anticipated impacts of projected future sea level rise on coastal hazards, and the potential physical, economic, social, environmental, and cultural impacts of sea level rise in Hawaii. A key component of the report was a numerical modeling effort by the University of Hawaii (UH) to estimate the potential impacts of a 3.2-foot rise in sea level. UH used the most current available information on climate change and sea level rise from the Intergovernmental Panel on Climate Change (IPCC) Assessment Report 5 (AR5). The UH numerical modeling is based on the upper end of the IPCC AR5 representative concentration pathway (RCP) 8.5 sea level rise scenario, which predicts up to 3.2 feet of global sea level rise by the year 2100. However, based on recent peer-reviewed publications, it is possible that sea level rise could be significantly greater than the RCP 8.5 sea level rise scenario by the end of this century. Sweet et al. (2017) suggest that global mean sea level rise in the range of 6.4 feet to 8.8 feet is physically plausible by the end of this century, which is significantly higher than the worst-case IPCC AR5 projections.

UH modeled the potential impacts that a 3.2-foot rise in sea level would have on coastal hazards including passive flooding, annual high wave flooding, and coastal erosion. The footprint of these three hazards were combined to define the projected extent of chronic flooding due to sea level rise, referred to as the *sea level rise exposure area (SLR-XA)*. Flooding in the SLR-XA is associated with long-term, chronic hazards punctuated by annual or more frequent flooding events. The SLR-XA model results for the project site are shown in Figure 5-3 through Figure 5-6.

Figure 5-3 depicts the potential for passive flooding with 3.2 feet of sea level rise. Passive flooding includes areas that are hydrologically connected to the ocean (marine flooding) and low-lying areas that are not hydrologically connected to the ocean (groundwater). The model results indicate that the project site will not be vulnerable to passive flooding with 3.2 feet of sea level rise.

Figure 5-4 depicts the potential for annual high wave flooding with 3.2 feet of sea level rise. The annual high wave flooding model propagates the maximum annually recurring wave, calculated from historical wave buoy data, over the reef and to the shore along 1-dimensional cross-shore profiles extracted from a 1-meter digital elevation model. The model depicts the spatial extent of inundation that is greater than 10cm in depth. The model results indicate that the project site will not be vulnerable to annual high wave flooding with 3.2 feet of sea level rise.

Figure 5-5 depicts the estimated area that could be exposed to erosion with 0.5 to 3.2 feet of sea level rise. The results of the erosion model represent the combined results of measured, historical erosion rates and the compounding impacts of projected higher water levels associated with projected sea level rise. The model results indicate that the project site will experience accretion with 3.2 feet of sea level rise.

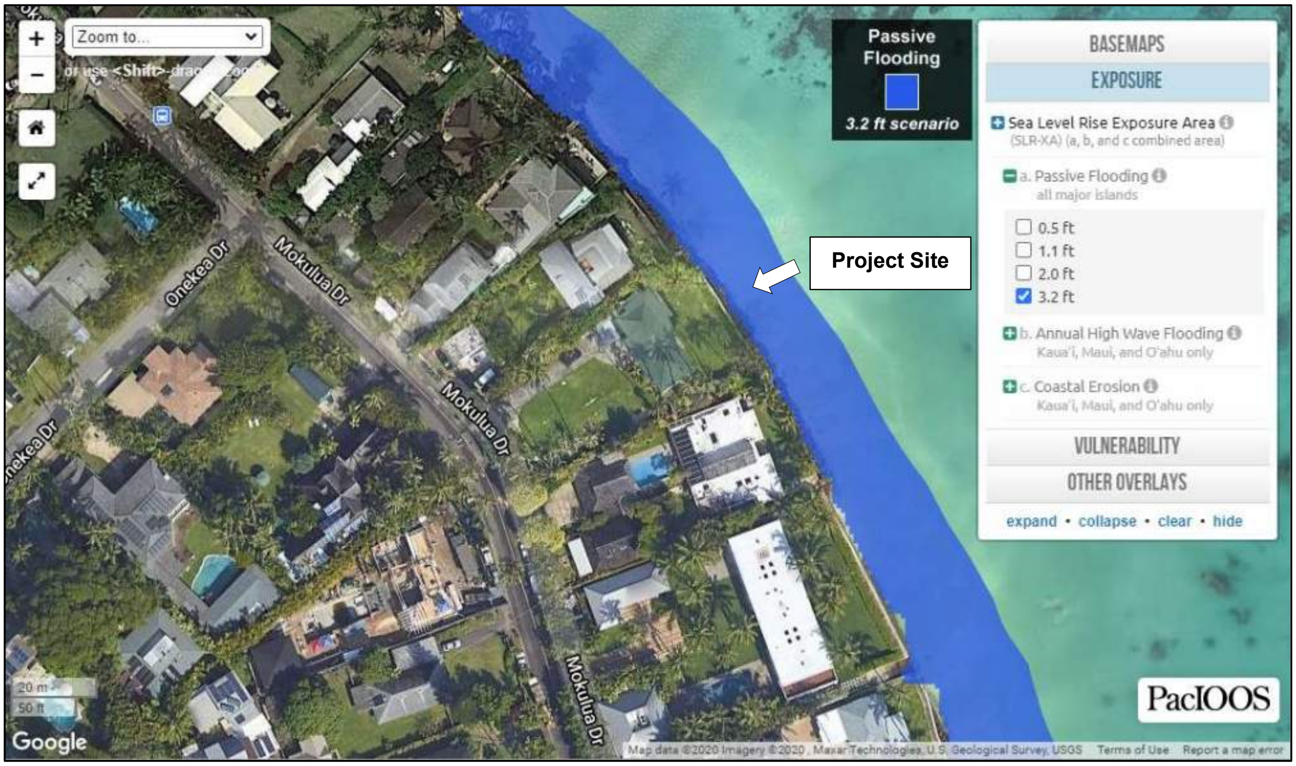

Figure 5-3 Passive flooding with 3.2 feet of sea level rise (PacIOOS, 2020)

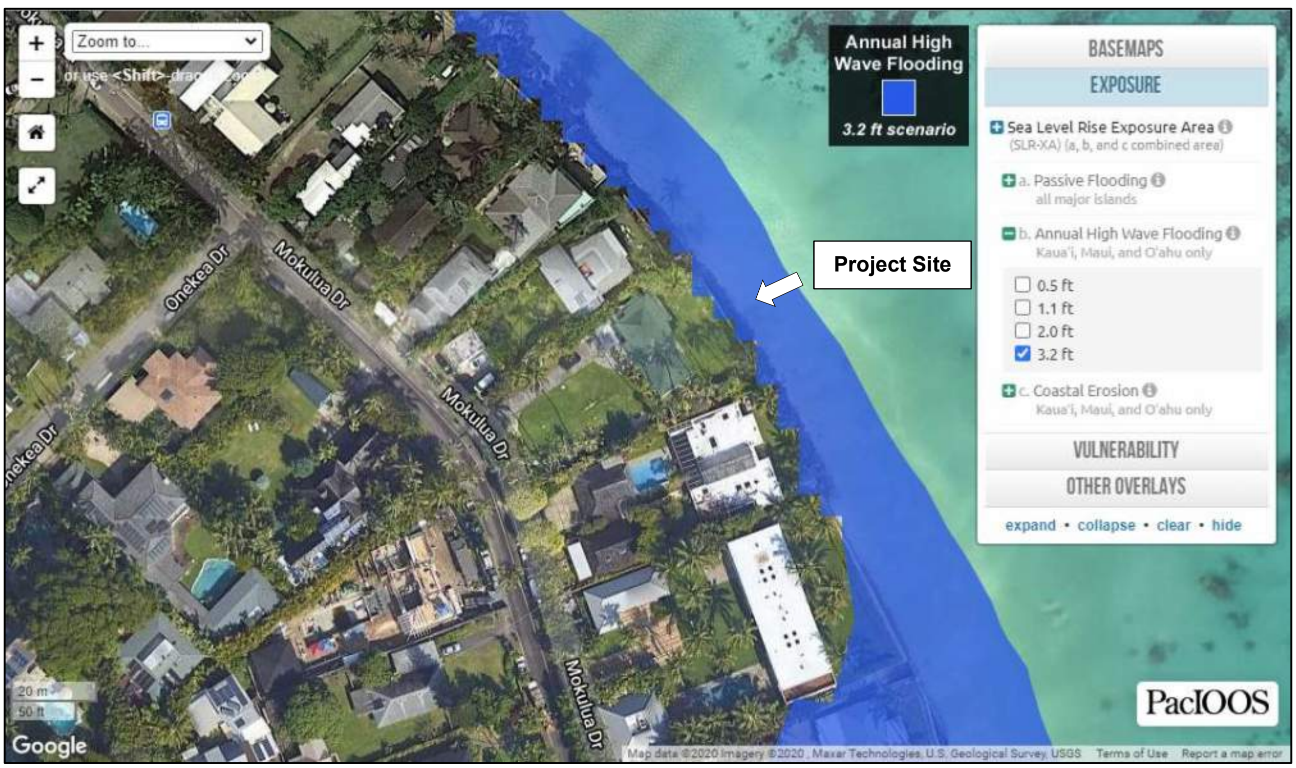

Figure 5-4 Annual high wave flooding with 3.2 feet of sea level rise (PacIOOS, 2020)

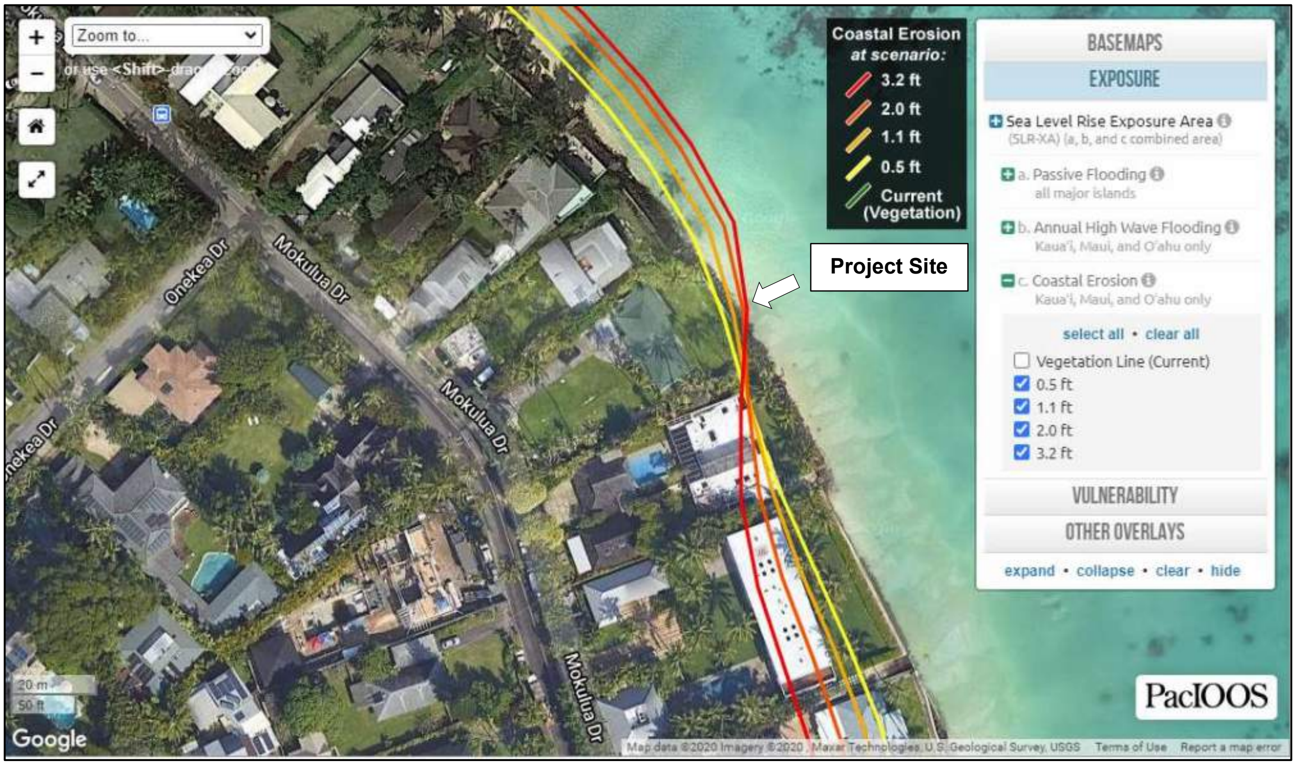

Figure 5-5 Coastal erosion with 0.5 to 3.2 feet of sea level rise (PacIOOS, 2020)

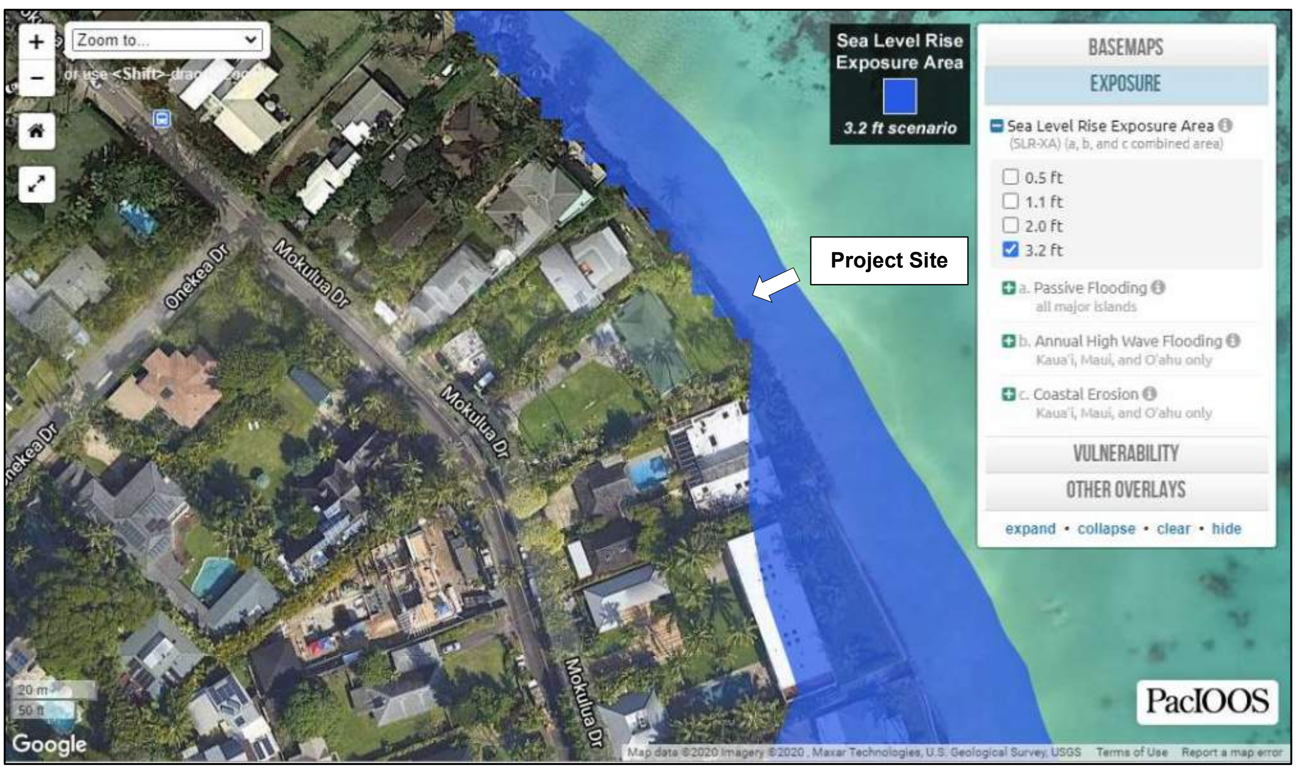

Figure 5-6 Combined hazard exposure with 3.2 feet of sea level rise (PacIOOS, 2020)

The erosion model results are useful for considering the potential impacts of erosion at the island or community level; however, there are certain assumptions, limitations, and uncertainties that must be understood when considering the results at the parcel level. The projected erosion hazard lines for the project site are derived from historical erosion rates that are based on historical shoreline positions at individual transects located 20 meters apart along the coastline. Each transect is characterized by a unique combination of physical and environmental factors that influence shoreline change at that specific transect. Erosion projections that are based on historical erosion rates may not be entirely accurate predictions of future conditions but are often used for planning purposes.

The portion of the SLR-XA erosion model used to project coastal response to rising sea levels assumes that all changes in the nearshore, shoreline, and terrestrial area (to the maximum extent of erosion) are occurring in mobile sandy substrate. The model implicitly assumes that sand moves freely along the affected dry and submerged coastal profile, allowing the entire system to respond to the effects of sea level rise. However, the assumption that the affected system is composed entirely of sand is not accurate for much of Oahu's coastline, including the project site, where shallow fringing reefs dominate the nearshore. Another notable assumption occurs where projected erosion impacts are presented along shorelines with engineered structures, such as seawalls and revetments. The model uses the "all sand" substrate for predictive modeling but does not account for the presence of engineered shore protection structures. Typically, these structures are utilized to abate the impacts of shoreline erosion and act counter to the natural drivers of shoreline retreat.

The coastline of Oahu is characterized by a broad spectrum of environments that include locations where sand is no longer present, the geology of the coastline has fundamentally changed, the coastline has areas of harder substrate, the shoreline is armored or otherwise engineered, and a myriad of others that are not an 'all sand' environment. A sea level rise influenced model that predicts coastal change in an all sand environment is not expected to accurately predict coastal change across the full spectrum of coastal environments present on Oahu. At the project site, the nearshore is dominated by a shallow fringing reef with a thin veneer of sand, and the the seawall and rock apron create a physical boundary between the terrestrial and marine environments. The structures protect the terrestrial area from erosion and there is no expectation of erosion while the structures are intact. The project site is a location where, due to the presence of an engineered shoreline, the inherent environmental assumptions upon which the erosion model are based are not met. Furthermore, the erosion model does not account for the potential longevity of the structures.

Figure 5-6 depicts the Sea Level Rise Exposure Area (SLR-XA), which represents the combined footprint of the three individual hazards that were modeled - passive flooding, annual high wave flooding, and coastal erosion - with 3.2 feet of sea level rise. It is important to understand the underlying assumptions, limitations, and uncertainties of the SLR-XA model when considering the results at the parcel level. The project site is situated at a headland where the orientation of the shoreline transitions from approximately 160 degrees (to the south) to 135 degrees (to the north). The dominant shoreline change trend to the south has been erosion, whereas accretion has been the dominant trend to the north. The SLR-XA model projects that the shoreline south of the project site will experience increased erosion and flooding with sea level rise, whereas the shoreline to north will experience accretion and minimal flooding (Figure 5-5). The significant variability of the projected hazards over a small geographic area suggests that further study is required in order to quantify the potential impacts of sea level rise at the project site.

6. ALTERNATIVES ANALYSIS

6.1 Introduction

The objectives for this project are to:

- Repair damage and structural deficiencies of the existing seawall.
- Comply with the conditions of the easement to maintain the structures in a safe condition.
- Provide long-term protection for the property and existing single-family home.

SEI evaluated eight (8) alternatives to determine if they are suitable for the project site conditions and capable of achieving the project objectives:

- No Action
- Managed Retreat
- Beach Nourishment
- Rock Revetment
- Hybrid Seawall-Revetment
- Seawall Removal
- Seawall Replacement
- Seawall Repair

Alternatives were evaluated based on the following criteria:

- Effectiveness (i.e. capable of achieving the project objectives)
- Design Considerations (i.e. suitability, durability, design life)
- Costs (i.e. initial costs, recurring costs, cost-benefit ratio)
- Feasibility (i.e. constructability, regulatory requirements, community support/opposition)
- Potential Impacts (i.e. coastal processes, environment, shoreline access, adjacent properties)

Ideally, the recommended engineering alternative would satisfy the project objectives, while minimizing potential negative impacts to the environment and adjacent shorelines.

6.2 No Action

The No Action alternative would involve leaving the seawall in its existing location and condition with no repairs or modifications. This approach would do nothing to improve the condition or functionality of the seawall. The seawall is over half a century old and is in a deteriorated condition. If the seawall is not repaired, the structure can be expected to continue to deteriorate. If the seawall deteriorates to a point that it is no longer serviceable, the structure may fail, or removal may be required.

The seawall protects the project site and the adjacent properties from erosion and wave overtopping. If the seawall were to fail or be removed, the terrestrial area would be unprotected. The shoreline would be exposed to erosion, flooding would occur more frequently, and property damage would be expected. Failure or removal of the seawall would expose the project site and the adjacent properties to increased hazard risk. The seawall is in a serviceable condition and repairs are feasible.

Advantages

+ No cost.

Disadvantages

- Does not address the damages and structural deficiencies of the existing seawall.
- Does not comply with the requirements of the easement.
- Does not provide long-term protection for the property and existing single-family home.
- Continued deterioration of the seawall could create a risk to public health and safety.

No Action would have no immediate impacts to the project site, the nearshore waters, or adjacent properties. However, the likelihood of seawall failure would increase over the long-term. If no mitigative action is taken to repair the seawall, damage will continue and the level of deterioration of the seawall could eventually result in failure, which would negatively impact the project site and adjacent properties. No Action would not satisfy the project objectives and is therefore not the preferred alternative.

6.3 Managed Retreat

Managed Retreat (also referred to as "adaptive realignment") is a coastal management strategy that is intended to allow the shoreline to naturally move inland, rather than fixing the shoreline with engineered shore protection structures. Managed Retreat typically involves modification, relocation, or removal of existing structures to reduce hazard exposure and maintain a natural shoreline. Managed Retreat strategies can be horizontal or vertical in nature. Horizontal retreat strategies seek to reduce hazard exposure by moving structures further inland, whereas vertical retreat strategies seek to reduce exposure by elevating structures above the hazard.

Shoreline setbacks require development to be set back a minimum distance from the shoreline. The shoreline setback is a "horizontal retreat strategy" in that it creates a buffer zone of open space that reduces the potential for infrastructure to be exposed to erosion and flooding. The purpose of the shoreline setbacks is to protect and preserve the natural shoreline, lateral shoreline access, and open space along the shoreline. The City & County of Honolulu requires shoreline setbacks for new construction along the shoreline. The existing single-family home has a shoreline setback of 40 feet, which is the minimum setback required by the City & County of Honolulu.

Freeboard involves elevating structures above the Base Flood Elevation (BFE). Freeboard is an accommodation strategy that can also be considered a form of "vertical retreat". The project is located in Flood Zone AE, which designates areas subject to inundation by the 1% annual chance flood event. The existing single-family home was constructed in 1939 and is approximately 10 feet above mean sea level, which is 4 feet above the BFE of 6 feet.

Managed Retreat is a relatively new concept that is being evaluated for applicability in Hawaii. In 2018, the Hawaii Office of Planning (OP) published a report entitled, *Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawaii*. The study evaluated options to establish policies, regulations, tools, and programs to support a managed retreat strategy in response to sea level rise.

The study found that retreat is one of three primary adaptation strategies, along with accommodation, and protection, and that, prior to deciding upon retreat, accommodation and protection must be examined to determine which strategy is the best for the area dealing with coastal hazards, climate change and sea level rise. The study also found that retreat is only effective when done voluntarily and that economic incentive programs to fund retreat (e.g., buyouts, transferrable development rights, rolling easements) are problematic and unlikely to be effective in Hawaii due to the high cost of coastal real estate. The report noted that retreat from chronic coastal hazards (e.g., erosion and sea level rise) is incremental and typically takes decades to complete.

Managed retreat would likely require relocating the existing single-family home further from the shoreline. The home is 80 years old and the foundation is slab-on-grade, so moving the home from its current location is not a practical option. Redevelopment of the property would likely require demolition of the existing single-family home and pool. Additional structures would also be required to mitigate potential impacts to the neighboring properties and shore protection structures. While this option may reduce vulnerability of infrastructure to coastal hazards and sea level rise, complete redevelopment of the property is not a reasonable or economically practical option.

Managed retreat at the project site could potentially involve removal of the existing seawall and rock apron, which would allow the terrestrial area to erode and sand to migrate naturally along the beach. While this may result in a temporary increase in beach width, the eroded sand would be unstable and would be expected to mobilize and spread throughout the littoral system during normal seasonal beach processes. In the absence of the seawall, the terrestrial area would be exposed to erosion and flooding, and the project site and adjacent properties would be more vulnerable to coastal hazards and sea level rise.

<u>Advantages</u>

+ Reduces vulnerability of infrastructure to coastal hazards and sea level rise.
+ Avoids costs and requirements associated with shore protection or beach restoration.
+ Allows the shoreline to migrate naturally.

<u>Disadvantages</u>

– Does not address the damages and structural deficiencies of the existing seawall.
– Does not comply with the requirements of the easement.
– Does not provide long-term protection for the property and existing single-family home.
– Would only be effective if implemented at the community level.
– No existing rules, programs, or policies to manage or facilitate the retreat process.

Managed Retreat may be considered as a long-term option but is not necessary at this time. The existing seawall is in a serviceable condition. Until retreat is determined to be feasible or necessary, and rules, programs and policies are in place to manage the retreat process, other appropriate solutions should be considered. Managed retreat would not achieve the project objectives and is therefore not the preferred alternative.

6.4 Beach Nourishment

Beach nourishment typically involves placement of beach fill to specified profiles that are designed to augment the natural morphology of the beach to offset the effects of chronic, seasonal, or episodic erosion. Regulatory agencies and the public are generally supportive of beach nourishment because it has minimal environmental impacts and is consistent with State and County policies that seek to preserve and enhance beach resources and shoreline public access.

The shoreline fronting the seawall consists of a narrow sandy beach that is dynamic and ephemeral. The beach consists of a thin veneer of sand with no evidence of stable beach profile. When sand is present along the shoreline, the beach is generally exposed only during lower tides. At high tide, waves wash up to the seawall and the beach face is entirely submerged. Beach nourishment at the project site would consist of placing sand directly on the shoreline to increase the elevation and width of the beach.

One of the factors that can limit the effectiveness of beach nourishment projects is the loss of sand due to natural littoral processes, such as longshore and cross-shore sediment transport. Sand placed only at the project site would be unstable and would be expected to mobilize and spread throughout the littoral system during normal seasonal beach processes. Engineered containment structures, such as groins, would be required to stabilize the sand and maintain a stable beach. T-head groins decrease and reorient the amount of wave energy reaching the beach and create artificial littoral cells to stabilize the sand. An example of beach nourishment with stabilizing T-head groins is shown in Figure 6-1.

Figure 6-1 Example of beach nourishment with T-head groins (Iroquois Point, Oahu)

Beach nourishment accompanied by the construction of groins to stabilize the sand fill would be the most effective means to restore and maintain a stable beach, while providing a natural protective buffer to protect the terrestrial area and infrastructure. A series of groin structures accompanied by beach fill would create stable, wide beach cells within the groins, stable fillets on the outside of each groin, and would reduce the loss of sand to the north and south.

A disadvantage of beach nourishment with stabilizing groins is the potential for down drift effects that can negatively impact nearby shorelines. The scale of the project would need to be expanded to include a sufficient number of groins spanning a significant length of shoreline. This would require a regional effort to restore and maintain a beach along this section of coastline. In addition to the large scale of the project, finding an appropriate source of beach sand has become a significant challenge for beach nourishment projects in Hawaii. Offshore sand mining has become a viable alternative to terrestrial sand mining; however, due to the high costs for sand recovery and transportation, offshore sand is only practical for large-scale beach nourishment projects.

In 2009, the U.S. Army Corps of Engineers and Hawaii Department of Land and Natural Resources evaluated options for large-scale beach nourishment at Lanikai. The first option was for direct placement of sand with no stabilizing structures. The conceptual design produced a dry beach width of 30 feet and would require 182,000 cubic yards of sand for the initial nourishment at an estimated cost of $33,000,000. Additional nourishment of the beach was projected to be necessary every 8.4 years, resulting in an estimated total cost over 50 years of $109,000,000. The second option included construction of twelve (12) T-head groins. This concept also produced a minimum dry beach width of 30 feet and required 146,000 cubic yards of sand for an estimated initial cost of $33,400,000 and a total cost of $41,600,000 over 50 years. The groins would be located seaward of the shoreline, so easements would be required for the groins, which would further increase costs.

<u>Advantages</u>

+ Increases beach volume and width.
+ Improves lateral shoreline access.
+ Provides some additional protection against erosion and flooding.
+ Agencies and the public are generally supportive of beach nourishment projects.

<u>Disadvantages</u>

– Does not address the damage and structural deficiencies of the existing seawall.
– Does not comply with the requirements of the easement.
– Does not provide long-term protection for the property and existing single-family home.
– Requires an adequate quantity of compatible beach quality sand.
– Requires discharge of fill material (sand) in waters of the United States.
– Groins and beach fill would have a very large structural footprint along the shoreline.
– Project would need to be a regional effort spanning multiple properties.
– Very high costs for design, environmental review, permitting, construction.
– Groins would require easements.

Small-scale beach nourishment without stabilizing structures would not be effective at the project site, and large-scale beach nourishment with stabilizing structures is not practical at the parcel level. Beach nourishment is therefore not the preferred alternative.

6.5 Rock Revetment

A revetment is a sloping, un-cemented structure constructed of wave-resistant material. The most common method of revetment construction is to place a layer of armor stone, sized according to the design wave height, over an underlayer of smaller rock that sits atop geotextile filter fabric. The underlayer is designed to distribute the weight of the armor layer and to prevent loss of fine material through voids in the revetment. An example of a rock revetment is shown in Figure 6-2.

Figure 6-2 Rock revetment at Kahului Harbor (Kahului, Maui, Hawaii)

An advantage of a revetment is that the rough porous rock surface and sloping face of the structure will tend to absorb wave energy, reduce wave reflection, and may help to promote accretion of sand on a sandy beach when a sufficient volume of sand is available in the littoral system. Additional advantages of revetments are that materials are readily available and localized damage can be easily repaired by placement of additional armor stone.

The rough and porous surface and flatter slope of revetments absorb and dissipate more wave energy than the smooth vertical surfaces of seawalls. Revetments are more effective in reducing wave reflection, runup, and overtopping, which increases the potential for sand accumulation seaward of the structure. Because of its durability, flexibility, and reduced wave reflection, a revetment is often considered the best erosion control/shore protection measure for sites where shoreline hardening is considered appropriate.

Properly designed and constructed rock revetments are durable, flexible, and highly resistant to wave damage. Rock revetment design is dependent on sea level elevation, design wave height, and scour depth. The revetment designs presented below incorporate a 2.3-foot higher than present sea level, with consequent increases in predicted wave exposure and scour depth. Utilizing 2.3 feet of sea level rise, which is currently projected for 50 years in the future, provides suitable design criteria within the effective life span of similar structures. Structure maintenance, improvements, or replacement are appropriate at the end of the structure's projected life span or when environmental changes exceed design conditions. Adaptation to rising sea levels and their resulting impacts predicted at time frames beyond the structure's design life should be incorporated at that time.

Armor stone size is based on the design wave height, H_s, at the structure during a 50-year NE swell. This wave height H_s was modeled to be 5.1 feet. The required armor stone weight for stability under the design wave height is given by the Hudson Formula (USACE, 1984/2006):

$$W = \frac{w_r {H_s}^3}{K_D (S_r - 1)^3 cot\theta}$$

where:

W = weight in pounds of an individual armor stone
w_r = unit weight of the stone, 160 lb/feet^3
H_s= wave height, 5.1 feet
K_D = armor stone stability coefficient, 2
S_r = specific gravity of the stone relative to seawater, 2.5
cot θ = cotangent of the groin side slope, 1.5

The armor layer is typically two stone diameters in thickness; however, an adjustment can be made for single stone layer design. For this design, the stone weight is increased by 30% and the stones are required to be keyed and fitted for maximum stability. The suggested armor stone weight using the Hudson Formula for single stone armor layer is therefore 2,800 lbs with a corresponding nominal diameter of approximately 2.6 feet. A range of ±25% of the median weight is typically utilized, which yields a stone weight range of 2,100 to 3,500 lbs. Underlayer stone is sized at approximately 1/10 the armor stone weight, resulting in underlayer stone size between about 200 and 350 lbs. The nominal diameter for this stone weight is 1.2 feet. The underlayer sizing is important to provide porosity for energy dissipation, to achieve interlocking between the armor and underlayer, and to ensure that the underlayer material cannot be removed through voids in the armor layer. The underlayer stone should be placed in a layer two stone-widths thick, or 2.4 feet.

It is preferred that the toe of the revetment be founded on hard, non-erodible substrate to prevent scour and undermining of the structure. Based on the results of the geotechnical investigations, the depth to hard nonerodable substrate is more than 28 feet below the existing backshore grade. In the absence of hard substrate, a scour apron can be designed to mitigate the effects of scour. The revetment toe would consist of a three-stone wide apron at the approximate scour depth, in this case, the top of the scour apron would be at -5.5 feet msl.

SEI evaluated two options for a rock revetment at the project site. Both options would extend beyond the limits of the easement area and would require demolition and removal of the existing seawall and rock apron. Return walls would also be required to stabilize and protect the adjacent properties and existing shore protection structures.

The first option would be to construct a rock revetment landward of the existing seawall (Figure 6-3 and Figure 6-4). The crest of the structure would be placed at +10.5 feet msl to match the existing backshore topography with a slope of 1V:1.5H to ensure stability. The structure would be 40.2 feet wide with a total area of 3,880 square feet. The entire structure would be in the Special Management Area. The structure would occupy 100% of the yard area and would encroach 4 feet into the existing single-family home.

To mitigate the need to modify or remove the existing single-family home, an alternative would be to construct a rock revetment beginning at the seaward edge of the existing rock apron (Figure 6-5 and Figure 6-6). The structure would be 40.2 feet wide with a total area of 3,970 square feet. The landward portion of the structure would be in the Special Management Area. The seaward portion of the structure would be in the Conservation District. The structure would occupy approximately 70% of the yard area seaward of the existing single-family home.

<u>Advantages</u>

+ Provide long-term protection for the property and existing single-family home.
+ Better wave energy dissipation characteristics than a seawall.
+ Less reflective than a seawall and may facilitate sand accretion seaward of the structure.
+ Does not negatively impact lateral shoreline access.

<u>Disadvantages</u>

– Largest structural footprint of the options considered.
– Very high costs for design, environmental review, permitting, and construction.
– Only feasible if a portion of the structure extends seaward of the shoreline.
– Requires demolition and removal of the existing seawall and rock apron.
– Public could traverse the revetment creating potential privacy, security, and liability issues.
– Uncertainty regarding entitlement implications and regulatory requirements.
– Agency and public opposition to construction of new shore protection structures.

A rock revetment is an appropriate engineering solution for the project site. However, given the very large structural footprint, high costs for design, environmental review, permitting, and construction, and the need for additional structures to protect the adjacent properties and existing shore protection structures, a rock revetment is not the preferred alternative.

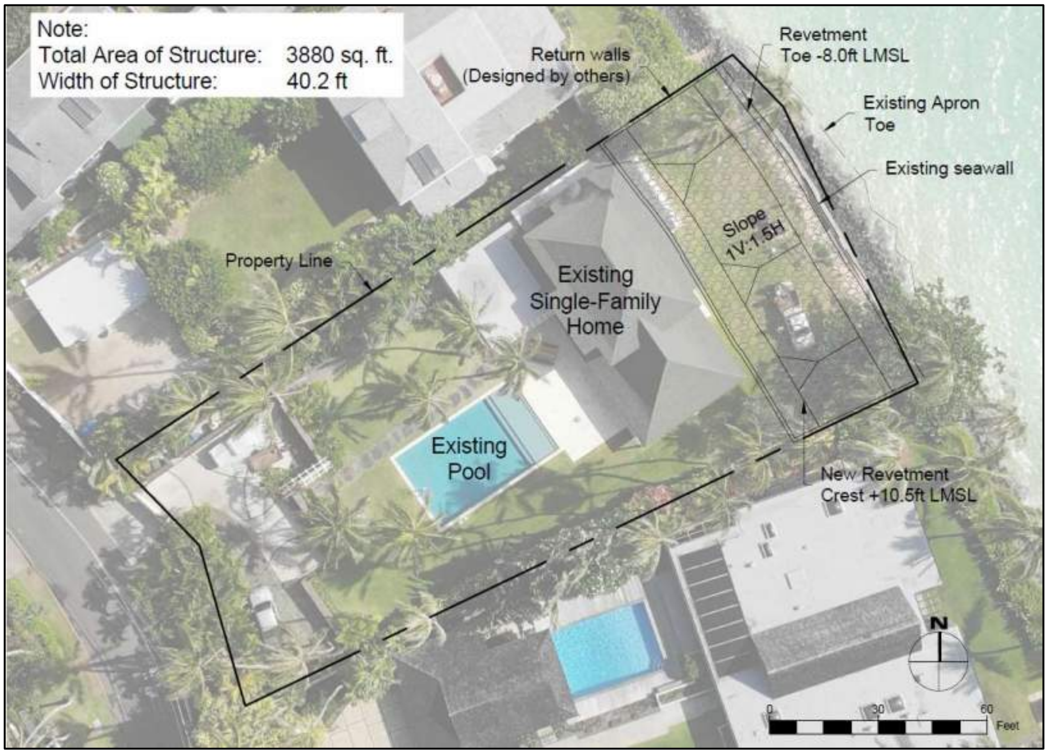

Figure 6-3 Conceptual plan view for rock revetment landward of the shoreline

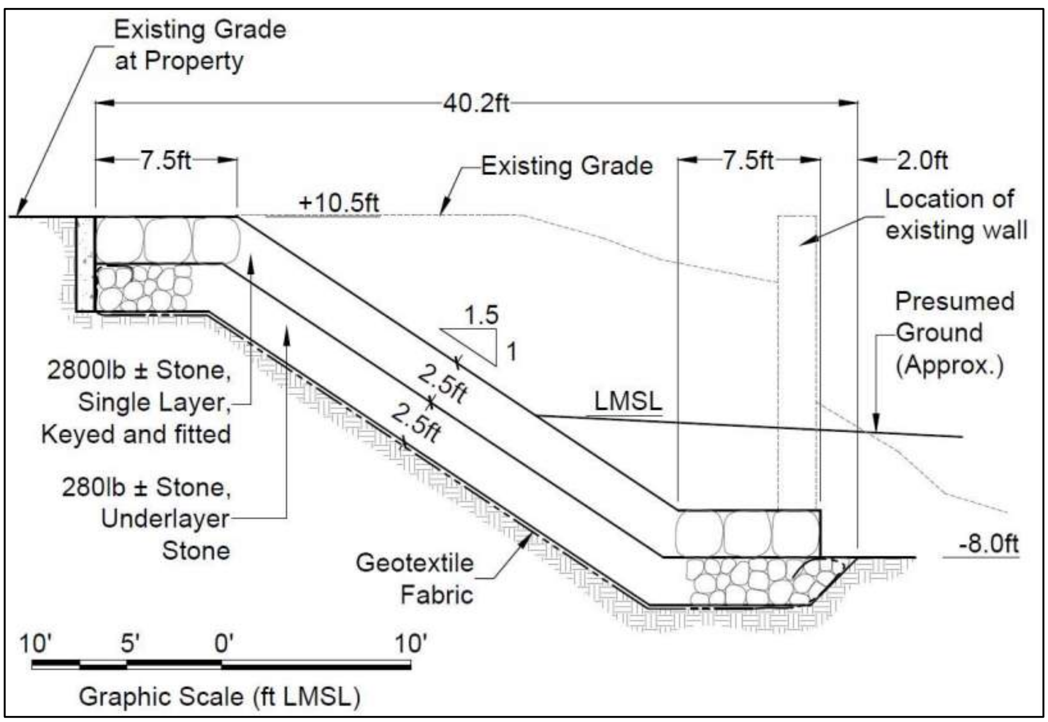

Figure 6-4 Conceptual section view for rock revetment landward of the shoreline

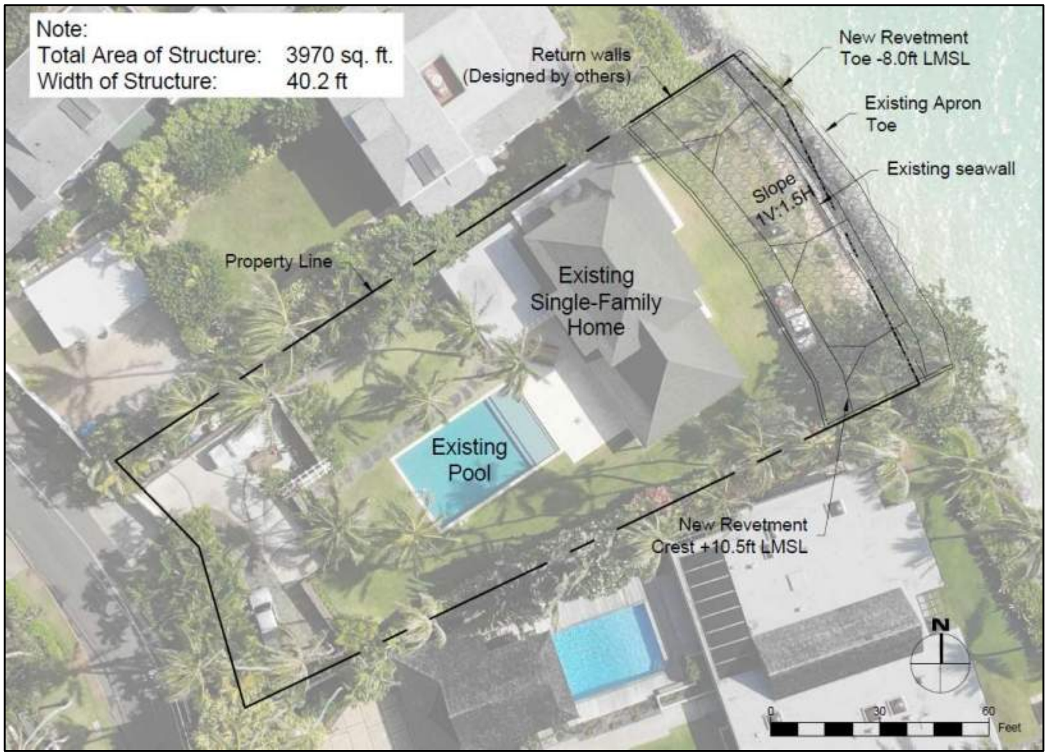

Figure 6-5 Conceptual plan view for rock revetment seaward of the shoreline

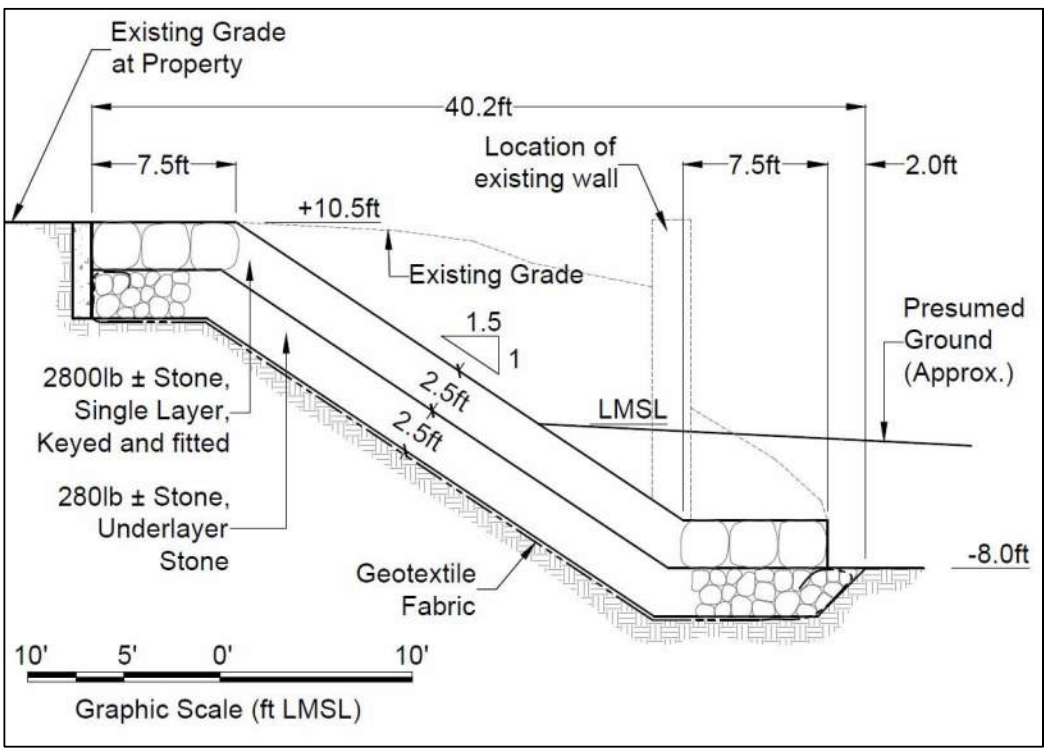

Figure 6-6 Conceptual section view for rock revetment seaward of the shoreline

6.6 Hybrid Seawall-Revetment

Another potential long-term engineering solution for the project site is a hybrid seawall-revetment, which is a shore protection structure that is composed of two primary elements: a seawall (e.g., sheet pile, reinforced concrete, or cemented rock masonry) and a uniform armor rock rubblemound revetment. An example of a hybrid seawall-revetment is shown in Figure 6-7.

Figure 6-7 Hybrid seawall-revetment (Kapaa, Kauai, Hawaii)

An advantage of a hybrid seawall-revetment is that the structure has a slightly smaller structural footprint than a traditional rock revetment and can be designed to be modified to withstand changing design wave conditions as sea level rises. Additional advantages of a hybrid seawall-revetment are that materials are readily available and localized damage can be easily repaired by placement of additional armor stone. Properly designed and constructed hybrid seawall-revetments are durable, flexible, and highly resistant to wave damage. A disadvantage of a hybrid seawall-revetment is that it would still have a relatively large structural footprint within the property.

<u>Advantages</u>

+ Provide long-term protection for the property and existing single-family home.
+ Better wave energy dissipation characteristics than a seawall.
+ Less reflective than a seawall and may facilitate sand accretion seaward of the structure.
+ Does not negatively impact lateral shoreline access.

Disadvantages

- Large structural footprint.
- Very high costs for design, environmental review, permitting, and construction.
- Requires demolition and removal of the existing seawall and rock apron.
- Public could traverse the structure creating potential privacy, security, and liability issues.
- Agency and public opposition to construction of new shore protection structures.

The hybrid seawall-revetment design is dependent on sea level elevation, design wave height, and scour depth. The designs presented below incorporate a 2.3-foot higher than present sea level, with consequent increases in predicted wave exposure and scour depth. Utilizing 2.3 feet of sea level rise, which is currently projected for 50 years in the future, provides suitable design criteria within the effective life span of similar structures. Structure maintenance, improvements, or replacement are appropriate at the end of the structure's projected life span or when the environment changes beyond design conditions. Adaptation to rising sea levels and their resulting impacts predicted at time frames beyond the structure's design life should be incorporated at that time.

SEI evaluated two options for a hybrid seawall-revetment at the project site. The armor and underlayer stone size and placement would be the same as for the rock revetment options. Both options would extend beyond the limits of the easement area and would require demolition and removal of the existing seawall and rock apron. Return walls would also be required to stabilize and protect the adjacent properties and existing shore protection structures.

The first option would be to construct a rock a hybrid seawall-revetment landward of the existing seawall (Figure 6-8 and Figure 6-9). The crest of the structure would be placed at +10.5 feet msl to match the existing backshore topography with a slope of 1V:1.5H to ensure stability. The structure would be 32.9 feet wide with a total area of 3,145 square feet. The entire structure would be in the Special Management Area. The structure would occupy approximately 90% of the yard area seaward of the existing single-family home.

An alternative would be to construct a hybrid seawall-revetment beginning at the seaward edge of the existing rock apron (Figure 6-10 and Figure 6-11). The structure would be 32.9 feet wide with a total area of 3,225 square feet. The landward portion of the structure would be in the Special Management Area. The seaward portion of the structure would be in the Conservation District. The structure would occupy approximately 60% of the yard area seaward of the existing single-family home.

A hybrid seawall-revetment is an appropriate engineering solution for the project site. However, given the large structural footprint, high costs for design, environmental review, permitting, and construction, and the need for additional structures to protect the adjacent properties and existing shore protection structures, a hybrid seawall-revetment is not the preferred alternative.

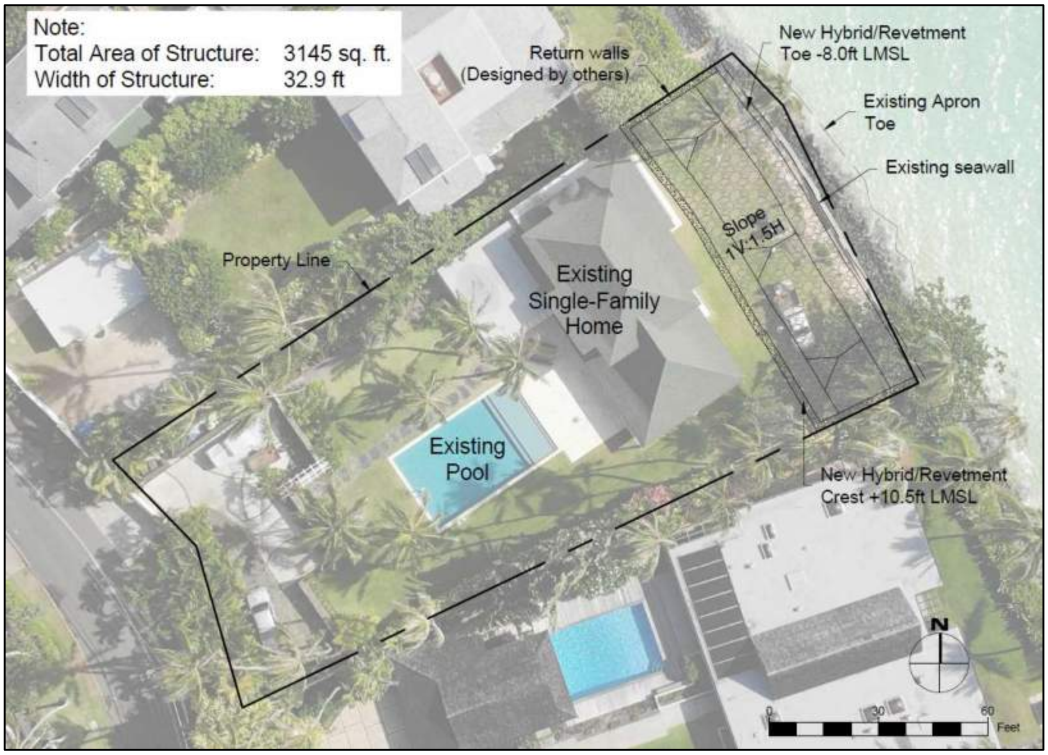

Figure 6-8 Conceptual plan view for hybrid seawall-revetment landward of the shoreline

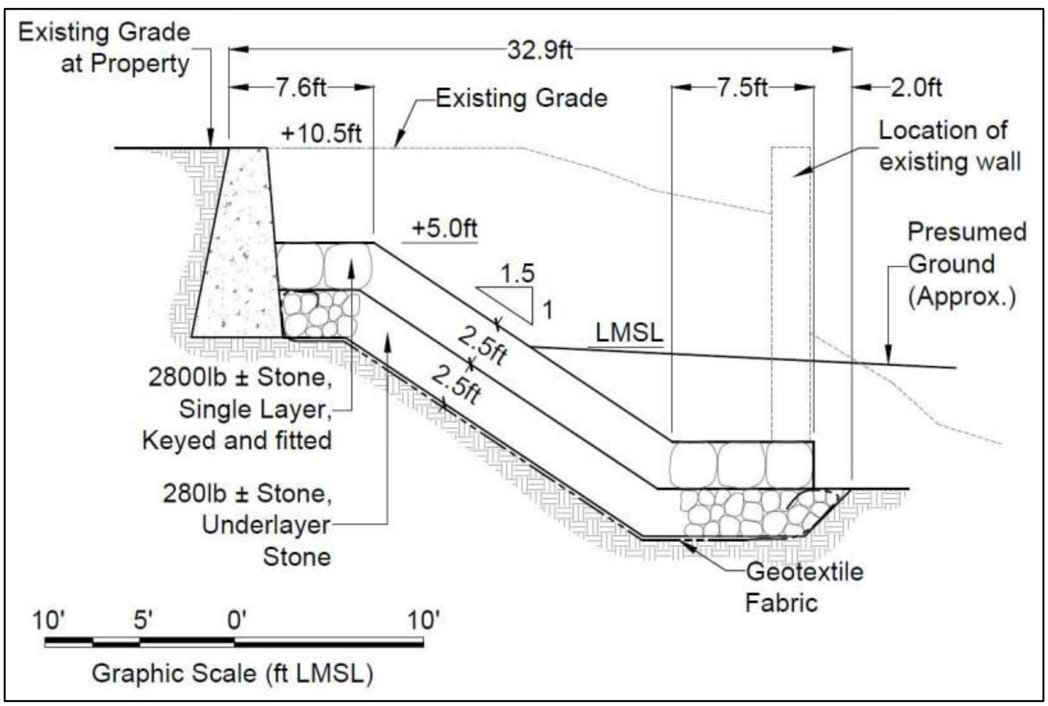

Figure 6-9 Conceptual section view for hybrid seawall-revetment landward of the shoreline

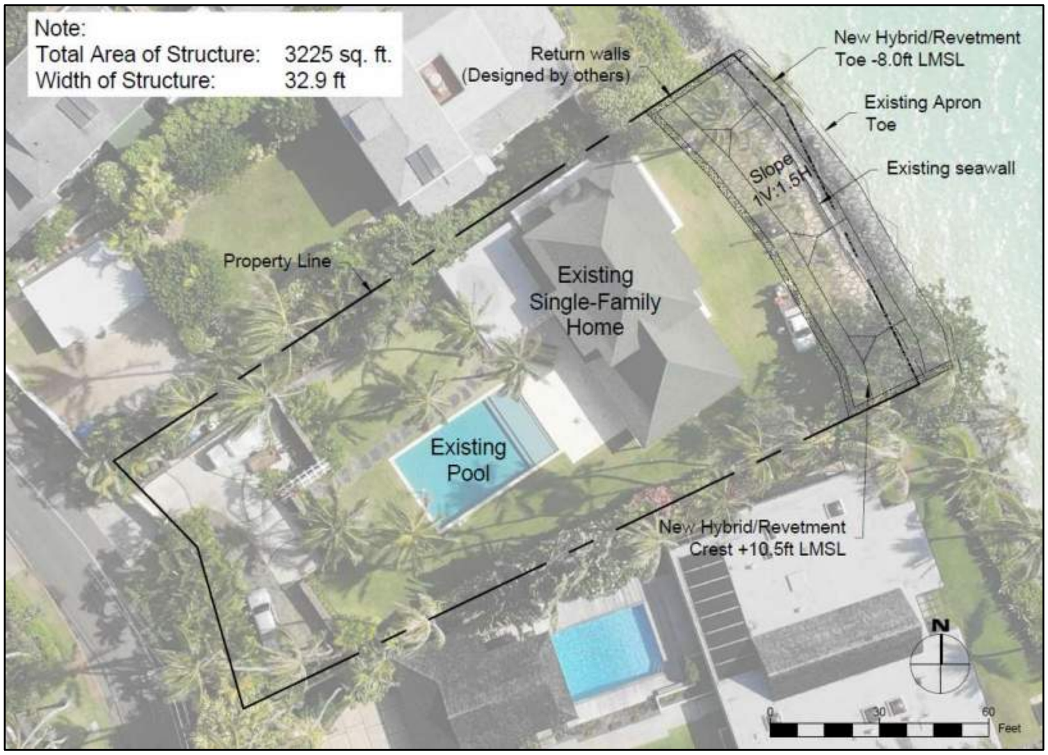

Figure 6-10 Conceptual plan view for hybrid seawall-revetment seaward of the shoreline

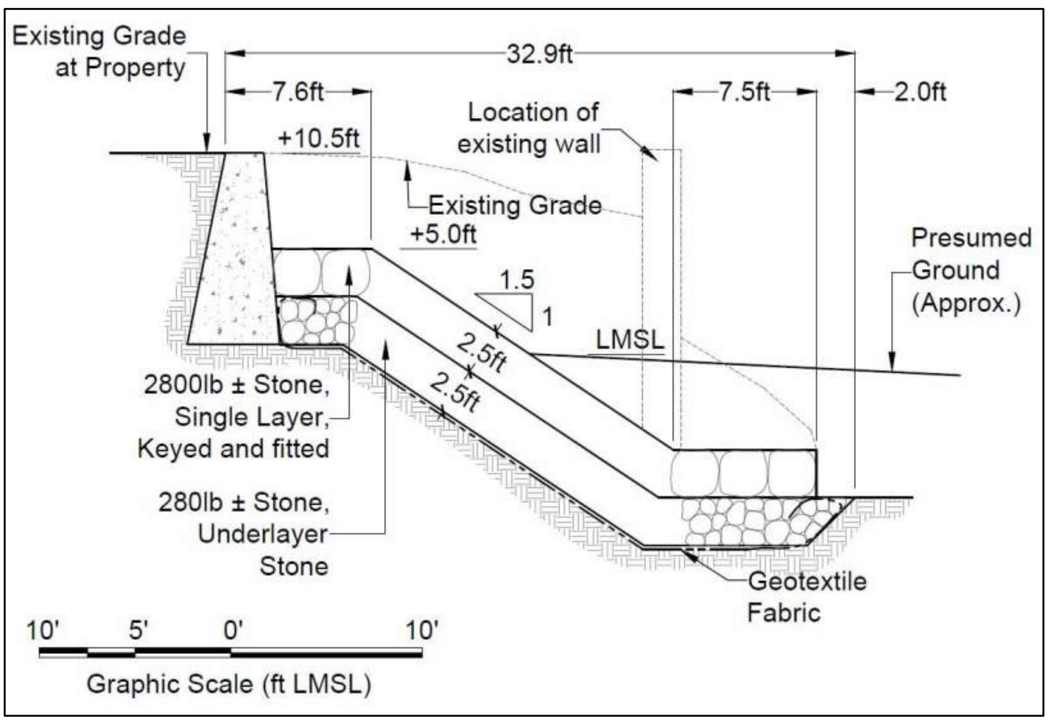

Figure 6-11 Conceptual section view for hybrid seawall-revetment seaward of the shoreline

6.7 Seawall Removal

The seawall removal alternative would involve removing the existing seawall and rock apron and allowing the shoreline to migrate naturally. As sea levels continue to rise, this would likely result in significant erosion, flooding, and permanent loss of land. The seawall is over half a century old and is in a deteriorated condition. The seawall is covered by an easement that confers unto the Grantee the "right, privilege, and authority to use, maintain, repair, replace and remove the existing seawall". The easement also requires that the Grantee "shall keep the easement area and the improvements thereon in a safe condition". Repairs are necessary in order to maintain the seawall in a safe condition and prevent it from being "substantially or completed destroyed", which would result in termination of the easement. If the seawall is not repaired and continues to deteriorate to a point that it is no longer serviceable, the structure may eventually fail, or removal may be required.

<u>Advantages</u>

+ None.

<u>Disadvantages</u>

- Does not address damage and structural deficiencies of the existing seawall.
- Does not provide long-term protection for the property and existing single-family home.
- High costs for demolition and removal.
- Potential environmental impacts during the demolition and removal process.
- Could potentially damage or destabilize adjacent shore protection structures.

The seawall protects the project site and the adjacent properties from erosion and wave overtopping. If the seawall were to be removed, the terrestrial area would be exposed to erosion, wave overtopping and flooding would occur more frequently, and property damage would be expected. Demolition and removal of the seawall would require extensive excavation, which would disturb a large volume of the existing soil in the terrestrial area making it more unconsolidated and prone to erosion. While erosion of the terrestrial sediment may result in a temporary increase in beach width, the eroded material would be unstable and would be expected to mobilize and spread throughout the littoral system during normal seasonal beach processes.

Seawall removal would not achieve the project objectives and would expose the project site and adjacent properties to increased hazard risk. The seawall is in a serviceable condition and repairs are feasible. Seawall removal is therefore not the preferred alternative.

6.8 Seawall Replacement

A seawall is a vertical or sloping concrete, concrete rubble masonry (CRM), cement masonry unit (CMU), or sheet pile wall used to protect the land from wave damage and erosion. A seawall, if properly designed and constructed, is a proven, durable, and relatively low-maintenance shore protection method. Seawalls also have the advantage of having a relatively small footprint along the shoreline.

Seawalls are not flexible structures, and their structural stability is dependent on the design and strength of their foundations. If the foundation of a seawall is breached, hydraulic action can erode the retained sediment inshore of the wall. With the loss of enough retained sediment, the ground surface behind the seawall will collapse and sinkholes will form. Sinkholes can compromise the structural integrity of a seawall and may result in failure of the structure. To avoid foundation problems, the seawall foundation should be well below the potential scour depth, which can require extensive excavation.

The impervious and vertical face of a seawall results in very little wave energy dissipation. Incident wave energy is deflected upward, downward, and seaward. Reflected wave energy can inhibit accretion of sand seaward of the wall. The downward energy component can cause scour at the base of the wall. Therefore, the foundation of a seawall is critical for its stability, particularly on sandy and eroding shorelines. Ideally, seawalls are constructed on hard, non-erodible substrate.

A new wall can be designed and constructed to provide adequate bearing, overturning, and sliding resistance with a spread footing set at a depth below design scour level. In addition to providing adequate wall resistance against design forces, the advantage of this option is that it will be designed to account for the risk of scour and undermining. A conceptual plan for a new seawall is shown in Figure 6-12.

<u>Advantages</u>

+ Designed to meet current structural code requirements.
+ Provides long term protection against erosion and flooding.
+ Provides more options to improve the seawall (e.g., appearance, size, ocean access).

<u>Disadvantages</u>

- Construction costs would be significantly higher than the repair option.
- Construction duration would be significantly longer than the repair option.
- Excavation to the depth required for scour resistance would be difficult and costly.
- Requires demolition and removal of the existing seawall and rock apron.
- Agency and public opposition to construction of new shore protection structures.

Seawall replacement is an appropriate engineering solution for the project site and would achieve the project objective to provide long-term protection for the property and existing single-family home. However, due to the high costs for demolition and removal of the existing seawall, and regulatory restrictions on construction of new shore protection structures, seawall replacement may not be a feasible option.

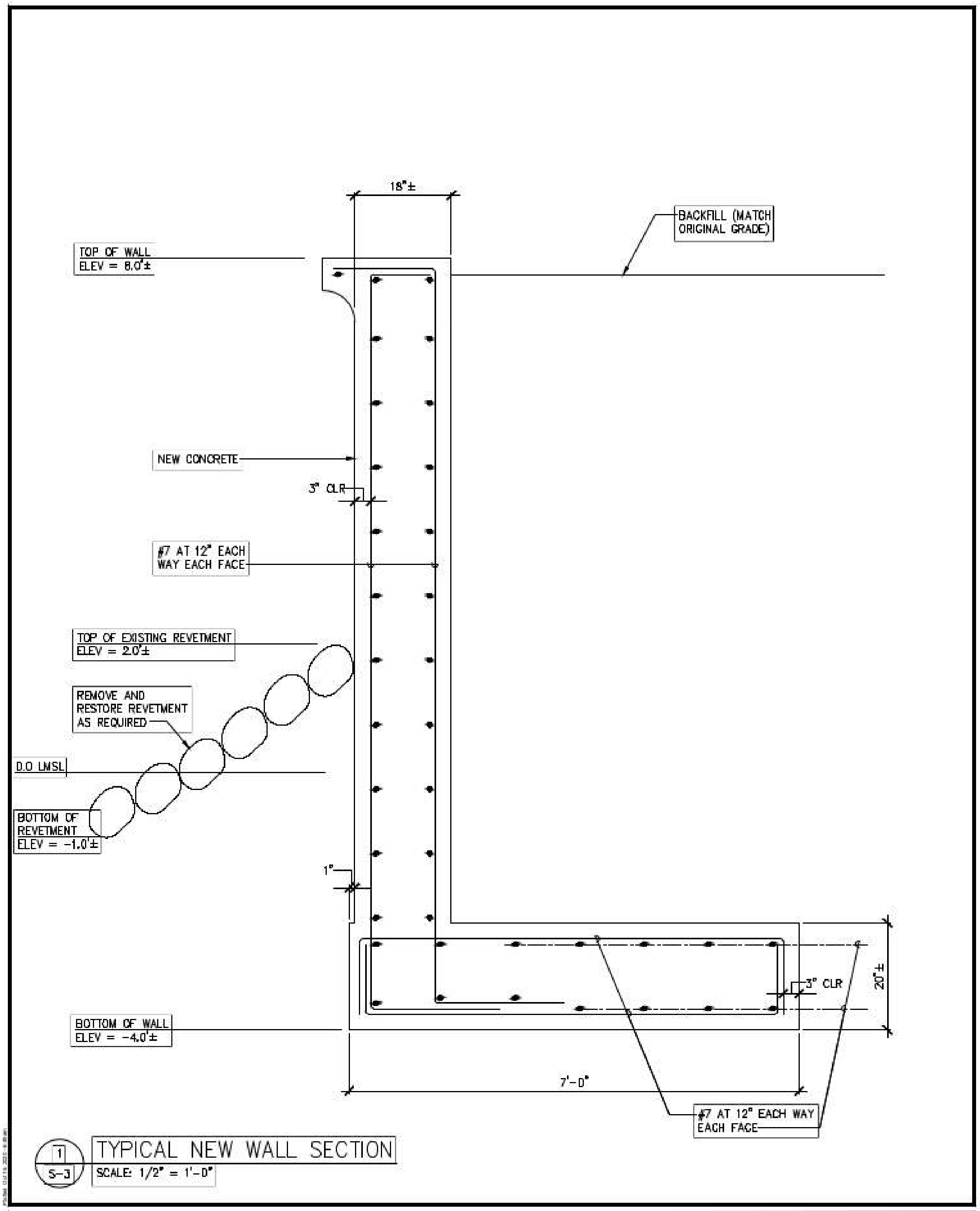

Figure 6-12 Conceptual design for seawall replacement (MKE)

6.9 Seawall Repair

The existing seawall exhibits a variety of damage and structural deficiencies including settlement, outward rotation, cracking, undermining, and sinkholes. The most critical structural deficiency is the shallow depth of the existing foundation, which makes the wall vulnerable to scour and undermining. To address these issues, the seawall should be repaired or replaced. A conceptual plan for the seawall repair option is shown in Figure 6-13.

Seawall repair could be accomplished by driving sheetpile along the existing seawall. The sheetpile would be driven to hard substrate, thereby preventing any future scour and undermining. as well as providing adequate bearing, overturning, and sliding resistance. One option would be to install a steel sheetpile cutoff wall and associated tieback system seaward of the existing wall. This option would require filling existing voids beneath the seawall foundation to to support the wall.

An alternative would be to install sheetpile on the landward side of the existing seawall. The existing seawall and the sheetpile wall would be structurally connected by construction of a concrete width extension and sheetpile cap dowelled to the existing wall. This would mitigate additional settling and rotation should undermining of the wall continue. The landward sheetpile option is anticipated to be significantly more expensive than placing the sheetpile seaward of the wall due to the addition of the dowelled concrete cap and increased sizes for the sheetpile and tieback system to accommodate the added load demands from the existing wall.

<u>Advantages</u>

+ Improves structural integrity without having to construct a new seawall.
+ Avoids costs for demolition and removal of the existing seawall and rock apron.
+ May extend the life of the structure for an undetermined amount of time.
+ Would have the least impact on the appearance of the shoreline.
+ Concrete cap would provide additional protection from sea level rise.
+ Construction costs would be significantly lower than the seawall replacement option.
+ Construction would be significantly faster than the seawall replacement option.
+ No substantial impacts on existing lateral shoreline access or coastal processes.
+ No substantial impacts on existing viewplanes to or along the shoreline

<u>Disadvantages</u>

– Requires demolition and removal of the existing concrete counterforts.
– More expensive than installing sheetpile seaward of the existing seawall.

The seawall repair option would retain the existing rock apron. An advantage of using a rock apron in a coastal environment is its capacity to disperse wave energy. This wave dispersion characteristic significantly reduces reflected wave energy while also preventing the downward motion of reflected wave energy that results in scour of the natural sediment. By dispersing wave energy as it impacts the shoreline, these installations improve the longevity of the backing structure and assist in protecting the backshore when paired with a seawall.

In a study of shoreline structures in Lanikai and their relationship to coastal conditions, Lipp (1995) showed that measured beach profiles in Lanikai were of similar slope fronting beaches and dissipative seawalls (i.e., seawalls with rubblemound/scour aprons). Maintining the existing rock apron will help to reduce scour with a significant reduction in reflected wave energy. This reduction in wave energy at the face of the seawall is expected to steepen the beach profile and allow sand to build up makai of the structure when there is available material. Lipp (1995) documented this effect in Lanikai and it has been corroborated with empirical evidence from the region.

Repairing the seawall is the most cost-effective option as it would require less excavation and would eliminate the costs to demolish and remove the existing seawall. The work is also less invasive and minimizes potential environmental impacts. A sheetpile wall landward of the existing seawall would provide adequate resistance to design lateral forces and overturning moments produced by the retained soil and may extend the life of the structure for an undetermined amount of time. Seawall repair is therefore the preferred alternative.

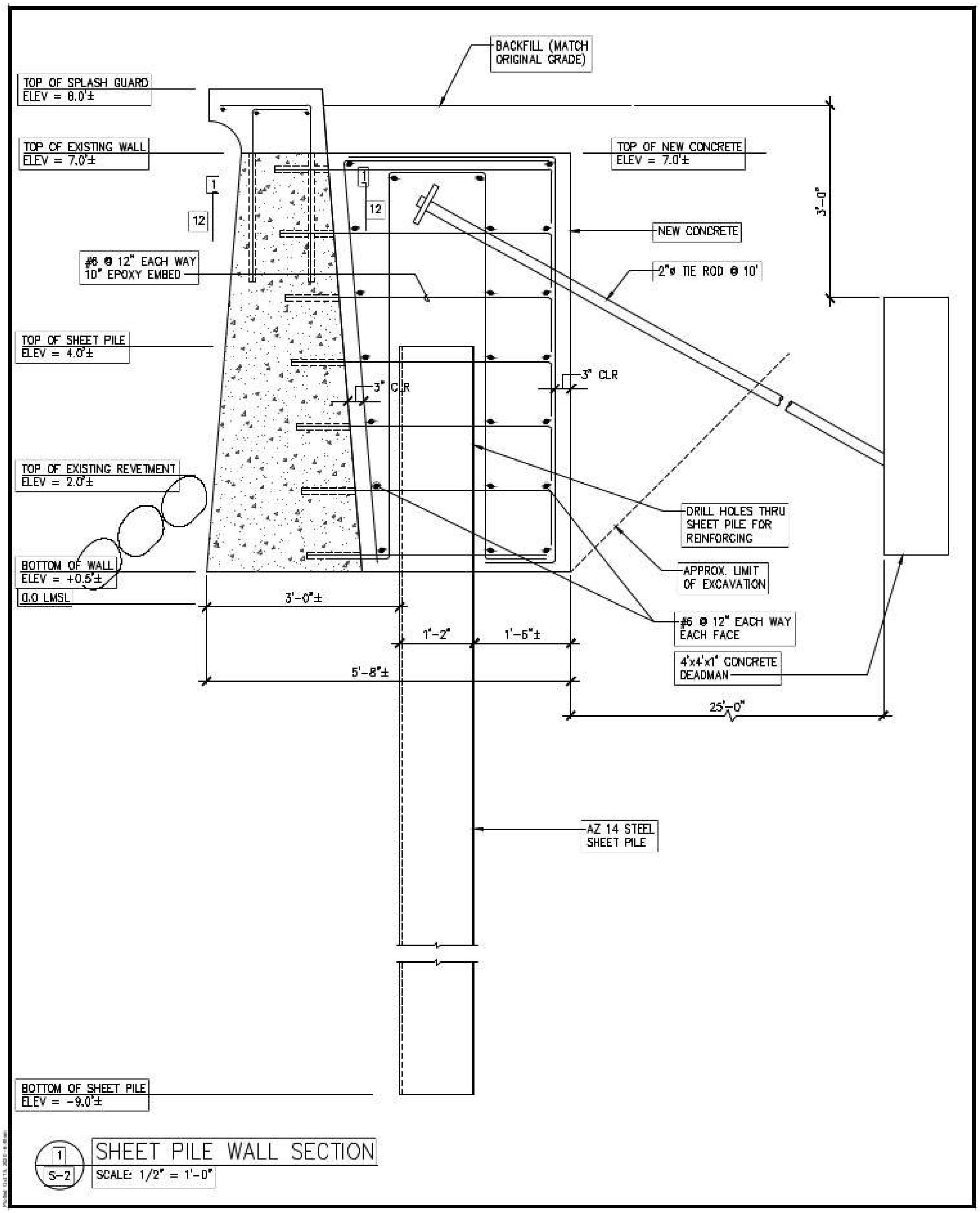

Figure 6-13 Conceptual plan for seawall repair (MKE)

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Appendix G

Marine Research Consultants, Inc. Baseline Assessment of the Marine Environment 1226 Mokulua Drive, Kreuger Seawall Kailua, Oahu, Hawaii, (September 2020)

BASELINE ASSESSMENT OF THE MARINE ENVIRONMENT
1226 MOKULUA DR, KRUEGER SEAWALL
KAILUA, OAHU, HAWAII

Prepared for:

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September 6, 2020

I. INTRODUCTION AND PURPOSE

The Krueger Lanikai property at 1226 Mokulua Dr., Kailua, Oahu, is fronted by a 90 foot-long, 6 to 8-foot-high seawall constructed of unreinforced concrete. The seawall is fronted by a rock apron that is approximately 4 feet high, 10 feet wide, and runs along the length of the seawall. The rock apron is composed of basaltic boulders 9 to 18 inches in diameter (Figure 1).

A structural assessment of the condition of the seawall was conducted by MKE Associates LLC under subcontract to Sea Engineering, Inc. This survey identified various forms of damage including gaps between the subject seawall and the south adjacent wall, settlement along the southern portion of the wall, and outward rotation of the wall. Evidence of previous repairs include concrete work at several panel joints as well as infill of the sinkholes with concrete and boulders.

Sea Engineering, Inc., presented two options to address the failing seawall. The first option entailed repair of the existing seawall; the second option included replacement of the existing seawall. SEI has recommended repair as the preferred alternative as it is the least expensive, is the least invasive with minimal potential for environmental impacts, and is the most feasible from a regulatory perspective.

Proposed seawall repair procedures will include:

- Driving a sheet pile along the existing seawall.
- Installing a steel sheet pile cutoff wall and associated tieback system seaward of the existing wall.
- Filling existing voids beneath the seawall foundation to support the wall.
- Reworking the rock apron armor stone to achieve a uniform structure with appropriate layering.
- Installing geotextile fabric to mitigate backshore erosion.

This report, intended to support the 401 Water Quality Certification (WQC) application, provides results of field assessments of the physical/chemical and biological composition of nearshore waters encompassing the areas that may be affected by the retrofits of the Krueger Seawall.

Figure 1. Krueger Lanikai Seawall, 1226 Mokulua Dr., Kailua, Oahu.

II. WATER QUALITY

A. Methods

The purpose of the assessment is to provide a quantitative depiction of the existing condition of marine water chemistry in the area that has the potential to be affected by the proposed seawall retrofit project. Evaluation of the existing condition of the water chemistry provides an insight into the physical and chemical factors that influence the marine setting. Understanding the existing physical and chemical conditions of the marine environment provides a basis for predicting the potential affects that might occur as a result of the proposed project.

Water chemistry field collection was conducted on May 15, 2020. Water chemistry was assessed by collecting three linear sets of samples (i.e. transects) extending perpendicular to the shoreline from the highest wash of waves to approximately 50 m offshore. All samples were collected by investigators swimming from shore. Transect 1 was located off the southeast end of the property line, Transect 2 extended from the center of the property, and Transect 3 was located off the northwest end of the property line (Figure 2).

Water samples were collected at six locations along each transect. The first sample was collected as close to the shoreline as possible; samples were then collected at 1, 5, 10, 20, and 50 meters (m) from the shoreline. Such a sampling scheme is designed to span the greatest range of salinity with respect to potential freshwater efflux at the shoreline. Sampling was more concentrated in the nearshore zone because this area is closest to the region where seawall work will be performed, and hence is most important with respect to identifying the effects of shoreline modification. At sampling stations within 10 m of the shoreline, water samples were collected at the mid-point of the water column. Beyond 10 m from the shoreline, two samples were collected at each station: a surface sample was collected within 10 centimeters (cm) of the air-water interface, and a bottom sample was collected within 20 cm of the seafloor.

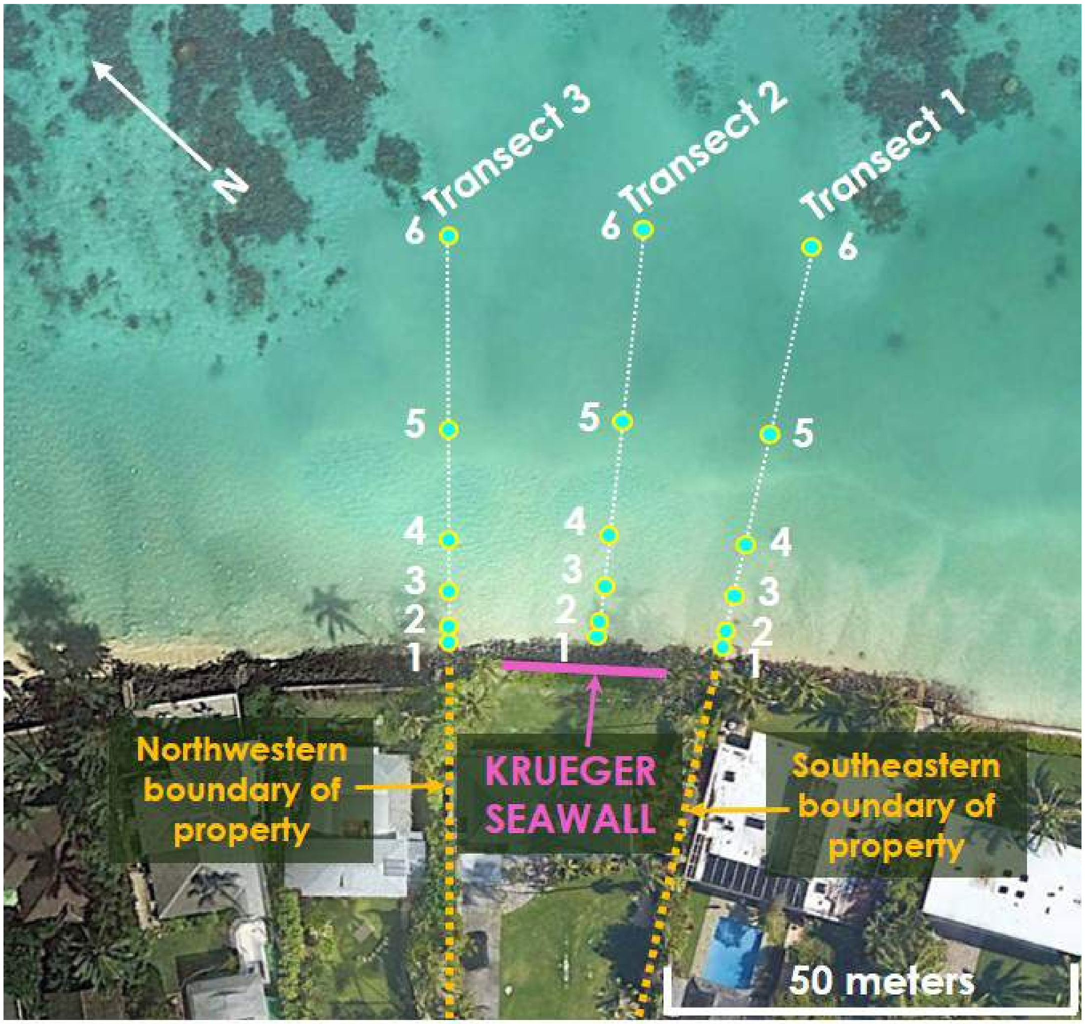


Figure 2. Aerial photograph of section of Lanikai shoreline showing location of the Krueger Seawall at 1226 Mokulua Dr., Kailua, Oahu. Also shown are locations of water sampling stations along three transects that extend from the shoreline to approximately 50 m offshore.

Water quality constituents evaluated included all specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (b) (Open Coastal waters) of the State of Hawaii Department of Health Water Quality Standards (DOH-WQS). These criteria include: total nitrogen (TN), nitrate + nitrite nitrogen (NO_3^- + NO_2^-, hereafter referred to as NO_3^-), ammonium nitrogen (NH_4^+), total phosphorus (TP), Chlorophyll a (Chl *a*), turbidity, temperature, pH, and salinity. In addition, dissolved silicate (Si) and orthophosphate phosphorus (PO_4^{-3}) were reported because these constituents are sensitive indicators of biological activity and the degree of groundwater mixing.

Analyses for Si, NH_4^+, PO_4^{3-}, and NO_3^- were performed with a Seal Analytical AutoAnalyzer 3 HR (AA3HR) using standard methods for seawater analysis. TN and TP were analyzed in a similar fashion following digestion. Total organic nitrogen (TON) and total organic phosphorus (TOP) were calculated as the difference between TN and dissolved inorganic N and TP and dissolved inorganic P, respectively.

Water for other analyses was kept chilled until analysis. Chl *a* was measured by filtering 150 ml through GFF/F glass-fiber filters; pigments on filters were extracted in 90% acetone in the dark at -20 °C for 24 hours. Fluorescence of the extract was measured with a Turner Designs Trilogy Fluorometer model 7200-000 equipped with an extracted chlorophyll non-acidification module. Salinity was determined using a Mettler Toledo Seven Excellence Multi-parameter meter with an InLab 731-ISM conductivity probe, calibrated to a Hach Instruments traceable salinity standard of 35.00 ppt, 53.0 mS/cm, with a readability of 0.01 parts per thousand (‰ or ppt). Turbidity was determined using a Hanna Instruments Model #HI88703 Turbidimeter and reported in nephelometric turbidity units (NTU) (precision of 0.01 NTU). *In situ* measurements of salinity, temperature, and depth were acquired using an RBR-Concerto CTD calibrated to factory standards.

EPA and Standard Methods (SM) methods that were employed for chemical analyses, as well as detection limits, are listed in the Code of Federal Regulations (CRF) Title 40, Chapter 1, Part 136, are as follows:

NH_4^+: EPA 350.1, Rev. 2.0 or SM4500-NH3 G, detection limit 0.48 µg/L.
NO_3^- + NO_2^-: EPA 353.2, Rev. 2.0 or SM4500-NO3F, detection limit 0.084 µg/L
PO_4^{-3}: EPA 365.5 or SM4500-P F, detection limit 0.28 µg/L.
Total P: EPA 365.1, Rev. 2.0 or SM4500-P E J, detection limit 0.93 µg/L.
Total N: SM 4500-N C., detection limit 1.96 µg/L.
Si: EPA 370.1 or SM 4500 SiO2 E, detection limit 0.45 µg/L.
Chlorophyll *a*: SM 10200, detection limit 0.006 µg/L.
pH: EPA 150.1 or SM4500H+B, detection limit 0.002 pH units
Turbidity: EPA 180.1, Rev. 2.0 or SM2130 B, detection limit 0.008 NTU.
Temperature: SM 2550 B, detection limit 0.01 degrees centigrade.
Salinity: SM 2520, detection limit 0.003 ppt.
Dissolved Oxygen: SM4500 O G, and detection limit 0.01% sat.

All fieldwork was conducted by Dr. Steven Dollar and Ms. Andrea Millan. All laboratory analyses were conducted by Marine Consulting and Analytical Resources, LLC, located in Honolulu, Hawaii.

B. Results

1. Distribution of Chemical Constituents

The base of the Krueger Seawall consists of boulders that are submerged at high tide and exposed at low tide. Extending from the seawall approximately 50 m offshore to the outer boundary of the study area the seafloor consists of medium-grained sand. In the outer regions of the study area, patches of coral rubble were interspersed in the sand. Water depth at the outer boundary of the survey area was approximately 1.5 m.

Tables 1 and 2 show results of all water chemistry analyses on samples collected off the Krueger Seawall on May 15, 2020. Concentrations of eight dissolved nutrient constituents are plotted as functions of distance from the shoreline in Figure 3. Values of salinity, Chl *a*, turbidity, pH, temperature, and dissolved oxygen are plotted as functions of distance from the shoreline in Figure 4.

Elevated values of several nutrient constituents at the shoreline that decrease with distance from shore were evident on all three transects. The most pronounced horizontal gradients were for Si, which show elevated values at the shoreline and at 5 m from the shoreline, with a small decrease in the sample 1 m from shore. Salinity reflects this pattern with lowest salinity at the locations with highest Si (Figure 3). Plots of PO_4^{3-}, NO_3^{-} and NH_4^{+} also show the decrease at 1 m from the shoreline. The pattern of elevated nutrients and lower salinity near the shoreline is indicative of freshwater entering the ocean at the shoreline. Of interest is that the values of nutrients at 1 m are lower that at 5 m and the values of salinity are higher at 1 m and lower at 5 m. This suggests that there may be two points of freshwater entry into the nearshore zone.

From the shoreline to 20 m offshore, PO_4^{3-} and NO_3^{-} showed a slight gradient of decreasing concentration in Transects 1 and 3. This trend was not present in Transect 2. TN and TON were slightly elevated in the shoreline samples (most pronounced in Transect 1) and showed consistent concentrations at the other five locations. NH_4^+ was elevated in the samples within 10 m of the shoreline before reaching consistent concentrations at 20 m and 50 m from the shoreline. TOP and TP showed no consistent concentration gradient with distance from shore.

Chl *a*, turbidity, temperature, dissolved oxygen, and pH all display similar patterns, with peak values at the shoreline, and decreasing values with distance seaward (Figure 4). At the shoreline, the values of all of these constituents were slightly lower at Transect 1, located at the eastern boundary of the Krueger property.

2. Compliance with DOH-WQS Criteria

State of Hawaii Department of Health Water Quality Standards (DOH-WQS) that apply to the area offshore of the Kreuger property are listed as "open coastal water" in HRS Chapter §11-54-6(b). Two sets of standards are listed depending on whether an area receives more than 3 million gallons per day (mgd) of freshwater input per shoreline mile ("wet standards"), or less than 3 mgd of freshwater input per shoreline mile ("dry"). As the study area off the northeast coast of Oahu likely receives less than 3 mgd per mile in May, dry criteria were used for this evaluation.

The DOH-WQS are also separated into three standards: 1) geometric means, 2) "not to exceed (NTE) more than 10% of the time," and 3) "NTE more than 2% of the time." As all of these classifications require multiple samplings, they cannot be used for a strict evaluation of whether a single sampling can be used to determine compliance. However, the values from a single sample set can provide a guideline to evaluate the overall status of sampled waters in terms relative to State standards.

Values that exceed the "NTE more than 10% of the time" are shaded blue and values that exceed the "NTE more than 2% of the time" are shaded peach in Tables 1 and 2. The NH_4^+ value from the shoreline sample of Transect 1 was the only nutrient sample to exceed State standards. Concentrations of PO_4^{3-}, NO_3^-, Si, TOP, TON, TP, and TN did not exceed DOH-WQS limits at any of the sampling sites.

The shoreline samples on Transects 2 and 3, as well as the 50 m from the shoreline deep sample of Transect 2, exceeded the DOH 10% limit for Chl *a*. Several values of turbidity near the shoreline of all three transects exceeded the DOH 2% limit and all values exceeded the DOH 10% limit. The elevated turbidity relative to the DOH dry standards is likely a result of resuspension of the sediment by wave forces affecting the entire survey area and surrounding nearshore waters, which is not a typical condition in open coastal habitats in Hawaii.

With the exceptions described above, the area within the scope of the present project is within the specific criteria of the DOH-WQS, with the caveat that this consideration is for a single sample set. As a result, it does not appear that there are any significant inputs of materials from land beyond the immediate shoreline that are impacting coastal ocean waters offshore of the Kreuger Seawall project site.

III. BIOTIC COMMUNITY STRUCTURE

A. Methods

Biotic community structure of the marine environment was semi-quantitatively assessed on May 15, 2020, by investigators swimming throughout the area from the shoreline to approximately 75 m offshore at each of the survey transect sites described in the sections above (Figure 2). During these reconnaissance swims, notes were taken on physical structure and marine species abundance. Numerous photographs were taken of typical features of all habitats to provide a descriptive representation of the area fronting the project site.

B. Results

The base of the seawall consists of rocks and boulders that form a band extending approximately one meter offshore. Two juvenile convict tangs (*Acanthurus triostegus*) were observed in the shallow rocky area along the base of the seawall. The boulders provide habitat for attached marine species including *Cellana* sp. (opihi) and crustose coralline algae (Figure 5). No corals or filamentous algae were observed on the boulders forming the base of the seawall.

The seafloor adjacent to the boulders supporting the seawall consists of a sand surface devoid of any solid surfaces. Further offshore but within 50 m of the shoreline the composition of the seafloor includes patches of rubble partially covered with turf algae (Figure 6). No coral, seagrass, or fish were observed within this region.

The marine habitat beyond approximately 50 m of the seawall consists of a sand bottom interspersed with patch reefs composed of fossil reef structures colonized by living coral colonies (Figure 7). Water depth in this area is approximately 2 m. At low tide, the coral heads extend to the water surface. The most common corals observed were *Montipora capitata*, *Montipora patula,* and *Porites compressa*. Several small colonies of *Porites lobata* were also observed. Many colonies of *P. compressa* were heavily overgrown with macroalgae, primarily *Asparagopsis taxiformis*, and cyanobacteria. An unidentified octocoral was observed growing on dead portions of stony coral (Figure 8). This species resembles *Xenia elongata,* which has not been previously recorded in Hawaii. Of note is that the patch reefs off Lanikai were severely impacted by the global El Nino bleaching events of 2014 and 2015. Hence, much of the coral observed during this survey was likely less than five years old.

The only other macroinvertebrate observed in this area was the black sea cucumber (*Holothuria atra*). No seagrass was observed on the sandy bottom.

The most abundant fish species in the patch reef zone were the convict tang (*Acanthurus triostegus*), yellow tang (*Zebrasoma flavescens*), sailfin tang (*Zebrasoma veliferum*), ringtail surgeonfish (*Acanthurus blochii*), goldring surgeonfish (*Ctenochaetus strigosus*), bluespine unicornfish (*Naso unicornis*), threadfin butterflyfish (*Chaetodon auriga*), bullethead parrotfish (*Chlororus spilurus*), palenose parrotfish (*Scarus psittacus*), saddle wrasse (*Thalassoma duperrey*), and yellowfin goatfish (*Mulloidichthys vanicolensis*).

C. Threatened and Endangered Species

Several species of marine animals that occur in Hawaiian waters have been declared threatened or endangered by Federal jurisdiction. The threatened green sea turtle (*Chelonia mydas*) occurs commonly throughout the Hawaiian Islands and is frequently observed in the nearshore areas of Oahu. The endangered hawksbill turtle (*Eretmochelys imbricata*) is known infrequently in Hawaiian waters.

No sea turtles were observed within the survey area during the present study, although they undoubtedly occur in the area.

Populations of the endangered humpback whale (*Megaptera novaeangliae*) winter in the Hawaiian Islands from December to April. While the present survey was conducted in May when most of the migrating population has left Hawaiian waters, the survey area is not conducive to whale habitation owing to shallow depth and lack of access across the outer reef. The Hawaiian monk seal, (*Monachus schauinslandi*) is an endangered earless seal that is endemic to the waters off the Hawaiian Islands. Monk seals commonly haul out of the water onto sandy beaches to rest. No seals were observed during the present survey work at the Krueger Seawall, although the sand beaches northwest of the property could provide haul-out areas.

IV. DISCUSSION and CONCLUSIONS

The purpose of this assessment is to assemble baseline information to make valid evaluations of the potential for impacts to the marine environment from the proposed repair of the seawall fronting the Krueger property. The information collected in this study provides the basis to understand some of the important processes that are operating in the nearshore ocean in order to address any concerns that might be raised in the planning process for the proposed project.

The physical structure of the intertidal marine habitat adjacent to the seawall is composed of boulders and rocks. Seaward of the rock base, the seafloor consists of a uniform sand bottom. Beyond 50 m of the seawall the sand flat grades into an area of patch reefs.

Analysis of a series of water samples collected along transects that extended from the shoreline of the project site to 50 m offshore indicates that there is a minimal input of groundwater at the shoreline along the seawall. Naturally occurring groundwater contains higher nutrient concentrations than seawater, resulting in elevated concentrations in nearshore samples compared to offshore samples. However, only NH_4^+ from the shoreline sample of Transect 1 exceeded State standards for nutrients. Concentrations of PO_4, NO_3^-, Si, TOP, TON, TP, and TN did not exceed DOH-WQS limits at any of the sampling sites. Two shoreline samples and one offshore sample exceeded the DOH 10% limit for Chl *a*. Several values of turbidity near the shoreline of all three transects exceeded the DOH 2% limit and all values exceeded the DOH 10% limit. The elevated turbidity near the shoreline is likely a result of resuspension of the sediment by wave energy affected the shallow water column. Overall, water quality off the Krueger Seawall site represents typical marine settings in Hawaii with no indication of any contamination from activities on land.

Results of biotic surveys reveal that the boulders forming the base of the seawall do not serve as settling surfaces for corals or seagrass. The only macroinvertebrate that was observed on the boulders were opihi (*Cellana* sp.). The sand flats adjacent to the seawall were also devoid of corals and seagrass. At a distance of approximately 50 m offshore, numerous patch reefs colonized by several species of common Hawaiian corals and algae occur. A host of common Hawaiian reef fish were observed on the patch reefs. Of note is that the patch reefs off Lanikai were severely impacted by the global El Nino bleaching events of 2014 and 2015. Hence, much of the coral observed during this survey had recovered from this stress over the last five years.

Although no sea turtles were observed during the survey, they likely occupy the area at times. The possible small temporary changes to water quality that might occur from the seawall repair process should not be of a magnitude to affect turtle behavior, as they are often observed in turbid waters. However, during construction operations, observers should be in place to spot any turtles that might enter the work area. If turtles are observed in the active construction area, a mitigation plan should be implemented to stop work until turtles leave the area.

Based on the results of this survey, it can be concluded that with proper management and mitigation practices, the proposed seawall repairs should have little or no potential for significant effects to the existing marine environment.

TABLE 1. Results of analysis of water chemistry samples collected May 15, 2020, off the Krueger Seawall project site. Nutrient concentrations are shown in micromolar (µM) units. Abbreviations as follows: S=surface; D=deep; DFS=distance from shore. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed (NTE) more than 10% of the time" and "NTE more than 2% of the time" water quality standards for open coastal waters under "dry" conditions. Peach shaded values exceed DOH 10% standards. Blue shaded values exceed DOH 2% standards. For transect site locations, see Figure 2.

TRANSECT	NUMBER	DEPTH	DFS (m)	PO_4^{3-} (µM)	NO_3^- (µM)	NH_4^+ (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	Salt (ppt)	Chl *a* (µg/l)	TURB (NTU)	TEMP (°C)	pH (rel)	O2 %sat
1	1	S	0	0.05	0.31	1.15	7.13	0.24	10.23	0.30	11.69	34.47	0.49	0.86	27.74	8.072	99.230
	2	S	1	0.06	0.24	0.13	4.61	0.19	6.51	0.25	6.87	34.58	0.37	1.48	27.70	8.072	98.360
	3	S	5	0.08	0.28	0.32	5.86	0.22	6.27	0.30	6.88	34.54	0.34	0.96	27.65	8.072	99.572
	4	S	10	0.05	0.25	0.19	4.08	0.24	6.67	0.30	7.11	34.69	0.32	0.74	27.44	8.060	96.764
	5	S	20	0.07	0.17	0.10	3.69	0.27	6.40	0.34	6.67	34.80	0.37	0.78	27.45	8.053	94.353
	5	D	20	0.06	0.11	0.10	2.48	0.25	6.46	0.31	6.66	34.76	0.38	0.83	27.42	8.047	93.580
	6	S	50	0.04	0.19	0.09	2.30	0.24	6.52	0.27	6.80	34.80	0.31	0.77	27.37	8.033	93.886
	6	D	50	0.05	0.23	0.22	2.88	0.30	6.89	0.34	7.34	34.80	0.33	0.67	27.38	8.036	93.918
2	1	S	0	0.10	0.22	0.35	8.07	0.25	6.81	0.35	7.38	34.40	0.61	1.99	27.88	8.086	101.158
	2	S	1	0.05	0.19	0.07	4.96	0.26	6.28	0.31	6.55	34.58	0.40	1.84	27.85	8.074	102.689
	3	S	5	0.07	0.28	0.34	6.25	0.21	6.73	0.28	7.35	34.58	0.38	1.16	27.82	8.078	102.601
	4	S	10	0.08	0.19	0.32	4.12	0.25	6.76	0.32	7.27	34.72	0.31	0.95	27.61	8.072	99.237
	5	S	20	0.04	0.20	0.10	4.23	0.25	6.79	0.29	7.08	34.72	0.32	0.64	27.66	8.064	97.251
	5	D	20	0.05	0.20	0.12	5.64	0.21	6.69	0.27	7.01	34.68	0.39	0.67	27.50	8.060	96.276
	6	S	50	0.08	0.24	0.08	3.18	0.25	7.12	0.33	7.43	34.80	0.30	0.77	27.45	8.042	94.097
	6	D	50	0.04	0.20	0.15	2.38	0.33	6.90	0.37	7.25	34.83	0.80	2.08	27.45	8.044	93.304
3	1	S	0	0.08	0.51	0.19	6.46	0.29	7.26	0.37	7.95	34.53	0.50	1.54	27.97	8.088	102.012
	2	S	1	0.08	0.27	0.34	4.10	0.23	6.91	0.31	7.52	34.65	0.38	0.53	27.81	8.075	100.732
	3	S	5	0.08	0.29	0.17	4.84	0.29	6.76	0.37	7.21	34.57	0.35	1.25	27.89	8.079	102.650
	4	S	10	0.07	0.25	0.20	4.36	0.29	6.35	0.36	6.80	34.65	0.34	1.11	27.63	8.081	98.516
	5	S	20	0.06	0.07	0.08	3.28	0.23	6.82	0.30	6.97	34.79	0.38	0.62	27.62	8.060	98.505
	5	D	20	0.07	0.13	0.08	2.51	0.19	7.08	0.26	7.29	34.79	0.49	0.89	27.56	8.051	98.087
	6	S	50	0.06	0.06	0.07	2.84	0.17	6.52	0.23	6.65	34.76	0.33	0.69	27.51	8.048	94.678
	6	D	50	0.06	0.11	0.10	2.69	0.21	7.65	0.28	7.87	34.83	0.44	0.86	27.51	8.048	95.656
DOH NTE 10%					0.71	0.36				0.97	12.86	*	0.50	0.50	**	***	****
DOH NTE 2%					1.43	0.64				1.45	17.86		1.00	1.00			

* Salinity shall not vary more than ten percent from natural or seasonal changes condsidering hydrologic input and oceanographic conditions.
** Temperature shall not vary more than 1 °C from "ambient conditions."
*** pH shall not vary more than 0.5 units from a value of 8.1.
**** Dissolved Oxygen not less than 75% saturation.

TABLE 2. Results of analysis of water chemistry samples collected May 15, 2020, off the Krueger Seawall project site. Nutrient concentrations are shown in micrograms per liter (µg/L). Abbreviations as follows: S=surface; D=deep; DFS=distance from shore. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed (NTE) more than 10% of the time" and "NTE more than 2% of the time" water quality standards for open coastal waters under "dry" conditions. Peach shaded values exceed DOH 10% standards. Blue shaded values exceed DOH 2% standards. For transect site locations, see Figure 2.

TRANSECT	NUMBER	DEPTH	DFS (m)	PO_4^{3-} (µg/L)	NO_3^- (µg/L)	NH_4^+ (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	Salt (ppt)	Chl *a* (µg/l)	TURB (NTU)	TEMP (°C)	pH (rel)	O2 %sat
1	1	S	0	1.67	4.33	16.09	199.61	7.58	143.22	9.25	163.63	34.47	0.49	0.86	27.74	8.072	99.230
	2	S	1	1.71	3.30	1.85	129.03	6.01	91.09	7.71	96.24	34.58	0.37	1.48	27.70	8.072	98.360
	3	S	5	2.36	3.96	4.49	163.96	6.88	87.80	9.24	96.25	34.54	0.34	0.96	27.65	8.072	99.572
	4	S	10	1.64	3.55	2.65	114.14	7.53	93.37	9.17	99.57	34.69	0.32	0.74	27.44	8.060	96.764
	5	S	20	2.14	2.41	1.41	103.34	8.32	89.59	10.46	93.41	34.80	0.37	0.78	27.45	8.053	94.353
	5	D	20	1.89	1.53	1.36	69.57	7.62	90.40	9.51	93.28	34.76	0.38	0.83	27.42	8.047	93.580
	6	S	50	1.15	2.70	1.27	64.35	7.30	91.27	8.45	95.24	34.80	0.31	0.77	27.37	8.033	93.886
	6	D	50	1.46	3.28	3.04	80.71	9.21	96.43	10.67	102.75	34.80	0.33	0.67	27.38	8.036	93.918
2	1	S	0	3.01	3.12	4.83	225.85	7.78	95.32	10.79	103.26	34.40	0.61	1.99	27.88	8.086	101.158
	2	S	1	1.43	2.71	0.97	138.85	8.10	87.97	9.53	91.64	34.58	0.40	1.84	27.85	8.074	102.689
	3	S	5	2.08	3.95	4.76	174.86	6.60	94.19	8.68	102.90	34.58	0.38	1.16	27.82	8.078	102.601
	4	S	10	2.36	2.68	4.49	115.43	7.65	94.58	10.01	101.75	34.72	0.31	0.95	27.61	8.072	99.237
	5	S	20	1.15	2.77	1.40	118.53	7.84	94.99	8.99	99.16	34.72	0.32	0.64	27.66	8.064	97.251
	5	D	20	1.67	2.79	1.64	157.86	6.65	93.69	8.32	98.11	34.68	0.39	0.67	27.50	8.060	96.276
	6	S	50	2.39	3.30	1.13	89.15	7.72	99.65	10.11	104.08	34.80	0.30	0.77	27.45	8.042	94.097
	6	D	50	1.18	2.77	2.11	66.59	10.34	96.58	11.51	101.46	34.83	0.80	2.08	27.45	8.044	93.304
3	1	S	0	2.36	7.12	2.60	180.85	9.00	101.62	11.36	111.34	34.53	0.50	1.54	27.97	8.088	102.012
	2	S	1	2.51	3.78	4.72	114.88	7.15	96.71	9.66	105.21	34.65	0.38	0.53	27.81	8.075	100.732
	3	S	5	2.45	4.03	2.31	135.48	9.10	94.65	11.54	101.00	34.57	0.35	1.25	27.89	8.079	102.650
	4	S	10	2.17	3.57	2.76	122.12	9.13	88.85	11.30	95.17	34.65	0.34	1.11	27.63	8.081	98.516
	5	S	20	1.95	1.03	1.08	91.95	7.28	95.46	9.23	97.57	34.79	0.38	0.62	27.62	8.060	98.505
	5	D	20	2.23	1.86	1.16	70.25	5.82	99.10	8.05	102.12	34.79	0.49	0.89	27.56	8.051	98.087
	6	S	50	1.83	0.86	1.04	79.39	5.16	91.23	6.98	93.13	34.76	0.33	0.69	27.51	8.048	94.678
	6	D	50	1.98	1.55	1.46	75.34	6.66	107.16	8.64	110.17	34.83	0.44	0.86	27.51	8.048	95.656
DOH NTE 10%					10.00	5.00				30.00	180.00	*	0.50	0.50	**	***	****
DOH NTE 2%					20.00	9.00				45.00	250.00		1.00	1.00			

* Salinity shall not vary more than ten percent from natural or seasonal changes condsidering hydrologic input and oceanographic conditions.
** Temperature shall not vary more than 1 °C from "ambient conditions."
*** pH shall not vary more than 0.5 units from a value of 8.1.
**** Dissolved Oxygen not less than 75% saturation.

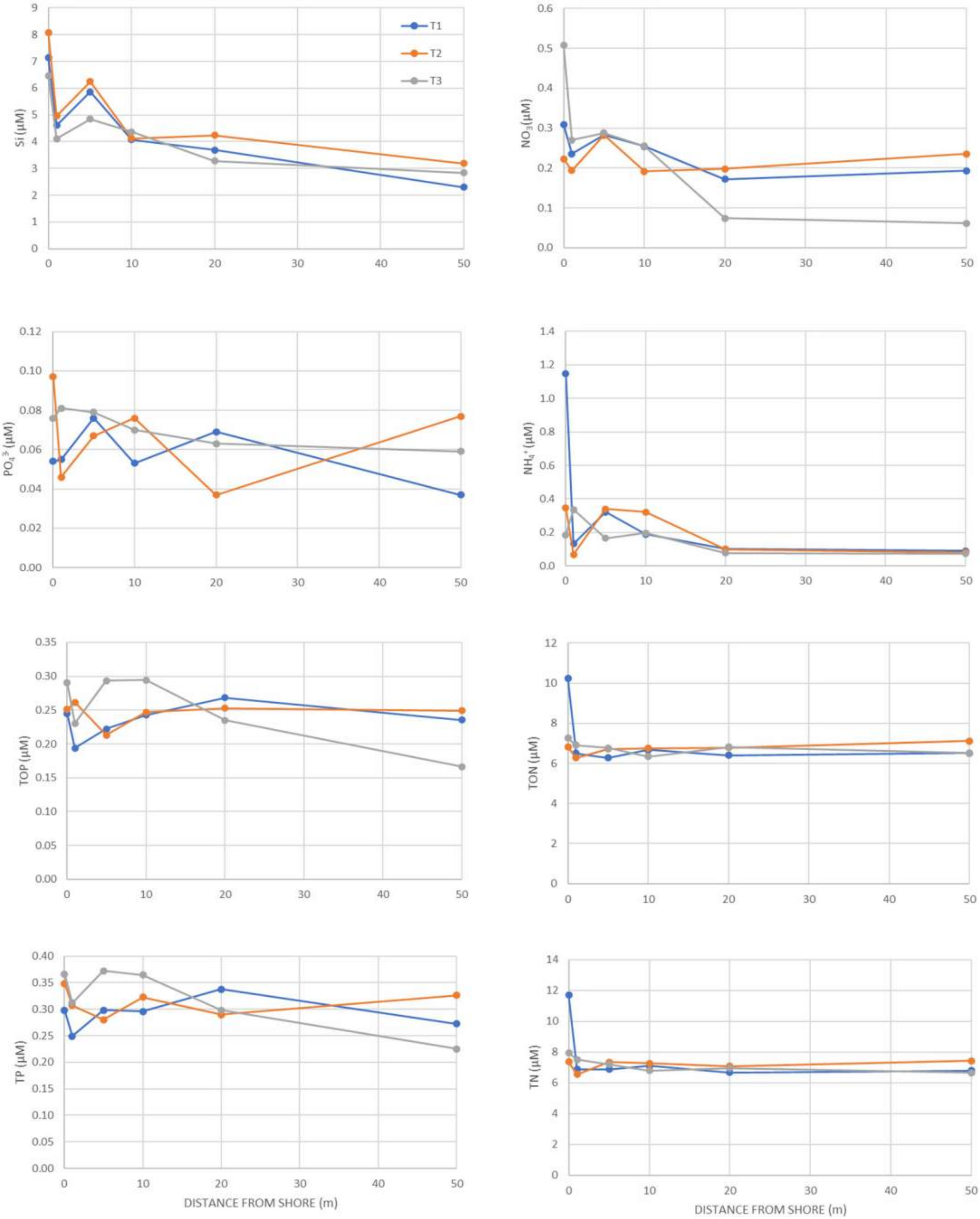


Figure 3. Plots of dissolved nutrients in surface samples collected on May 15, 2020, along three transects that extended from the shoreline to 50 meters from shore fronting the Krueger Seawall at 1226 Mokulua in Kailua, Oahu. For transect locations, see Figure 2.

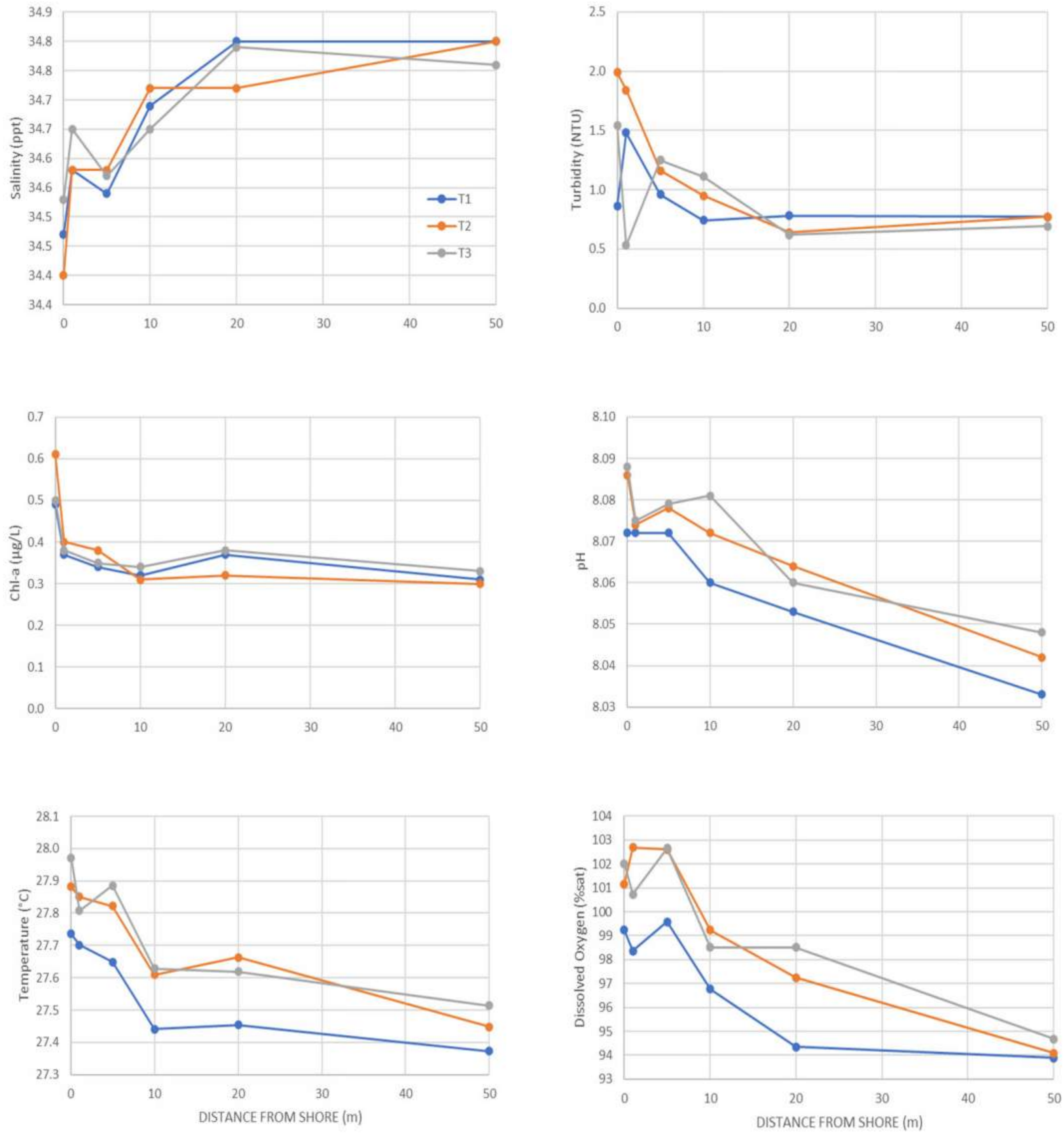


Figure 4. Plots of water quality constituents in surface samples collected on May 15, 2020, along three transects that extended from the shoreline to 50 meters from shore fronting the Krueger Seawall at 1226 Mokulua in Kailua, Oahu. For transect locations, see Figure 2.

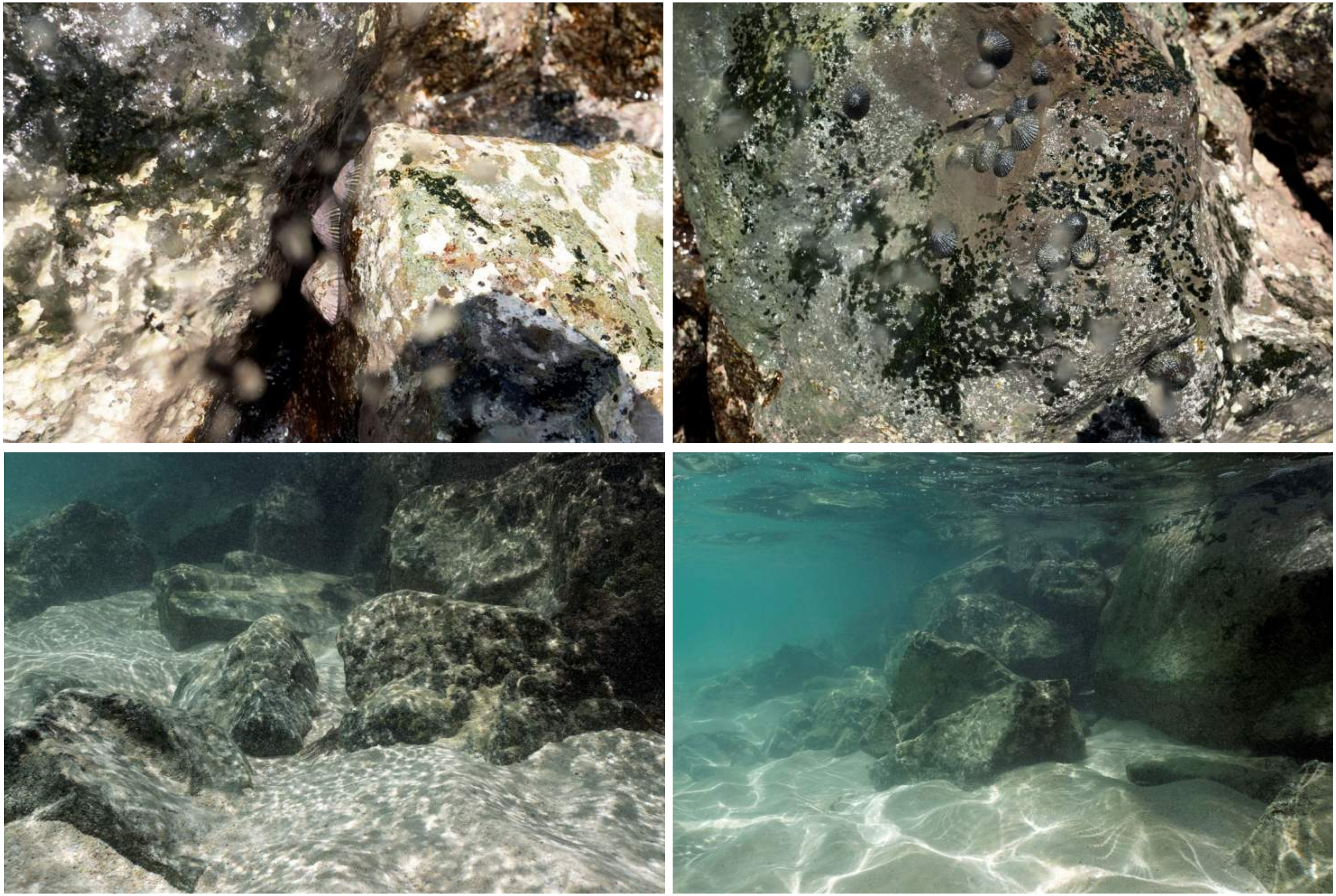


Figure 5. Top photographs show opihi (*Cellana* sp.) inhabiting wave washed boulders and stones supporting the seawall. Bottom photographs show submerged boulders and stones at the base of the seawall.

Figure 6. Top photographs show sandy bottom, which extends from the base of the boulders supporting the seawall to approximately 50 m offshore. Bottom photographs show rubble on sandy bottom offshore of the Krueger Seawall.

Figure 7. Top photographs show reef between 50 and 75 m offshore of the Krueger Seawall. Bottom left photograph shows colony of *Montipora capitata*. Bottom right photograph shows tire colonized by *Montipora patula,* turf algae, and macroalgae.

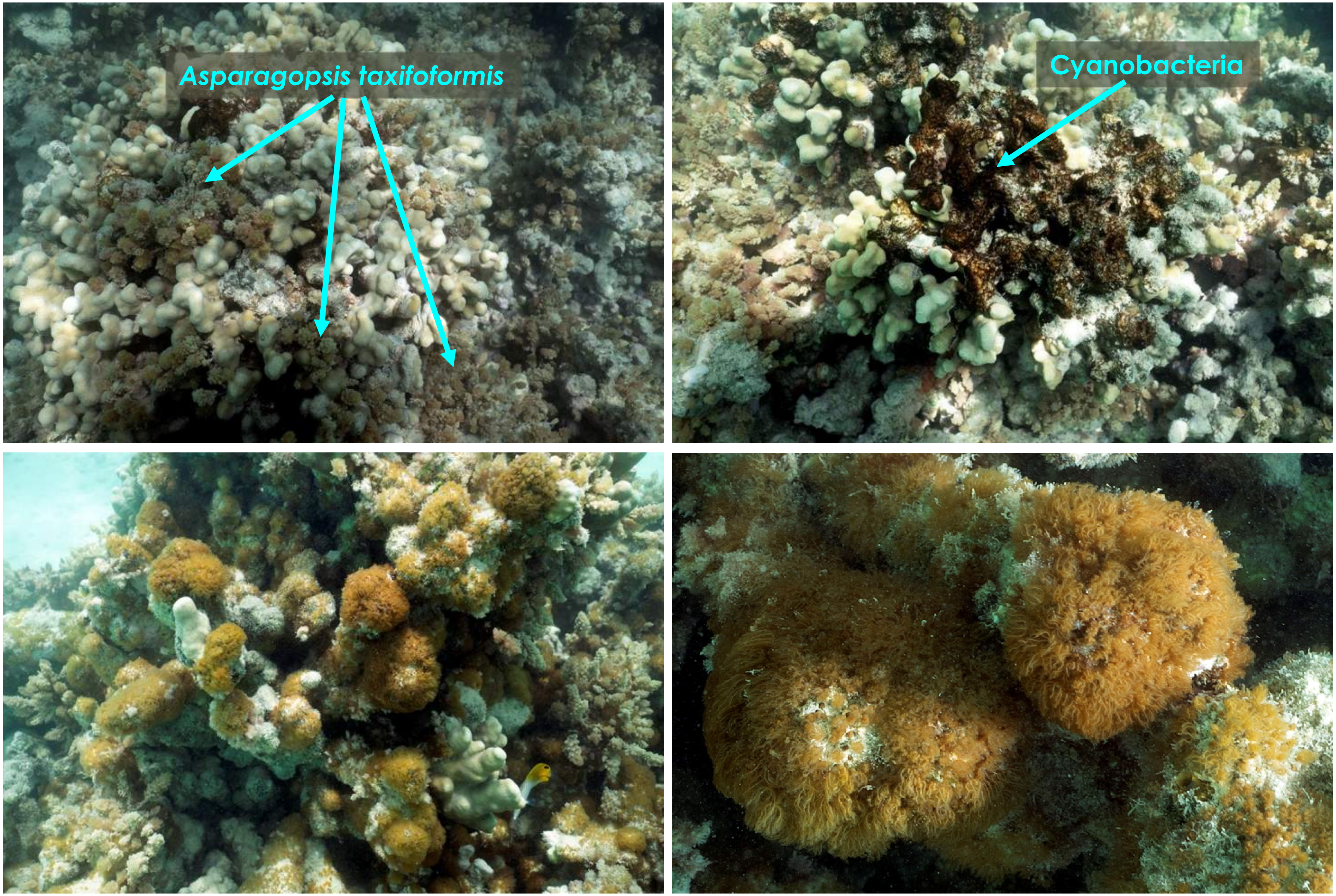


Figure 8. Photographs were collected between 50 and 75 m offshore of the Krueger Seawall. Top images show overgrowth of *Porites compressa* by *Asparagopsis taxiformis* (left) and cyanobacteria (right). Bottom images show overgrowth of reef by unknown organism, possibly *Xenia elongata*.

Appendix H

AECOS Memo
Observations on Nesting Wedged-tailed Shearwaters on a Private Home Site in Lanikai
(September 2020)

DRAFT
Observations on nesting Wedged-tailed Shearwaters on a private home site in Lanikai

Reginald David and Eric Guinther
AECOS Inc.

September 14, 2020

This brief report presents observations and an assessment of Wedge-tailed Shearwater (*ʻuaʻu kani* or *Ardenna pacifica*) nesting behind a seawall at 1226A Mokulua Drive, Lanikai, Oʻahu. This bird constructs burrows in sandy soil behind the shore or in rock crevices. The situation at 1226A Mokulua Drive is typical, actually presently ideal for burrows, because the sandy soil—recently exposed by cutting back of *naupaka kahakai* (*Scaevola sericea*) shrubs—is a low scarp, stabilized by roots of a lawn behind (Figures 1 and 6). However, the seawall is failing and needs to be replaced.

Eric Guinther visited the site on July 31, 2020, responding to a request to confirm and assess impacts of the new seawall preconstruction efforts on at least one occupied nest first observed on July 11 (Jeff Overton, G70, pers. comm.). Although initially reported that three burrows were present, a fourth burrow was apparently constructed sometime in the last week of July, as four were observed on July 31. These were photographed (Figures 2, 3, 4, and 5) and an attempt made to confirm presence, or at least active use, at each burrow. However, no sitting birds could be seen or heard. Evidence surrounding each of the burrow sites indicated each was recently maintained, suggesting all four were recently active nests.

Wedge-tailed Shearwaters are protected under both the federal Migratory Bird Treaty Act (MBTA) and State of Hawaii statutes as a native species. What that protection means in practice, is that neither the birds nor their burrows should be disturbed until their nests fail, are abandoned, or fledge young birds. Wedge-tailed Shearwaters usually fledge after approximately 100 to 115 days of egg laying. So, in this case, fledging ought to occur sometime between late October through the end of November.

No practical way exists to obtain a permit to allow disturbance of the nesting burrows. Given the location of the burrows, the high predator load in a developed area—including cats, dogs, and rats—the chances that the nests will go full term are low.

By now (September 2020), determining if the burrows are still active is relatively straight forward as the eggs should have hatched if they are going to, and the chicks must be fed on a regular basis; the area around and close to active burrows should show a lot of footprints, and the smell of any active burrows is distinctive.

Reginald David

Eric Guinther

Figure 1. View of the seawall and exposed strip of sand between lawn and seawall where nesting is occurring, looking west.

Figure 2a and 2b. Burrow No. 1; note bird tracks around entrance to burrow.

Figure 3a and 3b. Burrow No.2. Appears maintained.

Figure 4a and 4b. Burrow No. 3. Tracks visible; appeared after July 11.

Figure 4c. Burrow No.3; note fresh dropping on grass above burrow.

Figure 5 (upper). Burrow No.4. Appeared after July 11.
Figure 6 (lower). Burrow area looking east.

Appendix I

Keala Pono Archaeological Consulting, LLC Archaeological Assessment for the Repair of a Noncomforming Seawall at 1226a Mokulua Drive in Lanikai, Kailua Ahupua‘a, Ko‘olaupoko District, Island of O‘ahu (August 2020)

DRAFT—Archaeological Assessment for the Repair of a Nonconforming Seawall at 1226A Mokulua Drive in Lanikai, Kailua Ahupua‘a, Ko‘olaupoko District, Island of O‘ahu

TMK: (1) 4-3-005:056

Prepared For:

David & Terri Krueger, Landowners

August 2020

Keala Pono Archaeological Consulting, LLC ● PO Box 1645, Kaneohe, HI 96744 ● Phone 808.381.2361

DRAFT—Archaeological Assessment for the Repair of a Nonconforming Seawall at 1226A Mokulua Drive in Lanikai, Kailua Ahupua‘a, Ko‘olaupoko District, Island of O‘ahu

TMK: (1) 4-3-005:056

Prepared For:

David & Terri Krueger, Landowners

Prepared By:

Windy Keala McElroy, PhD
and
Kālenalani McElroy, MA

August 2020

Keala Pono

Keala Pono Archaeological Consulting, LLC ● PO Box 1645, Kaneohe, HI 96744 ● Phone 808.381.2361

MANAGEMENT SUMMARY

An archaeological inventory survey (AIS) was conducted for a beach lot property in Lanikai at 1226a Mokulua Drive, Kailua Ahupuaʻa, Koʻolaupoko District, Oʻahu at TMK: (1) 4-3-005: 056. The survey was done in preparation for ground disturbance associated with repairs to the property's concrete seawall. The archaeological work included a pedestrian survey that covered 100% of the project area, as well as test excavations consisting of three trenches. The property has been disturbed by modern use, and no archaeological remains were found on the surface. Likewise, no subsurface cultural features or deposits were encountered during excavation. No further work is recommended.

CONTENTS

MANAGEMENT SUMMARY ... i

FIGURES ... iv

TABLES ... iv

INTRODUCTION ... 1
- The Project Location and Description ... 1
- The Natural Environment ... 1

BACKGROUND ... 6
- Kailua in the Pre-Contact Era ... 6
  - Inoa ʻĀina: Place Names ... 6
  - Moʻolelo ... 7
  - ʻŌlelo Noʻeau ... 9
  - Ka Makani a me Ka Ua: The Wind and the Rain ... 10
  - Traditional Land Use ... 10
- Kailua in the Historic Era ... 11
  - Early Historical Accounts of Land Use in the Kailua Area ... 12
  - Land Ownership and Māhele Land Tenure ... 12
  - Historic Land Use ... 14
- Previous Archaeology ... 18
- Summary of Background Information ... 23
- Anticipated Findings and Research Questions ... 23

METHODS ... 24

RESULTS ... 25
- Pedestrian Survey ... 25
- Subsurface Testing ... 25
- Summary of Findings ... 25

SUMMARY AND RECOMMENDATIONS ... 32

GLOSSARY ... 33

REFERENCES ... 35

APPENDIX A: LAND COMMISSION AWARDS ... 38

Figures

Figure 1. Project area shown on a topographic map (USGS 2017). 2
Figure 2. Project area (in red) shown on a portion of TMK plat (1) 4-3-005. 3
Figure 3. Soils in the vicinity of the project area. Data from Foote et al. (1972). 4
Figure 4. Portion of an early Kailua map (Wall 1899). 15
Figure 5. Portion of an early Kailua map (King 1900). 16
Figure 6. Portion of a Koʻolaupoko fisheries map (Dunn n.d.). 17
Figure 7. Previous archaeology in the vicinity of the project area. 19
Figure 8. Previously recorded sites in the vicinity of the project area. 20
Figure 9. Excavation of TR 2. Orientation is to the southeast. 24
Figure 10. Location of test units on aerial imagery. 26
Figure 11. Wider view of trench locations on a topographic map (USGS 1998). 27
Figure 12. TR 1 northwest face profile drawing. 29
Figure 13. TR 1 northwest face photo. 29
Figure 14. TR 2 southwest face profile drawing. 30
Figure 15. TR 2 southwest face photo. 30
Figure 16. TR 3 southwest face profile drawing. 31
Figure 17. TR 3 southwest face photo. 31

Tables

Table 1. Previous Archaeology in Lanikai 21
Table 2. Soil Descriptions 28

INTRODUCTION

At the request of homeowners David and Terri Krueger, Keala Pono Archaeological Consulting conducted an archaeological inventory survey (AIS) for seawall repairs in Lanikai, Kailua Ahupuaʻa, Koʻolaupoko District, Oʻahu. Construction will take place on the makai (east) side of TMK: (1) 4-3-005:056 located at 1226a Mokulua Drive. This work was designed to identify, document, assess significance, and provide mitigation recommendations for any historic properties that may be located in the project area in anticipation of the proposed repairs.

This report is drafted to meet the requirements and standards of state historic preservation law, as set out in Chapter 6E of the Hawaiʻi Revised Statutes and the State Historic Preservation Division's (SHPD's) draft *Rules Governing Standards for Archaeological Inventory Surveys and Reports*, Hawaii Administrative Rules (HAR) §13–276. Due to negative findings, the AIS results are presented as an archaeological assessment per HAR §13–275-5(b)(5)(A).

The report begins with a description of the project area and a historical overview of land use, Hawaiian traditions, and archaeology in the area. The next section presents methods used in the fieldwork, followed by results of the survey. Project results are summarized and recommendations are made in the final section. Hawaiian words and technical terms are defined in a glossary at the end of the document.

The Project Location and Description

The project area is located in Kailua on the coast of Lanikai, Koʻolaupoko District, on the island of Oʻahu (Figure 1). The survey consists of 380 m^2 (4,000 ft^2) on the makai (east) side of the beachfront parcel TMK: (1) 4-3-005:056 (Figure 2). The parcel is .17 ha (.42 ac.) and owned by the Krueger Trust. The property is bounded by the ocean on the east, Mokulua Drive on the west, and private lots on the north and south. The existing seawall is constructed from unreinforced concrete and is roughly 24.4 m (90 ft) long, 40.6–43.2 cm (16–17 in) wide at the top, and 1.5–2.1 m (5–7 ft) high amsl. Construction activities for the repair project consists of inserting sheet pile and a dowelled cap along the dilapidated seawall to prevent further erosion and improve its structural integrity. Excavations will extend to approximately 5.2 m (17 ft) below the existing grade.

The Natural Environment

Today's Kailua town proper is situated between the ocean on the east, by Kawainui Marsh and Puʻu O Ehu on the west, by Kaʻelepulu Stream on the south, and by Oneawa Hills, formerly called Mahinui Hills on the north. Lanikai is the section of Kailua between Alāla and Wailea Points on the southeast side of Kailua. About 3,500 years ago when the sea level was higher, this entire area was a submerged barrier reef with a huge sandbar. As the sea levels dropped, sand and alluvial sediments accumulated, forming the flatland foundation for Kailua town, and Kawainui, which no longer open to the ocean, was transformed from a pond into a marsh. Today the coral reef extends approximately a half mile outside of Lanikai, providing a protected sandy beach (Clark 2005:65). Two islands off of Lanikai are the Mokuluas (Moku Nui and Moku ʻIki), which are Hawaiʻi State Seabird Sanctuaries.

Because of the geological history of Kailua, soils of the current project area are classified as Beaches (BS), backed by Jaucas sand (JaC), and the project area lies entirely in Beaches (Foote et al. 1972) (Figure 3). The Beaches soil classification is described as follows:

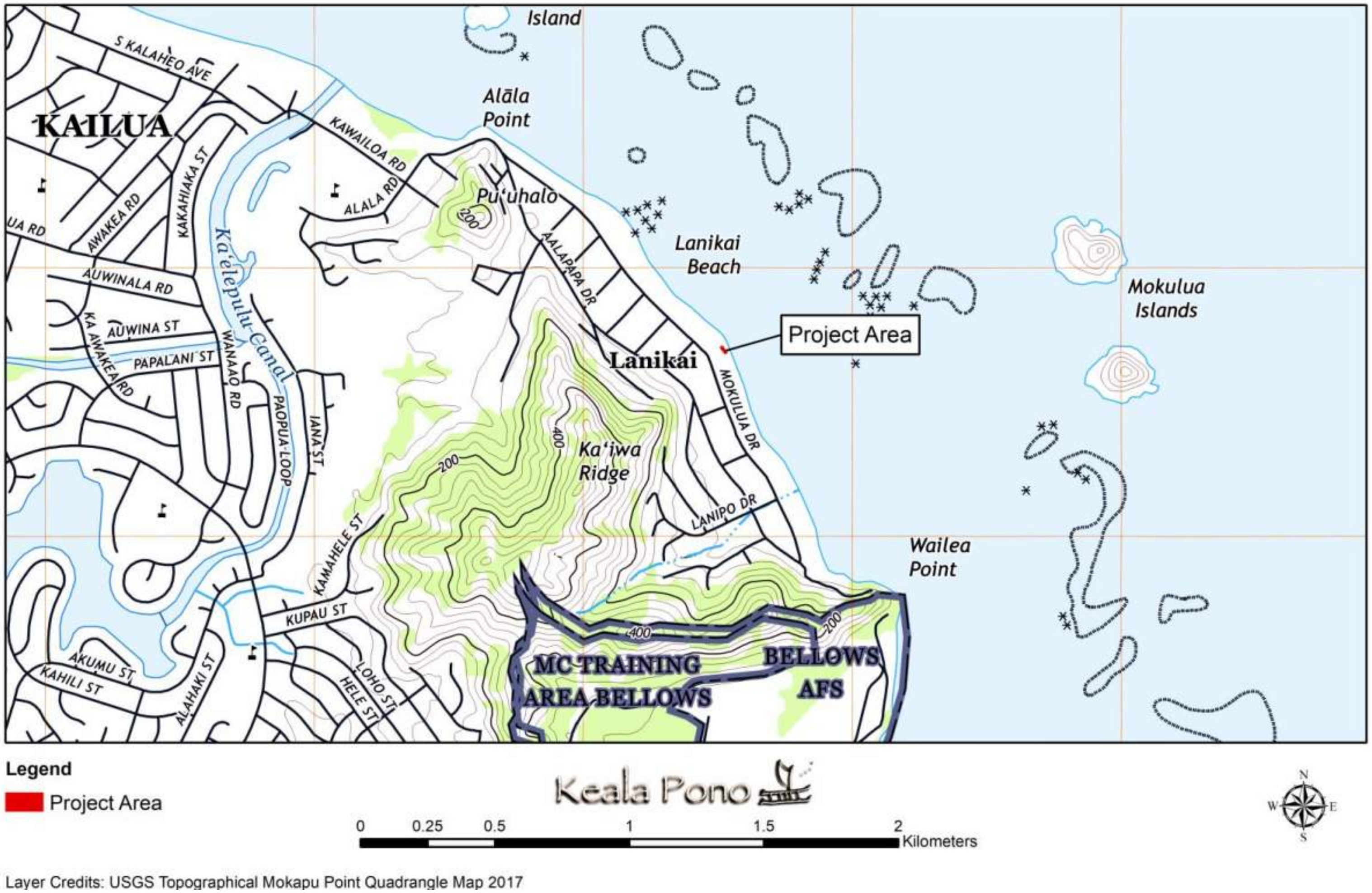


Figure 1. Project area shown on a topographic map (USGS 2017).

Figure 2. Project area (in red) shown on a portion of TMK plat (1) 4-3-005.

Figure 3. Soils in the vicinity of the project area. Data from Foote et al. (1972).

> Beaches (BS) occur as sandy, gravelly, or cobbly areas on all the islands… They are all washed and rewashed by ocean waves. The beaches consist mainly of light-colored sands derived from coral and seashells. A few of the beaches, however, are dark colored because their sands are from basalt and andesite. Beaches have no value for farming. Where accessible and free of cobblestones and stones, they are highly suitable for recreational uses and resort development. (Capability classification VIIIw, nonirrigated). (Foote et al. 1972:28)

Jaucas sands are described as "excessively drained soils that occur as narrow strips on coastal plains, adjacent to the ocean… developed in wind- and water-deposited sand from coral and seashells" (Foote et al. 1972:48). Jaucas sands are found from sea level to an elevation of 30 m (100 ft), and are further described as follows:

> Jaucas sand, 0 to 15 percent slopes (JaC) --- The slope range of this soil is 0 to 15 percent, but in most places the slope does not exceed 7 percent… In a representative profile the soil is single grain, pale brown to very pale brown, sandy, and more than 60 inches deep. In many places the surface layer is dark brown as a result of accumulation of organic matter and alluvium. The soil is neutral to moderately alkaline throughout the profile. Permeability is rapid, and runoff is very slow to slow. The hazard of water erosion is slight, but wind erosion is a severe hazard where vegetation has been removed. The available water capacity is 0.5 to 1.0 inch per foot of soil. In places roots penetrate to a depth of 5 feet or more. Workability is slightly difficult because the soil is loose and lacks stability for use of equipment. (Foote et al. 1972:48)

Topography of the project area is flat, with an approximately 3 m (10 ft) drop to the ocean on the east side. Rainfall in the project area averages 80 cm (31 in) per year (Giambelluca et al. 2013). The closest fresh water source to the project area is Mokulua Stream, a non-perennial watercourse which is approximately 640 m (.4 mi) away to the south.

Background

This section provides an overview of the cultural and historical characteristics of the project area, including moʻolelo, place names, ʻōlelo noʻeau, a discussion of land use through time, historic maps, Māhele land documents, and summaries of previous archaeological studies. Research was conducted at the Hawaiʻi State Library, the University of Hawaiʻi at Mānoa libraries, the SHPD library, and online on the Office of Hawaiian Affairs website and the Waihona Aina, Huapala, and Ulukau databases. Archaeological reports, historic maps, and historical reference books were among the materials examined.

Kailua in the Pre-Contact Era

> Native traditions describe the formation (literally the birth) of the Hawaiian Islands and the presence of life on and around them, in the context of genealogical accounts… As this Hawaiian genealogical account continues, we find that these same god-beings, or creative forces of nature who gave birth to the islands, were also the parents of the first man (Hāloa), and from this ancestor, all Hawaiian people are descended. It was in this context of kinship, that the ancient Hawaiians addressed their environment. (Maly and Maly 2003)

The history of Kailua begins with the history of Oʻahu Island:

> Oʻahu is also a new name, given in memory of an ancestor of the people of Oʻahu. Lolo-imehani, Lalo-waia, and Lalo-oho-aniani were the ancient names of Oʻahu. Oʻahu was the child of Papa and Lua… and because Oʻahu was a good chief and the people lived harmoniously after the time of Wākea mā, Oʻahu's descendants gave the name of their good chief to the island --- Oʻahu-a-Lua. (Kamakau 1991:129)

Inoa ʻĀina: Place Names

There are other means, besides chanted genealogies and their accompanied stories, by which Hawaiʻi's history has been preserved. One often overlooked source of history is the information embedded in the Hawaiian landscape. Hawaiian place names "usually have understandable meanings, and the stories illustrating many of the place names are well known and appreciated… The place names provide a living and largely intelligible history" (Pukui et al. 1974:xii). Lanikai is situated between Alāla and Wailea Points in the ahupuaʻa of Kailua. The meanings of these place names and others in the vicinity are delineated in *Place Names of Hawaii*:

> Alāla. High point between Kailua beach and Lanikai, Oʻahu. A tall stone at the point is used by fishermen as a landmark to locate a fishing station at sea. *Lit.*, awakening. (Pukui et al. 1974:9)
>
> Kaʻiwa….Peak and Ridge above Lanikai, Oʻahu, where frigate birds (*ʻiwa*) are often seen. (Pukui et al. 1974:70)
>
> Kaʻōhao. Old name for Lanikai, Oʻahu. *Lit.*, the tying (two women were tied together here with a loincloth after being beaten in a kōnane game…). (Pukui et al. 1974:85)
>
> Kapoho….Point, Mōkapu Peninsula, Oʻahu, where salt was formerly obtained by evaporation of seawater. *Lit.*, the depression. (Pukui et al. 1974:89)

> Lanikai. Section of Kailua, surfing beach, and elementary school, Mōkapu qd., Oʻahu. Development here began in 1924; the name was changed from Kaʻōhao to Lanikai, in the belief held that it meant ʻheavenly seaʼ …This is English word order; in Hawaiian the qualifier commonly follows the noun, hence Lanikai means ʻsea heaven, marine heavenʼ. (Pukui et al. 1974:129)

> Mokulua. Two islets (24.1 acres, 225 feet elevation) off Lanikai, Oʻahu. *Lit*., two islands. (Pukui et al. 1974:155)

> Wailea….Point between Lanikai and Waimānalo, Oʻahu. *Lit*., Water of Lea (canoe makers' goddess; also the name of a fish god that stands on this point). (Pukui et al. 1974:224)

Moʻolelo

Kailua is mentioned in several moʻolelo. Perhaps one of the most revealing aspects of the moʻolelo of Kailua is that they attribute many of the earliest construction works of the area, such as Ulupō Heiau and the islands and reef off of Lanikai, to the Menehune (Sterling and Summers 1978). The Menehune are a legendary race of small people originally from Kahiki that were brought to Oʻahu as servants to build things in Kailua and Pūowaina (Punchbowl) (Fornander 1969). Regarding the construction of the Mokulua Islands and reef, it is said that the Menehune began to build these for protection of the people, but after only one night of work the construction was never finished (McAllister in Sterling and Summers 1978). It can be debated whether or not the Menehune were literally small people, and whether or not they were brought to live in Kailua by force or decided to live there by their own free will, but what is more significant is that since they are of the earliest migrations to Hawaiʻi, the fact that they are credited with building many structures in Kailua suggests that Kailua is one of the earlier places of Oʻahu to be settled in pre-history.

Another migration to Kailua is chronicled by Kamakau. Perhaps this migration occurred after the Menehune because the names of the travelers and the name of their ship are still remembered:

> ʻO nā haole mua i ʻōlelo ʻia, ua hiki mai ma Koʻolau o Oʻahu, aia ma Kāneʻohe a me Kailua. I ka wā o ʻAuanini, ke aliʻi e noho ana ma Kapalawai [Kalapawai], ma Kailua, a ʻo Kaomealani ke aliʻi me Muaokalani, kāna wahine; e noho ana lāua ma Kaʻōpūloha i Kāneʻohe. Ua kū mai kekahi moku ma kai o Mōkapu, ʻo Ulupana ka inoa o ua moku lā; ʻo Mololana ke kāpena, a ʻo Mālaea ka wahine. A ʻo ka inoa o nā kānaka, ʻo ia hoʻi ʻo Olomana, ʻo Aniani a me Holokamakani; aia nō ko lākou mau inoa i kapa ʻia ma kekahi mau ʻāina a me nā puʻu kaulana. Na kēlā mau aliʻi i kapa i ko lākou mau inoa a hiki i kēia lā (Kamakau 1996:41).

> *The first foreigners, it is said, arrived at Koʻolau, Oʻahu, there at Kāneʻohe and Kailua, in the time of ʻAuanini, the chief who was living at Kapalawai [Kalapawai], at Kailua, and Chief Kaomealani with his wife Muaokalani, who were living at Kaʻōpūloha in Kāneʻohe. A ship anchored offshore of Mōkapu, Ulupana was the name of that ship; Mololana was the captain, and Mālaea was the wife. And the name of the people, they were Olomana, Aniani, and Holokamakani. Their names were indeed given to some lands and famous hills. Those were the chiefs who have given their names until today. [translation by D. Duhaylonsod]*

Several of the Kailua moʻolelo center on Kawainui. This implies the great significance of this resource to the history of the region. Like other fishponds, Kawainui was the home of a guardian spirit, also called a moʻo kiaʻi or akua moʻo. These guardian spirits looked after the well-being of the people, ensuring that the land and/or sea would provide for the populace as long as the people remained good stewards. The guardian of Kawainui was a moʻo named Hauwahine, and Hauwahine's companion was the moʻo who dwelled near Kaʻelepulu Stream (Kelly and Nakamura 1981).

In addition to getting the benevolent help of their guardian spirits, the Kailua people also were assisted by the mythological tree, Mākālei. This tree came up from the sea, intending to go to Nuʻuanu. However, the shouting from the Menehune and other ʻeʻepa people caused Mākālei to fall near Kawainui. It became rooted there, and its magical powers attracted fish from the neighboring waters to the area (Kelly and Nakamura 1981).

So sustaining was the fishpond of Kawainui that even its mud was edible. The mud of Kawainui, or lepo ʻai ʻia, was purposely brought from Kahiki and put into the fishpond. According to a report by the Bishop Museum, a moʻolelo states that this mud even nourished Kamehameha and his warriors in more recent times:

> [The lepo ʻai ʻia mud] is found only there [at Kawainui]. When there was a shortage of taro in Kailua during the time Kamehameha and his warriors stayed there, the men of Kailua went to Kawainui Pond to get the edible mud. A strict kapu had to be imposed during diving for the mud. No one was allowed to utter a word at that time. If the kapu were broken, the ordinary mud in the pond would rise, cover the diver and drown him. (Kelly and Nakamura 1981:5)

The old name for Lanikai was Kaʻōhao, which translates to ʻthe tying,' in relation to part of the epic tale, "Story of Lonoikamakahiki" in the *Fornander Collection of Hawaiian Antiquities and Folklore* (Fornander 1916). Hauna, prophet of Lonoikamakahiki left Hawaiʻi island to sail to Oʻahu, where he landed in Lanikai and saw women playing kōnane with their husbands. Noticing that the women were going to win the game, he decided to make a wager and challenge them, first covering the board with a piece of kapa:

> The women said to Hauna "We have nothing to offer on our side excepting ourselves. If you beat us in this present unfinished game, you can take us as your property." Hauna then said: "I have two double canoes filled with things that are valuable; the chief articles of value on the canoes, however, are a large number of feather cloaks. If you two beat me, you two shall have the goods in the canoes together with the men on board." The women replied: "It is a bet." Hauna then said: "Let me make the first move"...But when the kapa was removed in order to continue the game, Hauna caught up some of the stones which gave the women the best advantage with the kapa. Hauna then made the first move and after a few more moves, the women were beaten. At this he said: "I have won you two."...Hauna took the women and tied them together with a loincloth and led them to the place where the canoes were lying. Because these women were led by Hauna, the place where this act took place was given the name Kaohao [Kaʻōhao] and it so remains to this day. The place is in Kailua, Koʻolaupoko, Oʻahu. (Fornander 1916:312, 314)

Lanikai was also home to a beautiful chiefess, Kaʻiwa, of which a hill in the area is named. Ahiki fell madly in love with Kaʻiwa and began coming to Lanikai to see her. One day, Kaulekoa of Kāneʻohe (also known as Kana) stopped Ahiki on his journey and that is why the peak named Ahiki stands in front of the other two, Mount Olomana and Pākuʻi (Sterling and Summers 1978).

In Lanikai, it is said that a cave at Alāla Point extends underground all the way to Mid Pacific Country Club, and that the cave was once used as a place of refuge (Sterling and Summers 1978).

Near the location of the cave, are several basalt and coral rocks collectively known as Kanepolū. According to moʻolelo, King Kamehameha III was fishing in Lanikai and staying in the cave. The king sent for a man named Kanepolū, who "was born, grew up, and died in one day" (Nawelu in Sterling and Summers 1978:238). The stones were set up as guardians to keep watch for the arrival of Kanepolū. However, Kanepolū arrived at the cave as night was beginning to fall, and he tripped on the coral stone and was killed. This stone represented his leg; the location of the rest of his body is unknown (Nawelu in Sterling and Summers 1978:238).

There was also a heiau at Alāla Point (McAllister 1933). When Kūaliʻi made this heiau kapu, a vast fire could be seen burning in the distance on Molokaʻi. Kūaliʻi was worried that the bright glow of the fire would prevent having a successful procession to the heiau, but his kahuna replied that the fire would die down if only Kūaliʻi was to say that it should be so. At these words, the kahuna prayed, and the fire subsided so that the procession could continue (Kamakau in Sterling and Summers 1978:238).

ʻŌlelo Noʻeau

Traditional proverbs and wise sayings, also known as ʻōlelo noʻeau, have been another means by which the history of Hawaiian locales have been recorded. In 1983, Mary Kawena Pukui published a volume of close to 3,000 ʻōlelo noʻeau or Hawaiian proverbs/wise sayings that she collected throughout the islands. The introductory chapter of that book reminds us that if we could understand these proverbs and wise sayings well, then we would understand Hawaiʻi well (Pukui 1983).

Only three ʻōlelo noʻeau concerning Kailua are recorded in Pukui's compilation. Two of these are suggested to commemorate Kamehameha's visits to Kailua after taking control of Oʻahu. The third ʻōlelo noʻeau does not pertain to any particular historical person, but rather, it points out the hau trees which grow at Kailua and the characteristics of the rope which can be made from its bark. Here are the sayings as they appear in Pukui's publication (1983:60, 193, 230).

> Hawaiʻi palu lāʻī.
>
> *Ti-leaf lickers of Hawaiʻi.*
>
> This saying originated after Kamehameha conquered the island of Oʻahu. The people of Kailua, Oʻahu, gave a great feast for him, not expecting him to bring such a crowd of people. The first to arrive ate up the meat, so the second group had to be content with licking and nibbling at the bits of meat that adhered to the ti leaves. In derision, the people of Oʻahu called them "ti-leaf lickers."

> Kini Kailua, mano Kāneʻohe.
>
> *Forty thousand in Kailua, four thousand in Kāneʻohe.*
>
> A great number. Said by a woman named Kawaihoʻolana whose grandson was ruthlessly murdered by someone from either Kailua or Kāneʻohe. She declared that this many would perish by sorcery to avenge him. Another version credits Keohokauouli, a kahuna in the time of Kamehameha, for this saying. He suggested sorcery as a means of destroying the conqueror's Oʻahu enemies.

> Mālama o ʻike i ke kaula ʻili hau o Kailua.
>
> *Take care lest you feel the hau-bark rope of Kailua.*
>
> Take care lest you get hurt. When braided into a rounded rope, hau bark is strong, and when used as a switch, it can be painful.

Ka Makani a me Ka Ua: The Wind and the Rain

With their lives closely connected to the natural environment and physical surroundings, Hawaiian winds and rains were individually named and associated with a specific place, region, or island. In *Hānau Ka Ua*, Akana and Gonzales (2015:xv) explain that kūpuna "knew when a particular rain would fall, its color, duration, intensity, the path it would take, the sound it made on the trees, the scent it carried, and the effect it had on people." The following wind and rain names associated with the project region offer further insight on kūpuna perspectives of the project area.

While several winds and rains are noted for the greater Kailua area, only one name was found that is specifically associated with Kaʻōhao (Lanikai). This is a rain known as Hāʻao, and it was mentioned in mele:

E nānā iho ana i Waipuʻilani	Gazing down on Waipuʻilani
E noho iho ana i Kaʻanaokāhinahina	Residing there at Kaʻanaokāhinahina
Eia au i ka ua a ka Hāʻao	Here am I in the Hāʻao rain
I walea ai i ke kui pua ʻāhihi	Delightedly stringing lehua ʻāhihi blossoms
He lei no Lea, wahine i ke kuahiwi	As a lei for Lea, woman of the mountain

> From a mele by Kapauakanoa…Note: "Lea is both the name of a goddess of canoe makers and the name of a fish god who stands in Wailea ("Water of Lea") Point between Kaʻōhao in Kailua and Waimānalo, Oʻahu… (Akana and Gonzalez 2015:27–28)

Rains of other parts of Kailua are ʻĀpuakea, Kapuaʻikanaka, and Kuahine (Akana and Gonzalez 2015). A wind of Kailua is Malanai, described as a gentle tradewind breeze (Nakuina 2005).

Traditional Land Use

In early Hawaiian history, Oʻahu's windward coast was noted for its "many attractive bays, beaches, and stream-watered lowlands and valleys all the way from Kailua to Laʻie" (Handy et al. 1991:268). Bays throughout Hawaiʻi, such as that at Kailua, "generally had a cluster of houses where the families of fishermen lived" (Handy et al. 1991:287). But the added abundant resources of Kailua's perennial streams and thriving fishponds clearly promoted a regional population that was greater than that of other areas. The ahupuaʻa of Kailua, along with Kāneʻohe, "was rich in fishponds and tillable lands, [and it] was the seat of the ruling chiefs of Koʻolaupoko (Short Koʻolau) which was the southern portion of the windward coast" (Handy et al. 1991:272). Handy et al. further illustrate why the Kailua area was a favorable place to live, citing not only the fishponds and streams but also the extensive wetlands, which were converted into agricultural terraces:

> Undoubtedly further reasons for the attractiveness of Kailua as a place of residence for an aliʻi nui with his large entourage were the great natural fishponds, Kaʻelepulu and Kawainui, and the complex of artificial salt-water ponds that are between Kailua and Kaneʻohe in the Mokapu area: Halelou, Nuʻupia, and Kaluapuhi. Kailua must formerly have been very rich agriculturally, having one of the most extensive continuous terrace areas on Oahu, extending inland one and a half miles from the margin of Kawainui Swamp. Terraces extended up into the various valleys that run back into the Koʻolau range. There were some terraces watered by springs and a small stream

> from Olomana mountain along the western slope of the ridge that lies southeast of Kawainui Swamp, and another system of terraces was east of the seaward end of the ridge, watered by the stream which joins Kawainui and Kaʻelepulu Ponds. There were also terraces north of the Kawainui Pond, and several terrace areas flanked Kaʻelepulu Pond at the base of the ridge to the eastward. (Handy et al. 1991:457)

From mountain to sea, the district of Kailua also had its fair share of religious structures to serve the needs of its large population. At the entrance of Lanikai, Alāla Heiau was thought to have been located on Alāla Point. McAllister (1933:190) states that "Tradition for ages past has credited the heiau of Alala...as having the distinction of being the temple where the ceremonies attending the royal birth of Kualii, about 1640, were performed, but of which no traces of any kind now remain..." According to McAllister (1933), no evidence or other features are present in that area. Charles Kamanu Sr., Solomon Mahoe Jr., and Nawelu also mention a cave used for refuge at Alāla Point, the entrances of which are now obstructed (Sterling and Summers 1978).

Furthermore, there were natural shrines on the hillsides named Alāla and Waileʻa. These were said to be used as lookouts by fishermen, as told in a 1939 account:

> The fishermen of old watched this big rock on the hill [Alāla] and Waileʻa another natural shrine a distance away at a place called Waileʻa, to locate the best fishing grounds in the sea. "It is too bad," said Mrs. Ailona, "to deprive Alāla of an unobstructed view of the sea [speaking of a large house blocking the view], for Alāla is not only a shrine but a 'fish' god. So is Waileʻa." (Charles in Sterling and Summers 1978:239)

Charles went on to say that the Waileʻa shrine was situated above "Hale Aloha," where an old road was once located (Charles in Sterling and Summers 1978:239). Charles would use the road to participate in hukilau when she was young.

Between 1435 and 1508 Mokulua Drive, less than half a mile from the project area, it is said that there was once a stream which drained out into the sea, and the area was called Punawai (Mahoe in Sterling and Summers 1978). "In the olden days the women lived here at Punawai while their menfolk practiced spear-throwing at Kaʻohao. The men were under kapu during these practice sessions, coming to their women only on weekends…" (Mahoe in Sterling and Summers 1978).

Kailua in the Historic Era

When the first Westerners arrived in the Hawaiian archipelago in 1778, the islands were not yet united under one sovereign. At that time, Kailua and the entire island of Oʻahu were under the rule of Chief Kahahana. In 1783, Chief Kahahana's reign was ended with the invasion and victory of Chief Kahekili of Maui. This would forever be the end of Oʻahu's independence as a separate island kingdom. When Chief Kahekili died in 1794, control of Oʻahu went to his son Kalanikūpule. The following year, Chief Kamehameha of Hawai'i Island invaded Oʻahu to engage Kalanikūpule in battle. Kamehameha overwhelmed Kalanikūpule's warriors, effectively gaining control of all the islands from Hawaiʻi to Oʻahu. Eventually, Kamehameha would make a peaceful agreement with Chief Kaumualiʻi of Kauaʻi, bringing that island and Niʻihau into the fold and thereby uniting the Hawaiian archipelago under one rule (Kamakau 1996, Kanahele 1995).

Early Historical Accounts of Land Use in the Kailua Area

It is recorded that in 1778 James Cook became the first westerner to see the Hawaiian Islands. Following Cook, a wave of other western explorers landed on Hawaiʻi's shores. In 1779, William Bligh, the "sailing master of the HMS Resolution, and his fellow crewmembers, are the first Westerners to get a look at the shores and hills of Kailua ahupuaa" (Hall 1998:22). The midshipman George Gilbert remarked about the cultivation of the land and the relative lack of trees seen:

> The interior part is hilly, the shore low and exceeding(ly) well cultivated but very bare of wood. The Natives here don't appear to be very numerous and as soon as we came near the land they ventured onboard, without any hesitation and were very friendly… and in the evening sailed from the island; which is called by the Natives Oowahoo. (Gilbert in Hall 1998:22)

Around the same time as the arrival of the first westerners to Hawaiʻi, Oʻahu was experiencing major political changes. It was during this time, as mentioned above, that Oʻahu's sovereignty ended with the invasion of the Maui chiefs, and the Maui rule was subsequently overcome by the invasion of the forces from Hawaiʻi Island. Yet throughout this tumultuous period, Kailua remained an important seat of Oʻahu governance. Kailua retained its prominence after the invasion of Kahekili from Maui in 1783:

> In historic times Kahekili, the high chief of Maui, battled the Oʻahu chiefs and finally killed Kahahana, taking his place as high chief [of Oʻahu]… [Kahekili] chose… and settled in Kailua with several of his supporting chiefs. (Kelly and Nakamura 1981:6)

And a decade later, after the invasion of Kamehameha from Hawaiʻi Island, Kailua again retained its significance as a place of rule. Kamehameha not only lived and ruled from there, but the new king himself also worked in the fishponds of Kailua as an encouragement to his chiefs and commoners to be productive and raise food:

> The last, and most notable, chief who had attachments to Kailua and to Kawainui was Kamehameha I. He conquered Oʻahu in 1795, and had the problem of feeding the members of his retinue, far away from their homes on the Island of Hawaiʻi. Kamehameha I encouraged the development of the natural resources of Oʻahu to provide his chiefs and followers with sufficient food… While he [Kamehameha] lived on Oahu he encouraged the chiefs and commoners to raise food and he went fishing and would work himself at carrying rock or timber. They all saw that he labored himself with his own hands. He worked at the fishponds at Kawainui, [and] Kaʻelepulu. (Kelly and Nakamura 1981:7)

When Kamehameha died in 1819, his windward lands were divided between his sons Liholiho and Kauikeaouli. Kailua Ahupuaʻa went to the younger son, Kauikeaouli, who would later become Kamehameha III (Hall 1998).

Land Ownership and Māhele Land Tenure

The change in the traditional land tenure system in Hawaiʻi began with the appointment of the Board of Commissioners to Quiet Land Titles by Kamehameha III in 1845. The Great Māhele took place during the first few months of 1848 when Kamehameha III and more than 240 of his chiefs worked out their interests in the lands of the Kingdom. This division of land was recorded in the Māhele Book. The King retained roughly a million acres as his own as Crown Lands, while approximately a million and a half acres were designated as Government Lands. The Konohiki Awards amounted to about a million and a half acres, however title was not awarded until the konohiki presented the claim before the Land Commission.

In the fall of 1850 legislation was passed allowing citizens to present claims before the Land Commission for lands that they were cultivating within the Crown, Government, or Konohiki lands. By 1855 the Land Commission had made visits to all of the islands and had received testimony for about 12,000 land claims. This testimony is recorded in 50 volumes that have since been rendered on microfilm. Ultimately between 9,000 and 11,000 land claims were awarded to kamaʻāina totaling only about 30,000 acres and recorded in ten large volumes.

Although the Māhele had specifically set aside lands for the King, the government, and the chiefs, this did not necessarily alienate the makaʻāinana from their land. On the contrary, access to the land was fostered through the reciprocal relationships, which continued to exist between the commoners and the chiefs. Perhaps the chiefs were expected to better care for the commoners' rights than the commoners themselves who arguably might have been more ignorant of foreign land tenure systems. Indeed, the ahupuaʻa rights of the makaʻāinana were not extinguished with the advent of the Māhele, and Beamer points out that there are "numerous examples of hoaʻāina living on Government and Crown Lands Post-Mahele which indicate the government recognized their rights to do so" (Beamer 2008:274).

> Hoaʻāina who chose not to acquire allodial lands through the Kuleana Act continued to live on Government and Crown Lands as they had been doing as a class previously for generations. Since all titles were awarded, "subject to the rights of native tenants." The hoaʻāina possessed habitation and use rights over their lands. (Beamer 2008:274)

For those commoners who did seek their individual land titles, the process that they needed to follow consisted of filing a claim with the Land Commission; having their land claim surveyed; testifying in person on behalf of their claim; and submitting their final Land Commission Award to get a binding royal patent. However, in actuality, the vast majority of the native population never received any land commission awards recognizing their land holdings due to several reasons such as their unfamiliarity with the process, their distrust of the process, and/or their desire to cling to their traditional way of land tenure regardless of how they felt about the new system. In 1850, the king passed another law, this one allowing foreigners to buy land. This further hindered the process of natives securing lands for their families.

Hundreds of land claims up and down windward Oʻahu were awarded to commoners. In the Koʻolaupoko District, 199 awards were "granted in the Kailua and Waimanalo ahupuaʻa, each averaging roughly 10 acres" (Hall 1998:53). However, most of the windward Oʻahu lands went to Kamehameha III's queen, Kalama, and to several of the other high chiefs. Kailua in particular found Queen Kalama as its dominant landholder, followed by Princess Kamāmalu. Their land claims in Kailua are described as follows:

> Kamamalu submitted her claims for the ili of Kaelepulu and Keolu; while Kalama's claims included Kawainui and the ili of Mokapu, Oneawa, and Keahupuaanui. (Hall 1998:52)

There were few Land Commission Awards (LCAs) granted in Lanikai, however one is located near the project area. LCA 2657:2 is 0.44 acres and was awarded to Mahuia (Appendix A). The LCA included two ʻāpana in Kailua, the first is located in the ʻili of Kuailima, and the second is in

Ka‘ōhao adjacent to the project area to the north. The parcel is described in the Māhele Book as being located between the ocean to the east and the kula of the konohiki to the west. Usage of the parcel was not described.

Historic Land Use

Following the Resident-Alien Act in 1850 which allowed foreigners to "purchase (for the first time) fee simple lands in the islands… title to much of the land, which had only recently been made available to Hawaiian alii and commoners, is lost forever as it is passed into the hands of the newly arrived" (Hall 1998:54). The cultivation of both sugarcane and of pineapple, which would come after the turn of the century, would be attempted in Kailua but neither would be productive. Within a decade, the Chinese laborers moved off of Kāne‘ohe plantations and started rice-farming operations in Kailua.

> Chinese cane laborers from the Kaneohe plantations have been permitted to begin establishing rice paddies in Kailua's Kaelepulu pond area and the Kawainui marshes… Wetland taro, which had been actively cultivated in the Kaelepulu and Kawainui marshes for nearly 500 years, will shortly be thoroughly displaced in the ponds and wetlands for the new cash crop. (Hall 1998:62)

Besides large-scale agricultural enterprises, Kailua also saw the imprint of the cattle industry. By the end of the 1800s, ranching operations found their foothold on the Kailua flatlands. J.P. Mendonca and C. Bolte partnered and approached the Kailua landowner D. Rice "to lease 15,000 acres of Kailua's central landholdings to raise Angus beef cattle… [their future company] will come to own practically all of Kailua, except for the lands held by the Bishop Estate" (Hall 1998:91).

Two historic maps were found that date to this time period. The first one is dated 1899 (Figure 4). It shows the smaller divisions of land within the district of Kailua. The current project area is located within the subdivision labeled as Alaapapa, with an area called Mokulua adjacent to the southeast. The map shows that numerous Land Commission Awards recognized throughout Kailua, with Alaapapa labeled as Grant 967 S.P. Miki.

The second map dates to 1900 (Figure 5). Like the previous map, this one shows the traditional names of the many ‘ili throughout the ahupua‘a. The map confirms what other textual references say, that the ali‘i residents of Kailua, such as Queen Kalama and Princess Kamāmalu, held onto their Kailua landholdings. However, other Kailua parcels clearly show that they have been bought by foreigners by that time. The land division of Mokulua is not shown on this map, and it appears that Alaapapa covers the two land divisions shown on the earlier map. A road that leads into Lanikai just mauka of the current project area is labeled "Ala Aupuni."

A historic map of an unknown date illustrates the fisheries of Ko‘olaupoko (Figure 6). This map focuses on the marine resources of the region and names the Alaapapa Fishery and Kailua (B) Fishery in Lanikai, with the project area just within the former. Inland is the Kaelepulu Fishpond, where the subdivision of Enchanted Lakes is today. The road that loops around Lanikai is in place at this time, although none of the connecting streets within the loop or surrounding streets are shown.

In the first decade of the 20th century, the copra industry was also started in Kailua, beginning with the planting of 10,000 coconut trees in 1908, where Kalaheo and Oneawa streets are today, in a

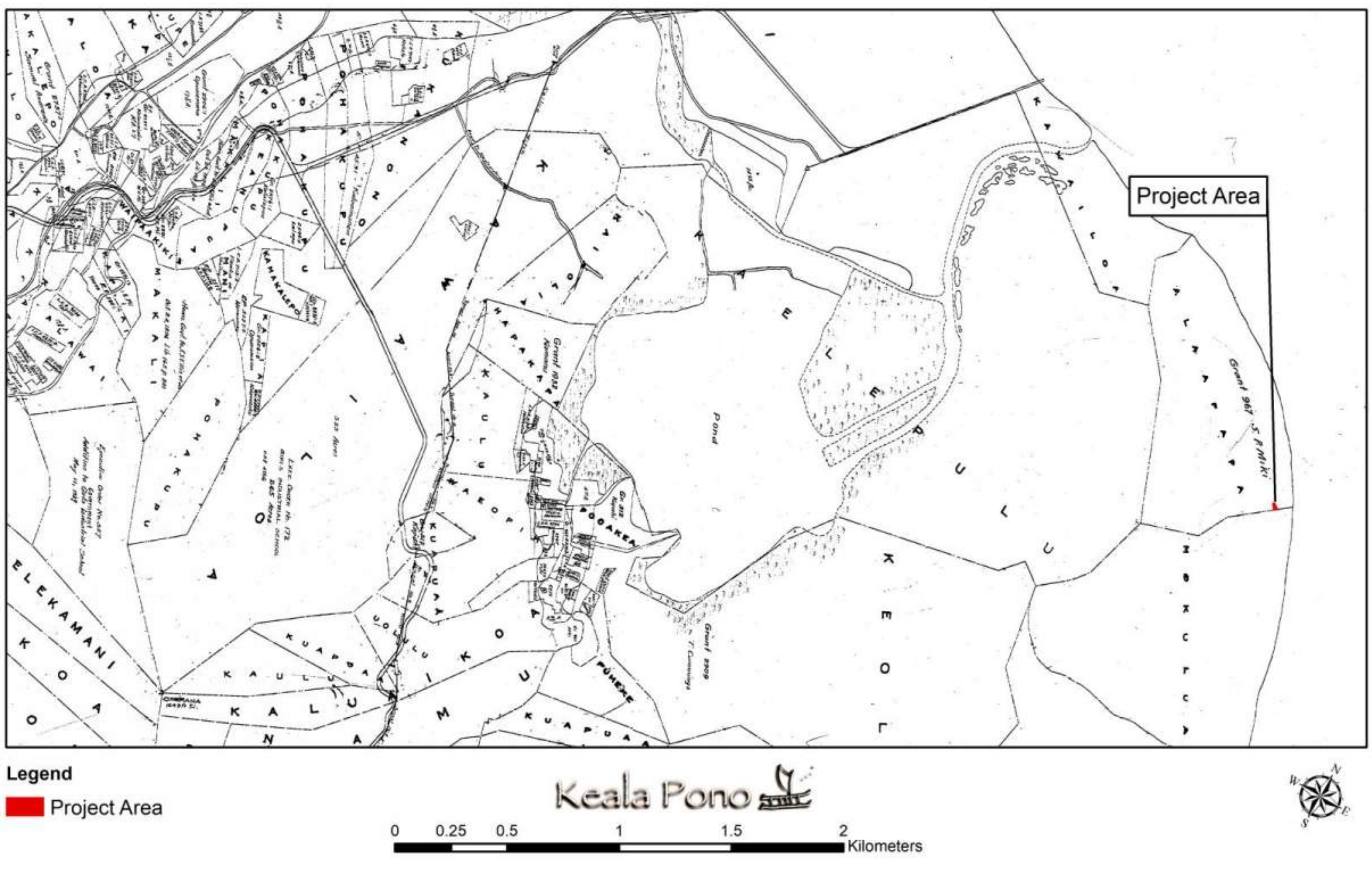


Figure 4. Portion of an early Kailua map (Wall 1899).

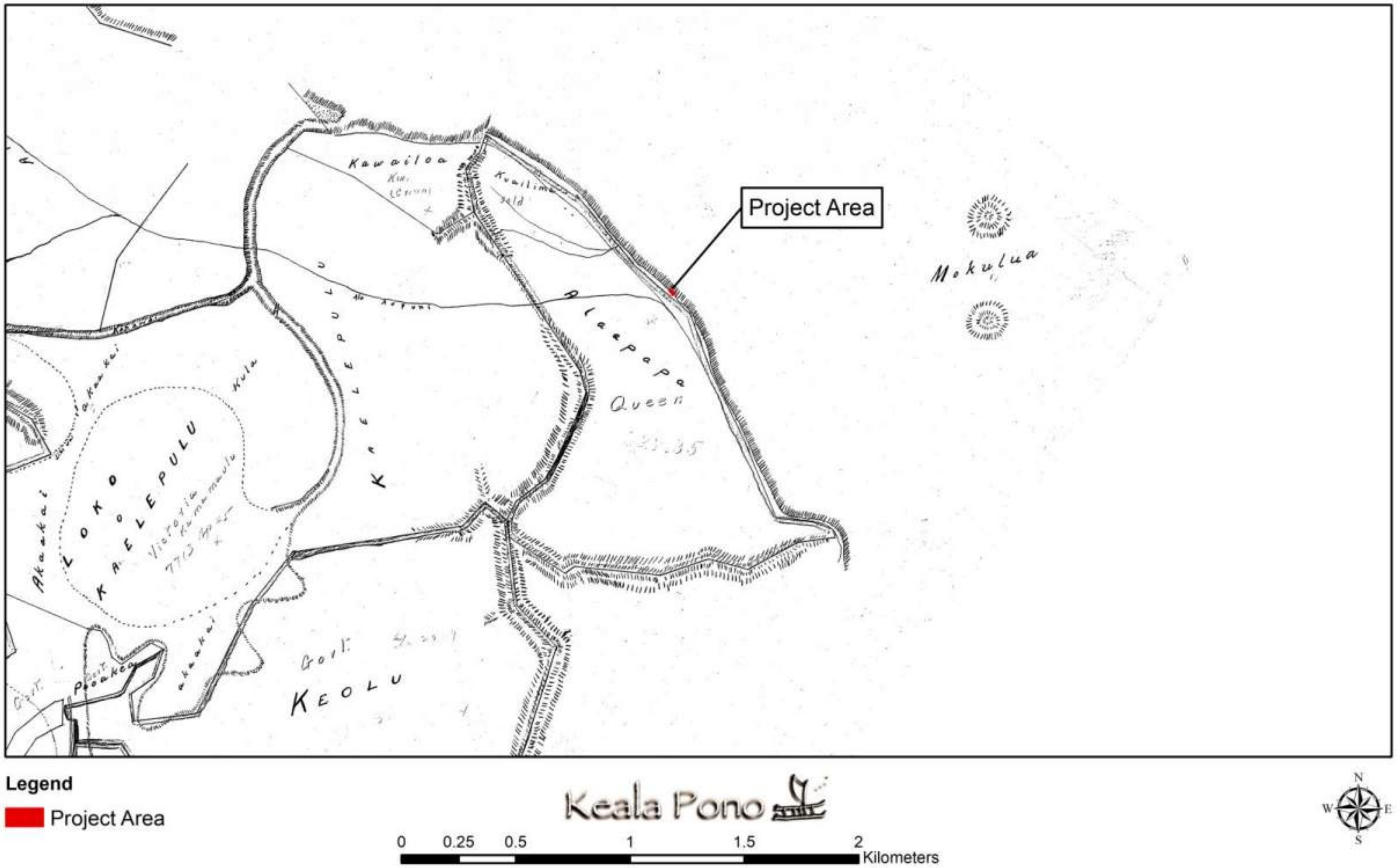


Figure 5. Portion of an early Kailua map (King 1900).

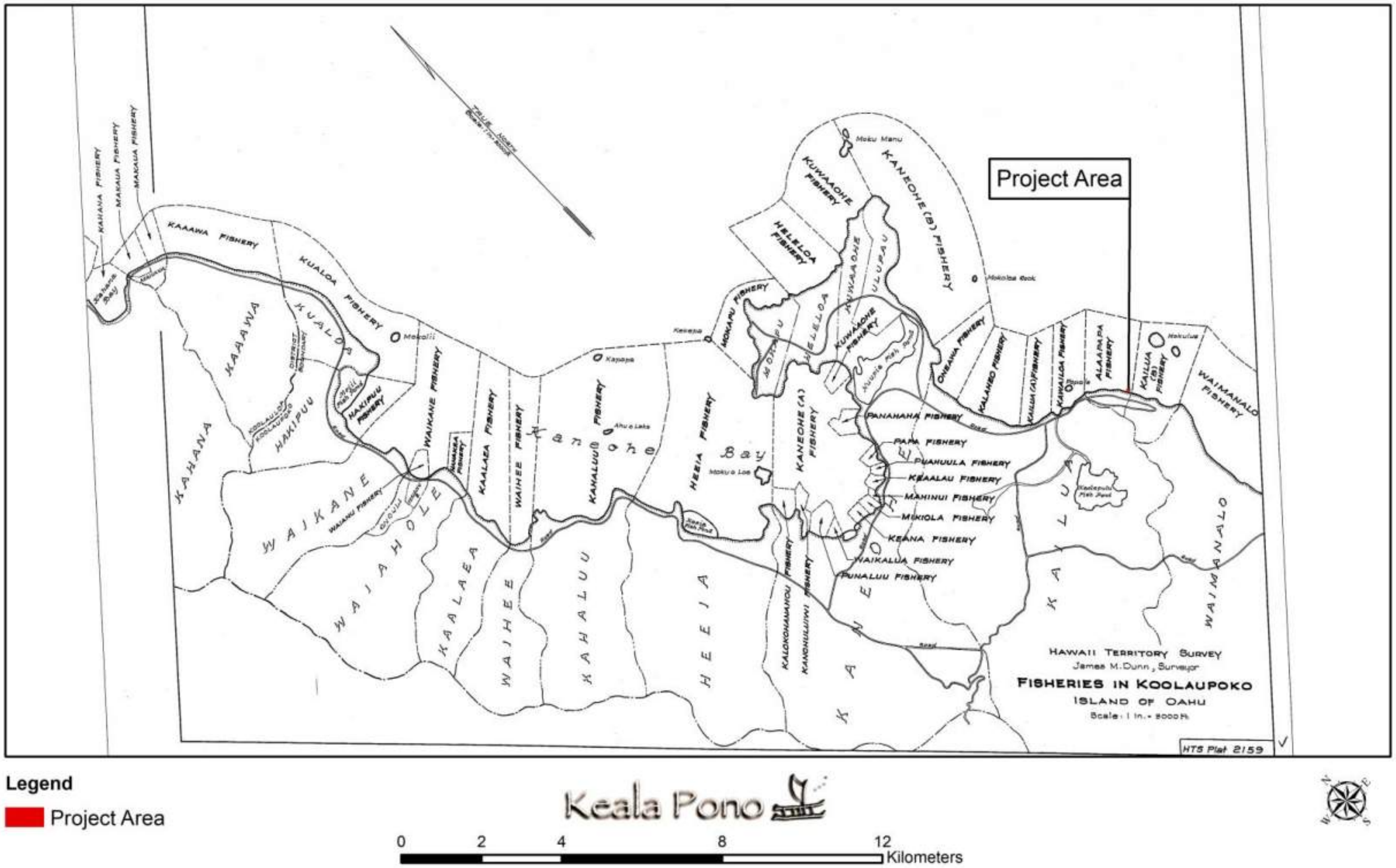


Figure 6. Portion of a Ko'olaupoko fisheries map (Dunn n.d.).

grassy expanse of sand flats (Hall 1998:113). The next year, investors planted an additional 130,000 trees, many of which were imported from Samoa, and all of these coconut trees were "laid out on 320 acres behind the 4-mile stretch of Kailua's shoreline…The 140,000 plantings, each with a life span of 100 years, will shortly lend the area its name of Coconut Grove" (Hall 1998:113, 123).

Expanding out of the cattle ranching enterprises, Arthur Rice and Harold Castle established the earliest dairies in the coastal regions of Kailua. This occurred around 1910, with dairies located at today's Coconut Grove area noted above (Kailua Historical Society 2009:182). Later, in the 1920s, the Campos family added their family dairy to the operations in Kailua, leasing land from Kaʻelepulu and Olomana all the way to Bellows Beach in Waimānalo. "Initially, they trucked their raw milk to Meadow Gold (Dairymen's) in Honolulu for processing, but in the early 1950s the Campos, Moanalua, and Rico dairies united to form the Honolulu-based Foremost Dairy (Kailua Historical Society 2009:183).

Interestingly, as early as 1910 there was speculation of turning Kailua into a dream vacation destination of sorts. That year, "thirty-three 1-acre beachfront Kailua properties along Kalaheo Road are advertised in Honolulu for lease to those who wish to build summer cottages for their families on Kailua Bay's secluded 4-mile stretch of beach" (Hall 1998:117). In 1917, after the demand for coconut oil declined causing a decrease in copra profits, Arthur Rice of the Hawaiian Copra Company "plans to develop subdivision of 'tract housing' in the flat open coconut orchards… He initiates the first steps that, over time, will see Kailua become a year-round residential town… [and he] will become recognized as the founding father of what will develop as residential Kailua" (Hall 1998:123–124).

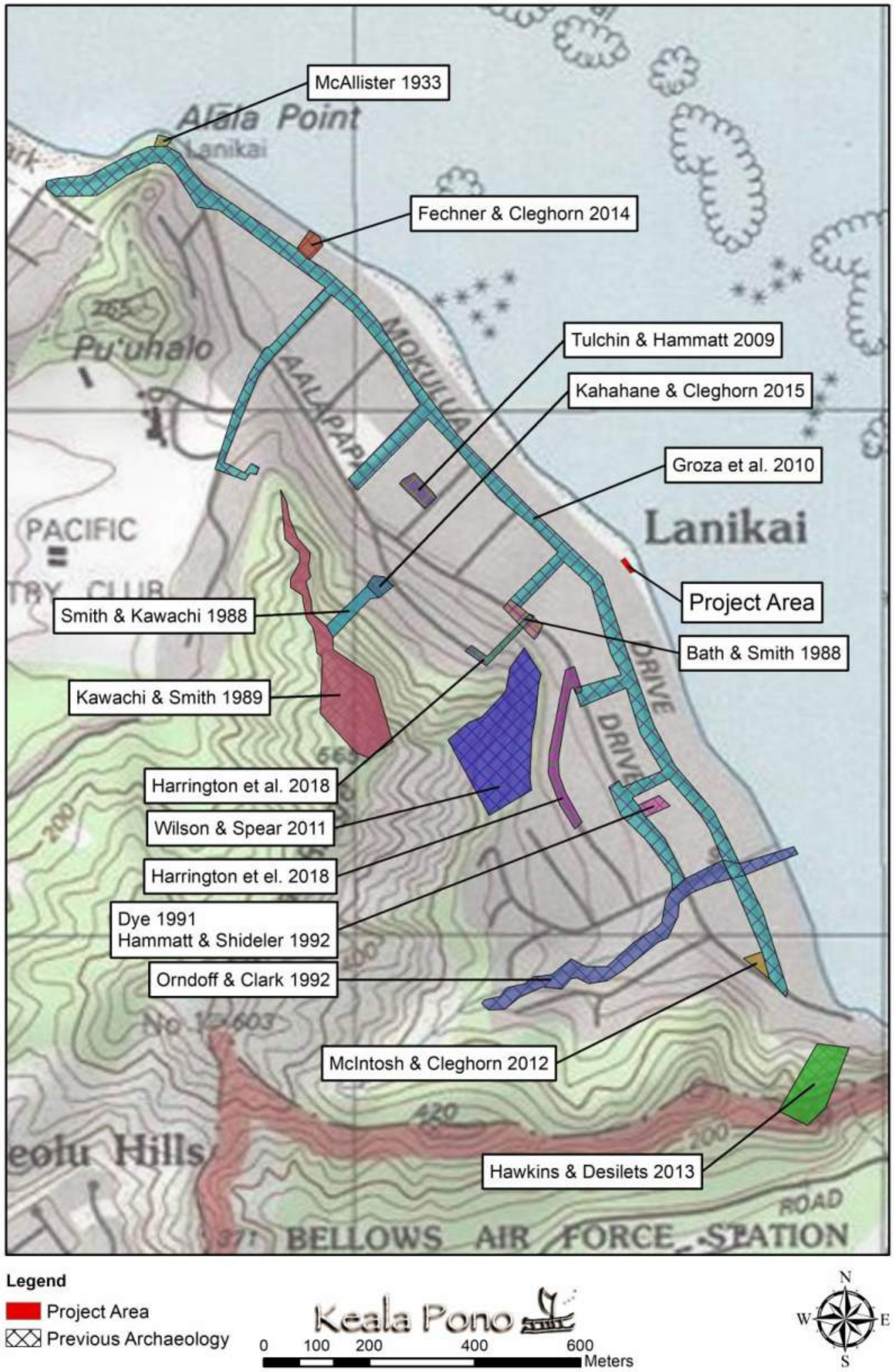
In 1924, development began in Kaʻōhao by Charles R. Frazier, who urbanized 311 acres, creating the upscale beachfront community of Lanikai that we know today (Clark 2002). Frazier chose the name Lanikai, thinking that the word translated to 'heavenly sea,' although the literal translation is more like 'sea heaven' or 'marine heaven' (Pukui et al. 1974:85). In 1926 a faux lighthouse was erected at the entrance to Lanikai, at Alāla Point, as a monument. Although the structure resembles a lighthouse, it does not function as such. Designed by the famous local architect Hart Wood, the structure still stands today and has been nominated to the National Register of Historic Places (NRHP).

What are now known as the "Lanikai Pillboxes" were constructed in the 1940s as observation bunkers for Battery Wailea and the nearby Bellows Field (Young 2015). Battery Wailea, situated at Waileʻa Point, was armed with two guns and was operational for only a few years, between 1942 and 1945. The observation bunkers, located on Kaʻiwa Ridge, were referred to as Fire Control Station Podmore, named after a nearby triangulation station (Young 2015).

Intense real estate development in Kailua occurred in the 1950s when the Pali Highway was built, and tunnels were bored through the Koʻolau Mountains. This development soon displaced many of the agriculture and ranching enterprises of Kailua (Kailua Historical Society 2009:191–192).

Previous Archaeology

Several archaeological studies have been carried out in Lanikai, as summarized below. Each study is listed in Table 1 and illustrated in Figure 7. State Inventory of Historic Places (SIHP) numbers are prefixed by 50-80-11 (Figure 8).



Layer Credits: USGS Topographical Mokapu Point Quadrangle Map 1999

Figure 7. Previous archaeology in the vicinity of the project area.

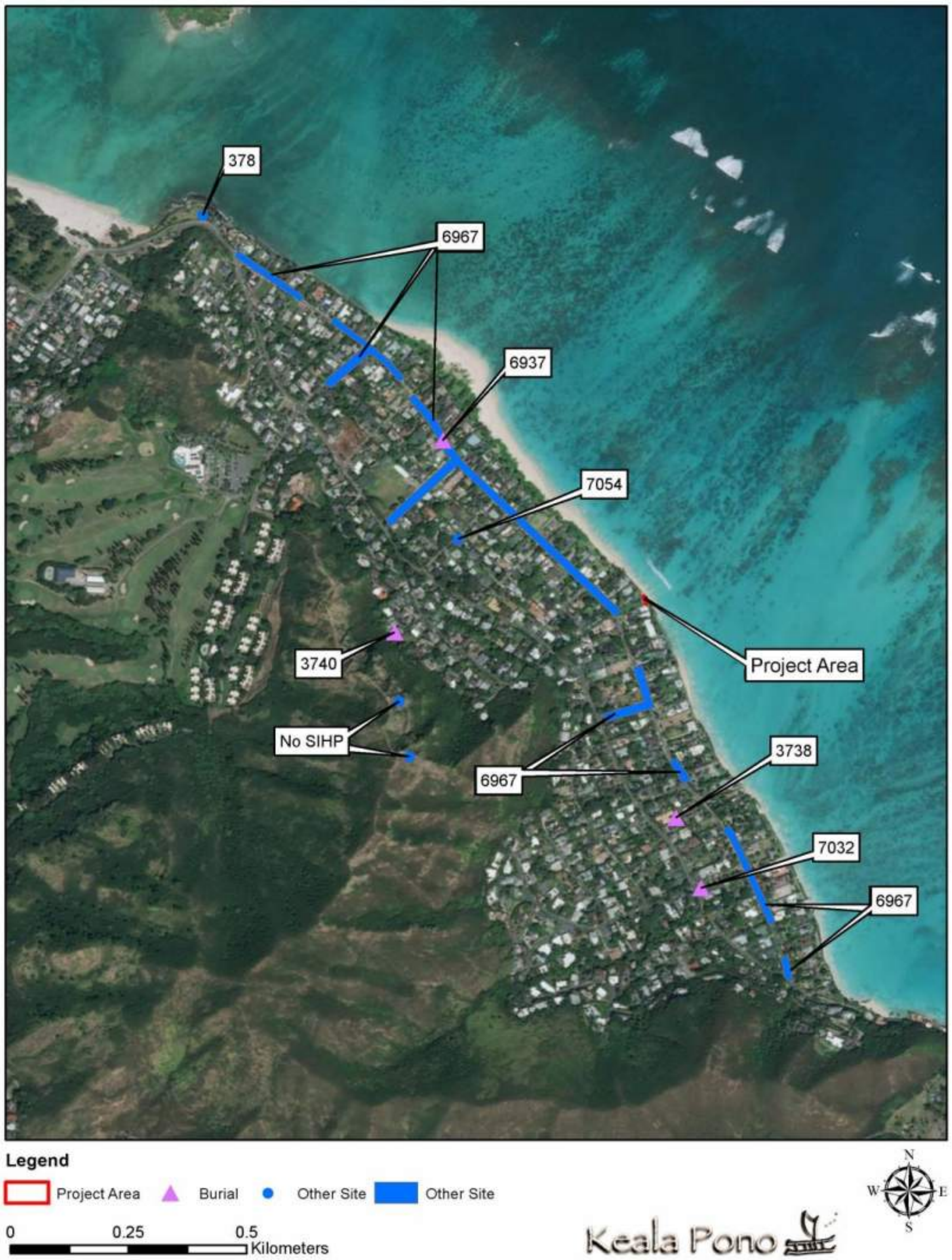


Figure 8. Previously recorded sites in the vicinity of the project area.

Table 1. Previous Archaeology in Lanikai

Author	Location	Work Completed	Findings
McAllister 1933	Island-Wide	Survey	Noted Alāla Heiau (Site 378) in Lanikai.
Bath & Smith 1988	Koʻohoʻo Pl.	Burial Report	Reported on the inadvertent discovery of human remains, SIHP 3738.
Smith & Kawachi 1988	1063 Koʻohoʻo Pl.	Burial Report	Recorded the inadvertent discovery of human remains, SIHP 3740
Kawachi & Smith 1989	Kaiʻwa Ridge	Field Check	Noted WWII bunkers; no SIHP numbers were assigned.
Dye 1991	1414 Aʻalapapa Dr.	Burial Report	Reported on the disinterment of human burials, SIHP 3738.
Orndoff & Clark 1991	Poʻopoʻo Gulch	Literature Review with Monitoring Findings	None.
Hammatt & Shideler 1992	1414 Aʻalapapa Dr.	Burial Report	Reported on the disinterment of human burials, SIHP 3738.
Tulchin & Hammatt 2009	136 Haokea Dr.	Archaeological Inventory Survey	Identified a pre-contact hearth, SIHP 7054.
Groza et al. 2010	Mokulua Dr., Multiple TMK	Archaeological Monitoring	Identified two sets of human remains (SIHP 6937 and 7032) and a subsurface cultural layer (SIHP 6967).
Wilson & Spear 2011	End of Kehaulani Dr.	Archaeological Inventory Survey	None.
Hawkins & Desilets 2013	1611 Mokulua Dr.	Archaeological Inventory Survey	None.
Fechner & Cleghorn 2014	860 Mokulua Dr.	Archaeological Inventory Survey	None.
McIntosh and Cleghorn 2014	1561 Mokulua Dr.	Archaeological Inventory Survey	None.
Kahahane and Cleghorn 2015	1055 Koʻohoʻō Pl.	Archaeological Inventory Survey	None.
Harrington et al. 2018	Koʻohoʻō Pl. and Mōkōlea Dr.	Literature Review and Field Inspection	None.

The earliest archaeological work in the vicinity of the project area is from an island-wide survey conducted by J.G. McAllister (1933). Some of this work was based on descriptions of heiau provided by T.G. Thrum in various articles published in *Thrum's Hawaiian Almanac and Annual*.

McAllister identified one archaeological site in Lanikai, Alala Heiau (Site 378), and quoted Thrum's description of the heiau, although both Thrum and McAllister did not find any physical evidence of the site (McAllister 1933:190):

> Site 378. Alala heiau, said to have been at Alala Point, Kailua. When the site was indicated by Solomon Mahoe, my reaction was similar to that already expressed by Thrum:
>
> > Tradition for ages past has credited the heiau of Alala…as having the distinction of being a temple where the ceremonies attending the royal birth of Kualii, about 1640, were performed, but of which no traces of any kind now remain…The site to which we were directed, while convenient and appropriate for a koʻa or fisher-folks' heiau, gave no evidence by stones of the vicinity, contour of the hill at the point shown, or other feature, of ever having been the location of a temple of the importance alleged.

In Hawaiʻi, sandy areas near the ocean are often related to traditional Hawaiian burials. Inadvertent discoveries of human remains have been documented in and around Lanikai and the current project area, making these findings of particular significance. A single burial at Koʻohoʻo Place was designated as SIHP 3740 and disinterred (Smith and Kawachi 1988). Another single burial was found at the base of the hill near the end of Koʻohoʻo Place and designated as SIHP 3738 (Bath and Smith 1988). Human burials encountered nearby at Aʻalapapa Drive were subsumed under the SIHP 3738 site number (Dye 1991, Hammatt and Shideler 1992). This latter find included the remains of at least three individuals, all of which were disinterred. Two sets of human remains found on Mokulua Drive were designated as SIHP 6937 and 7032, respectively (Groza et al. 2010).

Other archaeological resources known for Lanikai include a subsurface cultural layer, a hearth, and two WWII bunkers. The cultural layer was found during archaeological monitoring that identified the two sets of human remains on Mokulua Drive (Groza et al. 2010). It was designated as SIHP 6967. The hearth was recorded during an archaeological inventory survey at Haokea Drive (Tulchin and Hammatt 2009). It was designated as SIHP 7054. The two WWII bunkers were identified during a field check of Kaʻiwa Ridge, although no SIHP numbers were assigned (Kawachi and Smith 1989). They are known today as the Lanikai Pillboxes, the history of which is noted above.

Other studies in Lanikai did not yield any findings. These consist of a literature review that also presented archaeological monitoring findings for Poʻopoʻo Gulch (Orndoff and Clark 1991), a pedestrian survey at the end of Kehaulani Drive (Wilson and Spear 2011), a survey that excavated 11 backhoe trenches on Mokulua Drive (Hawkins and Desilets 2013), a survey that excavated two backhoe trenches also on Mokulua Drive (Fechner and Cleghorn 2014), a survey with subsurface testing across the entire area of a proposed pool on Mokulua Drive (McIntosh and Cleghorn 2014), a survey with subsurface testing at Koʻohoʻō Place (Kahahane and Cleghorn 2015), and a literature review and field check at two locations in Lanikai and two locations near Kailua Beach (Harrington et al. 2018).

Summary of Background Information

Place names, moʻolelo, historic maps, and previous archaeological reports are among the sources that provide information on the pre- and post-contact use of Lanikai. Kailua once supported a sizeable population and has been associated with aliʻi in times past. The ocean and coast provided marine food sources, which were a main part of the traditional diet. Although Lanikai is relatively dry today, a stream was once located near the project area. This provided fresh water and may have been used to water crops. A heiau once stood at Alāla Point, and fishing lookouts were situated on Alāla and Waileʻa Points, on either end of Lanikai. Human burials are known to occur in sandy areas along the coast and elsewhere.

Anticipated Findings and Research Questions

Because of the modern use of the project area as a seawall and landscaped lawn, it is not likely that surface archaeological resources remain. Although no previous archaeological fieldwork has been done specifically within the project area, studies conducted nearby can help inform on the kinds of subsurface archaeological resources that may be found. Previous archaeological research nearby has identified human burials, a subsurface cultural layer, and a hearth. These might be expected within the project area as well. Human burials may or may not be defined by a burial pit. They may be whole burials or fragmentary in nature. Cultural layers are characterized by darkened sediment, often with charcoal fragments, midden, and/or artifacts within the layer. Cultural layers might also contain features such as hearths. These are often bowl-shaped in cross-section and may contain fire-cracked rock in addition to darkened sediment and charcoal.

Research questions will broadly address the identification of the above archaeological resources and may become more narrowly focused based on the kinds of resources that are found. Initial research questions are as follows:

1. Are there subsurface cultural deposits or evidence of human burials within the survey area? Where are they located and what time period do they belong to?
2. Are there any vestiges of historic-era use of the project area, particularly subsurface remnants of military use of the coastline?

Once these basic questions are answered, additional research questions may be developed in consultation with SHPD, tailored to the specific kinds of archaeological resources that occur in the project area.

METHODS

Pedestrian survey and subsurface testing were conducted on August 4, 2020 by Windy McElroy, PhD and Kālenalani McElroy, MA. Windy McElroy served as Principal Investigator, overseeing all aspects of the project.

For the pedestrian survey, the ground surface was visually inspected for surface archaeological remains, with transects walked for the entire area. Archaeologists were spaced approximately 2 m apart. Of the 380 m^2 (4,000 ft^2) survey area, 100% was covered on foot. Vegetation was very light, consisting of landscaped grass with a few large coconut trees and naupaka bushes, and did not affect visibility.

Test trenches (TR) were excavated in three locations throughout the project area. The excavation strategy was approved by SHPD beforehand via email but modified slightly on the day of the survey because of the presence of shearwater (*Puffinus pacificus*) burrows along the makai edge of the property. The SHPD-approved testing strategy called for three 5 foot (1.5 m)-long trenches to be excavated along the seawall. The three trenches were placed in a slightly different configuration to avoid the shearwater nesting burrows. Excavation was accomplished with a mini-excavator (Figure 9). Vertical provenience was measured from the surface, and trenches were excavated to as deep as safely possible. Profiles were drawn and photographed, and soils were described using the USDA *Soil Survey Manual* (Soil Science Division Staff 2017), Munsell soil color charts (Munsell 2010), and a sediment texture flowchart (Thien 1979). Test unit locations were recorded with a 3 m-accurate Garmin GPSmap 62st, and all units were backfilled after excavation.

The scale in all field photographs is marked in 10 cm increments. The north arrow on all maps points to magnetic north. Throughout this report rock sizes follow the conventions outlined in *Field Book for Describing and Sampling Soils*: Gravel <7 cm; Cobble 7–25 cm; Stone 25–60 cm; Boulder >60 cm (Schoeneberger et al. 2002:2–35). No materials were collected and no laboratory analyses were conducted.

Figure 9. Excavation of TR 2. Orientation is to the southeast.

RESULTS

Pedestrian survey and subsurface testing were conducted in the 380 m^2 (4,000 ft^2) project area. No archaeological resources were found on the surface. Excavation of three trenches did not yield any evidence of subsurface archaeological deposits or features. Stratigraphy consisted mostly of topsoil above a natural beach deposit.

Pedestrian Survey

The surface survey included 100% of the 380 m^2 (4,000 ft^2) project area. No surface archaeological remains were observed within any part of the project area; any archaeological features that may have once been present are no longer there because of the extensive modern use of these lands. The entire project area consists of a landscaped yard.

Subsurface Testing

The three test units were placed within the project area to determine the presence or absence of subsurface archaeological deposits or material (Figures 10 and 11 and Table 2). No archaeological resources were found in any of the test units, and stratigraphy consisted mostly of topsoil above a natural beach deposit. Details of the three excavations are as follows:

TR 1 was located near the existing seawall (see Figure 10). The trench measured 1.71 x 1.29 m and was excavated to 155 cm below surface (cmbs). Stratigraphy consisted of fill for the seawall with a natural beach deposit toward the west side of the trench (Figures 12 and 13, see Table 2). Modern debris was observed throughout the fill deposit, including concrete rubble and discarded shoes No archaeological deposits or materials were identified.

TR 2 was placed on the north side of the project area (see Figure 10). This trench was offset from the existing seawall to avoid shearwater burrows. The trench measured 1.82 x .71 m and was excavated to 161 cmbs. Stratigraphy consisted of a layer of topsoil above a natural beach deposit (Figures 14 and 15, see Table 2). A buried sprinkler line was observed in the topsoil at 12 cmbs. No archaeological deposits or material were identified.

TR 3 was excavated on the south side of the project area (see Figure 10). This trench was also offset from the existing seawall to avoid shearwater burrows. The trench measured 1.79 x .71 m and extended to 1.52 cmbs. Stratigraphy was consistent with that of TR 2, with a layer of topsoil above a natural beach deposit (Figures 16 and 17, see Table 2). No archaeological deposits or material were identified.

Summary of Findings

Pedestrian survey of 380 m^2 (4,000 ft^2) of a beachfront property in Lanikai yielded no findings. The entire project area has been disturbed by modern use, such as landscaping for the lawn and installation of a sea wall for erosion control. Subsurface testing, consisting of three trenches, did not identify any subsurface cultural deposits or features. Stratigraphy consisted mostly of topsoil above a natural beach deposit, although one trench placed against the sea wall identified the fill deposit for the sea wall.

Figure 10. Location of test units on aerial imagery.

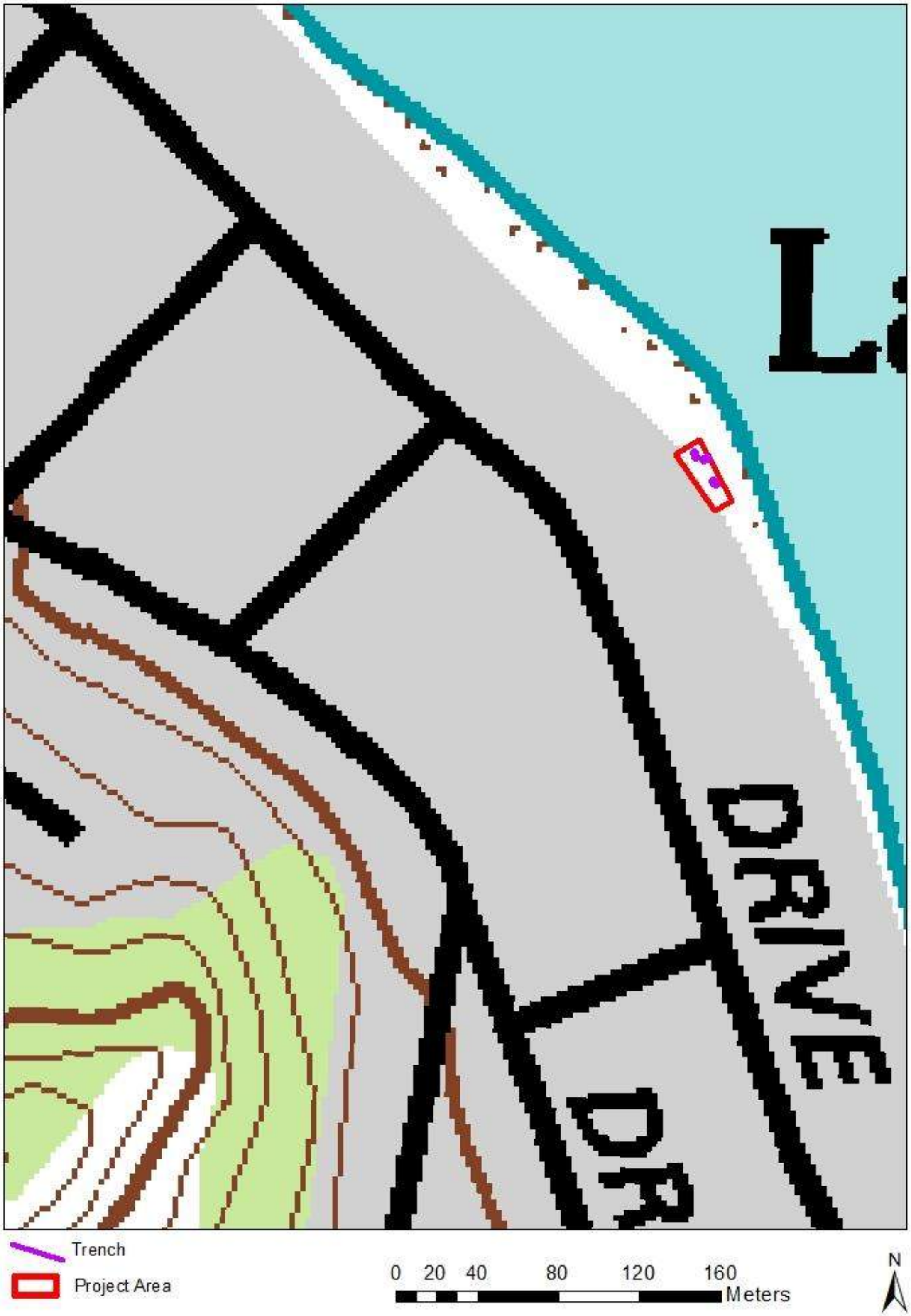


Figure 11. Wider view of trench locations on a topographic map (USGS 1998).

Table 2. Soil Descriptions

Location	Layer	Depth (cmbs)	Color	Description	Interpretation
TR 1	I	0–150+	10YR 6/3 Pale Brown	Fine sand; 1% roots, 10% coral stones and cobbles; modern debris; broken, very abrupt boundary.	Fill for Existing Sea Wall
	II	80–150+	10YR 8/4 Very Pale Brown	Fine sand; no roots; 1 coral cobbles; base of excavation.	Natural Beach Deposit
TR 2	I	0–26	10YR 5/3 Brown	Loamy sand; 80% roots, no rocks; sprinkler line; smooth, abrupt boundary.	Topsoil for Lawn
	II	26–150+	10YR 8/3 Very Pale Brown	Fine sand; 7% roots, 1% coral cobbles; base of excavation.	Natural Beach Deposit
TR 3	I	0–24	10YR 5/3 Brown	Loamy sand; 80% roots, no rocks; sprinkler line; smooth, abrupt boundary.	Topsoil for Lawn
	II	152+	10YR 8/3 Very Pale Brown	Fine sand; 3% roots, 1% coral cobbles; base of excavation.	Natural Beach Deposit

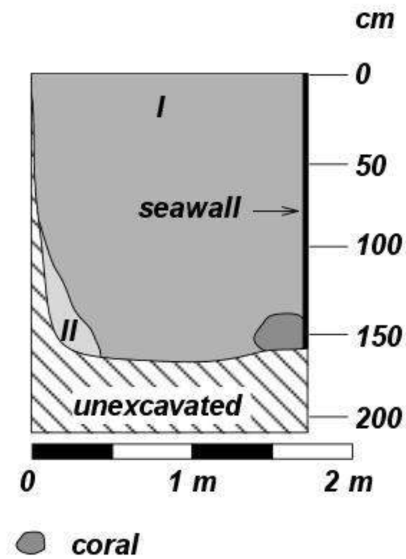


Figure 12. TR 1 northwest face profile drawing.

Figure 13. TR 1 northwest face photo.

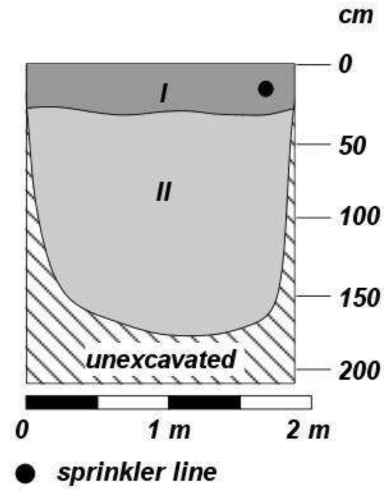


Figure 14. TR 2 southwest face profile drawing.

Figure 15. TR 2 southwest face photo.

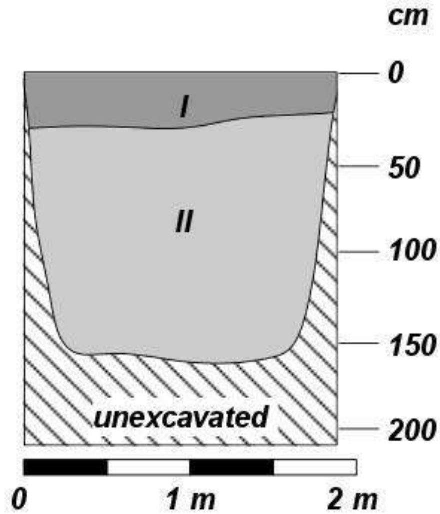


Figure 16. TR 3 southwest face profile drawing.

Figure 17. TR 3 southwest face photo.

SUMMARY AND RECOMMENDATIONS

An archaeological inventory survey was conducted on the makai (east) side of TMK: (1) 4-3-005: 056 in Lanikai, Kailua Ahupuaʻa, Koʻolaupoko District, on the island of Oʻahu. Seawall repairs are proposed for the property to help curtail erosion. The archaeological work included pedestrian survey that covered 100% of the 380 m^2 (4,000 ft^2) project area, as well as test excavations consisting of three trenches.

No surface archaeological remains were found during pedestrian survey of the project area. The entire area has been disturbed by modern activity, particularly the landscaping of the lawn. Likewise, subsurface testing did not yield any evidence of subsurface archaeological features or deposits. Due to negative findings, the AIS results are presented as an archaeological assessment per HAR §13–275-5(b)(5)(A). No further work is recommended.

GLOSSARY

ahupuaʻa	Traditional Hawaiian land division usually extending from the uplands to the sea.
ʻai	Food or food plant, especially vegetable food as distinguished from iʻa, meat or fleshy food.
ʻāina	Land.
akua	God, goddess, spirit, ghost, devil, image.
aliʻi	Chief, chiefess, monarch.
aliʻi nui	High chief.
boulder	Rock 60 cm and greater.
cobble	Rock fragment ranging from 7 cm to 25 cm.
ʻeʻepa	Extraordinary, incomprehensible, abnormal, peculiar.
gravel	Rock fragment less than 7 cm.
hau	The indigenous tree *Hibiscus tiliaceous*, which had many uses in traditional Hawaiʻi. Sandals were fashioned from the bark and cordage was made from fibers. Wood was shaped into net floats, canoe booms, and various sports equipment and flowers were used medicinally.
heiau	Place of worship and ritual in traditional Hawaiʻi.
hoaʻāina	Native tenants that worked the land.
hukilau	A net for fishing; to fish with a net.
iʻa	Fish or other marine animal.
ʻili	Traditional land division, usually a subdivision of an ahupuaʻa.
inoa	Name, title, or namesake.
ʻiwa	The frigate bird *Fregata minor palmerstoni*.
Kahiki	A far away land, sometimes refers to Tahiti.
kahuna	An expert in any profession, often referring to a priest, sorcerer, or magician.
kamaʻāina	Native-born.
kapa	Tapa cloth.
kapu	Taboo, prohibited, forbidden.
kiaʻi	Guard, caretaker; to watch or guard; to overlook, as a bluff.
koʻa	Fishing shrine.
kōnane	A traditional Hawaiian game played with pebbles on a wooden or stone board.
konohiki	The overseer of an ahupuaʻa ranked below a chief; land or fishing rights under control of the konohiki; such rights are sometimes called konohiki rights.
kuleana	Right, title, property, portion, responsibility, jurisdiction, authority, interest, claim, ownership.
kupuna	Grandparent, ancestor; kūpuna is the plural form.

lepo	Dirt, earth; dirty.
Māhele	The 1848 division of land.
maka‘āinana	Common people, or populace; translates to “people that attend the land.”
makai	Toward the sea.
makani	Wind, breeze.
mele	Song, chant, or poem.
Menehune	Small people of legend who worked at night to build structures such as fishponds, roads, and heiau.
midden	A heap or stratum of refuse normally found on the site of an ancient settlement. In Hawai‘i, the term generally refers to food remains, whether or not they appear as a heap or stratum.
moku	District, island.
mo‘o	Lizard, dragon, water spirit.
mo‘olelo	A story, myth, history, tradition, legend, or record.
naupaka	The native shrub *Scaevola* sp., varieties of which are found both in the uplands and by the sea.
post-contact	After A.D. 1778 and the first written records of the Hawaiian Islands made by Captain James Cook and his crew.
pre-contact	Prior to A.D. 1778 and the first written records of the Hawaiian Islands made by Captain James Cook and his crew.
pu‘u	Hill, mound, peak.
stone	Rock fragment ranging from 25 cm to 60 cm.
ua	Rain, rainy, to rain.

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APPENDIX A: LAND COMMISSION AWARDS

Pages for LCA 2657 in the Māhele Book

295

Uku pau loa $1.00

W. L. Lee
G. M. Robertson
J. H. Smith
J. Kekaulahao

Honolulu Feberuari 15. 1853.

Helu 3440 B Naluahinui — Kahaluu, Kona, Hawaii

Apana 1. E hoomaka ma ke kihi Hikina o kuio pa pili ana ma ka papohaku, a me ka aina o ke Aupuni, a e holo ana Ak. 28° Kom. 63 kap. alaila Hema 73° 15' Kom. 56 kap. alaila Hema 17° Hi. 25 kap. alaila Ak. 52° 45' Hi. 69 kap. a hiki i kahi i hoomaka'i.
Maia Apana - 121 fathoms
J. Fuller
1st Nov. 1851

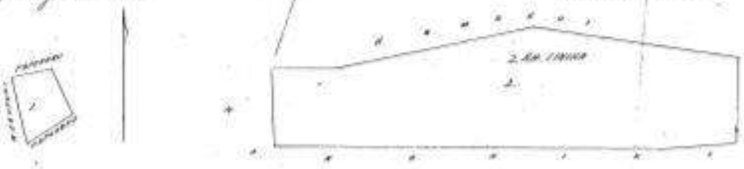
Apana 2. E hoomaka ma ke kihi Hikina Akau, a e holo

Hema	15° 31'	Hikina	2.16 kh.	ma ka aina o ke Konohiki
"	67° 15'	Kom.	1.97 "	"
"	71° 45'	"	9.67 "	"
Akau	20° 31'	"	1.96 "	"
"	71° 15'	Hikina	1.67 "	"
"	59° 30'	"	5.02 "	Kamuui
"	79°	"	5.36 "	" a hiki i kahi i hoomaka'i. [illegible]

pana aina he 2½ Eka.

J. Fuller
Lunanaaina

Kona, Hawaii, Aug. 24. 1852.



Uku pau loa $6.00

W. L. Lee
G. M. Robertson
J. H. Smith
J. Kekaulahao

Honolulu, Feberuari 15. 1853

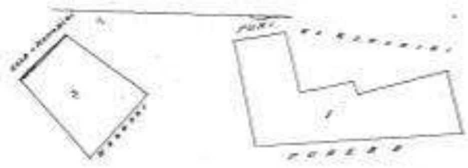
Helu 2657 Mahuia — Kailua, Koolaupoko, Oahu.

Apana 1. Aina mo'o i loko o Kuaihina, Kapa, Kailua, Oahu.
E hoomaka ma ke kihi Hikina, e holo ana Hema 78½° Kom. i 2.60 kh. ma ka palena me Kailikahi, Malaila aku Ak. 8° Kom. i 1.22 kh. ma ka palena me Hoki; Malaila aku Ak. 71° Hi. i 1.65 kh. ma ke Konohiki, Malaila aku Ak. 12° Kom. i 1.31 kh. Malaila aku Ak. 65° Hi. i 0.30 kh. Malaila aku Ak. 14° Kom. i 2.22 kh. Malaila aku, Ak. 76° Hi. i 1.51 kh. ma ke Konohiki, Malaila aku Hema 9[illegible] i 5.00 kh. ma ka palena o Puhuke, a hiki i kahi i hoomaka'i. He Eka 1, me 2 60/100 kh. huinaha.

Apana 2. He pakale ma Mapapa, Kaohao. Kailua.
E hoomaka ma ke kihi Komohana, e holo ana Hema 45° Hi. i 1.60 kh. ma ka palena kula o Konohiki, Malaila aku Ak. 45° Hi. i 2.55 kh. Malaila aku Ak. 35° Kom. i 3.10 kh. ma kahakai, Malaila aku Hema 37½° Kom. i 2.61 kh. a hiki i ka hoomaka ana. He 4 40/100 kh. huinaha.
Pau loa 1 Eka 7 kh. huinaha.

A. Bishop Ana ana.

246



Uku pau loa $5.00

B. L. Lee
G. M. Robertson
J. H. Smith
J. Kekaulahao

Honolulu Feberuari 23, 1852

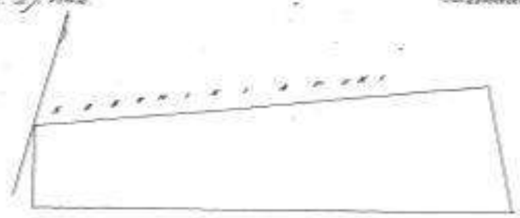
Helu 5635P Maikiki — Kahaluu, Kona, Hawaii.

E hoomaka ma ke kihi Akau, a e holo
Hema 25° 45' Hikina 3.10 kh. ma ka aina o ke Konohiki.
" 74° 20' Kom. 11.60 " " " " " "
Akau 15° " 1.98 " " " " " "
" 68° 30' Hikina 11.10 " " " " " " a hiki i kahi i hoomaka'i.
Moku o keia Apana Aina he 2 7/10 Eka.

Kona, Hawaii Aug. 27, 1852

J. Fuller
Tumaanaaina

2 KAULAHAO = 1 iniha



Uku pau loa $5.00

B. L. Lee
G. M. Robertson
J. H. Smith
J. Kekaulahao

Honolulu Feberuari 23, 1852.

Helu 5635E Kumau — Kahaluu, Kona, Hawaii

E hoomaka ma ke kihi Komohana Hema, a e holo
Akau 58° Kom. 1.27 kh. ma ka aina o ke Konohiki
" 67° 30' Hik. 7.19 " " " " " Naaukau.
" 65° 15' " 2.74 " " " " " "
" 81° " 3.86 " " " " " "
" 65° " 7.90 " " " " "
Hema 31° " 1.44 " " " " " Konohiki
" 67° Kom. 3.30 " " " " " "
" 66° 20' " 2.98 " " " " " "
" 77° 15' " 2.90 " " " " " "
" 67° 30' " 6.50 " " " " " " a hiki i kahi i hoomaka'i. Moku
o keia Apana Aina he 2 1/2 Eka

Kona Hawaii, Augate 23, 1852.

J. Fuller
Tumaanaaina

Appendix J

Early Consultation

OFFICE OF PLANNING
STATE OF HAWAII

DAVID Y. IGE
GOVERNOR

MARY ALICE EVANS
DIRECTOR
OFFICE OF PLANNING

235 South Beretania Street, 6th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

Telephone: (808) 587-2846
Fax: (808) 587-2824
Web: http://planning.hawaii.gov/

DTS 202006291151LI

July 9, 2020

Mr. Jeff Overton, Principal
Group 70 International, Inc.
111 S. King Street, Suite 170
Honolulu, Hawaii 96813

Dear Mr. Overton:

Subject: Early Consultation for Chapter 343, Hawaii Revised Statutes, Draft Environmental Assessment, Repair of Existing Shore Protection for 1226a Mokulua Drive, Kailua, Oahu, Hawaii; Tax Map Key: (1) 4-3-005: 056

The Office of Planning (OP) is in receipt of your Draft Environmental Assessment (Draft EA) early consultation request, received June 16, 2020, for the proposed repair of existing shore protection project located at 1226a Mokulua Drive, Kailua, Oahu.

According to the early consultation request, the proposed project is for "repair" of existing shore protection system, which is comprised of a seawall and revetment. The purpose of preparation of the subject EA is to support a shoreline setback variance for the proposed project.

At this time, the subject request did not provide sufficient information on the proposed project for review and comments. The OP looks forward to receiving the Draft EA when it is available for review.

If you have any questions regarding this letter, please contact Shichao Li of our office at (808) 587-2841.

Sincerely,

Mary Alice Evans

Mary Alice Evans
Director

DEPARTMENT OF DESIGN AND CONSTRUCTION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 11TH FLOOR
HONOLULU, HAWAII 96813
Phone: (808) 768-8480 • Fax: (808) 768-4567
Web site: www.honolulu.gov

August 20, 2020

G70
ATTN: Jeff Overton
111 S. King Street, Suite 170
Honolulu, HI 96813

Dear Mr. Overton,

Subject: Early Consultation for Chapter 343, Hawaii Revised Statutes (HRS)
Draft Environmental Assessment
Repair of Existing Shore Protection for 1226a Mokulua Drive
TMK: (1) 4-3-005:056

Thank you for the opportunity to review and comment. The Department of Design and Construction does not have any comments at this time.

Should you have any further questions, please contact me at 768-8480.

Sincerely,

Mark Yonamine, P.E
Director

MY:ms (815881)

DAVID Y. IGE
GOVERNOR OF
HAWAI'I

STATE OF HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES

OFFICE OF CONSERVATION AND COASTAL LANDS
POST OFFICE BOX 621
HONOLULU, HAWAI'I 96809

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
FIRST DEPUTY

JEFFREY T. PEARSON, P.E.
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

REF:OCCL:SS

Correspondence: OA 20-179

JUL - 2 2020

G70 International
c/o Jeff Overton, Principal
111 S. King Street, Suite 170
Honolulu, HI 96813

SUBJECT: Environmental Assessment Pre-Consultation Regarding Shoreline Protection for 1226a Mokulua Drive, Lanikai, Kailua, Oahu; Tax Map Key (1) 4-3-005:056

Dear Mr. Overton:

Thank you for contacting the Department of Land and Natural Resources, Office of Conservation and Coastal Lands (OCCL) regarding the Environmental Assessment (EA) that is being prepared for the owners of the subject property. Your letter states that the owners are pursuing approval to repair their existing shoreline protection system that is comprised of a seawall and revetment. It was noted in the letter that the existing shore protection is covered by a non-exclusive easement.

The OCCL appreciates your notification of the proposed construction and will wait until the Draft Environmental Assessment (DEA) is received before making any comments, determinations, or decisions.

If you have further questions, please feel free to contact Salvatore Saluga in the Office of Conservation and Coastal Lands at 587-0399 or Salvatore.J.Saluga@hawaii.gov.

Sincerely,

Sam Lemmo

SAMUEL J. LEMMO, ADMINISTRATOR
OFFICE OF CONSERVATION AND COASTAL LANDS

DEPARTMENT OF PLANNING AND PERMITTING
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 7TH FLOOR • HONOLULU, HAWAII 96813
PHONE: (808) 768-8000 • FAX: (808) 768-6041
DEPT. WEB SITE: www.honoluludpp.org • CITY WEB SITE: www.honolulu.gov

KIRK CALDWELL
MAYOR

KATHY K. SOKUGAWA
ACTING DIRECTOR

TIMOTHY F. T. HIU
DEPUTY DIRECTOR

EUGENE H. TAKAHASHI
DEPUTY DIRECTOR

July 31, 2020

2020/ELOG-1103(ST)

RECEIVED
AUG 04 2020
G70

Mr. Jeff Overton, AICP
G70
111 South King Street, Suite 170
Honolulu, Hawaii 96813-4307

Dear Mr. Overton:

SUBJECT: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
1226 Mokulua Drive - Lanikai
Tax Map Key 4-3-005: 056

This is in response to your letter, received June 10, 2020, requesting input regarding the preparation of a Draft EA for proposed repairs to existing seawall and revetment, at the above-referenced property.

We note that our records indicate that there were two previous inquires in 1999 regarding the potential consolidation of then accreted lands makai of this parcel, and on the status of possible buried walls built on the property prior to World War II (File Nos. 1999/CLOG-3593 and 4318). This correspondence should be retrieved from our Data Access and Imaging Branch (DAIB) to provide a regulatory context to the current shoreline situation and a discussion should be included in the Draft EA. We also note that our records indicate that there was action on this subject property, along with adjoining Parcels 57, 76 and 88 (File No. 68/VLOG-115), which relates to the requirements of the original 10-foot setback from the "zone of wave action", set forth in Ordinance Nos. 2837 and 2892 (1966). Because this record has not been scanned into the computer system, it will need to be retrieve from the microfiche records also found in DAIB. You may contact Ms. Jocelyn Godoy of DAIB, at (808) 768-8276 for assistance.

Furthermore, the site may be subject to flooding and increased risk of impact due to sea level rise (SLR). The Draft EA must disclose the impacts of the SLR to the property.

We will provide substantive comments when a complete Draft EA is submitted for our review. Should you have any questions, please contact Steve Tagawa, of our Land Use Approval Branch, at 768-8024.

Very truly yours,

FOR Kathy K. Sokugawa
Acting Director

Noelle Besa Wright

From: 220017-01 1226 mokulua drive
Sent: Monday, June 15, 2020 2:42 PM
To: 'billhicksknb@gmail.com'
Cc: Jeff Overton
Subject: RE: Input on repairs

Aloha Chair Hicks,

Thank you for confirming receipt of the letter and for your input regarding the project. We understand the board has no objection to the repairs.

We will continue to keep you and the Kailua NB updated as the draft EA progresses.

Mahalo,

G70
Noelle Besa Wright
Planner

t 808.523.5866
e noellew@g70.design

From: billhicksknb@gmail.com <billhicksknb@gmail.com>
Sent: Saturday, June 13, 2020 11:26 AM
To: 220017-01 1226 mokulua drive <1226mokulua@g70.design>
Subject: Input on repairs

Aloha Jeff…

I am in receipt of your letter dated June 9, 2020 and understand you are conducting a draft EA. We have no objection to the necessary repair of the required existing shoreline protection system. We look forward to future updates.

Aloha,
Bill Hicks
Chairman, Kailua Neighborhood Board