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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

Office of Conservation and Coastal Lands
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

DLNR: OCCL: SL

Correspondence: Draft EA for MA-12-252

JUN 23 2012

FILE COPY

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OFC. OF ENVIRONMENTAL QUALITY CONTROL

RECEIVED

MEMORANDUM

To: Mr. Gary Hooser
Office of Environmental Quality Control

From: Samuel J. Lemmo
Office of Conservation and Coastal Lands

Subject: Draft Environmental Assessment (EA) for Permanent Shore Protection of the Hololani Resort Condominiums Located at 4401 Lower Honoapiilani Road, Lahaina, Maui, TMK: (2) 4-3-010:009.

The Department of Land and Natural Resources has reviewed the Draft Environmental Assessment (EA) for the proposed project and anticipates a Finding of No Significant Impact (FONSI) determination. Please publish notice of availability for this project in the **June 23, 2012** issue of the Environmental Notice. We have enclosed the applicant's completed OEQC Bulletin Publication Form and one (1) copy of the document in pdf format on a CD; and one (1) hardcopy of the Draft EA.

Should you wish to provide comments regarding this project please respond by the 30th Comment Day Deadline: July 23, 2012. If no response is received by the comment deadline, we will assume there are no comments. Please contact Brad Romine in the Office of Conservation and Coastal Lands at (808) 587-0049 should you have any questions.

Enclosures: *OEQC Bulletin Publication Form (hard copy)*
One (1) CD with pdf of the Draft EA
One (1) hardcopy of the Draft EA

Project Name: Permanent Shore Protection of the Hololani Resort Condominiums

Publication Form
The Environmental Notice
Office of Environmental Quality Control

Instructions: Please submit one hardcopy of the document along a with determination letter from the agency. On a compact disk, put an electronic copy of this publication form in MS Word and a PDF of the EA or EIS. Please make sure that your PDF documents are ADA compliant. Mahalo.

Applicable Law: **Chapter 343, Hawaii Revised Statutes; Title 13, Chapter 5, Hawaii Administrative Rules**

Type of Document: **Draft Environmental Assessment**
Island: **Maui**
District: **Lahaina**
TMK: **(2) 4-3-010:009**
Permits Required: **Conservation District Use Application, Shoreline Setback Variance, Special Management Area (Major)**

Applicant or Proposing Agency: **Association of Apartment Owners of the Hololani Resort Condominiums**
Address: c/o 1417 116th Ave NE, Bellevue, WA 98004
Contact & Phone: Mr. Stuart Allen (425) 454-3605 , ext 130

Approving Agency/ Accepting Authority: **State Department of Land and Natural Resources – Office of Conservation and Coastal Lands**
Address: 1151 Punchbowl Street, Room 131 Honolulu, Hawai`i 96813
Contact & Phone: ????

Consultant: **Sea Engineering, Inc.**
Address: Makai Research Pier
41-305 Kalanianaole Highway
Waimanalo, HI 96795
Contact & Phone: **James Barry 259-7966 ext. 24**

Project Summary: Summary of the direct, indirect, secondary, and cumulative impacts of the proposed action (less than 200 words). Please keep the summary brief and on this one page.

Hololani Resort Condominiums, located along the Kahana Coast in West Maui, consists of twin 8-story building with 63 apartments. The shoreline is chronically eroding, with an average annual erosion rate of approximately 0.8 feet per year.

Since the lot was originally partitioned in 1959, it has eroded almost 40 feet, moving the active erosion scarp to within 15 feet of the northern building's corner in 2007. Nearly 5,000 square feet of property has been lost.

Temporary shoreline stabilization structures have been authorized by County and State agencies since 1988. The most recent temporary structure was permitted in 2007 under the condition that permanent shore protection be engineered for the site to protect the habitable structures on the property from potentially catastrophic damage.

The proposed shore protection is a structure consisting of a sloping rock revetment that rises to a crest at +6 ft MSL, backed by a vertical seawall that rises to grade at +12 ft. The rock revetment will minimize wave reflection to help allow accretion of sand, and the vertical wall will minimize the horizontal extent of the structure. The revetment crest will help provide lateral access during seasonal low sand conditions.

Draft and Final Environmental Assessment Checklist

FOR OEQC USE ONLY
Date Received:
Date of Publication:
Draft EA Comment Deadline:
Draft EA Place in Public Library:

Project Name: Permanent Shore Protection of the Hololani Resort Condominiums

Draft Environmental Assessment

Conditions Which Triggered Ch. 343, HRS, EIS Law. Check All That Apply:

Applicable sections *(check all that apply)*:

___ use of state or county lands or funds
X use of conservation district lands
X use within shoreline setback area
___ use of historic site or district
___ use of land in the Waikiki district
___ amendment to county general plan
___ reclassification of conservation lands
___ construction or modification of helicopter facilities
___ wastewater facility, waste-to-energy facility, landfill, oil refinery, or power-generating facility

Content Requirements; Draft EA (see Sec. 11-200-10 thru 13, HAR)

___ Agency submittal letter and anticipated determination
X Identification of applicant or proposing agency
X Identification of approving agency
X Identification of agencies, citizen groups, and individuals consulted in making the assessment
X General description of the action's technical, economic, social, and environmental characteristics; time frame; funding source
X Summary description of the affected environment, including suitable and adequate regional, location and site maps such as Flood Insurance Rate Maps, Floodway Boundary Maps, or United States Geological Survey topographic maps
X Impacts to cultural practices and resources, past and current (Act 50, 2000)
X Identification and summary of impacts and proposed mitigation measures
X Alternatives considered
X Discussion of findings and reasons supporting the agency anticipated determination
X List of all required permits and approvals (State, federal, county), if any
X Written comments and responses to the comments under the early consultation under HAR 11-200-9(a)(1), 11-200-9(b)(1), or 11-200-15.

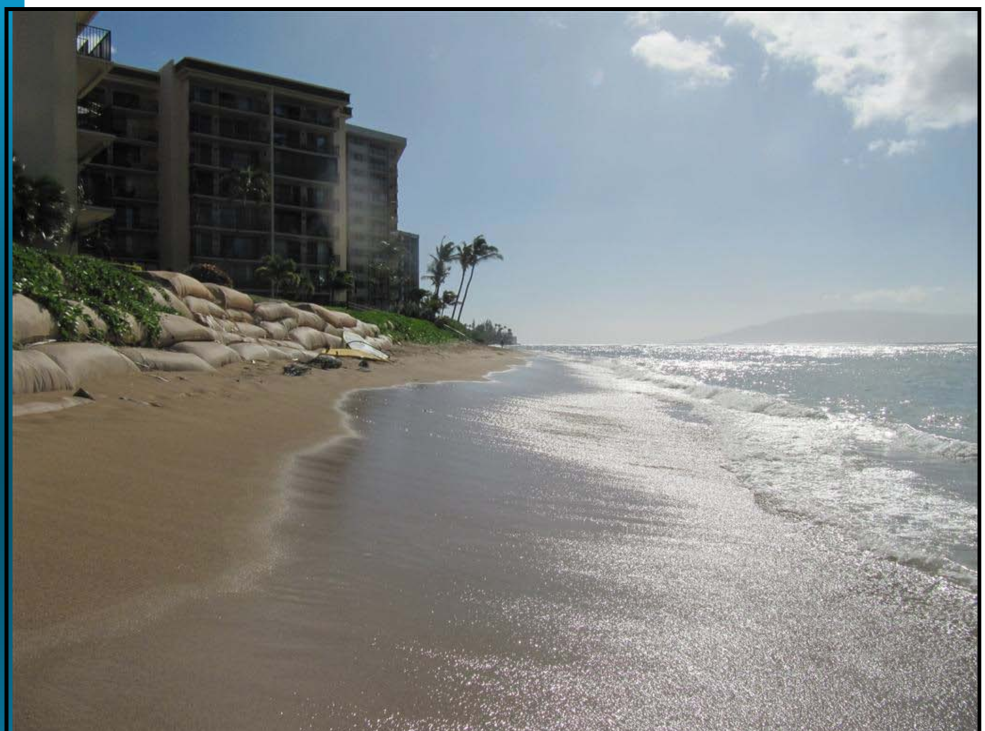
Final Environmental Assessment
Finding of No Significant Impact (FONSI)

___ Agency submittal letter
___ Agency determination
___ Discussion of findings and reasons supporting the agency determination
___ Written comments and responses to the comments under the statutorily prescribed public review periods

DRAFT ENVIRONMENTAL ASSESSMENT FOR PERMANENT SHORE PROTECTION OF THE HOLOLANI RESORT CONDOMINIUMS

KAHANANUI, LAHAINA, MAUI

June, 2012



Prepared for:
Association of Apartment Owners of
Hololani Resort Condominiums
4401 Lower Honoapiilani Road
Lahaina, Hawaii 96761

Accepting Authority:
State of Hawaii Department of Land and Natural Resources, Land Division – Office of Conservation and Coastal Lands
1151 Punchbowl Street, Room 131
Honolulu, Hawaii 96813

Prepared by:
Sea Engineering, Inc.
Makai Research Pier
Waimanalo, HI 96795

SEI Job No. 25291

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PROJECT SUMMARY

Project:	Hololani Shore Protection
Owner:	Association of Apartment Owners of the Hololani Resort Condominiums 4401 Lower Honoapiilani Road Lahaina, Hawaii 96761
Consultant:	Sea Engineering, Inc. Makai Research Pier 41-305 Kalanianaole Highway Waimanalo, HI 96744 Contact: Jim Barry, Phone (808) 259-7966 ext. 24 Email: jbarry@seaengineering.com
Location:	Kahana, Maui, Hawaii
Tax Map Keys:	(2) 4-3-010:009
State Land Use District:	Urban
County Zoning:	H-2 (Hotel)
FIRM:	Zone AE (15 ft), Zone VE (15 &14 ft)
Proposed Action:	Construction of hybrid rock rubble mound revetment and seawall shore protection
Required Permits:	
Federal Department of the Army	Rivers and Harbors Act, Section 10 Clean Water Act, Section 401
State of Hawaii Department of Land and Natural Resources	Conservation District Use Permit
State of Hawaii Department of Health	Clean Water Act, Section 404
County of Maui Department of Planning / Planning Commission	1. SMA (Special Management Area) 2. SSV (Shoreline Setback Variance)
Actions Requiring Environmental Assessment:	Work within the Shoreline Setback Zone, and within the State Conservation District
Anticipated Determination:	Finding of No Significant Impact (FONSI)
Estimated Cost:	$2.1M (construction)

1. INTRODUCTION AND SUMMARY

1.1 Executive Summary

Hololani Resort Condominiums, located along 400 feet of the Kahana Coast in West Maui, consists of twin 8-story buildings with 63 apartments. The shoreline is dominated by a tall erosion scarp within the native volcanic clay substrate[1]. The sand beach fronting the property is seasonally dynamic, with summer seasonal waves and Kona storms causing sand accretion, and winter seasonal waves eroding the beach. The shoreline is chronically eroding, with an average annual erosion rate of around 0.8 feet per year.

Since the lot was originally partitioned in 1959, it has eroded almost 40 feet, moving the active erosion scarp to within 15 feet of northern building's corner in 2007. Nearly 5,000 square feet of property has eroded between the two buildings and the shoreline. This has significantly reduced the buffer area between the inhabited structures and the shoreline that affords protection from potential damage due to large wave events.

The need to stabilize this coastline has been apparent for some time. Temporary shoreline stabilization structures were authorized by County and State agencies as far back as 1988. The most recent temporary structure, a combination of geotextile sand bags and rock mattresses, has not shown any apparent impacts on the seasonal behavior of the beach, though it has helped in slowing the ongoing, chronic erosion and has provided a more durable coastline for mitigating coastal natural hazards. However, the temporary measures are not an adequate long-term solution, as highlighted in the winter of 2010/2011 when wave damage to the temporary structure resulted in repairs costing nearly 1/3 of the total structure's value. In addition, failure of any individual sand bag has the ability, and a history at this location, for destabilizing entire sections of the structure.

Three general options exist:

1. Continue to maintain the temporary structure;
2. Design and build a well engineered and appropriately sized permanent structure, or,
3. Remove the existing structures and allow chronic erosion to undermine and destabilize the inhabited buildings.

While beach nourishment is also a regional option, it cannot guarantee the safety of the building or its inhabitants without additional measures.

[1] Note: in this report the term "clay" is used to describe the predominant silt, silty sand, silty gravels as well as clay of the Pulehu clay loam that appears to form most of the substrate at the project site (see Section 4.1.14).

The preferred alternative proposed as a solution to protect the condominium buildings is a hybrid structure that consists of a sloping rock revetment that rises to a crest at +6 ft MSL[2], backed by a vertical seawall that rises to grade at +12 ft. The revetment crest will provide lateral access during seasonal periods of low sand. This structure would protect 372 ft of the 400-ft shoreline. The north end would terminate at the County drainage easement, but, with assistance from neighbors and the County, it could be constructed to extend across the easement. The south end would terminate well before the property line, leaving space as a buffer to minimize end-effect related erosion.

This option would protect the structure and the inhabitants with minimal influence on the seasonal beach dynamics along the coastline. As there is no inland sand mauka of the structure, but rather a clay bank, there will not be any impoundment of beach quality sand. In addition, replacing an eroding clay bank with an engineered revetment reduces reflected wave energy and eliminates the turbidity issues associated with bank erosion. With current beach volumes during periods of south swell activity, the majority of the shoreline structure will disappear beneath the accreting beach.

1.2 Project Location and General Description

The Hololani Resort Condominiums (the Hololani) consist of twin 8-story buildings with 63 apartment units, a 1-story commercial building, and minor structures that include a swimming pool and pool deck. The complex is located on the Kahana coast of West Maui, approximately 7 miles north of Lahaina (Figure 1-1). The project shoreline is approximately 400 feet in length and is at the north end of an 1,800-ft reach of sand beach that fronts six condominium resort properties (see Figure 3-1). The Pohailani Condominiums north of, and adjacent to the Hololani are fronted by a grouted stone seawall. A Maui County drainage easement and storm drain separate the Hololani and Pohailani properties. The storm drain and surroundings are in an extreme state of disrepair (see Section 2.5.1). Shoreline hardening extends north from the storm drain for at least 600 feet across three properties. The adjacent property to the south is the Royal Kahana Resort.

The Hololani has a long history of shoreline erosion problems. Currently, the erosion has been arrested by placement of temporary protection, but the erosional escarpment is within 15 ft of the north building. An aerial photographic analysis completed by SEI in 2001 showed 14 ft of erosion and 28 ft of erosion of the vegetation line at the center and northern parts of the property, respectively, between 1949 and 1997, with an average erosion rate of about 0.8 ft per year (see Section 4.1.12). The erosion analysis of the University of Hawaii Coastal Geology Group

[2] All elevations in this report are referenced to the Mean Sea Level (MSL) datum.

(UHCGG) also found a long term erosion rate of about 0.8 feet per year, which was typical for that region (Fletcher *et al*, 2003).

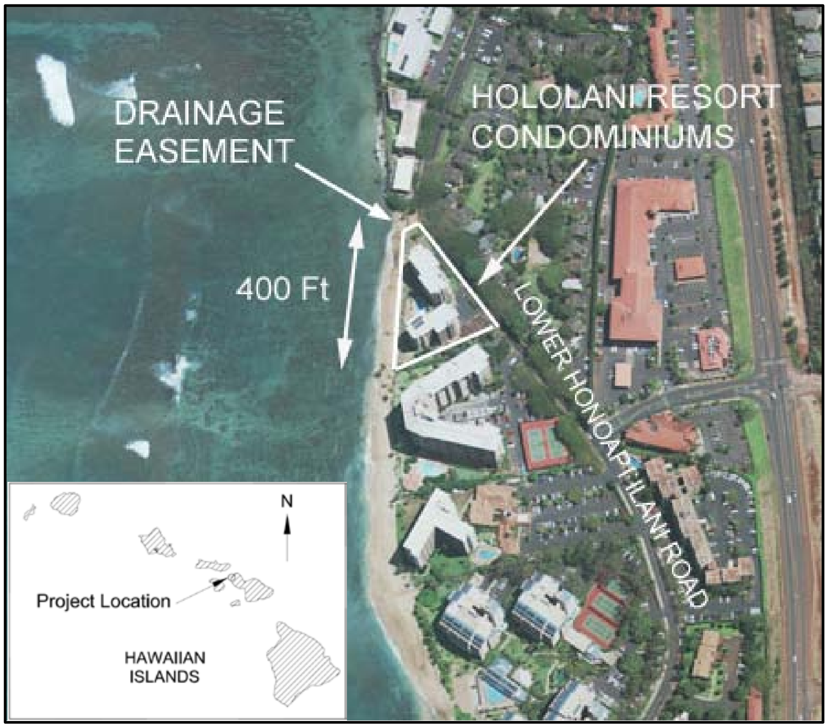


Figure 1-1. Project site location

The Hololani property was originally part of the Bechert Estate. The estate was partitioned in 1959 into five lots, with Lot 1 then sub-divided into Lots 1-A, 1-B, and 1-C, with the Hololani property being Lot 1-A (see Appendix C, Valera, Inc. 2011). Assuming the original subdivision boundary was close to what would now be considered a legal definition of the shoreline (a reasonable assumption based on the 1949 aerial photograph), shoreline surveys show that the property eroded approximately 25 ft between the time of the partitioning and Certified Shoreline documentation in 1972. The present shoreline is approximately 17 ft mauka from the 1972 shoreline. Although there have been intermittent periods of accretion – notably in 1961 and 1987, it appears that the shoreline has receded close to 40 ft since the partitioning in 1959.

The west-facing shoreline is subject to waves from the south, west, and north, with seasonal and short term effects on the sand beach. Very generally, waves from the south during the summer season tend to push sand north so that a beach is created in front of the Hololani. Winter waves from the north tend to transport the sand south and denude the beach. However, large volumes of sand accretion have occurred due to Kona Storm waves during the winter season – these waves are generally from the southwest.

While the seasonal changes are pronounced, there appears to have been a net loss of sand from the overall system, so that the protective sand beach has been lost with increasing frequency, leaving the red clay shoreline embankment increasingly exposed.

Long-time Hololani residents identify the construction of the county drainline in the easement at the north end of the property as the catalyst that precipitated the onset of serious coastal erosion. Efforts to combat the erosion have been on-going since construction of a sand bag wall in 1988. Typical fabric sand bags are a time-honored method of erosion control, but they quickly degrade in the tropical sun and will not stand up to forces caused by waves of any appreciable size. The sand bag efforts that occurred in 1988 and later years were somewhat effective in slowing the erosion, but the trend continued. During the winter of 2006-2007, the erosion problem became dire, with large sections of the shoreline calving in to the sea. Figures 1-2 and 1-3 are photographs taken in January of 2007 that show the extreme erosion that was taking place at the time. The erosion posed a significant threat to the Hololani buildings and caused significant turbidity in nearshore waters. The boulders in the photograph are the remnants of non-engineered shore protection that was only temporarily effective. The boulders became a safety hazard and were removed soon after.

The erosion in 2007 progressed to the point where the buildings and possibly the underground parking structure were threatened. At its closest approach, the erosion scarp was only 15 feet from the north building (Figure 1-3). A site visit by staff of the State Department of Land and Natural Resources, Office of Conservation and Coastal Lands (DLNR-OCCL) on January 11, 2007 determined that the north building was at risk without immediate shore protection. Sea Engineering, Inc. (SEI), designed a temporary geotextile sand bag and rock mattress structure that met requirements set by the DLNR-OCCL for an emergency protection structure. The structure was constructed in November and December 2007 under an authorization for an emergency request (DLNR File No. Emergency-OA-07-08). The temporary structure was also authorized under emergency provisions by the Maui County Planning Department. The understanding contained in the DLNR-OCCL authorization was that the structure was intended to be temporary until the required permits were obtained for a permanent solution.

Figure 1-4 is a view of the temporary structure soon after completion. Materials and construction costs were in excess of $400,000.

SEI has monitored the shoreline conditions at the Hololani since emplacement of the temporary structure in December, 2007. The following trends have been observed:

- Sand accretion occurs when winds and waves have a southerly component, such as during southern swell or Kona storm conditions;
- Accretion of sand has not been inhibited by the presence of the temporary shore protection;
- Erosion is pronounced when incident waves have a strong northerly or northeasterly component.

The 2009-2010 winter wave season was one of the more energetic on record, and the presence of the temporary structure certainly prevented continued shoreline erosion and saved the Hololani from possible irreparable structural damage. Although a robust structure, the temporary emergency revetment has suffered damage. The 2010-2011 winter wave season was particularly damaging, and repairs to the temporary structures totaled $140,000. Some of the damage is shown in Figure 1-5.

The ability of temporary shore protection structures to withstand severe conditions is limited by the size and types of materials used to construct them – for example, by the size of the geotextile sand bags used at the Hololani. The design lifetime is difficult to predict as the structures do not have accepted engineering design guidelines, and unexpected occurrences – such as damage from wear of the geotextile material causing some of the bags to lose their sand fill and deflate – can have major debilitating effects on the structure. The open coast wave climate of West Maui can produce prolonged high wave conditions that will eventually destroy any under-engineered coastal structure. It is clear that an engineered shore protection structure is necessary for the survival of the Hololani buildings and the safety of the inhabitants.

In April of 2010, Sea Engineering was contracted by the Hololani Association of Apartment Owners (AOAO) to design permanent shore protection to replace the existing geotextile sand bags. A Basis of Design Report was submitted to the Hololani with the design for two suitable design alternatives - a rock rubble mound revetment and a hybrid seawall/revetment.

The hybrid seawall/revetment structure was chosen as the preferred design alternative. It has numerous advantages, including:

1. A reduced design footprint that can be placed within the original property limits of the Hololani;

2. Preservation of lateral shoreline access along the lowered height of the revetment crest portion of the structure;

3. A reduction of reflected wave energy when compared to the native clay embankment, the existing temporary emergency structure, and a seawall alternative;

4. Improved capacity to allow for seasonal beach accretion.

Permanent engineered shore protection will allow the Hololani to prevent future erosion damage and avoid the recurring efforts at expensive, messy and often ineffective temporary emergency protection measures.

Lower Honoapiilani Road, a vital component of the West Maui transportation infrastructure, closely approaches the coast at the north end of the Hololani. The property is a buffer between the road and the sea, and protection of the Hololani also serves to protect the road. The drainage easement between the Hololani and Pohailani properties is in an extreme state of disrepair due to the lack of protection from years of coastal erosion, and the drain line functions poorly, allowing water to pool on the roadway. Although the proposed structure ends at the drainage easement, one design alternative is presented in Section 2.4.1 that will protect the easement area and portions of the Pohailani property, and require improvements to the drain line (Figure 2-8). This alternative requires cooperation and assistance from the Pohailani and Maui County Department of Public Works. However, even if the structure terminates at the drainage easement, it will be designed to facilitate future improvements to the easement area.

Figure 1-2. Severe erosion, January 2007

Figure 1-3. Erosion conditions threatening the north building in January 2007

Figure 1-4. Freshly installed temporary shore protection, January 2008

Figure 1-5. Extensive damage caused by high waves, January 2011

1.2 Project Purpose and Objectives

The purpose of the project is to provide the Hololani with permanent shore protection that will protect the condominium buildings from wave damage and alleviate the necessity of implementing non-engineered emergency measures. The selected design alternatives should have the following characteristics:

- The design will protect the valuable shorefront property without causing degradation to the sand beach;
- The structure will be unobtrusive when the beach is healthy (i.e. beach sand volume is high);
- The protection will withstand an extreme storm event without failure or damage.

1.3 Summary Description of the Project

The proposed action is a hybrid shore protection structure that combines a vertical seawall with a sloping rock rubble mound revetment. The proposed layout of the structure is shown in Figure 1-6, and the design cross-section is shown in Figure 1-7. The structure will protect approximately 370 feet of the approximately 400 feet of shoreline that fronts the Hololani. The remainder will be left as a buffer to minimize end-effect related erosion of the neighboring property to the south. The north end of the structure will stop and return at the edge of the drainage easement, although an alternative is presented in Section 2.4.1 that will improve the easement area as well. The hybrid structure has the following benefits:

1. The structure footprint has been minimized in order to fit within the original property boundaries and have the least excursion into the Conservation District and navigable waters of the United States;

2. The rock rubble mound revetment that forms the seaward toe of the structure will minimize wave reflection and allow seasonal sand accretion;

3. The crest of the rock rubble mound revetment is 5 ft in width, and will provide lateral shoreline access when seasonal conditions prevent the formation of a sand beach.

4. The structure offers long-term erosion protection for the Hololani property.

5. Preventing erosion of the native clay embankment will help prevent the formation of turbidity in nearshore waters during high wave conditions.

The top of the toe of the rock revetment will be at an elevation of - 0.5 ft MSL, and the crest of the revetment will be at an elevation of +6 ft. The rock revetment has been designed for a 50-year wave event.

The wall will be constructed of vinyl sheet pile, with a concrete cap at an elevation of approximately +12 ft, and driven to a depth of -10 ft or rock refusal. The sheet pile wall will have a line of soil anchors spaced at 5-ft centers for reinforcement. The vinyl product will not corrode, is resistant to degradation from ultra-violet sunlight, and is typically guaranteed for 50 years. The product is new to Hawaii, but has been used on mainland projects for over 20 years.

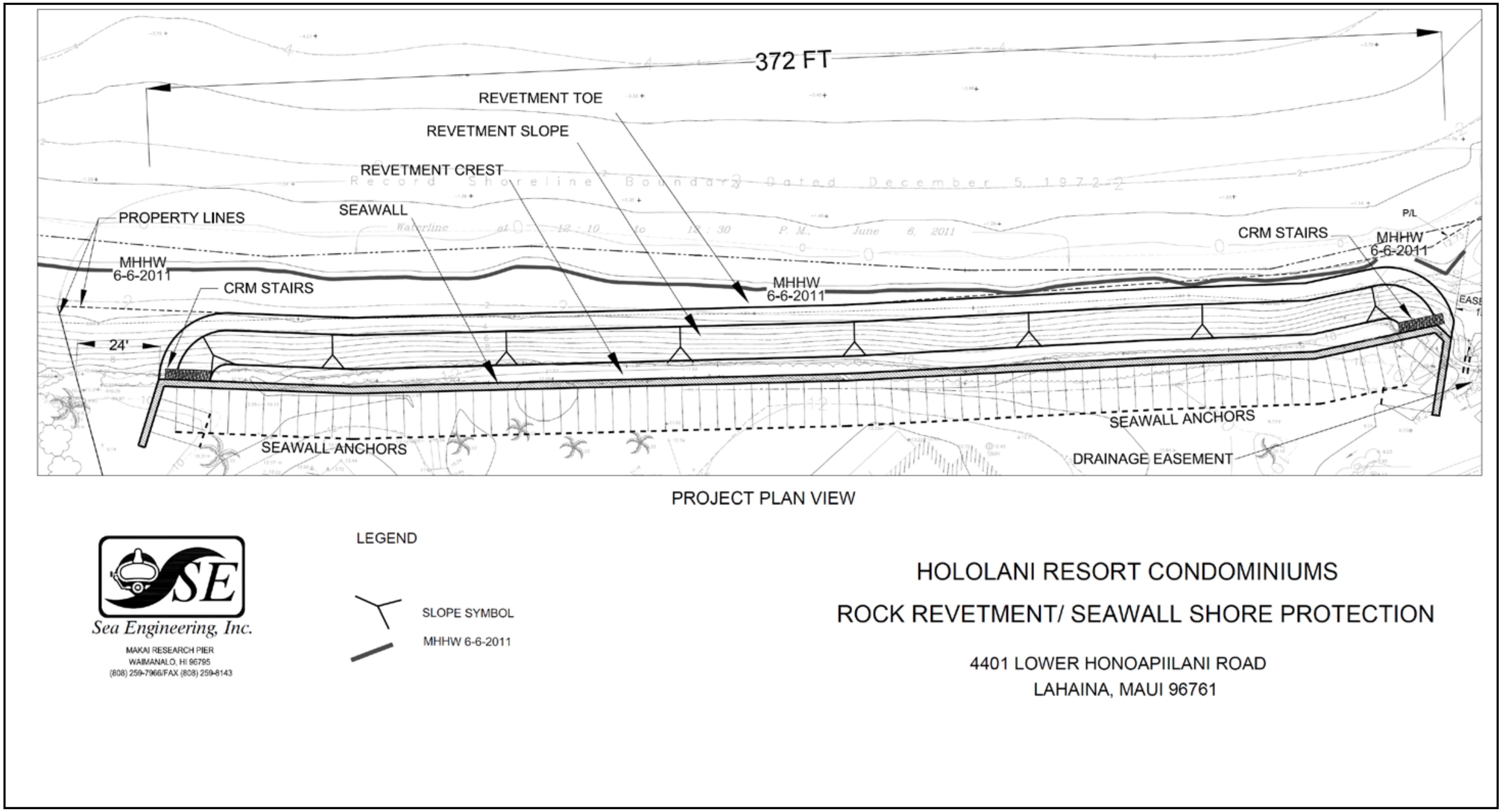


Figure 1-6. Layout of proposed hybrid revetment and seawall

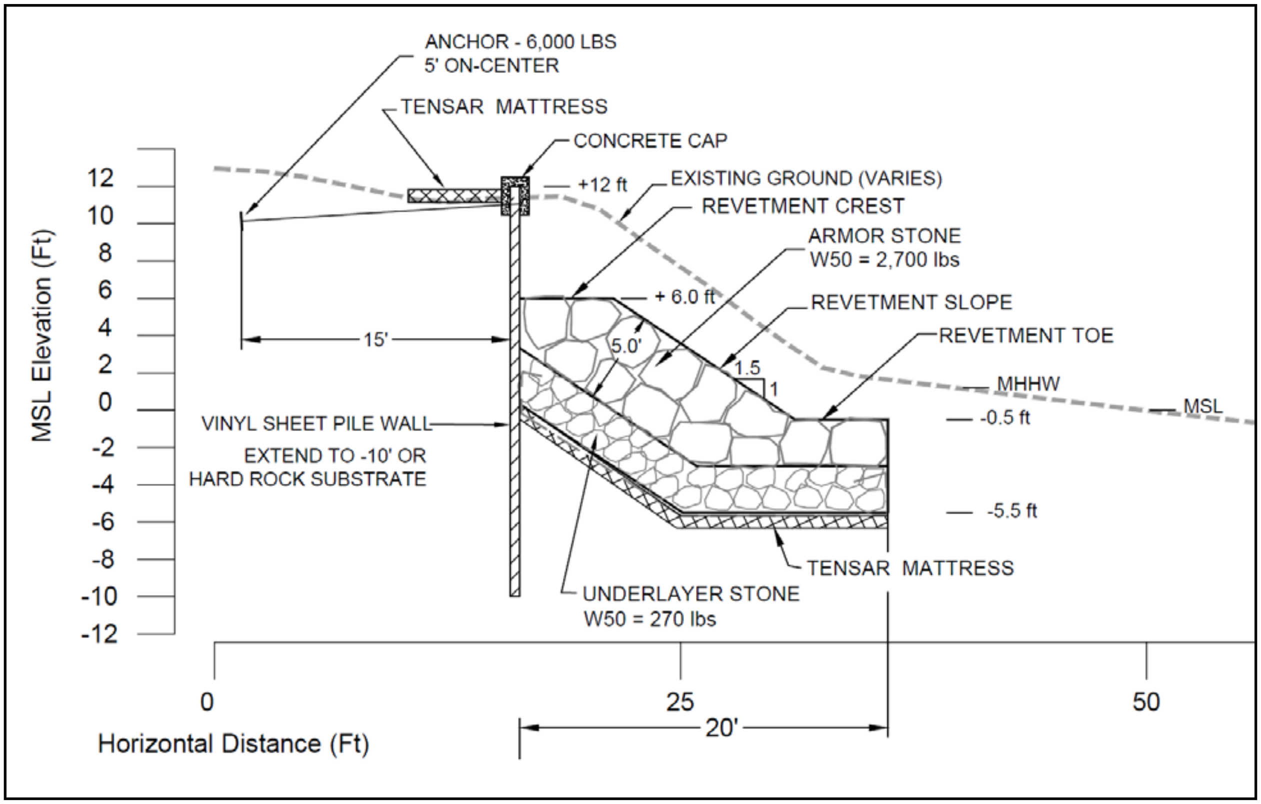


Figure 1-7. Cross-section of the proposed shore protection structure

1.4 Relationship to Governmental Plans, Policies and Control

1.4.1 Summary of Government Permits Required

Potential government permit requirements for a beach improvement project include the following:

Federal

- Section 10, Work in Navigable Waters of the U.S. (U.S. Army Corps of Engineers)
- Section 404, Clean Water Act, for Fill in Waters of the U.S. (U.S. Army Corps of Engineers)

State of Hawaii

- Conservation District Use Permit (DLNR-OCCL)
- Coastal Zone Management Consistency Review (DBEDT, Department of Planning, CZM Program)
- Clean Water Act, Section 401 Water Quality Certification (DOH-CWB)

County of Maui

- Special Management Area (SMA-Major)
- Shoreline Setback Variance (SSV)

1.4.2 Environmental Assessment and Accepting Agency

Three of the required permits, the State CDUP, and County SMA and SSV, require the environmental review process that is detailed in Chapter 343 of the Hawaii Revised Statutes. The process requires the submission of an Environmental Assessment (EA) to be reviewed by interested parties and decision makers to ensure that environmental concerns are given appropriate consideration.

Upon inquiry to both DLNR-OCCL and the County of Maui Planning Department, it was agreed that DLNR-OCCL should be the accepting agency for the EA (see Appendix A).

1.4.3 Federal Permits Required

A request for jurisdictional determination was made to the Regulatory Branch of the U.S. Department of the Army, Corps of Engineers, Honolulu District (USACE). A June 6, 2011 topographic survey by the project surveyors, Valera, Inc., showed that the project extents were behind the Mean Higher High Water Mark (MHHWM) demarcated at 1.2 ft MSL. The USACE agreed that under the circumstances shown, the Department of the Army (DA) permits were not required but might be advisable for ease of construction. The correspondence is part of Appendix A.

It is known that the beach profiles are subject to seasonal change and the MHHWM may be further inland when the project undergoes construction. There may be significant excavation and shoring for the construction process that requires incursion seaward of the MHHWM (see Section 2.5). Also, if beach sand is excavated, it will likely be placed on the makai side of the shored excavation to ensure that all beach sand is conserved. In this location it would be considered fill in waters of the U.S.

Obtaining the DA permits is recommended to ensure that construction of the project structures can be done in the best possible manner without imposition of undue constraints on the contractor or delays to the project.

Assuming that some work will be done seaward of the high tide line, and that fill (i.e. sand, sand bags or other shoring) will be placed seaward of the MHHW line (elevation 1.2 ft from MSL), two permits are required from the U.S. Army Corps of Engineers:

1. Section 10 of the Rivers and Harbors Act of 1889, which pertains to work in Navigable Waters of the United States.
2. Section 404 of the Clean Water Act, which pertains to placing fill into waters of the U.S.

The Federal Section 404 permit in turn triggers the Section 401 of the Clean Water Act permit which calls for compliance with State water quality standards. This permit is administered by the State Department of Health, Clean Water Branch (DOH-CWB). The Federal permits also require that the project be consistent with the policy objectives of the State Coastal Zone Management (CZM) program.

Notifications of the USACE permit applications are sent out to interested parties, and a 30-day comment period ensues. Other federal laws that may affect the project include:

- Endangered Species Act
- Magnuson-Stevens Fisheries Conservation and Management Act
- National Historic Preservation Act.

1.4.4 Property Boundaries and Shoreline Certification (State/County Jurisdictional Determination)

The following property history has been researched by Valera, Inc., and is included in a letter report contained in Appendix C (Valera, Inc. 2011). The Hololani property was originally part of the Bechert Estate. The estate was partitioned in 1959 into five lots, with Lot 1 then sub-divided into Lots 1-A, 1-B, and 1-C, with the Hololani property being Lot 1-A. A certified shoreline was established on December 5, 1972. The property was conveyed to Lokelani Construction Co. in December 1972, and the certified shoreline was adopted as the seaward boundary of the property. In 1980, approval was given for a certified shoreline over a portion of the Hololani Property – approximately 90 ft at the northern end - as well as portions of the adjacent Pohailani property. The survey showed 5 to 10 ft of shoreline erosion for about 30 ft at the northern edge (along the drainage easement), and a similar amount of accretion for the next 60 ft south. The survey map also shows a 3-ft wide concrete swale and headwall in the easement area. These features no longer exist.

In addition,

- A 1990 shoreline certification application was approved for shoreline protection purposes. A total of 2,729 sq ft was shown as eroded since 1972.

- A 1995 application was disapproved due to lack of documentation of the presence of sand bags, concrete sidewalk, and stairs from the swimming pool to the ocean. The application indicated 1,888 sq ft of erosion.

- A 2001 shoreline certification application was approved for shoreline protection purposes. A total of 3,321 sq ft was eroded.

- Two applications submitted in April and June of 2007 for shoreline protection purposes were disapproved. The applications showed 5,519 sq ft and 4,412 sq ft of erosion respectively. Reasons given for disapproval are 1) because of sand bags placed makai of the seaward property line (April), and 2) a lack of documentation for a concrete walkway and boulder shore protection existing at the time (June).

1.4.4.1 Shoreline Certification for the Proposed Project

As the proposed project will be located both seaward and landward of what would be a reasonable shoreline determination, and will require both State and County permits, the need for a Shoreline Certification is unclear. The presence of a temporarily hardened shoreline also complicates the certification. However, DLNR-OCCL has recommended that a shoreline certification be done and has indicated that the existing sand bag revetment will not derail the process as it is a legal structure (see DLNR letter, Appendix A). The project surveyors, Valera Inc. are responsible for the shoreline certification for the project.

Shoreline certification for the Hololani property is in-progress.

1.4.5 State of Hawaii Permits Necessary for the Proposed Project

State permits consist of the Conservation District Use Permit (CDUP), the Clean Water Act Section 401 Water Quality Certification (WQC), and the Coastal Zone Management (CZM) consistency determination.

The CDUP is required for all projects that are located in the State Conservation District. For shoreline projects, the Conservation District includes all lands seaward of the Certified Shoreline ("Submerged Lands"). The permit is administered through the State Department of Land and

Natural Resources, Land Division (DLNR). County SMA permits must be in place prior to issuance of a CDUP.

The 401 Water Quality Certification is administered by the State Department of Health, Clean Water Branch (DOH-CWB). The permit requires submission of an *Applicable Monitoring and Assessment Program* (AMAP) with the permit application. The AMAP details the program that will be used during construction to monitor construction Best Management Practice (BMP) activities and conduct water quality testing to ensure compliance with State regulations.

The CZM consistency review ensures that the project is consistent with State coastal policies as much as possible. The CZM program is administered by the State Department of Business, Economic Development, and Tourism (DBEDT), Office of Planning.

1.4.5.1 Relationship of the Project to the State Conservation District Rules

The Board of Land and Natural Resources (BLNR) regulates uses of the State Conservation District by issuing Conservation District Use Permits for approved activities.

While the exact jurisdictional limits have not been determined (pending resolution of a Shoreline Certification application), much of the proposed project will be built on Conservation District land under the jurisdiction of the DLNR-OCCL. Statutes governing use administration procedures of the Conservation District are written in Hawaii Revised Statutes, Chapter 183C (HRS183C Conservation District). Administration is further clarified by the Hawaii Administrative Rules, Title 13, Chapter 5 (HAR §13-5 Conservation District). The project area in the Conservation District is classified as a Resource Sub-Zone. The identified land use for the project is *Shoreline Erosion Control* (§13-5-22) and will require a "D-1" (Board) Conservation District Use permit. The use requirements are that:

> *…the applicant shows that (1) the applicant would be deprived of all reasonable use of the land or building without the permit; (2) the use would not adversely affect beach processes or lateral access along the shoreline, without adequately compensating the State for its loss; or (3) public facilities critical to public health, safety, and welfare would be severely damaged or destroyed without a shoreline erosion control structure, and there are no reasonable alternatives...*

The critical requirement for this project is that it will not adversely affect beach processes, as it will be replacing an eroding clay embankment with a less reflective structure. The hardship criterion (1) and the purpose and need for the project are explained in Section 2.1. The design elements that address lateral access along the shoreline are shown in Section 2.3. Criterion (3) is also met for this project due to the proximity of Lower Honoapiilani Road, a vital coastal thoroughfare, that is potentially threatened by coastal erosion, and the public drainage outlet on the north end of the property that is almost non-functional due to deterioration of the shoreline from coastal erosion.

In addition, all projects must meet the following criteria as outlined in HAR §13-5-30:

1. **The proposed land use is consistent with the purpose of the conservation district;**

Discussion: The purpose of the Conservation District is to conserve, protect, and preserve the important natural resources of the State through appropriate management and use to promote their long-term sustainability and the public's health, safety, and welfare (HAR §13-5-1). As shown in this EA, the proposed project will prevent the deterioration of the shoreline that would occur without the project. It is important to note that the native shoreline condition is a steep, hard clay escarpment that is highly reflective to incident waves. Construction of a less reflective rock rubble mound revetment will help reduce wave reflection and assist the sand accretion characteristics of the shoreline, thus promoting beach recovery when seasonal conditions are favorable. The project will therefore not have a negative impact on the native beach, but will actually help beach stabilization.

In addition, it should be noted that the temporary shore protection that is in place has improved the water quality in the area by preventing the erosion of the red clay substrate and suspension of the resulting fine particulates in the water column. Damage inflicted on the temporary protection since December 2007 is indicative of the severe shoreline erosion that would have occurred if the protection were not in place. Looking forward, there is no doubt that serious erosion and property damage will occur if the proposed project is not implemented. A dangerous shoreline escarpment would migrate mauka, and eventually both buildings would be structurally threatened and would probably need to be abandoned and condemned. All of these things would entail serious and negative impacts on the shoreline and cause loss of use. A portion of Lower Honoapiilani Road is already threatened by coastal erosion near the drainage easement, and this condition will become worse if the shoreline erosion is allowed to continue.

2. **The proposed land use is consistent with the objectives of the subzone of the land on which the use will occur;**

Discussion: The proposed project is in the Resource Subzone of the Conservation District, and consists of land use activities consistent with uses *P-15 Shoreline Erosion Control* (HAR §13-5-22). As specified in HAR §13-5-24(a), these uses are permitted in this Subzone with the acquisition of a Land Board-approved Conservation District Use Permit. The applicant is seeking this permit coverage for the project.

3. **The proposed land use complies with provisions and guidelines contained in chapter 205A, HRS, entitled "Coastal Zone Management," where applicable;**

<u>Discussion</u>: The Hawaii Coastal Zone Management Program Consistency Review confirms the consistency of the project with the Coastal Zone Management Act and the objectives outlined in Chapter 205A, HRS (see Section 1.4.5.3).

4. **The proposed land use will not cause substantial adverse impact to existing natural resources within the surrounding area, community or region;**

<u>Discussion</u>: No adverse impacts due to the proposed project have been identified. Construction of a less reflective rock rubble mound revetment will reduce wave reflection and assist the sand accretion characteristics of the shoreline, thus promoting beach recovery when seasonal conditions are favorable. The project will therefore not have a negative impact on the native beach, but may actually help beach stabilization.

The proposed project will have beneficial environmental effects by preventing shoreline erosion of turbidity-causing red clay, and thereby maintain or improve water quality in the vicinity. The proposed project will also help protect vital infrastructure – a public drain line and coastal roadway. As an additional benefit, lateral access along the shoreline will be improved during seasonal low sand conditions.

5. **The proposed land use, including buildings, structures and facilities, shall be compatible with the locality and surrounding areas, appropriate to the physical conditions and capabilities of the specific parcel or parcels;**

<u>Discussion</u>: The proposed project will replace existing temporary shore protection with a permanent engineered structure similar in size and appropriate for the existing wave environment. It is designed to protect both of the major buildings on the property.

6. **The existing physical and environmental aspects of the land, such as natural beauty and open space characteristics, will be preserved or improved upon, whichever is applicable;**

<u>Discussion</u>: The proposed structure is engineered to be long-lasting and visually neutral. It will allow the natural beauty of the shoreline to be preserved, and will remove unattractive temporary shore protection items that are close to, or have exceeded, their design life.

7. **Subdivision of land will not be utilized to increase the intensity of land uses in the conservation district;**

Discussion: No property subdivision is needed for the proposed project.

8. **The proposed land use will not be materially detrimental to the public health, safety and welfare.**

Discussion: The proposed project will help preserve infrastructure vital to public health, safety and welfare. No detrimental impacts have been identified.

1.4.5.2 Relationship of the Project to the State Department of Health - Clean Water Branch

The Clean Water Act (CWA) is the key legislation governing surface water quality protection in the United States. Sections 401, 402, and 404 of the Act require permits for actions that involve wastewater discharges or discharge of dredged or fill material into waters of the United States. In Hawaii, the U.S. Environmental Protection Agency has delegated responsibility for implementing the Act to the State. A Section 401 Water Quality Certification Application for this project will be submitted to the State Department of Health.

While the proposed structure will be built landward of the MHHW line as surveyed on June 6, 2011, the location of that line is subject to change with accretion or erosion of the beach sand substrate. Actions that may constitute fill into waters of the United States include:

- Placement of revetment materials (geotextile, tensar mattresses, underlayer stone, or armor stone) if the MHHW line moves landward from the June 6, 2011 location.
- Excavation of beach sand during construction and placement of sand on the shoreline below the MHHW line. Actual construction methodology will be determined by the contractor.
- Temporary placement of geotextile sand bags or other materials seaward of the excavation for purposes of shoring or protection from wave action.

The Water Quality Certification will require submission to the DOH of an Applicable Monitoring and Assessment Plan (AMAP) which will detail the water quality sampling and testing necessary during construction, and outline the Best Management Practices(BMP's) that will be used to prevent contamination of coastal waters.

1.4.5.3 Relationship of the Project to the Coastal Zone Management Program

Enacted as Chapter 205A, HRS, the Hawaii Coastal Zone Management (CZM) Program was promulgated in 1977 in response to the Federal Coastal Zone Management Act of 1972. The CZM area encompasses the entire state, including all marine waters seaward to the extent of the state's police power and management authority, as well as the 12-mile U.S. territorial sea and all archipelagic waters.

The relationship of the project to the objectives and policies of the CZM program listed in 205A-2, HRS, are as follows:

1. Recreational Resources

<u>Objective</u>: Provide coastal recreational opportunities accessible to the public.

<u>Policies:</u>

A. Improve coordination and funding of coastal recreational planning and management; and
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 replacement of coastal resources having significant recreational value including, but not limited to, surfing sites, fishponds, and sand beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the State for recreation when replacement 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. Ensuring public recreational uses of county, state, and federally owned or controlled shoreline lands and waters having recreational value consistent with public safety standards and conservation of natural resources;

vi. Adopting water quality standards and regulating point and nonpoint 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, and 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 Commission, Board of Land and Natural Resources, and county authorities.

Discussion: The project will stabilize the shoreline and prevent foreseeable hazards due to uncontrolled erosion, thus promoting public use. Lateral shoreline access will be improved during seasonal low sand conditions when access is significantly limited on the native coastline. The project will improve seasonal beach accretion when compared to the native clay escarpment.

2. Historic Resources

Objective: Protect, preserve, and, where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Policies:

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.

Discussion: No historic or archaeological sites or resources are known or likely to exist at the site and which would be affected by the project. The construction specifications will contain provisions to protect any historic resources and alert the proper agencies should any be found during the construction activities.

3. Scenic and Open Space Resources

Objective: Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.

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 such 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 that are not coastal dependent to locate in inland areas.

Discussion: The proposed structure is engineered to be long-lasting and visually neutral. It will allow the natural beauty of the shoreline to be preserved, and will remove unattractive temporary shore protection items that are close to, or have exceeded, their design life. During periods of seasonal beach accretion, much of the structure will be buried in the sand. The project will also prevent the release of the clay substrate, thereby preventing highly turbid plumes in coastal waters.

4. Coastal Ecosystems

Objective: Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.

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, including reefs, of significant biological or economic importance;

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 that reflect the tolerance of fresh water and marine ecosystems and maintain and enhance water quality through the development and implementation of point and nonpoint source water pollution control measures.

Discussion: The proposed project will enhance local water quality by preventing the erosion of the red clay substrate at the site. The project will assist in amelioration of the drain line condition at the north end of the property.

5. Economic Uses

Objective: Provide public or private facilities and improvements important to the State's economy in suitable locations.

Policies:

A. Concentrate coastal dependent development in appropriate areas;

B. Ensure that coastal dependent development such as harbors and ports, and coastal related development such as visitor industry facilities and energy generating facilities, are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and

C. Direct the location and expansion of coastal dependent developments to areas presently designated and used for such developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:

   i. Use of presently designated locations is not feasible;

   ii. Adverse environmental effects are minimized; and

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

Discussion: The project area is a recognized coastal development area and is an important contributor to the island economy.

6. Coastal Hazards

Objective: Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.

Policies:

A. Develop and communicate adequate information about storm wave, tsunami, flood, erosion, subsidence, and point and nonpoint source pollution hazards;

B. Control development in areas subject to storm wave, tsunami, flood, erosion, hurricane, wind, subsidence, and point and nonpoint source pollution hazards;

C. Ensure that developments comply with requirements of the Federal Flood Insurance Program; and

D. Prevent coastal flooding from inland projects.

Discussion: The proposed project is engineered to prevent damage to the shoreline in the event of storm waves. Stabilization of the shoreline, where coastal erosion has drastically reduced the natural buffering capacity, is a significant improvement for coastal natural hazard mitigation. The project will not cause additional development, but will protect and enhance existing development. The project will assist in amelioration of the drain line condition at the north end of the property to reduce nonpoint source runoff. The project will not increase coastal flooding due to high waves or tsunami.

7. Managing Development

Objective: Improve the development review process, communication, and public participation in the management of coastal resources and hazards.

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 proposed project permitting and approval process will provide an opportunity for public participation in the plan formulation process.

8. Public Participation

Objective: Stimulate public awareness, education, and participation in coastal management.

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: The public will have an opportunity to review and comment on this EA as part of the public review process. Public hearings will be scheduled before the Maui Planning Commission as well as the State Board of Land and Natural Resources.

9. Beach Protection

Objective: Protect beaches for public use and recreation.

Policies:

A. Locate new structures inland from the shoreline setback to conserve open space, minimize interference with natural shoreline processes, and minimize loss of improvements due to erosion;

B. Prohibit construction of private erosion-protection structures seaward of the shoreline, except when they result in improved aesthetic and engineering solutions to erosion at the sites and do not interfere with existing recreational and waterline activities; and

C. Minimize the construction of public erosion-protection structures seaward of the shoreline.

Discussion: The project has been engineered to minimize the horizontal footprint seaward of the shoreline, and also minimize wave reflection in order to promote accretion of a sand beach. No beach quality sediment will be impounded landward of the project.

10. Marine Resources

Objective: Promote the protection, use, and development of marine and coastal resources to assure their sustainability.

Policies:

A. Ensure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;

B. Coordinate the management of marine and coastal resources and activities to improve effectiveness and efficiency;

C. 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;

D. Promote research, study, and understanding of ocean processes, marine life, and other ocean resources in order to acquire and inventory information necessary to understand how ocean development activities relate to and impact upon ocean and coastal resources; and

E. Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.

Discussion: The proposed project will not significantly affect marine and coastal resources. The project plan will be coordinated with federal and state marine resource agencies. The project will improve nearshore water quality by preventing release of the turbidity inducing native clay substrate into the water.

1.4.5.4 Coastal Zone Management Program Federal Consistency Review

As the project will require federal permits from the USACE, the project will undergo a review and certification by the State of Hawaii DBEDT to ensure that the project is consistent with the polices and objectives of the CZM program.

1.4.6 County of Maui Permits Necessary for the Proposed Project

The proposed project is in the shoreline setback zone and is part of a Special Management Area and will therefore require Shoreline Setback Variance (SSV) and the Special Management Area (SMA) permits administered by the Maui County Department of Planning. The permits are granted by the Maui County Planning Commission.

1.4.6.1 Shoreline Setback Variance

The Shoreline Setback Zone is a demarcation based on the location of the Certified Shoreline and either 1) average lot depth, or 2) the Average Erosion Hazard Rate (AEHR), whichever is greater. The Hololani has an average lot depth of approximately 160 ft, which gives a setback distance of 40 ft. The setback based on the AEHR is approximately 65 ft. Construction activity in this zone is limited by statute to minor structures. The proposed project will therefore need a variance.

The rules pertaining to a variance are listed in the *Shoreline Rules for the Maui Planning Commission* (§12-203). As the proposed project will artificially fix the shoreline, the variance may be granted if the commission finds that shoreline erosion will cause hardship to the applicant if the improvements are not allowed in the shoreline area.

The grounds of hardship are:

- The applicant would be deprived of reasonable use of the land if required to fully comply with the shoreline setback rules;
- The applicant's proposal is due to unique circumstances and does not draw into question the reasonableness of the shoreline setback rules; and
- The proposal is the practicable alternative which best conforms to the purpose of the shoreline setback rules.

A statement of hardship is contained in Section 2.1.1 of this document.

The variance requires the following conditions (from §12-203-15):

1. To maintain and require safe lateral access to and along the shoreline for public use or adequately compensate for its loss;

Discussion: Lateral access on the beach varies seasonally with the volume of sand present. During seasons with low beach sand, Lateral access is difficult due to the rough terrain and wave action. The proposed project will improve lateral access during these times by providing a relatively flat surface on the revetment crest at the +6 ft elevation. During seasonal high sand conditions, much of the proposed structure will be buried beneath the sand and will not impact beach access.

2. To minimize risk of adverse impacts on beach processes;

Discussion: The proposed structure is designed to have a minimum horizontal footprint and to absorb wave action as much as possible. A hardened temporary structure has been in place since December, 2007, and it has not noticeably interfered with the accretion of beach sand. The rough, sloping, and porous rock rubblemound revetment will absorb wave energy, thereby reducing wave reflection, and will promote percolation of sediment-laden waters – especially when compared to the native condition consisting of an erosion scarp in the native clay substrate.

3. To minimize risk of structures failing and becoming loose rocks or rubble on public property;

Discussion: The proposed structure is engineered to modern coastal engineering design standards.

4. (N/A – relating to buildings exceeding height limitations)

5. To comply with chapters 19.62 ("Flood Hazard Areas") and 20.08 ("Soil Erosion and Sedimentation Control"), Maui County Code, relating to flood hazard districts. And erosion and sedimentation control respectively;

Discussion: The project will not increase the Base Flood Elevation of the property (see Section 4.1.11.2), nor have a detrimental effect on the adjoining drainage. The project plans and specifications will comply with the rules and Best Management Practices contained in Chapter 20.08.

The Shoreline Rules further state:

> *Notwithstanding the above conditions or grounds of hardship, the commission may consider granting a variance for the protection of a legal habitable structure or public infrastructure; provided that, the structure is at risk of damage from coastal erosion, poses a danger to the health, safety and welfare of the public, and is the best shoreline management option in accordance with relevant state policy on shoreline hardening.*

1.4.6.2 Special Management Area

As portions of the project are landward of the presumed Certified Shoreline and in the proximity of the shoreline, a Maui County SMA permit is therefore required. As the project cost will likely be in excess of $500,000, the permit will be a major permit and require a public hearing before the Maui County Planning Commission in compliance with the Maui County SMA Rules (MC-12-02, Chapter 202.

Special Management Area designations are required by Chapter 205A (HRS) to promote the CZM policies and objectives for coastal areas that are in county jurisdiction (see Section 1.4.4. 3). The project should therefore comply with the objectives and policies contained in 205A-2, HRS and the review guidelines contained in 205A-26, HRS.

1.4.7 Relationship of the project to the Hawaii State Planning Act

The Hawaii State Planning Act (Chapter 226, Hawaii Revised Statutes, as amended) outlines themes, goals, guidelines, and policies for statewide planning. The proposed project relates to the following objectives stated in §226-13, *Objectives and policies for the physical environment--land, air, and water quality*:

- Promote effective measures to achieve desired quality in Hawaii's surface, ground, and coastal waters.
- Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters.

Discussion: The project will help to maintain the water quality in nearshore waters that become degraded by coastal erosion of the red clay substrate, as well as protecting the Hololani property from chronic erosion that threatens structural integrity of habitable structures. Stabilizing a chronically eroding shoreline when it approaches habitable structures is a significant and necessary step in coastal natural hazard mitigation. The proposed project will aid in maintaining a buffer of land between the Hololani buildings and incident coastal hazards.

1.4.8 Relationship of the project to the Maui County General Plan

The Maui County General Plan (1990 update) sets broad objectives and policies to guide the long-range development of the County. Under the subject of Public Safety, it is the policy of the General Plan to:

- Maintain a state of preparedness for man-made or natural disasters, and;

- Encourage industries to provide for themselves protection services to meet their special needs.

1.4.9 Relationship of the project to the West Maui Community Plan

The West Maui Community Plan is one of nine community plans for Maui County. The community plans detail desired land use patterns and goals, objectives, policies and implementing actions for various functional areas. The Hololani is located on lands designated “Hotel”, with the drainage easement area designated “Public or Quasi-Public”. The “Hotel” designation is for primarily transient accommodations. The “Public or Quasi-Public” designation for the drainage easement is for public utilities.

No specific implementing actions are listed for the environs of the Hololani Property.

2. DETAILED DESCRIPTION OF THE PROPOSED ACTION

2.1 Purpose and Need for the Proposed Action

The purpose of the project is to provide an engineered shore protection structure that both meets the needs of the condominium association for long-term protection of their buildings, and is responsible to the public by helping to maintain a healthy sand beach during periods of seasonal sand accretion, and by providing safe lateral access during periods of erosion.

The need for the project is perhaps best shown by the extensive erosion shown in Figures 1-2 and 1-3, photographs of the dire conditions that existed before the existing temporary protection was put in place. The north building is within 15 feet of the shoreline erosional escarpment and will inevitably need abandonment if not adequately protected. The erosion shown in the photographs is a result of years of chronic erosion coupled with significant individual erosion events.

The proposed action is a hybrid shore protection structure that combines a vertical seawall with a sloping rock revetment. The proposed alignment of the structure is shown in Figure 1-6, and the design cross-section is shown in Figure 1-7.

The Hololani AOAO has a long history of efforts to combat erosion at the property. Robust but temporary emergency shore protection consisting of geotextile sand bags and gravel-filled marine mattresses has been in place since December, 2007. Authorization for placement of the emergency shore protection was given by the County of Maui Planning Department and the State of Hawaii DLNR-OCCL because the severe erosion that took place during the winter of 2006-2007 threatened the buildings with collapse. Authorization was given under the condition that the Hololani AOAO seek a permanent shore protection solution.

The temporary shore protection is not engineered to withstand prolonged exposure to winter wave conditions, and is expensive to maintain. After four winter high wave seasons, the temporary protection is nearing the end of its design life (see Figure 1-5). Deterioration of the structure is unsightly and some of the damage, such as deflated sand bags, can be a public nuisance.

The hybrid wall and revetment structure is designed to withstand extreme wave conditions, be minimally reflective and hence enable beach sand accretion, provide lateral coastal access, reduce turbidity in nearshore waters, and minimize the amount of material placed in Navigable Waters of the United States and the State Conservation District.

2.1.1 Statement of Hardship

From HAR §13-5-22:

> *…the applicant shows that (1) the applicant would be deprived of all reasonable use of the land or building without the permit; (2) the use would not adversely affect beach processes or lateral access along the shoreline, without adequately compensating the State for its loss; or (3) public facilities critical to public health, safety, and welfare would be severely damaged or destroyed without a shoreline erosion control structure, and there are no reasonable alternatives...*

From *Shoreline Rules for the Maui Planning Commission* (§12-203):
The grounds of hardship are:

- The applicant would be deprived of reasonable use of the land if required to fully comply with the shoreline setback rules;
- The applicant's proposal is due to unique circumstances and does not draw into question the reasonableness of the shoreline setback rules; and
- The proposal is the practicable alternative which best conforms to the purpose of the shoreline setback rules.

The Hololani Resort Condominiums is a set of two 8-story buildings containing 63 residential apartment units and one 1-story commercial building used as office space and a community center. An underground parking garage is located underneath the main buildings. Minor structures on the property include a swimming pool and paved pool deck. The property was developed 1974.

The shoreline in the vicinity of the Hololani has been shown to be eroding at an average rate of approximately 0.8 ft per year, but the erosion is also highly dynamic (see Section 4.1.10) and can erode at an accelerated rate in some areas (see Figure 1-2).

The Hololani shoreline is an escarpment of red volcanic clay with an elevation that ranges between 10 ft and 12 ft MSL. When exposed to wave action, it is highly susceptible to erosion, and erodes by calving along more or less vertical planes. The material is not compatible with beach building processes as the clay is composed of particles that remain in suspension and are transported offshore as turbid plumes. In the absence of sand, the shoreline does not adjust to form morphologies commonly associated with sand beaches, such as a planar swash zone, berm crest and backshore zone, but remains an escarpment cut from the volcanic clay. Ultimately, the existing beach will not be improved by leaving a steep clay embankment along the shoreline.

The Hololani AOAO has been fighting erosion of their shoreline since 1988, when they armored their shoreline with sand bags. The sand bags were maintained at various levels until 2001, when they were replaced in part with large geotextile bags ("seabags") at the north end of the property. During the winter of 2006-2007, the erosion became a dire situation (see Figure 1-2), with erosional escarpment approaching within 15 ft of the north building. During this time, the erosion line in some places advanced several feet in a matter of days. It became apparent to all who were closely monitoring the situation – the Hololani AOAO, the DLNR-OCCL representatives, and the Maui Planning Department representatives – that the situation was an emergency and the Hololani buildings were threatened with a potentially catastrophic situation. In response, the Hololani constructed a $400,000 temporary seabag structure over the length of the property (see Figure 1-4).

Damage inflicted on the temporary protection since December 2007 is indicative of the severe shoreline erosion that would have occurred if the protection were not in place. Looking forward, there is no doubt that serious erosion and property damage will inevitably occur if the proposed project is not implemented. A dangerous shoreline escarpment would migrate mauka, and eventually both buildings would likely be structurally threatened, and would probably face abandonment. Without shore protection, the owners would suffer the loss of all reasonable use of the property.

The Hololani erosion problem has been recognized by county and state agencies since the implementation of temporary shore protection in 1988. An engineered permanent solution to the problem has been mandated by DLNR-OCCL in letters of permission for emergency temporary protection since 2007 (see Appendix A). The Hololani AOAO has a long record of working with State of Hawaii and County of Maui agencies to implement the best solution to the erosion problem according to established rules and regulations. The long-standing coastal erosion emergency at the Hololani is unique and does not call into question the reasonableness of the shoreline setback regulations or CZM policies and objectives.

Alternative actions have been investigated (see Section 3), and the proposed action has the following characteristics that conform to the purpose of the shoreline rules:

1. The proposed structure has been designed to reduce wave reflection and thereby minimize the effect on normal coastal process.

2. The proposed structure has been designed to facilitate lateral coastal access.

3. The proposed structure will not impound beach quality sand.

4. The proposed structure has been designed to modern coastal engineering standards for a 50-year return period event and will be visually neutral.

5. The proposed structure has been designed with a minimal footprint in Conservation District Land and navigable waters of the United States.

6. The proposed structure will help to protect vital public infrastructure consisting of a drainage line and a roadway (Lower Honoapiilani Road).

2.2 Design Conditions and Armor Stone Size

Coastal engineering structures that protect life and property are generally designed for a “worst case” wave condition such as occurs during a hurricane or large storm, or from a similar extreme event with a low statistical probability of occurrence. A 50-year recurrence interval wave event is typically used for coastal engineering design criteria.

The Hawaiian Islands are annually exposed to severe storms and storm waves generated by passing low-pressure systems, tropical storms including hurricanes, and large swell waves generated by distant North Pacific or South Pacific storms. Table 2-1 lists various recurrence wave heights for wave approach to West Maui from the North, West and South. The values in the table are derived from an 11-year hindcast of oceanographic conditions.

Table 2-1. Recurrence interval wave heights

Recurrence Interval:	2-Year	5-Year	10- Year	25-Year	50-Year	100-Year
North Sector	15.6 ft	17.6 ft	19.0 ft	21.0 ft	22.5 ft	24.0 ft
West Sector	9.2 ft	11.0 ft	12.4 ft	14.3 ft	15.7 ft	17.1 ft
South Sector	75.6 ft	5.9 ft	6.1 ft	6.4 ft	6.6 ft	6.8 ft

Shore protection structures are designed for waves that break nearshore, close to the toe of the structure. These waves are physically limited in their size by the water depth. Various phenomena add to the nearshore water level and this contributes to the wave size. The large deepwater waves such as those in Table 2-1 cause a super-elevation in water level known as wave set-up, and low atmospheric pressure and high wind conditions contribute to the phenomenon known as storm surge. Other water-level contributors include global sea level rise and mesoscale eddies, a phenomenon identified locally in Hawaii that can last several weeks and contribute as much as an additional 0.5 ft of sea level. Table 2-2 lists the water level parameters used to calculate the project design wave height.

Based on offshore profiles, an average MSL water depth of 3 ft is used for calculation of nearshore design wave heights. Adding a stillwater level rise of 4.0 ft to this yields a design water depth of 7.0 ft. A water depth to breaking wave height (d/Hb) ratio of 0.78 is used for breaking wave criteria, giving a design wave height of 5.5 ft at the structure toe.

The median armor stone weight (W50) based on the design wave height is 2,700 lbs, and the nominal stone diameter is 2.5 ft. Two layers of armor stone are used in the design (see Figure 1-7).

Table 2-8. Combined Stillwater Level Rise for 50-year Conditions

Parameter	Stillwater Rise (ft - MSL)
Tide (MHHW)	1.2
Storm Surge	0.5
Wave Setup	1.5
Other Phenomena (Mesoscale Eddies, Sea Level Rise)	.8
Total Stillwater Level Rise	4.0
Nominal Water Depth	3.0
Design Water Depth (d)	7.0
Design Wave Height (d/Hb = 0.78)	5.5

2.3 Design Cross-Section

Figure 1-7 is a cross-section of the hybrid seawall and revetment structure. The hybrid design section has a footprint approximately 7 to 10 ft less wide than that of a full revetment design.

The narrow footprint allows the structure to be built with less excursion from the existing coastal bluff and entirely within the original property limits. The structure is composed of two primary elements: a vinyl sheet pile seawall and a uniform armor rock rubble mound revetment.

The revetment armor stone size and profile, including the revetment toe, is designed according to the criteria in Table 2-2. The revetment crest is at +6 ft and is two stone diameters in width (approximately 5 ft). While the revetment protects the foundation of the seawall, it also helps to reduce wave reflection and allow percolation of wave uprush, both of which are necessary to promote the accretion of sand. The sand movements at the Hololani are complicated, and are probably caused by a seasonal variation in wave approach direction. The addition of an absorptive rubble mound revetment at the base of the seawall will not guarantee the presence of a beach, but it will facilitate the formation of a beach when oceanographic conditions allow.

The seawall portion of the structure is composed of vinyl sheet pile. Earlier design phases considered the use of 1) a reinforced concrete wall, and 2) a cemented rock masonry (CRM) wall. Both of these structures would be free standing ("gravity") walls, which rely on a strong substrate for support. However, geotechnical engineering calculations indicate that the southern portion of the property has weak soil conditions that will not support gravity structures (Section 4.1.14). The sheet pile design was chosen as it is stable under the existing site conditions.

2.3.1 Armor Rock Revetment Section

The armor rock is allowed to range in weight from 0.75 x W50 to 1.25 x W50 (2025 lbs to 3375 lbs). The stones are placed on a slope of 1.5 Horizontal to 1 Vertical, and the section is two stones in thickness, as shown in Figure 1-7. The armor layer is placed on an underlayer of smaller stone with a nominal weight of 10% of the armor stone. The underlayer stone is a critical component of the revetment as it supports and evenly spreads the weight of the armor layer, and acts to further dissipate hydraulic loads due to wave action. Table 2-2 summarizes the design stone weights and layer thicknesses for the revetment portion of the project. The underlayer stone range is somewhat expanded to improve stone interlocking and assist in sourcing.

Table 2-2. Armor unit weight and nominal diameter

	W_{50} (lbs)	Stone Size Range (lbs)	Armor Unit Diameter (ft)	Layer Thickness (ft)
Armor Layer	2,700	2025 - 3375	2.5	5.0
Underlayer	270	100 - 340	1.2	2.4

The revetment is placed on a prepared slope at 1.5 Horizontal to 1 Vertical. Geotextile filter fabric is laid on the slope below the underlayer stone to stabilize the soil by preventing the migration of fine sediments. An additional layer of Tensar rock mattresses will be used to strengthen the substrate where the soil conditions may be too weak to support the revetment structure (see IGE 2011).

2.3.2 Structure Toe

The revetment toe is the revetment section at the base of the structure. The toe design is dependent on the substrate type. Substrate conditions, based on the geotechnical report by Island Geotechnical, are discussed in Section 4.1.14. Most of the structure will require a toe designed for soft substrate conditions, with excess stone contained in a 5-ft apron for protection from scour (see Figure 1-7). The top of the toe is located at an elevation of -.5 ft MSL. The geometry of the armor stone and underlayer stone size requires excavation to a depth of -5.5 ft MSL in order to properly place the toe. Another foot of excavation will be necessary in areas where Tensar mattresses are used to reinforce the soil. The presence of rock shown in some of the boring results (see Section 4.1.14), may allow an alternative toe configuration. If the substrate is competent rock, the revetment can be keyed into it for protection and stability. Figure 2-1 illustrates the toe design for a hard bottom.

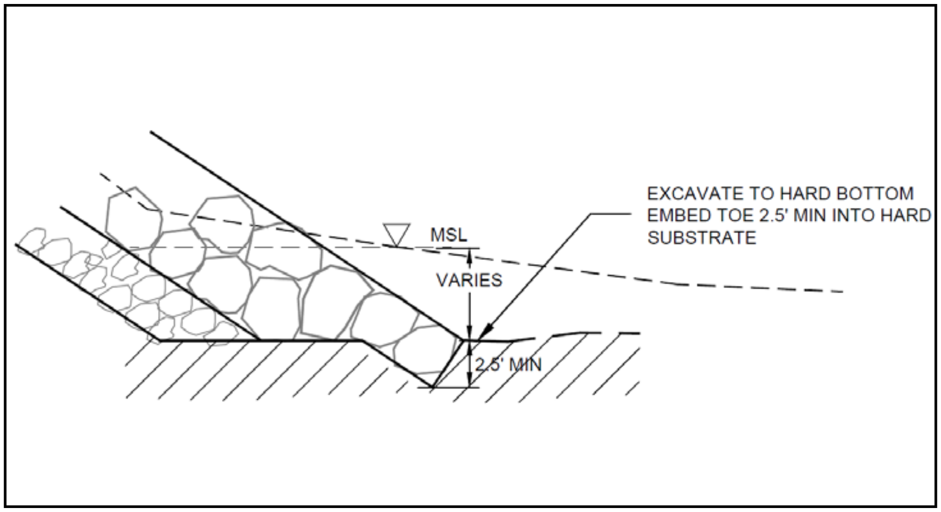


Figure 2-1. Toe configurations for hard substrate

2.3.3 Revetment Crest

The revetment has a horizontal crest two nominal stone diameters in width (approximately 5 ft – see Figure 1-7). The crest is designed to help dissipate wave forces during high wave conditions. It will also allow lateral access during seasonal conditions when the beach is absent. Pedestrian access to jetties and revetments is not typically encouraged, but it is difficult to control and is an invariable result of the construction of such structures. As the rubble mound structures are meant to be flexible and have some movement when stressed, it is not feasible to construct a walkway on the surface of the revetment crest that would be stable under design wave conditions. The best alternative to facilitate pedestrian use is to specify tightly packed stone placement and to use stone with flat, horizontal surfaces on the crest.

The design wave runup elevation is 13.25 ft (see Table 2-3). The revetment would need to built to that elevation in order to prevent wave overtopping. While the revetment will attenuate a significant amount of wave energy, the seawall will also be impacted by breaking waves, and the 12 ft crest elevation will occasionally be overtopped. Spray can also be a significant wetting factor when winds turn on-shore. The existing Tensar rock mattresses used for the temporary emergency protection can be used for scour protection behind the seawall to protect the wall and the anchor system.

Table 2-3. Wave runup

Structure Slope	Design Wave Height (ft)	Wave Runup (ft)	Design Water Level (ft)	Runup Elevation (ft)
1V : 1.5H	5.5	9.3	4.0	13.3

2.3.4 Vinyl Sheet Pile Wall

The seawall portion of the structure will be constructed of vinyl sheet pile. The sheet pile is formed from interlocking “z” sheets of vinyl that are driven to an elevation of -20 ft or until hard substrate is found. The interlocking sheets form a durable impervious wall. The wall will be visible as it rises from behind the rock revetment at +6 ft to the wall crest at +12 ft. The sheet pile will be capped with a formed concrete block. Figure 2-2 is a photograph from the manufacturer’s website that shows an example vinyl sheet pile wall with a concrete cap. The sheet pile is supported laterally by the placement of deadman anchors at 5-ft intervals at a distance 15 ft landward of the wall. The anchors are connected to the sheet pile with stainless steel cable or solid rod (see Figure 1-7). The use of vinyl sheet pile is a relatively recent innovation, but coastal structures have now been in place for over 20 years. It has proven to be a durable and effective product that is relatively low cost. Although it is being specified for this project due to the geotechnical site conditions (see Section 4.1.14), it is also advantageous because it:

- Requires less excavation than gravity wall structures
- Minimizes the disturbance of existing ground in front of the wall
- Does not corrode in the marine environment.

The six-foot vertical drop from the top of the seawall to the revetment crest will require accident prevention measures such as appropriate landscaping or a safety rail with a minimum height of 42-inches.

Figure 2-2. Example of vinyl sheet pile wall with a concrete cap (from manufacturer's website)

2.4 Revetment Alignment and Footprint

Figure 1-6 is a plan view of the concept design that shows the alignment of the revetment with the toe set against the makai property line. The crest of the structure will fall close to the existing vegetation line for most of the alignment. The entire structure is landward of the MHHW line (+1.2 ft) as mapped on June 6, 2011. At the south end of the structure, abutting the adjacent property of the Royal Kahana Condominiums, the sheet pile wall is returned landward to protect against flanking of the revetment by continued erosion (Figure 2-3).

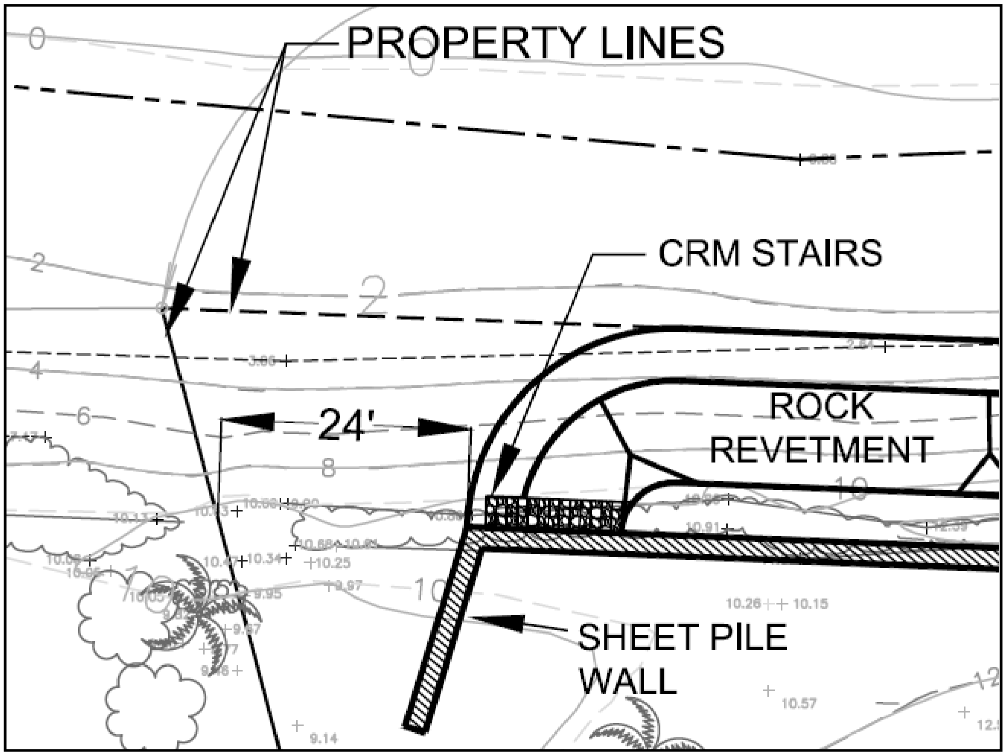


Figure 2-3. Proposed structure alignment at the south boundary

The revetment is stopped 24 ft from the property line to minimize adverse effects on the adjoining Royal Kahana property. Cement Rubble Masonry (CRM) stairs will be used to help provide lateral access to the revetment crest.

2.4.1 Drainage Easement at the North End

The north end of the Hololani property contains a Maui County drainage easement that borders with the Pohailani condominium property line. The easement area has been severely eroded, and the CRM seawall that protects the Pohailani is undermined and in poor condition (Figure 2-4). The drainline has been progressively cut back, and is now blocked by sand and debris, and is essentially non-functioning (Figure 2-5). The area contains power poles, a HECO manhole, and a transformer for the Pohailani – and all are at risk from a severe storm event.

The present alignment design of the proposed seawall/revetment structure is contained within the Hololani property line and outside of the drainage easement (Figure 2-6). The revetment is ended at the edge of the easement, and the seawall portion turns and proceeds along the easement boundary to the mauka property line. The wall can be used as an abutting surface for future improvements of the drain line and easement area.

An alternative north end configuration, shown in Figure 2-7, would extend the structure to intersect a new or repaired seawall at the Pohailani property. This alternative would be a reasonable way to rebuild the drainage system and protect the utilities, the Pohailani property, and the nearby highway. However, the alternative would require the close cooperation of the Pohailani AOAO, and the Maui County Department of Public works for the installation of a new drainpipe. Both entities have received letters of intent and a preliminary report discussing shore protection options (see Appendix A). Representatives of the Pohailani have indicated that they would prefer this design alternative for the easement area and have asked to have it retained as an option in this EA.

Figure 2-4. Photograph of the drainage easement showing utilities and seawall undermining

Figure 2-5. Photograph of the drainage easement showing buried drain line

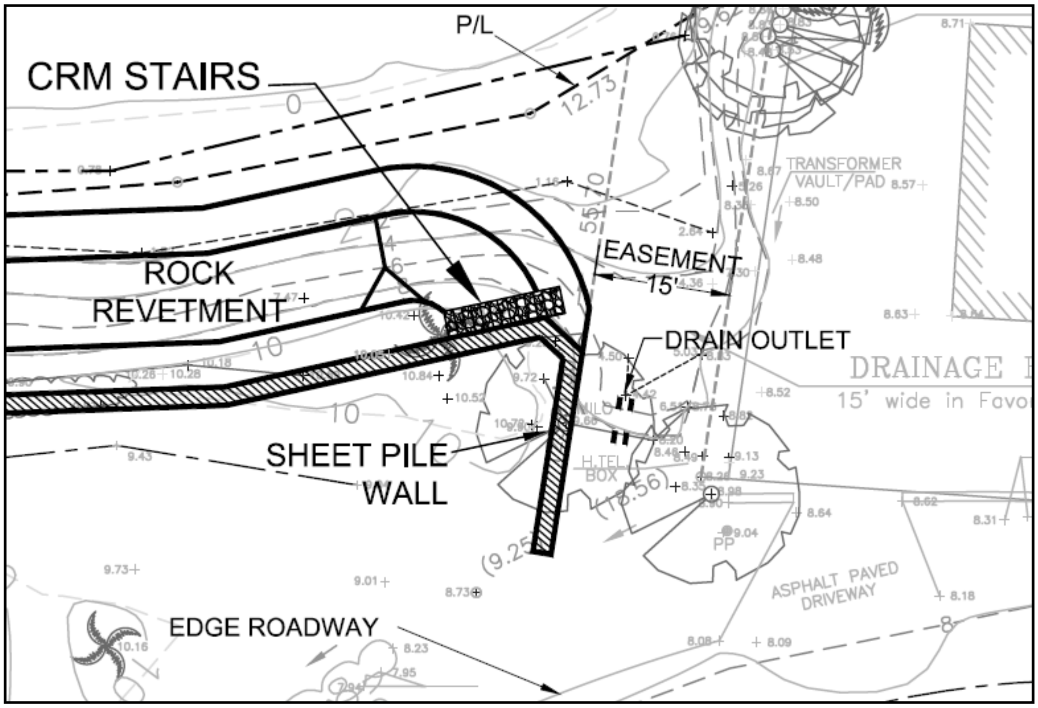


Figure 2-6. North end configuration for the proposed structure

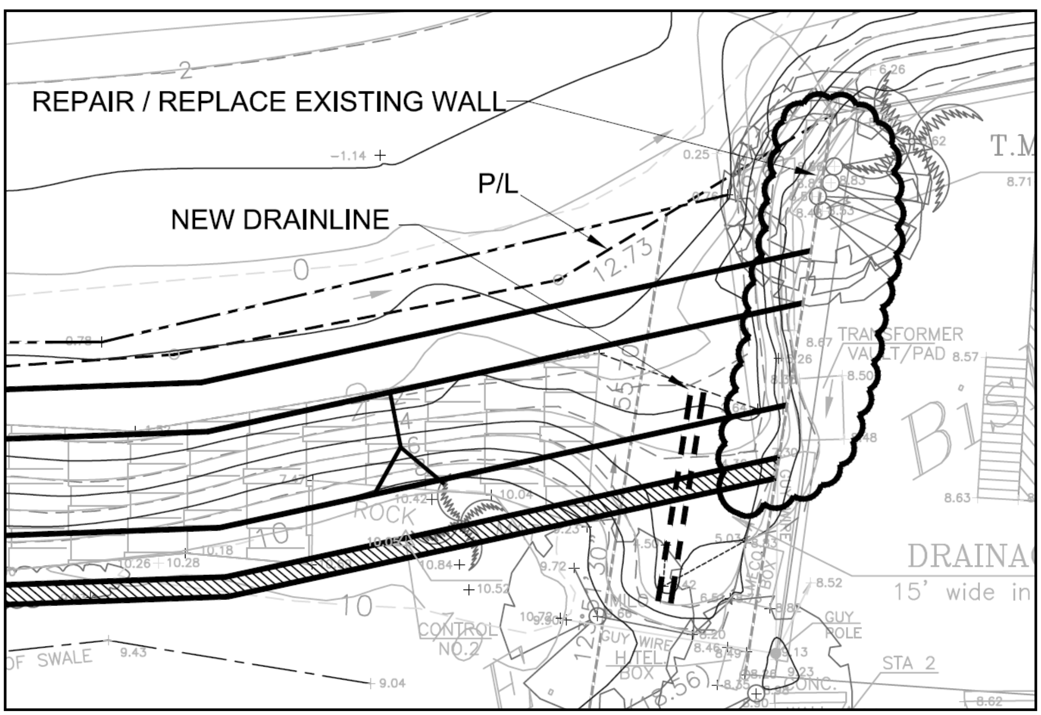


Figure 2-7. Alternative configuration for the north end, with new drain line

2.5 Construction Method

A possible construction method is shown in Figures 2-8 and 2-9, which illustrate a two-phase operation. In Phase 1, an excavator or back-hoe accesses the shoreline from the drainage easement and works progressively south by excavating and constructing the revetment toe, and building a temporary road bed. The toe excavation is protected by cantilevered steel sheet pile. In Phase 2, the machinery works back north, dismantling the road, building the rest of the revetment, and removing all remaining temporary shoring. The construction sequence is:

1. (Phase 1) Shore the excavation area with steel sheet pile or road plates in a section sized according to the reach of the equipment. Excavate top at 2H:1V slope; excavate toe behind shoring and place geotextile filter, Tensar mattresses, underlayer stone and armor stone. Construct roadway on top of revetment toe using underlayer stone and road plates to an elevation of +2 ft.
2. Use existing sand bags to construct a berm inside of the temporary shoring on the makai side before removing temporary shoring sheet pile. Place vinyl sheet pile wall and anchors before removing temporary shoring sheet pile on the mauka side.
3. Move forward on the road bed and emplace shoring for the next section.
4. (Phase 2) When the south end is reached, build armor stone slope and crest. Move back north – remove roadbed (excess underlayer stone) and progressively complete revetment. Remove geotextile sand bag berm before moving north to new section. Back-fill and compact top surface excavation, install Tensar mattress and landscaping.

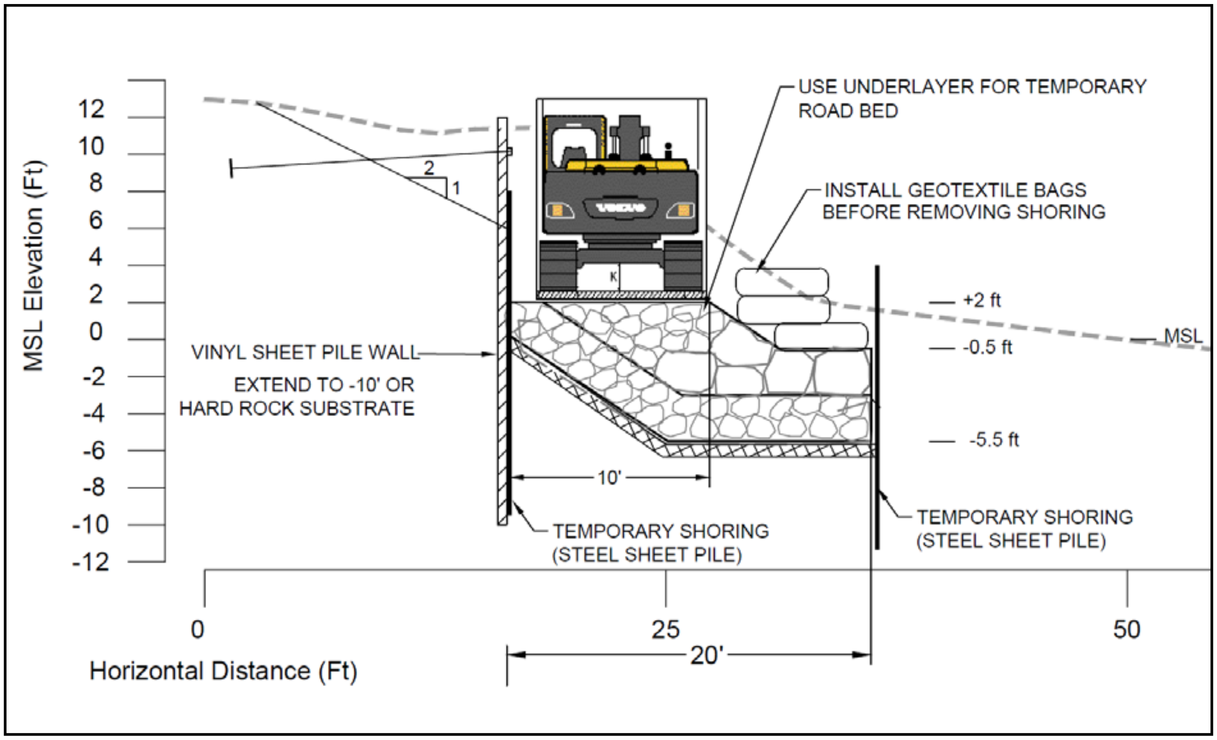


Figure 2-8. Construction of temporary road bed and structure toe – Phase 1, construction moving south.

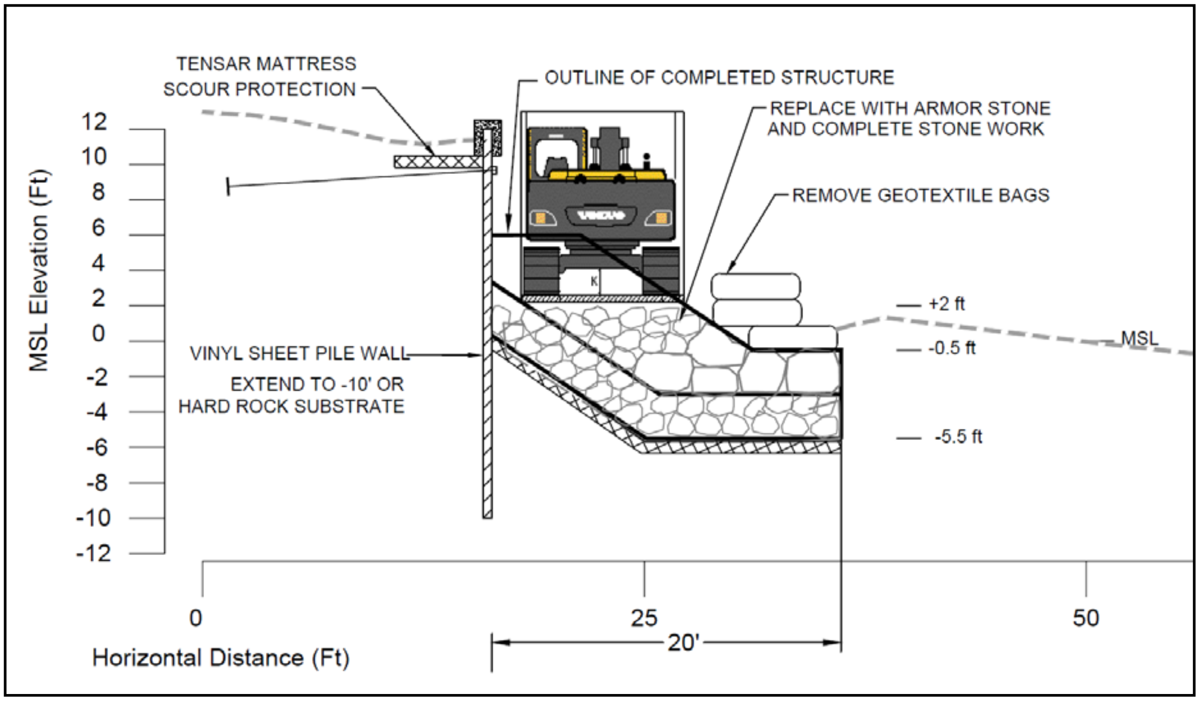


Figure 2-9. Construction of remainder of structure, removal of temporary shoring – Phase 2, construction moving north.

2.6 Estimate of Material Quantities

The following material quantities are based on the dimensions in Figures 1-6 and 1-7. The quantities are conservative estimates. Quantities below MHHW are based on elevation rather than the high water mark, and therefore represent the maximum quantities that could be placed in federal jurisdiction (see Section 1.4.3)

Table 2-4. Material Quantities

	Total Quantity	Quantity below MHHW
Armor Stone	1,785 tons	800 tons
Underlayer Stone	1,150 tons	1,080 tons
Vinyl Sheetpile	9,300 sq ft	4,740 sq ft
Tensar Mattress	8,170 sq ft (76 x 21.5' x 5')	8,170 sq ft
Seabags	145 bags (approx.) 2.5 cu yds per bag (362.5 cu yds)	145 bags (approx.) 2.5 cu yds per bag (362.5 cu yds)
Excavation (seawall)	475 cu yds	None
Excavation (revetment)	2,600 cu yds	1,475 cu yds

2.7 Cost Estimate

Cost estimates in Table 2-4 are approximate and based on existing available information, including manufacturers' quotations and previous cost estimates made for the Hololani.

Table 2-4. Cost Estimate

Major Items	Cost	Ancilliary Items	Cost
Sheet Pile Wall ($60/sq ft)	$528,000	Landscaping	$30,000
Revetment Construction Armor Stone: $550 cu yd Underlayer: $350 cu yd	$900,000	Safety Railing	$40,000
Geotextile	$50,000	Beach Access Stairs	$18,000
Tensar Mattresses ($35/sq ft)	$290,000		
Excavation/Shoring/Dewatering	$150,000		
Mobilization	$50,000		
Water Quality Monitoring and Miscellaneous Environmental	$75,000		
Total	**$2.04M**		**$88,000**

3. ALTERNATIVES CONSIDERED

Coastal engineering alternatives to the proposed action included:

- No Action
- Rock rubble mound revetment
- Seawall
- Beach nourishment
- Alternative temporary solutions

3.1 No Action

A 2001 erosion analysis by SEI, and a 2006 study by the UHCGG found similar long term erosion rates of about 0.8 ft per year along the Hololani reach. The 1972 Certified Shoreline (the currently recognized property boundaries of the Hololani) is 25 ft mauka from the original property boundary determined at the 1959 partitioning of the Bechert Estate. The present shoreline at the top of the temporary emergency shore protection is approximately 17 ft mauka of the 1972 shoreline. Therefore, approximately 40 ft of shoreline erosion is surmised to have occurred since 1959.

Attempts to stabilize the shoreline have been on-going since 1988. However, erosion during the 2006/2007 winter reached within 15 ft of the north building (see Figure 1-3) and the threat to the structural integrity of the building became clear to both the Maui County Department of Planning and the State of Hawaii DLNR-OCCL. A site visit by staff of the DLNR-OCCL on January 11, 2007 determined that the north building was in danger without immediate shore protection.

At that time, SEI designed the temporary geotextile sand bag and marine mattress structure that was constructed in December 2007, and remains in place today.

The temporary shore protection was damaged during both the winters of 2009/2010 and the winter of 2010/2011.

During the winter of 2010/2011 the substrate in front of the temporary shore protection was scoured and eroded. The marine mattress toe protection for the temporary structure articulated down as designed to protect the integrity of the structure (Figure 3-1). The structure was repaired in January, 2011 at a cost of $140K. Repairs to the temporary structure are not only expensive, they are difficult to do, requiring significant on-site mobilization of pumps and fill material for the sand bags and marine mattresses.

Figure 3-1. Articulation of marine mattresses in response to erosion of the substrate: April 2008 (top), January 2011 (bottom)

The experience of the last five years has shown that erosion at the Hololani is likely to continue, and perhaps accelerate. Without the existing temporary shore protection, it is likely that at least the north building would not now be habitable, and would be a danger to the public. The temporary emergency structure will not withstand repeated winters with the strong wave conditions typical of West Maui. Removal of the temporary emergency structure would not improve either the condition of the beach or lateral public access, as the native coastline is a steep erosion scarp in clay substrate, with a wet rocky beach at its toe. In addition, both the County and State agencies have a history of identifying and supporting the need for coastal stabilization at this location.

The No Action alternative would likely result in the eventually condemnation of one or both of the Hololani buildings.

3.2 Rock Rubble Mound Revetment

A rock rubble mound revetment is a sloping uncemented structure built using boulder-sized rock. The most common method of revetment construction is to place an armor layer of stone, sized according to the design wave height, over an underlayer and filter designed to distribute the weight of the armor layer and to prevent loss of fine shoreline material through voids in the revetment. The armor layer and underlayer are typically two stone diameters in thickness. Figure 1-9 is a typical design cross section that would be used for a revetment structure constructed at the Hololani.

One major advantage of a revetment is that the rough porous rock surface and relatively flat slope of the structure will tend to absorb wave energy, reduce wave reflection, and help to promote accretion of sand on a sandy beach. Revetments in Hawaii are typically built on a slope of 1.5 to 2 horizontal to 1 vertical to ensure stability.

Toe scour protection can be provided by excavating to place the toe on solid substrate where possible, constructing the foundation as much as practical below the maximum depth of anticipated scour, or extending the toe to provide a scour apron of excess stone.

Properly designed and constructed rock revetments are durable, flexible, and highly resistant to wave damage. Should toe scour occur, the structure can settle and readjust without major failure. Damage from large waves is typically not catastrophic, and the revetment can still function effectively even if damage occurs. From a coastal engineering perspective, a rock rubblemound revetment is a reasonable shore protection alternative.

Figure 3-2 is a design cross-section of a rock revetment using the design criteria from Section 2. The revetment portion of the project is extended to the +12 ft elevation. The revetment crest shown in Figure 3-2 is somewhat truncated, but is a reasonable response to minimize the structure footprint. Nevertheless, the footprint is increased in horizontal extent by 9 ft in comparison with the selected design alternative. The 9-ft increase in footprint would have to be accommodated by either placing the toe of the structure further beyond the property line onto State Land or by moving the crest landward and effectively shrinking the already sparse buffer space between the habitable dwellings and natural coastal hazards.

The hybrid seawall/rock revetment structure chosen as the preferred alternative has the following advantages:

- The reduced footprint allows construction within the original property lines while maintaining buffer space between the buildings and the shoreline,
- The hybrid revetment crest at +6 ft allows lateral shoreline access;
- Shoreline excavation and material volume is reduced.

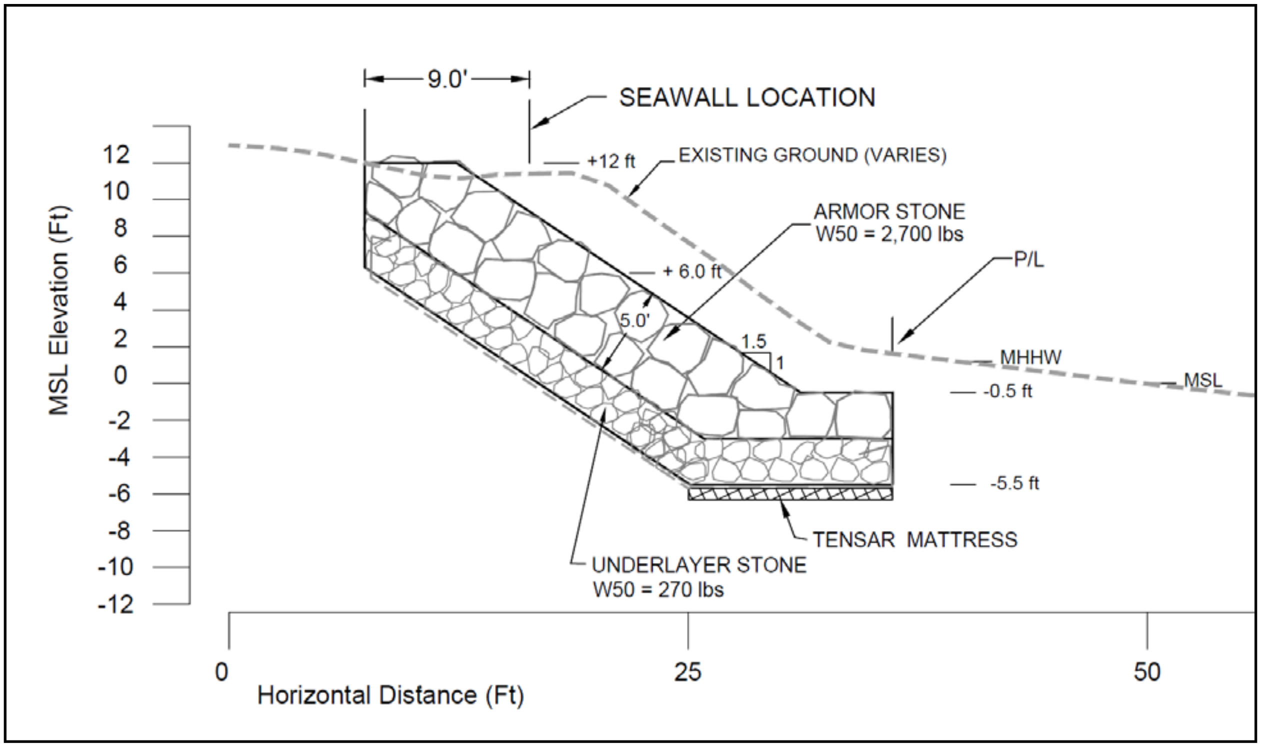


Figure 3-2. Design cross-section for full revetment structure

3.3 Seawall

A seawall is a vertical or sloping concrete, cement-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, long lasting, and relatively low maintenance shore protection method. Seawalls also have the advantage of having a relatively small footprint on the shore. Figure 3-3 is a typical design cross-section for a seawall structure at the Hololani.

The impervious and vertical face of a seawall results in very little wave energy dissipation. Hence, wave energy is deflected both upward and downward, and also a large amount of wave energy is reflected seaward. Reflected wave energy can inhibit accretion of sand in front of the wall, so that seawalls are not a suitable alternative if maintaining a beach is desired.

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 a sandy and eroding shoreline. Ideally, a seawall should be constructed on solid, non-erodible substrate. Seawalls are not flexible structures, and their structural stability is dependent on the stability of their foundations.

If the foundation of the seawall is breached, hydraulic action can erode fill material behind the wall. With the loss of enough fill, the ground surface behind the seawall will collapse into a sink hole. When a sink hole is observed, repairs should be made as soon as possible or the wall will eventually fail. Repairs are usually done by excavating behind the wall, reinforcing the foundation with concrete, and replacing the fill with appropriately graded material. To avoid foundation problems, the seawall foundation should be well below the potential scour level, and this typically requires extensive excavation.

A seawall would be effective at preventing further shoreline erosion at the Hololani. However, while sand will likely still come and go with changing wave conditions, the reflective properties of the seawall will at times interfere with the accretion process. The coastal bluff along the shoreline fronting the Hololani has an elevation ranging between 10 and 12 ft MSL. Construction of a seawall will result in a significant vertical drop in front of the property. During periods when the beach sand is low and the water level (e.g. due to waves and tide) is high, lateral access will be difficult along the beach.

Summarizing, a seawall structure is not recommended for the Hololani shore protection:

- The vertical wall face will increase wave reflection, which inhibits sand accretion and degrades the beach;
- During conditions of low sand, the vertical seawall face will be an imposing edifice with a potentially dangerous vertical drop;
- A properly designed and built seawall will require extensive excavation.

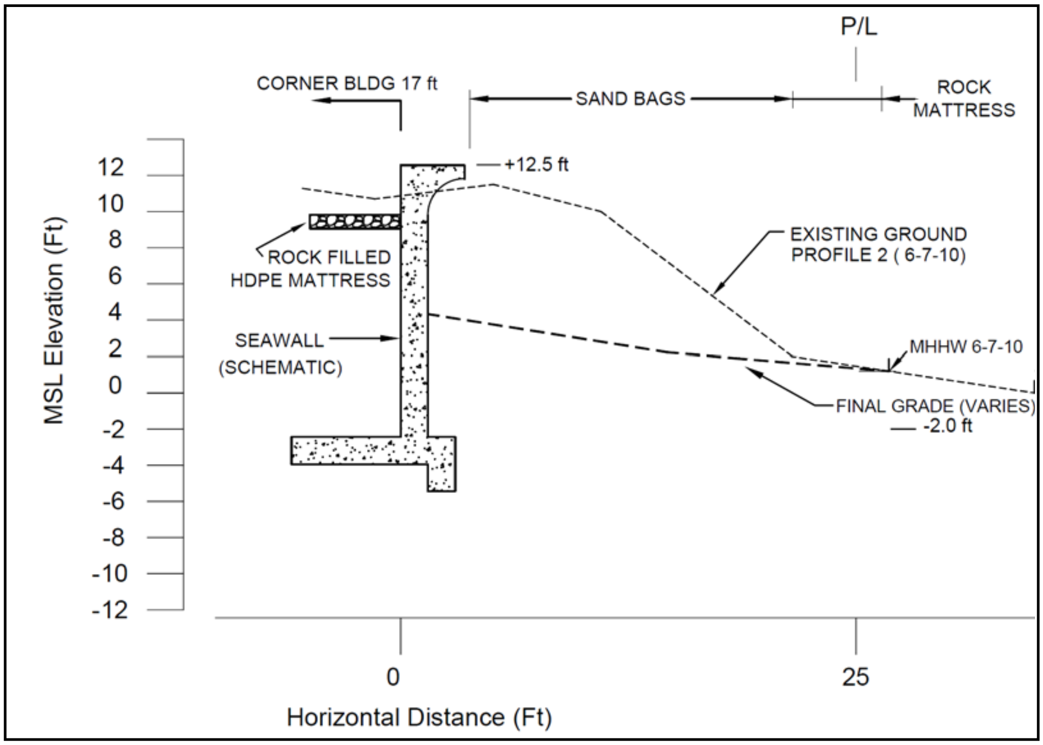


Figure 3-3. Cross-section for a typical seawall structure at the Hololani

3.4 Beach Nourishment

When sand loss is gradual and the beach has a high economic value for recreation and tourism, it is often good coastal management policy to replenish the littoral cell with sand from offshore or other sources. Historical aerial photographs indicate a regional loss of sand in the Kahana area, particularly along the reach between the Hololani and the Kahana Stream mouth, and virtually all of the properties south of the Hololani show some indications of erosion. On a regional level, there is no doubt that the coast would benefit from a large scale beach nourishment project.

There is seasonal and episodic transport of sand at Kahana Beach in general, and the Hololani reach in particular. South swells and Kona storms occasionally produce a high volume of sand in front of the Hololani. However, this is a seasonal or transient phenomena, and opposing forces (i.e. waves from the north) can quickly diminish this beach sand (see Section 4.1.11). The amount of sand that accumulates in front of the Hololani is in part due to the salient formed by the Pohailani seawall that functions like a groin (see Figure 4.13). Pushing the beach further seaward would require distribution of sand all the way to the Kahana Stream mouth (See Figure 4-1). The Kahana littoral cell is an approximate 3,000-ft reach from S-Turns to the mouth of the

Kahana Stream. Based on profiles and beach characteristics at the Hololani, and using a nominal beach crest elevation of +5 ft, a relatively modest beach nourishment effort to widen the beach by 20 ft would require approximately 20,000 cy of sand[3].

Beach nourishment along the Hololani reach alone would require the use of stabilization structures such as "T" groins and a more modest sand requirement of about 3,000 cy. A schematic for the layout of potential stabilizing structures for the Hololani reach is shown in Figure 3-4. While they are generally highly effective, these kinds of structures are also highly visible and constitute a major change in the character of the shoreline.

Beach nourishment requires a supply of sand that is ideally similar in character to the native beach sand. While sand may seem like a plentiful commodity, the reality is that good quality beach sand is in short supply in the Hawaiian Islands. Appropriate onshore sources of sand are limited in supply, and overseas sources have proven elusive. Inland dune deposits have been used for some nourishment efforts, but the process of transport by wind preferentially selects a naturally fine grain size, and dune sand therefore tends to be composed of grains that are too fine for many beach applications. Although offshore sand deposits also tend to have grain sizes that are finer than many beaches, the use of offshore sand is technically feasible. Potential borrow sources require exploration using marine geophysical survey techniques to characterize deposit size, and extensive sampling to ensure adequate grain size characteristics. Recovery can be done using clamshell or hydraulic dredging methods. Both the exploration and dredging efforts are expensive.

If a suitable sand source were found, beach nourishment applied to the entire littoral cell would greatly benefit the regional Kahana community and it should therefore be seriously considered for long-term beach management in this area. Beach nourishment of a 3,000-ft reach has not been done in Hawaii to date, and it would probably be a difficult construction task involving multiple beach access points. The project would ideally be cost-shared by the entire community.

If the Kahana littoral cell were replenished with sand, it is not clear how stable the sand would be, once placed. The volume of sand would likely slowly diminish with time, but with an unknown rate of attrition. It is known, however that individual storm events or other weather conditions can cause rapid beach changes, and dynamic areas such as the Hololani shoreline can lose their beach in a short time even if it is widened with beach nourishment. Although the beaches may eventually recover, such events can cause severe coastal erosion. With the present

[3] Note: a project of similar size at Kuhio Beach in Waikiki is presently under construction at a cost of $2.2M (March 2012).

lack of buffer space between the buildings and the shoreline, beach nourishment is not a stand-alone solution to the coastal erosion hazard present at the Hololani.

Beach nourishment is not recommended as an immediate coastal engineering solution to the Hololani coastal erosion problem:

- Due to the advanced and critical erosion condition of the Hololani shorefront, a coastal protection structure would be recommended as a back-stop even if a regional beach nourishment project were implemented;

- Appropriate sand resources are difficult to find, and have not been identified in the area. A comprehensive prospecting effort consisting of geophysical surveying and sampling will be necessary;

- An appropriate beach nourishment project will affect the entire littoral cell from the Kahana Stream to S-Turns unless retention structures are used;

- Beach nourishment of the entire Kahana littoral cell is recommended as a regional beach management project.

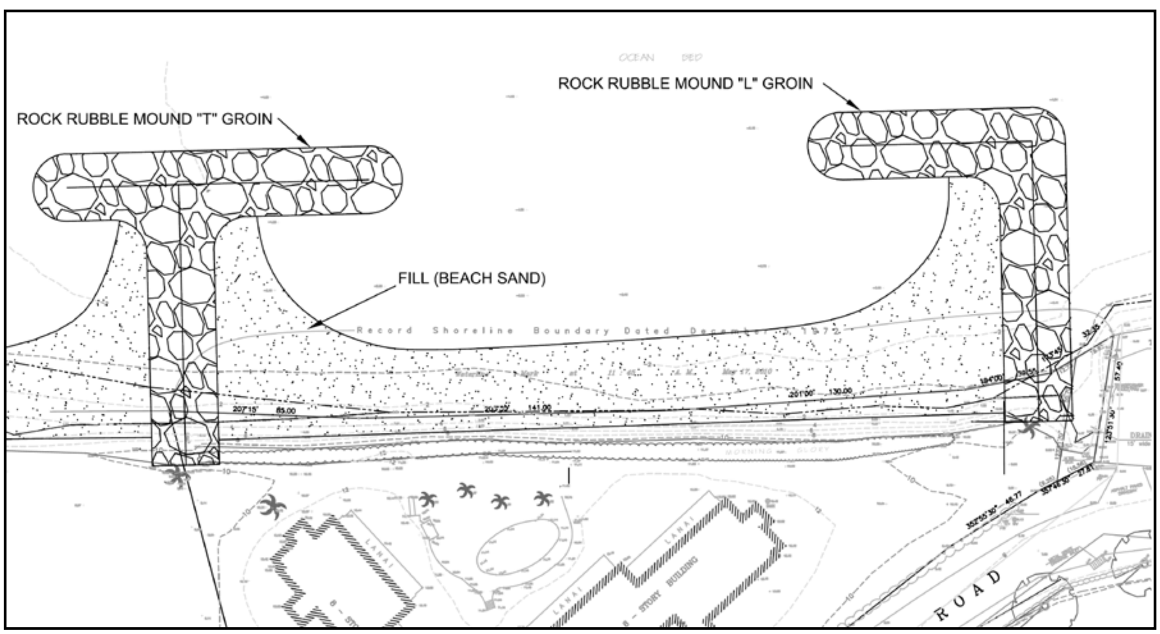


Figure 3-4. Schematic of possible groin structures for use in the stabilization of sand fill

3.5 Alternative Temporary Structures and Artificial Reefs

Alternative temporary structures include the type of sand bag revetment and articulating mattress bank protection that are currently in place at the Hololani. They are intended as temporary measures for stabilizing the shoreline while the design and permit process for a permanent structure proceeds. These structures do not meet engineering standards for long-term design for the kind of wave conditions that occur in West Maui. As such, they cannot be recommended for long-term coastal protection. The design life for these structures is difficult to predict with any certainty. The experience of the Hololani has been that maintenance of temporary structures is both difficult and expensive.

Various forms of man-made reef or shoaling structures have been proposed for beach protection. Reefs can act as mechanisms for wave energy dissipation through breaking, and can alter the direction of wave approach through the processes of wave refraction and diffraction. Although some success has been reported in these efforts, man-made shoals have not been designed, or even proposed, as structures engineered to protect infrastructure or property for extreme events, and do not meet coastal engineering design standards for that kind of protection. Such structures are also difficult to construct, as they are inherently shallow water features, yet require a substantial marine platform for placement.

Figure 3-5 is a photograph of an existing artificial reef in Queensland, Australia. The reef is constructed of large geotextile sand bags. Despite the large footprint of the structure, positive effects of the reef on shoreline stability have not been conclusively demonstrated.

In coral reef environments such as exist in Hawaii and offshore of the Hololani, the placement of offshore reef structures would probably cause the destruction of a large number of coral communities, and require substantial and expensive mitigation efforts. The probability of being granted a Federal or State permit for a man-made reef to be constructed over existing substrate off the Hololani is considered remote.

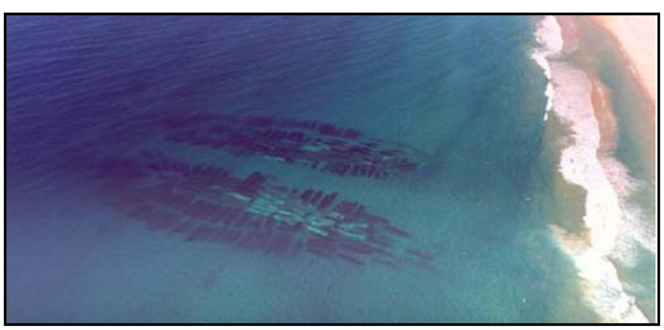


Figure 3-5. Narrowneck Reef, Queensland, Australia (photo from ASR - www.asrltd.com)

4. NATURAL ENVIRONMENTAL SETTING

4.1 General Physical Environment

The physical geography of project site area is dominated by the ancient West Maui Volcano, which has collapsed and eroded into the West Maui Mountains. The nearly circular shape of the volcano has generated a similarly curved shoreline. The area is part of the Maui Nui complex, that includes the islands of Maui, Lanai, Molokai, and Kahoolawe. The islands form a ring of protection that limits wave exposure (see Figure 4-8). The channels between the islands shape the tide-generated currents, and the prominent land masses, especially Haleakala volcano, greatly affect the local wind conditions. The Kahana area borders the Pailolo channel, which runs between Maui and Molokai.

4.1.1 Climate

As with the rest of the Hawaiian Islands, the climate of West Maui is characterized by two seasons: generally dry summers influenced predominately by trade winds, and more inclement winters that see the occasional passage of mid-latitude storm systems accompanied by regional rainfall events. Winter months are also characterized by shifting wind patterns, including the south and west winds known as Kona conditions, and light and variable conditions that can transform into mid-day sea breezes and night-time land breezes due to diurnal heating and cooling of the inland mountains.

Air temperatures and rainfall follow the seasonal cycle, with cooler temperatures and most rainfall occurring during the winter months of December, January, and February. Average monthly rainfall is 3 to 4 inches during the winter, and less than 0.5 inches in the summer. Orographic (elevation-based) precipitation occurs year-round in the higher mountain elevations and can produce flash floods at lower elevations. Winter temperatures vary from about 65°F to about 80°F (typically in the 70’s), and warm to the mid-70’s to high 80’s in the summer months.

4.1.2 Air Quality

The air quality in West Maui is good. Local sources of pollution include vehicle exhaust from Lower Honoapiilani Road, and windblown dust from fields and other open areas during dry periods. These effects are temporary and usually cleared by typical prevailing wind conditions. Occasional high levels of fine particulate matter (popularly known as *“Vog”*) may occur due to the confluence of activity of Kilauea volcano and light wind conditions

4.1.3 Noise

The Kahana area is relatively quiet. Vehicular traffic on Lower Honoapiilani Road generates some road and engine noise, but it is a slow moving highway and levels are low. Probably the most noticeable noise in the area is due to the ambient wind and sea conditions. "White noise" – low level, but broad spectrum sounds due to breaking waves – will actually help mask other sound sources.

4.1.4 Wind Conditions

The predominant winds in the Hawaiian Islands are the northeast tradewinds. During the summer months of April through October, the tradewinds occur 80-95 percent of the time with average speeds of 10-20 mph. The tradewind frequency decreases to 50-60 percent of the time during the winter months, when southerly or "Kona" winds may occur. Kona winds are generally associated with local low pressure systems. Kona conditions occur about 10 percent of the time during a typical year, with winds ranging from light and variable to gale strength. A severe, relatively long duration Kona storm which occurred in January 1980 produced sustained wind speeds of 30 mph, with gusts in excess of 50 mph, from the southwest. Winds of hurricane strength occur infrequently in Hawaii, but they are important for design purposes because of their intensity.

The blocking effect of the West Maui mountains decreases the influence of tradewinds in the Kahana area, and causes the winds that occur to come from a more northerly directions (following the land contours). A land-sea breeze condition caused by the diurnal heating and cooling of the land often predominates in coastal areas. However, wind speeds in the channels between Maui, Molokai, and Lanai can be significantly faster due to the funneling effect caused by the land masses.

4.1.5 Coastal Morphology and Geography

The shoreline along the coast is governed by the underlying volcanic rock formations. The coastal processes along the regional shoreline are complicated by the bay and headland morphology, the presence of offshore fringing reefs, and a seasonal wave climate with two opposing wave approach directions.

Figure 4-1 is an aerial photograph showing geographic features near the Kahana area, and the condominium resorts and hotels along the reach. Kahana Beach extends north from the Kahana Beach Resort to the Pohailani Condominiums, a distance of approximately 1,500 feet. The sand beach is reliably in place between the Kahana Beach and Royal Kahana structures, although the width of the beach may vary seasonally. In front of the Hololani, the beach presence varies more dramatically. Southern swell during the summer, and Kona conditions during the winter tend to move sand from the southern reaches of Kahana Beach, constructing a beach in front of the Hololani. Conversely, waves from the north tend to move the sand to the south, at time completely removing the beach and causing shoreline erosion. Sand is now rarely, if ever, present in front of the Pohailani Condominiums, although older aerial photographs show that beaches were not uncommon there in the past.

The shoreline is hardened with seawalls from the Pohailani north for about 650 ft. The mouth of Kahana Stream is about 1,500 ft north of the Hololani property. Alluvial cobbles and boulders have built a broad delta formation at the stream mouth that tends to focus nearshore waves and trap sand. There are no engineered shore protection structures south of the Hololani except for a seawall fronting the Kahana Beach hotel. The shoreline is composed of hard rock outcrops south of the Kahana Beach hotel, and becomes a prominent salient south of S-Turns.

4.1.6 Bathymetry and Nearshore Bottom Conditions

The bathymetric and nearshore conditions at the Hololani are typical for the region, with a fringing offshore reef interrupted by pockets of sand. A complete survey of the offshore biological conditions was conducted by Marine Research Consultants and is included as an appendix to this report (MRC, 2010 see Appendix D). Figure 4-2 is a photograph of the project shoreline that shows the existing temporary shore protection, including rock-filled Tensar mattresses used for toe protection, and the geotextile sand bag revetment. The amount of sand on the beach is highly variable, and depends in part on the local wave climate. Waves from the south during the summer tend to bring sand to the Hololani from the more southern reaches of Kahana Beach. Conversely, waves from the north and northeast tend to strip the sand away (see Section 4.1.9).

During conditions when the beach sand has migrated away from the area fronting the Hololani, the substrate is littered with stony plates of beach rock (Figure 4-3). Beach rock is formed by weakly cemented beach sand, and there are linear outcrops visible in many nearshore areas of West Maui. The presence of the beach rock fragments – and the apparent onshore migration of these fragments during high surf conditions – are an indication of offshore sources. The beach rock fragments are difficult and uncomfortable to walk on, and have been destructive to the existing temporary emergency shore protection. The substrate underlying the sand and beach rock, and also existing behind the temporary shore protection structure is red clay that is typical of much of the Maui shoreline (Figure 4-4). The red clay is easily suspended in the water column when eroded, and can lead to significant turbidity issues when exposed (see Figure 4-5).

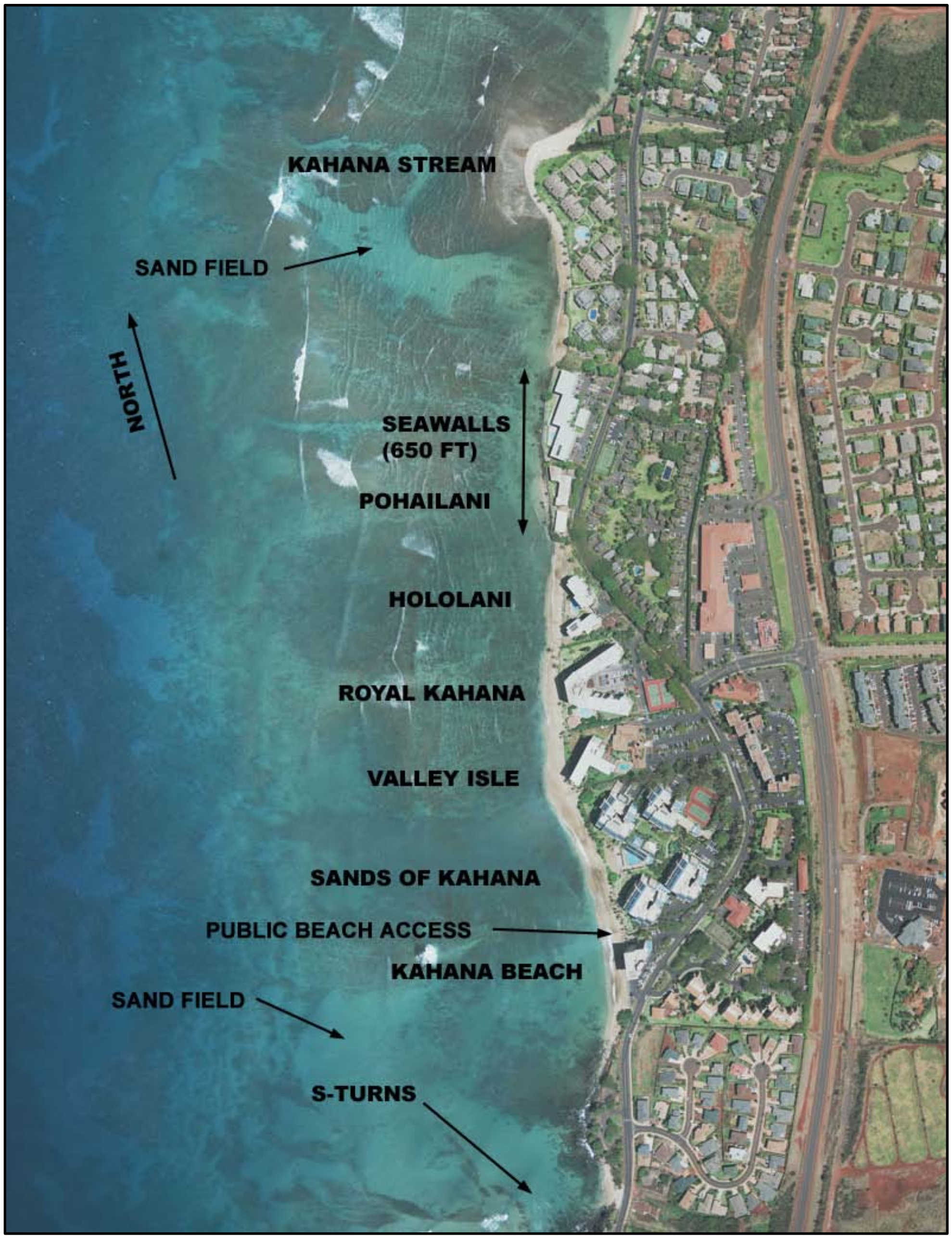


Figure 4-1. Condominiums and geographic features near Kahana Beach

According to the MRC report, the nearshore area within 50 ft of the shoreline and water depths of 1 to 5 ft consists of a pitted and eroded limestone platform covered with a veneer of calcareous sand and rubble (Figure 4-6). This area is devoid of living corals, but covered with a invasive red alga.

Past the nearshore intertidal area, the bottom substrate is a limestone reef platform covered with sand and rubble that extends offshore for about 300 ft to about 25 ft of water depth and transitions to a sandy plain. Aerial photographs indicate that hard reef bottom is re-established further offshore, past the limits of the MRC survey.

Figure 4-6 is a set of bathymetric profiles at the Hololani that show the shoreline escarpment (including elements of the temporary shore protection), and the nearshore bottom configuration. Much of the area that will be excavated for placement of permanent shore protection is now occupied by geotextile sand bags.

Offshore sand fields appear to exist to the north near the Kahana Stream mouth, and to the south near S-Turns (see Figure 4-1). The sand thickness in these areas has not been investigated.

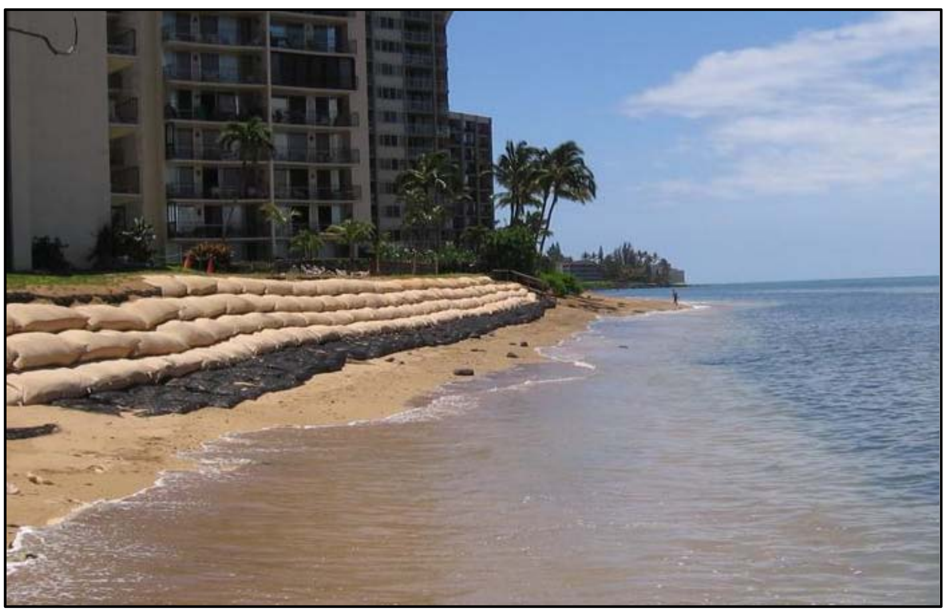


Figure 4-2. Shoreline at Hololani showing the existing shoreline bluff with temporary shore protection

Figure 4-3. Beach rock fragments exposed during low sand conditions; note draped rock mattress shore protection at adjoining Royal Kahana property

Figure 4-4 Native substrate at Hololani showing red clay layer

Figure 4-5. Turbidity caused by erosion of red clay substrate

Figure 4-6. Sand, rubble and red alga in the nearshore zone

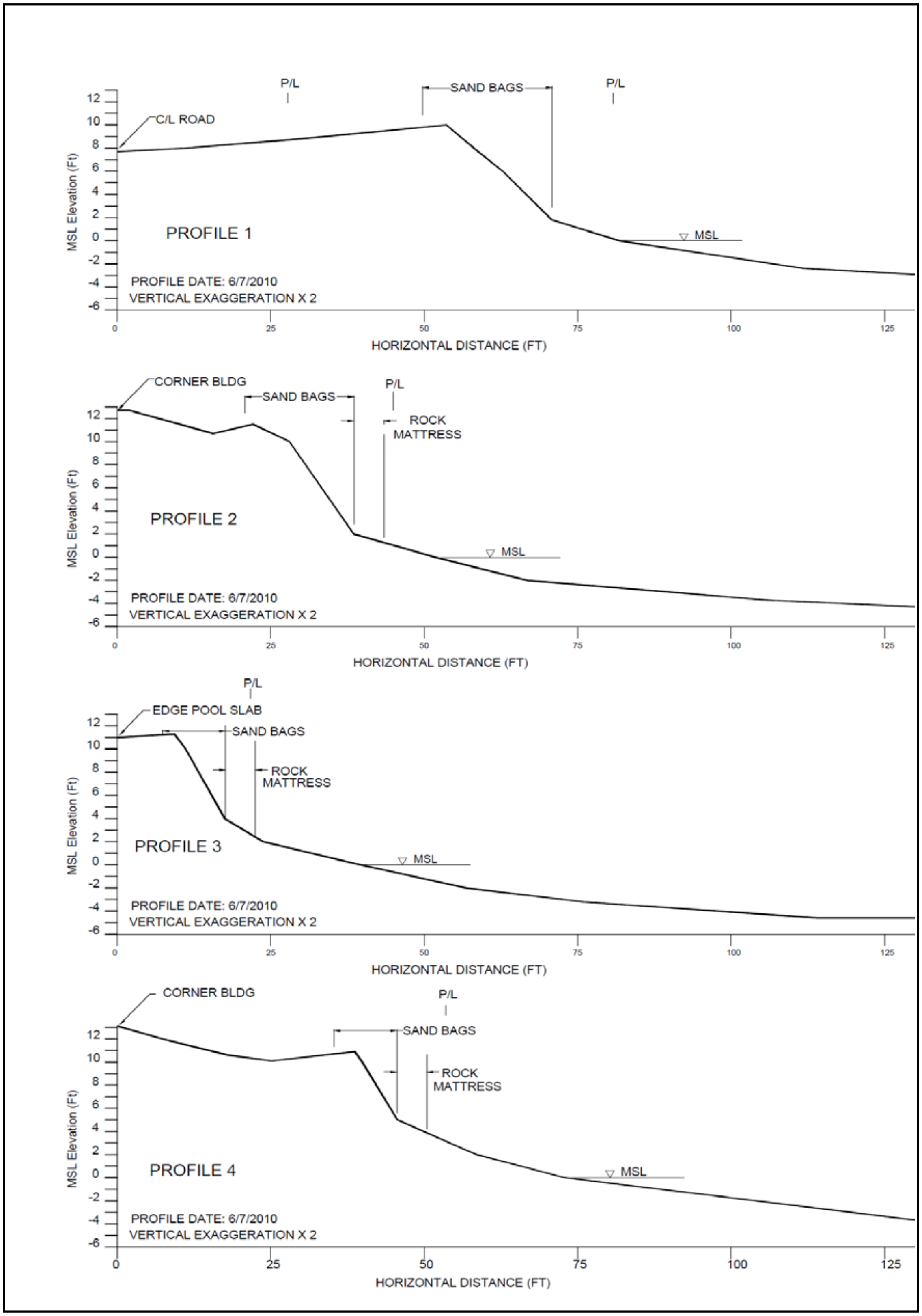


Figure 4-7. Shoreline profiles from June, 2010

4.1.7 Wave Conditions

4.1.7.1 Waves in Hawaii

Surrounded by the Pacific Ocean, the Hawaiian Islands are subject to wave approach from all directions. The general Hawaiian wave climate can be described by four primary wave types: 1) trade wind waves generated by the prevailing northeast trade winds; 2) North Pacific swell produced by mid-latitude low pressure systems; 3) southern swell generated by mid-latitude storms of the southern hemisphere; and 4) Kona storm waves generated by local low pressure storm systems. In addition, the islands are occasionally affected by waves generated by tropical storms and hurricanes.

Tradewind waves may be present in Hawaiian waters throughout the year and typically have periods of 6 to 8 seconds and deepwater wave heights of 4 to 8 feet.

Southern swell is generated by southern hemisphere storms and is most prevalent during the months of April through October. These long, low waves typically approach from the south with periods of 12 to 20 seconds and typical deepwater wave heights of 1 to 5 feet.

Kona storm waves are generated by mid-latitude low-pressure system and occur at random intervals throughout the year, especially during the winter months. They approach from the south through west directions. Some winter seasons have several Kona storms; others have none. Kona storm waves typically have periods raging from 6 to 10 seconds; wave heights are dependent upon the storm intensity, but deepwater heights can exceed 15 feet.

North Pacific swell is produced by severe winter storms in the Aleutian area of the North Pacific, and by other mid-latitude low-pressure systems. North swell may arrive in Hawaiian waters throughout the year, but is largest and most frequent during the winter months of October through March. North swell approaches from the west through north, and occasionally from the north-northeast, with periods of 12 to 20 seconds, and typical deepwater heights of 5 to 10 feet. However, deepwater wave heights of over 20 feet - with breaking wave heights of over 30 feet - are not uncommon.

Although statistically rare, large waves generated by the close passage of hurricanes can be extremely destructive. Hurricane Iwa (1982) and Hurricane Iniki (1992) each caused serious damage to beaches and property on Kauai, as well as at locations on Oahu and Maui.

The Kahana shoreline is at the center of the Maui Nui complex, which consists of the islands of Maui, Lanai, Molokai, and Kahoolawe. These islands shelter the Kahana area from direct exposure to northeast trade wind generated waves and North Pacific swell from the northwest. However, the area is exposed to southern swell, North Pacific swell from the north, and occasional swell from the west. Figure 4-8 shows the direct wave exposure at the Hololani.

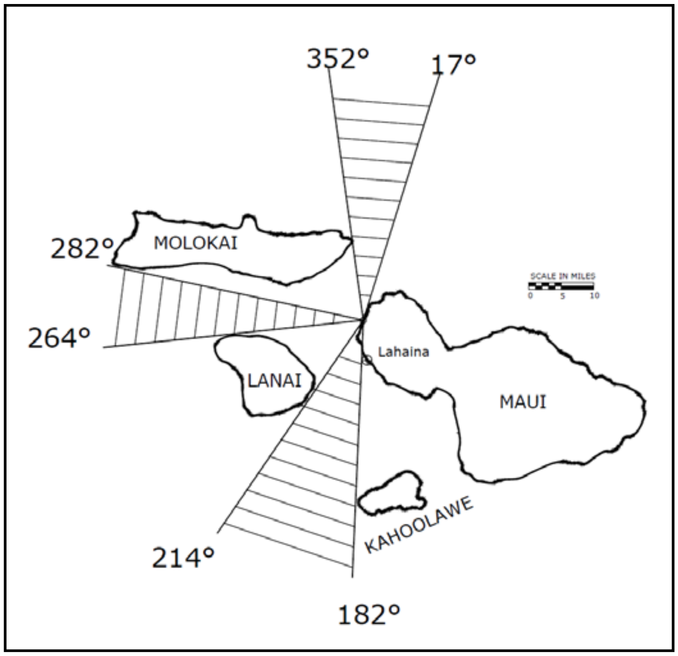


Figure 4-8. Wave exposure at Kahana

4.1.7.2 Extreme Wave Heights

As discussed above, the Hawaiian Islands are annually exposed to severe storms and storm waves generated by passing low-pressure systems, tropical storms including hurricanes, and large swell waves generated by distant North Pacific or South Pacific storms.

Wave hindcast data were generated by SEI using the WaveWatchIII (WW3) wave generation model and 11 years of meterological data for the North and South Pacific oceans. Data were hindcast at three locations (or “virtual buoys”) in the Maui Nui complex at locations designed to best capture ocean swell from the North, West, and South.

The hindcast data produces hourly records of wave and wind conditions for the 11-year period from 1997 through 2008. The data were used as a statistical basis for generating 50-year return period wave information.

Recurrence interval wave heights are listed in Table 4-1. For the north sector, the 50-year deepwater wave height is 22.5 feet with a period of 15 seconds. For the west sector, the 50-year deepwater wave height is 15.7 feet with a wave period of 16 seconds. For the south sector, the 50-year deepwater wave height is 6.6 feet with a wave period of 16 seconds.

The SEI data set does not include the effects of Hurricane Iniki, which occurred in 1992. Hurricanes are rare in Hawaii, but the effects are severe. The U.S. Army Corps of Engineers (USACE) also has a network of virtual buoys for forecast and hindcast purposes as part of their Wave Information Studies (WIS) program. Station 81114 showed a maximum significant wave height of 18.9 feet from the Southwest during Hurricane Iniki.

Table 4-1. Recurrence interval wave heights

Recurrence Interval:	2-Year	5-Year	10- Year	25-Year	50-Year	100-Year
North Sector	15.6 ft	17.6 ft	19.0 ft	21.0 ft	22.5 ft	24.0 ft
West Sector	9.2 ft	11.0 ft	12.4 ft	14.3 ft	15.7 ft	17.1 ft
South Sector	75.6 ft	5.9 ft	6.1 ft	6.4 ft	6.6 ft	6.8 ft

4.1.7.3 Transformation of Waves in Shallow Water

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 will cause wave crests to converge or diverge and may locally increase or decrease wave heights. Not strictly a shallow water phenomenon, w*ave diffraction* is the lateral transmission of wave energy along the wave crest, and will cause the spreading of waves in a shadow zone, such as occurs behind a breakwater or other barrier.

Two numerical wave models were used to analyze the transition of waves from deepwater to the project site. The *SWAN* (Simulating Waves Nearshore) model was used to calculate the propagation of waves from deepwater to a nearshore zone offshore of the Kahana area. The numerical wave model *CGWave* was then used to model the refraction, diffraction, and shoaling characteristics near the project site. Figure 4-9 is an example of the SWAN modeling, and shows the effects of waves approaching Maui from the Southwest. Figure 4-10 is an example of CGWave modeling showing waves approaching the project site from the North. Figure 4-11 is the CGWave wave modeling result overlaid on an aerial photograph. The figure shows wave convergence areas overlying images of wave breaking, illustrating the accuracy of the modeling.

The wave models allow the calculation of wave transformation from deep water to the breaking point. Three wave approach directions were modeled, with wave height parameters from Table 4-1. Waves from both the north and south directions are at high angles to the project shoreline and are therefore highly refracted as they move to the project site. Waves from the west have a direct approach to the shoreline and refraction effects are minimal.

Table 4-2 lists the combined diffraction, refraction and shoaling coefficients as a transmission coefficient, and resulting breaking wave heights for the three incident directions and wave parameters. The largest breaking wave height of 13.1 ft is derived from a 50-year wave from the northwest.

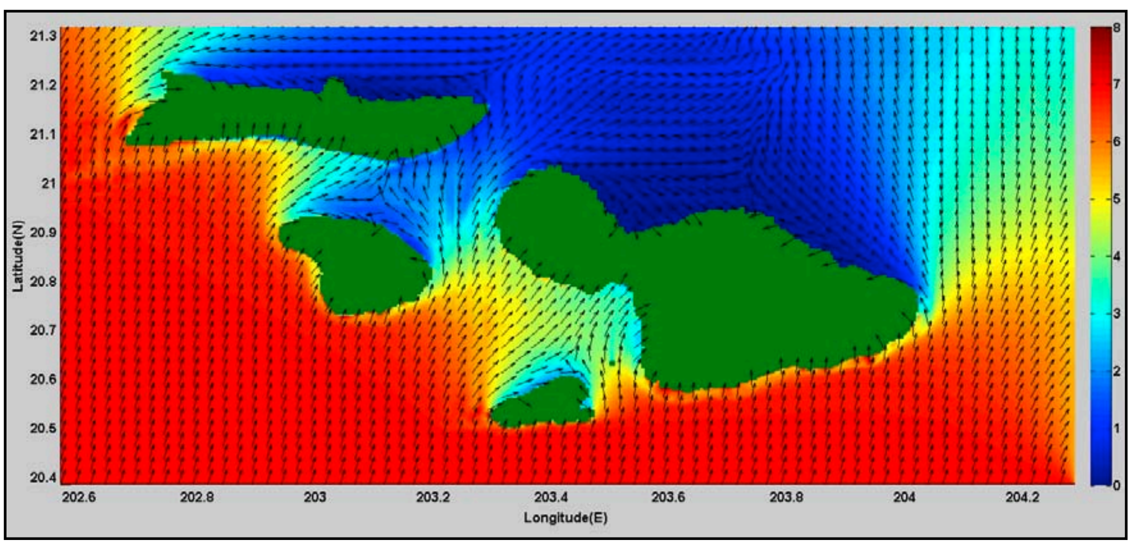


Figure 4-9. SWAN model for southern swell

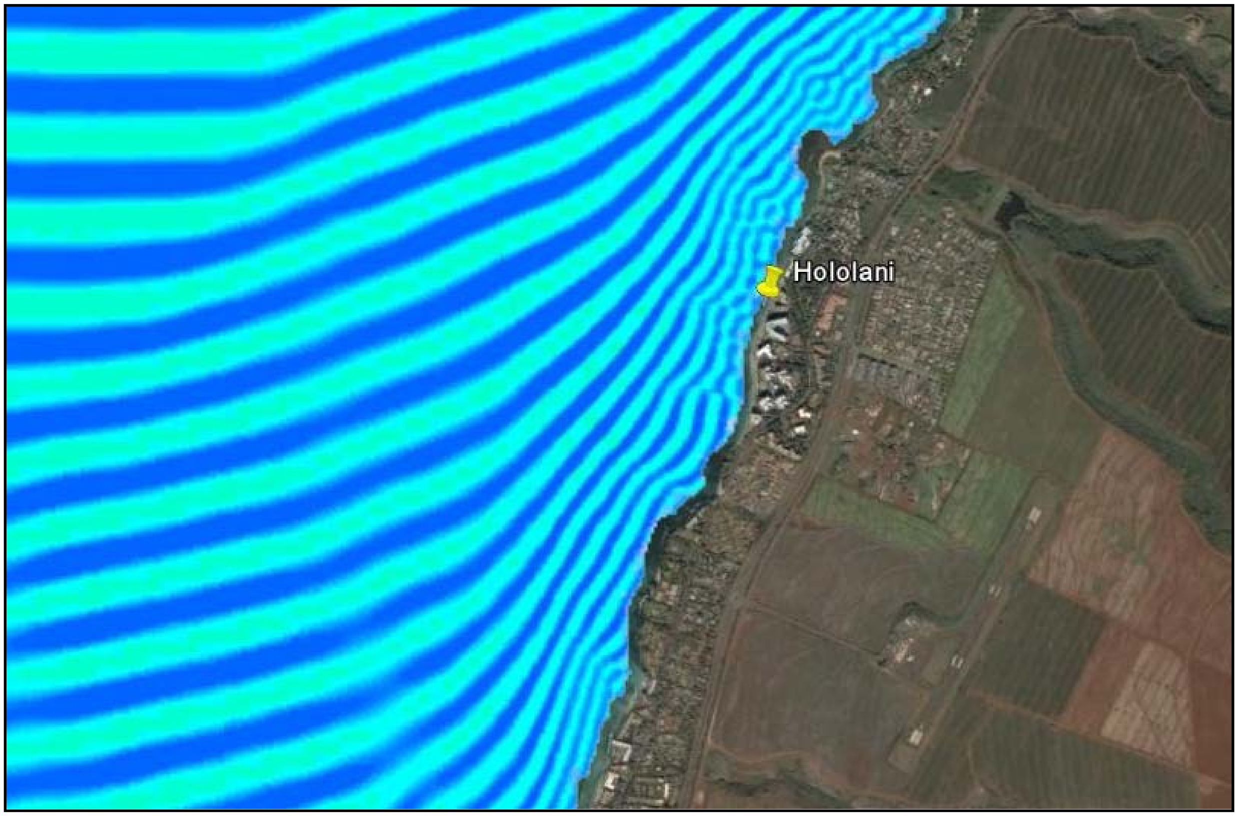


Figure 4-10. North swell wave approach at Kahana (background image from Google Earth)

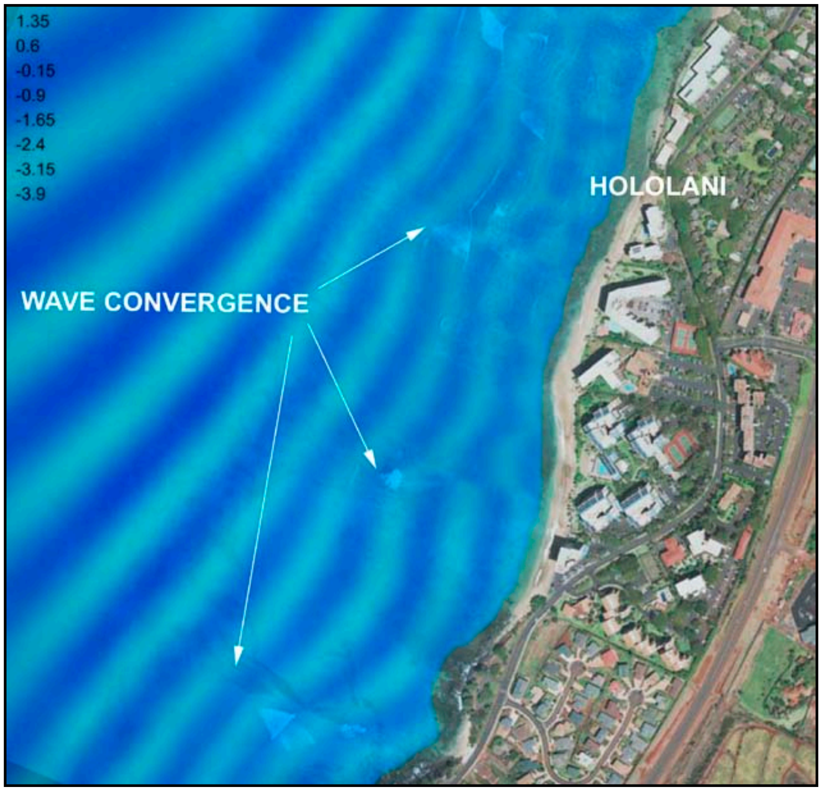


Figure 4-11. North swell with nearshore convergence at breaking points

Table 4-2. Breaking Wave Heights for 50-year waves

	Wave Period	Transmission Coefficient (Kt)	50-Year Deepwater Wave Height (H_0)	Breaking Wave Height ($H_b = H_0 \times K_t$)
North Sector (315°)	14s	0.57	22.4 ft	12.8 ft
	16s	0.585	22.4 ft	13.1 ft
North Sector (360°)	14 s	0.55	22.4 ft	12.3 ft
	16 s	0.56	22.4	12.5 ft
West Sector (270°)	14 s	0.59	15.7 ft	9.3 ft
	16 s	0.61	15.7 ft	9.6 ft
South Sector (200°)	14 s	0.61	6.6 ft	4.0 ft
	16 s	0.61	6.6 ft	4.0 ft

4.1.7.4 Depth Limited Wave Heights

Because waves break in water depths proportional to their height, waves in shallow water are necessarily limited in size. Wave heights are generally highest at the offshore breaking point and gradually diminish in size as the bottom depths decrease. Attenuation of wave height in the on-shore direction is due to the combination of wave breaking and friction. Large storm waves will initially break offshore in deep water, then reform and continue shoreward as progressively smaller waves, with wave breaking occurring several times before reaching the shore. The wave height at the shoreline is therefore dependant on the water level at the shoreline. To determine the actual design wave height at the shoreline, the design stillwater level must be determined.

Large breaking waves contribute to a phenomenon known as *wave setup*, which is a super-elevation of the water level that adds to the stillwater level rise during storms and other high surf conditions. Water level rise is also caused by wind, pressure levels, tides, and other oceanographic phenomena.

4.1.8 Tides and Stillwater Level Rise

4.1.8.1 Tides at Lahaina

The tides in the Hawaiian Islands are semi-diurnal in nature, with pronounced diurnal inequalities (i.e. two tidal cycles per day with the range of water level movement being unequal). The nearest official tide station to the project site is at Lahaina. The National Oceanic and Atmospheric Administration, National Ocean Service (NOS) tide levels at Lahaina are shown in Table 4-3:

Table 4-3. Lahaina Tides

Highest Tide (estimated)	1.6 feet
Mean Higher High Water	1.2 feet
Mean High Water	0.7 feet
Mean Tide Level	0.0 feet
Mean Low Water	-0.7 feet
Mean Lower Low Water	-1.0 feet

4.1.8.2 Stillwater Level Rise

In coastal engineering analysis, the total stillwater level rise for a storm event is considered is a linear combination of:

1) Astronomical tide (Sa),
2) Sea level rise due to atmospheric pressure reduction (Sp),
3) Wind tide caused by wind stress component perpendicular to the coast line (Sx),
4) Wind tide caused by wind stress component parallel to the coast line (Sy), and
5) Wave set-up on the beach as a result of the breaking waves (Sw).

or,

$$S = Sa + Sp + Sx + Sy + Sw$$

The combination of Sp, Sx and Sy is defined as storm surge. Outside of the breaking surf zone, the stillwater level is composed of storm surge added to the tide level. Wave setup (Sw) is a phenomenon caused by wave breaking, and occurs only inside the surf zone.

The total water level rise is therefore a combination of astronomical tide, storm surge and wave setup. In Hawaii, wave setup is typically the largest contribution to the stillwater level rise

For design purposes, an astronomical tide (Sa) of 1.2 feet (Mean Higher High Water) is considered appropriate due to the frequency of occurrence of this level of high tide.

The design water level rise due to the drop in pressure (Sp) is considered to be 0.3 feet. This is the case for a very strong winter low pressure system, or a hurricane approach at some distance from the project site, similar to conditions during Hurricanes Iniki.

Wind setup (Sx + Sy) is calculated analytically using methodology presented by C. L. Bretschneider (1967). A maximum wind setup of 0.2 feet at the project site is due to a 50-year wind speed of 34.2 kts from the West.

The storm surge for design is therefore 0.5 feet, which is a combination of pressure setup and wind setup.

Wave setup (Sw) was determined by using methodology described in the U.S. Army Corps of Engineers Shore Protection Manual (1984). Based on the initial breaker heights of 13.1 feet for a 50-year wave from the north (Table 4-2), the wave setup is calculated to be 1.5 feet.

4.1.8.3 Other Stillwater Level Rise Phenomena

Mesoscale Eddies

Hawaii is subject to periodic extreme tide levels due to large oceanic eddies that have recently been recognized and that sometimes propagate through the islands. These eddies, termed *mesoscale eddies* (Merrifield, 2004) produce tide levels that can be on the order of 0.5 ft higher than normal for periods up to several weeks.

It is now accepted among Hawaii coastal scientists and engineers that a 2003 erosion event that damaged the shoreline at Kaanapali, south of the project site, was caused by the vigorous and sustained occurrence of southern swell in combination with pronounced short-term increases in sea level due to the presence of mesoscale eddies (SEI 2003, Vitousek 2007). The highest sustained sea level measurements recorded at the Honolulu Harbor tide gauge occurred during September of 2003 (Firing and Merrifield, 2004). Comparison and analysis of tide level, satellite altimetry, and hydrographic measurements around the Hawaiian Islands suggest that the 2003 extreme water levels were largely due to an anti-cyclonic eddy with an offshore water level rise of about 0.5 ft and a diameter of roughly 186 miles. Figure 4-12 is a graph of measured and predicted tide at Honolulu Harbor during June of 2003. The figure shows a sustained super-elevation of water level of at least 0.5 ft throughout the month.

Nearshore waves are typically depth limited, meaning that the amount of wave energy that reaches the shoreline is directly tied to the water level at the shoreline. As wave energy increases exponentially with wave height, a water level increase of 0.5 ft can dramatically change the coastal processes at a particular shoreline. The existing equilibrium can be suddenly modified and large amounts of beach and shoreline sediment can be transported away in a relatively short period of time.

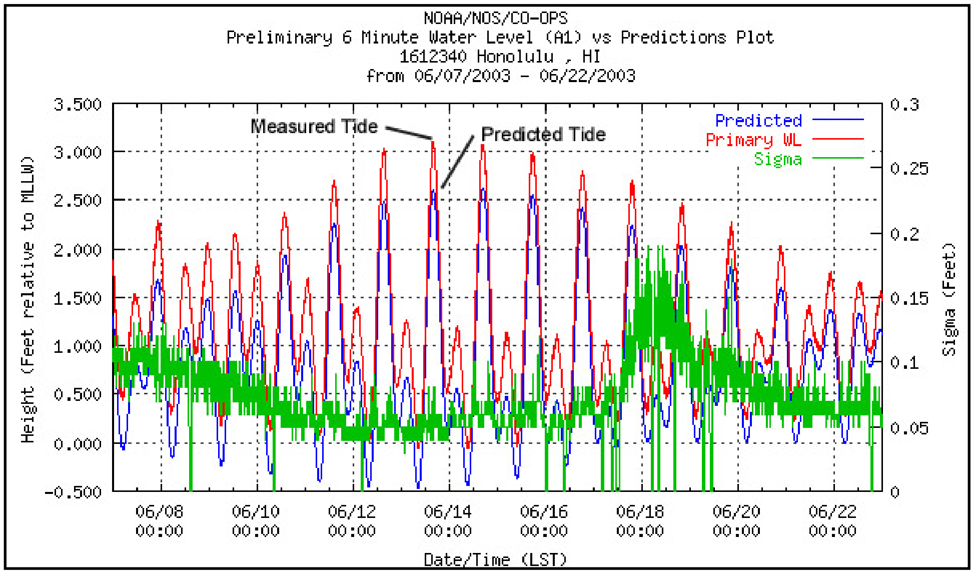


Figure 4-12. NOS tide record for June, 2003 showing influence of a mesoscale eddy

Global Sea Level Rise

It is also widely recognized that global warming has caused a world-wide acceleration in sea level rise. Estimates vary widely, but a 3-foot rise by the end of the present century is in use as a reasonable figure (Fletcher, 2009). However, sea level rise predictions in the Hawaiian Islands are not clear, and the state-of-the-science is in early stages. For example, there are indications that the effect in the islands will be delayed due to the remote location of the archipelago.

Given the uncertainties in stillwater elevation due to these short-term and long-term phenomena, and the need for a long term coastal engineering design, an extra 0.75 ft of stillwater level rise was added for the project design.

Table 4-4 shows the total project stillwater level rise of 3.95 feet to be a combination of astronomical tide (1.2 feet), storm surge (0.5 feet), wave setup (1.5 feet), and an extra 0.75 (say 0.8) feet to account for miscellaneous oceanographic phenomena including global warming induced sea level rise.

Table 4-4. Combined Stillwater Level Rise for 50-year Conditions

Parameter	Stillwater Rise (ft - MSL)
Tide (MHHW)	1.2
Storm Surge	0.5
Wave Setup	1.5

Other Phenomena	0.8
Total Stillwater Level Rise	4.0

4.1.9 Design Wave Height

As waves shoal and their forward speed is reduced, they tend to become higher and steeper. Waves break when the waveform becomes too steep to be maintained. This occurs at ratios of water depth to wave height (d/Hb) that range from 0.5 to 1.4, and depends on wave steepness and bed slope. An accepted value, based upon solitary wave theory, is a ratio of 0.78. In effect, wave heights over a reef flat are depth-limited, meaning there is a maximum wave height that can occur for a given depth of water. The bottom conditions at the project site are highly variable, with numerous patch reefs, holes, and sand bars. Based on offshore profiles, an average MSL water depth of 3 ft is used for calculation of nearshore design wave heights, and a d/Hb ratio of 0.78 is used for breaking wave criteria.

Table 4-5 shows the calculation of the design water depth and the design wave height given a d/Hb ratio of 0.78:

Table 4-5. Design wave heights

Parameter	Design Conditions (ft)
Total Stillwater Level Rise	4.0
Nominal Water Depth (MSL Datum)	3.0
Design Water Depth	7.0
Design Wave Height	5.5

4.1.10 Currents and Circulation

Local currents in the Hawaiian Islands are generally driven by the semi-diurnal tides. Surface currents can also be driven by the wind, and currents nearshore are predominately affected by the presence of reefs and breaking waves. Current measurements conducted by SEI off Kaanapali in 1986 showed prevailing currents to be reversing in nature with ebb tide currents flowing to the north and flood tide currents directionally inconsistent, flowing both north and south. The change in current direction lags the tide change by one to two hours. North flowing currents are stronger than south flowing currents with average speeds of about 0.25 knots. Flood tide currents flow at about half the speed of ebb tide currents.

Storlazzi and Jaffe (2006) found that vigorous tradewind conditions that prevail during the summer season caused relatively strong downwind currents. During periods of calm, termed “relaxation events”, currents were tide-dominated and skewed to the northeast. Large wave conditions prevalent during winter months induced offshore flows.

4.1.11 Shoreline Characteristics and Coastal Processes

The high angle of wave approach from winter north swells and summer south swells causes seasonal sand transport and shoreline re-orientation. There is one important exception to the winter pattern. Waves generated by irregularly occurring winter season Kona storms approach from the south and southwest and move sand northward along the beach, temporarily reversing the pattern.

After the construction of the temporary emergency shore protection in December 2007, the shoreline was qualitatively monitored for sand accretion, erosion and damage to the structure, with the following observations:

- The temporary structure did not appear to interfere with the sand accretion process. Kona conditions (winds and waves from the south and southwest) brought high volumes of sand to the Hololani reach (Figure 4-13);

- The Pohailani property acts like a groin to help retain sand on the Hololani reach.

- Southern swell appears to move sand to the Hololani, however the site is sheltered from that swell direction. During seasons with lower than normal wave heights (such as summer, 2010), the beach may accrete little sand. Conversely, the summer of 2011 had strong southern swell activity late in the summer, and an unusually wide beach was established as a result.

- Waves from the north and northeast have a highly detrimental effect on the beach, transporting sand away and to the south. The winter of 2010/2011 had a high frequency of large wave events from that direction, with resulting erosion of the shoreline, scour of the nearshore substrate, and damage to the structure.

Figure 4-13. Accretion of sand due to the occurrence of a Kona storm soon after construction of the temporary emergency structure

4.1.12 Shoreline History

Sea Engineering, Inc., and Makai Ocean Engineering (SEI and MOE, 1991) conducted an aerial photographic analysis of beach erosion at West Maui and other locations. The study included the Hololani property and evaluated changes of the vegetation line as shown on aerial photographs from 1949, 1961, 1975, and 1988. The aerial photographs were ortho-rectified to remove scale and distortion errors, and the beach vegetation lines were digitized for comparison. Selected discrete transects were then used to represent the behavior of the beach.

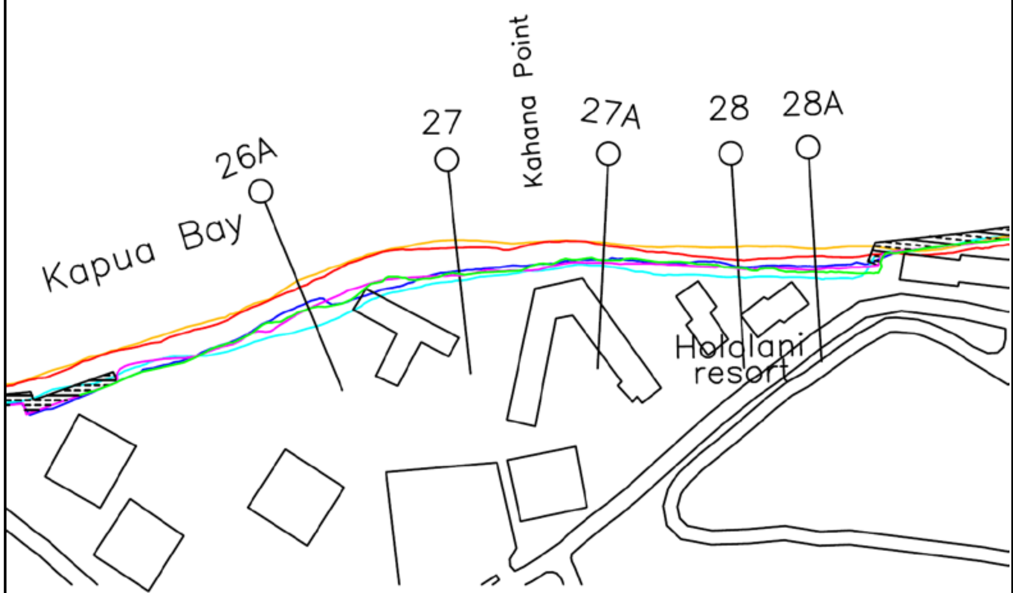
Figure 4-14 shows an updated version of the study done in 2001 and incorporating a 1997 aerial photograph. The vegetation line changes are measured relative to the first available aerial photograph (1949). Seaward excursions of the vegetation line are shown positive, landward excursions are shown negative. The erosion/accretion trends are consistent across Kahana Beach, and show a maximum accretion in 1961. By 1975, the vegetation line had moved back inland past the 1949 position to a position of maximum erosion. The beach apparently stabilized and grew between 1975 and 1987, but sand bags were emplaced in 1988 in response to a new threat of erosion. The trend that led to the emergency sand bag shore protection can be seen in the 1987 and 1988 data, where recession of between 3 ft and 9 ft of the vegetation line occurred. Between 1988 and 1997 the shoreline was relatively fixed, with minor excursions of the vegetation line probably caused by wave overtopping and localized damage to the sand bags.

Analysis of the vegetation line position shows the results of long term erosion or accretion trends or extreme erosional events. Short term beach changes that may be misleading are avoided using this methodology. However, using the vegetation line as a reference does not necessarily show changes in the beach itself. While the vegetation line can be fixed or recede, the sandy beach can grow wider or narrower in response to wave conditions or sand supply conditions that may not necessarily immediately affect the vegetation line. The 1975 aerial photograph shows that, while the vegetation line was in its most receded position at that time, the beach itself was wider relative to its present condition. Comparison of the 1975 photograph with later photographs show that the sand beach continued to narrow although the vegetation line moved seaward until 1987 and was then fixed by sand bag shore protection in 1988. In particular, the 1975 photograph shows a wide beach in front of the seawall that fronts the Pohailani condominium, adjacent to and north of the project site. This beach is completely absent in the 1997 photograph.

The 30-year erosion trends are shown in Figure 4-14 as the year 2027 shoreline position, as estimated from the 1997 position. The erosion rate was calculated only using data to 1988, as the shoreline became relatively fixed at that time (note: the sand bags deteriorated or were removed after completion of the study). Projected shoreline positions, assuming an absence of shore protection, vary from –38 ft to –12 ft, with the average for all transects being -24 ft, or 0.8 ft per year.   The high standard deviations associated with these numbers give uncertainty to the projected values and are also indicative of the dynamic nature of the beach over the period of the study.

The conclusions of the 2001 study were:

- The shoreline has been dynamic in the 48 years of the study, showing episodes of both strong erosion and accretion, with erosion dominating in recent years
- Aerial photographs reveal beach narrowing and an apparent loss of sand volume in the beaches in front of and adjacent to the Hololani resort
- Due to the prevailing erosion trend and loss of beach width, the shoreline will likely continue to erode in the absence of shore protection.



VEGETATION LINE CHANGES (FT)

	Trans26A	Trans27	Trans27A	Trans28	Trans28A
1949	0	0	0	0	0
1961	12	14	5	23	13
1975	-75	-58	-37	-30	-39
1987	-30	-41	-27	-12	-18
1988	-41	-49	-31	-15	-23
1997	-41	-47	-27	-14	-28
2027 Estimate (Relative to 1997)	-30	-38	-24	-12	-18
Standard Dev.	36	27	15	21	21

Figure 4-14. SEI 2001 study of shoreline erosion at Kahana

The University of Hawaii Coastal Geology Group (UHCGG) conducted a similar study in 2006. They used the low water mark for reference rather than the vegetation line, so the results of the study are somewhat different. They also show an erosion rate of approximately 0.8 ft per year near the Hololani (Figure 4-15).

The averaging induced in both studies by measuring “snapshots in time” does not adequately reproduce the extreme erosional events such as occurred at the Hololani during the winter of 2006/2007, or the kind of erosion that would likely have occurred during the winters of 2009 - 2010 and 2010-2011. However, the high standard deviation shown in the SEI study is indicative of the dynamic and unstable qualities of the shoreline.

What is striking when comparing the 1949 aerial photograph (Figure 4-16) with those of more recent years is the apparent change in the volume of sand. The 1949 photograph shows a healthy ribbon of sand offshore and adjacent to the beach along all of the Kahana coast all the way to Kahana Stream. It is possible that the loss of beach sand is the primary factor driving the erosion at Hololani in the Kahana area in general. The actual mechanism for the beach sand loss is difficult to quantify.

Figure 4-15. University of Hawaii Coastal Geology Group erosion rates at the Hololani

Figure 4-16. 1949 aerial photograph showing sand from Kahana beaches to Kahana Stream

4.1.13 Natural Hazards

A comprehensive report by the UH Coastal Geology Group and the U. S. Geological Survey gave a regional Overall Hazard Assessment for the project area as " moderate to high" (Fletcher *et al* 2002). The regional assessment is shown in cartographic form in Figure 4-17, taken from the report. The high tsunami hazard is due to the 1946 tsunami inundation of 15 ft (reported as 24 ft by Loomis, 1976). Other hazards include flash flooding caused by the steep terrain of the West Maui Mountains and the potential for heavy precipitation, as well as the chronic erosion conditions that are prevalent along the coast. Exposure to storms (in particular Kona storms), and moderately high wave conditions is intensified by projected global sea level rise. The region is also seismically active and is classified as a seismic hazard zone 2.

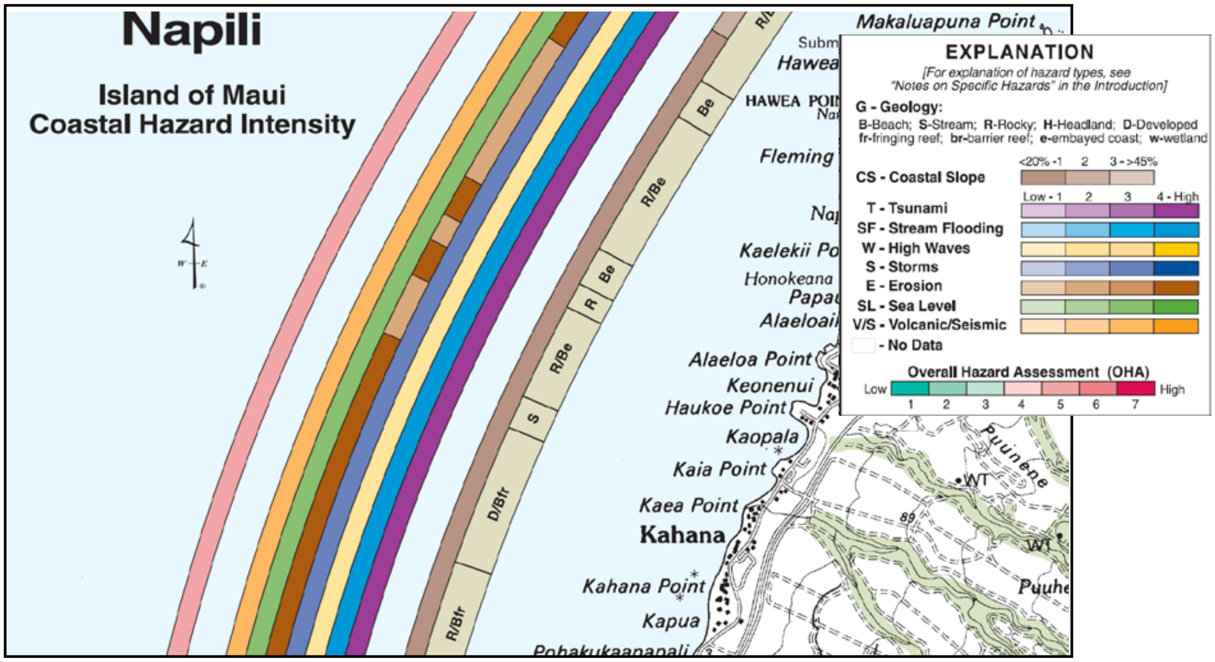


Figure 4-17. Coastal Hazards in the Kahana to Napili region of West Maui (modified from Fletcher *et al*, 2002)

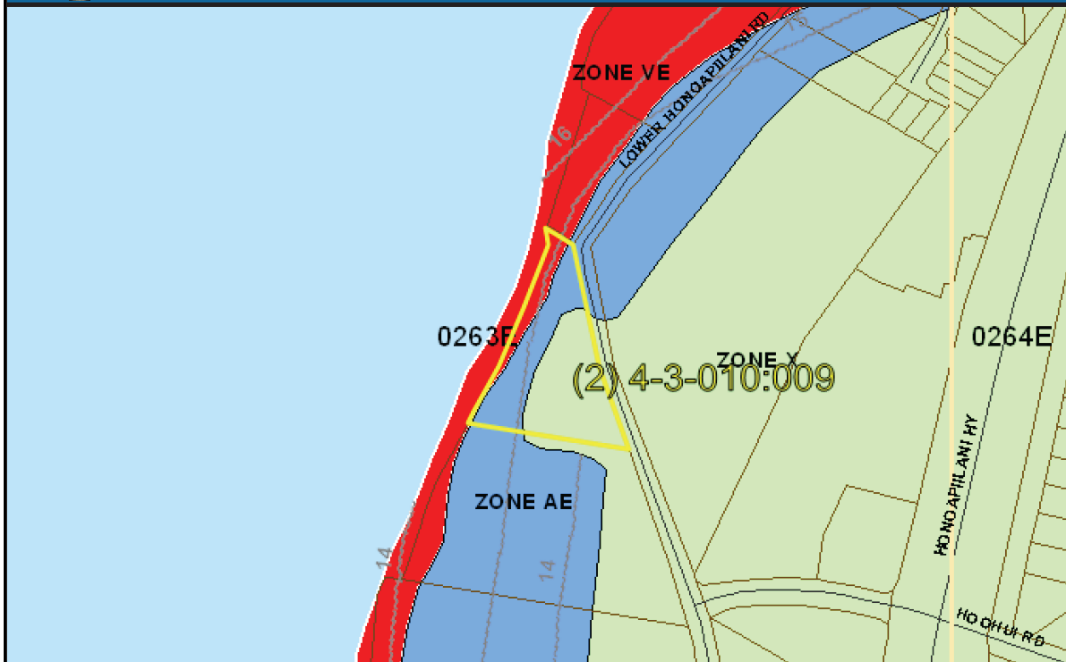
4.1.13.1 Flooding

Flood hazards for the portion of Kahana in which the project is located are depicted on Flood Insurance Rate Map (FIRM) Flood Sheet 1500030263E. That map indicates that there are no threats of flooding from streams but that the shoreline is exposed to flooding caused by storm waves and tsunami. The shoreline area where the proposed action will take place has portions in both the Zone VE (coastal flood zone with velocity hazard, 15 and 14-ft Base Flood Elevation) and Zone AE (Base Flood Elevation 14 ft). The hybrid revetment/seawall structure will have an elevation that it is at or close to existing grade for the site (see Figure 1-7). It will not significantly divert or otherwise affect coastal flooding. However, the revetment portion of the structure will tend to dissipate wave energy and reduce wave runup when compared to the steep clay embankment of the native substrate.

Roadway flooding can occur on the Honoapiilani Highway in the vicinity of the Hololani (Figure 4-18) during heavy rain events. In part this is due to restriction of the drainline north of the Hololani.

State of Hawaii

FLOOD HAZARD ASSESSMENT REPORT



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD ZONE DEFINITIONS

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD – The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zone A, AE, AH, AO, V, and VE. The Base Flood Elevation (BFE) is the water-surface elevation of the 1% annual chance flood. Mandatory flood insurance purchase applies in these zones:

- **Zone A:** No BFE determined.
- **Zone AE:** BFE determined.
- **Zone AH:** Flood depths of 1 to 3 feet (usually areas of ponding); BFE determined.
- **Zone AO:** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined.
- **Zone V:** Coastal flood zone with velocity hazard (wave action); no BFE determined.
- **Zone VE:** Coastal flood zone with velocity hazard (wave action); BFE determined.
- **Zone AEF:** Floodway areas in Zone AE. The floodway is the channel of stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without increasing the BFE.

NON-SPECIAL FLOOD HAZARD AREA – An area in a low-to-moderate risk flood zone. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

- **Zone XS (X shaded):** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- **Zone X:** Areas determined to be outside the 0.2% annual chance floodplain.

OTHER FLOOD AREAS

- **Zone D:** Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

PROPERTY INFORMATION

COUNTY:	MAUI
TMK NO:	(2) 4-3-010-009
PARCEL ADDRESS:	4401 LOWER HONOAPIILANI RD
FIRM INDEX DATE:	SEPTEMBER 25, 2009
LETTER OF MAP CHANGE(S):	NONE
FEMA FIRM PANEL(S):	1500030263E
PANEL EFFECTIVE DATE:	SEPTEMBER 25, 2009

PARCEL DATA FROM:	JUNE 2011
IMAGERY DATA FROM:	MAY 2005

IMPORTANT PHONE NUMBERS

County NFIP Coordinator
County of Maui
Francis Cerizo, CFM (808) 270-7771
State NFIP Coordinator
Carol Tyau-Beam, P.E., CFM (808) 587-0267

Disclaimer: The Department of Land and Natural Resources assumes no responsibility arising from the use of the information contained in this report. Viewers/Users are responsible for verifying the accuracy of the information and agree to indemnify the Department of Land and Natural Resources from any liability, which may arise from its use.

Preliminary DFIRM Disclaimer: If this map has been identified as "PRELIMINARY", please note that it is being provided for commenting purposes only and is not to be use for official/legal decisions or regulatory compliance.

Figure 4-18. Flooding of Honoapiilani highway during heavy rain

4.1.13.2 Tsunami

Tsunami are sea waves that result from large-scale seafloor displacements. They are most commonly caused by an earthquake (magnitude 7.0 or greater) adjacent to or under the ocean. 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 sea floor where the earthquake originated. Tsunami waves are only a foot or so high at sea, but they can have wave lengths of hundreds of miles and travel at 500 miles per hour. When they approach shore, they feel the bottom and slow down, increase greatly in height and then push inland at considerable speed. The water then recedes, also at considerable speed, and the recession often causes as much damage as the original wave front itself.

Most tsunamis in Hawaii originate from the tectonically active areas located around the Pacific Rim (e.g., Alaska, Chile, Japan). Waves originating with earthquakes in these areas take hours to reach Hawaii, and the network of sensors that is part of the Pacific tsunami warning system are able to give Hawaii several hours advance warning of tsunami from these locations. Less commonly, tsunamis originate from seismic activity in the Hawaiian Islands, and there is much less advance warning for these. The 1975 Halape earthquake (magnitude 7.2) produced a wave that reached Oahu in less than a half hour, for example.

Fletcher, *et al*. (2002) report that 10 of the 26 tsunamis with flood elevations greater than 3.3 feet (1 m) that have made landfall in the Hawaiian Islands during recorded history (as of 2002) have had “significant damaging effects on Oahu”. This means that, on average, one damaging tsunami reaches Oahu every 19 years. The recent record (1946 to the present) has seen five tsunami cause damage on Oahu, a rate that is very close to the longer term average. The most recent damaging tsunami is the Tohoku Tsunami, generated off Japan on March 11, 2011. Preliminary damage estimates by the State Civil Defense was $30.6 million. Residents of the Hololani report that it may have damaged the existing geotextile sand bag revetment.

The proposed hybrid revetment/seawall structure will be built at or close to existing grade, and will not divert or otherwise have a significant effect on floodwaters caused by tsunami.

4.1.13.3 Storm Waves

Waves and extreme wave heights are covered extensively in Section 4.1.3 of this report.

4.1.14 Geotechnical Site Conditions

Geotechnical borings were conducted by Island Geotechnical during the month of August, 2010. The borings were done at five locations along the shoreline crest. The complete geotechnical report and an addendum for structural analysis is included in Appendix B. According to the soils report, the USDA Soil Conservation Service lists the project site as being located in an area characterized by Pulehu Clay Loam and Jaucas Sand formations.

The Pulehu series is developed from alluvium washed from basic igneous rock – the volcanic foundation of the island, while the Jaucas series are calcareous soils derived from wind and water deposited sand from coral and sea shells. Both series are likely interbedded at this coastal site, but most of the substrate appears to be Pulehu type soils derived from terrigenous sources. In this report, the term “clay” is used to describe the very fine grained cohesive silt and silty sands and gravels as well as clay that form much of the substrate at the Hololani.

Figure 4-19 is a simplified schematic drawing of the foundation conditions. There is significant lateral variation in soils characteristics with depth and between borings. Borings 1 through 3 encountered moderately hard rock at elevations ranging from -9.3 ft to -4.8 ft. Hard rock is a desirable substrate condition for the revetment toe as it presents durable scour resistance and can be keyed into for revetment toe stability. Borings 4 and 5 at the southeast end of the property were done using portable equipment due to limited access. No hard substrate was found in either of these borings, and both showed very soft silty sand with high moisture content (approx. 35% to 40%), and low blow counts at a depth of -7 ft.

During a previous design effort in 1990, test pits were dug a five locations along the shoreline. Discontinuous lenses of beach rock were found in some areas. Beach rock is made from weakly cemented sand grains and is therefore easy to break apart.

The weak substrate found at Borings 4 and 5 at the southern end of the property have necessitated design revisions with the use of sheet pile and stabilization of the substrate with Tensar mattresses. The allowable bearing capacity of 1,500 lbs per sq ft (see Appendix B) is deemed by the project structural engineer as not enough to support a CRM retaining wall.

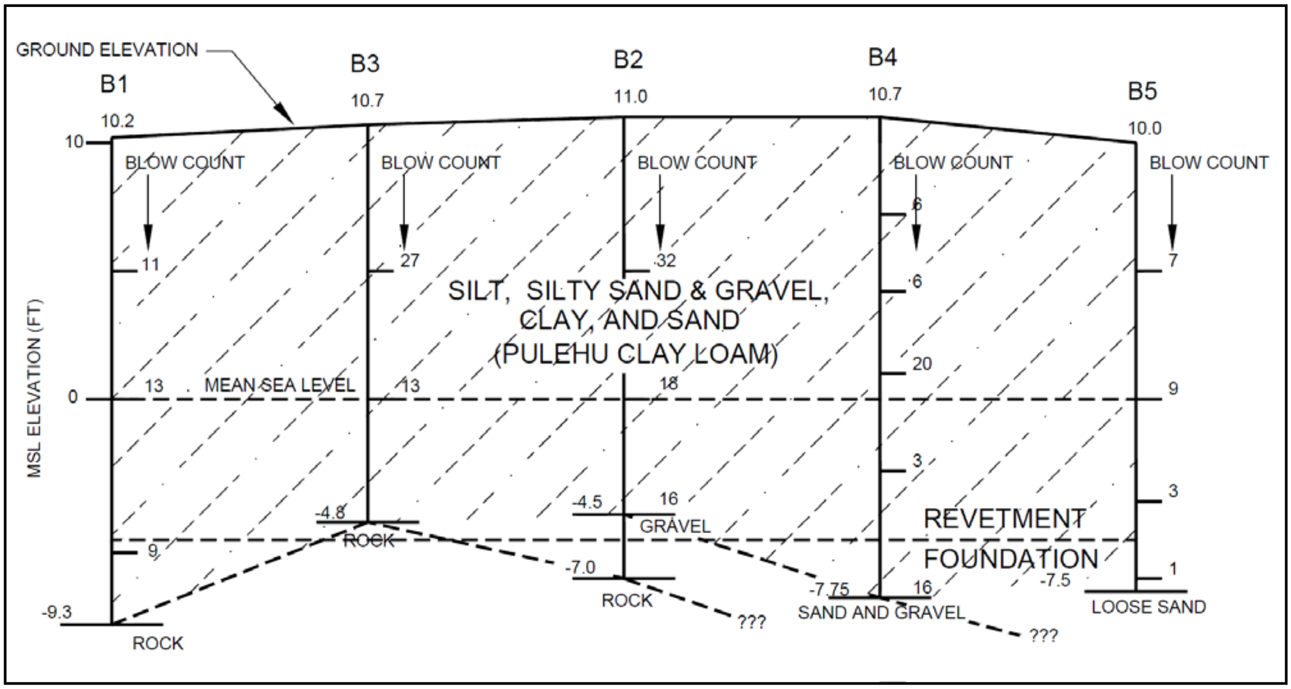


Figure 4-19. Schematic of foundation conditions (note: B1 is at the north end of the property)

4.1.15 Marine Water Quality

A baseline water quality study at the project site was conducted by Marine Research Consultants, Inc. (MRC) on August 15, 2010. The MRC report, *Baseline Assessment of Marine Water Chemistry And Marine Biotic Communities, Hololani Resort Condominium, West Maui, Hawaii* is in Appendix D. Seven stations were sampled along a transect perpendicular to the shoreline, with samples collected at 1, 5, 10, 25, 50, 150, and 300 meters from the water line (Figure 4-20). Two samples, surface and bottom samples, were collected at each station, except the extreme shallow water stations at 1 and 5 meters.

The site at Kahana is classified as Class A Open Coastal Waters by the State of Hawaii Department of Health (DOH), Hawaii Administrative Rules (HAR) 11-54, Section 6 (b).

The marine bottom type is classified as Subtype (A) – sand beaches; the marine bottom ecosystem is Class II.

Figure 4-20. Approximate location of water sampling stations off the Hololani

Water quality parameters measured were those designated for Class A Open Coastal Waters including:

1. Total dissolved nitrogen (TDN), nitrate + nitrite nitrogen (NO_3^- + NO_2^-, hereafter referred to as NO_3^-),
2. Ammonium nitrogen (NH_4^+),
3. Total dissolved phosphorus (TDP),
4. Chlorophyll a (Chl *a*),
5. Turbidity,
6. Temperature,
7. pH
8. Salinity
9. Silica (Si) and
10. Orthophosphate phosphorus (PO_4^{-3})

Silica and PO_4^{-3} were also reported because these parameters are sensitive indicators of biological activity and the degree of groundwater mixing.

The only nutrient constituents to exceed State of Hawaii water quality standards are nitrate-nitrogen (NO_3^-) within 25 m from shore and turbidity within 10 m of shore. The elevated concentration of NO_3^- near the shoreline is likely a result of mixing of groundwater with ocean water. The elevated concentration of turbidity is likely due to the suspension of sediment due to wave action in the surf zone. Beyond 50 m, all turbidity values were well below the standards.

Horizontal gradients in Si and NO_3^- (elevated concentrations) and salinity (lowered concentration) were found as nearshore samples displayed the effects fresh groundwater input. Low salinity groundwater percolates into the ocean at the shoreline and results in a nearshore zone of mixing.

The MRC reports further explains the small fresh ground water mixing zone at the site:

… the sampling site off the Hololani Resort is an open coastal area exposed to wind and wave, the zone of groundwater-ocean water mixing is small, extending only to distances of several meters from shore. These gradients are far less pronounced than at other areas of West Maui where either semi-enclosed embayments occur or mixing processes are less vigorous.

Horizontal gradients of other parameter indicate they are not derived from on-land sources at the site:

Water chemistry parameters that are not associated with groundwater input (NH_4^+, DON, DOP) do not show a sharp gradient of decreasing concentration with respect to distance from the shoreline. Rather, NH_4^+ showed a weak horizontal pattern of lower concentrations near the shoreline with higher values at the greatest distances from shore. TON and TOP showed no distinct gradients with respect to distance from the shoreline. Such patterns indicate that the concentrations of these chemical constituents are not a result of input of materials emanating from land.

Also,

Similar to the patterns of dissolved inorganic nutrients (Si and NO_3^-), the distribution of Chl a and turbidity also display peaks near the shoreline, with rapidly diminishing values seaward of the shoreline. Overall, values of Chlorophyll a are considered low with all values below 0.16 µg/L. The progressive decrease in values of turbidity with distance from shore is likely a *response to resuspension of fine-grained particulate material stirred by breaking waves in the nearshore zone. With decreasing wave energy and increasing water depth, turbidity in the water column increases.*

Minor vertical gradients were found:
. …there was distinct vertical stratification of nutrient concentrations off the Hololani Resort site between distances of 10 to 50 m from shore. Beyond 50 m, the water column was well mixed. Correspondingly, there was a consistent decrease in salinity of surface samples relative to deep samples within the 10-50 m from shore region. Values of turbidity were also slightly higher in all surface samples relative to deep samples at sampling sites 10-50 m from shore, and similar in value at stations farther offshore.

The vertical gradients are due to the buoyancy of the groundwater input:
…in areas where mixing processes are not sufficient to homogenize the water column, surface layers of low-salinity, high-nutrient water are often found overlying layers of higher salinity, lower nutrient water

4.2 General Biological Environment

4.2.1 Marine Biota Survey

MRC conducted a baseline study of the biological resources at the project site. The investigators swam the transect shown in Figure 4-20 in a zig zag pattern to encompass an approximate 100 yd corridor. The full MRC report, *Baseline Assessment of Marine Water Chemistry And Marine Biotic Communities, Hololani Resort Condominium, West Maui, Hawaii* is attached as an appendix. Italicized excerpts are used in this section to describe the offshore environment.

The sand beach that existed at the site during the survey extended only through the intertidal area. A limestone platform covered with sand and rubble extends approximately 300 ft offshore. A sandy plain extends from the edge of the limestone to the limits of the survey. The shallow nearshore area is subjected to direct wave impact from the typical northerly swell conditions. The occurrence and diversity of corals and other biota is influenced by the concussive effects of wave breaking and bottom scour caused by sand movement due to wave motions. Red algae dominates the nearshore, where wave effects inhibit the establishment of coral.

Reef fish were generally low in abundance. Mixed species of Acanthurids (surgeonfish) were the most common, and found in mid-water near the outer margin of the limestone reef platform. No turtles were observed during the survey, although they are commonly found in the area.

MRC divided the limestone reef platform into three zones based on bottom cover: the nearshore algae zone, the mid-reef algal-coral zone, and the outer reef coral zone.

4.2.1.1 Nearshore algae zone

The nearshore area within 50 ft of the shoreline and water depths of 1 to 5 ft consists of a pitted and eroded limestone platform covered with a veneer of calcareous sand and rubble. This area is devoid of living corals, but covered with a invasive red alga *Acanthophora specifera*. Other red alga were also found (*Hypnea musciformis* and *Halymenia formosa*).

The sand, rubble, and algal cover that typifies the nearshore zone are shown in Figure 4-6 of Section 4.1.4.

4.2.1.2 Mid-reef algal-coral zone

Further offshore, the algal cover remains dominant, but wave-resistant corals begin to appear:

With slightly increasing depth and distance from shore, dense algal coverage of the bottom persists, although isolated living coral heads begin to occur, primarily on the upper surfaces of rocky projections that are elevated above the limestone platform. Elevation of the reef surface increases the resiliency of these coral from the effects of sediment scour, and the competitive abilities of these corals is apparently sufficient to prevent them from being completely overgrown by algae. The predominant coral species occurring within the mid-reef area are Porites lobata *and* Montipora patula*. Within both the nearshore algal zone and the mid-reef algal-coral zone motile macrobenthos, particularly sea urchins, were extremely scarce, likely as a result of the force of breaking waves which is sufficient to prevent these unattached organisms to remain stable on the reef surface.*

Figure 4-21 shows the still-abundant red alga and encrusting corals that dominate the mid-reef zone.

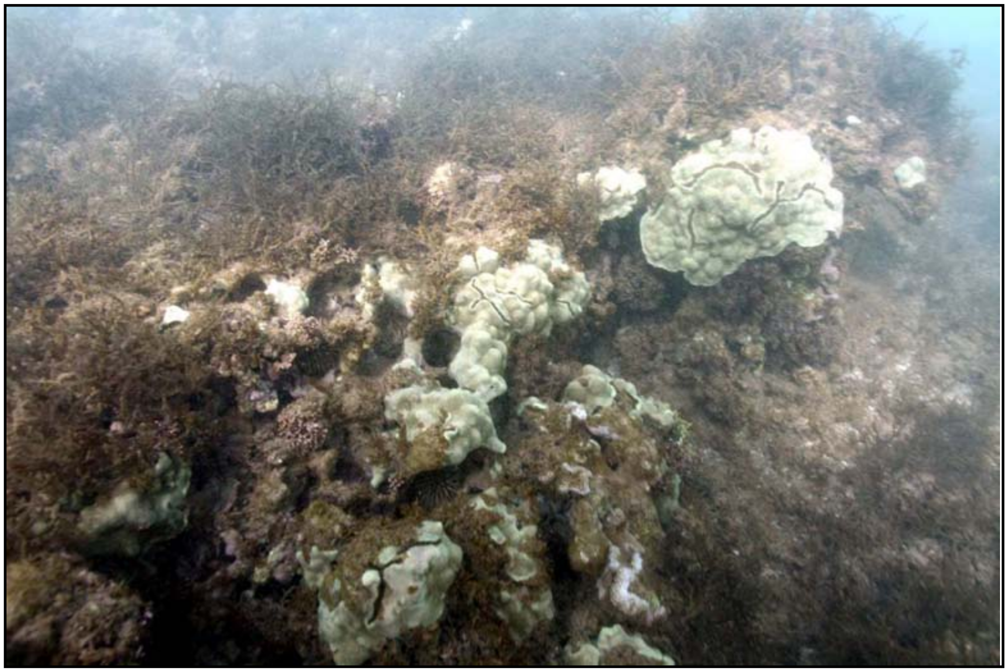


Figure 4-21. Red alga and encrusting coral on elevated surfaces in the mid-reef zone.

4.2.1.3 Outer reef coral zone

Approximately 200 ft offshore, the extensive algal cover diminishes and coral coverage increases (Figure 4-22):

The seaward boundary of the mid-reef algal-coral zone and the inshore boundary of the outer reef zone is demarcated by the boundary where extensive beds of algae no longer occur, and the bottom consists of either living corals or relatively bare turf-covered limestone. This zone extends across the reef platform from a distance of approximately 200 feet from shore to the seaward edge of the reef platform, and spans the depth range of approximately 10 to 25 feet. The primary coral species occurring in the outer reef zone were Pocillopora meandrina*, commonly called "cauliflower coral",* Porites lobata*, commonly called "lobe coral", and* Porites compressa*, commonly called "finger coral". Many of these colonies were up to several feet in diameter indicating that they are on the order of several decades old. The growth form of Porites compressa consists of elongated fingers, which are substantially more delicate and susceptible to breakage compared to the other corals. Hence, P. compressa is not found in areas that are routinely subjected to wave energy. The occurrence of large, intact colonies of P. compressa in the outer reef zone off of Hololani indicates that the outer reef zone has not sustained wave stress substantial enough to destroy these coral colonies over at least a decadal time interval.*

The outer reef zone terminates at a depth of approximately 25 feet in a margin between the limestone platform and sand plain. Seaward of the outer reef margin bottom composition consisted of a flat, gently sloping sand plain. In many areas of West Maui, the sand plains beyond the reef platform are colonized with vast pastures of the calcareous green alga Halimeda. No such pastures of Halimeda were observed during the present study off of the Hololani area.

*Other macro-invertebrates that were observed on the surface of the outer reef were several species of sea urchins (*Echinometra matheai, Echinothrix diadema, Tripneustes gratilla, *and* Heterocentrotus mammilatus*). None of these urchins were particularly abundant, but were found most commonly on the bare limestone reef platform rather than on living corals. It is well known that these urchins graze on benthic algae, and may be responsible for the absence of dense algae in the outer reef zones where wave energy is not sufficient to remove the urchins from the reef.*

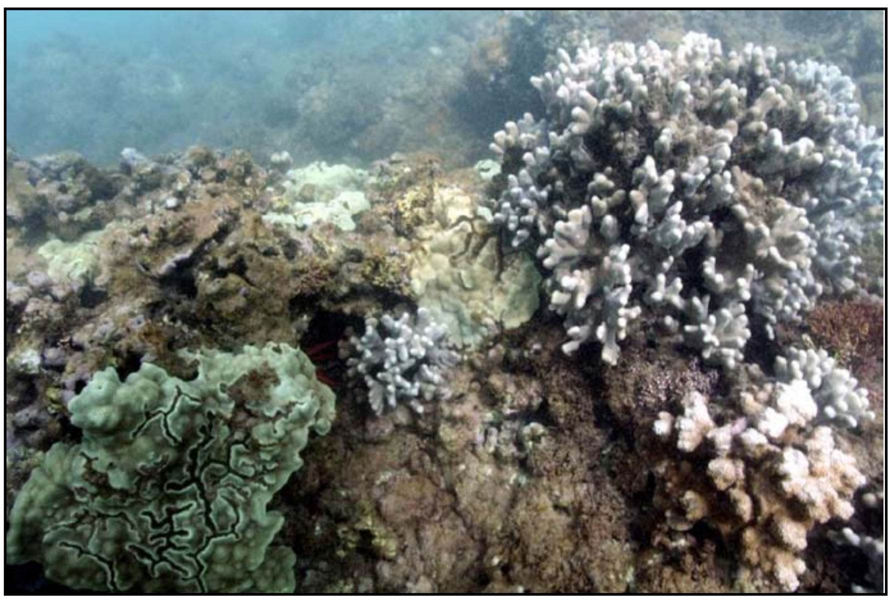


Figure 4-22. Outer reef zone, showing the presence of finger coral and encrusting coral

5. HUMAN ENVIRONMENTAL SETTING

5.1 Socio-Economic Environment

Maui County has a population of 154,834 according to the 2010 U.S. Census, up 21% since the year 2000. West Maui has a population of 20,890 between Lahaina town and Napili. The five major hotels and condominiums that front Kahana Beach – Hololani, Royal Kahana, Valley Isle, Sands of Kahana, and the Kahana Beach Resort (see Figure 4-1) - have a minimum of 652 units between them, and represent a significant part of the economy for Maui County. While these five are the beach front hotels, many other condominium and resort industry destinations occur between Lower Honoapiilani Road and Honoapiilani Highway, and also make use of Kahana Beach.

Since the closure of Lahaina's Pioneer Mill in 1999, the economy of West Maui has become increasing reliant on the visitor industy. Historically, pineapple and sugar cane were the two major crops in West Maui, but these have mostly been discontinued or are harvested at greatly reduced amounts. Coffee plantations have replaced some of the pineapple and sugar cane acreage, and are also popular tourist destinations of interest.

5.2 Historic, Cultural, and Archaeological Resources

Land use in the coastal area of West Maui in pre-contact and early historic times likely involved the use of coastal resources and small gardening plots. Industrial agriculture began with sugarcane cultivation in 1859 with the formation of the Lahaina Sugar Company. The Pioneer Mill Company bought Lahaina Sugar Company in 1863. They initiated the Pioneer Railroad line in 1882, but this was not extended to Kahana until 1919. Commercial and residential development of the coastal strip between Lower Honoapiilani Road and Honoapiilani Highway began in the 1960's. A 1975 aerial photograph shows extensive grading of the Hololani property during construction of the condominium buildings.

The extensive agricultural, and later commercial development likely destroyed any archaeological sites on the flat lands, and archaeological surveys generally concentrated on the incised gulch areas cut by streams.

A study conducted by Xamanek Researches (1999) as part of an Environmental Assessment for a County of Maui project found no archeological sites in the vicinity of the Hololani. Three sites, two previously known and one found by the authors on the shoreline, were found north of Kaea Point (mouth of the Kahana Stream).

Due to the extensive grading and construction at the Hololani, as well as the significant shoreline erosion that has occurred, it is unlikely that any historical or culturally significant features exist on the property.

5.3 Public Infrastructure and Services

5.3.1 Transportation

Access to the Hololani is provided by Lower Honoapiilani Road, a two-lane County-owned road that runs just mauka of the shorefront developments such as the Hololani that characterize the area. The road has a meandering character, and has its closest local approach to the shoreline on a tight curve near the drainage easement between the Hololani and Pohailani condominiums (see Figure 4-18).

The State-owned Honoapiilani Highway lies less than 1,000 feet inland from the shoreline and conducts most of the the through traffic in the region.

A federally sponsored project to widen Lower Honoapiilani Road is presently undergoing design and permitting processes by the County of Maui Department of Public Works. The project is called *Lower Honoapiilani Road Improvements Phase IV (Hoohui Rd. to Napilihau St.)*, and also involves improvements to the drain line between the Hololani and Pohailani (Munekiyo & Hiraga, 2002).

The Kapalua/West Maui Airport is about one mile distant from the Hololani.

5.3.2 Police

The Kahana area is served by the Maui Police Department's Lahaina patrol district. There is also a police sub-station in Napili.

5.3.3 Fire

Fire stations are located in Lahaina and Napili. The Napili station is closest to the Hololani. The Lahaina station includes a ladder company and has a boat for ocean rescues.

5.3.4 Water

Water is provided to the Hololani by pipelines buried under Lower Honapiilani Road.

5.3.5 Wastewater

Wastewater from the Hololani is treated at the Lahaina Wastewater Reclamation Facility.

5.3.6 Drainage

The Hololani shoreline is characterized by a drainage swale approximately 10 ft mauka of the shoreline escarpment. Runoff is to the north and south where it can percolate into the soil or flow mauka off the property into the storm drain. The storm drain outlet at the easement between the Hololani and Pohailani properties is termed "Outlet No. 1" in the County project "*Improvements to Lower Honoapiilani Road, Phase IV*" and is meant to be improved when the project moves forward.

5.3.7 Electrical

Electrical service is provided by Maui Electric Company (MECO). Poles and overhead lines run on the mauka side of the highway near the Hololani, and one is located on the north corner of the drainage easement. The poles accommodate telephone and cable television and internet as well as electrical. An electrical transformer on the Pohailani property was recently dismantled due to its proximity to an undercut wall. A new concrete vault was built closer to the roadway inside the drainage easement.

5.4 Recreation

The Hololani is both a resort destination for visitors and permanent home for many of the owners. Ocean based recreation is of primary importance, and includes typical swimming, sunbathing, and walking activities that are standard for most beach areas. The outer reef areas are good for snorkeling, with generally clean water and good coral growth. Although there are no named surf sites near the Hololani, surfing is possible during both the north and south swell seasons. The nearest named surf sites are "S-Turns" at the south end of Kahana Beach and "Little Makaha" at Napili Bay. Other sites may exist, but are not well known except by local inhabitants.

Strong trade winds blow through the Pailolo Channel, especially during the afternoon, and wind surfing and kite surfing are other popular sporting activities. Small watercraft such as kayaks are launched off Kahana Beach, and offer quick access to the offshore reefs for snorkelers.

5.5 Scenic and Aesthetic Resources

The oceanfront viewplane of West Maui is one of the finest in the world, and is one of the major attractions for visitors and permanent residents alike. The scenery includes views of the islands of Molokai and Lanai. The Pailolo Channel is famous for humpback whale activity.

Kahana Beach is an uninterrupted ¼-mile reach of sand that exists year-round between the Royal Kahana and the Kahana Beach hotels. The beach is extended in front of the Hololani during seasons and years when conditions are favorable. The beach is safe as the wave climate is mild and the fringing reef offers additional protection. The water is generally clear except during periods of heavy rain.

5.6 Coastal Access

The only official public coastal access point along the Kahana shoreline is a the Sands of Kahana complex (Figure 4-1). A little further south, there is coastal access at Pohaku Beach Park (S-Turns). The drainage easement at the north end of the Hololani property is also used.

At present, access along the beach varies with the amount of sand present. During seasons with little or no sand present, lateral access along the coastline is difficult.

6. ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

6.1 Impacts On the Physical Environment

6.1.1 Impacts On Noise and Air Quality

Noise and air quality impacts will occur only during construction. The project will require the operation of heavy machinery for excavation and installation of rock armor and sheet pile. Heavy equipment used will depend on the selected contractor, but may include pile driving equipment, bulldozer, and excavator.

Methodology for calculating noise levels is given in the 2006 Federal Transit Administration manual, *Transit Noise and Vibration Impact Assessment* (Hanson *et al*, 2006). The descriptor for noise levels is *Leq*, the equivalent noise level. It is calculated by modifying the acoustic emission level of the equipment for the amount of time in use (Usage Factor – *UF*), attenuation from topography (*G*) and distance (*D*). Noise levels are given in logarithmic units, dBA, which are decibels weighted to characteristics of the human ear. The equivalent noise level is given as:

$$Leq = EL + 10\log(UF) - 20\log(D/50) - 10G\log(D/50)$$

Pile drivers have an emission level of 101 dBA and a usage factor of 20%, dozers and excavators have an emission level of 85 dBA and a usage factor of 40%. Ground factors (*G*) were not considered.

Table 6-1 lists calculated noise levels at different distances, and the combined equivalent levels of two pieces of equipment. Due to the exponential nature of sound level perception, the source with the higher emission level dominates the noise field.

The noise levels in Table 6-1 are conservative, as a ground factor was not used and there will be some acoustic shielding from the Hololani buildings and the shoreline escarpment. Nevertheless, the levels are potentially significant.

Table 6-1. Equipment Equivalent Noise Levels (*Leq*)

Distance (ft)	Pile Driver (dBA)	Excavator (dBA)	Total (dBA)
50	96	81	96.1
100	90	75	90.1
200	84	69	84.1
500	76	61	76.1

Noise Level Mitigation

Construction noise levels can be mitigated to some extent by the following practices:

- Conduct operations on a set schedule during daylight hours only;
- If possible, conduct two or more high noise level operations simultaneously;
- Use vibratory versus impact equipment if possible;
- Make sure all equipment is in good working order and equipped with proper muffling;
- Enhance ground factors by stockpiling equipment and materials between the source area and the public.

Although none of the construction activities should cause excessive dust, air quality at the site may be reduced somewhat. Residual moisture levels in the soils should prevent or reduce dust production during excavation. Rock dumping and placement may cause intermittent dust production.

Air Quality Mitigation

Air quality impacts can be reduced by the following practices:

- Cover excavation spoil or wet it down periodically;
- Wash excessive dirt off armor stone;
- Make sure all engines are in proper working order.

If air quality impacts become significant, the contractor may be required to put up screening material.

6.1.2 Impacts On Shoreline Characteristics and Coastal Processes

6.1.2.1 Sand Accretion

Shoreline hardening is perceived as inevitably leading to beach narrowing and beach loss, especially on beaches that are undergoing long term retreat (OEQC, 1998). Shoreline hardening may also cause sediment impoundment when beach quality sand is trapped mauka of a coastal structure.

The proposed project does not impound beach quality sand as the eroding substrate at the Hololani is composed of red clay that is held in suspension as a turbid plume and does not contribute to beach building.

The existing temporary shore protection (a form of shoreline hardening) has been in place at the Hololani for approximately five years. During that time, numerous episodes of erosion and accretion of the sand beach have occurred. To all appearances, the temporary shoreline hardening that is in place has not affected the beach processes responsible for the sand movement.

The Hololani is at the north end of a littoral cell that includes all of Kahana Beach. Sand movement responds to the seasonal wave climate. Waves from the south during the summer (and during Kona storms) tend to bring sand to the Hololani from the more southern reaches of Kahana Beach. Conversely, waves from the north and northeast tend to strip the sand away (see Section 4.1.9). In each case, the sand is moving laterally along the beach versus in an onshore-offshore direction. The Hololani beach appears to be dominated by the longshore transport processes caused by waves from the north and south, and less by cross-shore transport.

Wave reflection from vertical escarpments, whether natural or man made, has a tendency to flatten sand beaches and move sand offshore. However, once sand accretion has removed the reflecting surface from coastal processes, it is no longer a factor unless water levels and wave heights increase so that the wall is again in reach. Nevertheless, the initial process of sand accretion is important. The existing temporary protection includes a scour apron constructed from Tensar marine mattresses. Filled with cobble-size rock, the mattresses allow wave uprush to percolate through the cobbles and deposit sand on top of the mattress. In this way they act much like a natural beach and help to "seed" sand accretion. Attenuating wave reflection and allowing percolation are key elements to beach building.

The proposed project is designed with a rock rubblemound revetment fronting a seawall. The slope and porosity of the revetment will help to reduce wave reflection and allow percolation and deposition, and thereby help the sand accretion process when seasonal wave patterns are favorable.

The proposed project is replacing a natural vertical escarpment with a high amount of wave reflection and low porosity with a sloping, permeable structure that will absorb wave energy, reduce wave reflection, and allow percolation through the structure. It is unlikely that the proposed structure will have a negative effect on coastal processes, and it may well have a long-term beneficial effect by promoting sand accretion.

6.1.2.2 Effect of the Pohailani Seawall

The Pohailani property has been protected by a seawall since at least 1988 (based on aerial photographs). With the recession of the Hololani shoreline, the Pohailani now acts as a barrier to the flow of sand to the north. Two alternatives have been presented for terminating the proposed structure at the north end:

1. Terminating the structure at the easement boundary (see Figure 2-7) , and
2. Extending the structure to the Pohailani seawall (see Figure 2-8).

The second option may reduce the barrier effect of the Pohailani seawall and allow more sand to be transported north. It is possible, under this scenario, that some beach narrowing may occur in front of the Hololani as a result. However, transport processes are complex, and beach behavior at the intersection of the revetment and the wall is difficult to predict with certainty. Negative effects are not likely to be significant.

6.1.2.3 End Effects at the Southern Boundary

The termination of a shore protection structure can result in additional scour in the vicinity of the termination commonly termed “end effects”. The proposed project is terminated approximately 24 ft before the southern property boundary with the Royal Kahana Condominiums (see Figure 2-4). The termination is done in order to isolate end effects on to the Hololani property as much as possible. The magnitude and ultimate shoreline condition resulting from the structure termination are difficult to predict with certainty.

Mitigation of End Effects at the Southern Boundary

To prevent effects on the neighboring property, the proposed structure has been terminated 24 ft from the property line. The native soil in this area will be disturbed as little as possible to keep it in its natural state of compaction. The existing shoreline in the termination area is presently protected by draped Tensar mattresses (see Figure 4-3). These have worked well to protect the shoreline and it is recommended to keep them in place.

6.1.3 Impacts On Marine Water Quality

6.1.3.1 Long-Term Impacts on Water Quality

The proposed project will seal off the red clay substrate at the project site and prevent erosion from wave action. When eroded, the red clay forms highly visible turbidity plumes that can linger in the nearshore waters, and eventually settle in deeper water offshore. The long-term effects of the project will likely be to improve the water quality in the vicinity.

6.1.3.2 Impacts on Water Quality During Construction

While long term effects on water quality due to the project are not likely, there will probably be short term elevations in turbidity and total suspended solids (TSS) during the construction phase of the project, as construction of the will occur at the shoreline. A Water Quality Certification (WQC) from the State Department of Health is being applied for. The WQC requires completion and acceptance of an Applicable Monitoring and Assessment Program (AMAP) that will detail water quality monitoring during construction. Impacts can be reduced using Best-Management-Practices (BMP's), and limited in areal extent by the use of silt curtains. The monitoring program will require regular measurement of water quality parameters in the vicinity of the project.

The following BMP's are typical for this type of project:

1. An effective turbidity barrier (e.g. silt curtain) shall be deployed as necessary to isolate the construction activity, to avoid degradation of marine waters and prevent migration of fine material and suspended solids during the construction operations. Barriers shall extend to the ocean bottom and be weighed down. The barriers shall remain in place during construction and until post-construction water quality monitoring results show water quality inside the barrier to be equivalent to ambient conditions as shown by control stations outside of the turbidity barriers.

2. Excavated material that is stockpiled on-site will be contained by barrier systems to prevent run-off into marine waters.

3. Fueling of equipment shall take place away from the water. Fuels, oils and waste materials shall be properly contained and not be allowed to leak, leach or otherwise enter marine waters. The Contractor shall have established procedures for immediate clean up of fuel or oil spills.

4. The contractor shall keep construction activities under surveillance, management, and control to avoid pollution of surface or marine waters. Shoreline construction activities shall cease when ocean conditions become severe enough that containment devices (i.e. silt curtains) become ineffective. Environmental resources outside the immediate area of material removal shall be protected.

5. A dust control program will be implemented, and wind blown sand and dust shall be prevented from blowing.

6. Material delivery and storage shall take place in designated areas.

7. The work shall be completed in accordance with all applicable State and County health and safety regulations.

8. Concrete truck wash water shall be contained in pits or other containment devices provided with impermeable liners for evaporative dissipation. Spoil shall be disposed of at an appropriate landfill site.

9. Stockpiled material for use or reuse in construction shall not be co-mingled with concrete truck wash water, equipment washdown effluent or other spoil.

6.2 Impacts On The Biological Environment

The project is expected to have no significant impact on the biological environment. No biological habitats will be significantly affected.

6.2.1 Impacts On Threatened and Endangered Species

The project area is not known as an endangered species habitat. The most likely endangered animals that may be encountered are sea turtles and monk seals. The project will have no long-term significant impacts on endangered species. However, care will be taken during construction to ensure that listed species are not disturbed.

The following procedures will be followed to mitigate any possible impact to endangered species:

- A survey of the project area will be performed just prior to commencement or resumption of construction activity to ensure that no protected species are in the project area. If protected species are detected, construction activities will be postponed until the animals voluntarily leave the area.

- If any listed species enter the project area during the conduct of construction activities, all activities will cease until the animals voluntarily depart the area.

- All on-site personnel will be apprised of the status of any listed species potentially present in the project area and the protections afforded to those species under Federal laws.

6.3 Impacts On the Human Environment

The project is expected to have no significant negative effects on the human environment. However, the project will have significant positive effects:

- The engineered structure will be attractive and visually neutral. Unsightly seabags will be removed.
- Permanent protection of the Hololani will remove a significant potential threat to the well-being of the residents and the local community.
- The project will protect or stabilize vital public infrastructure, including Lower Honoapiilani Road and the drainage easement.
- Lateral shoreline access will be improved.

6.3.1 Impacts On Historic, Cultural, and Archaeological Resources

Historic, cultural, or archeological sites have not been identified in the vicinity of the project. The project is therefore not likely to have any significant impacts.

6.3.2 Impacts On Public Infrastructure

The project will help to protect Lower Honoapiilani Road from coastal erosion. The project will dress the shoreline in the drainage easement in a fashion that will assist in future improvements. The alternative design presented (see Section 2.4.1) will permanently improve the easement area and drainage.

6.3.3 Impacts On Recreational Use

The project will have long-term postive impacts on recreational use in the vicinity. Use of nearshore waters (swimming, diving, surfing) will improved due to improved water quality. Lateral shoreline access will improved. The beach will be more user-friendly with removal of the temporary protection (seabags and mattresses).

The project will cause beach access restrictions during construction.

6.3.4 Impacts on Scenic and Aesthetic Resources

The project will improve the scenic and aesthetic resources in the area. The efforts to protect the shoreline at the Hololani have resulted in various unsightly non-engineered shoreline constructions, including sand bags, seabags, and boulder protection. The deteriorating temporary protection will be removed and replaced by an engineered and visually neutral structure.

6.3.5 Impacts on Coastal Access

Designated public access for Kahana Beach exists now only at the Sands of Kahana condominiums. The drainage easement between the Hololani and Pohailani is an unofficial access point. Coastal access will remain unchanged with the existing design as shown in Figure 2-7. The alternative design (Figure 2-8) will improve the easement area. A coastal access stairway can be designed into the alternative upon approval by the Department of Public Works.

Lateral coastal access will be improved by the proposed project. A 5-ft wide revetment crest at the +6 ft elevation (Figure 1-7) will allow lateral shoreline access during periods of high water and low beach sand volume.

7. CONCLUSIONS

Construction of permanent shore protection consisting of a hybrid rock rubble mound revetment and seawall is necessary to protect the twin habitable structures of the Hololani Resort Condominiums. Emplacement of an engineered structure will allow removal of the existing temporary protection, and will protect the Hololani buildings for the foreseeable future. Protection of the buildings is critical for all reasonable use of the property, and to maintain public safety and welfare. Ancillary benefits to protection of the Hololani include improvements to the nearshore water quality and protection of vital public infrastructure that includes Lower Honoapiilani Road and an important drainage line.

The proposed project will result in no long-term degradation of the environment or loss of habitat.

The project area is not known as an endangered or threatened species habitat. There are no known or identified historical or cultural resources at the immediate project site.

Minor impacts due to construction activity will include localized increase in noise, dust formation, equipment emissions, and restricted coastal access.

Based on the findings of this environmental assessment, it is reasonable to expect that this project will not result in significant adverse environmental impacts.

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APPENDIX A. GOVERNMENT AGENCY AND RELATED COMMUNICATIONS

1. Letter from DLNR Hololani Emergency Permit 2-06-07
2. Letter from DLNR 2 YR Permit Extension 5-03-10
3. Letter from DLNR Sand Bag Repair Approval 9-28-10
4. Letter to DLNR 3-24-11 Hololani Shore Protection
5. Letter from DLNR 5-01-11
6. Letter to Maui County Planning Department 3-24-11
7. Letter from Maui County Planning Dept 8-16-11
8. Letter to USACE Jurisdictional Inquiry 11-30-11
9. Letter from USACE Approved Jurisdictional Determination 1-27-12
10. Letter to Maui County Department of Public Works 3-24-11
11. Letter to Royal Kahana 3-24-11
12. Letter to Pohailani 3-24-11

1. Appendix A: Letter from DLNR Hololani Emergency Permit 2-06-07

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
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CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
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LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

DLNR.OCCL:DE

File No.: Emergency-OA-07-08

February 6, 2007

John C. Henry
Hololani Resident Manager
4401 L. Honoapiilani Rd
Lahaina, HI 96761

Mr. Henry:

SUBJECT: Emergency Erosion Control (Sandbags), Hololani Condominiums
4401 L. Honoapiilani Rd Lahaina, HI. TMK (2) 4-3-010:09.

The Department of Land and Natural Resources (DLNR), Office of Conservation and Coastal Lands (OCCL) has received your letter dated January 24, 2007 regarding an emergency request for a sand bag revetment fronting the property. Based on the information presented and a site visit by our staff on January 11, 2007 the large multi-story structure is in danger of collapse without immediate shore protection and justifies a temporary emergency response (Figure 1).

On February 2, 2007, the Department approved an emergency request of behalf of the Hololani Condominium landowners to place additional boulders and fabric on the shoreline in order to prevent a portion of the facility from being undermined by erosion. This authorization allowed Hololani to place boulders in the shoreline area for thirty (30) days. After this period, the boulders must be removed to the satisfaction of the Department.

As an interim measure (subsequent to the boulder removal), the landowner(s) would like to install a temporary engineered structure. The proposed sandbag and Tensar structure consists of approximately 380 linear feet of shoreline fronting the subject property. The revetment will be installed at elevation +2.5 ft to +10.0 (ft sl) and will consist of a combination of 144 Tensar units (0.75' X 5' X 10') (160 cubic yards of rock filled in a plastic mattress) as scour pad and splash apron and approximately 144 (5' X 10' X 1.5') Bulklift S.E.ABAG sandbags (360 cubic yards of sand). These will be installed in a sloping formation and built primarily seaward of the shoreline defined by the active erosional scarp. This authorization is for the referenced design presented in Figure 2 of the January 24, 2007 request letter (Figure 2).

The DLNR understands that during time the temporary sandbag/Tensar structure is in place, the landowner(s) intend to apply for a shoreline setback variance for an engineered rock revetment placed landward of and to replace the proposed sandbag structure, the installation of the bags is intended to be temporary until the required permits are obtained for a more permanent rock revetment.

Mitigation Measures (Best Management Practices)

Typical Best Management Practices shall be implemented to ensure that water quality and marine resources are protected and preserved. Mitigation measures involve the use of sand that is free of contaminants and low in silt content (to be determined). The applicant proposes to place the sandbags seaward of the shoreline at and will ensure silt is contained during construction activities. Excessive silt and turbidity shall be contained or otherwise minimized through the use of silt containment devices and barriers. Silt containment should be practiced for the duration of construction activities. The sandbag installation should occur during low tide to ensure activities do not discharge silt into state waters. Visual monitoring of the nearshore water quality condition should be practiced during sand placement; and if excessive turbidity occurs, sand placement shall stop and more effective silt containment measures utilized.

Sand Quality

Due to the contained use of the proposed sand, Best Management Practices, low silt content, limited duration of exposure and the high rate of flushing and circulation at the site, potential turbidity impacts from the proposed activities are estimated to be negligible. Near-shore turbidity associated with the use of this sand is not expected to impact marine life and will be quite short-lived in the nearshore waters and is not expected to exceed existing background levels.

Based on the information provided, the Department has made the following determinations:

1. There is an imminent threat to the existing dwelling with active erosion threatening the structure.
2. This berm is approximately defined by the active scarping and fallen vegetation. Erosion appears to have accelerated landward recently.
3. The proposed structure will provide temporary protection to the threatened structures until a more permanent solution is designed and approved.
4. There is no known beach-quality sand source stored behind the berm, it appears the area is composed a clay and weathered basalt that would not provide a useful source of sediment to the littoral system if were allowed to erode.
5. The area is largely armored with a large number of shoreline structures to the north and south of the property, specifically immediately to the north.
6. The applicant is developing a long-term plan for erosion control that may include stabilizing structures. This plan will be implemented before the 3 year expiration date of the emergency permit.

<u>DEPARTMENT ACTION</u>
Terms and Conditions

The Chairperson of the Department of Land and Natural Resources hereby authorizes your emergency request for temporary sandbag and Tensar mattress structure fronting the subject property. This authorization includes, but is not limited to the following terms and conditions:

1. This authorization will become valid upon the approval by the DLNR of:
   a. A sand source for the installation of the sand bags.
   b. A Best Management Practices (BMP's) Plan
   c. Installation sequence and work plan for the proposed structure.

2. The project includes the installation and replacement of approximately 144 (5' X 10' X 1.5') Bulklift S.E.ABAG sandbags (360 cubic yards of sand) in conjunction with 114 Tensar rock-filled units (160 cubic yards of rock).

3. This authorization is valid for three (3) years from the date of acceptance, at which time, the authorization shall expire.

4. The applicant shall ensure that excessive siltation and turbidity is contained or otherwise minimized to the satisfaction of the DLNR, DOH or other agency, through silt containment devices or barriers, high sand quality and selective sand placement;

5. Any work or construction authorized by this letter shall be initiated within six (6) months of the approval of such use, and, unless otherwise authorized, shall be completed within twelve (12) months of the approval of such use. The applicant shall notify the Department before construction activity is initiated and when it is completed.

6. Sand utilized for the project will be from an approved commercial sand source. No sand shall be extracted from the beach fronting the property for any purpose.

7. Authorization of the sand used for the bags is contingent upon review and approval of the sand by the Department. **Please submit sediment grain size analysis report** and specify the source to the DLNR for review to ensure the proposed sand meets minimum standards. The sand shall meet the following State quality standards:

   a) The proposed fill sand shall not contain more than six (6) percent fines, defined as the #200 sieve (0.074 mm).

   b) The proposed beach fill sand shall not contain more than ten (10) percent coarse sediment, defined as the #4 sieve (4.76 mm) and shall be screened to remove any non-beach compatible material and rubble.

c) No more than 50 (fifty) percent of the fill sand shall have a grain diameter less than 0.125 mm as measured by #120 Standard Sieve Mesh.

d) Beach fill shall be dominantly composed of naturally occurring carbonate beach or dune sand. Crushed limestone or other man made or non carbonate sands are unacceptable.

8. Transfer of ownership of the subject property includes the responsibility of the new owner to adhere to the terms and conditions of this authorization.

9. This action is temporary to alleviate the emergency until long-term measures can be implemented. The DLNR reserves the right to terminate this authorization if it is determined the structure is having an adverse impact on the environment or if other shore protection alternatives are available.

10. At the conclusion of work, the area shall be clean of all construction material, and the site shall be restored to a condition acceptable to the Chairperson.

11. The activity shall not adversely affect a federally listed threatened or endangered species or a species proposed for such designation, or destroy or adversely modify its designated critical habitat.

12. The activity shall not substantially disrupt the movement of those species of aquatic life indigenous to the area, including those species, which normally migrate through the area.

13. When the Chairperson is notified by the applicant or the public that an individual activity deviates from the scope of an application approved by this letter, or activities are adversely affecting fish or wildlife resources or their harvest, the Chairperson will direct the applicant to undertake corrective measures to address the condition affecting these resources. The applicant must suspend or modify the activity to the extent necessary to mitigate or eliminate the adverse effect.

14. When the Chairperson is notified by the U.S. Fish and Wildlife Service, the National Marine Fisheries Service or the State DLNR that an individual activity or activities authorized by this letter is adversely affecting fish or wildlife resources or their harvest, the Chairperson will direct the applicant to undertake corrective measures to address the condition affecting these resources. The applicant must suspend or modify the activity to the extent necessary to mitigate or eliminate the adverse effect.

15. To avoid encroachments upon the area, the applicant shall not use artificially accreted areas due to nourishment or hardening as indicators of the shoreline.

16. Where any interference, nuisance, or harm may be caused, or hazard established by the activities authorized under this authorization , the applicant shall be required to take measures to minimize or eliminate the interference, nuisance, harm or hazard.

17. No contamination of the marine or coastal environment (trash or debris) shall result from project-related activities authorized under this authorization .

18. No motorized construction equipment is to be operated in the water at any time.

19. In the event there is any petroleum spill on the sand, the operator shall promptly remove the contaminated sand from the beach and immediately contact the DLNR/OCCL staff at 587-0377, to conduct a visual inspection and to provide appropriate guidance.

20. For projects authorized by this letter, the applicant, its successors and assigns, shall indemnify and hold the State of Hawaii harmless from and against any loss, liability, claim, or demand for property damage, personal injury, and death arising out of any act or omission of the applicant, its successors, assigns, officers, employees, contractors, and agents under projects authorized under this permit.

21. The DLNR reserves the right to impose additional terms and conditions on projects authorized under this letter, if it deems them necessary.

22. The applicant shall comply with all applicable statutes, ordinances, rules, and regulations of the federal, state, and county governments for projects authorized under this letter.

23. In the event that historic sites, including human burials are uncovered during construction activities, all work in the vicinity must stop immediately and contact the State Historic Preservation Division at 692-8015.

24. The applicant shall obtain a right-of-entry permit or other land disposition approval from the State of Hawaii, Land Division prior to the inception of project work.

25. Failure on the part of the applicant to comply with any conditions imposed under this authorization shall render the authorization null and void.

26. The applicant shall take measures to ensure that the public is adequately informed of the project work once it is initiated and the need to avoid the project area during the operation and shall notify all abutting property owners and community organizations that may be affected by the proposed action.

27. The applicant shall implement standard Best Management Practices (BMPs), including the ability to contain and minimize silt in nearshore waters and clean up fuel; fluid or oil spills immediately for projects authorized by this letter. Equipment must not be refueled in the shoreline area. If visible petroleum, persistent turbidity or other unusual substances are observed in the water as a result of the proposed operation, all work must cease immediately to ascertain the source of the substance. The DLNR/OCCL staff shall be contacted immediately at 587-0377, to conduct a visual inspection and to provide appropriate guidance.

Additional Monitoring:

28. The applicant must submit a written completion report to the OCCL within two months of completion of the project. The completion report must include, as appropriate, descriptions of the construction activities, discussion(s) of any deviations from the proposed project design and the cause of these deviations, results of any environmental monitoring (primarily sand movement observations and turbidity observations), discussion(s) of any necessary corrective action(s), and photographs documenting the progress of the permitted work before, during and after sand placement.

29. As a temporary emergency project, the applicant shall provide an initial completion report and follow-up summary reports ***annually*** to the Department for three (3) years from the date of acceptance or until a permitted permanent structure is completed describing the condition of the sandbags and any impacts to the local nearshore processes.

Authorization Expiration:

30. This authorization shall expire three (3) years from the date of this letter. At that time, all activities authorized by the authorization shall be removed and the shoreline shall be returned to its original condition, unless a long-term plan has been approved. Failure to comply with these terms and conditions shall constitute a violation of Chapter 183C, Hawaii Revised Statutes and fines of $2,000 per day shall accrue for each day that the landowner fails to comply with the terms and conditions of this authorization.

Please acknowledge receipt of this authorization, with the above noted conditions, in the space provided below. Please sign two copies. Retain one and return the other within fifteen (15) days. Please notify the OCCL in advance of the anticipated construction dates and notify the OCCL immediately if any changes to the scope or schedule are anticipated.

Should you have any questions on any of these conditions, please contact the Office of Conservation and Coastal Lands (OCCL) at (808) 587-0377.

Sincerely,

PETER T. YOUNG, Chairperson
Department of Land and Natural Resources

Attachments (Figures 1, 2)

Maui Board Member
DAR/HPD
Maui County Planning Dept
OHA/DOH, Clean Water
USFWS/NMFS/USACE
Jim Barry Sea Engineering Makai Research Pier Waimanalo, Hawaii 96795-1820

I concur with the conditions of this letter:

____
Applicant's Signature

Date_________________

Note: transfer of ownership (Title) conveys all terms and conditions of this authorization to the new owner.

Figure 1. Site Conditions
January 31, 2007

Figure 2. Proposed Plan

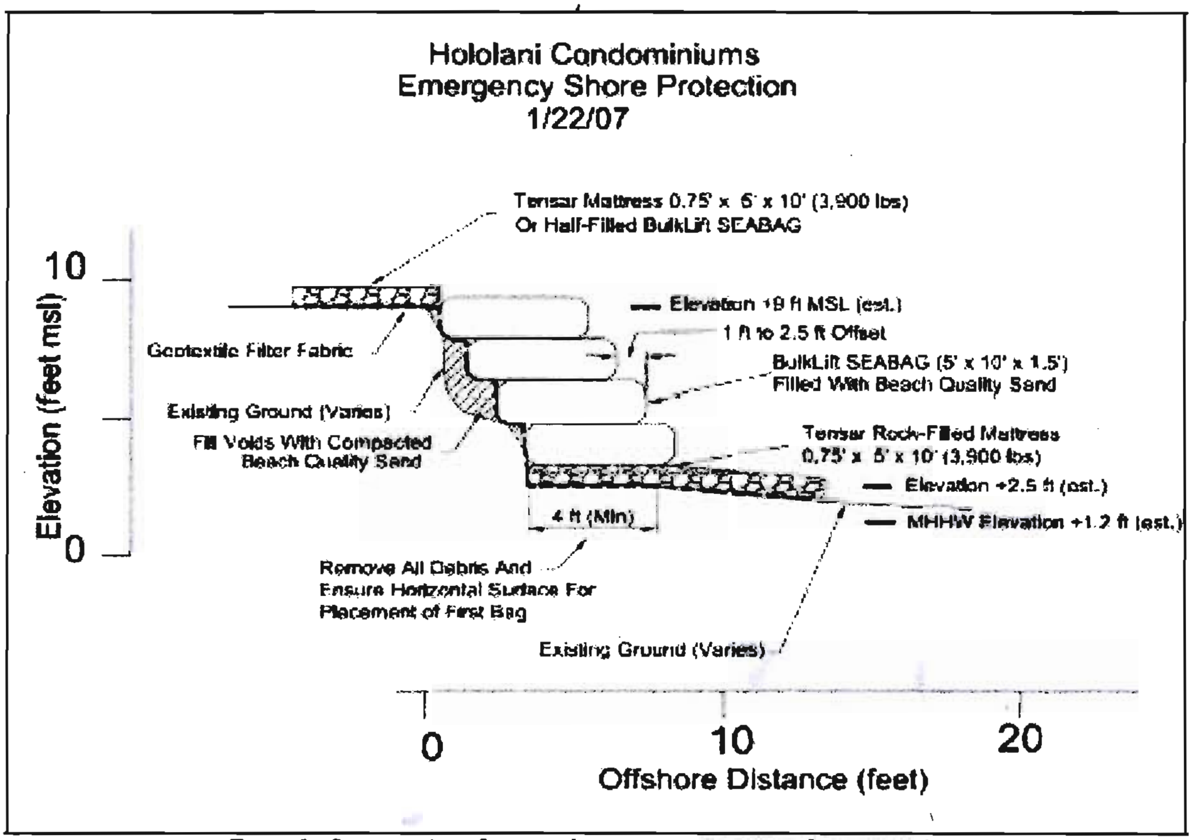

Figure 2. Cross-section of proposed temporary emergency shore protection.

2. Appendix A: Letter from DLNR 2 YR Permit Extension 5-03-10

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RUSSELL Y. TSUJI
FIRST DEPUTY

KEN C. KAWAHARA
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

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

DLNR.OCCL:DE

File No.: Emergency-MA-07-08

May 3, 2010

Ms. Lisa Howard
C/O Hawaii First
75 Kupuohi St. #205
Lahaina, HI 96761

Ms. Howard:

SUBJECT: Emergency Erosion Control (Sandbags), Request for Extension.
Hololani Condos 4401 L. Honoapiilani Rd Lahaina, HI. TMK (2) 4-3-010:09.

The Department of Land and Natural Resources (DLNR), Office of Conservation and Coastal Lands (OCCL) has received your April 22, 2010 request for extension for the subject emergency erosion control measures. Based on the information supplied, it is clear your client (Hololani Condominiums) is making an effort to develop a long-term solution to eventually replace the subject temporary emergency erosion control structure. Temporary emergency authorization MA-07-08 was issued February 6, 2007 allowing Hololani to place Geobags and erosion blankets in the shoreline area for up to 3 years. After this period, the material must be removed to the satisfaction of the DLNR. Your request for an extension to emergency permit MA-07-08 is granted for a period of 2 additional years. The new expiration for emergency permit MA-07-08 is May 1, 2012. This extension is based on the understanding that your client is working towards a permitted long-term erosion control measure and will require additional time to process the necessary plans and permit applications.

In order to consider your request for maintenance and repairs to the existing emergency sandbags and Tensar® mattresses the DLNR requires more information. Please supply the following information to the DLNR, OCCL within 60 days:

1. Please provide a detailed site plan identifying the sandbags and Tensar® mattresses that require repair and or replacement.
2. Please provide a detailed repair plan with a description of the method of replacement and the sequence or construction. For example how will the displaced bags and fabric be replaced (filled in place or overlying bags removed first).
3. Scaled Cross-section and plan view of proposed actions with volume, quantities and type of material.

a. Material list with size, type and quantity of all proposed material.
b. Sand source and volume. Include sediment grain size analysis of proposed sand source.
c. Installation/ removal method, anchoring system and estimated construction timeframe.
d. Best Management Practices (BMPs) to minimize environmental disturbance of surrounding areas and prevent discharge into state waters.
e. Estimated time the activities will need to be in place and anticipated construction date.
f. Proposed access plan for equipment and materials.
g. Timetable for development of a long-term plan for erosion control and mitigation.

Should you have any questions on any of these conditions, please contact the Office of Conservation and Coastal Lands (OCCL) at (808) 587-0377.

Sincerely,

SAM LEMMO, Administrator
Office of Conservation and Coastal Lands
Department of Land and Natural Resources

cc: Chairperson
Maui Board Member
Maui County Planning Dept- Jim Buika
Danny Lentz Hololani Resident Manager 4401 L. Honoapiilani Rd Lahaina, HI 96761
Joseph Higgins Allana, Buik & Bers, Inc. 75 Kupuohi St. #207 Lahaina, HI 96761

3. Appendix A: Letter from DLNR Sand Bag Repair Approval 9-28-10

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RUSSELL Y. TSUJI
ACTING FIRST DEPUTY

LENORE N. OHYE
ACTING DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
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CONSERVATION AND COASTAL LANDS
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HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Office of Conservation and Coastal Lands
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

DLNR.OCCL:CC File No.: Emergency-MA-07-08

September 28, 2010

Mr. Joseph Higgins, PE
Allana Buick & Bers, Inc
707 Richards Street, Suite 635
Honolulu, HI 96813

Mr. Higgins:

SUBJECT: Emergency Erosion Control (Sandbags), Repair and Maintenance Request for Emergency Authorization MA-07-08. Hololani Condos 4401 L. Honoapiilani Rd Lahaina, HI. TMK (2) 4-3-010:09.

The Department of Land and Natural Resources (DLNR), Office of Conservation and Coastal Lands (OCCL) has received your August 11, 2010 request for maintenance and repairs to the existing emergency sandbags, geotextile cloth, and Tensar® mattresses, as approved in the temporary emergency authorization MA-07-08. Temporary emergency authorization MA-07-08 was issued February 6, 2007 allowing Hololani to place Geobags and erosion blankets in the shoreline area for up to 3 years, and has been extended for 2 years. Your request for maintenance and repairs to the existing emergency sandbags, geotextile cloth, and Tensar® mattresses has been approved, provided you adhere to the following conditions:

Mitigation Measures (Best Management Practices)

Typical Best Management Practices shall be implemented to ensure that water quality and marine resources are protected and preserved. Mitigation measures involve the use of sand that is free of contaminants and low in silt content (to be determined). The applicant proposes to place the sandbags seaward of the shoreline at and will ensure silt is contained during construction activities. Excessive silt and turbidity shall be contained or otherwise minimized through the use of silt containment devices and barriers. Silt containment should be practiced for the duration of construction activities. The sandbag installation should occur during low tide to ensure activities do not discharge silt into state waters. Visual monitoring of the nearshore water quality condition should be practiced during sand placement; and if excessive turbidity occurs, sand placement shall stop and more effective silt containment measures utilized.

Sand Quality

Due to the contained use of the proposed sand, Best Management Practices, low silt content, limited duration of exposure and the high rate of flushing and circulation at the site, potential turbidity impacts from the proposed activities are estimated to be negligible. Near-shore turbidity associated with the use of this sand is not expected to impact marine life and will be quite short-lived in the nearshore waters and is not expected to exceed existing background levels.

DEPARTMENT ACTION

Terms and Conditions

Applicant is authorized to conduct repair and maintenance activities for temporary sandbag and Tensar mattress structure fronting the subject property. This authorization includes, but is not limited to the following terms and conditions:

1. This authorization will become valid upon the approval by the DLNR of:
   a. A sand source for the installation of the sand bags.
   b. A Best Management Practices (BMP's) Plan
   c. Installation sequence and work plan for the proposed structure.

2. The project includes the repair or replacement of approximately 12 (5' X 10' X 1.5') Bulklift S.E.ABAG sandbags (360 cubic yards of sand), 3 Tensar rock-filled units (160 cubic yards of rock), and replacement of sections of geotextile fabric.

3. The applicant shall ensure that excessive siltation and turbidity is contained or otherwise minimized to the satisfaction of the DLNR, DOH or other agency, through silt containment devices or barriers, high sand quality and selective sand placement;

4. Any work or construction authorized by this letter shall be initiated within six (6) months of the approval of such use, and, unless otherwise authorized, shall be completed within twelve (12) months of the approval of such use. The applicant shall notify the Department before construction activity is initiated and when it is completed.

5. Sand utilized for the project will be from an approved commercial sand source. No sand shall be extracted from the beach fronting the property for any purpose.

6. Authorization of the sand used for the bags was based upon review and approval of the submitted grain size analysis. The sand has met the following State quality standards:

   a) The proposed fill sand does not contain more than six (6) percent fines, defined as the #200 sieve (0.074 mm).

   b) The proposed beach fill sand does not contain more than ten (10) percent coarse sediment, defined as the #4 sieve (4.76 mm) and shall be screened to remove any non-beach compatible material and rubble.

c) No more than 50 (fifty) percent of the fill sand has a grain diameter less than 0.125 mm as measured by #120 Standard Sieve Mesh.

d) Beach fill shall be dominantly composed of naturally occurring carbonate beach or dune sand. Crushed limestone or other man made or non carbonate sands are unacceptable.

7. Transfer of ownership of the subject property includes the responsibility of the new owner to adhere to the terms and conditions of this authorization.

8. This action is temporary to alleviate the emergency until long-term measures can be implemented. The DLNR reserves the right to terminate this authorization if it is determined the structure is having an adverse impact on the environment or if other shore protection alternatives are available.

9. At the conclusion of work, the area shall be clean of all construction material, and the site shall be restored to a condition acceptable to the Chairperson.

10. The activity shall not adversely affect a federally listed threatened or endangered species or a species proposed for such designation, or destroy or adversely modify its designated critical habitat.

11. The activity shall not substantially disrupt the movement of those species of aquatic life indigenous to the area, including those species, which normally migrate through the area.

12. When the Chairperson is notified by the applicant or the public that an individual activity deviates from the scope of an application approved by this letter, or activities are adversely affecting fish or wildlife resources or their harvest, the Chairperson will direct the applicant to undertake corrective measures to address the condition affecting these resources. The applicant must suspend or modify the activity to the extent necessary to mitigate or eliminate the adverse effect.

13. When the Chairperson is notified by the U.S. Fish and Wildlife Service, the National Marine Fisheries Service or the State DLNR that an individual activity or activities authorized by this letter is adversely affecting fish or wildlife resources or their harvest, the Chairperson will direct the applicant to undertake corrective measures to address the condition affecting these resources. The applicant must suspend or modify the activity to the extent necessary to mitigate or eliminate the adverse effect.

14. To avoid encroachments upon the area, the applicant shall not use artificially accreted areas due to nourishment or hardening as indicators of the shoreline.

15. Where any interference, nuisance, or harm may be caused, or hazard established by the activities authorized under this authorization, the applicant shall be required to take measures to minimize or eliminate the interference, nuisance, harm or hazard.

16. No contamination of the marine or coastal environment (trash or debris) shall result from project-related activities authorized under this authorization.

17. No motorized construction equipment is to be operated in the water at any time.

18. In the event there is any petroleum spill on the sand, the operator shall promptly remove the contaminated sand from the beach and immediately contact the DLNR/OCCL staff at 587-0377, to conduct a visual inspection and to provide appropriate guidance.

19. For repair and maintenance projects authorized by this letter, the applicant, its successors and assigns, shall indemnify and hold the State of Hawaii harmless from and against any loss, liability, claim, or demand for property damage, personal injury, and death arising out of any act or omission of the applicant, its successors, assigns, officers, employees, contractors, and agents under projects authorized under this permit.

20. The DLNR reserves the right to impose additional terms and conditions on projects authorized under this letter, if it deems them necessary.

21. The applicant shall comply with all applicable statutes, ordinances, rules, and regulations of the federal, state, and county governments for projects authorized under this letter.

22. In the event that historic sites, including human burials are uncovered during construction activities, all work in the vicinity must stop immediately and contact the State Historic Preservation Division at 692-8015.

23. The applicant shall obtain a right-of-entry permit or other land disposition approval from the State of Hawaii, Land Division prior to the inception of project work.

24. Failure on the part of the applicant to comply with any conditions imposed under this authorization shall render the authorization null and void.

25. The applicant shall take measures to ensure that the public is adequately informed of the project work once it is initiated and the need to avoid the project area during the operation and shall notify all abutting property owners and community organizations that may be affected by the proposed action.

26. The applicant shall implement standard Best Management Practices (BMPs), including the ability to contain and minimize silt in nearshore waters and clean up fuel; fluid or oil spills immediately for projects authorized by this letter. Equipment must not be refueled in the shoreline area. If visible petroleum, persistent turbidity or other unusual substances are observed in the water as a result of the proposed operation, all work must cease immediately to ascertain the source of the substance. The DLNR/OCCL staff

shall be contacted immediately at 587-0377, to conduct a visual inspection and to provide appropriate guidance.

Additional Monitoring:

27. The applicant must submit a written completion report to the OCCL within two months of completion of the repair and maintenance project. The completion report must include, as appropriate, descriptions of the repair and maintenance activities, discussion(s) of any deviations from the proposed project design and the cause of these deviations, results of any environmental monitoring (primarily sand movement observations and turbidity observations), discussion(s) of any necessary corrective action(s), and photographs documenting the progress of the permitted work before, during and after sand placement.

Should you have any questions on any of these conditions, please contact the Office of Conservation and Coastal Lands (OCCL) at (808) 587-0377.

Sincerely,

LAURA H. THIELEN, Chairperson
Department of Land and Natural Resources

cc: Maui Board Member
Maui County Planning Dept- Jim Buika
Danny Lentz Hololani Resident Manager 4401 L. Honoapiilani Rd Lahaina, HI 96761

4. Appendix A: Letter to DLNR 3-24-11 Hololani Shore Protection

Sea Engineering, Inc.

Makai Research Pier • Waimanalo, Hawaii 96795-1820 • E-mail: sei@seaengineering.com
Phone: (808) 259-7966 / FAX (808) 259-8143 • Website: www.seaengineering.com

March 24, 2011

Mr. Samuel J. Lemmo, Administrator
Office of Conservation and Coastal Lands,
State of Hawaii, Department of Land and Natural Resources
Post Office Box 621
Honolulu, HI, 96809

Dear Mr. Lemmo,

Subject: Hololani Resort Condominiums Permanent Shore Protection: Project Design and Preliminary Environmental Document

The Hololani Resort Condominiums (the Hololani) are located at 4401 Lower Honoapiilani Road in the Kahana area of Maui (TMK (2) 4-3-010:009), and have had an on-going coastal erosion problem since approximately 1988. During the Winter of 2006-2007, the situation became critical and Sea Engineering, Inc. (SEI) designed emergency temporary shore protection using Bulklift geotextile sand bags and Tensar rock-filled marine mattresses. The temporary shore protection was constructed in November and December of 2007. The structure was authorized by both Maui County Planning Department and the State Department of Land and Natural Resources, Office of Conservation and Coastal Lands (DLNR-OCCL). The latter authorization was File No. *Emergency-OA-07-08*. As part of this authorization, the Hololani was required to develop the design and aquire the necessary permits for a permanent shore protection solution.

SEI has been actively working with the Hololani to address their needs for robust and permanent shore protection. The document which accompanies this letter, *Environmental and Coastal Engineering Report For Hololani Shore Protection*, presents our preferred alternative for a permanent shore protection solution at the Hololani, as well as background for the project and preliminary environmental documentation.

We anticipate that this project will require Federal, State, and County permits. The most recent shoreline certification was granted in 2001. Two applications in 2007 were denied due to lack of documentation for approval of emergency sand bags that were in place along the shoreline (see Appendix B in the report). Apparently, these bags were part of interim measures for emergency protection taken before the November/December construction of the SEI designed structure.

We have several questions regarding implementation of the permit approval process for this project:

1) The permanent shore protection design will span what we believe would be a reasonable Certified Shoreline, i.e., we anticpate the need for Maui County Special Management Area

(SMA) and Shoreline Setback Variance (SSV) permits, as well as State Conservation District Use Permit (CDUP). Given the anticpated need for both County and State permits, is a Certified Shoreline determination required for the project to proceed? If it is necessary, can the shoreline certification be granted with the legally permitted temporary emergency shore protection in place?

2) Both the County SSV and the State CDUP require implementation of the HRS Chapter 343 environmental process, which requires submission of an Environmental Assessment (EA). With the understanding that the project will be in both State and County jurisdictions, which agency should be the accepting authority for the EA?

3) Please note that the preferred alternative has been selected to minimize the amount of material placed in the Conservation District and Federal Navigable Waters, and to enable construction within the metes and bounds of the Hololani property. However, in the event that crossing the property boundary becomes necessary due to design modifications as we proceed through the approval and permitting process, we would appreciate any information you can provide regarding obtaining an easement for construction on State Lands – what would be the procedure, and what fees or rates would apply?

Additionally, we welcome any comments you may have concerning this project. If you have questions or concerns, please feel free to contact me. I and other representatives of the Hololani AOAO are available to meet with DLNR-OCCL to discuss the project, and we encourage any such interaction that would mediate the intent of the project design with the mission and interests of the agency.

J. Barry

James H. Barry
Coastal Engineer
Sea Engineering, Inc.

Cc: Mr. Stuart Allen, Hololani AOAO
Mr. Joe Higgins, Allan, Buick and Bers, Inc.
Mr. James Buika, Maui County Planning Department
Ms. Lisa Howard, Hawaii First, Inc.

5. Appendix A: Letter from DLNR 5-01-11

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

GUY H. KAULUKUKUI
FIRST DEPUTY

WILLIAM M. TAM
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

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

Office of Conservation and Coastal Lands
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

DLNR:OCCL:.CC Correspondence: MA-11-190

MAY - 3 2011

Mr. James H. Barry
Coastal Engineer
Sea Engineering, Inc.

Dear Mr. Barry,

SUBJECT: Hololani Resort Condominiums Permanent Shore Protection: Project Design and Preliminary Environmental Document. 4401 Lower Honoapiilani Road, Lahaina, Hawaii, TMK (2) 4-3-010:009.

The Office of Conservation and Coastal Lands (OCCL) has received your March 24, 2011 request to review the project design and preliminary environmental document for the Hololani Resort Condominiums, 4401 Lower Honoapiilani Road, Lahaina, Hawaii, TMK (2) 4-3-010:009.

There were three specific questions you posed regarding the proposed project design and supporting document. First of which was the requirement for a certified shoreline for a project that is expected to extend across the jurisdictional boundary into the Conservation District. The OCCL recommends that you pursue a certified shoreline as it will assist both the public and the agencies in evaluating the impact and location of the proposal. As noted in your letter, the previous shoreline applications were rejected based on the presence of an unauthorized structure. A shoreline may be certified along a temporary structure if the structure is legal, there are no encroachments onto State land, and the shoreline is located in the position defined in Hawaii Revised Statute § 205A-1.

The second question is in regard to which agency, Maui County Planning Department or the OCCL, should be the receiving authority for the project's Environmental Assessment (EA). The OCCL and Maui County Planning Department will need to discuss this matter and agree upon who shall be the receiving agency.

The third question requests information regarding a potential application for a State easement in the event that the final structure crosses the makai private property boundary. In the event that the applicant desires to pursue an easement, this matter would be assessed by the Department of Land and Natural Resources (DLNR) as part of the Conservation District Use Application (CDUA) process with input from DLNR Land Division. The Board of Land and Natural Resources (BLNR) will determine if an easement will be granted and how much it will cost.

After reviewing the proposed project, the OCCL has several comments. The OCCL understands that there are limited options available for designing shoreline protection that will sufficiently protect the condominium building. The OCCL recommends that the final structural design be located as far mauka as possible to offset the impact it will have on the coastal resources. The OCCL is supportive of the incorporated coastal access pathway included in the preferred design. The OCCL acknowledges the benefits of the preferred hybrid design as it presents a limited footprint while still acting as an effective wave baffle and shoreline armoring structure.

The OCCL notes that these comments are intended solely to facilitate the permitting process, and give no opinion for or against shoreline hardening, at this time. Approval or disapproval of a project is at the discretion of the BLNR.

Should you have any questions or comments, please email Sea Grant Extension Agent Chris Conger, in the OCCL, at Chris.L.Conger@hawaii.gov.

Sincerely,

SAMUEL J LEMMO, Administrator
Office of Conservation and Coastal Lands

CC: Maui County Planning Department
Maui Land Division Office
Mr. Stuart Allen, Hololani AOAO
4401 Lower Honoapiilani Road
Lahaina, HI 96761

6. Appendix A: Letter to Maui County Planning Department 3-24-11

Sea Engineering, Inc.

Makai Research Pier • 41-305 Kalanianaole Hwy • Waimanalo, Hawaii 96795-1820
Phone: (808) 259-7966 • FAX (808) 259-8143 • E-mail: sei@seaengineering.com • Website: www.seaengineering.com

March 24, 2011

Jim Buika,
County of Maui Department of Planning, Current Division
250 South High Street
Wailuku, HI 9679

Dear Mr. Buika,

Subject: Hololani Resort Condominiums Permanent Shore Protection: Project Design and Preliminary Environmental Document

The Hololani Resort Condominiums (the Hololani) are located at 4401 Lower Honoapiilani Road in the Kahana area of Maui (TMK (2) 4-3-010:009), and have had an on-going coastal erosion problem since approximately 1988. During the Winter of 2006-2007, the situation became critical and Sea Engineering, Inc. (SEI) designed emergency temporary shore protection using Bulklift geotextile sand bags and Tensar rock-filled marine mattresses. The temporary shore protection was constructed in November and December of 2007. The structure was authorized by both Maui County Planning Department and the State Department of Land and Natural Resources, Office of Conservation and Coastal Lands (DLNR-OCCL). As part of this authorization, the Hololani was required to develop the design and aquire the necessary permits for a permanent shore protection solution.

SEI has been actively working with the Hololani to address their needs for robust and permanent shore protection. The document which accompanies this letter, *Environmental and Coastal Engineering Report for Hololani Shore Protection*, presents our preferred alternative for a permanent shore protection solution at the Hololani, as well as background for the project and preliminary environmental documentation.

We anticipate that this project will require Federal, State, and County permits. The most recent shoreline certification was granted in 2001. Two applications in 2007 were denied due to lack of documentation for approval of emergency sand bags that were in place along the shoreline (see Appendix B in the report). Apparently, these bags were part of interim measures for emergency protection taken before the November/December construction of the SEI designed structure.

The permanent shore protection design will span what we believe would be a reasonable Certified Shoreline, i.e., we anticpate the need for Maui County Special Management Area (SMA) and Shoreline Setback Variance (SSV) permits, as well as State Conservation District Use Permit (CDUP). We have written to DLNR-OCCL requesting their opinion on whether or not a Certified Shoreline is required for this project.

Both the County SSV and the State CDUP require implementation of the HRS Chapter 343 environmental process, which requires submission of an Environmental Assessment (EA). With the understanding that the project will be in both State and County jurisdictions, which agency should be the accepting authority for the EA?

Please note that the preferred alternative has been selected to minimize the amount of material placed in the Conservation District and Federal Navigable Waters, and to enable construction within the metes and bounds of the Hololani property.

We are sending copies of the report to other interested parties, including the neighboring Royal Kahana Resort Condominiums, and the Pohailani Condominiums, as well as the Department of Public works.

Additionally, we welcome any comments you may have concerning this project. If you have questions or concerns, please feel free to contact me. I and other representatives of the Hololani AOAO are available to meet to discuss the project, and we encourage any such interaction that would mediate the intent of the project design with the interests of Maui County.

J. Barry

James H. Barry, P.E
Coastal Engineer
Sea Engineering, Inc.

Cc: Mr. Stuart Allen, Hololani AOAO
Mr. Joe Higgins, Allan, Buick and Bers, Inc.
Mr. Sam Lemmo, DLNR-OCCL
Ms. Lisa Howard, Hawaii First, Inc.

7. Appendix A: Letter from Maui County Planning Dept 8-16-11

ALAN M. ARAKAWA
Mayor

WILLIAM R. SPENCE
Director

MICHELE CHOUTEAU McLEAN
Deputy Director

COUNTY OF MAUI

DEPARTMENT OF PLANNING

August 16, 2011

Mr. James Barry, Coastal Engineer
Sea Engineering, Inc
Makai Research Pier
41-305 Kalanianaole Highway
Waimanalo, Hawaii 96795

Dear Mr. Barry:

SUBJECT: COMMENTS ON THE PROPOSED HOLOLANI RESORT CONDOMINIUMS PERMANENT SHORE PROTECTION: PROJECT DESIGN AND PRELIMINARY ENVIRONMENTAL DOCUMENT; TMK: (2) 4-3-010:009 (RFC 2011/0127)

The Department of Planning (Department) is in receipt of your March 24, 2011 letter regarding the Department's review and permitting for the subject proposed shore protection project. The Department is interested in coordinating as a primary consulting party with Sea Engineering, Hololani Condominiums, and the State on this project.

From the information presented in the preliminary environmental document, the Department does not object to the proposed project alternative (a hybrid seawall and rock rubble mound revetment) at this time, but would highly encourage additional discussion of alternatives with all above-mentioned parties.

This is a landmark project that may determine the future of this particular stretch of coastline. A concern is that a regional approach may not have yet been fully considered or analyzed. A regional approach could result in broader success by protecting multiple assets, including the recreational beach, lateral public access, as well as private development. The Department is interested in further discussing and considering the alternative of beach nourishment in conjunction with stabilizing structures such as groins. The Department believes that this would also be an alternative favored by the State, which suggests using an "erosion control" approach – sand and structures together as a system – where feasible (Hawaii Coastal Erosion Management Plan, DLNR, 2000). The preliminary document seems to suggest that Sea Engineering and Hololani Condominiums would also conceptually support an erosion control approach, except that this approach may be "beyond the scope of what can be reasonably done by an individual condominium". The Department agrees that the erosion control approach would necessitate regional cooperation, but would like to see this option explored.

Additionally, the Department already recognizes a regional erosion problem whereby neighboring properties may soon face similar hazard threats and may also approach the State and County with similar protection requests. In fact, neighboring Royal Kahana Condominiums has recently requested emergency shoreline protection and has been encouraged to develop a long-term erosion control strategy. With the future upon us already, it makes good planning sense to consider the regional opportunities and to assess the collective resources available for those opportunities.

In terms of the proposed alternative, the Department agrees with Department of Land and Natural Resources-Office of Conservation and Coastal Lands (DLNR-OCCL) recommendations dated May 1, 2011, to ensure that the final structural design is located as far mauka as possible to minimize impacts to coastal resources. This would involve Hololani Condominium eliminating any non-essential development in favor of the seawall/revetment. The Department is also very supportive of an incorporated coastal access pathway and would be interested in reviewing more detailed plans for this. Finally, the Department requests photographic renderings of the final proposed alternative since the project will alter the existing nature of this shoreline area and these will be valuable for soliciting public comment.

If any part of the project will be carried out within County jurisdiction, the Department encourages the Applicant to apply for a Special Management Area Assessment Application found on the Maui County web page at http://www.co.maui.hi.us/index.aspx?NID=1354. As previously discussed with Sea Engineering by email for the proposed plan, the Department agrees that DLNR-OCCL should be the accepting authority for the Environmental Assessment (EA). However, it is strongly encouraged to submit the draft EA as a communication item for a hearing at the Maui Planning Commission. Also, the Department requests the opportunity to contribute to the list of agencies that will receive the draft EA for review.

Thank you for your cooperation. If you have any questions, please contact Coastal Resources Planner James Buika at james.buika@mauicounty.gov or at (808) 270-6271.

Sincerely,

CLAYTON I. YOSHIDA, AICP
Planning Program Administrator

for WILLIAM SPENCE
Planning Director

xc: William Spence, Planning Director
James A. Buika, Coastal Resources Planner
Tara Miller Owens, UH Sea Grant
Sam Lemmo, DLNR-OCCL
Chris Conger, UH Sea Grant, DLNR/OCCL
Project File
General File

WRS:CIY:JAB:sa
K:\WP_DOCS\PLANNING\RFC\2011\0127_HololaniShoreProtectionComment\Comments.doc

8. Appendix A: Letter to USACE Jurisdictional Inquiry 11-30-11

Sea Engineering, Inc.
Makai Research Pier • Waimanalo, Hawaii 96795-1820 • E-mail: sei@seaengineering.com
Phone: (808) 259-7966 / FAX (808) 259-8143 • Website: www.seaengineering.com

November 30, 2011

Mr. George Young, Chief
Department of the Army
U.S. Army Engineer District, Regulatory Branch
Fort Shafter,
Hawaii 96858

Subject: Jurisdictional Determination for Permanent Shore Protection, Hololani Condominiums, 4401 Lower Honoapiilani Highway, Kahananui, Maui TMK (2) 4-3-10: 09

Dear Mr. Young,

The Hololani Condominium complex is located at 4401 Lower Honoapiilani Highway on the Kahana coastline of West Maui and consists of two eight-story buildings with a total of sixty-three apartments. The complex is ocean front property with a shoreline approximately 400 feet in length. The project location is shown in Figure 1.

Coastal erosion at this site is well documented. In a 1998 aerial photograph study, Sea Engineering, Inc. (SEI) documented an average 30-year erosion rate of 0.8 feet per year, or 24 feet total. This study was conservative, using the vegetation line as the shoreline indicator, and photographs only up to the year 1988 when sand bags were placed. Similar erosion rates were found in studies done by the UH Coastal Geology Group. Figure 2 is a photograph from January, 2007 showing the dire erosion condition that existed at that time. Various temporary shore protection measures – small sand bags, large geotextile sand bags, boulders – were used with poor success until December 2007 when an SEI-designed temporary structure was constructed. The temporary shore protection consisted of large geotextile sand bags ("Seabags") stacked to form a revetment structure, with Tensar rock-filled mattresses used for toe protection and overtopping protection. In response to inquiries dated January 29, 2007, the USACE-Honolulu District determined that the 2007 temporary shore protection was outside of federal jurisdiction (letter dated February 26, 2007; File No. POH-2007-35). The project construction was shown to be well landward of the Mean Higher High Water Line (MHHW). The MHHW Line is the average of the highest predicted daily tide levels, and is generally considered representative of the High Tide Line in Hawaiian waters. A plan view of the existing temporary structure and the MHHW line mapped at that time is shown in Figure 3.

The structure held up well for several years, but was damaged during the 2010-2011 winter wave season and necessitated repairs. The structure was built under State of Hawaii and Maui County emergency authorization, with the condition that the Hololani Association of Apartment Owners (AOAO) proceed with the design for a permanent structure.

SEI has therefore been retained by the Hololani AOAO to design and obtain permits for a permanent shore protection structure. The proposed structure will be a combined seawall and rock rubble mound revetment in roughly the same location as the existing temporary shore protection. A hybrid design was used in order to provide effective protection, yet minimize both the design footprint and wave reflecting characteristics

A cross-section view of the proposed permanent shore protection structure is shown in Figure 4, and a plan view is shown in Figure 5. The new design is aligned to be landward of the MHHW Line as mapped on June 6, 2011 by Valera, Inc., licensed surveyors. The plan view shows the MHHW shoreline from 2007, as well as the more recently surveyed MHHW Line. The project shoreline varies seasonally due to sand movement in response to wave activity. Very generally, summer season waves from the south tend to cause accretion of sand in front of the Hololani shoreline reach, and winter season waves from the north tend to cause depletion of sand down to a rubble substrate. The June survey occurred during the seasonal transition between winter and summer, when the beach tends to be deflated. A recent photograph (Figure 5, November 25, 2011) shows the beach state during the summer to winter transition, with sand accretion occurring after a vigorous southern swell season and before the peak occurrence of winter north swells.

We are requesting a determination from your office for any requirements that fall within the jurisdiction of the U.S. Army Corps of Engineers for construction of new, permanent shore protection. We are primarily concerned with Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act. The proposed structure is aligned to be landward of the June 6, 2011 MHHW Line along the entire project reach. The construction work will not affect the course, location, or condition of the water body fronting the construction area. Please feel free to contact me if there are any further questions.

Thank you for the consideration of this project,

J. Barry

James H. Barry, P.E.
Coastal Engineer

Sea Engineering, Inc.

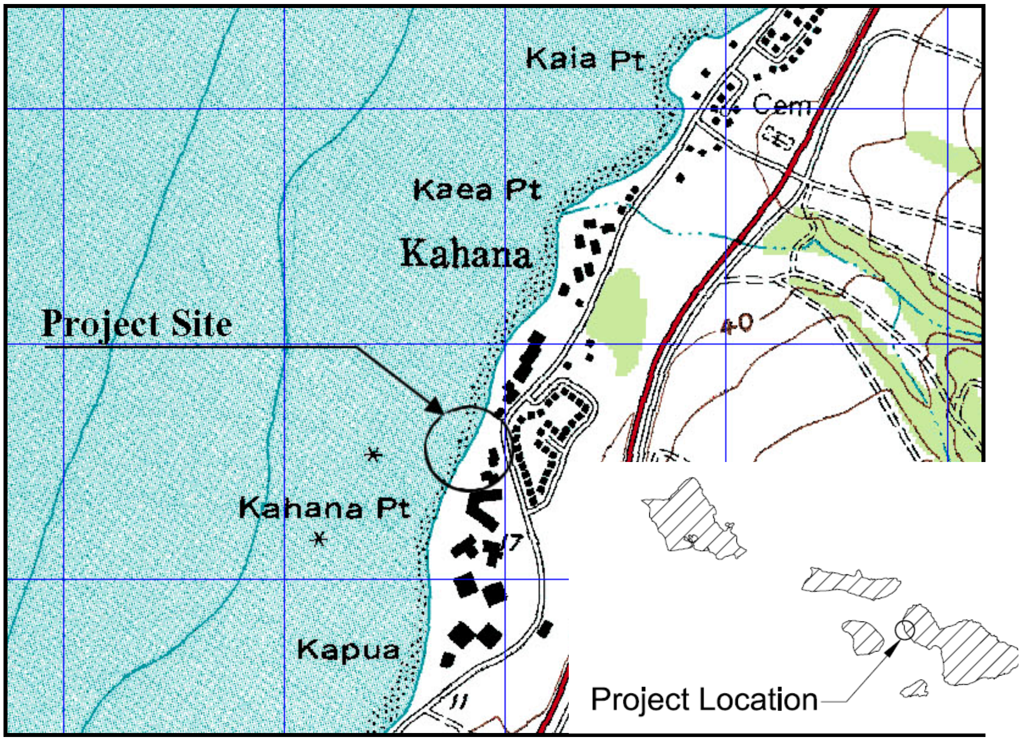


Figure 1. Project site location in West Maui

Figure 2. Project site shoreline, 1-11-07

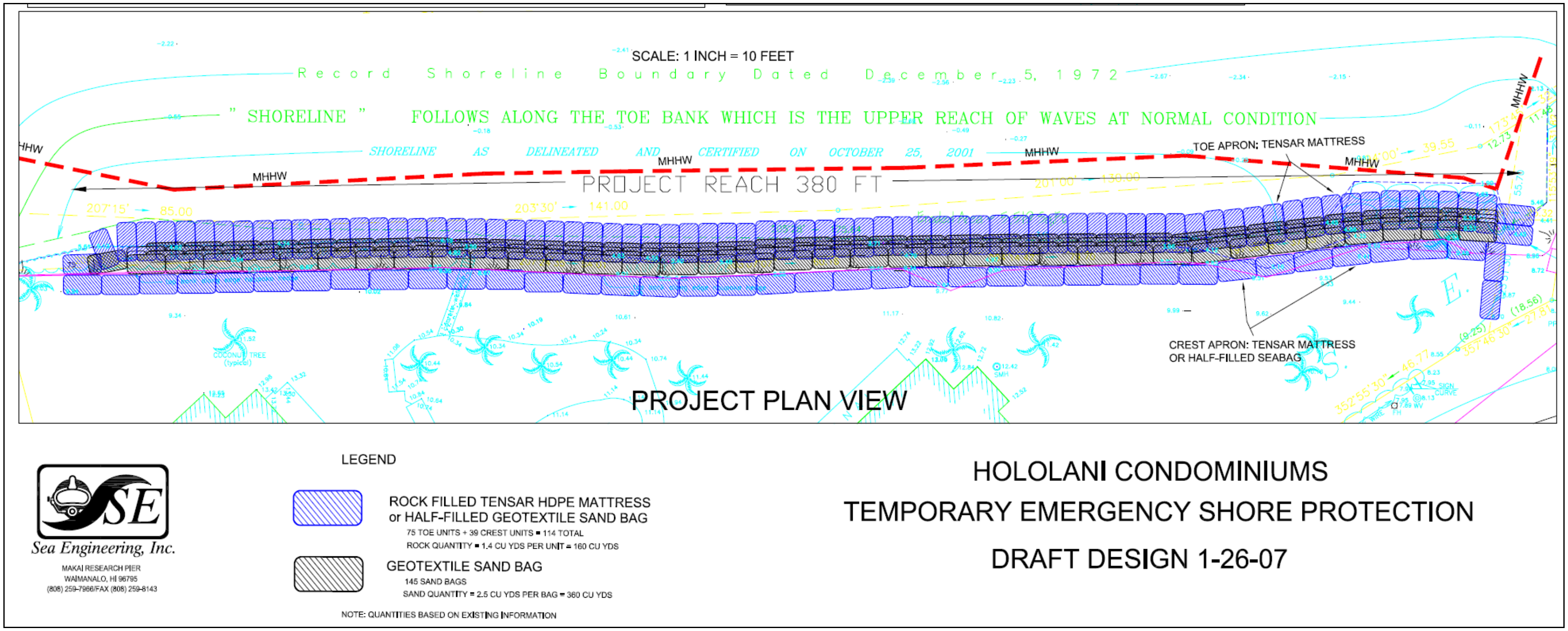


Figure 3. 2007 temporary shore protection plan, showing location of January 2007 MHHW level

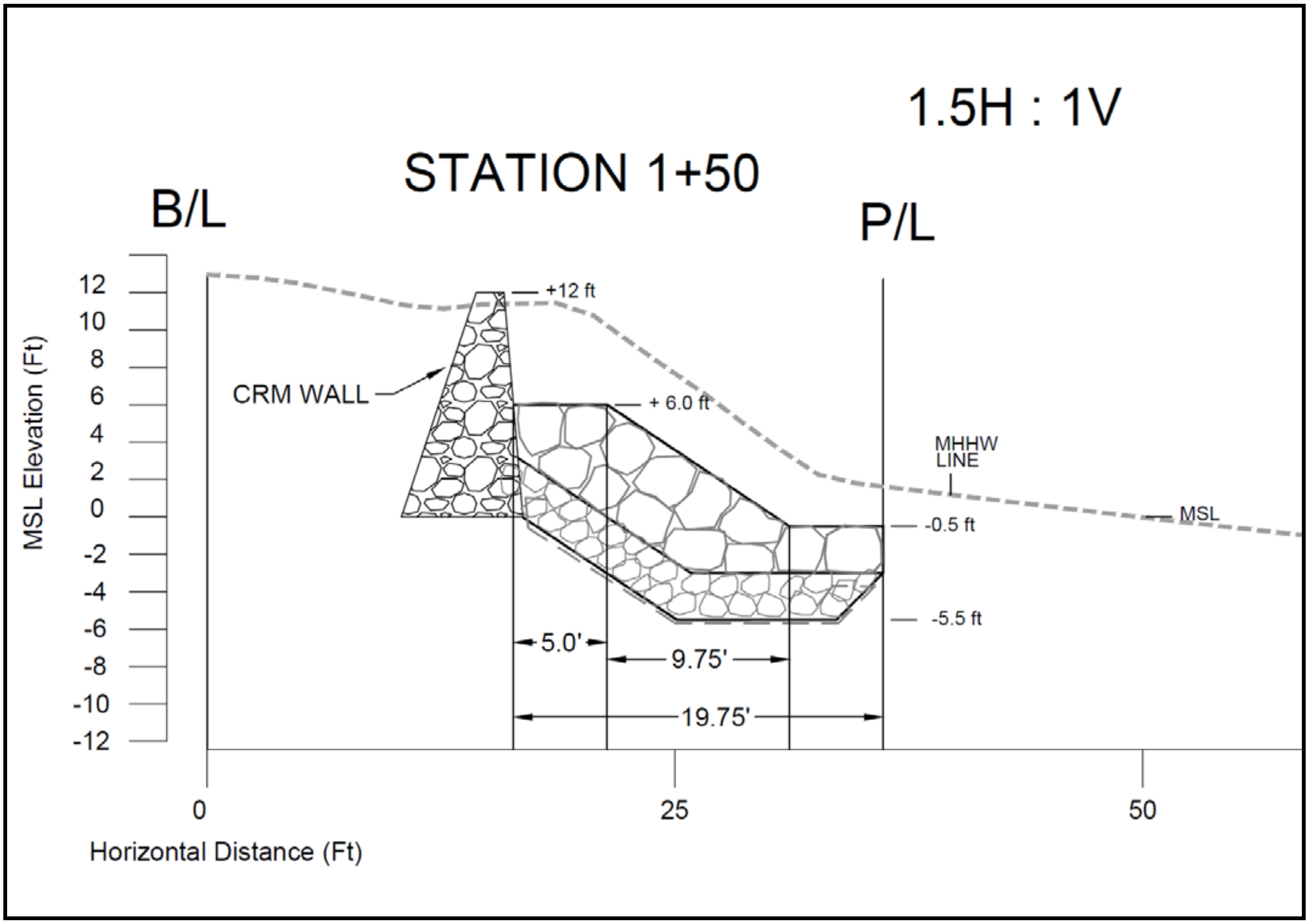


Figure 4. Permanent shore protection section, showing dimensions of the hybrid structure

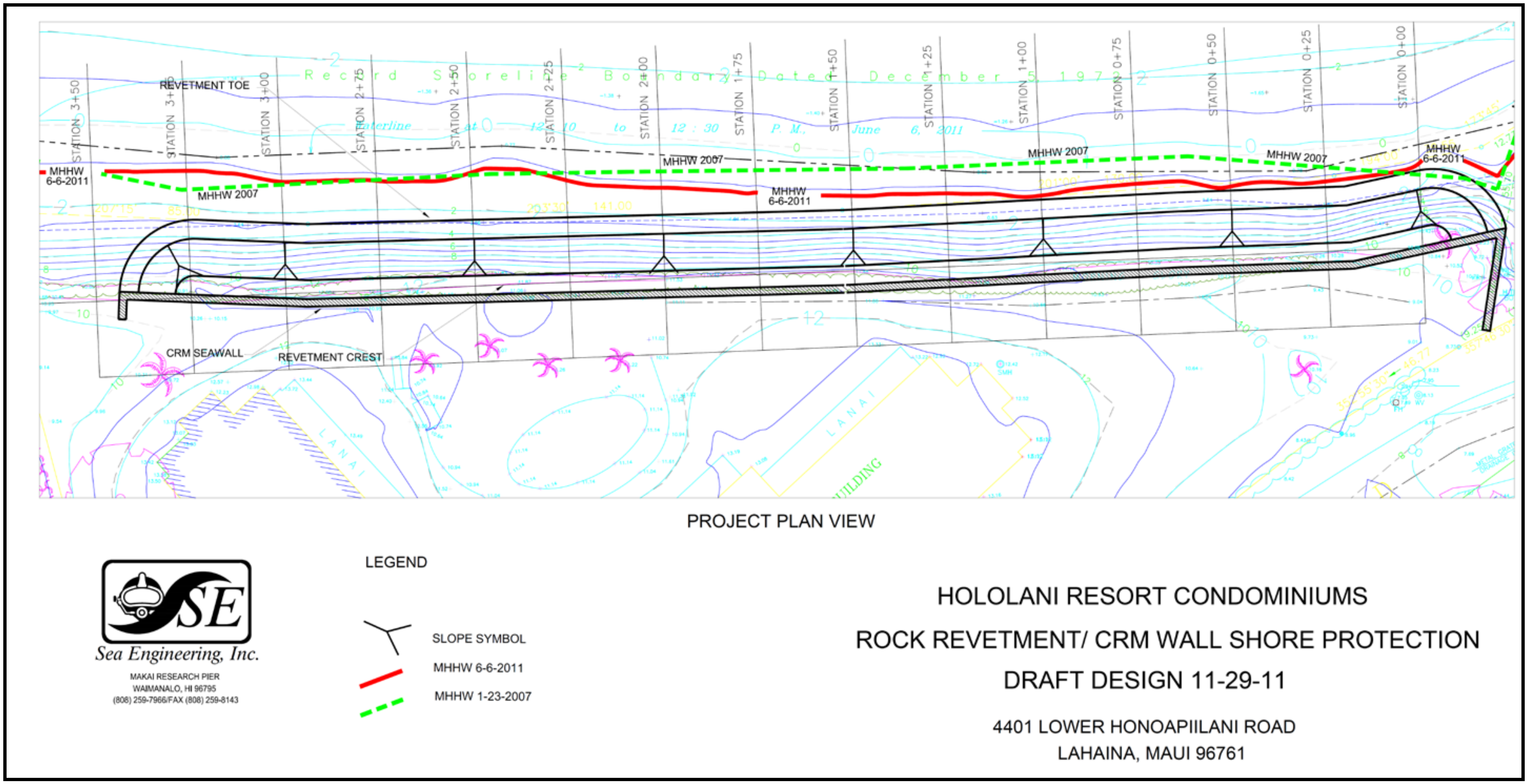


Figure 4. Permanent shore protection plan, with 2007 and 2011 MHHW levels

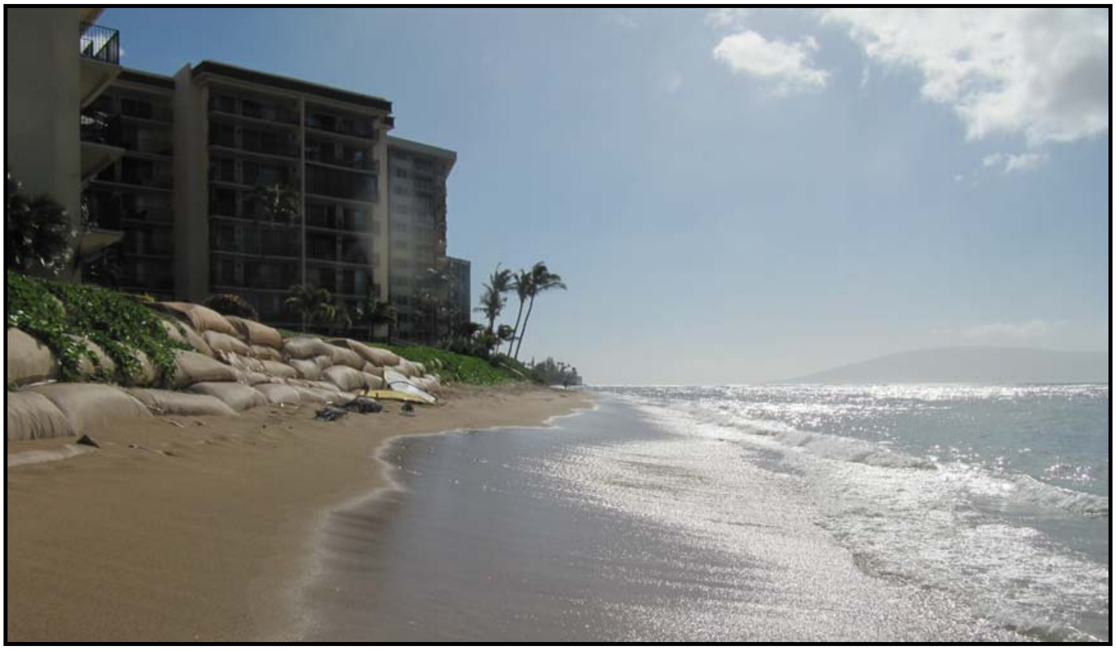


Figure 5. Hololani beach, 11-25-2011

9. Appendix A: Letter from USACE Approved Jurisdictional Determination 1-27-12

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, HONOLULU DISTRICT
FORT SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF:

January 27, 2012

Regulatory Branch

File Number POH-2007-00035

Sea Engineering, Inc.
Attention: James Barry
Makai Research Pier
Waimanalo, Hawaii 96795

APPROVED JURISDICTIONAL DETERMINATION
PERMIT REQUIRED

Dear Mr. Barry:

This is in response to your letter dated November 30, 2011 requesting a Jurisdictional Determination from the Department of the Army (DA) for the proposed Permanent Shore Protection of the Hololani Condominiums at 4401 Lower Honoapiilani Highway, Kahananui, Island of Maui, Hawaii. We have completed our review of the submitted documents pursuant to Section 10 of the Rivers and Harbors Act of 1899 (Section 10) and Section 404 of the Clean Water Act (Section 404) and have determined that the submitted documents, accurately identify a navigable water of the U.S. under the regulatory jurisdiction of U.S. Army Corps of Engineers (the Corps).

Section 10 requires that a DA permit be obtained from the Corps prior to undertaking any construction, dredging, or other activity occurring **in, over, or under or affecting navigable waters of the U.S.** For tidal waters, the shoreward limit of the **Corps' jurisdiction extends to the Mean High Water Mark**. Section 404 requires that a DA permit be obtained for the temporary and/or permanent **discharge (placement) of dredged and/or fill material into waters of the U.S.**, including wetlands. For tidally influenced waters, in the absence of adjacent wetlands, the shoreward limit of the **Corps' jurisdiction extends to the High Tide Line**, which in Hawai'i may be approximated by reference to the Mean Higher High Water Mark. For non-tidal waters, the lateral limits of the Corps' jurisdiction extend to the Ordinary High Water Mark or the approved delineated boundary of any adjacent wetlands.

The approximate 400-foot stretch of shoreline fronting the subject property is a reach of the **Pacific Ocean, a navigable water of the U.S., subject to Corps jurisdiction.** Be advised that positioning of sediment control **structures** such as sheet piles and the **staging and/or the use of equipment and/or machinery** waterward of the MHWM, in accordance with Section 10, **will require a DA permit** prior to commencement of work activity in a navigable water of the U.S.

The MHHWM, as demarcated in Figure 4 of your submittal, was surveyed on June 6, 2011 by Valera, Inc., in support of the proposed shore protection. The Corps concurs with the surveyed line. The submitted documents indicated that the proposed shoreline protection, consisting of a combination seawall and rock rubble revetment approximately 360-feet in length, will be constructed landward of the MHHWM at this location. Therefore, in accordance with Section 404, **a DA permit will not be required** as the proposed **shore protection construction activities will not result in the discharge of fill** material into a navigable water of the U.S. Be advised that the Corps regulates the use of sandbags, as it results in the temporary discharge of fill material and thus will require prior authorization from this office.

We advise your client to submit a DA Permit application and associated drawings that meet our drawing recommendations found at *http://www.poh.usace.army.mil/EC-R/EC-R.htm#Apply_for_a_Permit_* to the Corps. In addition, supporting information submitted with the permit application should include sufficient information concerning the scope of work, including the final construction design and specifications, method, sequence and schedule and use/placement of Best Management Practices, i.e. silt fences and sandbag berms required to construct the proposed shore protection and describe possible impacts of the construction and use of BMPs on the surrounding aquatic environment, should your proposed work be authorized. The Corps will at that time review the application to ensure the proposed work is not contrary to the public interest. Be advised, fill that results in either temporary or permanent loss of waters of the U.S. and/or associated function, may be required of your client to provide compensatory mitigation for any unavoidable impacts to the aquatic environment.

This letter contains an approved JD for the property in question and is valid for a period of five (5) years unless new information warrants revision of the determination before the expiration date. If you object to this determination, you may request an Administrative Appeal under Corps regulations at 33 Code of Federal Regulations (CFR) Part 331. Should you object to this determination, please notify this office and we will provide you with the informational materials required for an appeal and provide suspense dates based upon the date the appeal information is supplied to you.

Thank you for contacting us regarding this project. Should you have any questions, please contact Ms. Jessie Pa'ahana at *808.438.0391* or via email at *Jessie.K.Paahana@usace.army.mil*. You are encouraged to provide comments on your experience with the Honolulu District Regulatory Branch by accessing our web-based customer survey form at *http://www.per2.nwp.usace.army.mil/survey.html*.

Sincerely,

George P. Young, P.E.
Chief, Regulatory Branch

10. Appendix A: Letter to Maui County Department of Public Works 3-24-11

Sea Engineering, Inc.

Makai Research Pier • 41-305 Kalanianaole Hwy • Waimanalo, Hawaii 96795-1820
Phone: (808) 259-7966 • FAX (808) 259-8143 • E-mail: sei@seaengineering.com • Website: www.seaengineering.com

March 24, 2011

Mr. Cary Yamashita, Division Chief
County of Maui Department of Public Works,
Engineering Division,
200 South High Street (Kalana O Maui Bldg., 4th floor)
Wailuku, HI 96793

Dear Mr. Yamashita,

Subject: Hololani Resort Condominiums Permanent Shore Protection: Project Design and Preliminary Environmental Document

The Hololani Resort Condominiums (the Hololani) are located at 4401 Lower Honoapiilani Road in the Kahana area of Maui (TMK (2) 4-3-010:009), and have had an on-going coastal erosion problem since approximately 1988. During the Winter of 2006-2007, the situation became critical and Sea Engineering, Inc. (SEI) designed emergency temporary shore protection using Bulklift geotextile sand bags and Tensar rock-filled marine mattresses. The temporary shore protection was constructed in November and December of 2007. The structure was authorized by both the Maui County Planning Department and the State Department of Land and Natural Resources, Office of Conservation and Coastal Lands (DLNR-OCCL). As part of this authorization, the Hololani was required to develop the design and aquire the necessary permits for a permanent shore protection solution.

SEI has been actively working with the Hololani to address their needs for robust and permanent shore protection. The document which accompanies this letter, *Environmental and Coastal Engineering Report for Hololani Shore Protection*, presents our preferred alternative for a permanent shore protection solution at the Hololani, as well as background for the project and preliminary environmental documentation.

A drainage easement in favor of the County of Maui exists at the north end of the Hololani Property. As discussed in Section 2.5.1 (page 25) of the report, the easement area is severely eroded and the drainline is damaged and blocked. Figure 2-5 in the report shows the present design configuration for shore protection at the north end. The north side of the Hololani property (the south side of the easement) will be protected by a seawall approximately 12.5 ft in elevation (although the final design may vary). A low-crested revetment will front the seawall on the the makai side of the Hololani property, however this will return and end at the south easement boundary, as shown in the figure. The seawall will allow future repairs to the drainline and modifications of the easement area to be done as necessary and on a schedule set by Maui County.

An alternative design is presented in the report that will protect the easement area and allow the construction of a new drainline (Figure 2-6). This design would require the cooperation of the Department of Public Works and the adjacent Pohailani Condominium. Please note that the erosion problem at the Hololani is viewed as a critical situation, and implementation of the shore protection will be done as soon as permits are obtained. We hope to schedule construction during the summer of 2012.

We welcome any comments you may have concerning this project. If you have questions or concerns, please feel free to contact me. I and other representatives of the Hololani AOAO are available to meet to discuss the project, and we encourage any such interaction that would mediate the intent of the project design with the interests of Maui County.

J. Barry

James H. Barry, P.E
Coastal Engineer
Sea Engineering, Inc.

Cc: Mr. Stuart Allen, Hololani AOAO
Mr. Joe Higgins, Allan, Buick and Bers, Inc.
Mr. Jim Buika, Maui County Planning Department, Current Division
Ms. Lisa Howard, Hawaii First, Inc.

11. Appendix A: Letter to Royal Kahana 3-24-11

Sea Engineering, Inc.

Makai Research Pier • 41-305 Kalanianaole Hwy • Waimanalo, Hawaii 96795-1820
Phone: (808) 259-7966 • FAX (808) 259-8143 • E-mail: sei@seaengineering.com • Website: www.seaengineering.com

March 24, 2011

Mr. Patrick Kelley
Royal Kahana Resort Condominiums
4365 Lower Honoapiilani Road
Lahaina, HI 96761

Dear Mr. Kelley,

Subject: Hololani Resort Condominiums Permanent Shore Protection: Project Design and Preliminary Environmental Document

The Hololani Resort Condominiums (the Hololani) are located at 4401 Lower Honoapiilani Road in the Kahana area of Maui (TMK (2) 4-3-010:009), and have had an on-going coastal erosion problem since approximately 1988. During the Winter of 2006-2007, the situation became critical and Sea Engineering, Inc. (SEI) designed emergency temporary shore protection using Bulklift geotextile sand bags and Tensar rock-filled marine mattresses. The temporary shore protection was constructed in November and December of 2007. The structure was authorized by both the Maui County Planning Department and the State Department of Land and Natural Resources, Office of Conservation and Coastal Lands (DLNR-OCCL). As part of this authorization, the Hololani was required to develop the design and aquire the necessary permits for a permanent shore protection solution.

SEI has been actively working with the Hololani to address their needs for robust and permanent shore protection. The document which accompanies this letter, *Environmental and Coastal Engineering Report for Hololani Shore Protection*, presents our preferred alternative for a permanent shore protection solution at the Hololani, as well as background for the project and preliminary environmental documentation.

The south end of the new shore protection structure will abut the Royal Kahana property. The project layout is shown in Figure 1-7 of the report, and a close-up of the south boundary is shown in Figure 2-2. The design intent is to bury the structure with beach quality sand fill at this end, and let the sand naturally equilibrate to the existing shoreline processes. The natural slope of the beach sand will allow shoreline access in this area. The slight embayment of the structure design should help to capture sand and naturally maintain a beach.

Please note that this design is not finalized. We are in the preliminary phase of obtaining the required Federal, State, and County permits, and the Royal Kahana will have the opportunity to comment on the structure through the HRS Chapter 343 environmental process. However, as the project designer, I am committed to preventing or mitigating any effects of the new structure on the Royal Kahana property, and welcome any comments that you may have concerning the project. If you have questions or concerns, please feel free to contact me. I and other representatives of the Hololani AOAO are available to meet to discuss the project, and we look forward to solving the erosion problems at the site.

J. Barry

James H. Barry, P.E
Coastal Engineer
Sea Engineering, Inc.

Cc: Mr. Stuart Allen, Hololani AOAO
Mr. Joe Higgins, Allan, Buick and Bers, Inc.
Mr. Jim Buika, Maui County Planning Department, Current Division
Ms. Lisa Howard, Hawaii First, Inc.

12. Appendix A: Letter to Pohailani 3-24-11

Sea Engineering, Inc.

Makai Research Pier • 41-305 Kalanianaole Hwy • Waimanalo, Hawaii 96795-1820
Phone: (808) 259-7966 • FAX (808) 259-8143 • E-mail: sei@seaengineering.com • Website: www.seaengineering.com

March 24, 2011

Pohailani Condominiums AOAO
c/o Hawaiiana Management Co.
140 Hoohana Street, Suite 210
Kahului, HI 96732

Attn: Mr. Doug Jorg

Dear Mr. Jorg,

Subject: Hololani Resort Condominiums Permanent Shore Protection: Project Design and Preliminary Environmental Document

The Hololani Resort Condominiums (the Hololani) are located at 4401 Lower Honoapiilani Road in the Kahana area of Maui (TMK (2) 4-3-010:009), and have had an on-going coastal erosion problem since approximately 1988. During the Winter of 2006-2007, the situation became critical and Sea Engineering, Inc. (SEI) designed emergency temporary shore protection using Bulklift geotextile sand bags and Tensar rock-filled marine mattresses. The temporary shore protection was constructed in November and December of 2007. The structure was authorized by both the Maui County Planning Department and the State Department of Land and Natural Resources, Office of Conservation and Coastal Lands (DLNR-OCCL). As part of this authorization, the Hololani was required to develop the design and aquire the necessary permits for a permanent shore protection solution.

SEI has been actively working with the Hololani to address their needs for robust and permanent shore protection. The document which accompanies this letter, *Environmental and Coastal Engineering Report for Hololani Shore Protection*, presents our preferred alternative for a permanent shore protection solution at the Hololani, as well as background for the project and preliminary environmental documentation.

A drainage easement in favor of the County of Maui exists at the north end of the Hololani Property. As discussed in Section 2.5.1 (page 25) of the report, the easement area is severely eroded and the drainline is damaged and blocked. Figure 2-5 in the report shows the present design configuration for shore protection at the north end. The north side of the Hololani property (the south side of the easement) will be protected by a seawall approximately 12.5 ft in elevation (although the final design may vary). A low-crested revetment will front the seawall on the the makai side of the Hololani property, however this will return and end at the south easement boundary, as shown in the figure. The seawall will allow future repairs to the drainline and modifications of the easement area to be done as necessary and on a schedule set by Maui County.

An alternative design is presented in the report that will protect the easement area and allow the construction of a new drainline (Figure 2-6). This design would require the cooperation of the Pohailani Condominium AOAO as well as the Maui County Department of Public Works. The CRM (cemented rubble masonry) seawall that protects the south boundary of the Pohailani has been undermined by wave action and is in a general state of disrepair. In order to construct the alternative design, the wall at the Pohailani would need to be repaired to prevent flanking of the new Hololani structure.

Please note that the erosion problem at the Hololani is viewed as a critical situation, and implementation of the shore protection will be done as soon as permits are obtained. We hope to schedule construction during the summer of 2012.

We welcome any comments you may have concerning this project. If you have questions or concerns, please feel free to contact me. I and other representatives of the Hololani AOAO are available to meet to discuss the project, and we look forward to solving the erosion problems at the site.

J. Barry

James H. Barry, P.E
Coastal Engineer
Sea Engineering, Inc.

Cc: Mr. Stuart Allen, Hololani AOAO
Mr. Joe Higgins, Allan, Buick and Bers, Inc.
Mr. Jim Buika, Maui County Planning Department, Current Division
Ms. Lisa Howard, Hawaii First, Inc.

APPENDIX B. GEOTECHNICAL INFORMATION – ISLAND GEOTECHNICAL ENGINEERS, INC.

1. *Soils Report, Hololani Rock Revetment – August 31, 2010*
2. *Addendum to Soils Investigation Report – December 21, 2011*

REPORT
SOILS INVESTIGATION

HOLOLANI ROCK REVETMENT
4401 LOWER HONOAPIILANI ROAD

KAHANA, MAUI, HAWAII
TMK: (2) 4-3-10: 09

for

SEA ENGINEERING, INC.

Project No. 101408-FM
August 31, 2010

ISLAND GEOTECHNICAL ENGINEERING, INC.
Geotechnical Consultants

330 Ohukai Road, Suite 119
Kihei, Maui, Hawaii 96753
Phone: (808) 875-7355
Fax: (808) 875-7122

August 31, 2010
Project No. 101408-FM

Sea Engineering, Inc.
Attn: Mr. Jim Barry
Makai Research Pier
Waimanalo, Hawaii 96795

The attached report presents the results of a soils investigation at the site of the proposed Hololani Rock Revetment to be located at the Hololani Resort at 4401 Lower Honoapiilani Road in Kahana, Maui, Hawaii.

A summary of the findings is as follows:

1) The subsurface conditions at the site were explored by drilling 5 test borings to depths of 17.5 to 21.5 feet below existing grade. The general subsurface conditions at each test boring location are as follows:

   Boring 1 encountered very stiff sandy SILT with gravel from the surface to a depth of 0.5 feet below existing grade followed by very stiff SILT with sand to a depth of 4 feet below existing grade followed by moderately dense silty SAND to a depth of 8.5 feet below existing grade followed by moderately dense silty GRAVEL with sand to a depth of 9 feet below existing grade followed by moderately dense SAND with silt to a depth of 14.5 feet below existing grade followed by loose SAND with silt to a depth of 19.5 feet below existing grade followed by moderately hard ROCK to the final depth of the test boring at 20.5 feet below existing grade.

   Boring 2 encountered stiff SILT from the surface to a depth of 0.25 feet below existing grade followed by moderately dense silty GRAVEL with sand to a depth of 1 foot below existing grade followed by moderately dense SAND to a depth of 4.5 feet below existing grade followed by moderately dense to dense silty SAND with gravel to a depth of 9.5 feet below existing grade followed by moderately dense SAND with silt to a depth of 10.5 feet below existing grade followed by moderately dense SAND to a depth of 15.5 feet below existing grade followed by moderately dense silty GRAVEL with sand to a depth of 18 feet below existing grade followed by soft to moderately hard ROCK to a depth of 21 feet below existing grade followed by stiff CLAY to the final depth of the test boring at 21.5 feet below existing grade.

   Boring 3 encountered very dense silty SAND with gravel from the surface to a depth of 4.5 feet below existing grade followed by stiff sandy SILT to a depth of 5 feet below existing grade followed by moderately dense SAND with silt to a depth of 8.5 feet below existing grade followed by moderately dense SAND with silt and gravel to a depth of 11 feet below existing grade followed by moderately dense SAND to a depth of 14 feet below existing grade followed by stiff CLAY to a depth of 15.5 feet below existing grade followed by soft to moderately hard ROCK to the final depth of the test boring at 19.5 feet below existing grade.

Boring 4 encountered moderately stiff to stiff SILT with gravel from the surface to a depth of 2.5 feet below existing grade followed by moderately dense SAND with gravel to a depth of 3.5 feet below existing grade followed by very stiff sandy SILT to a depth of 5.5 feet below existing grade followed by loose silty SAND to a depth of 6.5 feet below existing grade followed by moderately stiff SILT to a depth of 8.5 feet below existing grade followed by moderately dense silty SAND with gravel to a depth of 9.5 feet below existing grade followed by very stiff sandy SILT to a depth of 11.5 feet below existing grade followed by moderately dense SAND with silt to a depth of 13 feet below existing grade followed by very loose SAND with silt to a depth of 18 feet below existing grade followed by moderately dense silty SAND with gravel to the final depth of the test boring at 19.75 feet below existing grade.

Boring 5 encountered stiff to very stiff SILT with sand from the surface to a depth of 3.5 feet below existing grade followed by loose silty SAND to a depth of 6 feet below existing grade followed by soft SILT to a depth of 6.5 feet below existing grade followed by loose silty SAND to a depth of 7.5 feet below existing grade followed by COBBLE to a depth of 8 feet below existing grade followed by loose silty SAND to a depth of 9 feet below existing grade followed by loose to moderately dense SAND with silt to a depth of 12 feet below existing grade followed by loose to very loose silty GRAVEL with sand to a depth of 13 feet below existing grade followed by loose to very loose silty SAND to the final depth of the test boring at 17.5 feet below existing grade.

2) Groundwater was encountered at 8.1 to 8.7 feet below existing grade.

Details of the findings and recommendations are presented in the attached report.

This investigation was made in accordance with generally accepted engineering procedures and included such field and laboratory tests considered necessary for the project. In the opinion of the undersigned, the accompanying report has been substantiated by mathematical data in conformity with generally accepted engineering principles and presents fairly the design information requested by your organization. No other warranty is either expressed or given.

Respectfully submitted,

ISLAND GEOTECHNICAL ENGINEERING, INC.

Charles K. Biegel, P.E.
President

CHARLES K. BIEGEL
LICENSED PROFESSIONAL ENGINEER
NO. 7568-C
HAWAII, U.S.A.

This work was prepared by
me or under my supervision.

TABLE OF CONTENTS

INTRODUCTION

This investigation was made for the purpose of obtaining information on the subsurface conditions from which to base recommendations for design for the proposed Hololani Rock Revetment in Kahana, Maui. The location of the site, relative to the existing streets and landmarks, is shown on the Vicinity Map, Plate 1.

SCOPE OF WORK

The services included drilling 5 test borings to depths of 17.5 to 21.5 feet below existing grade, obtaining samples of the underlying soils, performing laboratory tests on the samples, and performing an engineering analysis from the data gathered. In general, the following information is provided for use by the Architect and/or Engineer:

1. General subsurface conditions, as disclosed by the explorations.
2. Physical characteristics of the soils encountered.
3. Special considerations.

PLANNED DEVELOPMENT

From the information provided, a new rock revetment will be constructed along the makai property line of the Hololani Resort. A cross-section of the proposed revetment is shown on the attached Plate A.

SITE CONDITIONS

Surface

The property, designated by Tax Map Key (2) 4-3-10: 09, is located at 4401 Lower Honoapiilani Road in Kahana, Maui, Hawaii. At the time of the field investigation, the ground cover at the site consisted of manicured lawn.

Subsurface

Five (5) test borings were drilled to depths of 17.5 to 21.5 feet below existing grade to determine the subsurface conditions at the site. The locations of the explorations are shown on the Plot Plan, Plate 2. Detailed logs of the explorations are presented in the Appendix to this report.

Boring 1 encountered very stiff sandy SILT with gravel from the surface to a depth of 0.5 feet below existing grade followed by very stiff SILT with sand to a depth of 4 feet below existing grade followed by moderately dense silty SAND to a depth of 8.5 feet below existing grade followed by moderately dense silty GRAVEL with sand to a depth of 9 feet below existing grade followed by moderately dense SAND with silt to a depth of 14.5 feet below existing grade followed by loose SAND with silt to a depth of 19.5 feet below existing grade followed by moderately hard ROCK to the final depth of the test boring at 20.5 feet below existing grade.

Boring 2 encountered stiff SILT from the surface to a depth of 0.25 feet below existing grade followed by moderately dense silty GRAVEL with sand to a depth of 1 foot below existing grade followed by moderately dense SAND to a depth of 4.5 feet below existing grade followed by moderately dense to dense silty SAND with gravel to a depth of 9.5 feet below existing grade followed by moderately dense SAND with silt to a depth of 10.5 feet below existing grade followed by moderately dense SAND to a depth of 15.5 feet below existing grade followed by moderately dense silty GRAVEL with sand to a depth of 18 feet below existing grade followed by soft to moderately hard ROCK to a depth of 21 feet below existing grade followed by stiff CLAY to the final depth of the test boring at 21.5 feet below existing grade.

Boring 3 encountered very dense silty SAND with gravel from the surface to a depth of 4.5 feet below existing grade followed by stiff sandy SILT to a depth of 5 feet below existing grade followed by moderately dense SAND with silt to a depth of 8.5 feet below existing grade followed by moderately dense SAND with silt and gravel to a depth of 11 feet below existing grade followed by moderately dense SAND to a depth of 14 feet below existing grade followed by stiff CLAY to a depth of 15.5 feet below existing grade followed by soft to moderately hard ROCK to the final depth of the test boring at 19.5 feet below existing grade.

Boring 4 encountered moderately stiff to stiff SILT with gravel from the surface to a depth of 2.5 feet below existing grade followed by moderately dense SAND with gravel to a depth of 3.5 feet below existing grade followed by very stiff sandy SILT to a depth of 5.5 feet below existing grade followed by loose silty SAND to a depth of 6.5 feet below existing grade followed by moderately stiff SILT to a depth of 8.5 feet below existing grade followed by moderately dense silty SAND with gravel to a depth of 9.5 feet below existing grade followed by very stiff sandy SILT to a depth of 11.5 feet below existing grade followed by moderately dense SAND with silt to a depth of 13 feet below existing grade followed by very loose SAND with silt to a depth of 18 feet below existing grade followed by moderately dense silty SAND with gravel to the final depth of the test boring at 19.75 feet below existing grade.

Boring 5 encountered stiff to very stiff SILT with sand from the surface to a depth of 3.5 feet below existing grade followed by loose silty SAND to a depth of 6 feet below existing grade followed by soft SILT to a depth of 6.5 feet below existing grade followed by loose silty SAND to a depth of 7.5 feet below existing grade followed by COBBLE to a depth of 8 feet below existing grade followed by loose silty SAND to a depth of 9 feet below existing grade followed by loose to moderately dense SAND with silt to a depth of 12 feet below existing grade followed by loose to very loose silty GRAVEL with sand to a depth of 13 feet below existing grade followed by loose to very loose silty SAND to the final depth of the test boring at 17.5 feet below existing grade.

Groundwater was encountered in all of the explorations at depths of 8.1 to 8.7 feet below existing grade.

From the USDA Soil Conservation Service "Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii", the site is located in an area designated as Pulehu clay loam , 0 to 3 percent slopes (PsA) and Jaucas sand, 0 to 15 percent slopes (JaC).

The Pulehu series consist of well-drained soils on alluvial fans and stream terraces and in basins. These soils occur on the islands of Lanai, Maui, Molokai and Oahu. These soils developed in alluvium washed from basic igneous rock. Elevations range from nearly sea level to 300 feet. The shrink-swell potential is moderate to low. Depth to bedrock is greater than 5 feet (USDA, 1972, Plate 92 and pp. 115-116, 164-165).

The Jaucas series consists of excessively drained, calcareous soils that occur as narrow strips on coastal plains, adjacent to the ocean. These soils occur on all the islands of this survey area. They developed in wind and water deposited sand from coral and sea shells. Unified soil classification is SP. They are nearly level to strongly sloping. Elevations range from sea level to 100 feet. Depth to bedrock is greater than 5 feet. (USDA, 1972, pg.48, 158-159 and Plate 92).

Geology

The site is located on the west/northwest flank of the West Maui Mountains. The island of Maui is a volcanic doublet believed to have formed during the late Tertiary (between 1 and 12 million years ago).

The West Maui Mountains were built by lavas flowing from rift zones trending north and south and a central vent. The lava flows which form the mountain have been separated into three groups: Wailuku, Honolua, and Lahaina Volcanic Series (Stearns and MacDonald, 1942). The main lava mass that makes up the West Maui Mountains is known as the Wailuku Volcanic Series which consist of primitive olivine basalts and associated pyroclastic and intrusive rock.

Liquefaction Evaluation

Liquefaction is a common problem in earthquake prone zones where loose saturated soil deposits exist. The 1997 UBC classified Maui as being in earthquake zone 2B. Although the Holokai Resort is not believed to be in an “earthquake prone zone”, a liquefaction evaluation was performed by IGE for general information purposes.

IGE was not provided a hypothetical earthquake magnitude. For the purposes of an analysis, the following assumptions were made: Magnitude = 6.0 Peak Horizontal Ground Acceleration = 0.2g. Based on the above assumptions, the liquefaction potential for the site was determined to be low probability for Borings 1, 2, 3. For Borings 4 & 5, the liquefaction potential was determined to be low to moderate probability with the soil layer at 13 to 18 feet below existing grade having the greatest potential for liquefaction.

It should be noted that a complete liquefaction potential analysis would include test borings to at least 30 feet deep.

Seismically induced ground settlement resulting from the M = 6.0 earthquake (and PGA = 0.2g) is estimated to be less than ½" for the soils north of the existing swimming pool and nearly 2.0 inches for the soils south of the existing swimming pool.

Special Considerations

1. Groundwater was encountered in the borings at depths of 8.1 to 8.7 feet below existing grade. Excavations into the underlying soils are susceptible to caving, especially at or near the groundwater level.

2. Based on the schematic drawing provided on Plate A, the base of the Rock Rubble Mound Revetment will be at elevation -7.25 feet (msl). As shown on Plate 8, that would put the base in (or nearly in) the in-situ ROCK at Borings 1, 2 and 3; this ROCK should provide a good/firm base to construct the Rock Rubble Mound Revetment.

Conversely, the ROCK was not found at Borings 4 and 5 and instead loose to very loose SAND can be anticipated at msl of -7.25 feet. Boring 4 encountered moderately dense silty SAND with gravel at -8' msl which should provide a firm base to construct the Rock Rubble Mound Revetment. Boring 5 did not encountered a firm layer of material to construct the Rock Rubble Mound Revetment; Boring 5 was terminated at -7.5' msl due to the boring collapsed at that depth and the limitations of the portable equipment being used for this boring required the hole to be terminated. During construction of the Rock Rubble Mound Revetment in the area of Boring 5, stabilization of the base of the structure will likely be required.

ON-SITE OBSERVATION

During the progress of construction, so as to evaluate general compliance with the design concepts, specifications and recommendations contained herein, a representative from this office should be present to observe the following operations:

1. Site preparation.
2. Placement of fill and backfill.
3. Footing excavations and slab subgrade moisture conditioning and compaction.

REMARKS

The conclusions and recommendations contained herein are based on the findings and observations made at the exploration locations. If conditions are encountered during construction which appear to differ from those disclosed by the explorations, this office shall be notified so as to consider the need for modifications.

This report has been prepared for the exclusive use of Sea Engineering, Inc. and their respective design consultants. It shall not be used by or transferred to any other party or to another project without the consent and/or thorough review by this facility. Should the project be delayed beyond the period of one year from the date of this report, the report shall be reviewed relative to possible changed conditions.

Samples obtained in this investigation will deteriorate with time and will be unsuitable for further laboratory tests within one (1) month from the date of this report. Unless otherwise advised, the samples will be discarded at that time.

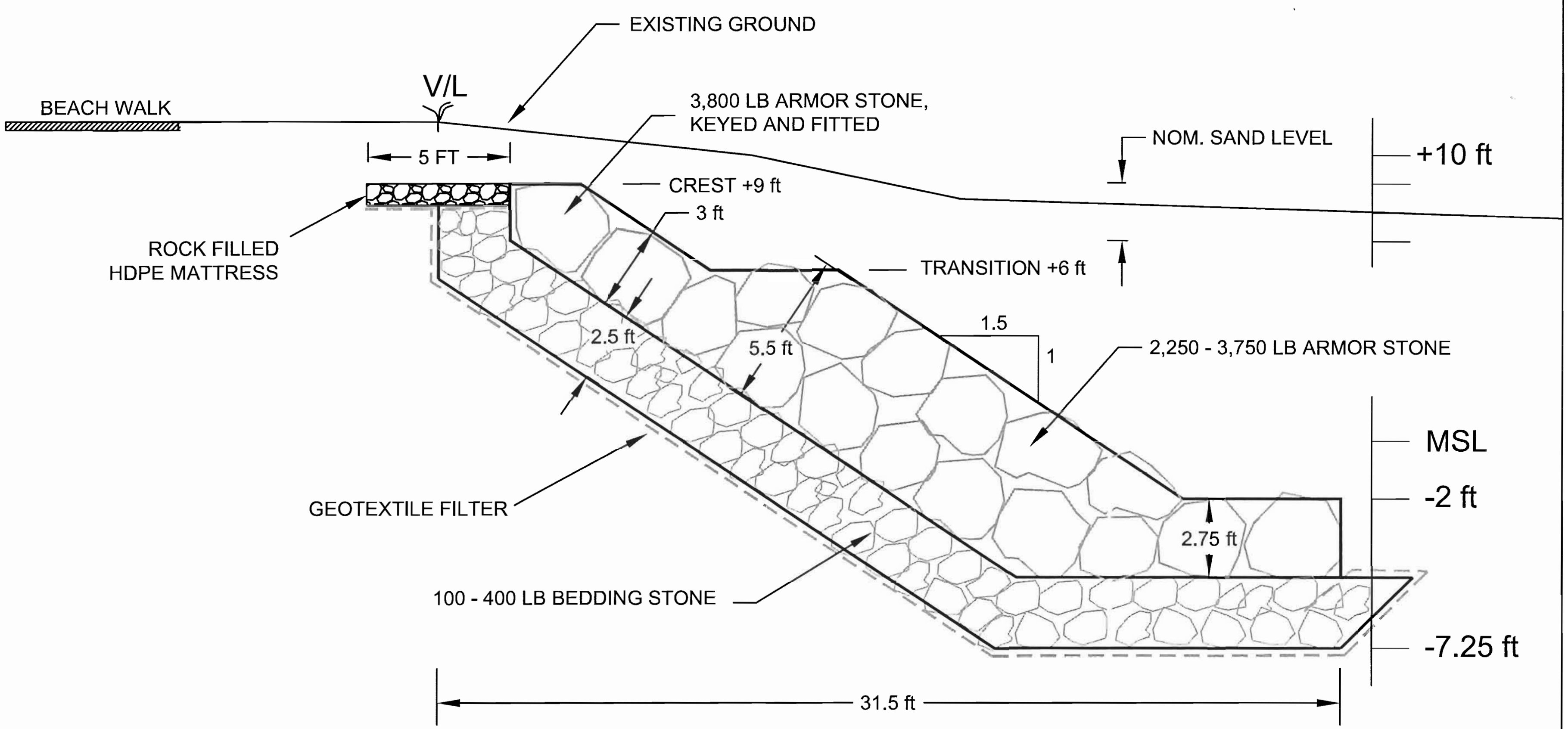
The following are included and complete this report:

Rock Rubble Mound Revetment Detail -------- Plate A

Vicinity Map -- Plate 1

Plot Plan -- Plate 2

Appendix: Field Investigation and Laboratory Testing



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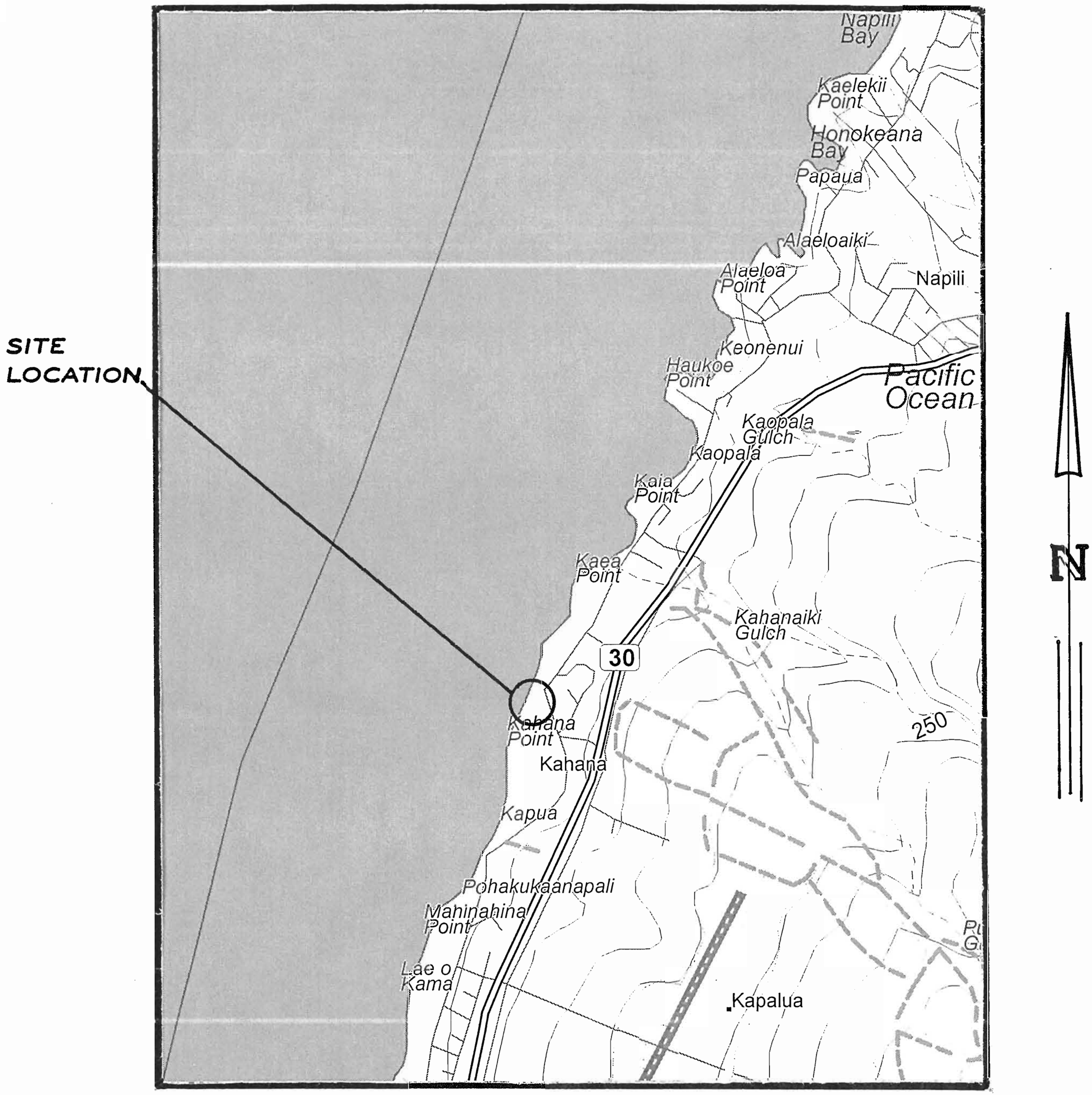
ROCK RUBBLE MOUND REVETMENT

NOTES:
1. ELEVATIONS BASED ON MSL DATUM

Plate A

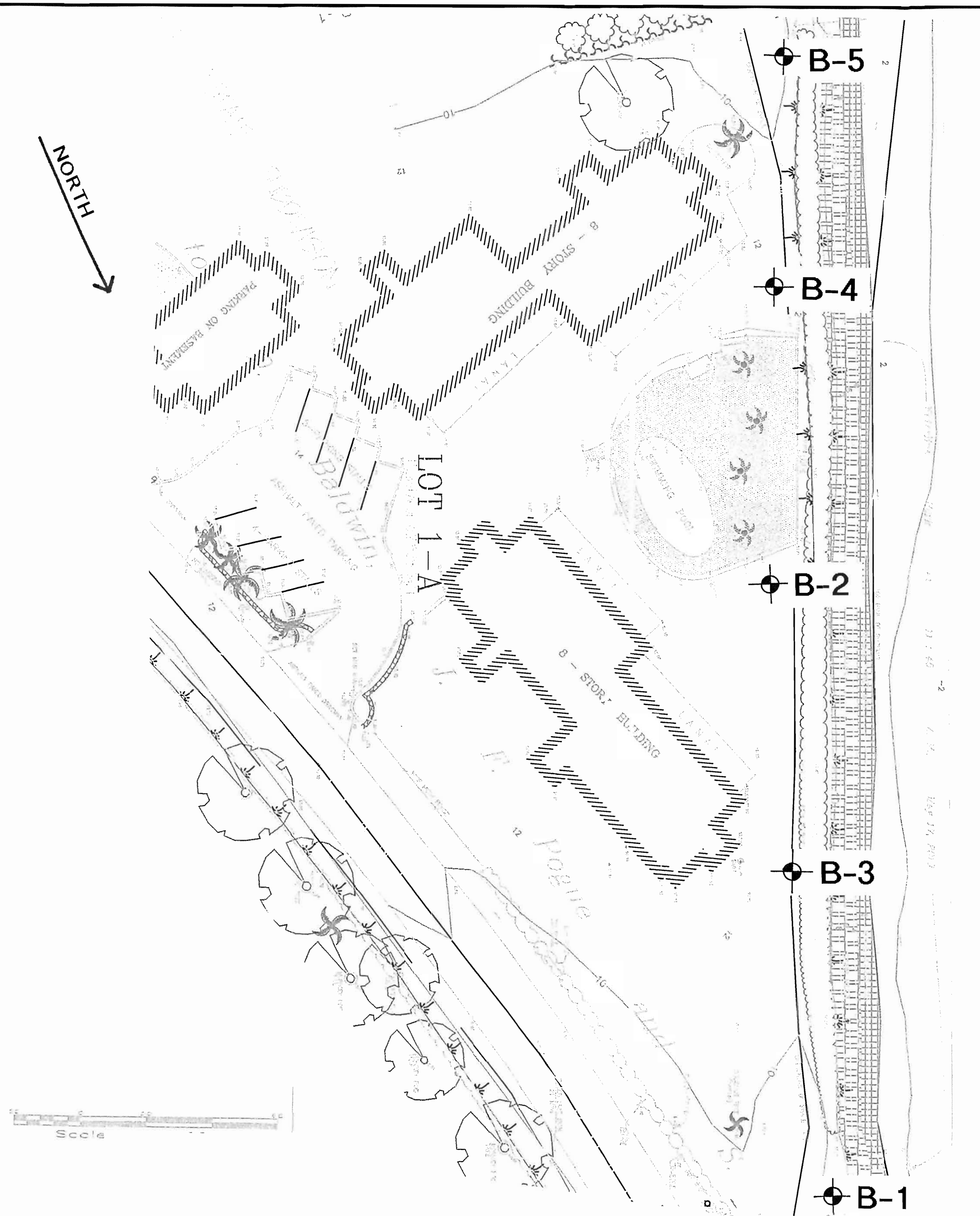
VICINITY MAP



REFERENCE:

USGS TOPOGRAPHIC MAP
NAPILI QUADRANGLE

HOLOLANI ROCK REVETMENT	
ISLAND GEOTECHNICAL ENGINEERING, INC. *Geotechnical Consultants*	PROJECT NO. 101408FM DATE Aug. 2010 SCALE 1" = 2000' PLATE 1



Plot Plan

Project: HOLOLANI ROCK REVETMENT	Project No.: 101408-FM
ISLAND GEOTECHNICAL ENGINEERING, INC.	PLATE 2

APPENDIX

FIELD INVESTIGATION AND LABORATORY TESTING

FIELD INVESTIGATION

General

The field investigation consisted of performing explorations at the locations shown on the Plot Plan. The method used for the exploratory work on this project is shown on the respective exploration log. A description of the various methods are presented below.

Test Borings Using Truck-Mounted Drilling Equipment

Truck-mounted borings are drilled using a gas-powered drilling rig. The hole is advanced using continuous flight augers, wash boring and/or NX coring.

Auger drilling is used in soils where caving does not occur. The augers are 4-1/2 inch diameter continuous helical flight augers with the lead auger having a head equipped with changeable cutting teeth. Soil cuttings are brought to the surface by the continuous flights. After the bore hole is advanced to the required depth and cleaned of cuttings by additional rotation of the augers, the augers are retracted for soil sampling or in-situ testing.

In soils where caving of the bore hole occurs, the hole is advanced by wash boring or hollow-stem augering. Wash boring consists of advancing steel casing by rotary action and water pressure to flush the soil from the casing. The lead section of the casing is equipped with a carbide or diamond casing bit. After the casing has been advanced to the required depth, soil samples are obtained through the inside of the casing. Hollow-stem drilling consists of advancing the hole with 7-5/8 inch outside diameter and 4-1/4 inch inside diameter augers. The leading drill bit is connected to drilling rods through the central portion of the auger. At the required sampling depth, the interior drill rods and lead bit are removed, and the soil sample is taken by driving a sampler through the “hollow” section of the augers.

Coring is used for hard formations such as rock, coral or boulders. The core barrel, consisting of a 5-foot long double tube, hardened steel barrel with either a carbide or diamond bit, is attached to drilling rods and set on the hard formation. The core barrel is advanced through the formation by rotation of the core barrel. Water is used to flush out the cuttings. Upon completion of the core run, the sample is removed from the core barrel and inspected. The total core recovery length and the sum of all intact pieces over 4-inches in length are measured. The length of core recovery divided by the length of the core run is the recovery ratio. The combined length of the 4-inch or longer pieces divided by the length of core run is the Rock Quality Designation (RQD). The values provide an indication of the quality of the formation.

Test Borings Using Portable Drilling Equipment

In areas inaccessible to truck-mounted equipment, portable drilling equipment is used to drill the test boring. The boring is advanced by either (1) continuous drive sampling, or by (2) using a small gas-powered drill rig with continuous flight augers, wash boring or NX coring.

Soil samples are obtained with a tripod and cathead assembly using soil sampling methods described below.

Test Pits Using Excavators / Backhoes

Test pits are excavated using an excavator or backhoe. Material excavated from the pit and the sides and bottom of the pit are visually inspected and a continuous log of the hole is kept.

<u>Explorations Using Hand Tools</u>

In inaccessible areas requiring only shallow explorations, borings and test pits are made using hand equipment. Borings are drilled using hand augers. Test pits are excavated using hand tools. Cuttings from the boring and/or pit are inspected and visually classified.

<u>Soil Sampling</u>

Relatively undisturbed samples of the underlying soils are obtained from borings by driving a sampling tube into the subsurface material using a 140-pound safety hammer falling from a height of 30 inches. Ring samples are obtained using a 3-inch outside diameter, 2.5-inch inside diameter steel sampling tube with an interior lining of one-inch long, thin brass rings. The tube is driven approximately 18 inches into the soil and a section of the central portion is placed in a close fitting waterproof container in order to retain field conditions until completion of the laboratory tests. Standard Penetration Test (SPT) values and disturbed soil samples are obtained with a 2-inch (outside diameter) split-barrel sampler instead of the 3-inch sampler. The number of blows required to drive the sampler into the ground is recorded at 6-inch intervals. The blow count for the last 12 inches is shown on the boring logs.

From test pit excavations, relatively undisturbed soil samples are obtained by pushing the 3-inch outside diameter sampling tube (mentioned above) into the ground with the backhoe bucket. In addition, undisturbed bulk samples are retained from cohesive type soil formations and disturbed bulk samples are retained from friable and cohesionless soil formations.

The soil samples are visually classified in the field using the Unified Soil Classification System.

Samples are packed in moisture-proof containers and transported to the laboratory for testing.

Dynamic Cone Penetrometer (DCP)

There are two types of DCP tests used in the field. One test is generally used for pavement design and the other test is generally used for foundation design.

The DCP test for pavement design is an in-place test generally performed on the near surface soils. The DCP consists of a steel rod with a steel cone attached to one end which is driven into the soil by means of a sliding hammer. The angle of the cone is 60 degrees. The depth of the cone penetration is recorded at selected penetration or hammer drop intervals. The standard DCP test is designed to penetrate soils to a total depth of 1 meter (39.4 inches), however, extension rods may be used to reach greater depths. The recorded data from the DCP test can be converted to CBR values for use in pavement design.

The DCP test for foundation design (aka Wildcat DCP) is used to evaluate the consistency of the subsurface soils to depths of 25 feet. The test is performed by driving a 1.4-inch diameter (10 square centimeter area) steel cone (cone is connected to 1.1-inch diameter steel rods) into the ground using a 35-pound slide hammer that is dropped from a height of 15 inches. The number of blows required to drive the steel cone 10 centimeters is recorded and the process is continued until the desired depth is reached. Blowcounts from this test can be converted to Standard Penetration Test (SPT) values.

LABORATORY TESTING

General

Laboratory tests are performed on various soil samples to determine their engineering properties. Laboratory tests results performed for this project are generally shown on the exploration logs or attached as stand alone documents. Descriptions of some of the various tests (that may or may not have been performed for this project) are listed below.

Unit Weight and Moisture Content

The in-place moisture content and unit weight of the samples are used to correlate similar soils at various depths. The sample is weighed, the volume determined, and a portion of the sample is placed in the oven. After oven-drying, the sample is again weighed to determine the moisture loss. The data is used to determine the wet-density, dry-density and in-place moisture content.

Direct Shear

Direct shear tests are performed to determine the strength characteristics of the representative soil samples. The test consists of placing the sample into a shear box, applying a normal load and then shearing the sample at a constant rate of strain. The shearing resistance is recorded at various rates of strain. By varying the normal load, the angle of internal friction and cohesion can be determined.

Consolidation Test

Consolidation tests are performed to obtain data from which time rates of consolidation and amounts of settlement may be estimated. The test is performed by placing a specimen in a consolidation apparatus. Loads are applied in increments to the circular face of a one-inch (1") high sample. Deformation or changes in thickness of the specimen are recorded at selected time intervals. Water is introduced to or allowed to drain from the sample through porous disks placed against the top and bottom faces of the specimen. The data is then used to plot a stress-volume strain curve which is used in estimating settlement.

Expansion Index Test

Expansion Index of fine-grained soils is determined in accordance with ASTM D 4829 test procedure. The soil specimen is compacted into a metal ring so that the degree of saturation is between 40 and 60 percent. The specimen and the ring are placed in a consolidometer. A vertical confining pressure of 1 psi is applied to the specimen and then the specimen is inundated with water. The deformation of the specimen is recorded for 24 hours. The data is used to determine the expansion potential of the soil.

One-Dimensional Swell Test

Another procedure for determining the expansion of fine-grained soils is ASTM D 4546 (Method B) test procedure. The soil specimen is compacted into a 2.5-inch diameter (1-inch height) metal ring using a 10-pound hammer. The specimen and the ring are placed in an expansion apparatus. A vertical pressure of 155 psi is applied to the specimen and then the specimen is inundated with water. The deformation of the specimen is recorded for 24 hours.

The test is similar in principle to the Expansion Index Test (see above) with the primary difference being the soil specimen in the One-Dimensional Swell Test is usually compacted to a higher dry density than the Expansion Index and, therefore, generally produces a higher degree of expansion.

Classification Tests

The soil samples are classified using the Unified Soil Classification System. Classification tests include sieve and hydrometer analysis to determine grain size distribution, and Atterberg Limits to determine the liquid limit, plastic limit and plasticity index.

California Bearing Ratio Test

California Bearing Ratio (CBR) tests are performed on materials to determine the bearing strength of the soil for determination of pavement sections. The sample is compacted into a 6-inch diameter mold in 5 equal layers. Each layer is compacted with a 10-pound hammer falling from a height of 18 inches, with each layer receiving 56 blows. The mold is then placed in a water bath for 4 days and the vertical swell is measured under a surcharge weight of 10 pounds. After the soaking period, the sample is placed in a CBR apparatus that has a 3-square inch penetrometer. The penetrometer is pressed vertically into the soil at constant strain and the loads required to press the penetrometer are recorded. A plot of the load-strain relationship is made to determine the CBR value.

Maximum Dry Density / Optimum Moisture Content

The maximum dry density and optimum moisture content of the material is determined in accordance with the ASTM D1557 test procedure. The sample is compacted into a mold in 5 equal layers using a 10-pound hammer falling from a height of 18 inches. The diameter of the mold is either 4 inches or 6 inches, depending on the proportion of gravel in the sample. The sample is compacted at various moisture contents to develop a compaction curve for the soil. The curve is usually bell-shaped with a peak indicating the maximum dry density and optimum moisture content.

Penetrometer Test

Penetrometer tests are performed on clayey soils to determine the consistency of the material and an approximate value of the unconfined compressive strength.

Torvane

Torvane tests are used to determine the approximate undrained shear strength of clayey soils. The torvane apparatus consists of a torque device with a small diameter plate that has vanes situated perpendicular to the plate. The vanes are pushed into the soil and torque is applied until failure occurs. The torque required to cause failure is converted to approximate undrained strength of the soil.

LOG OF BORING NO. 1

ELEVATION: see Plate 2

EQUIPMENT USED: B-59 Drill Rig

DEPTH OF BORING (FT.): 20.5

DATE DRILLED: June 9, 2010

DEPTH OF GROUNDWATER: 8.4 feet

DEPTH (FT.)	GRAPHIC SYMBOL	SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	BLOWS/FOOT	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)
0		ML	sandy SILT with gravel			brown	moist to very moist	very stiff		15.6	
		MH/ ML	SILT with sand		58	dark brown				45.8	
3											
		SM	silty SAND		11	brown	moist	mod. dense		10.6	
6											
							sat.				
		GM	silty GRAVEL with sand								
9		SP- SM	SAND with silt			gray				55.3	
					13	light yellowish brown				39.6	
12											
15					9	very dark grayish brown		loose		45.9	
18											
		rock	ROCK		206	black		mod. hard rock		18.0	
21			END OF BORING AT 20.5 FEET								

PROJECT NAME: HOLOLANI ROCK REVETMENT

PROJECT NO.: 101408-FM

ISLAND GEOTECHNICAL ENGINEERING, INC.

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PLATE 3

LOG OF BORING NO. 2

ELEVATION: see Plate 2

EQUIPMENT USED: B-59 Drill Rig

DEPTH OF BORING (FT.): 21.5

DATE DRILLED: June 9, 2010

DEPTH OF GROUNDWATER: 8.7 feet

DEPTH (FT.)	SOIL CLASSIFICATION	DESCRIPTION	BLOWS/FOOT	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)
0	ML	SILT (topsoil)		dark brown	moist	stiff		29.8	
	GM	silty GRAVEL with sand				mod. dense		8.3	
	SP	SAND	19	yellowish brown				9.3	
3	SP	cinder SAND		reddish brown					
	SM	silty SAND with gravel		brown					
			32			dense		18.1	
6					moist to very moist				
						mod. dense			
9					sat.				
	SP-SM	SAND with silt		dark gray				47.1	
	SP	SAND	18	olive gray to dark gray brown				37.7	
12									
15				reddish brown				37.6	
	GM	silty GRAVEL with sand	16					46.7	
18	rock	ROCK, weathered Core Run #1: 19' to 21.5' Rec. = 33% RQD = 30%	23/0"	dark gray		soft to mod. hard rock			
21	CL	CLAY		very dark gray		stiff		38.3	
		END OF BORING AT 21.5 FEET							

PROJECT NAME: HOLOLANI ROCK REVETMENT

PROJECT NO.: 101408-FM

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PLATE 4

LOG OF BORING NO. 3

ELEVATION: see Plate 2

EQUIPMENT USED: B-59 Drill Rig

DEPTH OF BORING (FT.): 19.5

DATE DRILLED: June 9, 2010

DEPTH OF GROUNDWATER: 8.6 feet

DEPTH (FT.)	GRAPHIC SYMBOL	SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	BLOWS/FOOT	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)
0 3		SM	silty SAND with gravel			dark grayish brown	mod. moist to moist	very dense		6.2	
		MH	sandy SILT			dark brown		stiff		14.9	
6		SP-SM	SAND with silt		27	dark yellowish brown	very moist	mod. dense		6.4	
9		SP-SM	SAND with silt and gravel		13	dark gray to grayish brown	sat.			42.4	
12		SP	SAND							38.5	
15		CL	CLAY			very dark gray to dark gray		stiff		43.8	
18		rock	ROCK: porous Core Run #1: 17.5' to 19.5' Rec. = 46% RQD = 33%		45/2"			soft rock mod. hard rock		12.4	
21			END OF BORING AT 19.5 FEET								

LOG OF BORING NO. 4

ELEVATION: see Plate 2

EQUIPMENT USED: Minuteman/Tripod Assembly

DEPTH OF BORING (FT.): 19.75

DATE DRILLED: August 13, 2010

DEPTH OF GROUNDWATER: 8.7 feet

DEPTH (FT.)	GRAPHIC SYMBOL	SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	BLOWS/FOOT	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)
0		MH	SILT with gravel			very dark grayish brown	moist	mod. stiff			
					15			stiff		25.6	
3		SP	SAND with gravel			dark reddish brown		mod. dense		23.3	
		MH	sandy SILT		19			very stiff		23.1	
6		SM	silty SAND			dark yellowish brown		loose		4.6	
		MH	SILT		6			mod. stiff		23.8	
							very moist				
9		SM	silty SAND with gravel			dark grayish brown	sat.	mod. dense		26.3	
		MH	sandy SILT		20			very stiff		16.2	
12		SP-SM	SAND with silt					mod. dense		36.5	
					3			very loose			
15											
18						very dark grayish brown		mod. dense		26.7	
		SM	silty SAND with gravel		16					43.6	
			END OF BORING AT 19.75 FEET								
21											

PROJECT NAME: HOLOLANI ROCK REVETMENT

PROJECT NO.: 101408-FM

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PLATE 6

LOG OF BORING NO. 5

EQUIPMENT USED: Minuteman/Tripod Assembly

DATE DRILLED: August 13, 2010

ELEVATION: see Plate 2

DEPTH OF BORING (FT.): 17.5

DEPTH OF GROUNDWATER: 8.1 feet

DEPTH (FT.)	SOIL CLASSIFICATION	DESCRIPTION	BLOWS/FOOT	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)
0	MH	SILT with sand	41	brown	mod. moist to moist	stiff / very stiff		14.1	
3				dark brown				12.4	
	SM	silty SAND	7			loose		7.2	
6	MH	SILT		very dark grayish brown		soft		26.7	
	SM	silty SAND	7		very moist	loose		34.9	
	cob	COBBLE							
	SM	silty SAND			sat.				
9	SP-SM	SAND with silt	9	dark gray				53.7	
						mod. dense		47.2	
12				grayish brown		loose to very loose		35.7 41.2	
	GM	silty GRAVEL with sand	3					39.5	
	SM	silty SAND							
15				very dark grayish brown				31.5	
			1					40.3	
18		END OF BORING AT 17.5 FEET							
21									

PROJECT NAME: HOLOLANI ROCK REVETMENT

PROJECT NO.: 101408-FM

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PLATE 7

Estimated ROCK Elevations at the Hololani Borings

Boring	Estimated MSL Elevation of Rock (*)
1	-9.5'
2	-8'
3	-5.5'
4	?
5	?

(*) Note that actual msl elevations at the borings was not provided to IGE. The elevation information on this table was estimated by interpolating the topographic map that was provided. All borings appear to be at about +10.0' msl.


06/09/2010

ISLAND GEOTECHNICAL ENGINEERING, INC.
Geotechnical Consultants

330 Ohukai Road, Suite 119
Kihei, Maui, Hawaii 96753
Phone: (808) 875-7355
Fax: (808) 875-7122

December 21, 2011
Project No. 101408-FM

Sea Engineering, Inc.
Attn: Mr. Jim Barry
Makai Research Pier
Waimanalo, Hawaii 96795

Subject: Addendum to Soils Investigation Report entitled, "Hololani Rock Revetment" dated August 31, 2010
Kahana, Maui, Hawaii

This letter is intended to provide additional information for the design and construction of the proposed Hololani Rock Revetment to be located at the Hololani Resort at 4401 Lower Honoapiilani Road in Kahana, Maui, Hawaii.

The proposed new structure will have a retaining wall integrated into the structure. Sheetpiling may be included in a portion of the structure. The details of the proposed structures that were provided to IGE are attached as the last two pages of this letter. The following are design values for the retaining wall:

<u>Foundations for Retaining Walls</u>
An allowable bearing value of 1,500 pounds per square foot may be used for retaining wall footings bearing on firm on-site soil or properly compacted fill and embedded at least 12 inches below the lowest adjacent compacted grade.

For footings located adjacent to new or existing utility trenches, the bottom of the footing shall be deepened below a 1 horizontal to 1 vertical plane projected upwards from the edge of the utility trench.

For footings located on or adjacent to slopes, the footing shall be deepened such that there is a minimum horizontal distance of 5 feet from the edge of the footing to the slope face.

The bearing values are for dead plus live loads and may be increased by one-third for momentary loads due to wind or seismic forces. If any footing is eccentrically loaded, the maximum edge pressure shall not exceed the bearing pressure for permanent or for momentary loads.

The bottom of all foundations should have a firm/unyielding surface.

Backfill around the perimeter of all foundations should be mechanically compacted to produce a firm/unyielding surface.

Settlement of the Retaining Wall Foundation
Under the fully applied recommended bearing pressure, it is estimated that settlement of continuous footings bearing on firm on-site soils or properly compacted fill will be less than 1 inch.

Differential settlement between footings will vary according to the size, bearing pressure and bearing material of the footing.

Lateral Resistance for the Retaining Wall
For resistance of lateral loads, such as wind or seismic forces, an allowable passive resistance equivalent to that exerted by a fluid weighing 200 pounds per cubic foot may be used for footings, or other structural elements, provided the vertical surface is in direct contact with undisturbed soil or properly compacted fill. For structural elements that are submerged, this value should be reduced to 95 pounds per cubic foot.

Frictional resistance between footings and the underlying materials may be assumed as 0.4 times the dead load for the on-site fine-grained soils and 0.5 times the dead load for the on-site granular soils (or imported granular soils).

Lateral resistance and friction may be combined.

Seismic Considerations
According to the 1997 Uniform Building Code, the site is in zone 2B. Based on the findings of our explorations and our local knowledge of the strata in this area, the soil profile type S_D is recommended for this site.

Slabs-on-Grade
For a concrete sidewalk, it is recommended that the sidewalk be supported with 4 inches of untreated base course gravel (utb).

Prior to placing the utb, the subgrade soil shall be moisture conditioned to within 0 & 3 percent of the optimum moisture content and compacted to a minimum of 95% of the maximum dry density (as determined by the ASTM D 1557 test procedure) if the material is granular or 90% of the maximum dry density (as determined by the ASTM D 1557 test procedure) if the material is fine-grained. Site grading should be designed to prevent ponding of water adjacent to the slab area.

<u>Foundation Preparation</u>
The bottom of the seawall/revetment structure is design to be at elevation -5.5' msl. Geotextile fabric shall be placed in the bottom of all wall foundation excavations prior to placement of any stone; geotextile fabric shall be Mirafi Filterweave 404 or Amoco Propex 2016 or an approved equivalent.

At elevation -5.5' msl, loose soil conditions are anticipated south of Boring 2 (see attached boring locations, Plate 2). In order to stabilize the loose conditions, it is recommended that the loose area be over-excavated by a minimum of 1 foot (to elevation -6.5' msl) and Triton Marine Mattress be placed into the excavation. The mattress shall have a minimum nominal thickness of 12". The construction and placement of the Triton Marine Mattress shall be in accordance with the manufacturer's recommendations. Each individual mattress shall cover the 19.75 feet plan width and each mattress shall be placed perpendicular to the shoreline. The geotextile fabric (mentioned in the previous paragraph) can be attached to the bottom of the mattress prior to placing the mattress into the foundation excavation.

<u>Sheetpile Design</u>
The soils design parameters for sheetpile design are shown on the attached Plate SP.

<u>Site Preparation and Grading</u>
It is recommended that the site be prepared in the following manner:

1. All vegetation, weeds, brush, roots, stumps, rubbish, debris, and other deleterious material shall be removed and disposed of off-site.

2. <u>Fill and Backfill in Structural Areas</u> Structural areas shall be defined as areas beneath, and to 1 feet beyond the edges of the structure.

   Structural fill and backfill material shall consist of untreated base course gravel. The material shall meet the grading requirements as shown on the attached Table 703.06-2.

   Each layer shall be placed in lifts not exceeding 6 inches in compacted thickness. Prior to compacting the soil, the soil's moisture content shall be adjusted to near optimum moisture content. Each layer shall be thoroughly compacted to at least 95 percent of the maximum dry density (ASTM D1557).

3. Fill and Backfill in Non-Structural Areas Non-structural areas shall be defined as areas beyond 1 feet from the edge of any structure.

   Non-structural fill and backfill material shall consist of material which is free of organics and debris. The material shall be less than 6 inches in greatest dimension.

   Each layer shall be placed in lifts not exceeding 12 inches in loose thickness. Prior to compacting the soil, the soil's moisture content shall be adjusted to near optimum moisture content. Each layer shall be thoroughly compacted prior to placing of any subsequent lifts to at least 90 percent of the maximum dry density as determined by the ASTM D 1557 test procedure.

4. Backfill Behind Retaining Walls Retaining wall backfill shall be defined as backfill that extends from the stem of the retaining wall to 6 inches beyond the heel of the wall footing or the footing excavation line, whichever is greater.

   All retaining wall backfill material shall consist of material that is in accordance with the project plans and specifications and meets the design criteria of the structural engineer. Granular backfill is recommended.

   Each layer of backfill shall be placed in layers not exceeding 6 inches in compacted thickness. Each layer of backfill shall be thoroughly compacted prior to placing of any subsequent lifts. All retaining wall backfill shall be compacted to at least 90 percent of the maximum dry density as determined by the ASTM D 1557 test procedure.

It is particularly important to see that all fill and backfill soils are properly compacted in order to maintain the recommended design parameters provided in this report.

ON-SITE OBSERVATION

During the progress of construction, so as to evaluate general compliance with the design concepts, specifications and recommendations contained herein, a representative from this office should be present to observe the following operations:

1. Site preparation.
2. Placement of fabric/mattresses and fill/backfill.
3. Foundation excavation and preparation.

REMARKS

The conclusions and recommendations contained herein are based on the findings and observations made at the exploration locations. If conditions are encountered during construction which appear to differ from those disclosed by the explorations, this office shall be notified so as to consider the need for modifications.

This report has been prepared for the exclusive use of Sea Engineering, Inc. and their respective design consultants. It shall not be used by or transferred to any other party or to another project without the consent and/or thorough review by this facility. Should the project be delayed beyond the period of one year from the date of this report, the report shall be reviewed relative to possible changed conditions.

This letter was made in accordance with generally accepted engineering procedures considered necessary for the project. In the opinion of the undersigned, the accompanying report has been substantiated by mathematical data in conformity with generally accepted engineering principles and presents fairly the design information requested by your organization. No other warranty is either expressed or given.

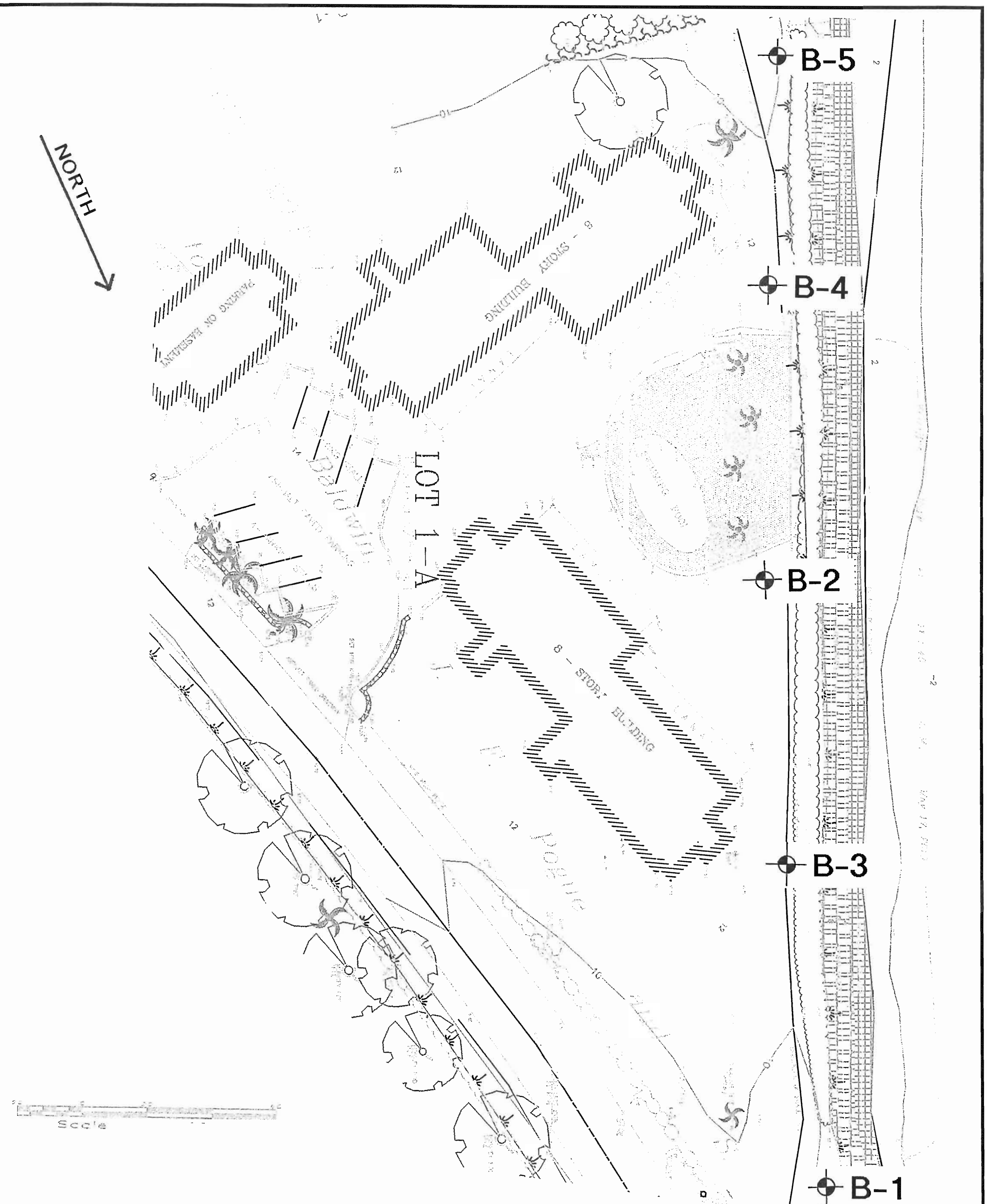
Respectfully submitted,

ISLAND GEOTECHNICAL ENGINEERING, INC.

Charles K. Biegel, P.E.
President

CHARLES K. BIEGEL
LICENSED PROFESSIONAL ENGINEER
NO. 7568-C
HAWAII, U.S.A.

This work was prepared by me or under my supervision.



Plot Plan

Project: HOLOLANI ROCK REVETMENT	Project No.: 101408-FM
ISLAND GEOTECHNICAL ENGINEERING, INC.	PLATE 2

TABLE 703.06-2 - UNTREATED BASE GRADING REQUIREMENTS			
Sieve Size	Percent Passing by Weight		
	2-1/2 Inch Maximum Nominal	1-1/2 Inch Maximum Nominal	3/4 Inch Maximum Nominal
3 Inch	100	-	-
2-1/2 Inch	90 - 100	-	-
2 Inch	-	100	-
1-1/2 Inch	65 - 90	90 - 100	-
1 Inch	-	-	100
3/4 Inch	45 - 70	50 - 90	90 – 100
No. 4	25 - 45	25 - 50	35 – 55
No. 200	3 - 9	3 - 9	3 – 9

SHEETPILE DESIGN VALUES

SHEETPILE DESIGN VALUES AT BORING 4

Depth	Unit Weight	Submerged Unit Weight	Ka	Ko	Kp
EG to -5' EG	132 pcf	70 pcf	.32	.48	3.12
-5' EG to -9' EG	121 pcf	72 pcf	.36	.53	2.77
-9' EG to -11' EG	132 pcf	70 pcf	.29	.45	3.39
-11' EG to -18' EG	102 pcf	40 pcf	.36	.53	2.77
Below -18' EG	119 pcf	57 pcf	.27	.43	3.69

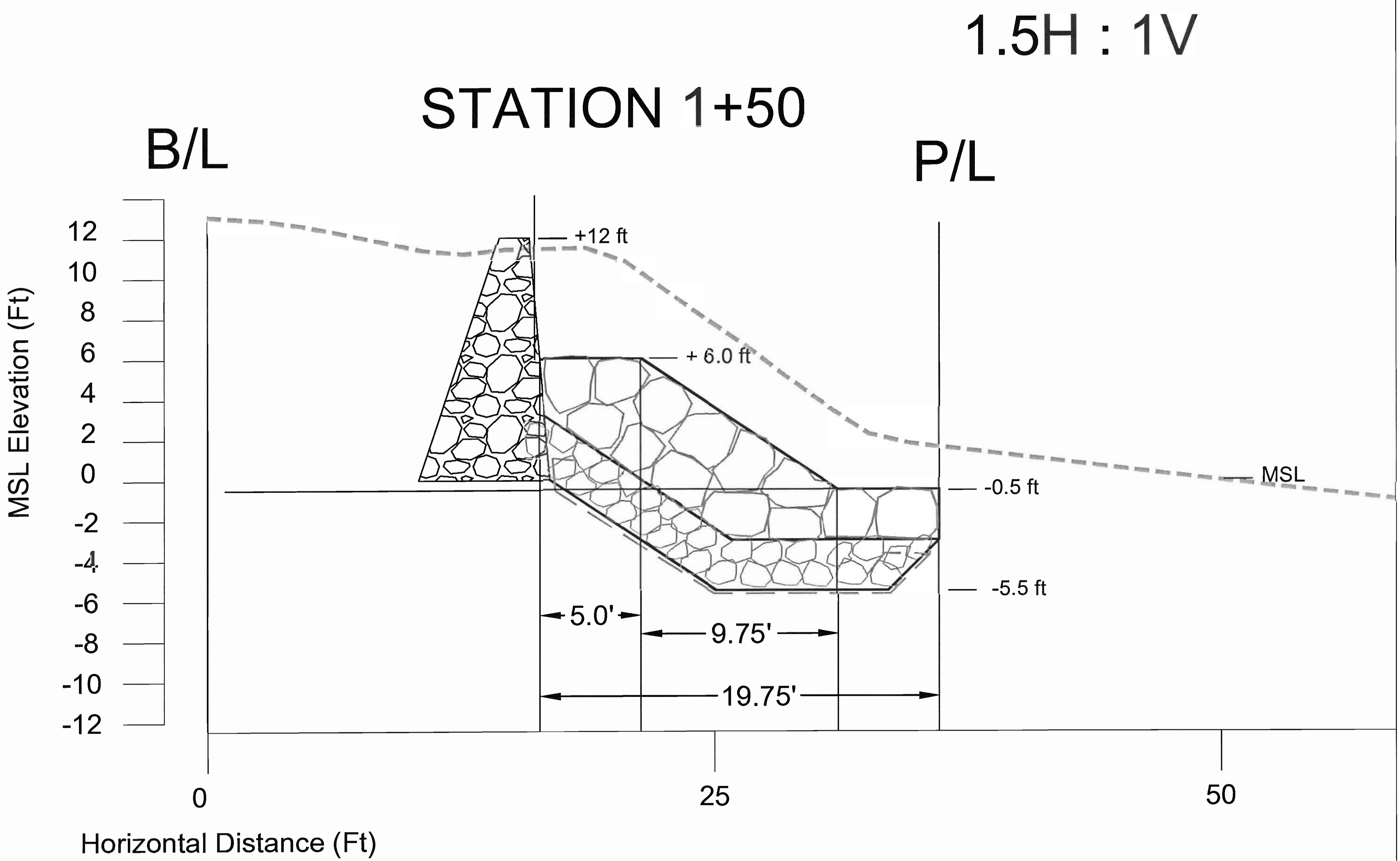
SHEETPILE DESIGN VALUES AT BORING 5

Depth	Unit Weight	Submerged Unit Weight	Ka	Ko	Kp
EG to -3' EG	135 pcf	73 pcf	.26	.41	3.85
-3' EG to -12' EG	111 pcf	49 pcf	.32	.48	3.12
-12' EG to -15' EG	102 pcf	40 pcf	.36	.53	2.77
Below -15' EG	97 pcf	35 pcf	.39	.56	2.56

SHEETPILE DESIGN VALUES FOR IMPORTED GRAVEL (UTB)

Unit Weight	Submerged Unit Weight	Ka	Ko	Kp
145 pcf	83 pcf	.26	.41	3.85

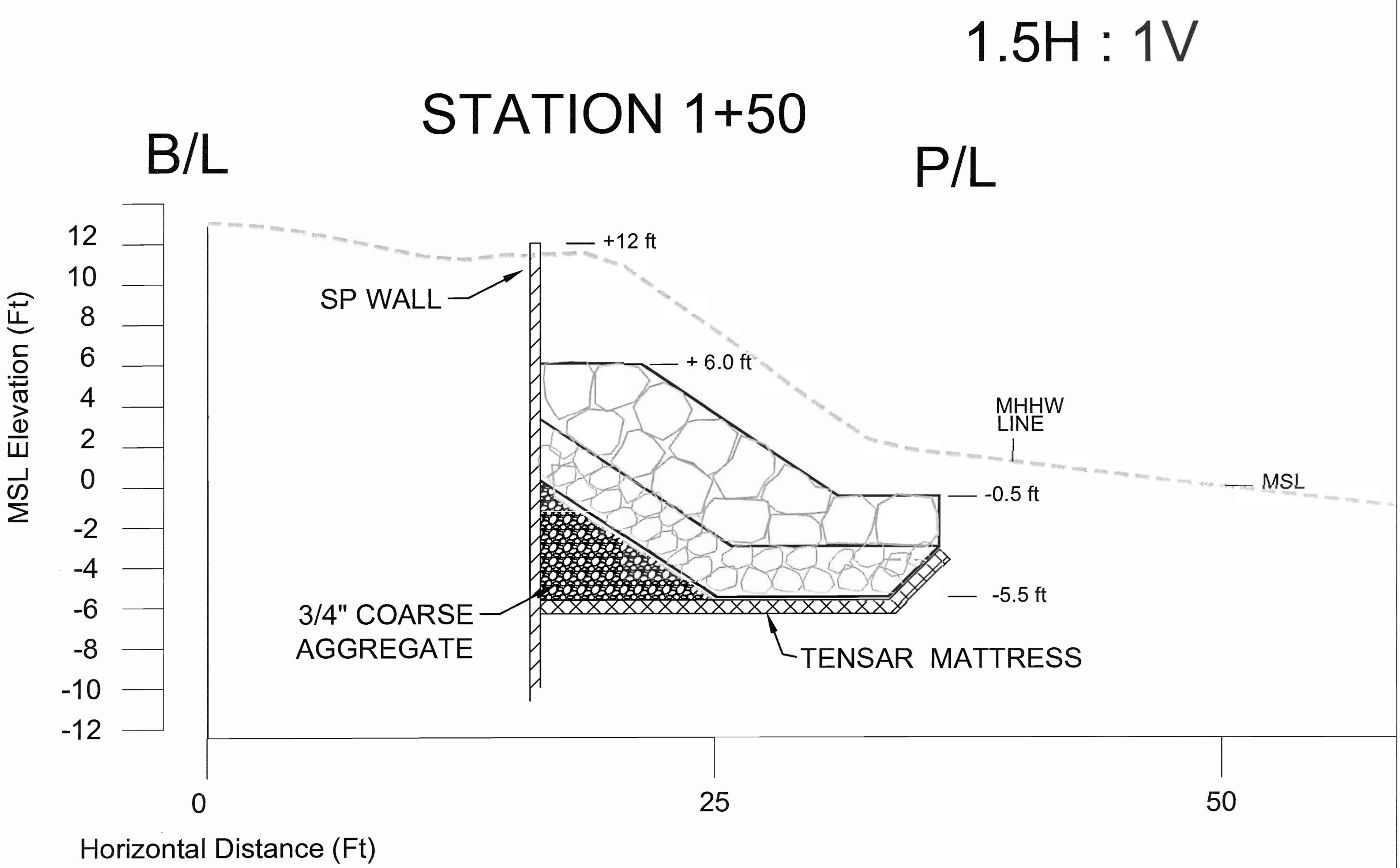
Note: EG means Existing Grade



Sea Engineering, Inc.

HOLOLANI
REVETMENT and SEAWALL

NOTES:
1. ELEVATIONS BASED ON MSL DATUM



Sea Engineering, Inc.

HOLOLANI

REVETMENT and SEAWALL

NOTES:

1. ELEVATIONS BASED ON MSL DATUM

APPENDIX C. SHORELINE SURVEY HISTORY – VALERA, INC.

Shoreline History at the Hololani Resort Condominums,

Lot 1-A Bechert Partition

Valera Inc., 2011

VALERA, INC.
SURVEYORS

1867-A VINEYARD STREET
WAILUKU, MAUI, HAWAII 96793

MAILING ADDRESS:

P.O. BOX 3173
WAILUKU, MAUI, HAWAII 96793

(808) 244-0985
FAX (808) 244-1982

FILE 7187
February 21, 2011

Shoreline History
Lot 1-A Bechert Partition
Portions Grant 1166 top D Baldwin, J.F. Poque and S.E. Bishop
West of Lower Honoapiilani Highway
Kahananui, Kaanapali, Lahaina, Hawaii
TMK: (2) 4-3-010:009

In 1959 Bechert Estate was partitioned into five (5) lots. See portion of map on Exhibits 1 and 1-A. Thence, Lot 1 was subdivided into Lots 1-A, 1-B and 1-C.

On December 5, 1972, Lot 1-A was granted shoreline certification by the Board of Land and Natural Resources. See Exhibit 2.

During the conveyance of the property in December 1972 to Lokelani Construction, Co., Inc., a California Corporation, by Hawaii Projects, Inc. (formerly known as Kaanapali Hotel Corp.), an Arizona Corporation, by Deed recorded in the Bureau of Conveyance of the State of Hawaii in Liber 8791, page 140, adopted the certified shoreline as the shoreline boundary of subsequent Lot 1-A. Metes and bounds description hereto attached as Exhibit 3

In 1980, a shoreline of Parcel 27 of TMK: (2) 4-3-005 and portion of Lot 1-A of Bechert Estate got approval from the State. Significant erosion was already observed on these small parcels. See Exhibit 4.

In 1990, a shoreline application for shoreline protection purposes was approved following the toe of sand bags and vegetation line criteria. A total of 2,729 square feet was eroded during this application.

In 1995, another shoreline application for shoreline protection purposes was filed but disapproved. The disapproval was due to the lack of documentation of the presence of sand bags and the concrete sidewalk and stairs from the swimming pool to the ocean. A total of 1,888 square feet was eroded in this application.

In 2001, a shoreline application for shoreline protection purposes was granted, using the toe of bank and vegetation line as the criteria. A total of 3,321 square feet was eroded.

In 2007 an attempt to apply for shoreline certification for shoreline protection purposes failed on two (2) occasions (April and June 2007). Erosions are 5,519 and 4,412 square feet respectively. Exhibits 5 and 6 are the reasons of diaapproval.

Edgardo V. Valera,
Principal
Valera, Inc.

Enclosures: Exhibits 1, 1-A, 2, 3 , 4, 5 and 6

See Sv.. F4.103

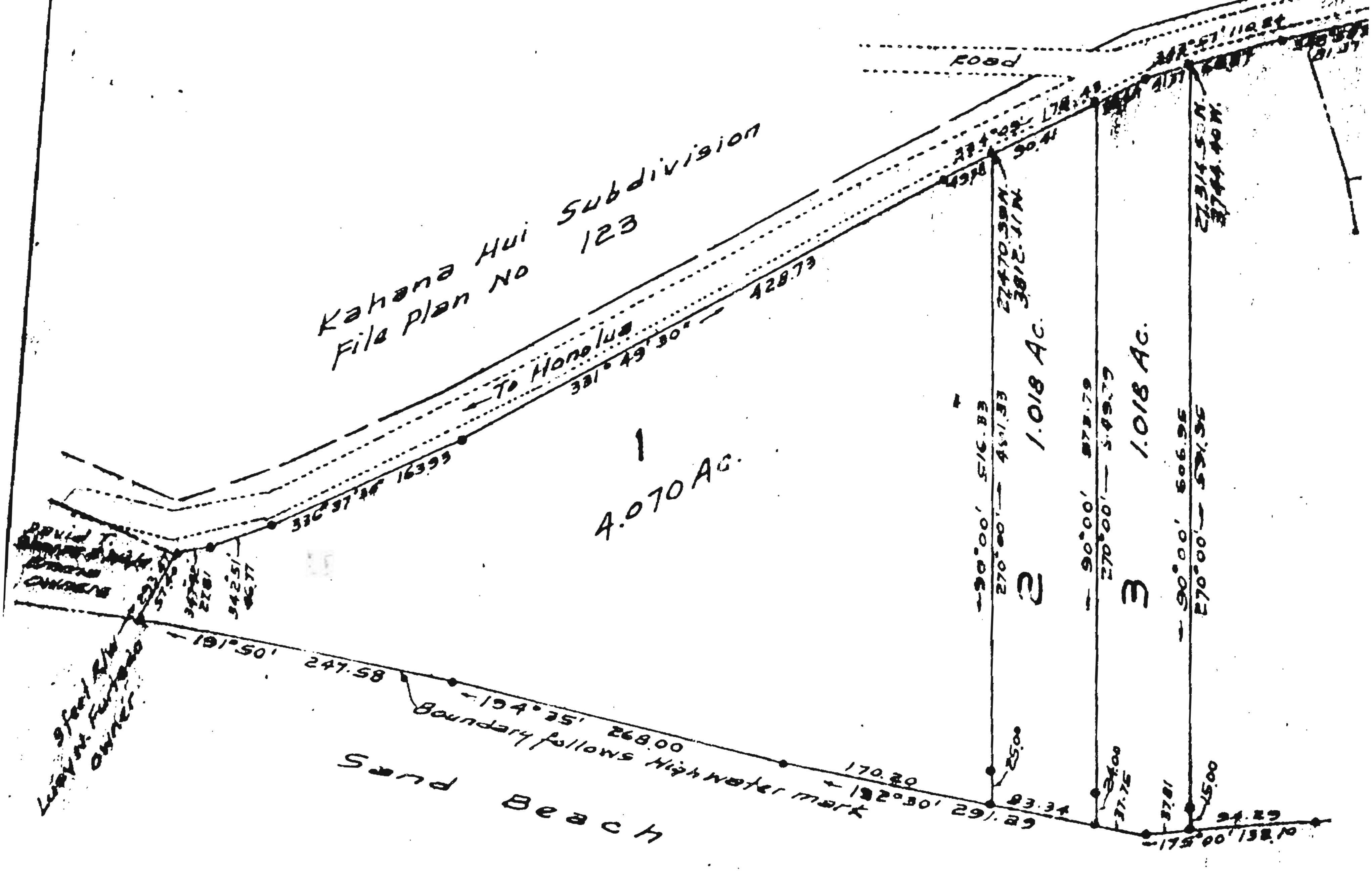
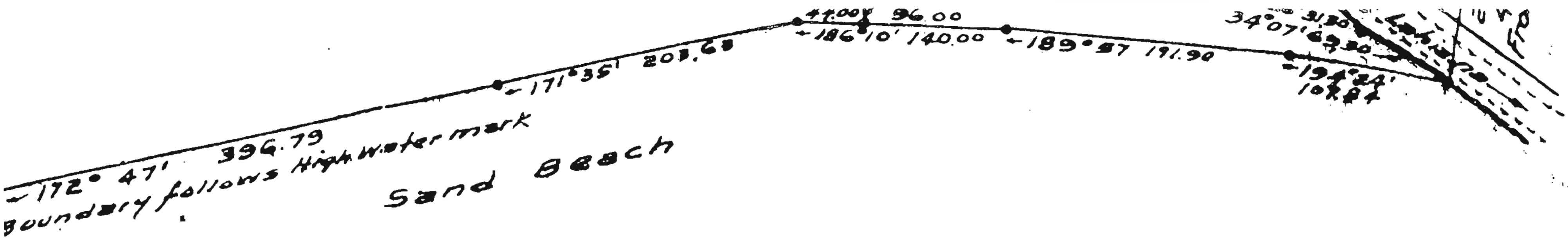


EXHIBIT 1



A N

BECHERT ESTATE PARTITION

Portion of Grant 1166 to D. Baldwin, J.F. Pogue and S.E. Bishop and all of R.P. 6231 L.C.Aw. 3985-I apanai to pala

Kahananui, Kaanapali, Maui, T.H.

Hyades B. Kiesel
George K. Hasegawa & Wife
Edward B. Watson
Akira Wada & Wife
Amelia B. Horiuchi
Edward B. Watson Jr

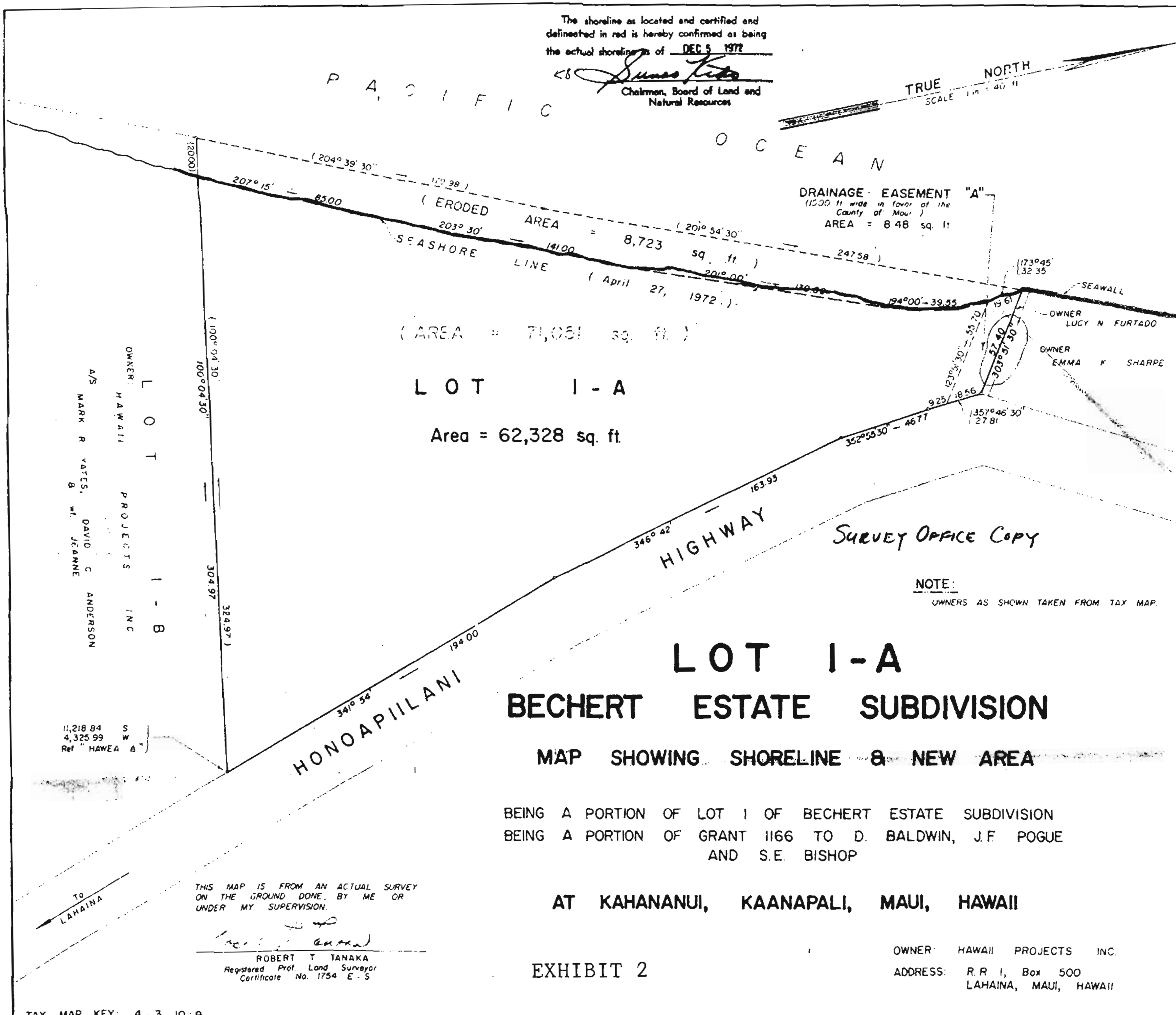
} owners

Address George K. Hasegawa
Lahaina, Maui, T.H.

Surveyed By M.R. Souza
Wailuku, Maui, T.H.
May 20, 1958

Item # 12
4.59

EXHIBIT 1-A



LOT I-A

BECHERT ESTATE SUBDIVISION

MAP SHOWING SHORELINE & NEW AREA

BEING A PORTION OF LOT I OF BECHERT ESTATE SUBDIVISION
BEING A PORTION OF GRANT 1166 TO D. BALDWIN, J.F. POGUE AND S.E. BISHOP

AT KAHANANUI, KAANAPALI, MAUI, HAWAII

EXHIBIT 2

OWNER: HAWAII PROJECTS INC.
ADDRESS: R.R. 1, Box 500 LAHAINA, MAUI, HAWAII

TAX MAP KEY: 4-3-10:9

LAND & CONSTRUCTION CO. INC.
261 Dairy Road Kahului, Maui, Hawaii

November 29, 1972

LOT 1-A

BECHERT ESTATE SUBDIVISION

BEING A PORTION OF LOT 1 OF
BECHERT ESTATE SUBDIVISION
BEING A PORTION OF GRANT 1166 TO D. BALDWIN,
J. F. POGUE AND S. E. BISHOP

SITUATED ON THE WEST SIDE OF HONOAPIILANI HIGHWAY
AT KAHANANUI, KAANAPALI, MAUI, HAWAII

Beginning at the Southeast corner of this parcel of land on the West side of Honoapiilani Highway, the coordinates of which referred to Government Survey Triangulation Station "Hawea" being 11,218.84 feet South and 4,325.99 feet West and running by azimuth measured clockwise from true South:

1. 100° 04' 30" 304.97 feet along Lot 1-B of this subdivision;

Thence along the seashore for the next five (5) courses, the azimuth and distance being:

2. 207° 15' [16] 85.00 feet;

3. 203° 30' 141.00 feet;

4. 201° 00' 130.00 feet;

5. 194° 00' [194 - 00] 39.55 feet; [39·55]

6. 173° 45' 32.35 feet;

7. 303° 51' 30" 57.40 feet along land [illegible] by Lucy N. Furtado;

8. 357° 46' 30" 27.81 feet along the West side of Honoapiilani Highway;

9. 352° 55' 30" 46.77 feet along same;

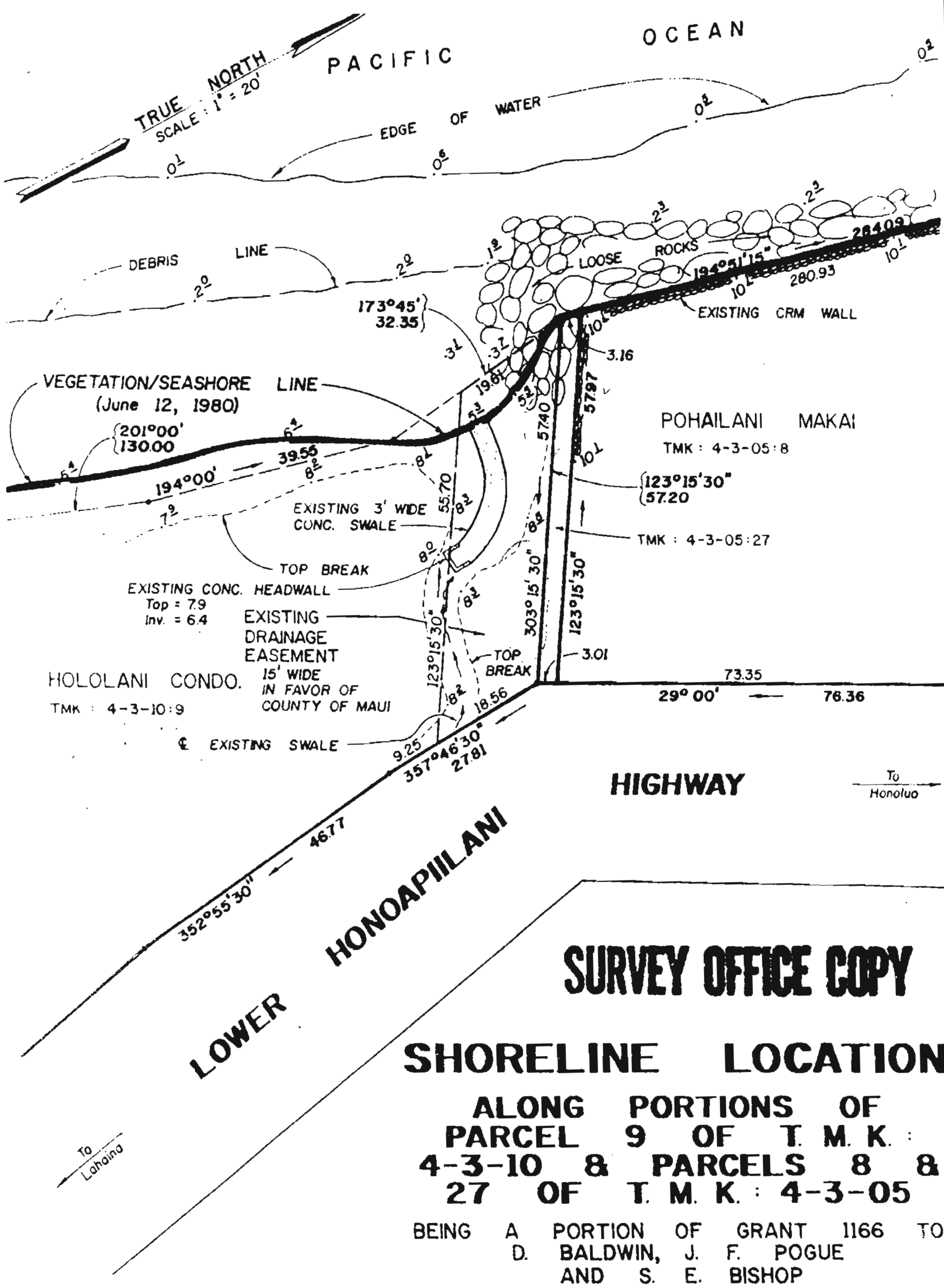
10. 346° 42' [346 - 42] 163.93 feet along same; [163.93]

11. 341° 54' [341° 54] 194.00 feet along same to the point of beginning and containing an area of 62,328 square feet. [194·00]

Being all of the land conveyed to L[illegible] Construction Co., Inc., a California corporation, by Hawaii Pro[illegible] Inc. (formerly known as Kaanapali [illegible] Corp.), an Arizona corporation, by Deed dated December 7, 1992, [illegible] in the Bureau of Conveyances of the State of Hawaii in Liber 8[illegible]

EXHIBIT

EXHIBIT 3



SURVEY OFFICE COPY

SHORELINE LOCATION

ALONG PORTIONS OF PARCEL 9 OF T. M. K. : 4-3-10 & PARCELS 8 & 27 OF T. M. K. : 4-3-05

BEING A PORTION OF GRANT 1166 TO D. BALDWIN, J. F. POGUE AND S. E. BISHOP

AT KAHANANUI, KAANAPALI, MAUI, HAWAII

NOTE :

6² DENOTES EXISTING GROUND ELEVATION.
ELEVATION DATUM = MEAN SEA LEVEL.

The shoreline as located and certified and ...neated in red is hereby confirmed as being actual shoreline as of JUL 9 1980

S. Ono

Chairman, Board of Land and Natural Resources

ROBERT T. TANAKA
REGISTERED PROFESSIONAL LAND SURVEYOR
No. 1754
HAWAII, U.S.A.

THIS MAP IS FROM AN ACTUAL SURVEY ON THE GROUND DONE BY ME OR UNDER MY DIRECT SUPERVISION.

6-25-80

ROBERT T. TANAKA — DATE
Reg. Professional Surveyor
Cert. No. 1754 E-S

RTIONS OF
X MAP KEY : 4-3-10:9 ; 4-3-05:8 & 27

EXHIBIT 4

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR

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

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

April 10, 2007

Mr. Edgardo V. Valera, LPLS
Valera, Inc.
1867 Vineyard Street
Wailuku, Hawaii 96793

Dear Mr. Valera:

Subject: Notice of Incomplete Shoreline Certification Application
Owner: Hololani, Association of Apartment Owners
Tax Map Key: (2) 4-3-010:009

Your application for shoreline certification of the subject property has been found to be incomplete for the following reasons:

Failure to provide documentation that the sand bags makai of the seaward boundary of the property were approved by government agencies or is exempt from such approval (§13-222-17(2)(i), HAR).

We retain one copy of map and photo for our records, and return the rest of the application, including the check, to you. Please resubmit a completed application. We encourage you to use our Shoreline Certification Application Form and refer to Chapter 13-222, HAR, which can both be found at our website: http://www.hawaii.gov/dlnr/lmd/rulesindex.html

If you have any questions, please feel free to contact us at 587-0430. Thank you.

Sincerely,

Barry Cheung
Land Agent

Enclosures

EXHIBIT 5

LINDA LINGLE
GOVERNOR OF HAWAII

ALLAN A. SMITH
INTERIM CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

June 12, 2007

Mr. Edgardo V. Valera, LPLS
Valera, Inc.
1867 Vineyard Street
Wailuku, Hawaii 96793

Dear Mr. Valera:

Subject: Shoreline Application, TMK (2) 4-3-010:009

Your application for shoreline certification of the subject property received by us on June 5, 2007 has been found to be incomplete for the following reason:

> Failure to provide a document supporting that the concrete walkway and the revetment were approved by the appropriate government agencies or were exempt from such approval (§13-222-7(b)(14), HAR). According to the letter dated February 6, 2007 from the Office of Conservation and Coastal Lands, your client was allowed to place boulders in the shoreline area for 30 days. After this period, the boulders were to be removed to the satisfaction of the Department. We understand the sand bags presently placed on the shoreline also need to be removed. Subsequent to such removal, an engineered structure consisting of sandbag and Tensar structure was to be installed.

We retain one copy of map and photo for our records, and return the rest of the application, including the check, to you. Please resubmit a completed application. We encourage you to use our Shoreline Certification Application Form and refer to Chapter 13-222, HAR, which can both be found at our website: http://www.hawaii.gov/dlnr/lmd/rulesindex.html

If you have any questions on the erosion control project, please contact Dolan Eversole of OCCL at 587-0377. If you have other questions, please feel free to contact us at 587-0430. Thank you.

Sincerely,

Barry Cheung
Land Agent

Enclosures

EXHIBIT 6

c: Dolan Eversole, OCCL

APPENDIX D. MARINE BIOLOGY AND WATER QUALITY – MARINE RESEARCH CONSULTANTS, INC.

Baseline Assessment of Marine Water Chemistry and Marine Biotic Communities,

Hololani Resort Condominium, West Maui, Hawaii;

Marine Research Consultants, Inc., 2010

BASELINE ASSESSMENT OF
MARINE WATER CHEMISTRY
AND MARINE BIOTIC COMMUNITIES
HOLOLANI RESORT CONDOMINUM
WEST MAUI, HAWAII

Prepared for:

Sea Engineering, Inc.
Makai Research Pier
Waimanalo, HI

By:

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822

December 2010

I. INTRODUCTION AND PURPOSE

The Hololani Resort Condominiums consist of twin 8-story buildings located on the Kahana coast of West Maui, approximately 0.4 miles north of Mahinahina Beach Park (known as S-Turns) (Figure 1). The project shoreline is approximately 400 feet in length and is at the north end of an 1800 foot reach of sand beach that fronts six condominium resort properties. The west-facing shoreline is subject to waves from the south, west, and north, which cause seasonal and short term effects on the sand beach. Waves from the south during the summer season generally tend to push sand north so that a beach is created in front of the Hololani Resort. Winter waves from the north tend to transport the sand south and denude the beach. However, some of the more extreme episodes of sand accretion have resulted from southwesterly Kona Storm waves that occur during the winter season.

As a result of these dynamic processes, the Hololani has a long history of shoreline erosion problems. An aerial photograph analysis completed by Sea Engineering Inc. (SEI) in 2001 showed that during the 48 year interval between 1949 and 1997 14 feet of erosion of the vegetation line occurred at the center of the property, while 28 feet of erosion occurred at the northern end of the property. While the seasonal changes are pronounced, there also appears to have been a net loss of sand from the overall system, so that the protective sand beach has been lost with increasing frequency, leaving the mud and clay shoreline embankment increasingly exposed.

Efforts to combat the erosion have been numerous, beginning with a sand bag wall constructed in 1988. During the winter of 2006-2007, the erosion problem became dire, with large sections of the shoreline calving into the sea. At this point, erosion had progressed to the point where the buildings and possibly the underground parking structure were threatened. It became obvious that shore protection was necessary to preserve the structural integrity of the Hololani buildings. SEI designed a temporary geotextile sand bag and rock mattress structure that met requirements set by the State of Hawaii Department of Land and Natural Resources Office of Conservation and Coastal Lands (DLNR-OCCL) for an emergency protection structure. The structure was constructed in November and December 2007.

Although a robust structure, the temporary revetment has suffered damage from the effects of two Hawaiian winter wave seasons (and the beginning of a third), and it is clear that a permanent shore protection structure is required for the safety of the building.

In May of 2010, SEI was contracted by the Hololani AOAO to design permanent shore protection to replace the existing geotextile sand bags. At the present time concept designs are being developed and reviewed.

The purpose of this document is to provide the results of rapid ecological assessments (REAs) of two aspects of the marine ecosystem fronting the Hololani Resort Condominiums. Water chemistry was assessed by collecting a set of samples extending from the shoreline to the open coastal ocean directly fronting the property. Marine community structure, primarily in terms of coral reef assemblages was also described based on rapid surveys. The purpose of these REAs was to provide a description of the existing condition of the marine environment. Evaluation of the existing condition of the water chemistry and marine communities provides an insight into the physical and chemical factors that influence the marine setting. As coral communities are both long-lived and attached to the bottom, they serve as the best indicators of the time-integrated forces that affect offshore reef areas. In addition, algal communities provide an insight into the existing physical/chemical conditions of the area. Understanding the existing physical, chemical and biological conditions of the marine environment that presently occur provides a basis for predicting potential affects that might occur as a result of the proposed shoreline modification.

II. METHODS

A. Water Quality/Chemistry

Water chemistry field collection was conducted on August 15, 2010. Samples within 10 m of the shoreline were collected by swimmers, while samples farther offshore were collected from a 21-foot boat. Water chemistry was assessed along a survey transect that extended perpendicular to the shoreline originating at the sand-water interface of the beach in the center of the Hololani Resort Condominium property. Water samples were collected at seven locations along a line from the shoreline to approximately 250 meters (m) offshore (samples collected 1, 5, 10, 25, 50,150 and 300 meters (m) from the shoreline) (Figure 1). 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 receives the majority of groundwater discharge, and hence is most important with respect to identifying the effects of shoreline modification.

Owing to the shallow depth of the near-shore shelf, at stations from the shoreline extending to 5 m from shore, a single sample was collected within 20 cm of the sea surface by swimmers working from shore. At stations 10 to 300 m from the shoreline, samples were collected at two depths; a surface sample was collected within approximately 20 centimeters (cm) of the sea surface, and a bottom sample was collected within 50 cm of the sea floor.

Water quality parameters evaluated included the 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 (DOH) Water Quality Standards. These criteria include: total dissolved nitrogen (TDN), nitrate + nitrite nitrogen (NO_3^- + NO_2^-, hereafter referred to as NO_3^-), ammonium nitrogen (NH_4^+), total dissolved phosphorus (TDP), Chlorophyll a (Chl a), turbidity, temperature, pH and salinity. In addition, silica (Si) and orthophosphate phosphorus (PO_4^{-3}) were also reported because these parameters are sensitive indicators of biological activity and the degree of groundwater mixing.

Surface water samples were collected by filling pre-rinsed 1-liter polyethylene bottles. “Deep” water samples were collected using a Niskin-type oceanographic sampling bottle. The bottle is lowered to the desired sampling depth with spring-loaded endcaps held open so water can pass freely through the bottle. At the desired sampling depth, a weighted messenger released from the surface triggers closure of the endcaps, isolating a volume of water.

Subsamples for nutrient analyses were immediately placed in 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and stored on ice. Analyses for Si, NH_4^+, PO_4^{3-}, and NO_3^- were performed of filtered subsamples with a Technicon Autoanalyzer using standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). TDN and TDP were analyzed in a similar fashion following digestion. Dissolved organic nitrogen (DON) and dissolved organic phosphorus (DOP) were calculated as the difference between TDN and dissolved inorganic N and TDP and dissolved inorganic P, respectively.

Water for other analyses was sub-sampled from 1-liter polyethylene bottles and kept chilled until analysis. Chl *a* was measured by filtering 300 ml of water through glass-fiber filters; pigments on filters were extracted in 90% acetone in the dark at -20° C for 12-24 hours. Fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer. Salinity was determined using an AGE Model 2100 laboratory salinometer with a readability of 0.0001‰ (ppt). Turbidity was determined using a 90-degree nephelometer, and reported in nephelometric turbidity units (NTU) (precision of 0.01 NTU). Vertical profiles of salinity, temperature and depth were acquired using a RBR-620 CTD calibrated to factory standards.

All fieldwork was conducted by Dr. Steven Dollar. All laboratory analyses were conducted by Marine Analytical Specialists located in Honolulu, HI (Labcode: HI 00009). This analytical laboratory possesses acceptable ratings from EPA-compliant proficiency and quality control testing.

B. Marine Biotic Community Structure

Biotic composition of the survey area was assessed by divers using SCUBA working from a 21-foot boat. Dive surveys were conducted by swimming in a zigzag pattern in a belt fronting the Resort Condominiums from the shoreline across the reef to a water depth of approximately 30 feet. These surveys covered a corridor approximately 100 m wide centered on the transect line used for water chemistry sampling. During these underwater investigations, notes on species composition were recorded, and numerous digital photographs recorded the existing conditions of the area. The baseline assessment was conducted by S. Dollar, accompanied by D. Rice and C. Andrews.

III. RESULTS

A. Water Quality/Chemistry

1. Distribution of Chemical Constituents

Tables 1 and 2 show results of all water chemistry analyses on samples collected off the Hololani Resort Condominiums in August 2010. Table 1 shows concentrations of dissolved nutrients in micromolar (µM) units; Table 2 shows concentrations in micrograms per liter (µg/L). Concentrations of eight dissolved nutrient constituents in surface and deep samples are plotted as functions of distance from the shoreline in Figure 2. Values of salinity, Chl *a* and turbidity as functions of distance from shore are shown in Figure 3.

Several patterns of distribution are evident in Tables 1 and 2 and Figures 2 and 3. It can be seen in Figure 2 that the dissolved nutrients Si and NO_3^- display distinctly elevated concentrations in the samples collected within 25 m from the shoreline. Salinity displays the opposite trend, with sharply lower concentrations in the nearshore samples (Figure 3). Beyond 50 m from the shoreline, concentrations of NO_3^- are essentially constant, while concentrations of Si gradually decrease, and salinity increases (Figures 2 and 3). Over the entire sampling range, the gradient in NO_3^- is about 65 μM (910 μg/L), while salinity changes by approximately 0.8 ppt.

As there are were no streams discharging to the ocean in the vicinity of the Hololani Resort Condominiums during the sampling, the horizontal gradients of Si, NO_3^- and salinity reflect input of groundwater to the ocean near the shoreline. Low salinity groundwater, which typically contains high concentrations of Si and NO_3^-, percolates to the ocean at the shoreline, resulting in a nearshore zone of mixing. In many areas of the Hawaiian Islands, such groundwater percolation results in steep horizontal gradients of increasing salinity and decreasing nutrients with increasing distance from shore, as is evident at the Hololani study site in West Maui. PO_4^{3-} is also generally elevated in groundwater relative to ocean water. However, in the data set collected off the Hololani, there is no consistent gradient in concentration of PO_4^{3-} with respect to distance from the shoreline (Figure 2). Horizontal gradients of TN and TP reflect the patterns of NO_3^- and PO_4^{3-}, respectively.

As the sampling site off the Hololani Resort is an open coastal area exposed to wind and wave, the zone of groundwater-ocean water mixing is small, extending only to distances of several meters from shore. These gradients are far less pronounced than at other areas of West Maui where either semi-enclosed embayments occur or physical mixing processes are less vigorous.

Water chemistry parameters that are not associated with groundwater input (NH_4^+, DON, DOP) do not show sharp gradients of decreasing concentration with respect to distance from the shoreline (Tables 1-2, Figure 2). Rather, NH_4^+ showed a weak horizontal pattern of lower concentrations near the shoreline with higher values at the greatest distances from shore. TON and TOP show no distinct gradients with respect to distance from the shoreline. Such patterns indicate that the concentrations of these organic chemical constituents are not a result of input of materials emanating from land.

Similar to the patterns of dissolved inorganic nutrients (Si and NO_3^-), the distributions of Chl *a* and turbidity also display peaks near the shoreline, with rapidly diminishing values seaward of the shoreline (Tables 1-2, Figure 3. Overall, values of Chlorophyll *a* are considered low with all values below 0.16 μg/L (Figure 3). The progressive decrease in values of turbidity with distance from shore is likely a response to resuspension of fine-grained particulate material stirred by breaking waves in the nearshore zone. With decreasing wave energy and increasing water depth, turbidity in the water column decreases (Figure 3).

In addition to horizontal gradients extending from the shoreline offshore, vertical gradients through the water column are often encountered. As groundwater has a salinity of essentially zero, it is more buoyant than seawater with a salinity of 35‰. Hence, in areas where mixing processes are not sufficient to homogenize the water column, surface layers of low-salinity, high-nutrient water are often found overlying layers of higher salinity, lower nutrient water. Inspection of Figure 2 indicates that there was distinct vertical stratification of nutrient concentrations off the Hololani Resort site between distances of 10 to 50 m from shore. Beyond 50 m, the water column was well mixed. Correspondingly, there was a consistent decrease in salinity of surface samples relative to deep samples within the 10-50 m from shore region. Values of turbidity were also slightly higher in all surface samples relative to deep samples at sampling sites 10-50 m from shore, and similar in value at stations farther offshore (Tables 1-2, Figure 3).

2. Compliance with DOH Criteria

Water Quality Standards for that apply to the areas offshore of Hololani Resort Condominiums 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 Hololani shoreline area probably receives less than 3 mgd per mile, dry criteria were used for this evaluation.

It can be seen in Tables 1 and 2 that the only nutrient constituents to exceed State of Hawaii water quality standards are nitrate-nitrogen (NO_3^-) at the sampling stations within 25 m from shore, and turbidity within 10 m from shore. As discussed above, the elevated concentration of NO_3^- near the shoreline is likely a result of mixing of groundwater with ocean water. The elevated concentrations of turbidity are likely a result of resuspension of fine-grained naturally occurring sediment by breaking waves in the nearshore zone. Beyond 50 m from shore, all values of turbidity were well below the standards.

B. Coral Reef Community Structure

1. Physical Structure

Physical composition of the survey area fronting the Hololani Resort Condominiums consists of a sand beach (at least during the present study) that extends through the intertidal area (Figure 4). The shallow nearshore region is composed of a limestone platform covered with sand and rubble (Figure 4). The limestone platform extends approximately 300 feet offshore, beyond which bottom composition consists primarily of a sandy plain that reaches offshore to the limit of the present survey. An important feature of the offshore area fronting the Hololani Resort is that the reef platform is routinely subjected to direct wave impact from northerly swells that break over the entire reef platform.

The baseline survey was conducted during a period of moderate north swell, and waves of 2-3 feet in face height were breaking at about the midpoint of the reef platform. Breaking waves resulted in substantial resuspension of naturally occurring calcium carbonate sand throughout the water column in the nearshore area. Beyond the area of wave break, resuspension of sand decreased markedly.

2. Biotic Community Structure

Composition of the reef communities fronting the Hololani Resort Condominiums property are in direct response to several physical factors. As described above, breaking waves result in concussive forces that prevent settlement and growth of some species, or cause breakage and fragmentation of existing species (primarily corals). In addition, resuspension of sand from wave action also prevents settlement and causes destructive abrasion of corals. These factors associated with wave energy decrease with distance from shore along the limestone reef platform. Coral communities reflect the stresses associated with both the concussive force of wave impacts and the scouring and burying from sand resuspended into the water column. In addition, corals and associated reef organisms require hard bottom for settlement, and area coverage of living corals is a direct function of available hard bottom (as opposed to sand bottom).

For the purposes of this report, coral reef community structure is divided into three zones: the "nearshore algae" zone, "mid-reef algal-coral" zone, and "outer-reef coral" zone. The seaward boundary of the outer-reef coral zone is defined by the termination of the limestone reef platform, beyond which bottom composition consists of a flat, gently sloping sand plain.

a. Nearshore Algae Zone

The physical composition of the nearshore algae zone consists of a pitted and eroded limestone platform of biotic origin covered with a veneer of calcareous sand and rubble. Within a depth range of 1 to 4-5 feet, and within a distance of approximately 50 feet from the shoreline, the limestone platform is devoid of living corals, but rather is covered with dense growth of the invasive red alga *Acanthophora specifera* (Figure 5). While *A. specifera* was by far the dominant alga, several other species of red alga were also noted, primarily *Hypnea musciformis* and *Halymenia formosa* (Figure 6).

b. Mid-reef algal-coral Zone

With slightly increasing depth and distance from shore, dense algal coverage of the bottom persists, although isolated living coral heads begin to occur, primarily on the upper surfaces of rocky projections that are elevated above the limestone platform (Figures 7 and 8). Elevation of the reef surface increases the resiliency of these coral from the effects of sediment scour, and the competitive abilities of these corals is apparently sufficient to prevent them from being completely overgrown by algae. The predominant coral species occurring within the mid-reef area are *Porites lobata* (Figure 7) and *Montipora patula* (Figure 8). Within both the nearshore algal zone and the mid-reef algal-coral zone motile macrobenthos, particularly sea urchins, were extremely scarce, likely as a result of the force of breaking waves which is sufficient to prevent these unattached organisms to remain stable on the reef surface.

c. Outer-reef coral Zone

The seaward boundary of the mid-reef algal-coral zone and the inshore boundary of the outer reef zone is demarcated by the boundary where extensive beds of algae no longer occur, and the bottom consists of either living corals or relatively bare turf-covered limestone (Figures 9-11). This zone extends across the reef platform from a distance of approximately 200 feet from shore to the seaward edge of the reef platform, and spans the depth range of approximately 10 to 25 feet. The primary coral species occurring in the outer reef zone were *Pocillopora meandrina*, commonly called "cauliflower coral" (Figures 9 and 11), *Porites lobata*, commonly called "lobe coral" (Figures 9-11), and *Porites compressa*, commonly called "finger coral" (Figure 10). Many of these colonies were up to several feet in diameter indicating that they are on the order of several decades old. The growth form of *Porites compressa* consists of elongated fingers, which are substantially more delicate and susceptible to breakage compared to the other corals. Hence, *P. compressa* is not found in areas that are routinely subjected to wave energy. The occurrence of large, intact colonies of *P. compressa* in the outer reef zone off of Hololani indicates that the outer reef zone has not sustained wave stress substantial enough to destroy these coral colonies over at least a decadal time interval.

The outer reef zone terminates at a depth of approximately 25 feet in a margin between the limestone platform and sand plain (Figure 12). Seaward of the outer reef margin bottom composition consisted of a flat, gently sloping sand plain. In many areas of West Maui, the sand plains beyond the reef platform are colonized with vast pastures of the calcareous green alga *Halimeda*. No such pastures of *Halimeda* were observed during the present study off of the Hololani area.

Other macro-invertebrates that were observed on the surface of the outer reef were several species of sea urchins (*Echinometra matheai*, *Echinothrix diadema, Tripneustes gratilla,* and *Heterocentrotus mammilatus*) (Figures 9 and 12). None of these urchins were particularly abundant, but were found most commonly on the bare limestone reef platform rather than on living corals. It is well known that these urchins graze on benthic algae, and may be responsible for the absence of dense algae in the outer reef zones where wave energy is not sufficient to remove the urchins from the reef.

Reef fish were low in abundance throughout the study area. The most common, and conspicuous fish were mixed-species of Acanthurids (surgeonfish) occupying mid-water near the outer margin of the reef platform. Green sea turtles (*Chelonia mydas*) are commonly found within the nearshore areas of West Maui. However, no turtles were observed during the present survey, although they undoubtedly occur on the reefs off the Hololani Resort.

IV. DISCUSSION and CONCLUSIONS

The purpose of this assessment is to assemble the information to make valid evaluations of the potential for impact to the marine environment from the proposed beach stabilization fronting the Hololani Resort Condominiums in West Maui, Hawaii. Permanent shore protection will prevent future erosion damage and avoid the recurring efforts at expensive, messy and often ineffective temporary emergency protection measures. The information collected in this study provides the basis to understand some of the important processes that are operating in the nearshore ocean, so as to be able to address any concerns that might be raised in the planning process for the beach stabilization.

Results of this baseline study reveal that the major factor shaping the composition of the marine communities off the project site is the concussive forces associated with breaking surf. Nearshore reef community structure is clearly in response to the degree of wave energy which controls community composition. The documented structure of the algal-coral communities off of the Hololani indicate that within the nearshore area where waves regularly break, the benthic community is dominated by invasive algae, with no corals present. At intermediate distances from shore, corals and algae co-occur. On the outer reef, benthic algae, including invasive species are essentially absent. Such a distinct zonation pattern may be in response to a combination of factors associated with wave energy. At shallower depths, algae can apparently flourish, while corals and motile benthos (sea urchins) are restricted owing to physical damage from concussive forces, and substantial sand scour. Beyond the zones where invasive algae dominates, wave forces are reduced to a level where coral communities can settle and grow, which grazers can proliferate to control algae abundance. The outer reef zones off Hololani are considered in a normal condition relative to other similar Hawaiian ecosystems with typical coral abundance and diversity, and no outward appearance of significant stress.

As corals are long-lived and fixed to the bottom, coral community structure provides an excellent integrator of physical conditions over time-scales of decades to centuries. Hence, the coral communities off Hololani have developed and grown throughout the large fluctuations of seasonal sand dynamics that have re-shaped the beach over the last several decades. As such, large fluctuations in beach structure occurring in the past have not had any apparent negative effects on offshore coral community structure. Thus, it is not likely that the proposed action to stabilize sand on the beach would have any negative effect to existing communities. The only foreseeable change may be if beach stabilization results in a seaward extension of more sand into the intertidal and subtidal areas. As corals do not occur in this region, such a situation does not appear to present any potential for concern as the nearshore is already composed of sand and rubble.

Results of the water quality reconnaissance survey indicate a small component of groundwater entering the ocean near the shoreline. The groundwater input is rapidly mixed to background coastal oceanic values through wave action, and likely only affects the zone presently occupied by dense invasive algae. Turbidity of the water column is peak at the shoreline and decreases steadily with distance from shore as a result of wave resuspension of naturally occurring bottom sediments. None of these factors are likely to be affected to a noticeable extent beyond the range of natural variability by the proposed beach stabilization.

All of these considerations indicate that the proposed shoreline stabilization at the Hololani Resort Condominiums will not have any significant negative or likely even measurable, effect on water quality or marine biota in the coastal ocean offshore of the property.

REFERENCES CITED

Grasshoff, K. 1983. Methods of seawater analysis. Verlag Chemie, Weinheim, 419 pp.

Strickland J. D. H. and T. R. Parsons. 1968. A practical handbook of sea-water analysis. Fisheries Research Bd. of Canada, Bull. 167. 311 p.

FIGURE 1. Aerial photograph of coastal region of west Maui showing location of Hololani Resort Condominiums in white circle. Yellow circles are approximate water sampling locations. Benthic reconnaissance surveys were conducted along a corridor approximately 50 m wide on either side of yellow line from the shoreline to an offshore depth of approximately 25 feet.

TABLE 1. Results of water chemistry analyses from ocean sampling stations off of the Hololani Resort in West Maui, Hawaii. Nutrient concentrations are shown in micromolar (μM) units. Samples were collected on August 15, 2010. See Figure 1 for locations of sampling stations. "S" indicates surface samples; "D" indicates deep sample approximately 0.5 m above the ocean floor. Also shown are DOH WQS for "open coastal waters" under "dry" conditions, "not to exceed more than 10% and 2% of the time" criteria. Shaded values indicate exceedance of DOH "not to exceed more than 10% of the time" criteria and "not to exceed more than2% of the time" criteria.

SAMPLE	DFS	DEPTH	PO_4^{3-}	$NO_3^-+NO_2^-$	NH_4^+	Si	TOP	TON	TP	TN	TURB	SALT	pH	Chl-a	TEMP	Diss. O_2
NUMBER	(m)	(feet)	(μM)	(μM)	(μM)	(μM)	(μM)	(μM)	(μM)	(μM)	(ntu)	(o/oo)	(std. units)	(μg/L)	deg. C	% sat.
1	1-S	1	0.11	4.63	0.07	15.06	0.37	8.65	0.48	13.35	2.58	34.33	8.11	0.16	23.08	109.5
2	5-S	1	0.11	4.92	0.05	14.62	0.31	6.69	0.42	11.66	2.61	34.34	8.10	0.13	23.12	109.4
3S	10-S	1	0.08	3.99	0.02	13.94	0.35	7.09	0.43	11.10	1.50	34.34	8.09	0.12	23.12	109.4
3B	10-D	5	0.15	0.93	0.11	5.87	0.34	6.87	0.49	7.91	0.66	34.83	8.16	0.06	23.12	109.4
4S	25-S	1	0.12	1.22	0.12	6.61	0.36	6.28	0.48	7.62	0.43	34.85	8.17	0.04	23.14	109.4
4B	25-D	8	0.08	0.36	0.11	5.03	0.36	8.17	0.44	8.64	0.34	34.91	8.16	0.02	23.11	109.4
5S	50-S	1	0.07	0.15	0.07	4.81	0.34	6.68	0.41	6.90	0.26	34.87	8.17	0.04	23.09	99.7
5B	50-D	11	0.10	0.15	0.09	3.89	0.35	6.40	0.45	6.64	0.22	34.91	8.17	0.02	23.11	101.9
6S	150-S	1	0.07	0.20	0.08	2.86	0.42	6.77	0.49	7.05	0.17	35.02	8.17	0.02	23.60	103.5
6B	150-D	29	0.17	0.19	0.06	2.70	0.28	6.73	0.45	6.98	0.19	34.98	8.15	0.04	23.55	95.4
7S	300-S	1	0.09	0.01	0.10	1.55	0.37	7.62	0.46	7.73	0.23	35.07	8.21	0.07	23.75	105.3
7B	300-D	46	0.11	0.00	0.09	1.34	0.39	7.12	0.50	7.21	0.12	35.09	8.21	0.07	23.77	103.8
DOH WQS NTE 10% (dry)			-	0.71	0.40				0.87	12.80	0.50	*	**	0.50	***	****
DOH WQS NTE 2% (dry)			-	1.40	0.60				1.40	17.80	1.00	*	**	1.00	***	****

*= Salinity shall not vary more than 10% from natural or seasonal changes considering hydrologic input and oceanographic factors.

**= pH shall not deviate more than 0.5 units from a value of 8.1.

***= Temperature shall not vary more than one degree C. from ambient conditions.

****=Dissolved oxygen shall not be below 75% saturation

ntu= nephelometric turbidity units

bdl = below detection limit

TABLE 2. Results of water chemistry analyses from ocean sampling stations off of the Hololani Resort Condominiums in West Maui, Hawaii. Nutrient concentrations are shown in units of micrograms per liter (µg/L). Samples were collected on August 15, 2010. See Figure 1 for locations of sampling stations. "S" indicates surface samples; "D" indicates deep sample approximately 0.5 m above the ocean floor. Also shown are DOH WQS for "open coastal waters" under "dry" conditions, "not to exceed more than 10% and 2% of the time" criteria. Shaded values indicate exceedance of DOH "not to exceed more than 10% of the time" criteria and "not to exceed more than2% of the time" criteria.

SAMPLE NUMBER	DFS (m)	DEPTH (feet)	PO_4^{3-} (µg/L)	$NO_3^-+NO_2^-$ (µg/L)	NH_4^+ (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	TURB (µg/L)	SALT (o/oo)	pH (std. units)	Chl-a (µg/L)	TEMP deg. C	Diss. O_2 % sat.
1	1-S	1	3.41	64.82	0.98	573.79	11.47	121.10	14.88	186.90	2.58	34.33	8.11	0.16	23.08	109.5
2	5-S	1	3.41	68.88	0.70	557.02	9.61	93.66	13.02	163.24	2.61	34.34	8.10	0.13	23.12	109.4
3S	10-S	1	2.48	55.86	0.28	531.11	10.85	99.26	13.33	155.40	1.50	34.34	8.09	0.12	23.12	109.4
3B	10-D	5	4.65	13.02	1.54	223.65	10.54	96.18	15.19	110.74	0.66	34.83	8.16	0.06	23.12	109.4
4S	25-S	1	3.72	17.08	1.68	251.84	11.16	87.92	14.88	106.68	0.43	34.85	8.17	0.04	23.14	109.4
4B	25-D	8	2.48	5.04	1.54	191.64	11.16	114.38	13.64	120.96	0.34	34.91	8.16	0.02	23.11	109.4
5S	50-S	1	2.17	2.10	0.98	183.26	10.54	93.52	12.71	96.60	0.26	34.87	8.17	0.04	23.09	99.7
5B	50-D	11	3.10	2.10	1.26	148.21	10.85	89.60	13.95	92.96	0.22	34.91	8.17	0.02	23.11	101.9
6S	150-S	1	2.17	2.80	1.12	108.97	13.02	94.78	15.19	98.70	0.17	35.02	8.17	0.02	23.60	103.5
6B	150-D	29	5.27	2.66	0.84	102.87	8.68	94.22	13.95	97.72	0.19	34.98	8.15	0.04	23.55	95.4
7S	300-S	1	2.79	0.14	1.40	59.06	11.47	106.68	14.26	108.22	0.23	35.07	8.21	0.07	23.75	105.3
7B	300-D	46	3.41	0.00	1.26	51.05	12.09	99.68	15.50	100.94	0.12	35.09	8.21	0.07	23.77	103.8
DOH WQS NTE 10% (dry)			-	10.00	5.00				30.00	180.00	0.50	*	**	0.50	***	****
DOH WQS NTE 2% (dry)			-	20.00	9.00				45.00	250.00	1.00	*	**	1.00	***	****

*= Salinity shall not vary more than 10% from natural or seasonal changes considering hydrologic input and oceanographic factors.

**= pH shall not deviate more than 0.5 units from a value of 8.1.

***= Temperature shall not vary more than one degree C. from ambient conditions.

****=Dissolved oxygen shall not be below 75% saturation

ntu= nephelometric turbidity units

bdl = below detection limit

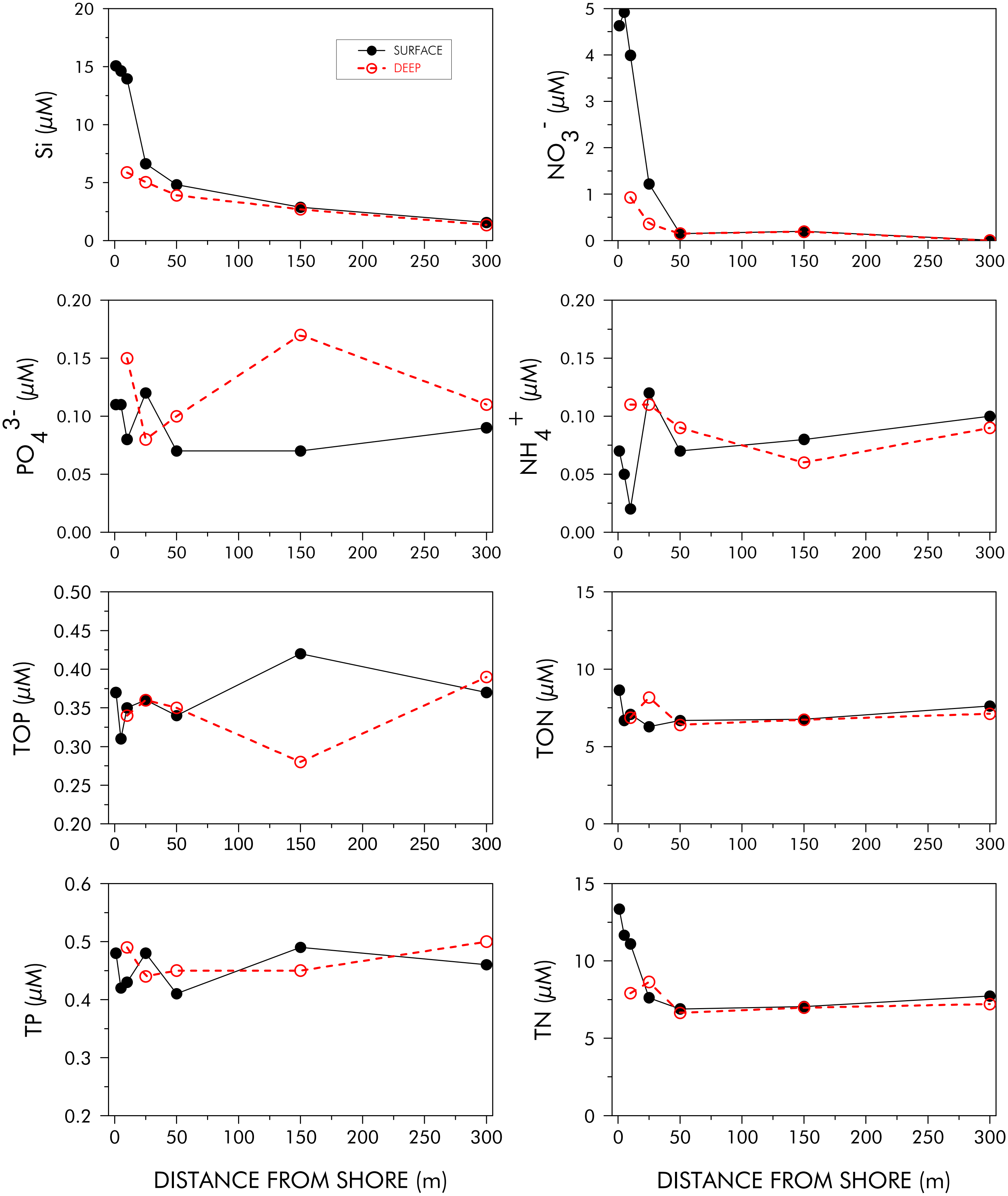


FIGURE 2. Plots of dissolved nutrients in surface (S) and deep (D) samples collected on August 15, 2010 at stations extrending from the shoreline to a distance of 300 m offshore of the Hololani Resort Condominium in West Maui, Hawaii. For sampling site locations, see Figure 1.

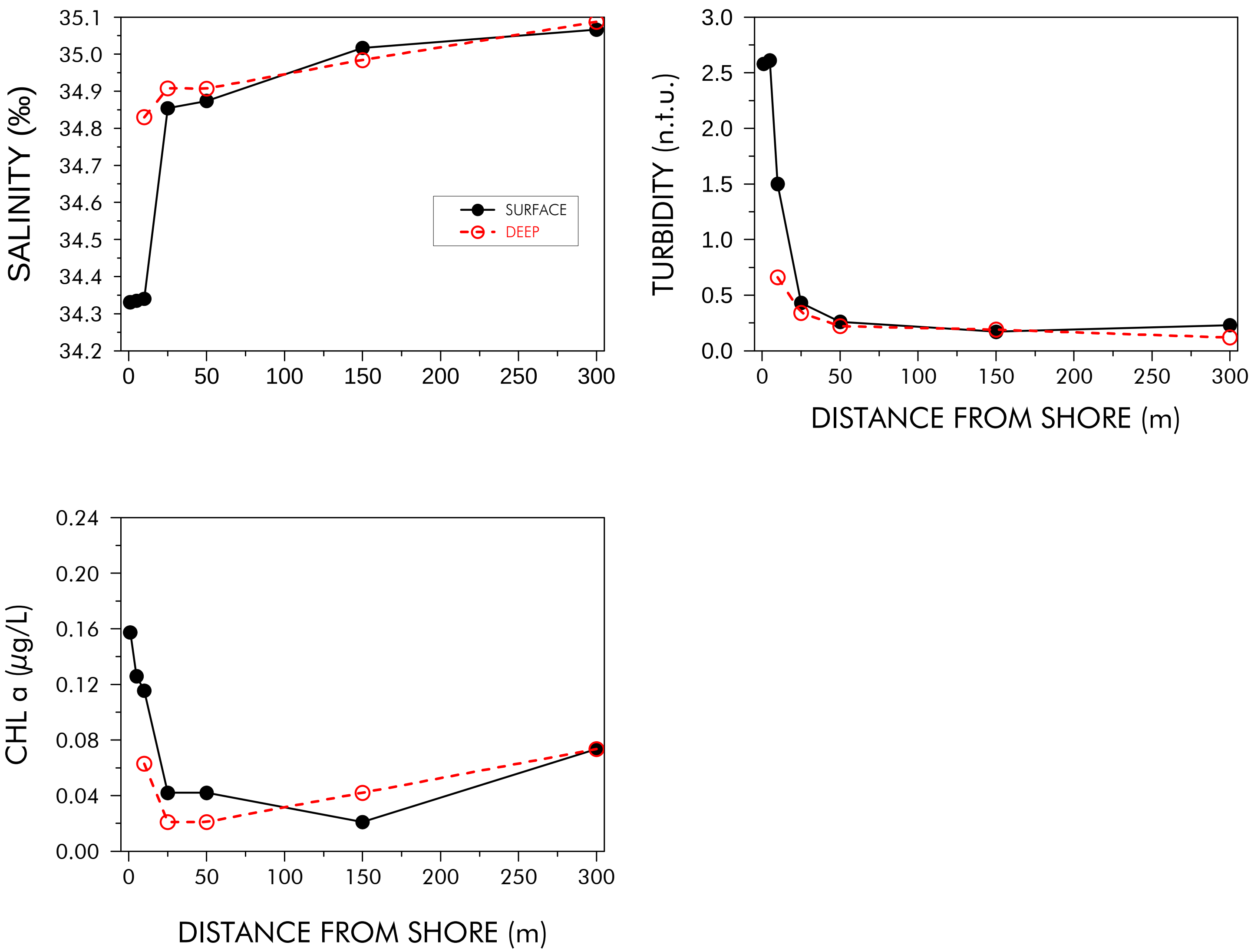


FIGURE 3. Plots of salinity, turbidity and chlorophyll a in surface (S) and deep (D) samples collected on August 15, 2010 at stations along a transect extending from the shoreline to a distance of 300 m offshore of the Hololani Resort Condominium in West Maui, Hawaii.For sampling site locations, see Figure 1.

FIGURE 4. Upper photo shows sand-bags at base of shoreline wall of the Hololani Resort Condominium property. Bottom photo shows sand-rubble bottom in the subtidal zone just off the beach.

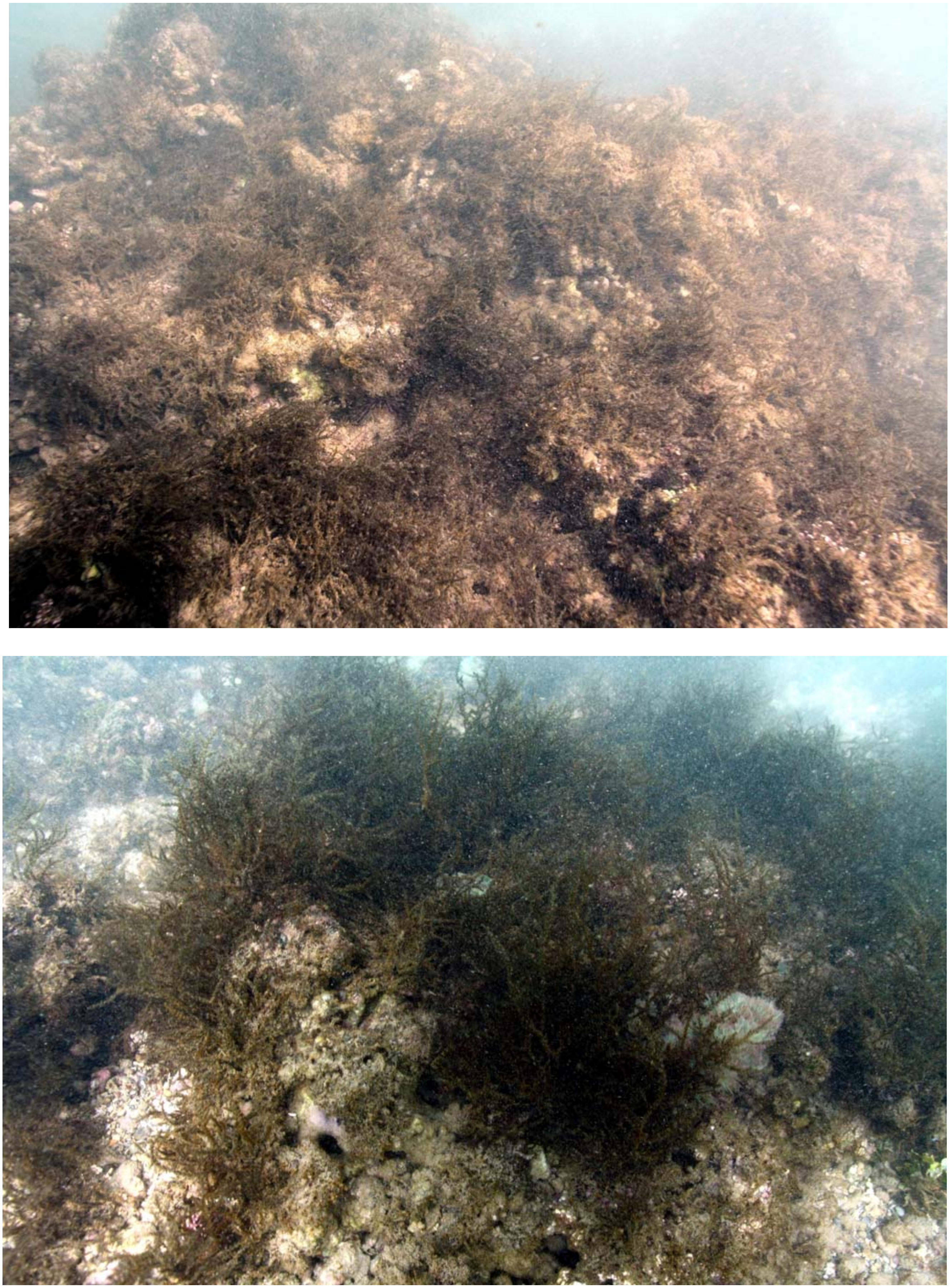


FIGURE 5. Dense growth of red alga *Acanthophora specifera* growing on the limestone reef platform in the nearshore algal zone fronting the Hololani Resort Condominiums, West Maui.

FIGURE 6. Mixed algal communities of red spiny branching alga *Acanthophora specifera*, and red alga *Grateloupia hawaiiana* that has the appearance of translucent pink blades growing on sand and rubble substratum in the nearshore area fronting the Hololani Resort Condominiums. West Maui.

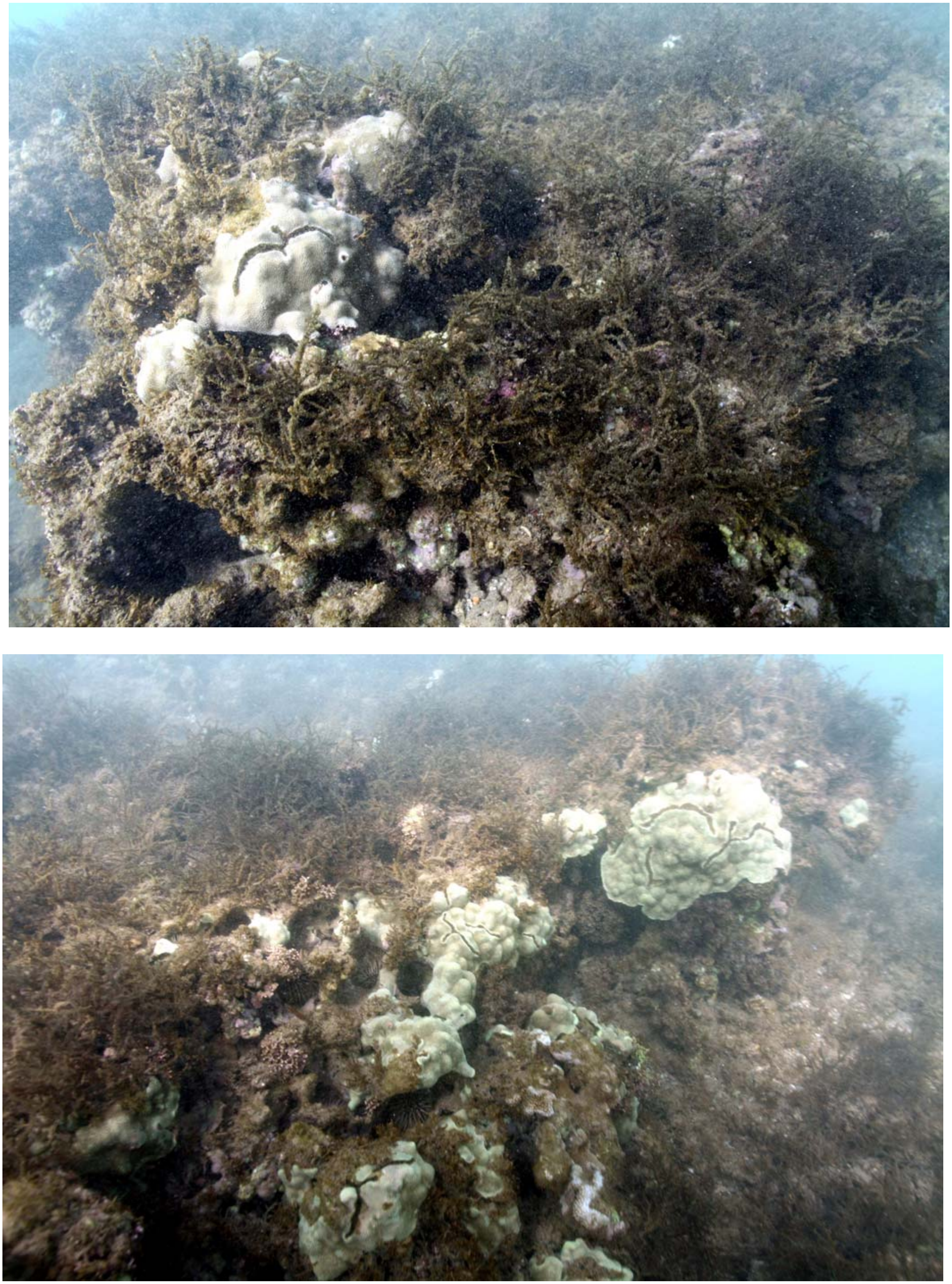


FIGURE 7. Dense growth of red spiny alga *Acanthophora specifera* interspersed with encrusting coral *Porites lobata* growing on limestone substratum in the nearshore area fronting the Hololani Resort Condominiums, West Maui.

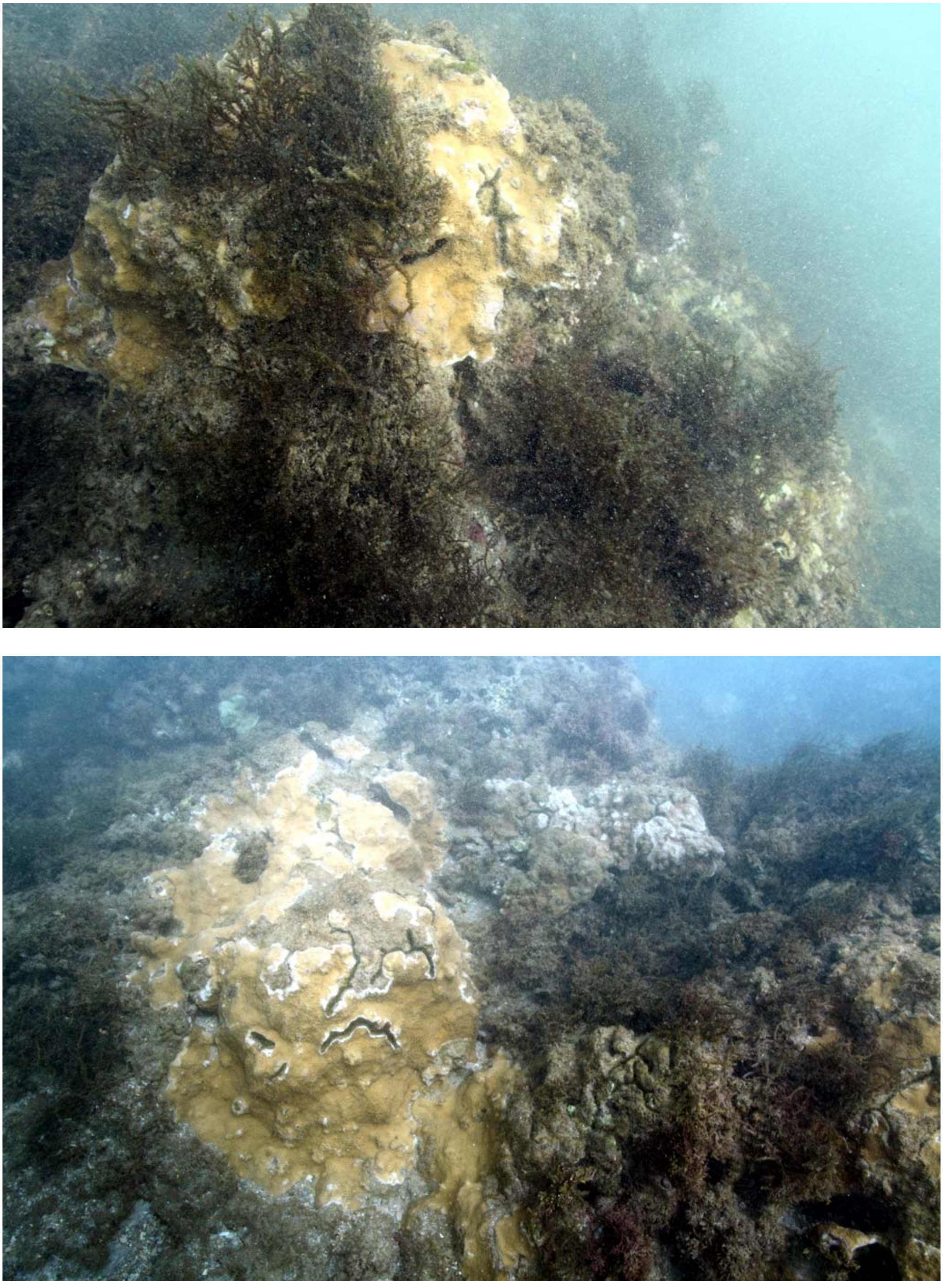


FIGURE 8. Dense growth of red spiny alga *Acanthophora specifera* interspersed with encrusting coral *Montipora patula* growing on limestone substratum in the nearshore area fronting the Hololani Resort Condominiums, West Maui.

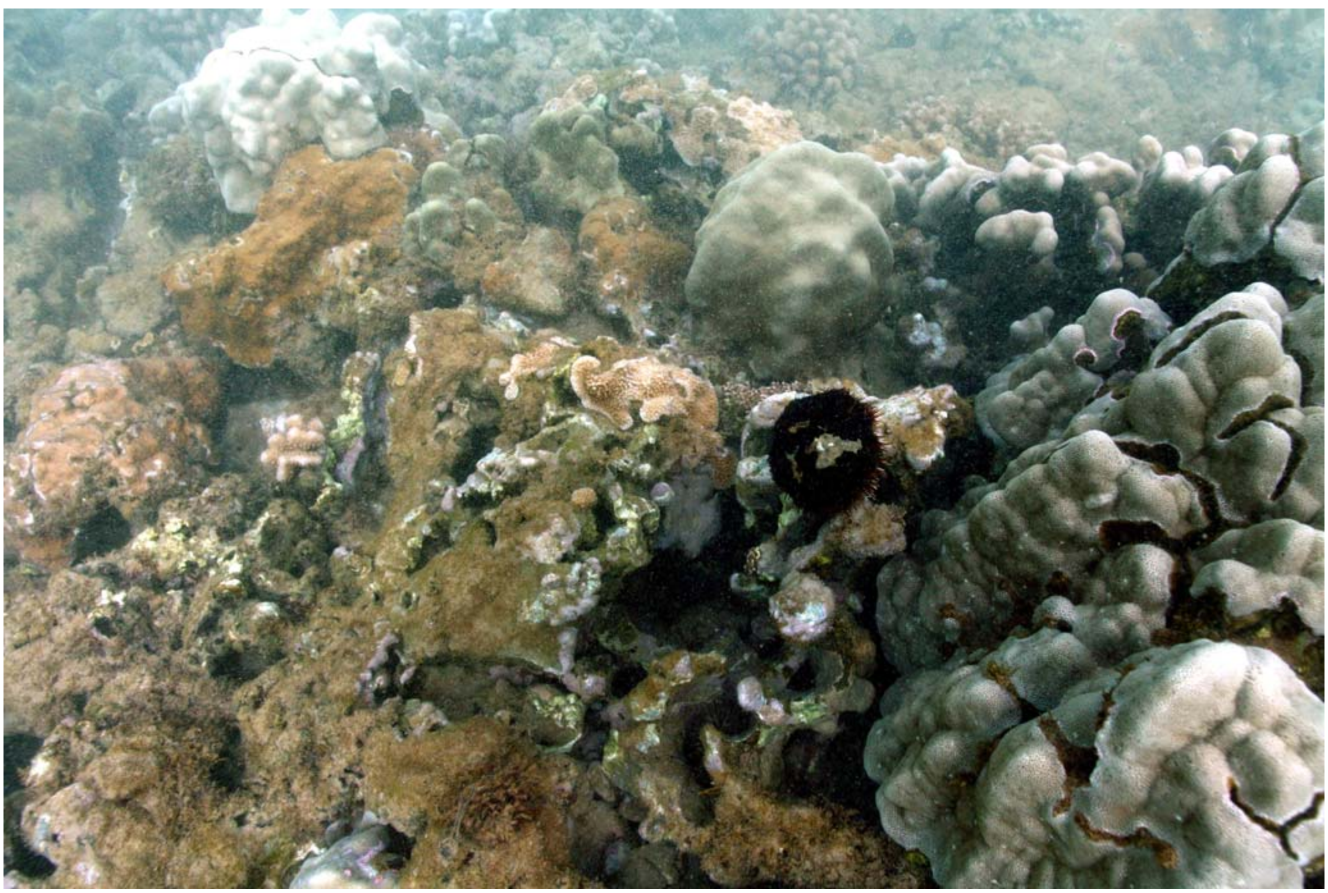


FIGURE 9. Reef corals on limestone platform on outer reef zone fronting the Hololani Resort Condominiums, West Maui. Hemispherical short-branched species in upper photo is *Pocillopora meandrina*. Variegated corals in upper and lower photos are *Porites lobata*. Tan colored encrusting coral in bottom photo is *Montipora patula*. Water depth is approximately 20 feet. Black sea urchin in bottom photo is *Tripneustes gratilla*.

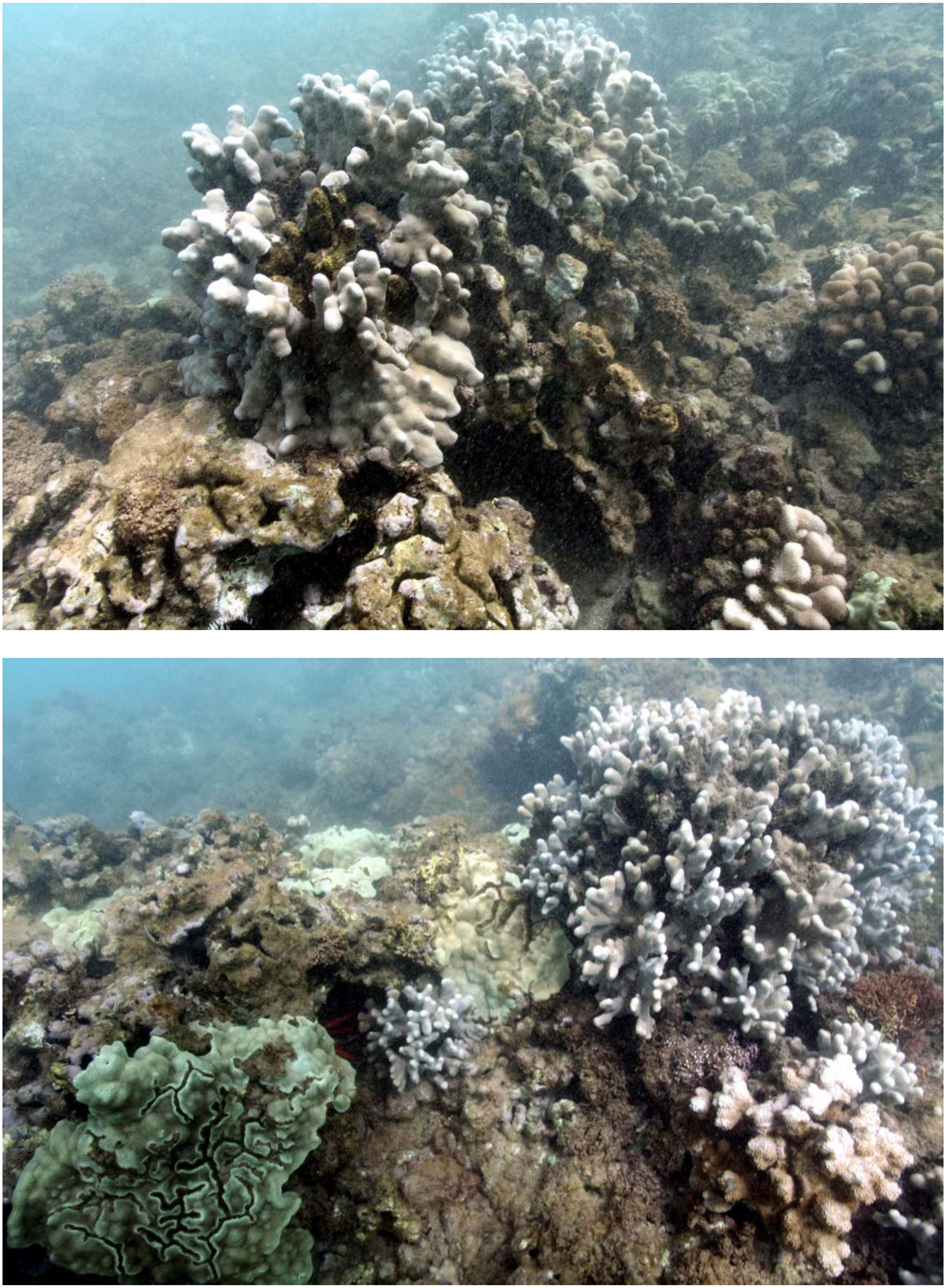
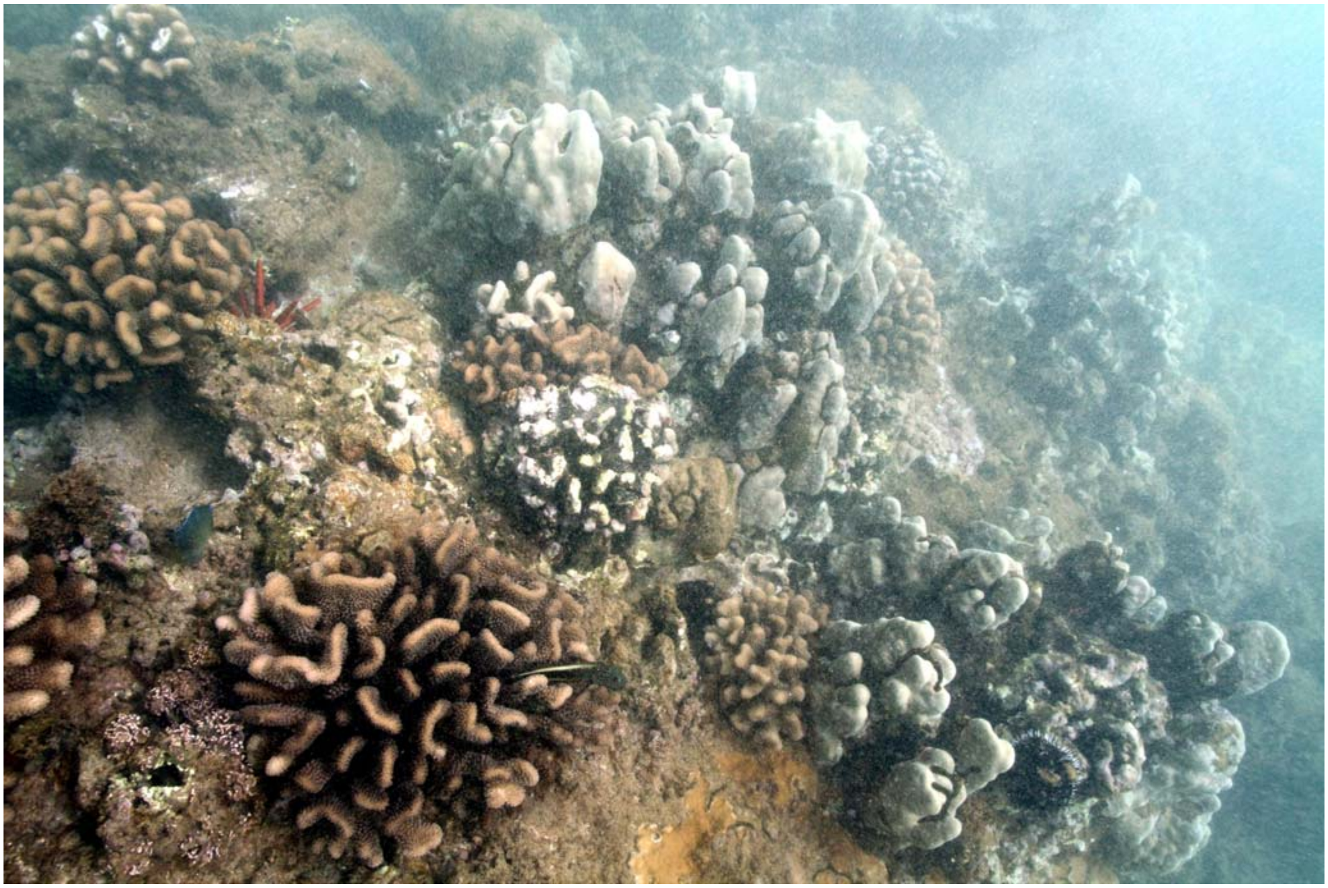


FIGURE 10. Reef corals on limestone platform on outer reef zone fronting the Hololani Resort Condominiums, West Maui. Grey-colored coral with finely branching tips is *Porites compressa*; green variegated coral in lower photo is *Porites lobata*. Water depth is approximately 25 feet.



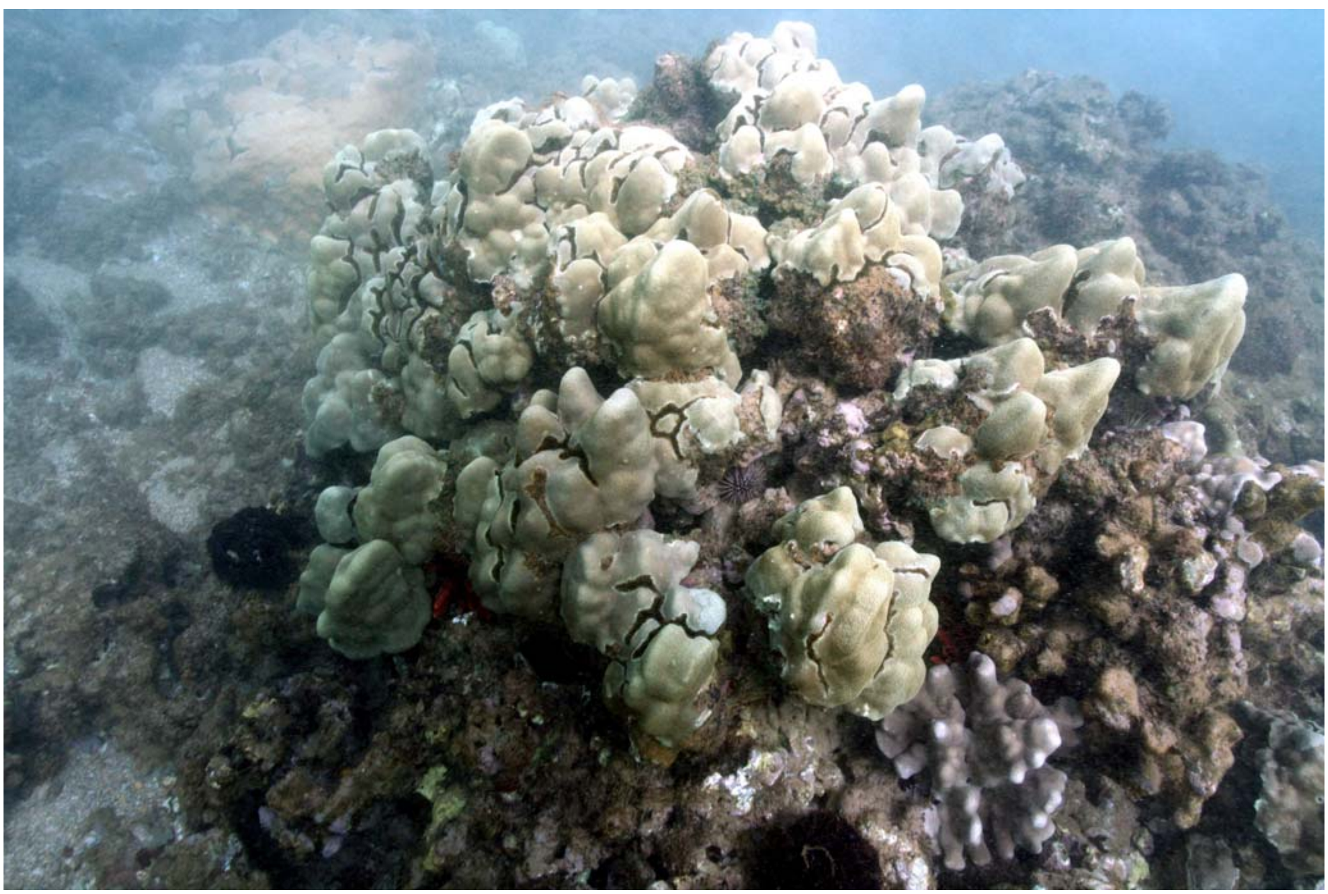


FIGURE 11. Reef corals on limestone platform on outer reef zone fronting the Hololani Resort Condominiums, West Maui. Hemispherical short-branched species in upper photo is *Pocillopora meandrina*. Variegated grey-green corals in upper and lower photos are *Porites lobata*. Water depth is approximately 20 feet.

FIGURE 12. Upper photo shows portion of outer reef platform devoid of corals or algae. Bottom photo shows seaward edge of outer reef platform adjacent to sand plain fronting the Hololani Resort Condominiums, West Maui. Black sea urchins in both photos are *Tripneustes gratilla*. Water depth is approximately 25 feet.