# DRAFT ENVIRONMENTAL ASSESSMENT

## Improvement of Nonconforming Seawall
## &
## Other Improvements within the Shoreline Setback Area

**TMK**
**3-5-003:008**
**3-5-003:009**
**3-5-003:010**

**Kahala, Oahu**

**Prepared by:**
**Plan Pacific, Inc.**

**January, 2006**

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DEPT OF PLANNING
and PERMITTING
CITY & COUNTY OF HONOLULU

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# 1.0 Project Summary

| | |
|---|---|
| **Proposed Action:** | Build support structure for the nonconforming seawall on parcel 10, install fence walls along sides of property, and make various other improvements on parcels 8, 9 & 10 |

**Property:**

| TMK | Street No. | Area (sq.ft.) |
|---|---|---|
| 3-5-003:008 | 4433 Kahala Ave | 38,465 |
| 3-5-003:009 | 4423 Kahala Ave | 40,224 |
| 3-5-003:010 | 4415 Kahala Ave | 37,213 |

| | |
|---|---|
| **Owner/Applicant:** | Barham Trust |
| **Planning & Zoning:** | State Urban District<br>R-7.5 Residential |
| **Special Management Area, Shoreline Setback:** | Located within the SMA and the shoreline area, subject to the 40-foot shoreline setback |
| **Permitting Agency:** | City & County of Honolulu Department of Planning and Permitting |
| **Consulted Agencies:** | City & County of Honolulu Department of Planning and Permitting<br>State Department of Land and Natural Resources |
| **Required Permits:** | Shoreline Setback Variance, Chapter 23, Revised Ordinances of Honolulu (ROH)<br>City & County of Honolulu Building Permit |
| **Chapter 343 Action:** | §343-5(3): Construction within the shoreline area as defined by Chapter 205A-41 |
| **Anticipated Determination:** | Finding of No Significant Impact (FONSI) |

# 2.0 Description of the Proposed Action

## 2.1 Site Description and Background

The project site consists of three shoreline lots within the Special Management Area (SMA) located at 4415, 4423, and 4433 Kahala Ave., Island of Oahu, TMKs 3-5-003:008, 009, and 010. **Figure 1** specifies the location. The properties are zoned R-7.5 Residential, have a total area of 115,902 square feet (sq.ft.), and are owned by the Barham Trust based in Beverly Hills, California. Previously developed individually as three residential properties, the site is currently vacant. The owner plans to construct three new single-family residences. Parcels 9 and 10 will be jointly developed. The applicant is in the process of amending a previously-granted Conditional Use Permit-Minor for joint development.

The shoreline is defined by the seaward edge of three existing nonconforming seawalls. A December 23, 2005 shoreline certification for all three parcels is pending approval of the Department of Land and Natural Resources (DLNR). The seawalls appear to have been constructed independently of each other, probably each to protect a residence. The City Department of Planning and Permitting (DPP) confirmed that the seawalls are nonconforming under the Shoreline Setback regulations (letter dated August 25, 2005; #2005/ELOG-1968(AM)).

The seawall on parcel 10, which is the chief subject of this Environmental Assessment (EA), is 121 feet long and connects to adjacent seawalls at both ends. A small stairway at the west end of the wall provides access to the beach from the parcel. A recent soil investigation found that portions of the existing wall do not extend down to solid substrate and recommended that the seawall be reinforced with an impermeable barrier to minimize future erosion.

Portions of the seawall's footing, totaling approximately 297 $ft^2$, extend past the face of the seawall, i.e. the property line, and encroach upon State owned lands. See Shoreline Survey, **Figure 7**. The encroachment required resolution before the applicant could perform any further activities on the property. On November 18, 2005, the State Board of Land and Natural Resources granted the applicant a 55-year term, non-exclusive easement for the encroaching portions of the seawall, subject to a fee based on appraisal.

In addition to the seawalls, there are various minor structures within the shoreline setback. They include a concrete tile block landing, two concrete pads, two short concrete walkways, two observation decks and a side wall. All structures are remnants of previous dwellings that no longer exist. The applicant proposes to demolish and remove most of the existing structures. See **Figure 4**, Topographic Survey. A temporary chin-link construction fence has been erected and will be removed upon completion of the intended residence.

## 2.2 Technical Characteristics

### 2.2.1 Proposed Seawall Support Structure (Parcel 10)

The applicant is proposing to construct a new support structure inland of the existing seawall to stabilize the wall and prevent undermining and failure.

The existing wall is constructed of concrete rubble masonry (CRM). It spans the shoreline property boundary measuring 6.25-feet above Mean Sea Level (MSL) and 121.04 feet long (see **Figure 5**). Not all the wall extends down to the solid coral ledge, making it susceptible to undermining by high surf and tidal events. Soil erosion mauka of the seawall gives evidence of previous undermining. The eroded area has been filled with course gravel. Lot elevations range from six to eight feet MSL. The seawall extends the length of the seaward property boundary. A set of stairs providing beach access form the property is incorporated in the west end of the wall.

To reinforce the wall and prevent further subsidence, the applicant is proposing to excavate behind the seawall and install a CRM support wall. The new support wall would be situated mauka of the existing seawall wall and then attached to the seawall by forcing lean concrete into a 6-inch void between the two structures. The new support and concrete "glue" would extend to the coral ledge, thereby filling any gaps and preventing further undermining. The new footing would be approximately 36 inches wide at the base and taper to 22 inches at the top. Granular fill would be placed behind the new footing, and finally the existing grade would be reestablished. The new structure will be entirely subterranean.

Not all of the existing seawall will require this type of support. The soils report prepared by Shinsato Engineering, Inc. (Project No. 05-0079, 2005, **Appendix B**) indicates that there are two different situations. Portions of the wall will require the above described support, while other portions are currently supported by a chair-like concrete structure. In this situation, a wedge of lean concrete would be placed under the support to provide additional stability. The structural engineer's drawings, **Figure 5**, provide visual representation of each type of solution. When the site is excavated, the extent of the two conditions will be determined; and the appropriate type of foundation support will be installed.

To prevent destabilization of the existing seawall, soil would be excavated from behind the seawall one section at a time. Excavated soil would be stockpiled onsite, and used to backfill the construction trench after the foundation improvements have been completed. Heavy equipment would be used for excavation, operated entirely landward of the seawall. Because construction would proceed in sections, the project would require only limited dewatering. Wastewater would be retained onsite and would not be discharged into State waters. Five palm trees along the seawall will have to be removed to enable construction of the proposed support structure. Construction is expected to take 4-6 weeks to complete.

### 2.2.2 Various Improvements (Parcels 8, 9, & 10)

In conjunction with building the new residences, the applicant is also proposing various other improvements within the shoreline setback across the three lots. These are shown in **Figure 6** and summarized below.

The topography of the property is generally flat with little to no rise in elevation from the seaward property line to the street. Minimal grading is proposed in the shoreline setback to provide more efficient drainage across the property. The grading will establish an 8-foot MSL elevation at the center of parcel 9 and taper down to a 6-foot elevation at the corners of parcels 8 and 10, so that any run-off will flow to new dry wells. The dry wells will be located at the southwest corner of parcel 10 and at the southeast corner of Parcel 8. They will be 6-feet in diameter and 4-feet deep for a total of 226 cubic feet (cu.ft).

The owner proposes to construct a new CRM (moss rock) fence wall along the western property line of parcel 10 to match the existing fence wall along the eastern property line of parcel 8. At the mauka edge of the shoreline setback, the sideyard walls are proposed to be 7'6" ft. in height, stepping down to 5'0" ft. in height at 13 feet. from the shoreline.

Since there is no documentary evidence to confirm that the shoreline setback portion of the existing parcel 8 sideyard wall is legally nonconforming, the owner requests after-the-fact approval as part of the Shoreline Setback Variance application. The owner also proposes to add a moss rock veneer to the parcel 8 wall, which is of concrete masonry unit (CMU) construction.

On parcel 10, the owner intends to demolish and remove a concrete slab and a concrete block landing located at the southwest corner, within the shoreline setback. The owner also proposes to repair small stairwell incorporated into the seawall.

The stairs incorporated into the seawall on parcel 9 are planned for removal, and the stairwell opening will be filled in with masonry to match the seawall.

On parcel 8, the applicant is proposing to repair the stairs incorporated into the seawall, remove a large concrete pad, remove the observation decks and associated walkways on the west side of the stairs and the southeast corner, and install a 75 $ft^2$ footbath and shower adjacent to the east side of the stairs. The 6-foot tall shower pole will be similar to those found at public beaches and will installed adjacent to the stairs. The footbath/shower will drain into the dry well situated in the corner of the property. A concrete landing at the top of the stairs will be extended to 16'3" in length and 5'4" in width. Please refer to the architect's drawings, **Figure 6**.

The owner also proposes to add trees, shrubs, and other landscaping materials in the shoreline setback.

## 2.3 Economic and Social Characteristics

The proposed project would not create any new employment or increase the resident population of the area. It would provide short-term construction employment and related State tax revenues. The estimated cost provided by Armstrong Builders to improve the seawall is $122,987.61.

### 2.4 Cultural and Historic Characteristics

The residential properties are not currently used for cultural or religious practices. Public access to the shoreline from the public road would not be infringed upon by the proposed project.

### 2.5 Environmental Characteristics

The shoreline of the three lots has been protected with seawalls since the 1960s. They were built in response to coastal erosion. Since then, the coastline of this particular area has experienced continual beach loss. Currently, the majority of the Kahala coastline is hardened by shoreline armoring.

Because of the beach loss, lateral access along the shoreline is limited or restricted during high tide. The presence of seawalls does not foreclose the possibility of future restoration or nourishment activities. The Coastal Engineering Evaluation, **Appendix A**, provides a more detailed discussion of shoreline conditions in Kahala.

The property does not contain threatened or endangered species of plants or animals.

## 3.0 Description of the Affected Environment, Impacts, and Mitigation

### 3.1 Surrounding Area

Kahala is a fully-developed residential community located east of Diamond Head. Zoned R-7.5 Residential, the area is subdivided into residential lots that are developed with single family residences. The area is characterized by warm temperatures and an average annual rainfall of approximately 23.62 inches.

The properties are bounded to the north by Kahala Ave., to the east and west by neighboring residential properties, and to the south by the shoreline. The adjacent properties to the east and west both have nonconforming seawalls built at approximately the same time as the seawalls on the subject lots. The proposed activities will be confined to the subject properties and will have no effect on the surrounding area.

### 3.2 Shoreline and Coastal Processes

According to the Coastal Engineering Evaluation provided by Sea Engineering, Inc. (**Appendix A**), the shoreline fronting the properties is prone to erosion evidenced by the wide area protected by seawalls. The beach itself is characterized by a "near vertical seawall with an elevation just over 6 feet MSL, some form of hard rock adjacent to the wall, a short sandy section less than 50 feet in width, and a wide expanse of limestone reef without appreciable elevation change" (Coastal Engineering Evaluation, January 2006). Very little sand has accumulated makai of the subject lots, consisting of small pockets mostly covered during higher tide events. The reef is characterized as typically -1.5 MSL 50 feet offshore then grading to approximately -2.5 MSL at 200 feet offshore.

Because of its location on the south shore of Oahu, the project area is most affected by southern swell waves and Kona storm waves. Southern swell waves are generated by mid-latitude storms in the southern hemisphere, while Kona storm waves are generated by local storm systems. The wide fringing reef at Kahala typically forces large waves to break far off shore, preventing them from reaching the shoreline. Larger waves reach the shoreline only in high water level conditions.

## 3.3 Soil/Topography

The topography of the property is generally flat with little to no rise in elevation from the seaward property line landward. According to the soils report provided by Shinsato Engineering, Inc. (**Appendix B**), the soils in the subject area are Jaucas sand, 0 to 15 percent slopes (JaC). "The Jaucas series consists of excessively drained, calcareous soils that occur as narrow strips on coastal plains, adjacent to the ocean." The JaC portion of the series is rapidly permeable making runoff very slow to slow. Subsurface borings ranging from 10 to 34.25 feet below existing grade show that the soils consist mostly of sand, gravel, and trace fines.

JaC soils are susceptible to water and wind erosion. Excavation of material on the landward side of parcel 10's seawall will increase the probability that soil will erode via wind or water into the adjacent beach and marine environments, especially during heavy rains and storm events. To mitigate soil erosion, exposed soils will be revegetated as soon as possible after construction has ended.

## 3.4 Water

All work is to take place landward of the shoreline. Thus, there will be no impact to the adjacent marine environment. Precautionary measures in accordance with Best Management Practices (BMP) will be taken to prevent discharge of materials into ocean waters.

## 3.4 Air

Air quality impacts related to the proposed project would include exhaust emission and dust generated by short-term construction activities. These impacts would be minimal because of the relatively small scope of the project. Construction activities will be conducted in accordance with State air pollution control regulations as outlined in Hawaii Administrative Rules (HAR), Chapter 11-60.1-33, Fugitive Dust.

## 3.6 Noise

The use of machinery and heavy equipment would produce a rise in the ambient noise levels of the area. To mitigate the impact of excess noise, work would be confined to normal daylight business hours and would last only to the completion of the project. Construction activities would comply with Hawaii Administrative Rules (HAR) Chapter 11-56, Community Noise Control, as determined by the State of Hawaii, Department of Health.

## 3.7 Flood Hazard

The lots lie within Flood Zones A and X on the Federal Flood Insurance Rate Map (FIRM). Roughly one quarter of the property lies within Zone A which is inundated with water by the 100-year flood, with no base flood elevations determined. Construction within Zone A must conform to the Flood Hazard District regulations of the Land Use Ordinance (LUO). Zone X is determined to be outside the 500-year flood plain. Construction within Zone X is not subject to Flood Hazard District regulations of the LUO.

## 3.8 Flora/Fauna

The three subject lots were fully developed with residential homes. Inspection of the site did not reveal any rare, threatened, or endangered species of plans or animals. Common plants that currently inhabit the property include palms, plumerias, grasses, and shrubs. Animals encountered on the property include various species of small birds.

## 3.9 Historical/Cultural/Archaeological

A letter November 22, 2004 was sent to the State Historic Preservation Division requesting any comments or concerns pertaining to excavation and improvement of the existing seawall. No response has been received implying that subject area does not support any historical or archaeological sites.

The fact that single-family residences were previously constructed and demolished on the subject property confirms the unlikelihood of encountering historical or archeological sites or artifacts. Should subsurface remains, artifacts, or other historical deposits be discovered during excavation activities, all work shall cease and the appropriate agencies and authorities notified.

Proposed activities will have no affect upon public use of the beach or ocean waters.

## 3.10 Recreational

There are two public beach rights-of-way near the subject property. One is two lots to the west of parcel 10, and the second is immediately adjacent to parcel 8 (**Figure 2**). The westerly right-of-way is identified as TMK 3-5-003:039, and the easterly right-of-way is identified as TMK 3-5-003:040. Because of beach loss, lateral access along the shoreline is restricted during high tide. During low tide, there is little to no beach fronting the subject lots or adjacent shoreline lots. The project will not impede public recreation activities or use of the beach. Kahala Beach is typically used by wading fishermen, seaweed collectors and spear fishermen.

## 3.11 Visual Resources

From the shoreline, the 180- degree panoramic view of the ocean extends from Koko Head in the distance to the nearby flanks of Diamond Head. Views landward are constrained by the existing seawalls. Views from and along the shoreline will not be affected by the proposed project. The existing side wall on parcel 8 steps to a reduced height near the shoreline, as will the proposed side wall on parcel 10. The proposed 6-foot-high shower pole on parcel 8 will not be noticeable in relation to the nearby coconut palms. Once construction on the property is completed, the chain-link security fence will be removed and replaced by landscaping. This will greatly improve the appearance of the property from the beach.

## 3.12 Roads and Utilities

Kahala Avenue borders the northern edge of the properties and provides access. Because the proposed activities are located along the side of the property furthest away from Kahala Ave., short-term construction related traffic will have little to no effect on the local traffic conditions. The proposed project is not expected to have any effect on local utilities, including water, sewer, electricity, drainage, solid waste disposal, and communication services.

### 3.13 Public Services

The proposed project will not result in any change in the demand or supply of public services, including law enforcement, fire protection, educational, medical, and recreation facilities.

### 3.14 Summary of Short-Term and Long-Term Impacts

Short-term impacts include temporary elevations in ambient noise during daylight hours, and dust and exhaust from construction activities and machinery. The project will have no long-term impact on recreational, biological, or scenic resources. Nor will the project have any long-term impacts on roads, utilities, or public services.

### 3.15 Adverse Environmental Effects Which Cannot Be Avoided

Installation of the new support structures behind the existing non-conforming seawall on Parcel 10 will prevent further undermining and subsidence of the subject property, and thus further limit the potential movement of sand seaward. The project is not anticipated to have any significant long-term impact on the existing littoral processes along Kahala Beach.

### 3.16 Irreversible and Irretrievable Commitments of Resources

Resources to be committed are limited to rock, other construction materials, and human effort. The project will be funded privately.

## 4.0 Alternatives

The Coastal Engineering Evaluation, prepared by Sea Engineering, Inc. assesses several alternatives. The discussion is summarized below.

### 4.1 No Action

According to the coastal engineering report, "the no action alternative would result in the gradual deterioration of the existing seawall." The existing sinkholes which are evidenced by large depressions adjacent to the seawall would continue to expand and deepen until eventual failure of the wall. If the wall were allowed to fail, large amounts of soil and debris would spill into the nearshore area. Erosion of the property would persist endangering the adjacent properties. High wave events would make erosion particularly severe causing high turbidity.

### 4.2 Beach Nourishment

Because of the general lack of sand at both the shoreline and offshore, the possibility of a beach naturally accreting is unlikely. Sand placed locally on the beach next to the project site would most likely be washed away in the larger regional littoral system. Beach nourishment in the Kahala area is only feasible on a grand scale involving the larger community.

Without large deposits of sand offshore that can be dredged and placed at the shoreline, sand would have to be imported from another source. Fine-grained sand from fossil dunes on the island of Maui is available, but is only appropriate on sheltered beaches. Therefore, beach nourishment is not a practical solution.

### 4.3 Revetment

Properly designed and constructed rock revetments are durable, flexible, and highly resistant to wave damage. A major advantage of a revetment is that the rough porous surface and relatively flat slope tend to absorb wave energy, reduce wave reflection, and promote accretion of sand.

Revetments in Hawaii are typically built with 1.5-2 horizontal to 1 vertical slope. The 6.25 foot MSL, therefore, would require a base width of about 12 feet. To prevent encroachment onto State owned lands, a revetment would have to be inset into the property causing a loss of useable land and difficulty interfacing with adjacent vertical walls.

### 4.4 Sand Bags

Recently, sand bags have been authorized by state and county governments as emergency and temporary solutions to coastal erosion. Sand bags are not an appropriate solution here because they are aesthetically unpleasing, become hazardous when algae growth occurs under repeated inundation, are difficult to fill and place, require a wide footprint, and are susceptible to slashing and other forms of vandalism. Placing bags in front of the existing wall would encroach onto State land.

### 4.5 Seawall Improvement, Preferred Alternative

As properly designed and constructed seawall is a proven durable, stable, low maintenance shore protection method. However, seawalls are narrow, inflexible structures whose suability is dependant upon the stability of their foundations.

Except for beach nourishment, all of the alternatives considered involve hardening of the shoreline. Beach nourishment is a realistic option, but only if undertaken as a joint community effort. If the pattern of coastal erosion persists, sand placed on the beach would likely be washed away requiring additional nourishment in the future. Improvement of the existing seawall is the most practical and least invasive option. Improvement will not change the existing environmental conditions.

## 5.0 Consistency with the Hawaii Coastal Zone Management (CZM) Objectives and Policies

Hawaii Revised Statutes (HRS) Chapter 205A sets forth objectives and policies for coastal zone management in the State of Hawaii, as well as delegating regulatory authority of the Special Management Area (SMA) to the counties. Under SMA regulations, single-family residences and accessory structures are exempt from permit requirements.

Objectives and policies relevant to beaches and shore protection structures include the following (HRS §205A-2):

(b)(1) Provide coastal recreational opportunities accessible to the public by:

(c)(1)(B-i) "protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas" (i.e., sandy beaches); and

(c)(1)(B-iii) "providing and managing adequate public access to and along shorelines with recreational value."

(b)(9) Protect beaches for public use and recreation by:

(c)(9) (B) "prohibiting construction of private erosion-protection seaward of the shoreline..."

Construction of a shore protection structure is a measure of last resort, usually undertaken when progressive coastal erosion threatens to destroy a home or other structure. Typically, the erosion has already consumed a portion of a homeowner's property. A shore protection structure prevents continued erosion of sediments from private property and therefore the further nourishment of the beach adjacent that property. In this specific case, the property has had a shore protection structure for approximately 40 years.

The CZM Act's policy to protect beaches and to prohibit shoreline structures is a statement of general public policy. The Act, however, also recognizes that shore protection is justified in certain circumstances where there is a hardship and therefore provides a variance procedure. Under HRS §205A-46(9), a variance may be granted where shoreline erosion would cause hardship if the shore protection structure were not allowed. In this case, the hardship would occur in the loss of land and use of that land if the shore protection structure were not repaired and maintained. Public natural resources would experience detrimental effects should the existing wall fail.

## 6.0 List of Approvals and Permits Required

The primary land use approval required is a Shoreline Setback Variance. The proposed improvements will be accessory to single-family residences that will be constructed on the three lots. A Building Permit will also be required for construction of the seawall support structure the fence walls, and other small structures.

## 7.0 Determination of Significance

The Department of Health Rules Chapter 11-200-12 provide thirteen "Significance Criteria" for determining if an action will have a significant impact on the environment. This includes all phases of a project, its expected consequences both primary and secondary, its cumulative impact with other projects, and its short and long-term effects. According to the Rules, an action shall be determined to have a significant impact on the environment if it meets any one of the criteria listed below.

1. **Involves an irrevocable commitment to loss or destruction of any natural cultural resources.**

   The proposed construction would not affect littoral processes, nor would it change the pattern of beach erosion along Kahala Beach. The project would not affect public access to the shoreline.

2. **Curtails the range of beneficial uses of the environment.**

   Evidenced by the area's zoning, the subject property is committed to residential development and use. The proposed project will not curtail the existing uses of the privately owned land. The support structure proposed for the seawall on parcel 10 would not affect beach resources inasmuch as it would neither alter the shoreline nor affect lateral access.

3. **Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS; and any revisions thereof and amendments thereto, court decisions, or executive orders.**

   The proposed activities are consistent with the Environmental Policies established in HRS, Chapter 344. The proposed activities would not alter the area's existing natural processes or resources and would not lower the quality of life for Hawaii residents. While the project does not support the guideline of preserving shorelines free of manmade structures, it is consistent with the longstanding history of government decisions approving shore protection structures in Kahala. This statement is supported by the fact that the subject seawall was constructed about 40 years ago and that this entire reach of shoreline is hardened.

4. **Substantially affects the economic or social welfare of the community or state.**

   The proposed project would have no significant effect on the socio-economic welfare of the community or state.

5. **Substantially affects public health.**

   The proposed project will not affect public health.

6. **Involves substantial secondary impacts, such as population changes or effects on public facilities.**

   The subject project does not involve substantial secondary impacts.

7. **Involves a substantial degradation of environmental quality.**

   It is not anticipated that the proposed project would further degrade environmental quality. The proposed seawall support structure is planned to be completely subterranean and will not change the existing natural processes of the area, nor will it result in aesthetic impacts. The rest of the proposed improvements are relatively small in size. In fact, several man-made structures will be removed from within the shoreline setback.

8. **Is individually limited but cumulatively has considerable effect on the environment, or involves a commitment for larger actions.**

The proposed project is individually limited, would itself have an insignificant effect on the environment, and does not involve a commitment for larger actions. The proposed seawall support structure will not increase shore protection structures along Kahala Beach, but simply maintain the status quo. The rest of the proposed structures and activities are small in size and will have no adverse effect on the surrounding environment.

9. **Substantially affect a rare, threatened or endangered species or its habitat.**

There are no rare, threatened, or endangered plants or animal species on the subject property.

10. **Detrimentally affects air or water quality or ambient noise levels.**

Construction may produce temporary impacts to air quality and noise levels. These impacts are short-term and would be negligible. All construction material will be free of contaminants or pollutants. Best Management Practices will be adhered to during construction to prevent debris, petrol products, or other construction-related material from entering coastal waters.

11. **Affects or is likely to suffer damage by being located in an environmentally sensitive area, such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, freshwater, or coastal water.**

The proposed seawall support is expressly designed to preserve residential structures from the effects of coastal erosion and flooding. The additional support to the existing wall will increase protection against storm waves and or tsunami. None of the proposed activities will increase the erosion or flood hazard for the subject property or surrounding properties.

12. **Substantially affects scenic vistas and view planes identified in county or state plans or studies.**

Because the proposed seawall support is subterranean, it would not affect scenic vistas or view planes identified by the county or state. The other proposed improvements are small in size. Planned landscaping improvements will enhance the appearance of the property from the shoreline.

## 13. Requires substantial energy consumption.

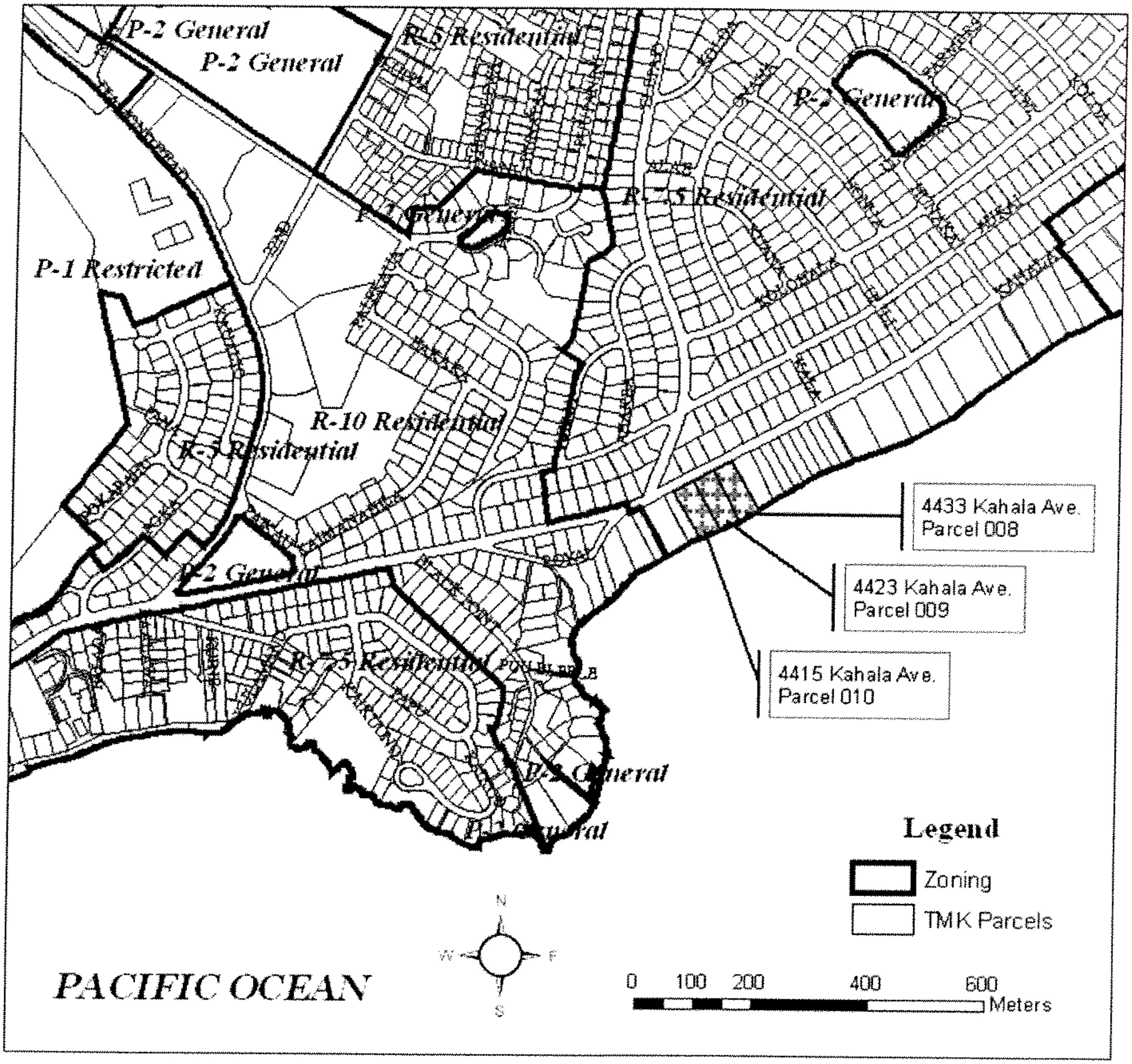
The proposed project and its related construction are relatively small in scale. They do not require any public or private utilities. Energy consumption will be limited to fuel for construction machinery.

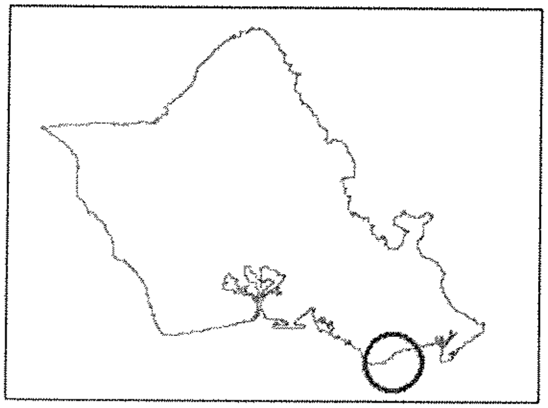
## 8.0 Anticipated Determination

Based on the findings of this Environmental Assessment (EA), it is anticipated that the approving agency will determine that the proposed project will not have a significant environmental impact, and an Environmental Impact Statement (EIS) will not be required.

Therefore, a Finding of No Significant Impact (FONSI) is anticipated.

# Figures





Location and Zoning Map
Tax Map Key: 3-5-003:008, 009, & 010

ArcGIS 9.1
Data provided by Honolulu Land Information System
This map should not be used for any spatial
analysis beyond the limits of the data
Data does not replace site surveys

Figure 1
Location & Zoning

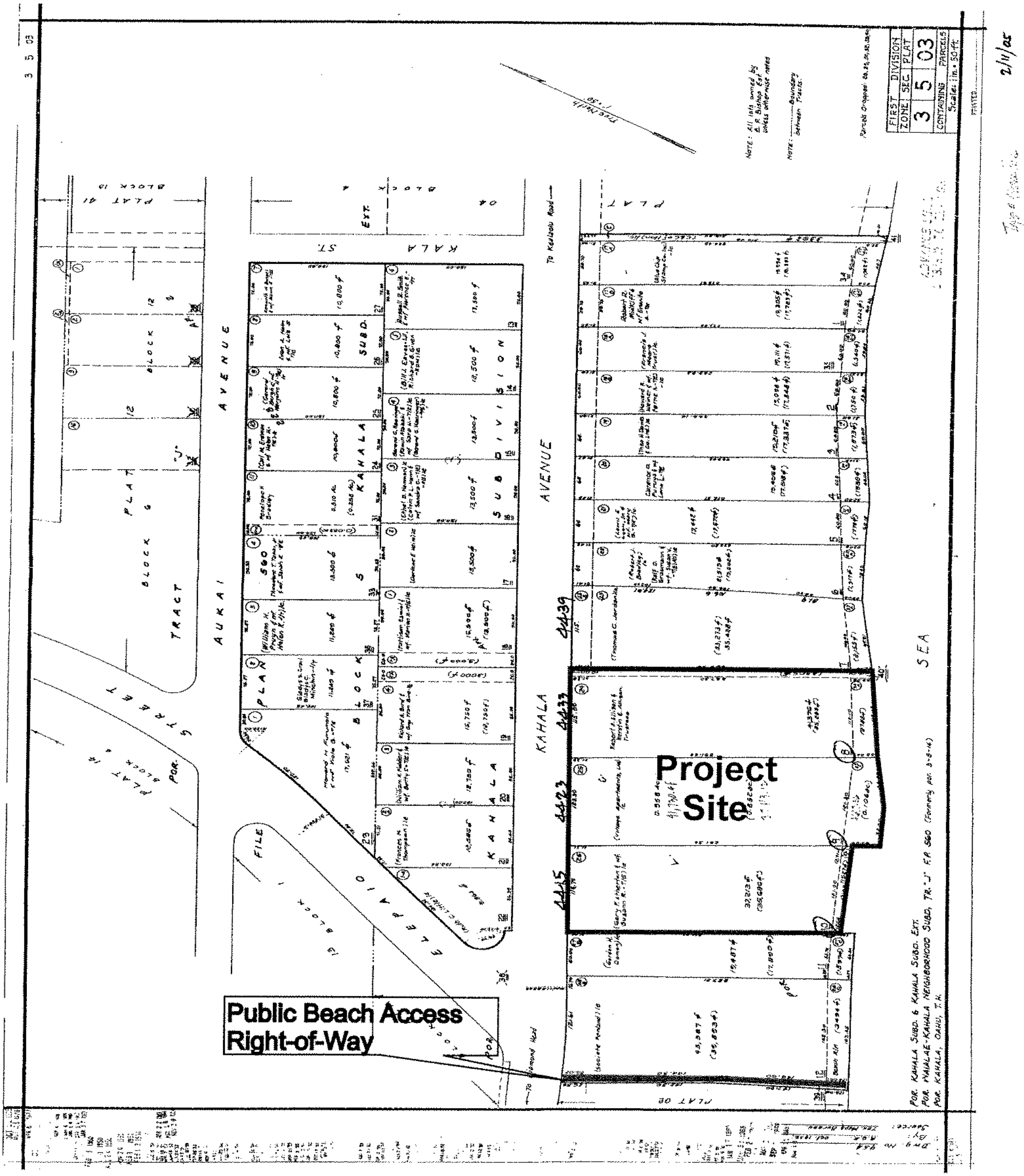


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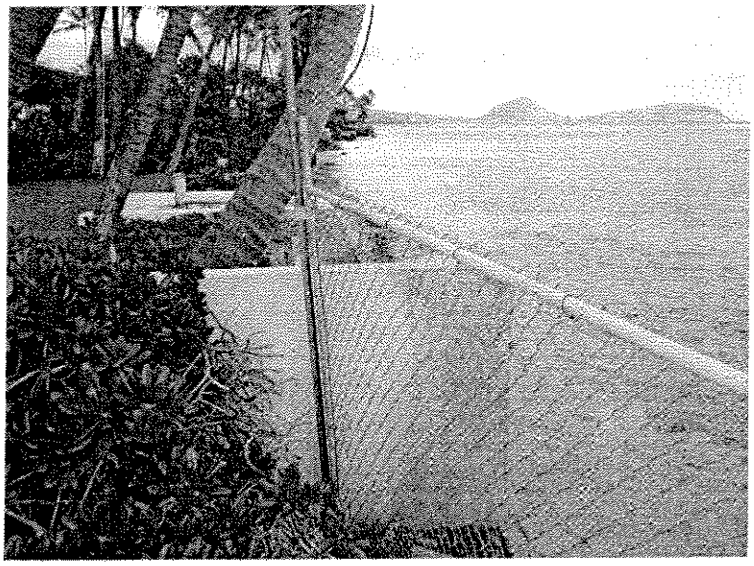
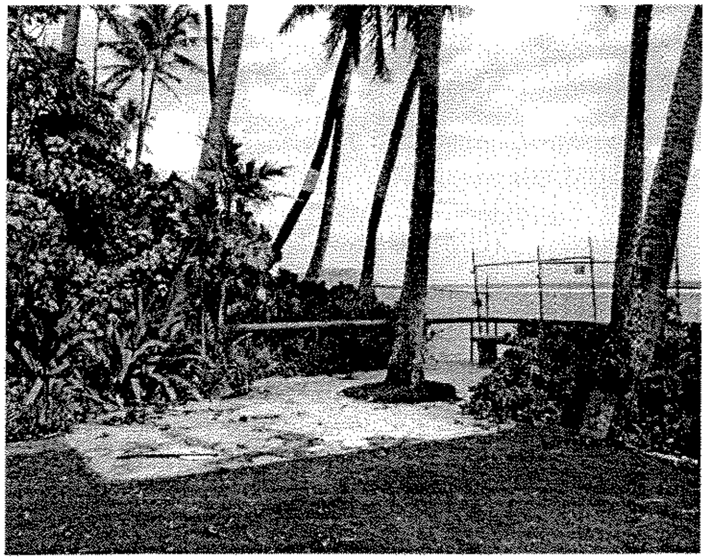
Figure 2
Tax Map Key

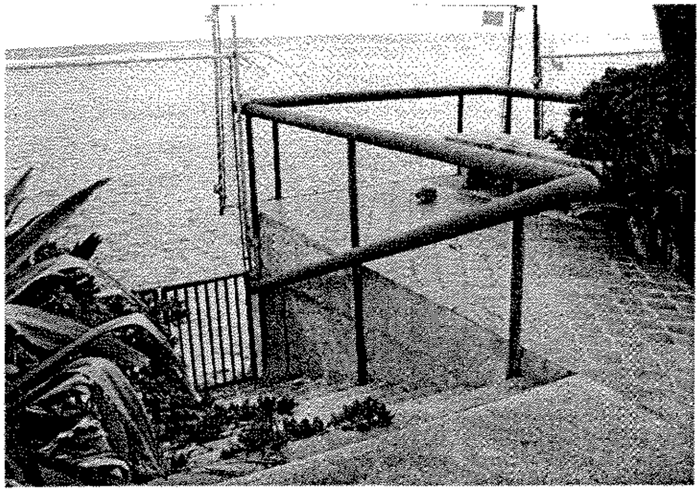


Side Wall: Parcel 8



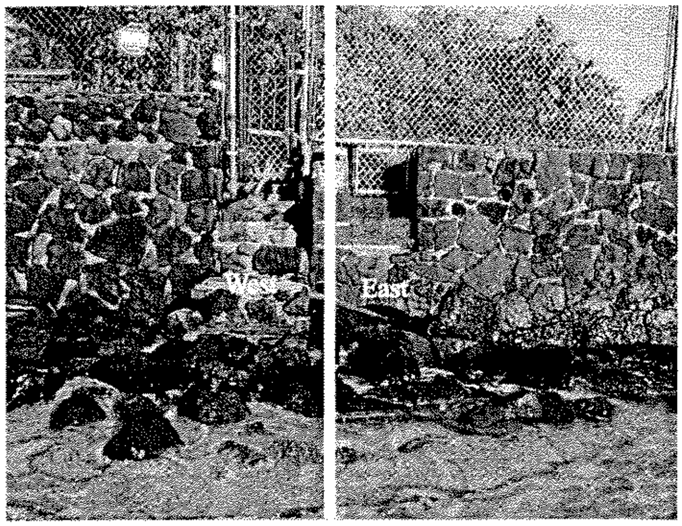
Observation Deck and Walkway: Parcel 8

Second Observation Deck, Walkway and Concrete Pad: Parcel 8



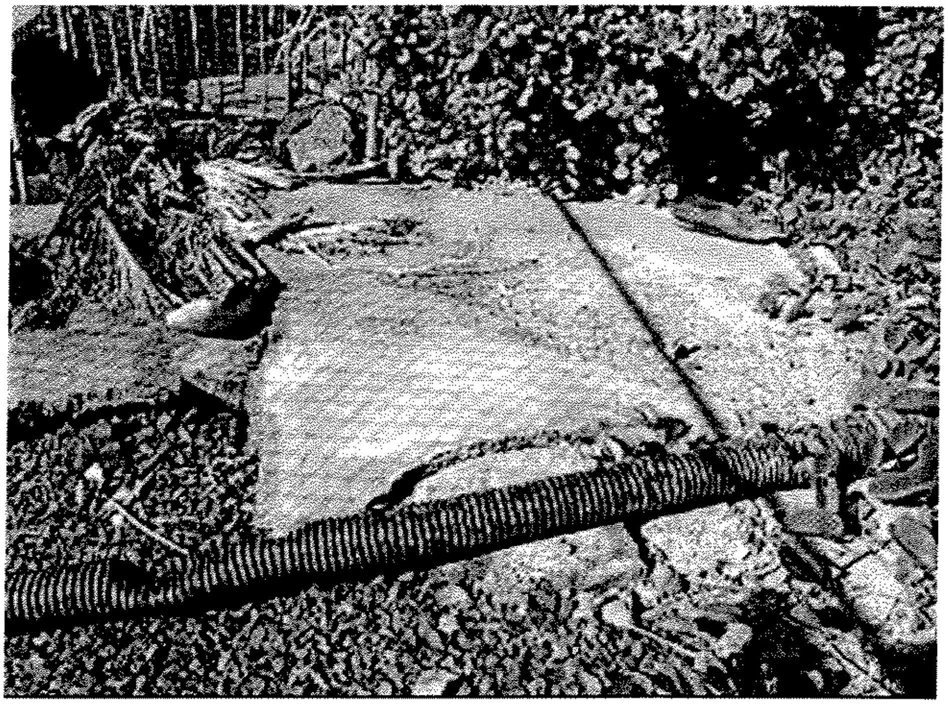
Stairs and Second Observation Deck: Parcel 8

Stairs: Parcel 9



East Set of Stairs to be Repaired: Parcel 10

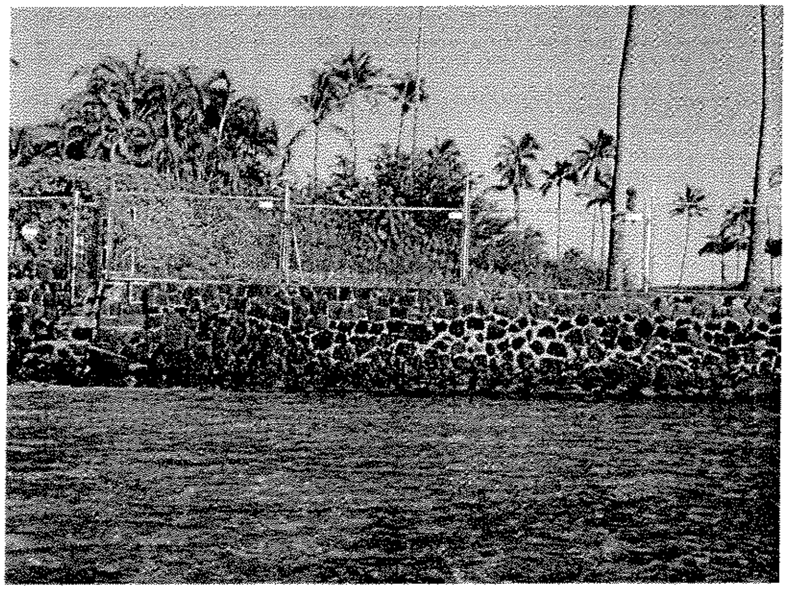
Figure 3
Photos



Concrete Pad: Parcel 10

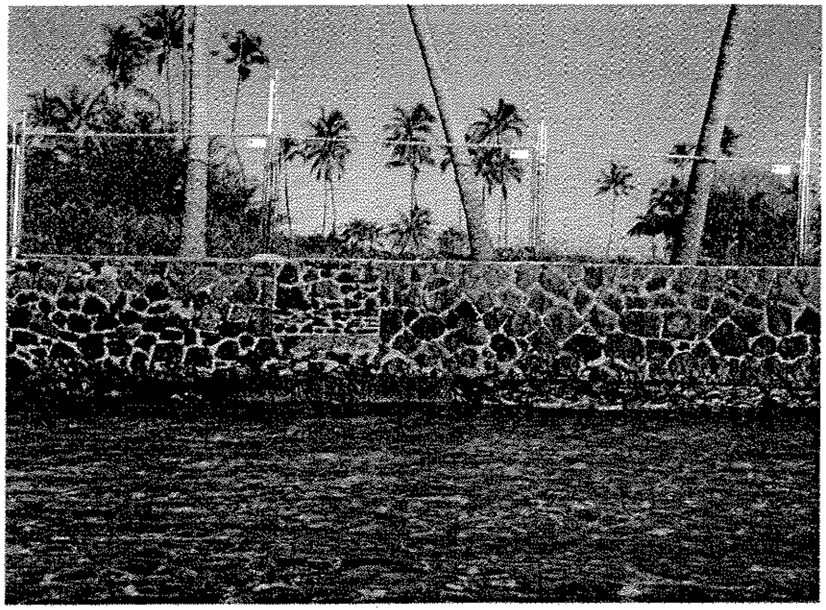
Gravel Fill Behind Seawall: Parcel 10

Figure 3
Photos



Seawall: Parcel 10-West End

Seawall: Parcel 10-Center



Seawall: Parcel 10-East End

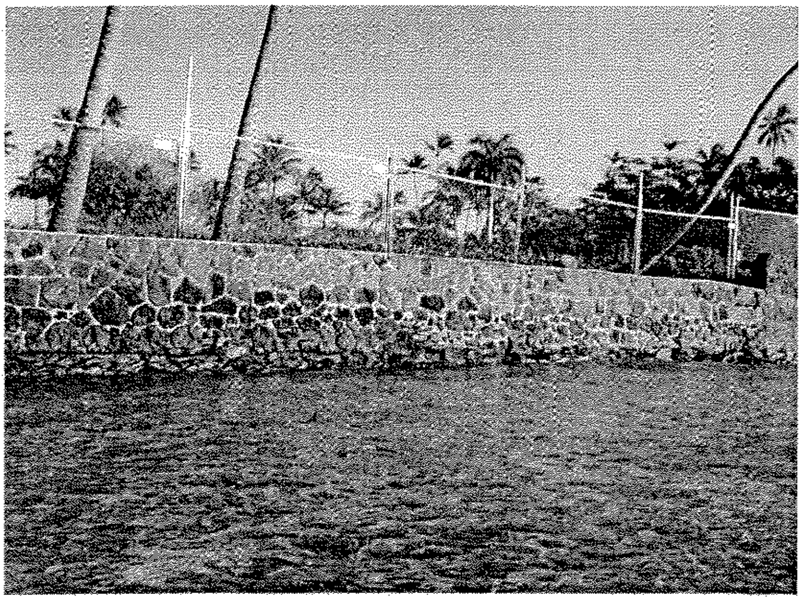


Figure 3
Photos

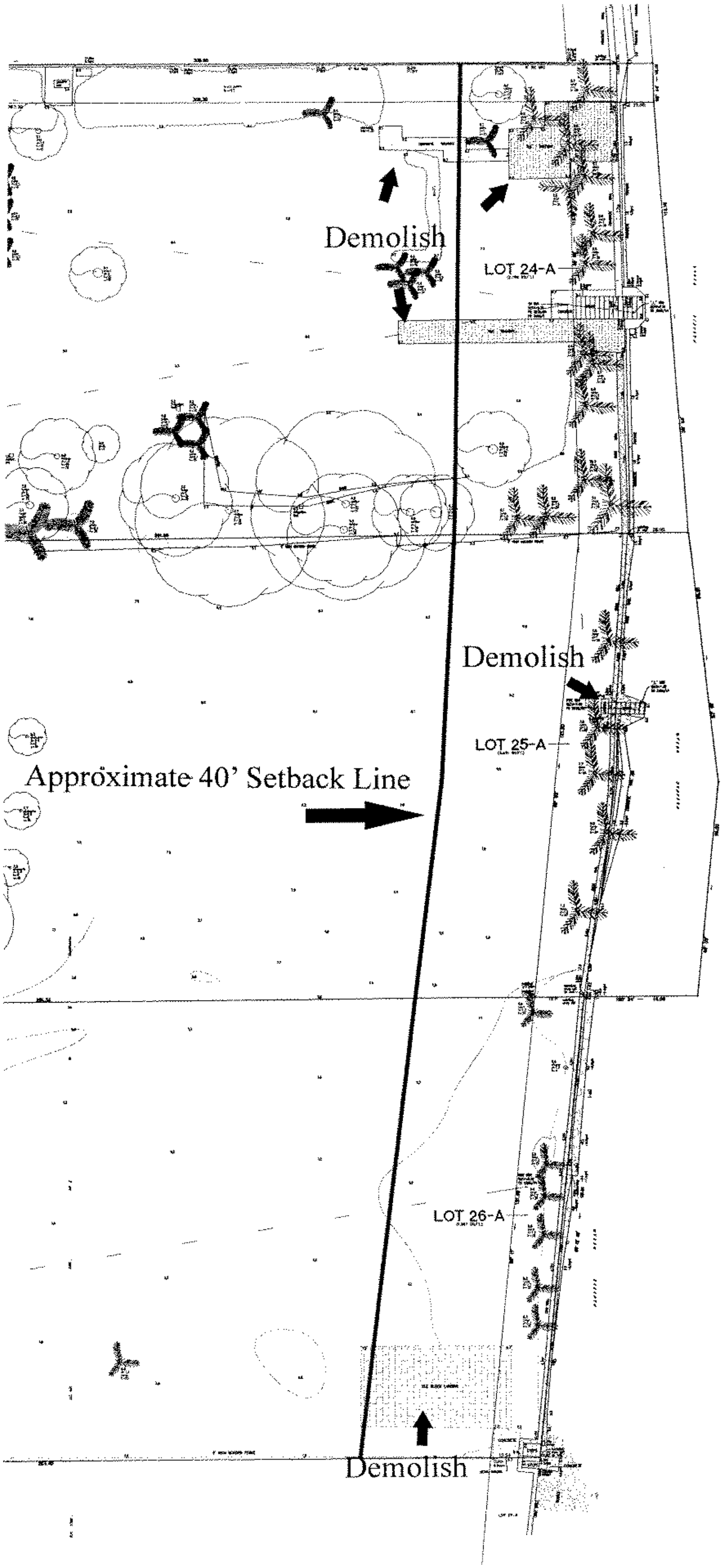
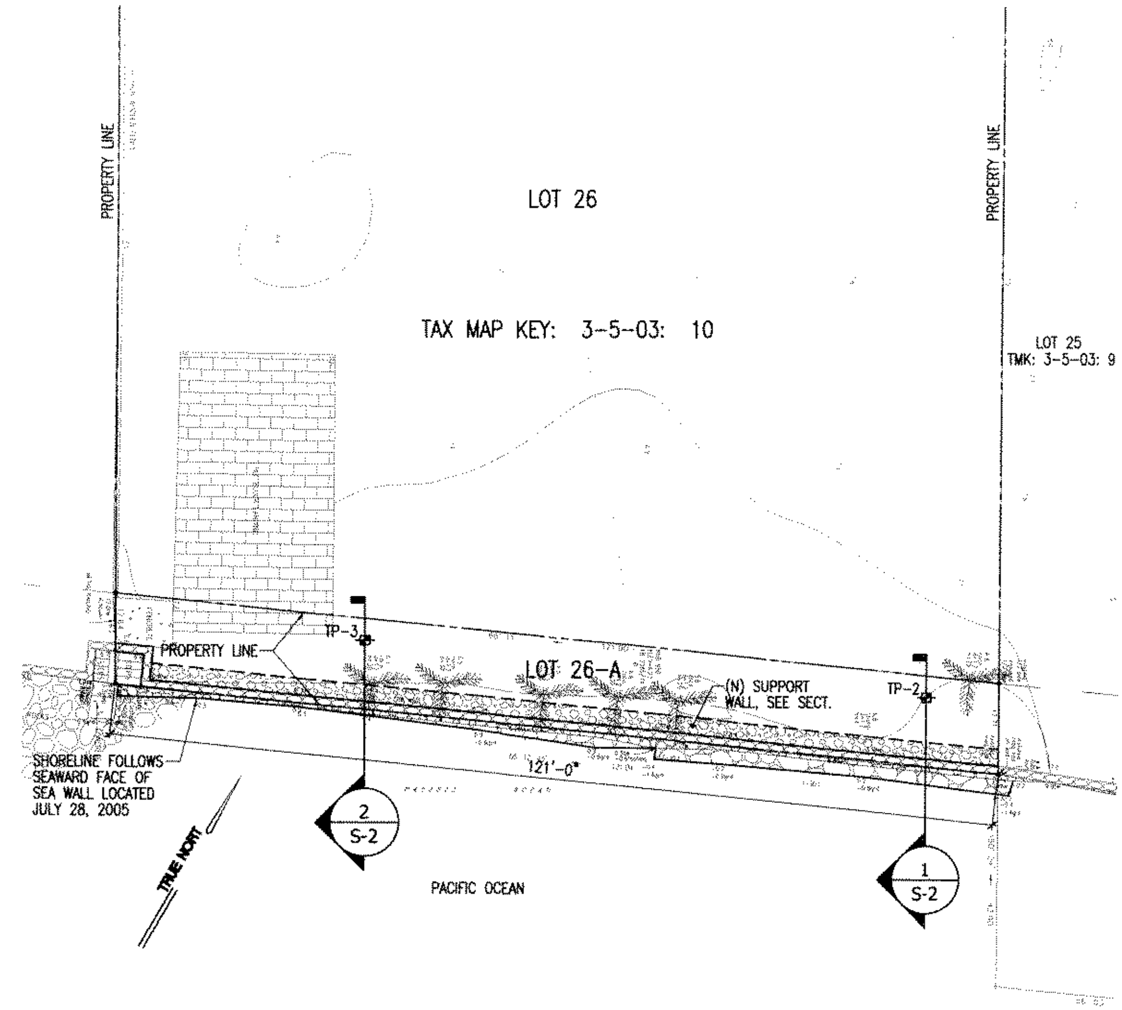
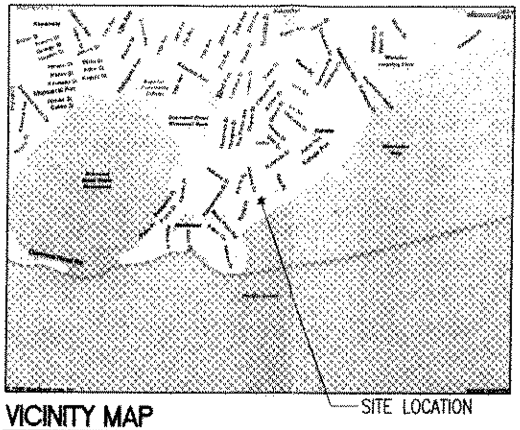


Figure 4
Topographic
Survey



**PLOT PLAN**
NOT TO SCALE



**VICINITY MAP**
NOT TO SCALE

## GENERAL NO

1. ALL MATERIALS AND WORKMANSHIP SHALL CONFORM TO THE DRAWINGS AND SPECIFICATIONS.

AND SPECIFICATIONS REPRESENT THE FINISHED STRUCTURE. THEY DO NOT I

NECESSARY TO PROTECT THE STRUCTURE DURING CONS

T, WIND, SEISMIC, ETC.
OBSERVATION VISITS TO THE SITE BY THE VISITS TO THE SITE STRUCTURAL ENC

3. THE CONTRACT
PROCEDURES INCLUDING LAGGING, SHORING AND PROTECTION OF
ANCE
WITH ALL NATIONAL, STATE AND LOCAL SAFETY ORDINANCES.
NTRACTOR SHALL BE SOLELY RESPONSIBLE FOR COORDINATING

DISCREPANCIES SHALL B

JOHN S. ALLISON
LICENSED PROFESSIONAL ENGINEER
No. 5933-S

John S. Allison
Signature
Expiration Date: 4/30/06
c by me or under my supervision and co
Department of Commerce and Consumer Affairs)

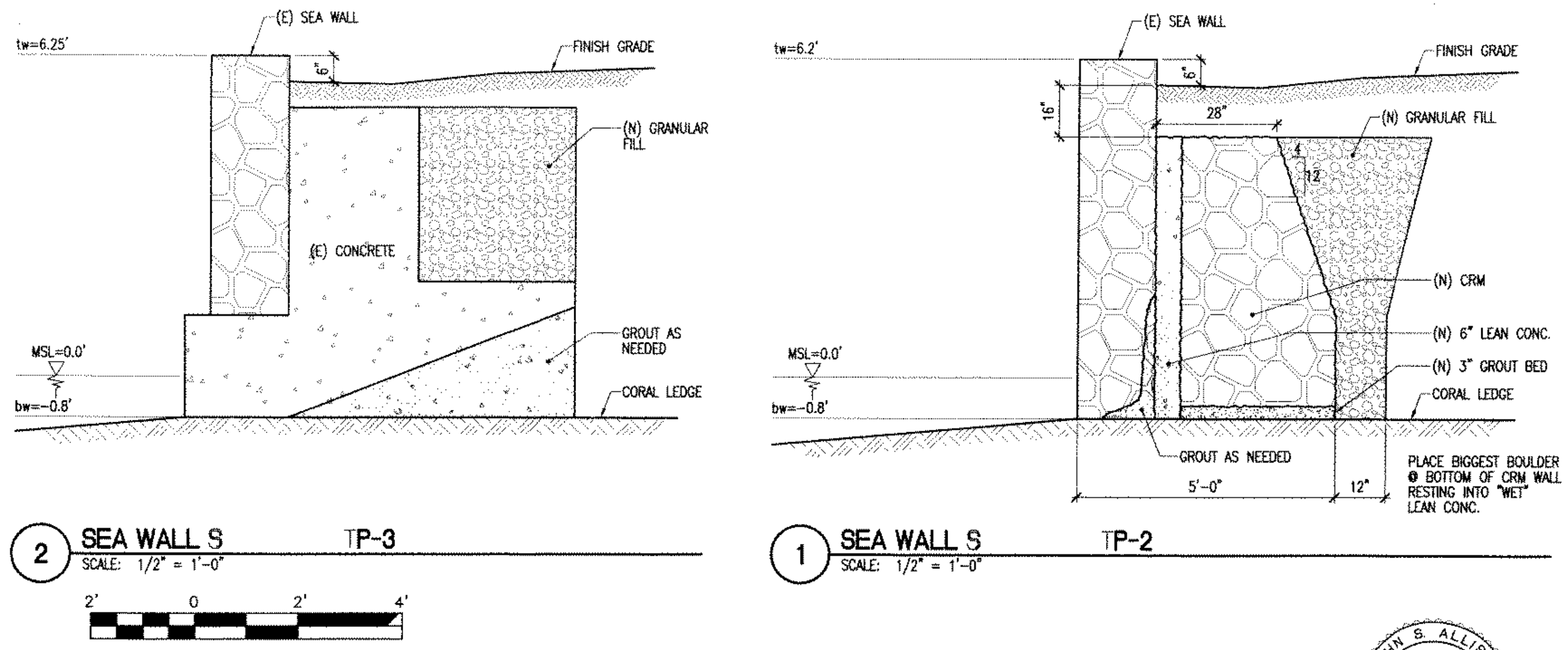
**4433 Kahala Ave. Residence - Sea Wall Repair**
TAX MAP KEY 3-5-003:010

DATE: 5
PROJECT NO:
ENGINEER:

AISE
ALLISON - IDE
STRUCTURAL ENGINEERS LLC

SHEET S-1
1 OF 2

Figure 5
Structural Engineer Drawaing
Note: Not to Scale



**LEGEND**

(E) EXISTING
(N) NEW
(TP) GEOTECHNICAL TEST PIT LOCATION

JOHN S. ALLISON
LICENSED PROFESSIONAL ENGINEER
No. 5933-S
HAWAII, U.S.A.

Signature
Expiration Date: 4/30/06
c by me or under my
supervision and co
Department of Commerce and Consumer Affairs)

DATE: 5
PROJECT NO:
ENGINEER:

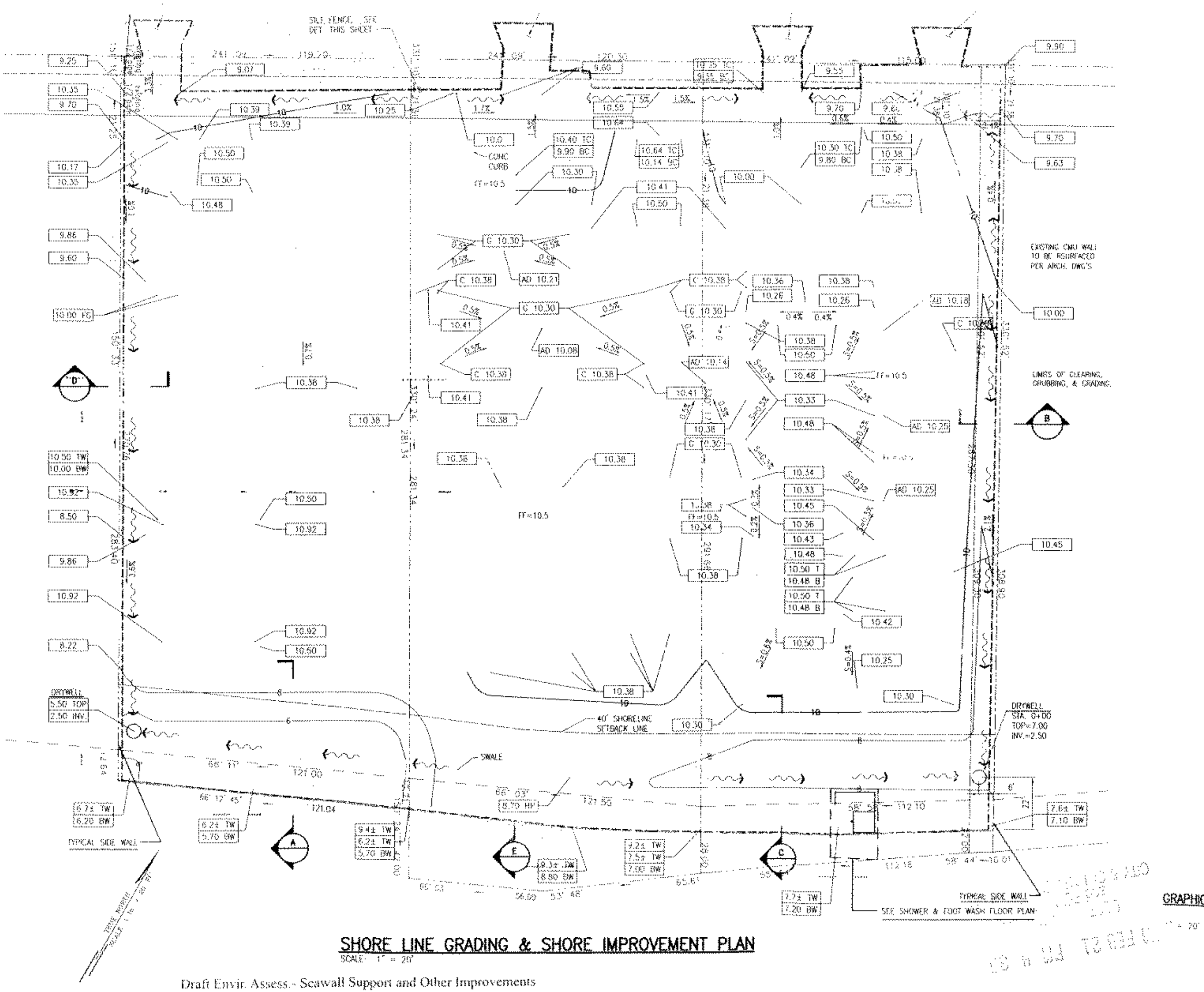
# 4433 Kahala Ave. Residence - Sea Wall Repair
TAX MAP KEY 3-5-003:010

ALLISON - IDE
STRUCTURAL ENGINEERS LLC

SHEET S-2
2 OF 2

Draft Envir. Assess.- Seawall Support and Other Improvements
Kahala, Oahu, TMK: 3-5-003:008, 009, & 010

Figure 5
Structural Engineer Drawaing
Note: Not to Scale



## SHORE LINE GRADING & SHORE IMPROVEMENT PLAN

SCALE: 1" = 20'

Draft Envir. Assess.- Seawall Support and Other Improvements
Kahala, Oahu, TMK: 3-5-003:008, 009, & 010

**LEGEND**

| | |
|---|---|
| 10.40 | SPOT ELEVATION |
| G 10.40 | GROUND ELEVATION |
| C 10.40 | CONCRETE ELEVATION |
| 10.40 TC | TOP OF CURB |
| 9.90 BC | BOTTOM OF CURB |
| ~<~> | SWALE (FLOW DIRECTION) |
| | CONSTRUCTION ENTRANCE |
| --- 8 --- | FINISH GRADE CONTOUR |
| | FENCE |
| | LIMITS OF CLEARING, GRUBBING, & GRADING |

*Architect of Record:*

**PACIFIC ATELIER**
INTERNATIONAL,INC.

*ARCHITECTURE*
*INTERIORS • PLANNING*

*717 Bishop Street, Suite 3655*
*Honolulu, Hawaii 96813*
*Tel.808.533.3688*
*Fax.808.533.3677*
*www.pacificatelier.com*

*Project:*
***4433 KAHALA AVENUE RESIDENCE***

*Address:*
*4433 KAHALA AVENUE*
*HONOLULU, HAWAII 96816*

*REVISION*
*ISSUE:* *DATE:*

*This work was prepared by me or under my supervision.*
*Construction of this project will be under my observation.*

*Engineer's Signature*

*SHEET TITLE:*

***GRADING & EROSION CONTROL PLAN***

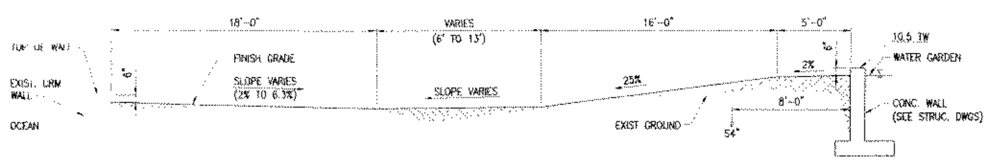
*SHEET NUMBER:*

**1**

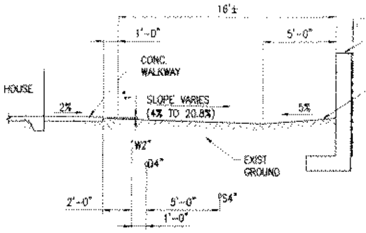
*OF*

*DATE:*

Figure 6
Proposed Improvements
Note: Not to Scale



A SECTION
NOT TO SCALE



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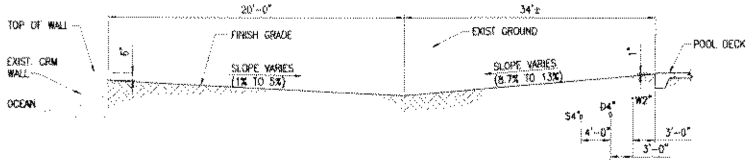
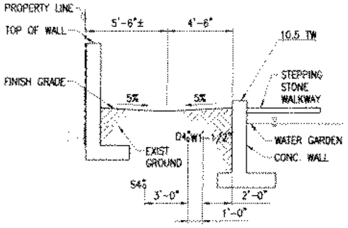
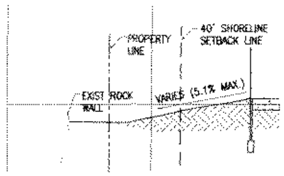


C SECTION
NOT TO SCALE



D SECTION
NOT TO SCALE



E SECTION
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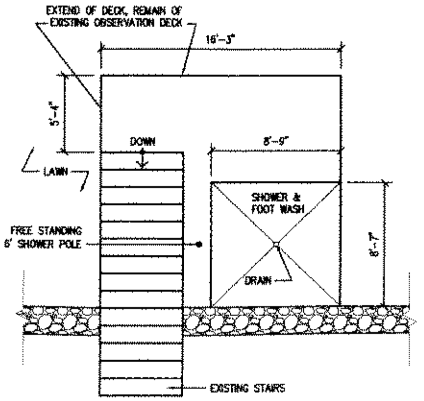
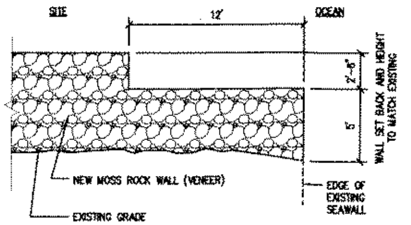


1 SHOWER & FOOT WASH FLOOR PLAN
1/8" = 1'-0"



2 TYPICAL SIDE WALL ELEVATION
1/8" = 1'-0"

Architect of Record:

**PACIFIC ATELIER**
INTERNATIONAL,INC.

ARCHITECTURE
INTERIORS + PLANNING

737 Bishop Street, Suite 1655
Honolulu, Hawaii 96813
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Project:
**4433 KAHALA AVENUE RESIDENCE**

Address:
4433 KAHALA AVENUE
HONOLULU, HAWAII 96816

REVISION
ISSUE: DATE:

This work was prepared by me or under my supervision.
Construction of this project will be under my observation.

Engineer's Signature

SHEET TITLE:
SITE SECTIONS

SHEET NUMBER:
**2**
OF

DATE:

Draft Envir. Assess.- Seawall Support and Other Improvements
Kahala, Oahu, TMK: 3-5-003:008, 009, & 010

Figure 6
Proposed Improvements
Note: Not to Scale

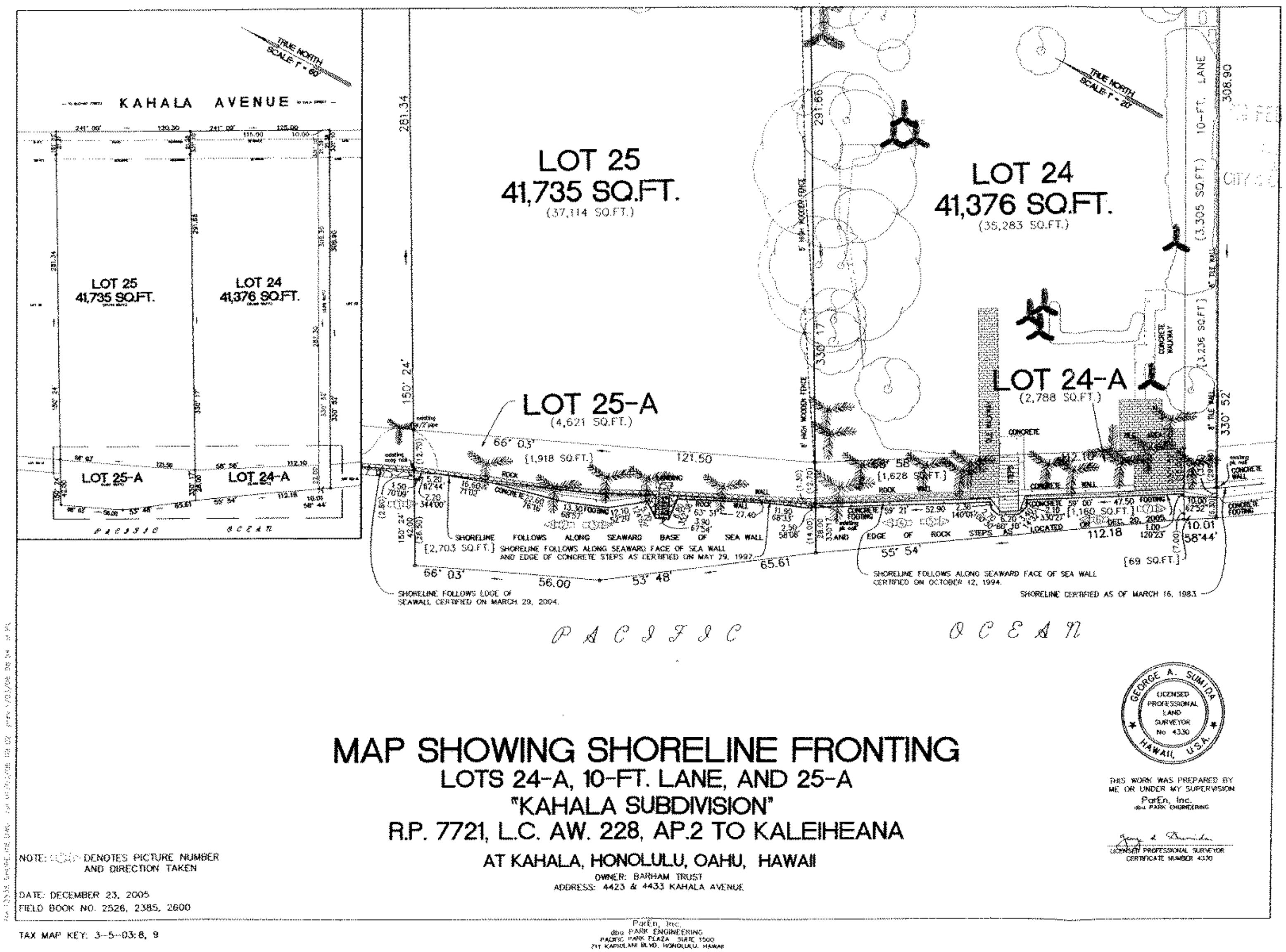
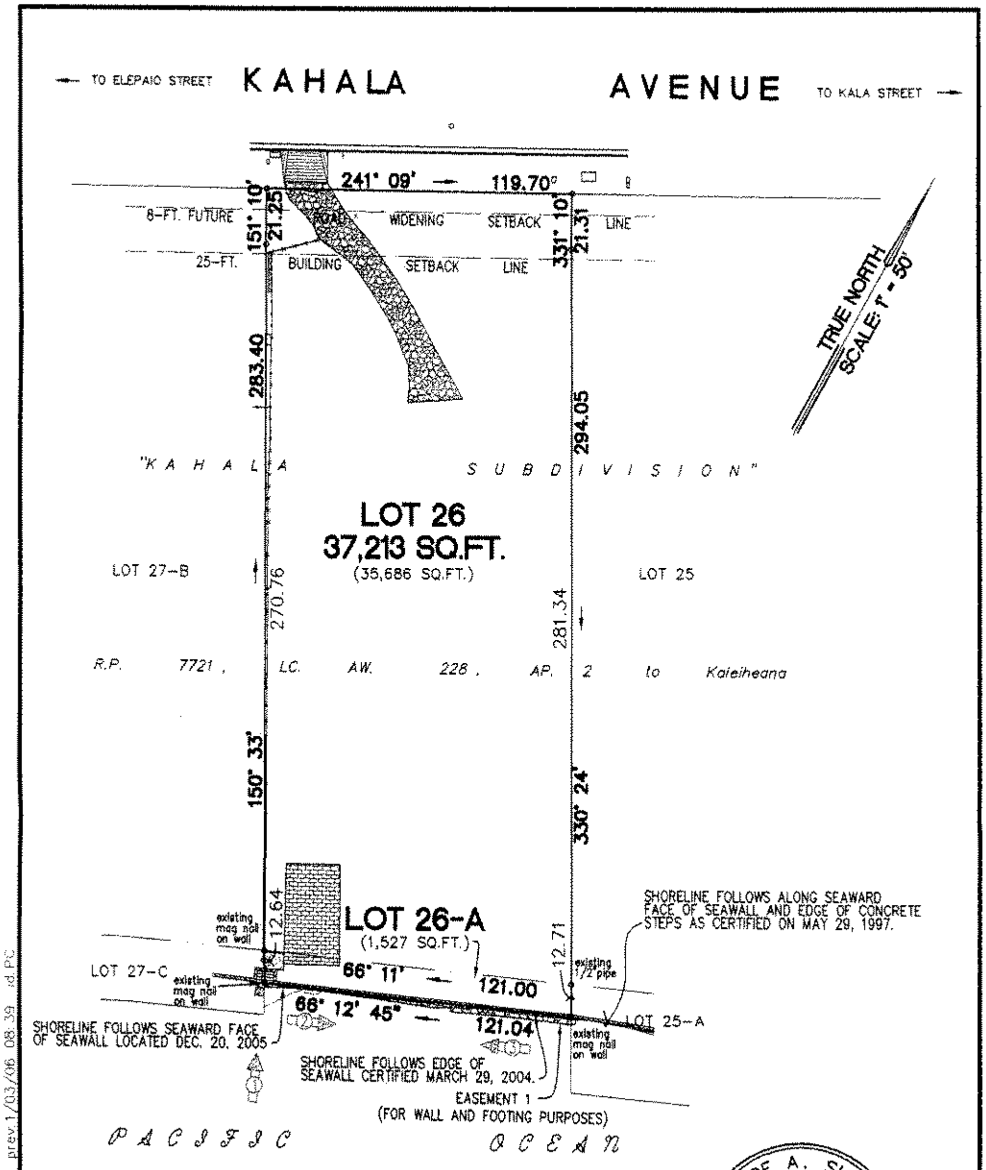


Figure 7
Shoreline Survey Map
Note: Not to Scale



# MAP SHOWING
## SHORELINE FRONTING LOT 26-A "KAHALA SUBDIVISION" R.P. 7721, L.C. AW. 228, AP. 2 TO KALEIHEANA AT KAHALA, HONOLULU, OAHU, HAWAII

OWNERS: BARHAM TRUST
ADDRESS: 4415 KAHALA AVENUE

GEORGE A. SUMIDA
No. 4330

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION
ParEn, Inc.
dba PARK ENGINEERING

George A. Sumida
LICENSED PROFESSIONAL SURVEYOR
CERTIFICATE NUMBER 4330

NOTE: ⇨ DENOTES PICTURE NUMBER AND DIRECTION TAKEN

DATE: DECEMBER 23, 2005
FIELD BOOK NO. 2385, 2600

file: 1353108 SHORELINE.DWG cur:01/03/06 09:02 prev:1/03/06 08:39 rd:PC

T.M.K.: 3-5-03:10

ParEn, Inc.
dba PARK ENGINEERING
PACIFIC PARK PLAZA SUITE 1500
711 KAPIOLANI BLVD. HONOLULU, HAWAII

Figure 7
Shoreline Survey Map
Note: Not to Scale

# Appendix A

# Coastal Engineering Evaluation for
# 4415 Kahala Avenue
# TMK: 3-5-059:10

## Barham Trust

January 2006

*Prepared for:*

PlanPacific, Inc.
345 Queen Street, Suite 802
Honolulu, HI  96813

*Submitted by:*

Sea Engineering, Inc.
Makai Research Pier
Waimanalo, Hawaii 96795

#5-78

## Table of Contents

## List of Figures

# COASTAL ENGINEERING EVALUATION
# FOR
# 4415 KAHALA AVENUE

## 1.0 INTRODUCTION

This coastal engineering assessment has been prepared as part of a project to repair a seawall fronting a shoreline lot in Kahala on the south shore of Oahu. The project site is located east of Diamond Head at 4415 Kahala Avenue, between Elepaio St. and Kala St. Three adjacent properties at 4415, 4423, and 4433 Kahala Avenue (TMK 3-5-059, parcels 10, 9, and 8, respectively) are proposed for development. Although similar protective seawalls front all three properties, repairs are necessary at only the western-most lot (parcel 10). The regional location of the project is shown in Figure 1-1. Figures 1-2 and 1-3 are aerial photographs of the site.

The project site is approximately one mile east of Diamond Head Beach Park, and approximately 1,000 feet east of the Black Point Peninsula. The lots are located on Kahala Beach, a 2-mile reach bordered by Black Point on the west and Wailupe Peninusla on the east. While much of Kahala Beach has a narrow sand beach, the western portion, including the project site, has only isolated sandy areas, and is mostly characterized by bare reef and rocks fronting the properties. All of the properties in the region are fronted by seawalls. Figure 1-4 is a photograph of the project reach at 4415 Kahala Avenue. The seawall fronting the property is 12 to 36 inches lower than adjacent walls. Figure 1-5 shows the general deterioration that has occurred behind the wall due to erosion of back fill material. The back fill probably leaked out through voids at the base of the wall.

A typical section for seawall repair is shown in Figure 1-6. Repairs vary somewhat at different sections of the wall, however all construction for the repairs will take place on the landward side of the wall.

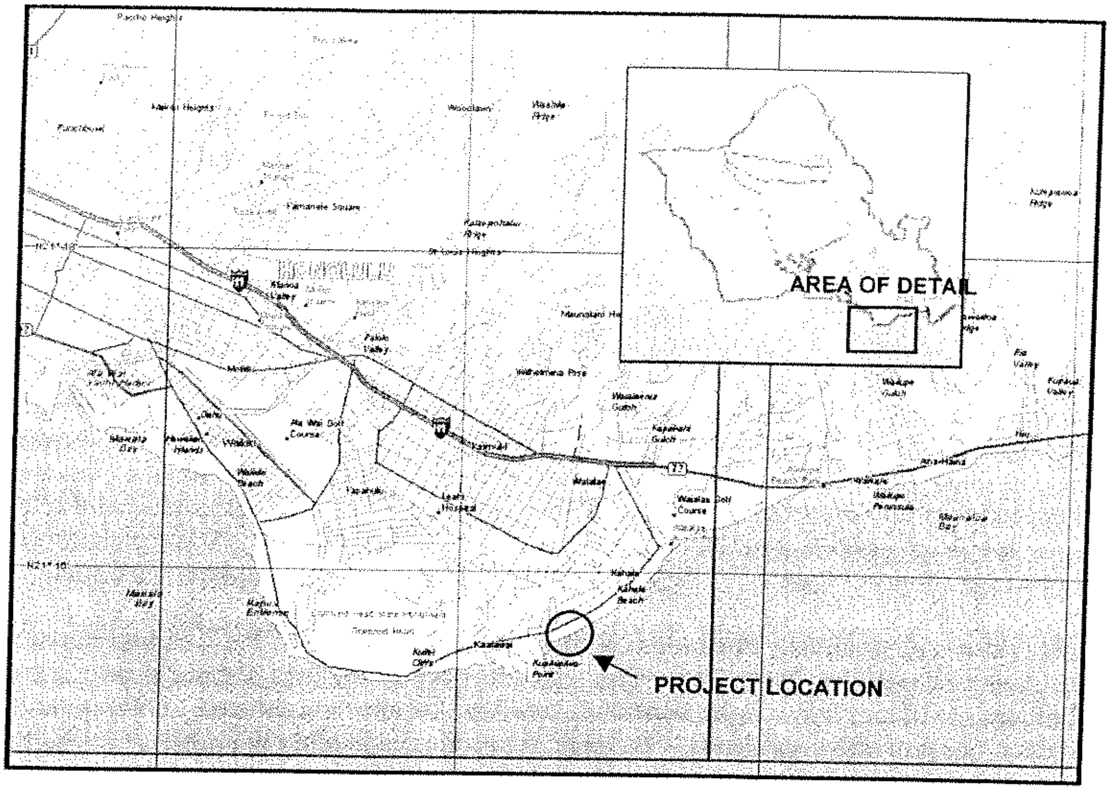


Figure 1-1. Project Location on the island of Oahu

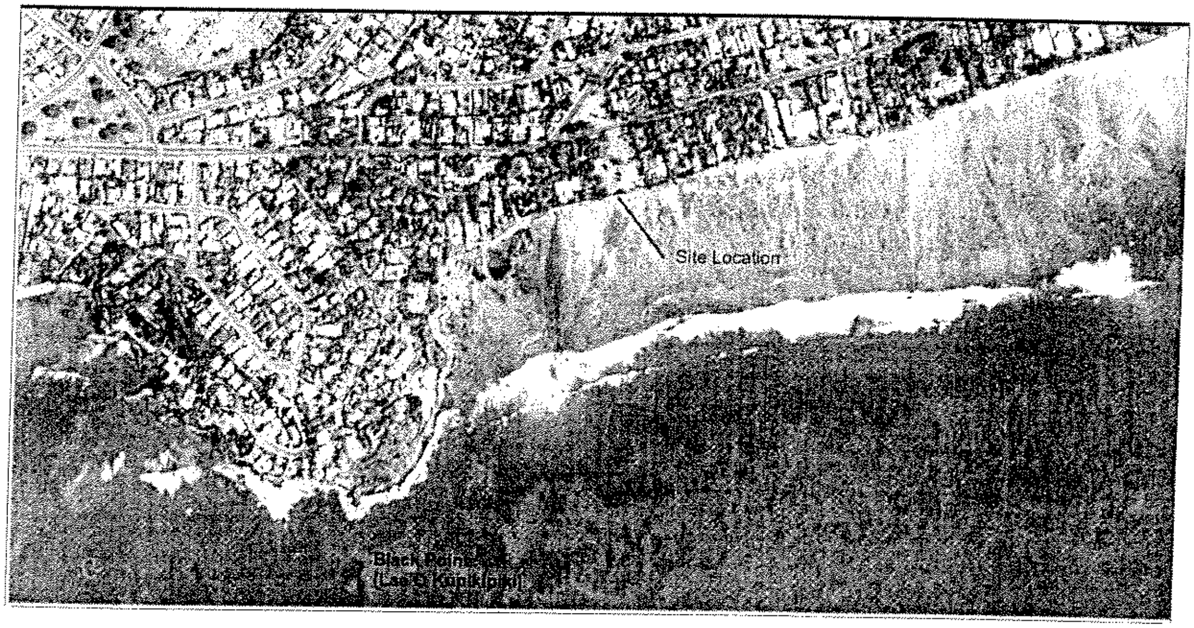


Figure 1-2. Aerial Photograph of the Project Site (1)

**Figure 1-3. Aerial Photograph of Project Site (2) showing the project reach and profile locations (from Google Earth)**

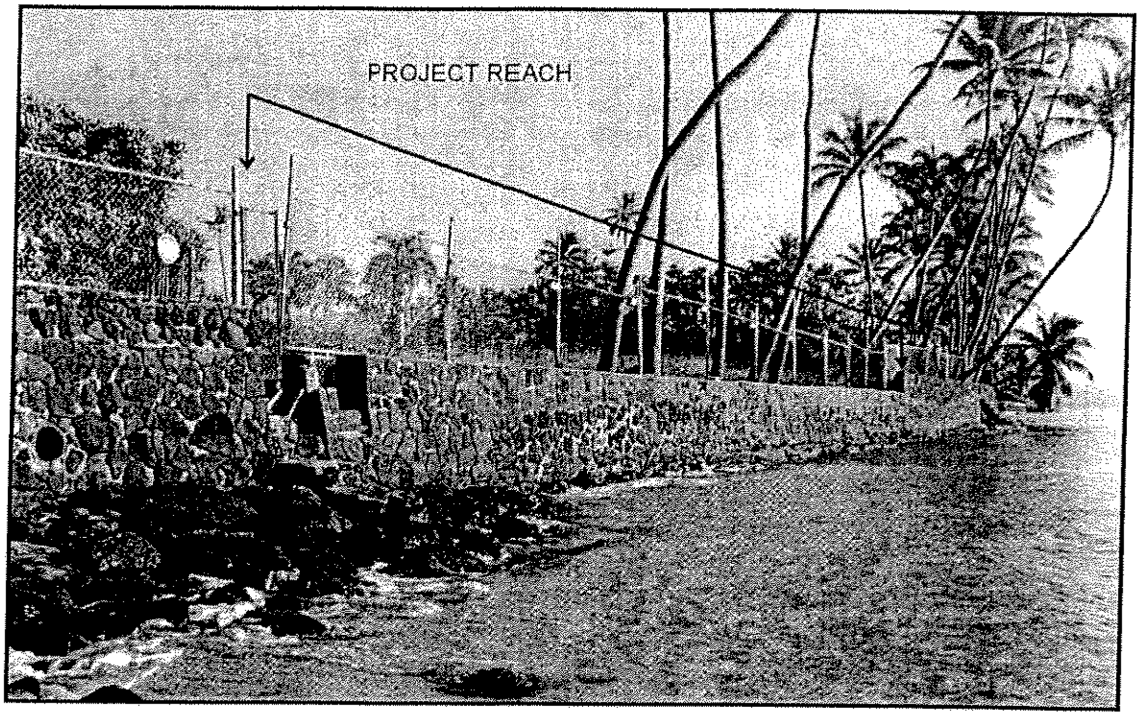


Figure 1-4. Project Reach

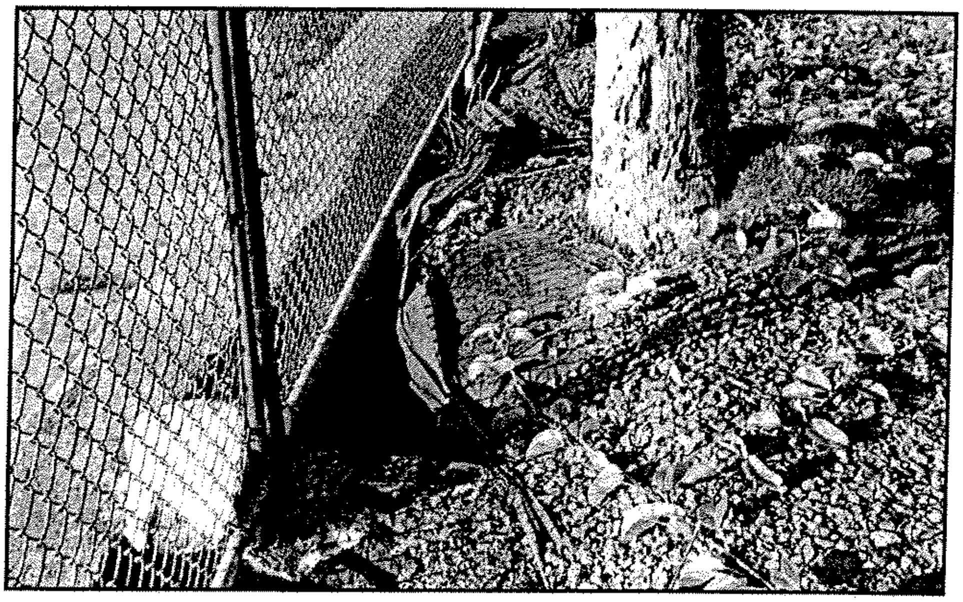


Figure 1-5. Sinkhole formation behind the seawall

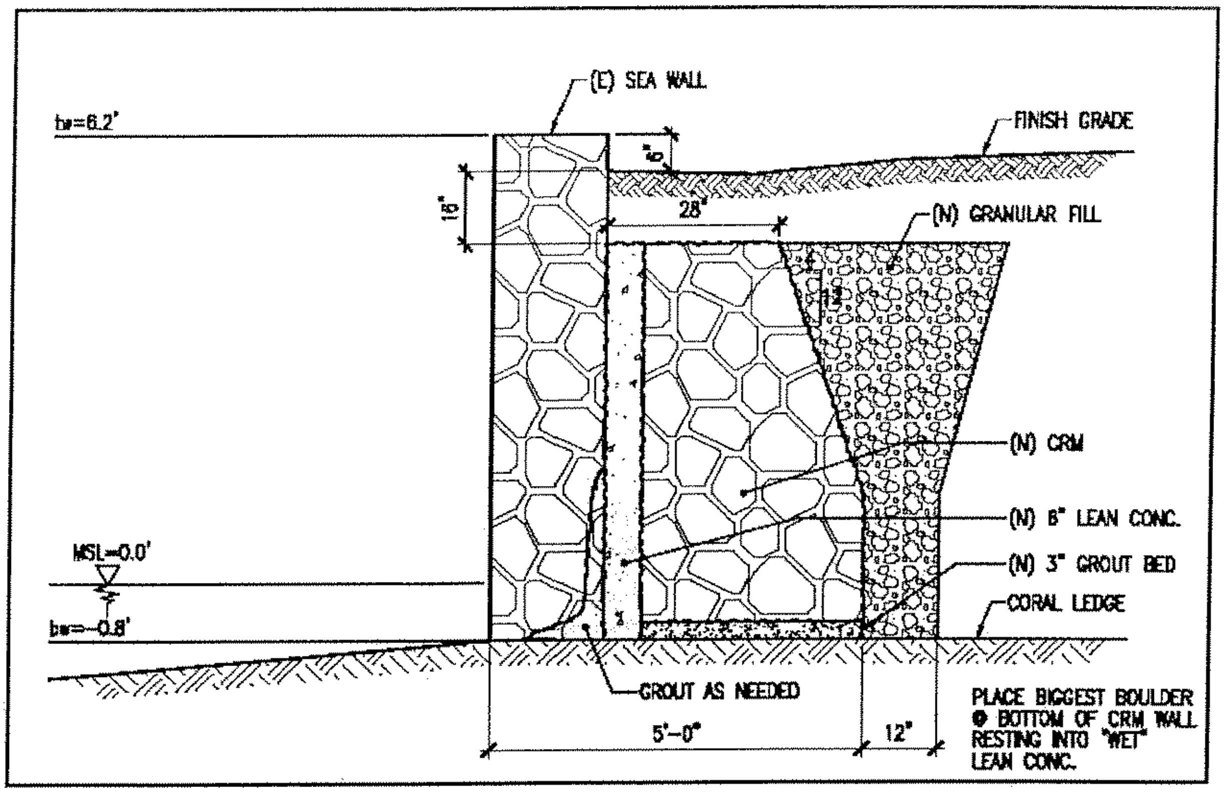


**Figure 1-6. Typical seawall repair (*N* indicates new work)**

## 2.0 SITE INVESTIGATIONS

### 2.1 Shoreline Description

The project shoreline is characterized by a wide fringing limestone reef flat over 850 feet in width. The reef flat widens to about 1500 feet at the eastern end of Kahala Beach. The shoreline is hardened by protective seawalls for at distance of at least 1000 feet on either side of the project site. Very little sand has accumulated along the shore in this area, existing as small pockets that are mostly covered during higher tide levels. Although public rights of way allow access to the beach, without sand cover the substrate in front of the seawalls and out on the reef flat is difficult to negotiate without protective foot wear. A storm drain exits the Elepaio Street public access, about 200 feet west of the project site. Traces of the excavation across the reef flat for the drain can be seen in Figure 1-3. However, at present the drain outlet is at the shoreline as the previous configuration was prone to clogging with sand.

Figure 2-1 is a photograph looking west toward Black Point from a point between the project site and the Elepaio Street public beach access. All properties in the vicinity are fronted by vertical or near-vertical seawalls. Sand areas are sparse and of limited extent. Basalt boulders and cobbles exist intermittently in this area – they are probably derived from the lava flow that forms the headland at Black Point.

Figure 2-2 is a photograph looking east from the project site along Kahala Beach. The substrate here is extremely difficult to walk on without footwear. Again all properties in view are fronted by shore protection structures.

No appreciable sand deposits were observed onshore or offshore during the site visit. In general, there appears to be very little sand available in the region for beach building processes.

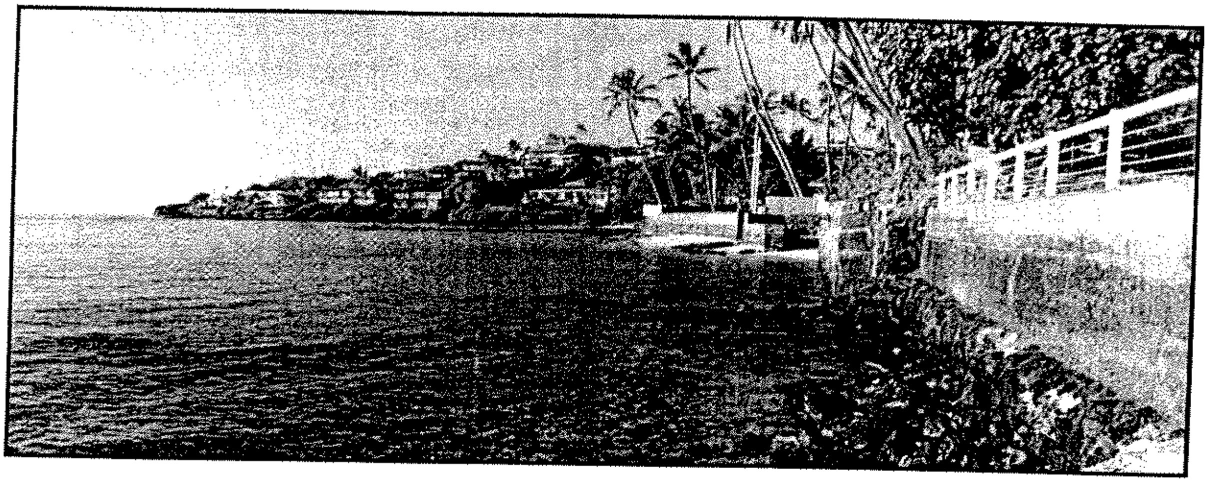


**Figure 2-1. View looking west toward Black Point**

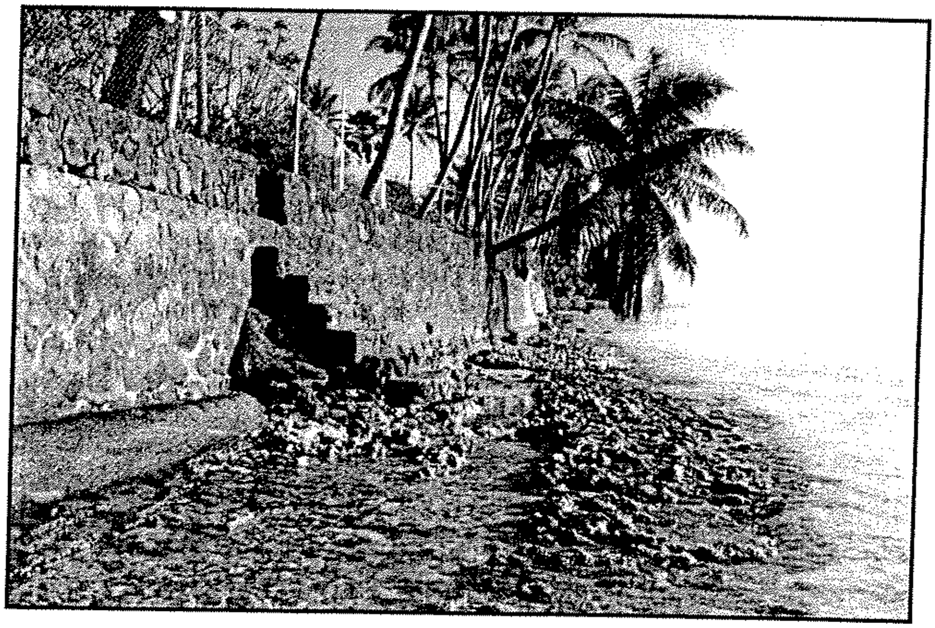


**Figure 2-2. View looking east from the project site.**

## 2.2 Beach Profiles

Three beach profiles were taken at the project site, at either end and at the middle of the property shoreline, extending 200 feet offshore. The locations of the profiles are shown in Figure 1-3. The profiles are shown in Figure 2-3. All profiles are similar, showing a near vertical seawall with an elevation just over 6 feet msl, some form of hard rock adjacent to the wall, a short sandy section less than 50 feet in width, and a wide expanse of limestone reef without appreciable elevation change. The sand is typically a few inches or less in thickness. The limestone reef flat has a typical relief less than 0.5 feet. Some areas in the reef flat appear to have been excavated on the order of 1 foot. These areas can be seen in the aerial photographs (e.g. Figure 1-3) and are often delineated by straight excavation edges and corners. The reef flat elevation is typically about –1.5 feet msl 50 feet offshore, and grades to about -2.5 feet at 200 feet offshore.

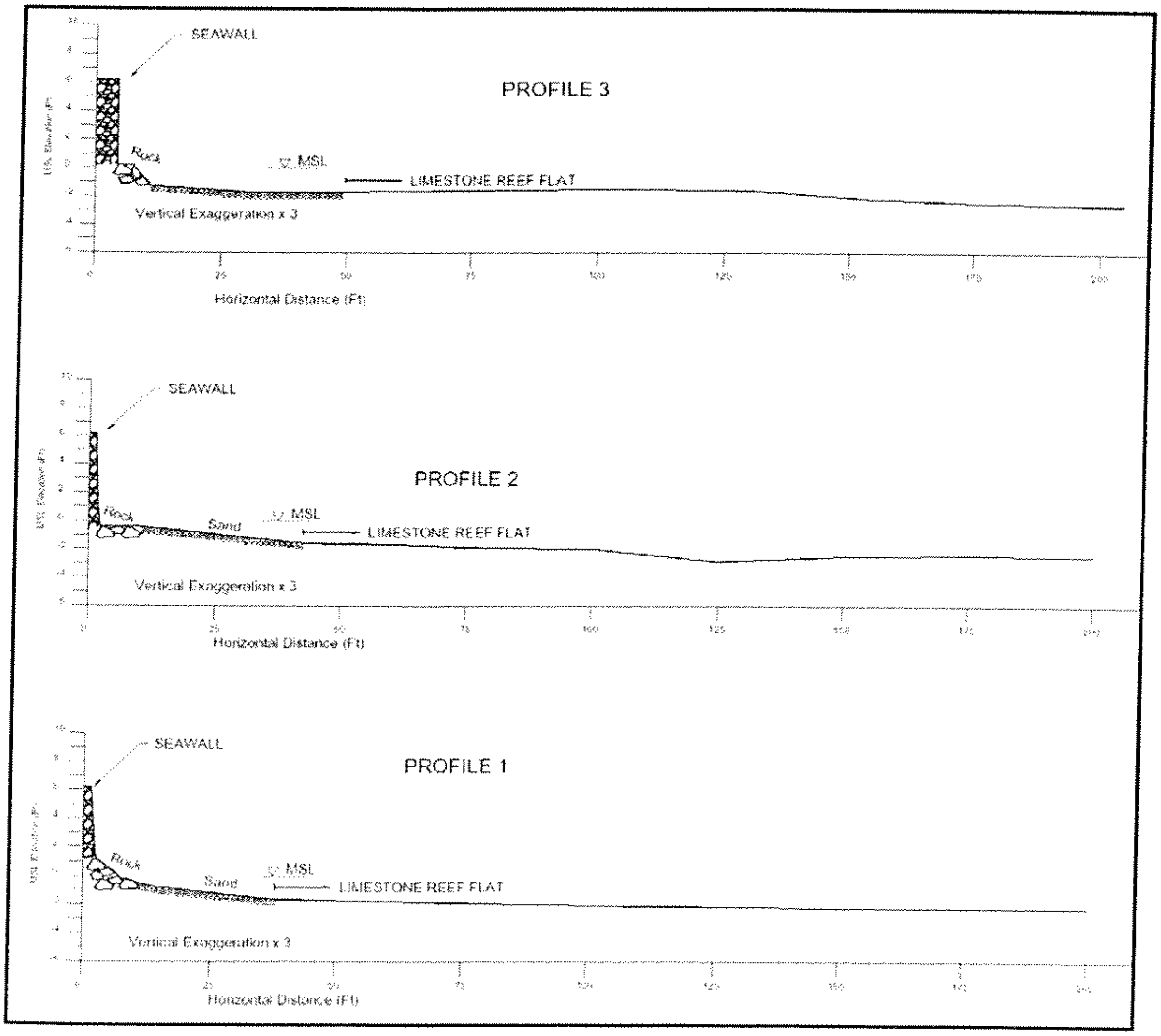


**Figure 2-3. Beach profiles**

## 2.3 Shoreline History

Hwang (1981) used historical aerial photograph analysis to assess shoreline change around Oahu, based on movement of the vegetation line between 1949 and 1979. Sea Engineering, Inc. (1988) updated Hwang's work through 1988 for the City and County Department of Land Utilization (now Department of Planning and Permitting). Transect locations from the 1988 SEI study are shown in Figure 2-4. Transect data are shown in Figure 2-5.

The SEI study shows transects on either side of the project site. Transect 5, west of the site, showed a net erosion of 8 feet between 1949 and 1988. Transect 4, east of the site showed a net accretion of 3 feet during the same time period. There does not appear to have been a statistical regional trend of erosion or accretion during the study period at the west end of Kahala Beach, although the prolific seawall construction indicates a probable erosion hazard.

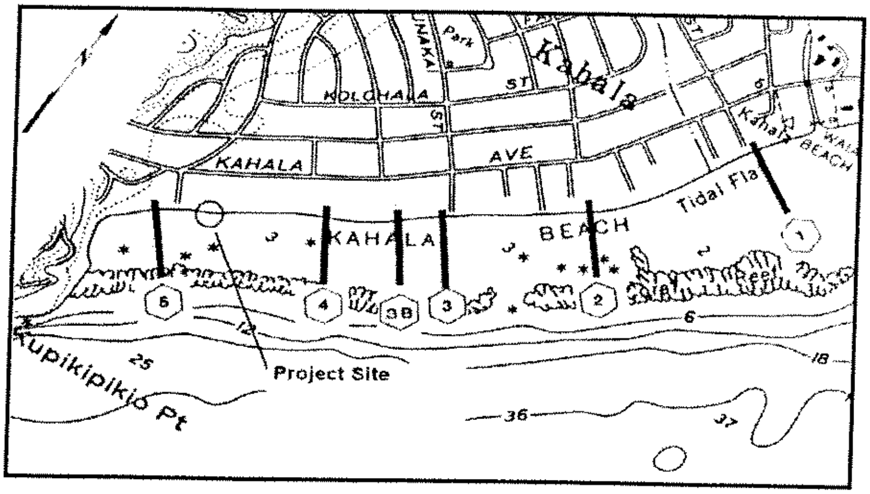


Figure 2-4. Erosion study transect locations (SEI 1988)

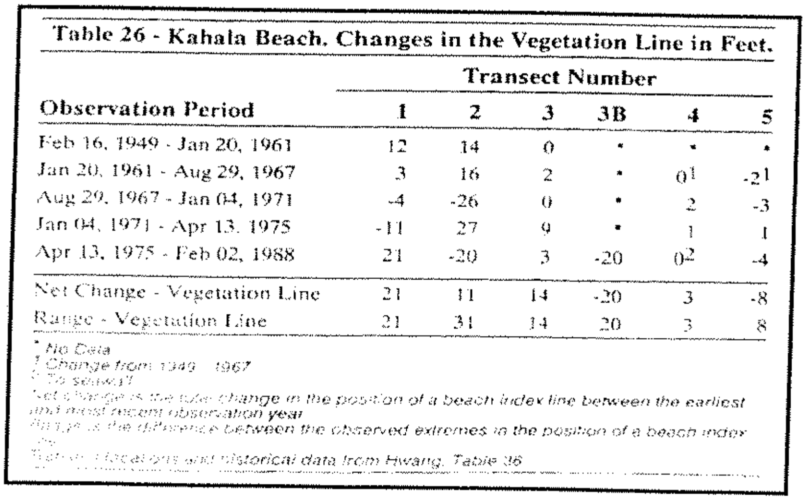


**Table 26 - Kahala Beach. Changes in the Vegetation Line in Feet.**

| | Transect Number | | | | | |
|---|---|---|---|---|---|---|
| **Observation Period** | **1** | **2** | **3** | **3B** | **4** | **5** |
| Feb 16, 1949 - Jan 20, 1961 | 12 | 14 | 0 | * | * | * |
| Jan 20, 1961 - Aug 29, 1967 | 3 | 16 | 2 | * | 0[1] | -2[1] |
| Aug 29, 1967 - Jan 04, 1971 | -4 | -26 | 0 | * | 2 | -3 |
| Jan 04, 1971 - Apr 13, 1975 | -11 | 27 | 9 | * | 1 | 1 |
| Apr 13, 1975 - Feb 02, 1988 | 21 | -20 | 3 | -20 | 0[2] | -4 |
| Net Change - Vegetation Line | 21 | 11 | 14 | -20 | 3 | -8 |
| Range - Vegetation Line | 21 | 31 | 14 | 20 | 3 | 8 |

* No Data

[1] Change from 1949 - 1967

[2] To seawall

Net change is the total change in the position of a beach index line between the earliest and most recent observation year

Range is the difference between the observed extremes in the position of a beach index line

Transect locations and historical data from Hwang, Table 36

Figure 2-5. Transect data

## 2.4 Biology

The following description of the flora and fauna on the fringing reef flat off Kahala Beach is from Aecos (1979:

> The inner reef flat off Kahala Beach is dominated by algae, which cover around 40% of hard bottom areas. Seventeen species are noted, with *Acanthophora spicifera, Dictypta acutiloba, Dictoyota Liagora* (sp.), and *Lyngbya majuscula* most abundant. *Halimeda discoidea, Liagora* (sp.), *Hypnea cervicornis,* and *Laurencia* (sp.) are common. Two of the more popular edible seaweeds, *Gracilaria burspastoris* and *G. coronipifolia,* occur in low abundance. Corals contribute less than one percent bottom cover, although coral cover increases and algal cover decreases seaward across the reef. *Pocillopora damicornis* is the most commonly encountered species. Only eight species of fishes are recorded on the shallow ref platform. *Stethojulis balteata* and *Acanthurus triostegus* are the most often encountered species. Large fishes, especially surgeonfishes, are abundant along the reef face. Seaward of the reef margin, coral cover reaches 30%, with *Porites lobata* the dominant form present.

## 2.5 Coastal Use

Despite the inhospitable substrate, the reef flat fronting Kahala Beach is used by wading fishermen, seaweed collectors, and spearfishermen. There are surfing breaks at the edge of the reef flat in the general vicinity (at Black Point and Hunakai Road), but not directly off the project site. The area in front of the project site is not used for sunbathing or swimming as there is no sand beach and the water is shallow.

# 3.0 OCEANOGRAPHIC SETTING

## 3.1 General Description

Kahala Beach is located on the south shore of the island of Oahu. It is primarily a residential area, with one beach front hotel, the Kahala Mandarin, located approximately one mile east of the project site. The region is a relatively flat coastal plain, elevated approximately 6 to 8 feet above mean sea level (MSL) at the shoreline. Kahala Beach is separated from the beaches in the vicinity of Diamond Head by the rocky peninsula of Black Point. Also known by the Hawaiian name *Lae o Kupikipiki o*, Black Point is a headland formed by a relatively young basaltic lava flow.

## 3.2 Oceanographic Conditions

### Wind

The prevailing winds are the northeast tradewinds, which wrap around the east side of the island and blow side-onshore in the project area. The tradewinds are typically present 80 percent of the time during the summer season from April to November, with wind speeds of 10 to 20 mph. During the winter months there is a general weakening of the tradewind system and the occurrence of southerly and westerly winds (Kona winds) due to both frontal systems passing through the islands and local low-pressure systems.

**Waves**

The general Hawaiian wave climate can be described by four primary wave types: 1) tradewind waves generated by the prevailing northeast winds; 2) North Pacific swell produced by mid-latitude low pressure systems; 3) southern swell generated by mid-latitude storms of the southern hemisphere; 4) Kona storm waves generated by local low pressure storm systems. In addition, the islands are affected by waves generated by nearby tropical storms and hurricanes.

Tradewind waves occur throughout the year, but the other wave types have seasonal distributions. North Pacific swell and Kona storm waves typically occur from October through March during the northern hemisphere winter. Conversely, southern swell typically occurs from April through September during the southern hemisphere winter. Hurricanes and tropical storms are also summer and fall phenomena. The project coastline faces south-southeast and is directly exposed to southern swell and Kona storm waves. The site is obliquely exposed to tradewind waves that wrap around the island from the east, and completely sheltered by the island from most north Pacific swell.

Tradewind waves result from the strong and steady tradewinds blowing from the northeast quadrant over long fetches of open ocean. Typical deepwater tradewind waves have periods of 5 to 10 seconds and heights of 3 to 10 feet.

Southern swell is generated by storms in the southern hemisphere and is most prevalent during the summer months. These waves are typically long and low, with periods of 12 to 20 seconds and deepwater wave heights of 2 to 6 feet. Southern swell is fairly common, occurring nearly 25 percent of the time during a typical year. They approach the Kahala area directly, and represent the greatest source of wave energy reaching the project site.

Kona storm waves occur at random intervals during the winter months, and approach from the sector south through west. The site can therefore be directly exposed to this wave type. Some winter seasons have several Kona storms; others have none. Wave heights are dependent upon the storm intensity, but deepwater heights can exceed 15 feet.

The infrequent offshore passage of hurricanes can generate large waves that affect the west coast of Hawaii. Many recorded tropical storms and hurricanes have approached the Hawaiian islands during the past 35 years. Most of these storms passed well to the south of the islands, but there have been notable exceptions. Hurricane Nina (1957) passed within 200 miles of the islands, Dot (1959) passed over Kauai, Iwa (1982) passed within 30 miles of Kauai, and Iniki (1992) passed directly over Kauai. These hurricanes generated waves that affected the entire island chain. For example, although the largest waves from Hurricane Iwa directly impacted Kauai, the estimated deepwater wave height off the west coast of Hawaii was 14 feet. In the event that a large hurricane passes near the coast, model hurricane scenarios predict deepwater wave heights over 30 feet.

### Nearshore Wave Heights

As deepwater waves propagate toward shore, they begin to encounter and be transformed by the ocean bottom. The process of *wave shoaling* generally steepens the wave and increases the wave height. The phenomenon of *wave refraction* will cause wave crests to bend and may locally increase or decrease the wave heights. *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 0.8, and is a mechanism for dissipating the wave energy.

The wide and shallow fringing reef flat that fronts Kahala Beach forces larger waves to break far offshore. The waves that reach the shoreline are limited by the water depth, so that larger waves will reach the shoreline during high water level conditions.

### Tides

The tides in Hawaii are semi-diurnal with pronounced diurnal inequalites; i.e. two tidal cycles per day with unequal water level ranges. The following tide levels have been established for the Honolulu area by the National Ocean Service:

| Tide Level | Feet (MSL) |
|---|---|
| Highest Water (2/14/1967) | 2.4 |
| Mean Higher High Water | 0.9 |
| Mean Sea Level | 0.0 (Reference Datum) |
| Mean Lower Low Water | -0.8 |
| Lowest Water (4/30/1911) | -2.2 |

### Hurricanes

Tropical cyclones originate over warm ocean waters, and they are considered hurricane strength when they generate sustained wind speeds over 64 knots (74mph). Hurricanes form near the equator, and in the central North Pacific usually move toward the west or northwest. During the primary hurricane season of July through September, Hurricanes generally form off the west coast of Mexico and move westward across the Central Pacific. These storms typically pass south of the Hawaiian Islands, and sometimes have a northward curvature near the islands. Late season hurricanes follow a somewhat different track, forming south of Hawaii and moving north toward the islands. Two hurricanes have actually passed through the Hawaiian islands in the past 25 years: hurricanes Iwa in 1982, and Iniki in 1992, both passing near or over the island of Kauai. These storms caused high surf and wave damage on the south and west shores of all the islands.

The *Windward Oahu Hurricane Vulnerability Study* (Sea Engineering, 1990) indicates that a theoretical model hurricane approaching from the south to southwest could result in deepwater waves 34 feet high with periods of 13 seconds.

### Still Water Level Rise

Storms and large waves produce storm surge and wave setup that results in elevated water levels at the shoreline. During prevailing, annual conditions this water level rise can be on the order of a foot above the tide level. However, during extreme events, the still water level rise can be significantly greater. During Hurricane Iniki, water level in Honolulu Harbor rose approximately 1.5 feet above normal levels. An extreme wave condition can raise the water level on the order of 2.5 feet or more.

### Tsunami

The south shore of Oahu area was inundated by the tsunamis of 1946, 1952, 1957, and 1960 with flood heights of 5, 3, 4, and 6 feet, respectively (Loomis, 1976). These measurements were off the Aina Haina area, about 3 miles east of the project site.

## 4.0 ALTERNATIVES CONSIDERED

Alternatives to the proposed seawall repair include no action, beach nourishment, a sloping rock revetment, geotextile sand-filled bags, or reconstruction and reinforcement of the existing wall.

### 4.1 No-Action

The no-action alternative would result in the gradual deterioration of the existing seawall. Sinkhole expansion will gradually undermine the wall, and may ultimately result in structural failure. No-action would have no appreciable effect on the beach environment until eventual failure of the wall, although back fill material will gradually leak out into the nearshore area. If allowed to occur, failure of the wall would cause erosion of the project shoreline, endanger adjacent properties, and would scatter debris along the shoreline. During high wave events the erosion would be particularly severe, and cause high turbidity in the nearshore waters.

### 4.2 Beach Nourishment

There appears to be a general lack of sand both at the shoreline and offshore at the project site. With sand available, it is possible that beaches would form naturally in the area. However, sand placed locally on the beach at the project site would be part of a large regional system, and would probably not stay in place unless accompanied by groin structures to minimize movement. Beach nourishment in this area is conceivable only on a grand scale as part of a larger regional effort.

Finding an appropriate source of beach sand has become a major problem for beach nourishment projects in the Hawaiian Islands. Sand from fossil dunes is presently available from the island of Maui, however it is fine-grained and only appropriate on sheltered beaches.

Beach nourishment is therefore not a practical solution for the project.

### 4.3 Revetment

A revetment is a sloping, un-cemented structure built of wave resistant material. 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. Properly designed and constructed rock revetments are durable, flexible, and highly resistant to wave damage. One major advantage of revetments 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 1.5-2 horizontal to 1 vertical slope to ensure stability. Conditions at the project site would call for a revetment to extend from about +7 feet to about –1 foot. This would require a horizontal footprint of about 12 feet.

A rock revetment would require demolition of the existing sea wall and would require excavation into the limestone substrate for placement of the revetment toe. A sloping revetment would have to be inset into the property, causing loss of useable land, and would be difficult to interface with adjacent vertical structures.

### 4.4 Sand Bags

In recent years, the state and counties have granted permission for property owners to place large geotextile sandbags (*Seabags*) on the beach fronting their property as emergency measures to prevent erosion. While they are expedient, they are several reasons why they are not appropriate here:

- They are aesthetically un-pleasing.
- They become slippery with algae growth under repeated inundation and are therefore hazardous.
- They are difficult to fill and place, especially in the quantity needed at this site.
- Like a revetment, they need to be stacked on a slope, and would therefore require a broad footprint.
- They are susceptible to vandalism and are, at best, a temporary solution.

Placing bags in front of the existing wall would require encroachment on State land.

### 4.5 Preferred Alternative, Seawall Repair

A seawall is a vertical or sloping concrete or concrete-rock-masonry 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 requiring limited horizontal space along the shore. Seawalls are not flexible structures, and their structural stability is dependent on the stability of their foundations. Seawalls adjoin the project site on both sides.

Seawalls tend to reflect incoming waves rather than absorb them. This characteristic makes them a less attractive erosion solution on many sandy shorelines as the reflected waves can scour the sand in front of the walls. However, it appears that the lack of sand at the project site is a regional problem and is not a direct result of the presence of seawalls.

Repair of the existing seawall is the preferred alternative. Except for beach nourishment, all alternatives considered result in shoreline hardening. Beach nourishment is a realistic option only if undertaken as a joint project by the larger community. Repairs to the existing seawall will not change the existing environment, and is the least invasive option of all the solutions considered.

## 5.0 PROJECT IMPACTS

Impacts are addressed in terms of the following significance criteria as presented in *A Guidebook for the Hawaii State Environmental Review Process*, prepared by the State Office of Environmental Quality Control, 1997.

(1) *"Irrevocable commitment to loss or destruction of any natural or cultural resource."* There is no significant flora or fauna which would be lost due to repair of the seawall. No threatened or endangered species would be impacted by the project. No known cultural resources are located on the property.

(2) *"Curtails the range of beneficial uses of the environment."* There will be no impact on public access to the shoreline. There will be no significant change in lateral access along the shore. There will be no impact to fishing on the reef flat seaward of the project site.

(3) *"Conflicts with the state's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS."* State waters will not be impacted by the project in any way.

(4) *"Substantially affects the economic or social welfare of the community or state."* The project would have no adverse social or economic impact to the state. The seawall will have some positive economic impact to the applicant by preventing erosion and loss of land.

(5) *"Substantially affects public health."* The project has no adverse public health impacts.

(6) *"Involves substantial secondary impacts."* The project will have no impact on public services or facilities.

(7) *"Involves a substantial degradation of environmental quality."* The project will have no significant adverse environmental impacts nor will it degrade environmental quality. It will not degrade water quality, nor impact marine flora and fauna. The proposed seawall is visually consistent with the existing protected shore on both sides of the project site.

(8) *"Has cumulative impacts."* The seawall would be a stand-alone project, with no cumulative impacts or commitment for larger actions.

(9) *"Substantially affects a rare, threatened, or endangered species or it habitat."* The affected environment will be unchanged by the project.

(10) *"Detrimentally affects air or water quality or ambient noise levels."* No debris, petroleum products, or other construction-related substances or materials will be allowed to flow, fall, leach or otherwise enter the coastal waters. All construction material will be free of contaminants or pollutants. Best Management Practices will be adhered to during construction to minimize environmental pollution and damage. There will be some

additional noise above ambient during construction resulting from equipment operation (trucks, back hoe, concrete operations).

(11) *"Affects or is likely to suffer damage by being in an environmentally sensitive area such as a flood plain, tsunami zone, beach or erosion prone area, or coastal waters."* The seawall may be subject to prevailing wave conditions at the shoreline, particularly during summer season high surf or Kona storms. The seawall will provide erosion and storm wave protection.

(12) *"Substantially affects scenic vistas and viewplanes identified in county or state plans or studies."* Project site scenery will remain unchanged.

(13) *"Requires substantial energy consumption."* No significant energy would be expended by construction of the revetment, nor would it entail any long-term commitment to energy use.

## 6.0 REFERENCES

AECOS, Inc., 1979, *Oahu Coral Reef Inventory*, prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division, Fort Shafter, Hawaii.

Hwang, Dennis, 1981, *Beach Changes on Oahu as Revealed by Aerial Photographs*, Hawaii Institute of Geophysics, University of Hawaii.

Loomis, Harold G., 1976, *Tsunami Wave Runup Heights in Hawaii*, Hawaii Institute of Geophysics, University of Hawaii.

Sea Engineering, Inc., 1989, *Oahu shoreline Study, Part 1, Data on Beach Changes (1988),* prepared for City and County of Honolulu, Department of Land Utilization.

Sea Engineering, Inc., 1990, *Windward Oahu Hurricane Vulnerability Study – Determination of Coastal Inundation Limits*, prepared for the State of Hawaii, Civil Defense and the U.S. Army Corps of Engineers, Honolulu Engineer District.

# Appendix B

# REPORT
# SOILS INVESTIGATION

## PROPOSED RESIDENCE
## 4433 KAHALA AVENUE
## HONOLULU, HAWAII
## TMK: 3-5-03: 08, 09 AND 10

for

RICHARD SHERMAN

PACIFIC ATELIER
Architects

Project No. 05-0079
June 16, 2005

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**SHINSATO ENGINEERING, INC.**
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June 16, 2005
Project No. 05-0079

Mr. Richard Sherman
c/o Pacific Atelier
737 Bishop Street, Suite 1655
Honolulu, Hawaii 96813

Gentlemen:

The attached report presents the results of a soils investigation at the site of the 4433 Kahala Avenue residence in Honolulu, Hawaii; TMK: 3-5-059: 08, 09 and 10.

A summary of the findings is as follows:

1) The subsurface condition of the site was explored by drilling nine (9) test borings to depths of 10 to 34.25 feet below existing grade and by excavating three (3) test pits to depths of 6 to 8 feet below grade.

   In general, the explorations disclosed the site to be underlain by loose to very dense, calcareous SAND to the final depths of Borings 1, 4, 5, 6, 7, 8, and 9. At Borings 2 and 3, loose to moderately dense, calcareous GRAVEL was found at 8.5 and 9 feet below grade and extended to 10 feet below grade. Below 10 feet, Borings 1, 3, 4 and 5 were probed using a 2-inch diameter probe rod advanced with a 140-pound driving weight dropping from a height of 30 inches. The material encountered graded moderately dense to very dense at 15 to 22 feet below grade and extended to the final depths of the borings at 17.33 to 34.25 feet below grade.

   Test Pits 1, 2 and 3 were excavated adjacent to the existing rock retaining walls (seawalls) at the back of the properties. The test pits disclosed the walls to be resting on very dense to hard coral.

2) Groundwater was encountered in the borings at depths of 5.92 to 8.17 feet below existing grade.

3) Special considerations will be required in the design and construction of the project due to existing site conditions. These include the following:

   a) The borings disclosed the upper SAND to be loose. It is recommended that the bottom of all footing excavations be compacted prior to construction of the footings.

   b) The underlying SAND is susceptible to caving. Excavation and trenching shall be done in accordance with applicable OSHA standards.

   c) Compaction of fills and backfills shall be performed with static rollers or small vibratory compactors. The use of large vibratory equipment may cause damage to adjacent structures.

   d) There are areas adjacent to the existing seawalls where the backfill material has eroded and created depressions. The erosion appears to be due to piping (internal erosion) of the sandy backfill material through separations between the wall foundation and the underlying coral and through openings in the wall. The piping is likely due to wave and tidal action. Underpinning of the wall foundation and installation of filter fabric or other impermeable barriers will minimize future erosion of the backfill material. Since the seawalls are along the shoreline, special techniques, methodology and/or permits may be required to implement the remedial work.

4) Based on the findings and observations of this investigation, it is concluded that spread and continuous footings may be used to support the proposed structure. A summary of the foundation design recommendations is as follows:

| | | |
|---|---|---|
| a. | Allowable soil bearing value: | 2,000 psf for an 18-inch wide footing embedded 12 inches below lowest adjacent grade (measured to bottom of footing) bearing on firm on-site soils or properly compacted fill. The bearing value may be increased by 250 psf for each additional foot of depth and by 250 psf for each additional foot of width to a maximum of 4,000 psf. |
| b. | Estimated settlement: | less than 3/4 inch. |
| c. | Passive earth resistance: | 300 pcf |
| d. | Frictional resistance: | 0.5 times the dead load for the underlying soils or imported select granular fill |
| e. | Active earth pressure: | 30 pcf free-standing wall, level backfill using on-site sandy soils or imported select granular fill; 45 pcf restrained wall, level backfill; increase for surcharge loading and sloping backfill |
| f. | Soil Type Profile: | $S_D$ (stiff soil) |

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,

SHINSATO ENGINEERING, INC.

Lawrence S Shinsato

Lawrence S. Shinsato, P.E.
President

LSS:ls

LAWRENCE S. SHINSATO
No. 4169-C

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or under my supervision.
License Expires 04/30/06

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## INTRODUCTION

This investigation was made for the purpose of obtaining information on the subsurface conditions from which to base recommendations for foundation design for the proposed 4433 Kahala Avenue residence in Honolulu, Hawaii. 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 9 test borings to depths of 10 to 34.25 feet, obtaining samples of the underlying soils, excavating three (3) test pits adjacent to the existing seawalls to depths of 6 to 8 feet below grade, performing laboratory tests on the samples to determine pertinent engineering characteristics, 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. Recommendations for foundation design, including bearing values, embedment depth and estimated settlement.
4. Recommendations for placement of fill and backfill.
5. Special considerations.

## PLANNED DEVELOPMENT

From the information provided, the project will consist of constructing various residential structures on the properties.

## SITE CONDITIONS

### Surface

The site consists of three parcels designated by Tax Map Key Numbers 3-5-03: 08, 09 and 10. They are located on the oceanside of Kahala Avenue between Elepaio Street and Kala Street. The properties are bound by existing residences to the east and west, Kahala Avenue to the north and the ocean to the south. At the time of the investigation, the lots were vacant and covered by weeds, trees, and shrubs. The topography of the lot is relatively level to gently sloping. There are seawalls along the back of the parcels.

### Subsurface

The subsurface conditions at the site were explored by drilling 9 test borings to depths of 10 to 34.25 feet and excavating three (3) test pits to depths of 6 to 8 feet below grade. The locations of the test borings and test pits are shown on the Plot Plan, Plate 2. Detailed logs of the test borings are presented in the Appendix to this report. Cross sections of the test pits are presented on Plate 2.1.

In general, the explorations disclosed the site to be underlain by loose to very dense, calcareous SAND to the final depths of Borings 1, 4, 5, 6, 7, 8, and 9. At Borings 2 and 3, loose to moderately dense, calcareous GRAVEL was found at 8.5 and 9 feet below grade and extended to 10 feet below grade. Below 10 feet, Borings 1, 3, 4 and 5 were probed using a 2-inch diameter probe rod advanced with a 140-pound driving weight dropping from a height of 30 inches. The material encountered graded moderately dense to very dense at 15 to 22 feet below grade and extended to the final depths of the borings at 17.33 to 34.25 feet below grade.

Test Pits 1, 2 and 3 were excavated adjacent to the existing rock retaining walls (seawalls) at the back of the properties. The test pits disclosed the walls to be resting on very dense to hard coral.

Groundwater was encountered in the borings at depths of 5.92 to 8.17 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 Jaucas sand, 0 to 15 percent slopes (JaC).

The Jaucas series consist of excessively drained, calcareous soils that occur as narrow strips on coastal plains, adjacent to the ocean. In the JaC portion of the series, permeability is rapid, and runoff is very slow to slow. The hazard of water erosion is slight, but wind erosion is a severe hazard where vegetation has been removed (USDA, 1972, pp. 48-49, Plate 63).

### Geology

The site is located on the southeastern end of the elongated Koolau Mountain range. The formation of the Koolau Mountain Range above sea level is believed to have begun in the late Tertiary/early Pleistocene time (between 1 and 12 million years ago) by eruptions of lava from a rift zone roughly paralleling the existing mountain crest trends. After cessation of the main volcanic activity, deep valleys such as Palolo and Manoa were carved into the mountain. During high stands of sea levels, the valleys were in filled with sediment (alluviated) grading to the high sea level stands.

Volcanic activity later resumed on the southeastern end of the Koolau Range. These late-stage eruptions, known as the Honolulu Volcanic Series, form familiar landmarks on Oahu such as Diamond Head, Punchbowl, Tantalus, Round Top and Salt Lake craters (Stearns and Vaksvik, 1935).

The underlying tan/white coralline sand found on the site is part of the marine deposits that developed along the shoreline of Oahu during changes in sea level from fringing coral reefs.

## CONCLUSIONS AND RECOMMENDATIONS

### General

Based on the findings and observations of this investigation, it is concluded that the proposed residential structures may be supported on spread and continuous footings bearing on firm on-site soils or properly compacted fill.

## Special Considerations

Special consideration will be required in the design and construction of the project due to existing condition:

a) The borings disclosed the upper SAND to be loose. It is recommended that the bottom of all footing excavations be compacted prior to construction of the footings.

b) The underlying SAND is susceptible to caving. Excavation and trenching shall be done in accordance with applicable OSHA standards.

c) Compaction of fills and backfills shall be performed with static rollers or small vibratory compactors. The use of large vibratory equipment may cause damage to adjacent structures.

d) There are areas adjacent to the existing seawalls where the backfill material has eroded and created depressions. The erosion appears to be due to piping (internal erosion) of the sandy backfill material through separations between the wall foundation and the underlying coral, and through openings in the wall. The piping is likely due to wave and tidal action. Underpinning of the wall foundation and installation of filter fabric or other impermeable barriers will minimize future erosion of the backfill material. Since the seawalls are along the shoreline, special techniques, methodology and/or permits may be required to implement the remedial work.

## Foundations

An allowable bearing value of 2,000 pounds per square foot may be used for an 18-inch wide footing embedded 12 inches below lowest adjacent grade. The bearing value may be increased by 250 psf for each additional foot of depth and by 250 psf for each additional foot of width to a maximum of 4,000 psf. The bottom of the footing shall bear on firm on-ste soil or properly compacted fill.

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 or twice the footing width, whichever is greater, from the edge of the footing to the slope face.

The bearing value is 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 footing excavations shall be compacted prior to laying of steel or placing of concrete. Any loose soils which cannot be compacted shall be removed to firm material and the resulting depression shall be backfilled with properly compacted structural fill. Disturbed soil and soil which falls into the footing excavation shall be removed prior to pouring of concrete.

## Soil Profile Type

In accordance with the 1997 Uniform Building Code, Section 1636, the soil profile type may be assumed as SD (stiff soil).

## Settlement

Under the fully applied recommended bearing pressure, it is estimated that settlement of footings up to 3 feet continuous or 5 feet square that bear on properly compacted fill or on firm on-site SAND is estimated to be less than 3/4 inch.

Differential settlement between footings will vary according to the size and bearing pressure of the footing.

## Lateral Resistance

For resistance of lateral loads, such as wind or seismic forces, an allowable passive resistance equivalent to that exerted by a fluid weighing 300 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.

Frictional resistance between footings and the underlying soils may be assumed as 0.5 times the dead load.

Lateral resistance and friction may be combined.

## Retaining Walls

Foundations for retaining walls shall be designed as per the foundation section of this report. For free-standing retaining walls with properly draining backfill, the following active earth pressures may be used to design the wall:

| Backfill Slope | Active Earth Pressure (pcf)<br>Horizontal Component | Vertical Component |
|---|---|---|
| Level | 30 | 0 |
| 3H:1V | 35 | 12 |
| 2H:1V | 45 | 22 |

These values apply to imported structural fill and non-expansive on-site soils placed within a 1H:2V plane projected upwards from the bottom edge of the footing.

Free-standing walls are defined as walls that are allowed to rotate between 0.005 and 0.01 times the wall height. The rotation of the wall develops "active earth pressures." If the wall is not allowed to move as in the case of basement walls or walls that are restrained at the top, the soil pressure that will develop is known as an "at-rest" pressure. For restrained walls, the above active earth pressures shall be increased by 50 percent.

The above active earth pressures do not include surcharge loads such as footings located within a 45-degree plane projected upwards from the heel of the footing, and/or from hydrostatic pressures. If such conditions occur, the active earth pressure shall be increased accordingly.

Drainage for the retaining wall backfill shall be accomplished by providing 4-inch diameter weepholes spaced 8-feet on-center (horizontally as well as vertically) or by using a minimum 4-inch diameter perforated PVC footing drain pipe. A 2-foot thick layer of crushed gravel (ASTM No. 67), which is wrapped with geotextile filter fabric, shall be placed above the pipe; the crushed gravel shall be continuous from weephole to weephole, or in the case of a footing drain pipe, laid throughout the full length of the pipe. Geotextile fabric shall be AMOCO 4545 or similar.

The backfill material for retaining walls shall be properly compacted in accordance with the Site Preparation and Grading section to this report. Also, surface drainage shall be designed to minimize surface water runoff from entering the backfill area. In non-pavement areas, the top 12 inches of backfill material shall be fine-grained, cohesive soil.

## Slab-on-Grade

No expansive type soils were observed on the site or encountered in the explorations. Conventional slab-on-grade construction may be used. However, during construction should expansive CLAY soils be found under slab areas, the expansive CLAY shall be removed and if necessary to achieve finished subgrade elevation, shall be replaced with properly compacted structural fill.

Moisture barriers shall be provided under floor slabs with moisture sensitive floor covering. This may consist of 6-mil polyethylene sheeting placed on 4-inches of compacted gravel base. Where the subgrade soil consists of the clean on-site sand, the gravel base material shall consist of 3/4-inch minus City and County of Honolulu aggregate base course gravel in order to minimize penetration or mixing of the sand with the normally used 3/4-inch clean gravel.

For design of slabs, a modulus of subgrade reaction of 150 pci may be used for the on-site soil or properly compacted structural fill.

Preparation of the subgrade shall be in accordance with the Site Preparation and Grading section to this report.

## Slopes

Cut and fill slopes shall not exceed 2 horizontal to 1 vertical (2H:1V). Fill slopes shall be constructed in accordance with the Site Preparation and Grading section to this report.

Exposed slopes shall be covered as soon as practical after construction to minimize erosion.

Fill slopes shall be constructed by either overfilling and cutting back to compacted soil, or the slope shall be track rolled at 5-foot vertical height intervals.

Temporary construction of cut slopes including trench excavations are susceptible to caving. Excavation and trenching shall be done in accordance with applicable OSHA standards.

## Pavement Design

For design of pavement areas, the recommended pavement sections are as follows:

| | Flexible Pavement | | | Rigid Pavement | |
|---|---|---|---|---|---|
| Traffic Load | A.C | Base | Subbase | PCC | Base |
| Vehicles 10,000 lbs. GVW or less | 2" | 6" | 0 | 5" | 0 |
| Over 10,000 lb. GVW | 2.5" | 6" | 0 | 6" | 4" |

The top 6 inches of pavement subgrade, subbase, and base course gravel shall be compacted to at least 95 percent of the maximum dry density (ASTM D1557).

All material quality and compaction requirements for pavement section shall be in accordance with the Hawaii Standard Specifications for Road, Bridge and Public Works Construction, dated 1994.

Site Preparation and Grading

It is recommended that the site be prepared in the following manner:

1. Clearing and Grubbing:

   In all areas to receive fill and in structural areas, all vegetation, weeds, brush, roots, stumps, rubbish, debris, old foundations and pavements, soft soil and other deleterious material shall be removed and disposed of off-site.

2. Preparation of Ground to Receive Fill:

   The exposed surface shall then be scarified to a depth of 6 inches, moisture conditioned to near optimum moisture (ASTM D1557-00) and then compacted to the degree of compaction specified below. If soft or loose spots are encountered, the loose/soft areas shall be removed to firm material and the resulting depression shall be filled with properly compacted fill.

3. Types of Fill and Backfill Material:

   Structural fill and backfill shall be described as material placed beneath buildings and extending a horizontal distance of 3 feet beyond the edge of the building line. Non-structural fill shall be described as material placed beyond 3 feet from the building line.

4. Material Quality:

   Fill and backfill material shall consist of soil which is free of organics and debris. The maximum size particle for fill and backfill material shall be as follows:

   a. Structural Fill

| | |
|---|---|
| Top 2 feet below finished subgrade (FSG) | 3" |

| | |
|---|---|
| Below 2 feet from FSG | 6" |

b. Non-structural fill and Pavement areas

| | |
|---|---|
| Top 2 feet from FSG | 3" |
| 2 to 6 feet from FSG | 6" |
| *Below 6 feet from FSG | 12" |

(FSG = Finished Subgrade Elevation; defined as the elevation below any subbase, and granular cushion fill beneath pavements and floor slabs).

*If larger rock or boulders (up to 12 inches in diameter) are used in deep fills, they shall be well embedded. The interstices between the rock or boulders shall be filled with fine-grained materials so as to produce a compacted mass. If utility lines are to be installed within fill areas, the maximum particle size shall be reduced to minimize obstruction of trenching work.

Structural fill shall have a Unified Soil Classification of either GW, GM, GC, SW, SM, SP or SC. The plasticity index of the fine portion as determined by the ASTM D4318-84 test shall be less than 15.

5. <u>Placement of Fill and Backfill:</u>

Each layer of fill and backfill material shall be placed in lifts not exceeding the following (loose thickness):

a. Structural Fill (including roadways)

| | |
|---|---|
| Top 2 feet below finished subgrade (FSG) | 8" |
| Below 2 feet from FSG | 12" |

b. Non-structural fill

| | |
|---|---|
| Top 6 feet from FSG | 12" |
| Below 6 feet from FSG | * |

*The loose thickness of this layer shall not exceed 1.5 times the largest size particle; this is predicated upon proper compaction of each lift.

Prior to placing of fill and backfill material, the material shall be aerated or moistened to near optimum moisture content (ASTM D1557-00 test procedure).

Where fill is placed on existing ground that is steeper than 5 horizontal to 1 vertical, the existing ground surface shall be benched into firm soil as the fill is placed.

6. Degree of Compaction:

Each layer of fill and backfill, and the ground surface that is exposed and scarified after clearing and grubbing shall be thoroughly compacted from edge to edge using conventional compaction equipment designed for the purpose. The minimum degree of compaction for each layer (as determined by the ASTM D1557-00 test procedure) shall be as follows:

| | | |
|---|---|---|
| a. | Structural Fill (under and 3 feet beyond the edge of buildings): | 95% |
| b. | Roadway Fill | |
| | Top 2 feet below finished subgrade (FSG) | 95% |
| | Below 2 feet from FSG | 90% |
| c. | Non-structural fill | *90% |

*Where compaction tests are not practical due to the size of the material, each layer shall be compacted by trackrolling until it does not weave or creep under the weight of the trackrolling equipment (D-8 dozer or larger).

It is particularly important to see that all fill and backfill soils are properly compacted in order for the design parameters to remain applicable.

7. Preparation of Footing Excavations:

Prior to placing of steel or pouring concrete, the bottom of footing excavations shall be cleaned of loose materials and soils that have been disturbed by the excavation process. Any soft/loose soils encountered at the bottom of the footing excavation that cannot be properly compacted shall be removed to firm material. The resulting depression shall then be backfilled with properly compacted structural fill, concrete, controlled low-strength material (CLSM) or other approved backfill material.

8. Site Drainage:

During construction, drainage shall be provided to minimize ponding of water adjacent to or on foundation and pavement areas. Ponded areas shall be drained immediately. Any subgrade soil that has become soft due to ponding shall be removed to firm material and replaced with compacted structural fill.

9. Erosion Control:

The on-site soils are susceptible to water and wind erosion. Exposed surfaces shall be covered with vegetation as soon as practical after construction.

Concentrated surface water flow shall not be allowed to run over slopes unless lined channels are provided.

10. Remedial Work To Minimize Soil Erosion Along Seawall:

Remedial work to minimize soil erosion may consist of the following:

a. Underpin or seal the underside of the seawall foundation using concrete or other types of sealant material. Because the seawall is located along the shoreline, special permits will likely be required if work is to be performed from the ocean side of the wall.

b. Excavate the existing soil from behind the seawall in order to install geotextile filter fabric against the face and heel of the seawall. The filter fabric shall be non-woven, minimum 8-ounce fabric. Backfill against the filter fabric with sand or well-graded gravel.

## INSPECTION

During the progress of construction, so as to verify compliance with the design concepts, recommendations and specifications, qualified engineering personnel should be present to observe the following operations:

1. Site preparation.
2. Placement of fill and backfill.
3. Footing excavations.

## REMARKS

The conclusions and recommendations contained herein are based on the findings and observations made at the boring 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.

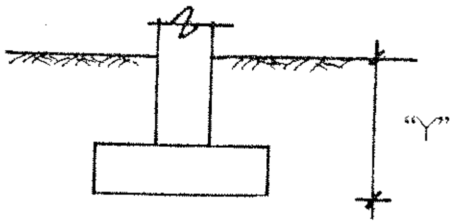
This report has been prepared for the exclusive use of Richard Sherman and his respective design consultants. It shall not be used by or transferred to any other party or to another project without the consent and/or thorough review by this facility. Should the project be delayed beyond the period of 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.

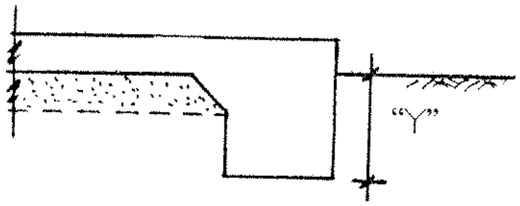
- o 0 o -

The following are included and complete this report:

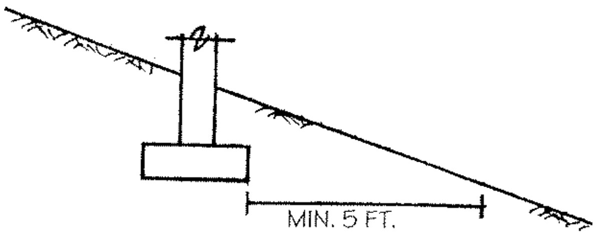
- "Y" = min. 12 inches for footings bearing on firm on-site soil and or properly compacted fill.
- Allowable soil bearing pressure = 2,000 psf for an 18-inch wide footing; the bearing value may be increased by 250 psf for each additional foot of depth below 12-inches and by 250 psf for each additional foot of width to a maximum of 4,000 psf
- Reinforcing details to be provided by others.



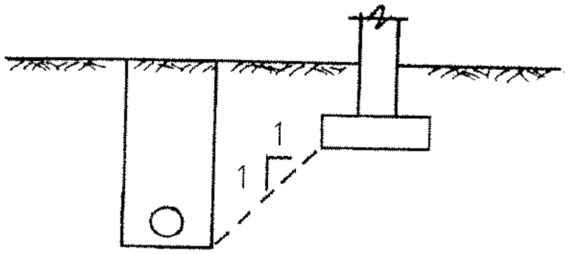
COLUMN FOOTING



THICKENED EDGE FOOTING



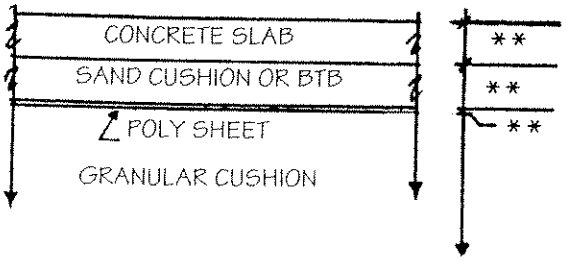
FOOTING ON SLOPE



FOOTING ADJACENT TO UTILITY TRENCH

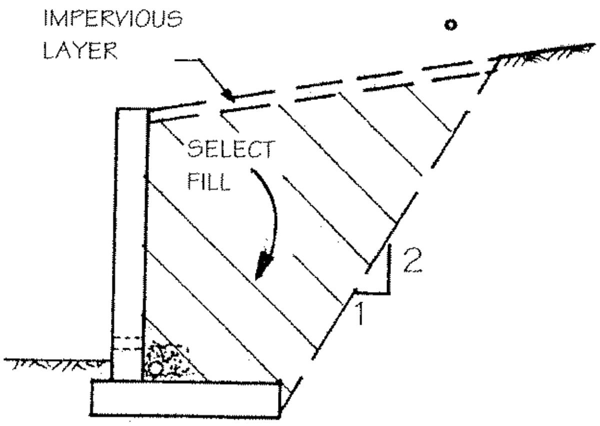
## FOOTING EMBEDMENT DEPTH DETAILS

**THICKNESS DETAILS BY OTHERS



*IF CLAY IS FOUND AT SUBGRADE ELEVATION BENEATH SLAB-ON-GRADE AREAS, THE CLAY SHALL BE REMOVED; IF NECESSARY REPLACE IT WITH PROPERLY COMAPCTED STRUCTURAL FILL.

SLAB-ON-GRADE



PROVIDE BACKFILL DRAINAGE USING WEEPHOLES OR FOOTING DRAIN; CAP SURFACE WITH IMPERVIOUS LAYER

RETAINING WALL BACKFILL

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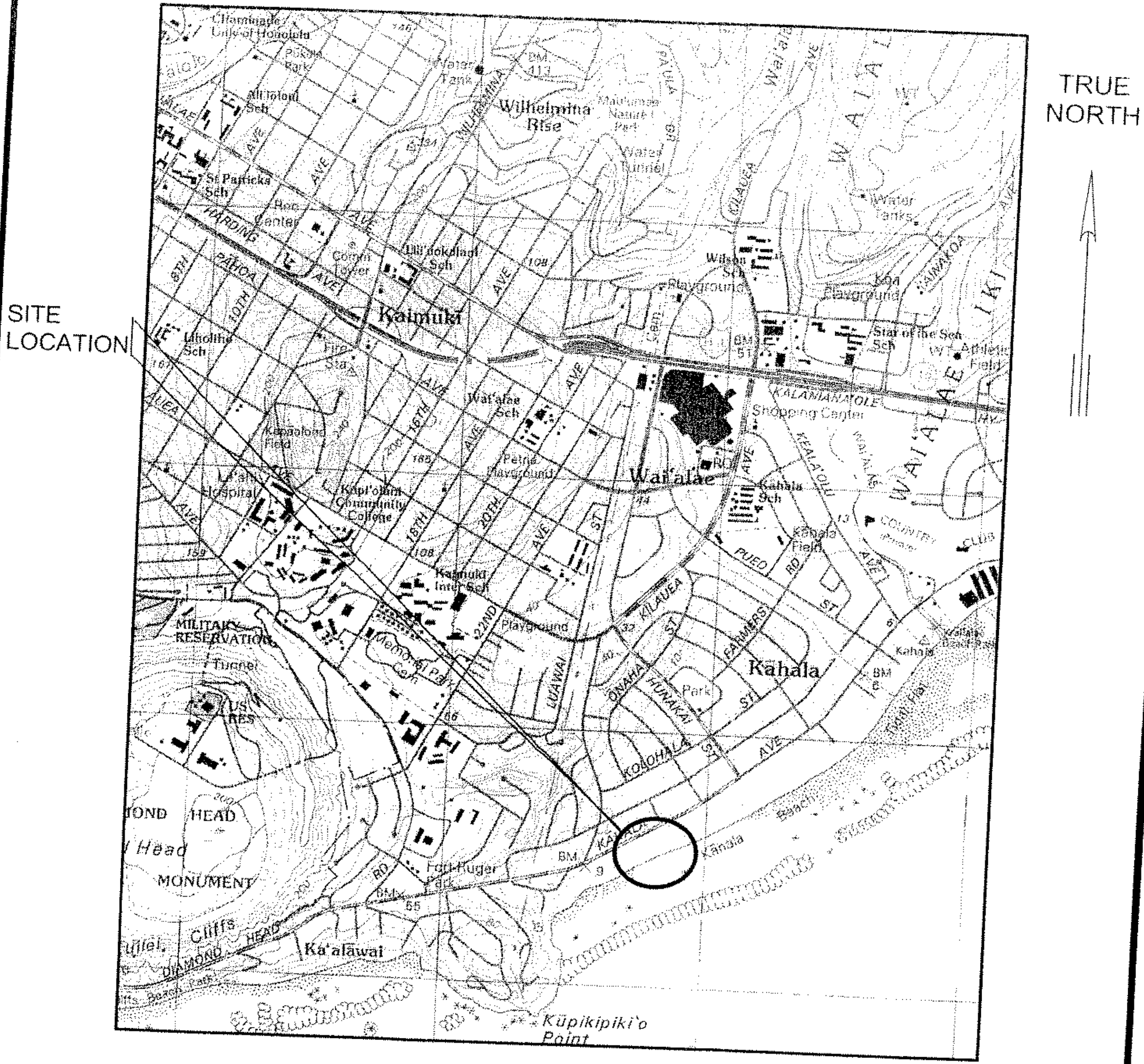
PLATE
A

# VICINITY MAP



**REFERENCE:**

USGS TOPOGRAPHIC MAP
HONOLULU QUADRANGLE
DATED 1998

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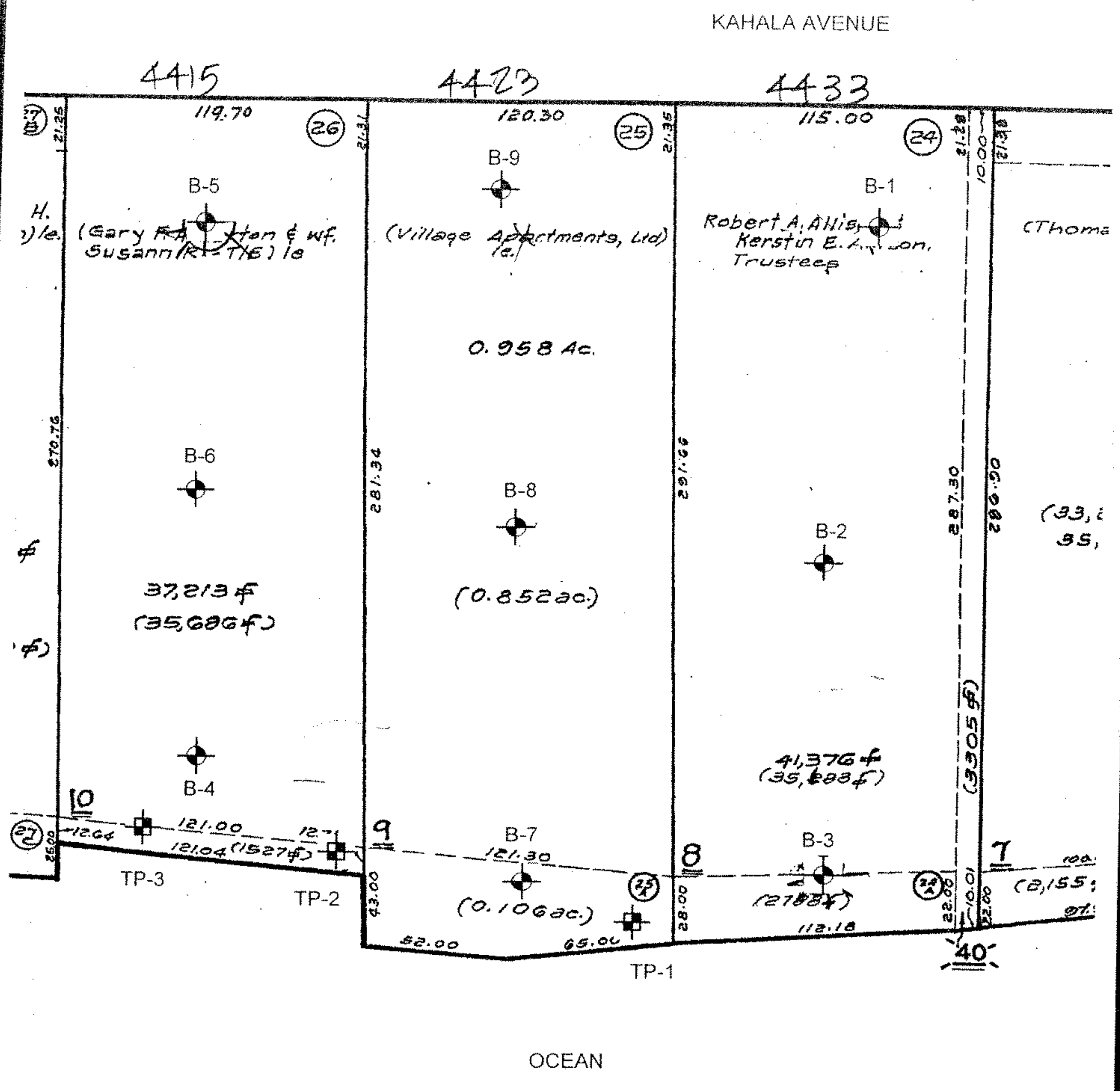
PROJECT NO.
05-0079

DATE:
06/05

SCALE:
1"=2000'

PLATE 1



LEGEND:

⌖ BORING LOCATION

▣ TEST PIT LOCATION

**PLOT PLAN**

SCALE: 1" = 60'

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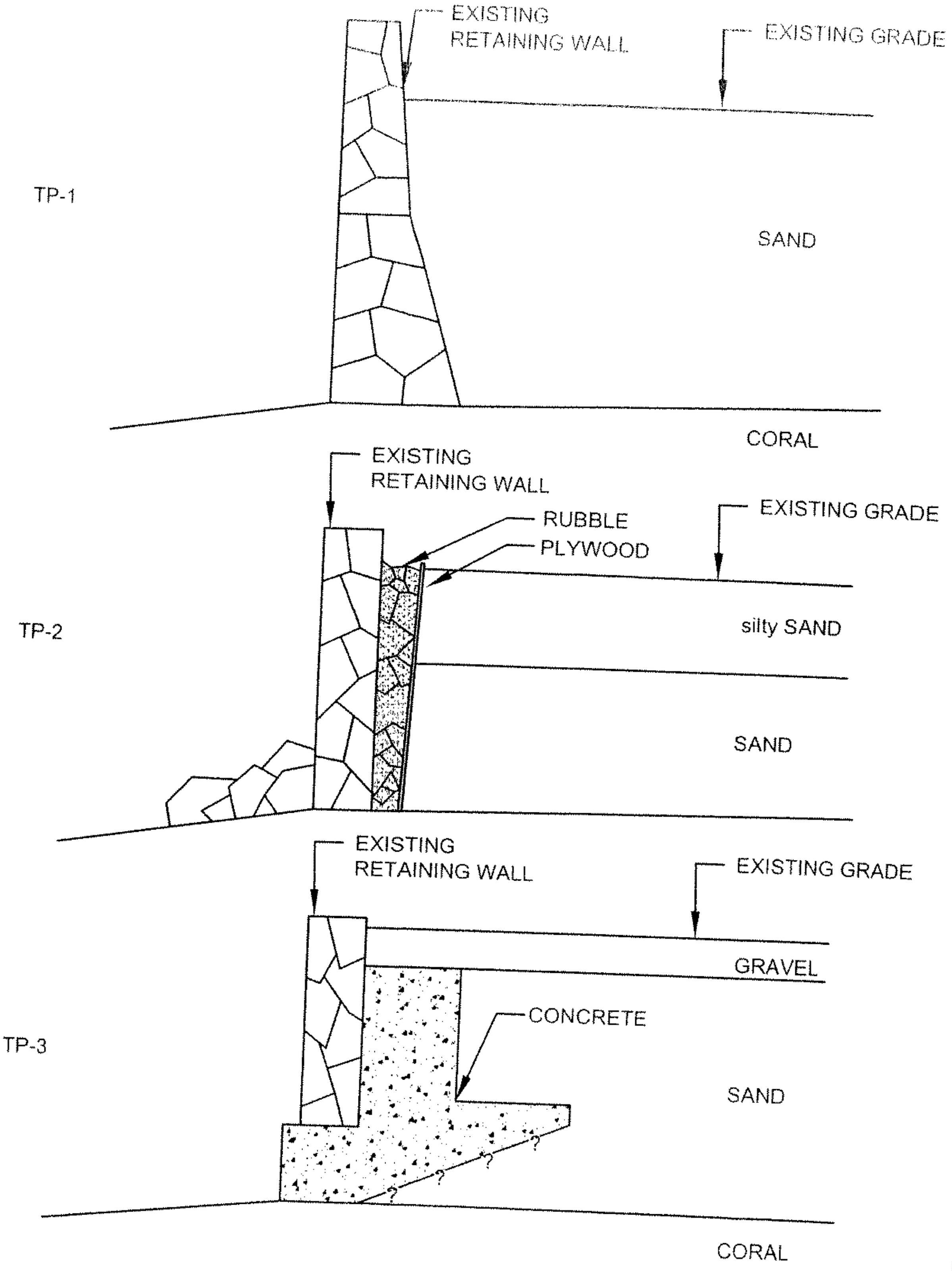
**PLATE**
**2**



## RETAINING WALL SECTIONS

SCALE: 1" = 4'

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PLATE
2.1

# 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 borings were drilled using a Badger drilling rig. The borings were advanced using 4-inch diameter continuous helical flight augers with the lead auger having a head equipped with changeable cutting teeth. Soil cuttings were brought to the surface by the continuous flights. After the bore hole was advanced to the required depth and cleaned of cuttings by additional rotation of the augers, the augers were retracted for soil sampling or in-situ testing.

### Soil Sampling

Relatively undisturbed samples of the underlying soils were 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 were 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 was driven approximately 18 inches into the soil and a section of the central portion was 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 were 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 was recorded at 6-inch intervals. The blow count for the last 12-inches is shown on the boring logs unless changes in the soil material are encountered. If changes are found, the blow counts for other intervals are shown on the logs.

Probing was done to determine soil consistency at deeper depths. The probe consists of a 2-inch diameter steel tip that is attached to AW drilling rods. The probe is driven into the underlying material with a 140-pound hammer falling from a height of 30-inches. Blow counts are recorded at 12-inch intervals and are shown on the boring logs.

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.

The test pits were excavated with a JCB217 backhoe to determine the geometry of the existing wall, the type of backfill material behind the wall, and the type of foundation material.

## LABORATORY TESTING

### General

Laboratory tests are performed on various soil samples to determine their engineering properties. Descriptions of the various tests are listed below.

### Classification Tests

The terms and symbols used to describe the soil materials are based on the Unified Soil Classification System which provides a basis for classifying soils using either visual methods or laboratory test results. Laboratory tests include sieve and hydrometer analysis for particle size distribution, and Atterberg Limits test for liquid limit, and plasticity index determination.

Grain-size distribution of the soil is determined by passing the soil through a series of sieves. If 50 percent or more of the soil by dry weight passes the #200 sieve, the soil is classified as fine-grained. If more than 50 percent of the soil by dry weight is retained on the #200 sieve, the soil is classified as coarse grained.

Coarse grained soils are described as follows:

| | |
|---|---|
| Boulder: | Material retained on a 12-inch square sieve |
| Cobble: | Material passing a 12-inch sieve but retained on a 3-inch sieve |
| Gravel: | Material passing a 3-inch sieve but retained on a #4 sieve |
| Sand: | Material passing a #4 sieve but retained on a #200 sieve |

Fine-grained materials are silts and clays. The liquid limit and plastic limit results from an Atterberg Limits test are used to determine if the soil is a silt or clay.

## 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. Saturated shear strength of the soil was determined by saturating the soil samples prior to performing the shear test.

# LOG OF BORING NO. 1

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

ELEVATION: **6**
DEPTH OF BORING (FT.): **27**
DEPTH TO GROUNDWATER (FT.): **6**
DATE DRILLED: **June 2, 2005**

| DEPTH (FT.) | GRAPHIC SYMBOL | UNIFIED SOIL CLASSIFICATION | DESCRIPTION | SAMPLE | BLOWS/FOOT | COLOR | MOISTURE | CONSISTENCY | DRY DENSITY (PCF) | MOISTURE CONTENT (% OF DRY WT.) | PENETROMETER (TSF) | TORVANE STRENGTH (TSF) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | SP | SAND; with gravel (basaltic), some silt | | | white/ gray | slightly moist | mod. dense | | | | |
| | | | --trace fines, no gravel | | | tan white | | | | | | |
| 2.5 | | | | | 26 | | | | 82.1 | 11.2 | | |
| | | | --trace gravel (calcareous), no roots | | | | | loose | | | | |
| | | | | | 12 | | | | 77.4 | 10.9 | | |
| 5 | | | | | | | | | | | | |
| | | | | | | | ▼ | mod. dense | 108.1 | 17.1 | | |
| | | | | | 21 | | | | | | | |
| 7.5 | | | | | | | | | | | | |
| | | | | | | | | loose | | | | |
| 10 | | | --with gravel (calcareous) | | 13 | | | | 82.3 | 41.9 | | |
| | | | --PROBE @ 10' | | 4 | | | | | | | |
| | | | | | 4 | | | | | | | |
| 12.5 | | | | | 2 | | | | | | | |
| | | | | | 4 | | | | | | | |
| 15 | | | | | 7 | | | | | | | |
| | | | | | 11 | | | mod. dense | | | | |
| | | | | | 11 | | | | | | | |
| 17.5 | | | | | 11 | | | | | | | |
| | | | | | 11 | | | | | | | |
| 20 | | | | | 30 | | | | | | | |
| | | | | | 23 | | | | | | | |
| | | | | | 13 | | | | | | | |
| 22.5 | | | | | 13 | | | | | | | |
| | | | | | 17 | | | | | | | |
| 25 | | | | | 30 | | | dense | | | | |
| | | | | | 30 | | | | | | | |
| | | | | | 62 | | | | | | | |
| 27.5 | | | END OF BORING | | | | | very dense | | | | |
| 30 | | | | | | | | | | | | |
| 32.5 | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | |

PROJECT NAME: 4433 KAHALA AVENUE RESIDENCE

PROJECT NO.: 05-0079

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PLATE

3

# LOG OF BORING NO. 2

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

ELEVATION: **6.5**
DEPTH OF BORING (FT.): **10**
DEPTH TO GROUNDWATER (FT.): **6.5**
DATE DRILLED: **June 3, 2005**

| DEPTH (FT.) | GRAPHIC SYMBOL | UNIFIED SOIL CLASSIFICATION | DESCRIPTION | SAMPLE | BLOWS/FOOT | COLOR | MOISTURE | CONSISTENCY | DRY DENSITY (PCF) | MOISTURE CONTENT (% OF DRY WT.) | PENETROMETER (TSF) | TORVANE STRENGTH (TSF) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | **SM** | silty SAND; (calcareous) with basaltic and calcareous gravel, few roots | | | orange brown | slightly moist | loose | | | | |
| | | **SP** | --trace fines, no gravel | | | tan white | | | | | | |
| 2.5 | | | | ■ | 13 | | | | 73.1 | 14.7 | | |
| | | | | ■ | 10 | | | | 82.4 | 10.3 | | |
| 5 | | | | | | | | | | | | |
| | | | --few calcareous gravel | ■ | | | | | 68.8 | 33.1 | | |
| | | | | | 17 | | ▼ | mod. dense | | | | |
| 7.5 | | | | | | | | | | | | |
| | | **GP** | GRAVEL; (calcareous) with sand, trace fines | | | | | loose | | | | |
| 10 | | | END OF BORING | ■ | 13 | | | | 82.5 | 21.9 | | |
| 12.5 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 17.5 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 22.5 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 27.5 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 32.5 | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | |

PROJECT NAME: 4433 KAHALA AVENUE RESIDENCE

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PLATE
4

# LOG OF BORING NO. 3

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

ELEVATION: **8.166**
DEPTH OF BORING (FT.): **34.25**
DEPTH TO GROUNDWATER (FT.): **8.166**
DATE DRILLED: **June 3, 2005**

| DEPTH (FT.) | GRAPHIC SYMBOL | UNIFIED SOIL CLASSIFICATION | DESCRIPTION | SAMPLE | BLOWS/FOOT | COLOR | MOISTURE | CONSISTENCY | DRY DENSITY (PCF) | MOISTURE CONTENT (% OF DRY WT.) | PENETROMETER (TSF) | TORVANE STRENGTH (TSF) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | SP-SM | SAND; (calcareous) with fines, few gravel<br>--trace fines<br>--no gravel | | | light orange brown | slightly moist | loose | | | | |
| | | | | | | tan white | | mod. dense | 80.8 | 11.6 | | |
| 2.5 | | | | | 23 | | | | | | | |
| | | | | | 23 | | | | 83.7 | 9.2 | | |
| 5 | | | | | | | | loose | | | | |
| 7.5 | | | | | 8 | | | | 80.8 | 10.3 | | |
| | | | | | | | ▼ | | | | | |
| 10 | | GP | GRAVEL; (calcareous) with sand, trace fines<br>--PROBE @ 10.5' | | 40 | | | mod. dense | 100.7 | 24.7 | | |
| | | | | | 18 | | | | | | | |
| 12.5 | | | | | 7 | | | loose | | | | |
| | | | | | 5 | | | | | | | |
| | | | | | 6 | | | | | | | |
| 15 | | | | | 8 | | | | | | | |
| | | | | | 8 | | | | | | | |
| 17.5 | | | | | 6 | | | | | | | |
| | | | | | 12 | | | mod. dense | | | | |
| | | | | | 12 | | | | | | | |
| 20 | | | | | 12 | | | | | | | |
| | | | | | 12 | | | | | | | |
| 22.5 | | | | | 22 | | | | | | | |
| | | | | | 18 | | | | | | | |
| | | | | | 21 | | | | | | | |
| 25 | | | | | 25 | | | | | | | |
| | | | | | 26 | | | | | | | |
| 27.5 | | | | | 24 | | | | | | | |
| | | | | | 17 | | | | | | | |
| | | | | | 20 | | | | | | | |
| 30 | | | | | 33 | | | dense | | | | |
| | | | | | 34 | | | | | | | |
| 32.5 | | | | | 91 | | | very dense | | | | |
| | | | | | 42 | | | dense | | | | |
| | | | | | 66/9" | | | very dense | | | | |
| 35 | | | END OF BORING | | | | | | | | | |

PROJECT NAME: 4433 KAHALA AVENUE RESIDENCE

PROJECT NO.: 05-0079

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PLATE 5

# LOG OF BORING NO. 4

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

ELEVATION: **6.666**
DEPTH OF BORING (FT.): **26.666**
DEPTH TO GROUNDWATER (FT.): **6.666**
DATE DRILLED: **June 6, 2005**

| DEPTH (FT.) | GRAPHIC SYMBOL | UNIFIED SOIL CLASSIFICATION | DESCRIPTION | SAMPLE | BLOWS/FOOT | COLOR | MOISTURE | CONSISTENCY | DRY DENSITY (PCF) | MOISTURE CONTENT (% OF DRY WT.) | PENETROMETER (TSF) | TORVANE STRENGTH (TSF) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | **SP** | SAND; (calcareous) trace fines, few roots | | | gray brown | slightly moist | loose | | | | |
| | | | | | | light tan | | | | | | |
| 2.5 | | | | | 19 | | | | | 2.5 | | |
| | | | | | 18 | | | | | | | |
| 5 | | | | | | | | | 83.5 | 4.8 | | |
| | | **SW-SM** | --with fines | | | | | | | | | |
| 7.5 | | | | | 8 | tan white | ▼ | | 85.3 | 27.8 | | |
| | | | --with calcareous gravel | | | | | | | | | |
| 10 | | | --PROBE @ 10' | | 18 | | | mod. dense | | | | |
| | | | | | 5 | | | loose | 75.4 | 26.2 | | |
| | | | | | 3 | | | | | | | |
| 12.5 | | | | | 1 | | | very loose | | | | |
| | | | | | 1 | | | | | | | |
| 15 | | | | | 3 | | | loose | | | | |
| | | | | | 4 | | | | | | | |
| | | | | | 12 | | | mod. dense | | | | |
| 17.5 | | | | | 14 | | | | | | | |
| | | | | | 21 | | | | | | | |
| 20 | | | | | 26 | | | | | | | |
| | | | | | 22 | | | | | | | |
| 22.5 | | | | | 21 | | | | | | | |
| | | | | | 49 | | | dense | | | | |
| | | | | | 39 | | | | | | | |
| 25 | | | | | 32 | | | | | | | |
| | | | | | 30 | | | | | | | |
| | | | | | 75/8" | | | very dense | | | | |
| 27.5 | | | END OF BORING | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 32.5 | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | |

PROJECT NAME: 4433 KAHALA AVENUE RESIDENCE

PROJECT NO.: 05-0079

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PLATE
6

# LOG OF BORING NO. 5

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

ELEVATION: **6.833**
DEPTH OF BORING (FT.): **17.333**
DEPTH TO GROUNDWATER (FT.): **6.833**
DATE DRILLED: **June 6, 2005**

| DEPTH (FT.) | GRAPHIC SYMBOL | UNIFIED SOIL CLASSIFICATION | DESCRIPTION | SAMPLE | BLOWS/FOOT | COLOR | MOISTURE | CONSISTENCY | DRY DENSITY (PCF) | MOISTURE CONTENT (% OF DRY WT.) | PENETROMETER (TSF) | TORVANE STRENGTH (TSF) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | **SP-SM** | SAND; (calcareous) with fines, few roots | | | brown | slightly moist | loose | | | | |
| | | **SP** | --trace fines | | | light tan | | | | | | |
| 2.5 | | | | ■ | 18 | | | | 76.4 | 6.4 | | |
| | | | | ■ | 12 | | | | 79.6 | 11.3 | | |
| 5 | | | | | | | | | | | | |
| | | | --some calcareous gravel | ■ | | | | | 92.1 | 17.3 | | |
| | | | | | 15 | | ▼ | | | | | |
| 7.5 | | | | | | | | | | | | |
| 10 | | | --with gravel | ■ | 11 | | | | 96.6 | 24.6 | | |
| | | | --PROBE @ 10' | | 5 | | | | | | | |
| | | | | | 2 | | | very loose | | | | |
| 12.5 | | | | | 2 | | | | | | | |
| | | | | | 2 | | | | | | | |
| 15 | | | | | 3 | | | | | | | |
| | | | | | 2 | | | | | | | |
| | | | | | 2 | | | | | | | |
| 17.5 | | | END OF BORING | | 40/4" | | | very dense | | | | |
| 20 | | | | | | | | | | | | |
| 22.5 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 27.5 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 32.5 | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | |

PROJECT NAME: 4433 KAHALA AVENUE RESIDENCE

PROJECT NO.: 05-0079

**SHINSATO ENGINEERING, INC.**

*Consulting Geotechnical Engineers*
98-747 Kuahao Place, #E
Pearl City, HI 96782

PLATE
7

# LOG OF BORING NO. 6

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

ELEVATION: **6.666**
DEPTH OF BORING (FT.): **10**
DEPTH TO GROUNDWATER (FT.): **6.666**
DATE DRILLED: **June 6, 2005**

| DEPTH (FT.) | GRAPHIC SYMBOL | UNIFIED SOIL CLASSIFICATION | DESCRIPTION | SAMPLE | BLOWS/FOOT | COLOR | MOISTURE | CONSISTENCY | DRY DENSITY (PCF) | MOISTURE CONTENT (% OF DRY WT.) | PENETROMETER (TSF) | TORVANE STRENGTH (TSF) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | **SP-SM** | SAND; (calcareous) with gravel and fines, few roots | | | tan | slightly moist | loose | | | | |
| | | **SP** | --trace fines, no gravel | | | | | | | | | |
| 2.5 | | | | ■ | 17 | light tan | | | 77.2 | 6.7 | | |
| | | | | ■ | 17 | tan white | | | 78.9 | 8.4 | | |
| 5 | | | | | | | | | | | | |
| | | | | ■ | 13 | | ▼ | | 81.5 | 26.1 | | |
| 7.5 | | | | | | | | | | | | |
| 10 | | | END OF BORING | ■ | 12 | | | | 120.2 | 26.3 | | |
| 12.5 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 17.5 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 22.5 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 27.5 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 32.5 | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | |

PROJECT NAME: 4433 KAHALA AVENUE RESIDENCE

PROJECT NO.: 05-0079

**SHINSATO ENGINEERING, INC.**

*Consulting Geotechnical Engineers*
98-747 Kuahao Place, #E
Pearl City, HI 96782

PLATE

8

# LOG OF BORING NO. 7

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

ELEVATION: **7.583**
DEPTH OF BORING (FT.): **10**
DEPTH TO GROUNDWATER (FT.): **7.583**
DATE DRILLED: **June 6, 2005**

| DEPTH (FT.) | GRAPHIC SYMBOL | UNIFIED SOIL CLASSIFICATION | DESCRIPTION | SAMPLE | BLOWS/FOOT | COLOR | MOISTURE | CONSISTENCY | DRY DENSITY (PCF) | MOISTURE CONTENT (% OF DRY WT.) | PENETROMETER (TSF) | TORVANE STRENGTH (TSF) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | **SP** | SAND; (calcareous) trace fines, few roots | | | light tan | slightly moist | loose | | | | |
| 2.5 | | | | ■ | 15 | | | | 81.4 | 2.7 | | |
| | | | | ◣ | 16 | | | | 58.9 | 6.1 | | |
| 5 | | | | | | | | | | | | |
| | | | | ■ | 9 | | | | 65.7 | 10.4 | | |
| 7.5 | | | | | | | ▼ | | | | | |
| 10 | | | | ■ | 42 | | | mod. dense | 90.8 | 27.4 | | |
| | | | END OF BORING | | | | | | | | | |
| 12.5 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 17.5 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 22.5 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 27.5 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 32.5 | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | |

PROJECT NAME: 4433 KAHALA AVENUE RESIDENCE

PROJECT NO.: 05-0079

**SHINSATO ENGINEERING, INC.**

*Consulting Geotechnical Engineers*
98-747 Kuahao Place, #E
Pearl City, HI 96782

PLATE

9

# LOG OF BORING NO. 8

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

ELEVATION: **6.0**
DEPTH OF BORING (FT.): **10**
DEPTH TO GROUNDWATER (FT.): **6**
DATE DRILLED: **June 7, 2005**

| DEPTH (FT.) | GRAPHIC SYMBOL | UNIFIED SOIL CLASSIFICATION | DESCRIPTION | SAMPLE | BLOWS/FOOT | COLOR | MOISTURE | CONSISTENCY | DRY DENSITY (PCF) | MOISTURE CONTENT (% OF DRY WT.) | PENETROMETER (TSF) | TORVANE STRENGTH (TSF) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | ░ | **SP** | SAND; (calcareous) trace fines, few gravel and roots | | | light brown | slightly moist | loose | | | | |
| | ░ | | --no gravel | | | light tan | | mod. dense | | | | |
| 2.5 | ░ | | | ■ | 22 | | | | 75.5 | 8.5 | | |
| | ░ | | | | | | | loose | | | | |
| | ░ | | | ■ | 14 | | | | 79.0 | 12.4 | | |
| 5 | ░ | | | | | | | | | | | |
| | ░ | | --few calcareous gravel | | | | ▼ | | | | | |
| | ░ | | | ■ | 20 | | | | 89.1 | 26.3 | | |
| 7.5 | ░ | | | | | | | | | | | |
| 10 | ░ | | | ■ | 10 | | | | 97.5 | 25.9 | | |
| | | | END OF BORING | | | | | | | | | |
| 12.5 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 17.5 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 22.5 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 27.5 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 32.5 | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | |

PROJECT NAME: 4433 KAHALA AVENUE RESIDENCE

PROJECT NO.: 05-0079

**SHINSATO ENGINEERING, INC.**

*Consulting Geotechnical Engineers*
98-747 Kuahao Place, #E
Pearl City, HI 96782

PLATE
10

# LOG OF BORING NO. 9

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

ELEVATION: **5.916**
DEPTH OF BORING (FT.): **10.5**
DEPTH TO GROUNDWATER (FT.): **5.916**
DATE DRILLED: **June 7, 2005**

| DEPTH (FT.) | GRAPHIC SYMBOL | UNIFIED SOIL CLASSIFICATION | DESCRIPTION | SAMPLE | BLOWS/FOOT | COLOR | MOISTURE | CONSISTENCY | DRY DENSITY (PCF) | MOISTURE CONTENT (% OF DRY WT.) | PENETROMETER (TSF) | TORVANE STRENGTH (TSF) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | **SP** | SAND; (calcareous) trace fines, few gravel and roots<br>--no gravel | | | light tan | slightly moist | loose | | | | |
| 2.5 | | | | | 8 | | | | | 4.1 | | |
| | | | | ■ | 11 | | | | 82.6 | 9.4 | | |
| 5 | | | | | | | | | | | | |
| | | | | | 10 | | ▼ | | | | | |
| 7.5 | | | | | | | | | | | | |
| | | | --with calcareous gravel | | | light gray | | | | | | |
| 10 | | | | ■ | | | | | 87.9 | 32.4 | | |
| | | | | | 1 | | | | | | | |
| | | | END OF BORING | | | | | | | | | |
| 12.5 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 17.5 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 22.5 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 27.5 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 32.5 | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | |

PROJECT NAME: 4433 KAHALA AVENUE RESIDENCE

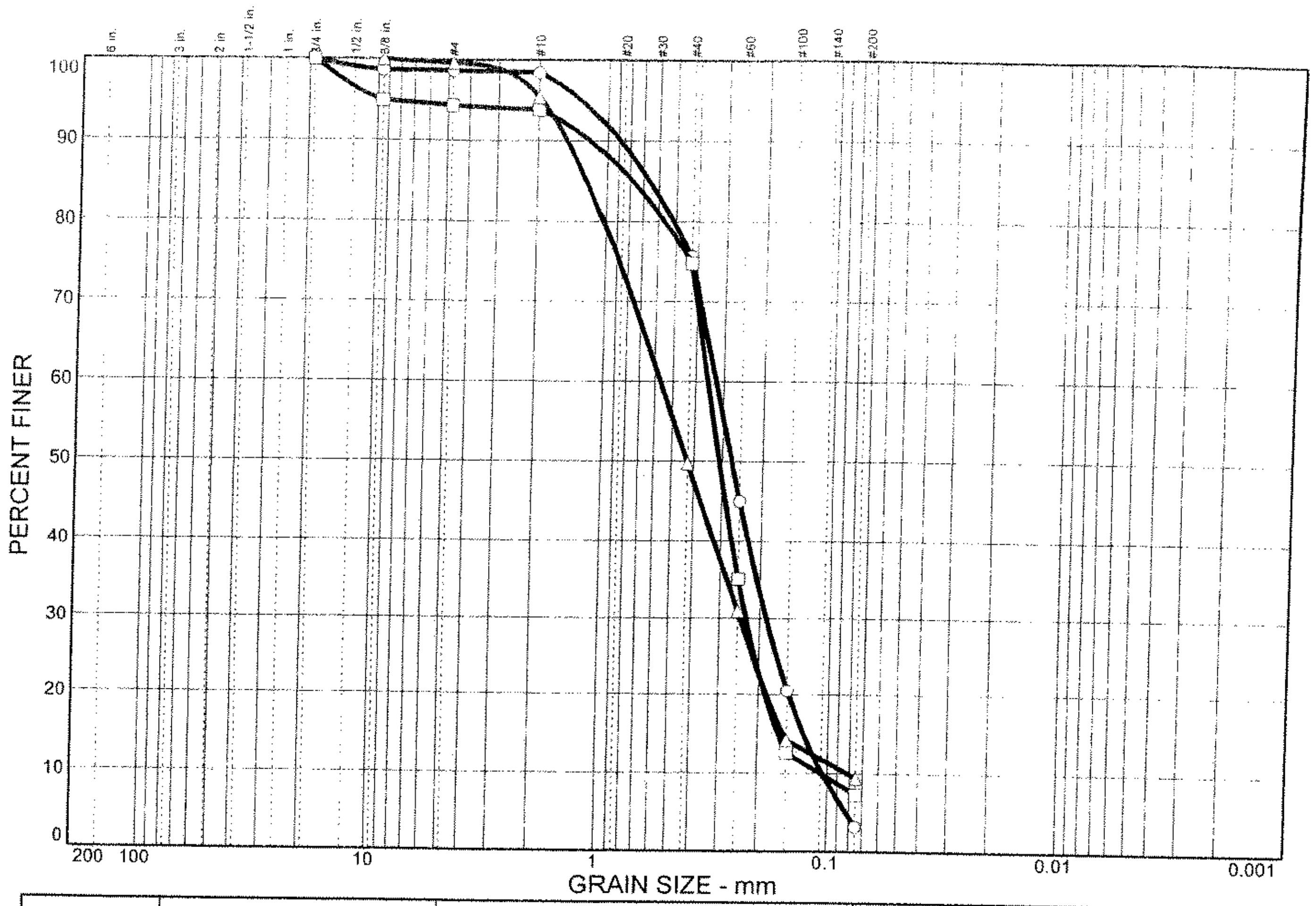
PROJECT NO.: 05-0079

**SHINSATO ENGINEERING, INC.**

*Consulting Geotechnical Engineers*
98-747 Kuahao Place, #E
Pearl City, HI 96782

PLATE
**11**

# Grain Size Distribution



| | % COBBLES | % GRAVEL | | % SAND | | | % FINES | |
|---|---|---|---|---|---|---|---|---|
| | | CRS. | FINE | CRS. | MEDIUM | FINE | SILT | CLAY |
| ○ | 0 | 0 | 1 | 0 | 23 | 72 | 3 | |
| □ | 0 | 0 | 6 | 1 | 19 | 67 | 7 | |
| △ | 0 | 0 | 0 | 4 | 46 | 40 | 9 | |
| | | | | | | | | |
| | | | | | | | | |

## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | DESCRIPTION | USCS |
|---|---|---|---|---|---|
| ○ | 1 | 1 | 2.0 | | |
| □ | 3 | 1 | 1.0 | --trace fines | |
| △ | 4 | 3 | 6.5 | --with fines | SW-SM |
| | | | | | |
| | | | | | |

Grain Size Distribution

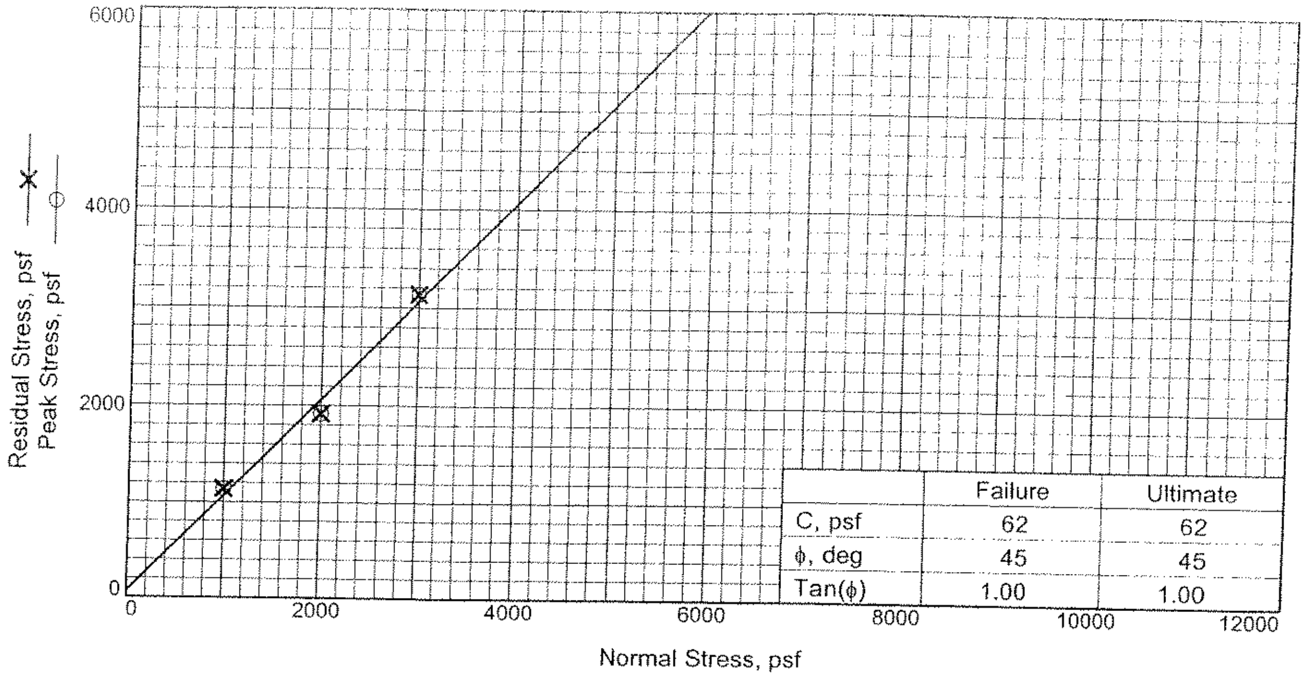
**Shinsato Engineering, Inc.**

**Client:**

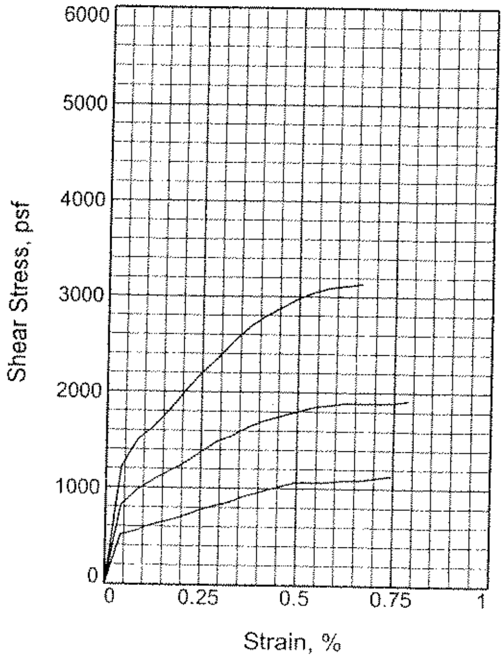
**Project:** 4433 KAHALA AVENUE RESIDENCE

**Project No.:** 05-0079

**PLATE** 12



| | Failure | Ultimate |
|---|---|---|
| C, psf | 62 | 62 |
| ϕ, deg | 45 | 45 |
| Tan(ϕ) | 1.00 | 1.00 |



| | Sample No. | 1 | 2 | 3 |
|---|---|---|---|---|
| Initial | Water Content, % | N/A | N/A | N/A |
| | Dry Density, pcf | N/A | N/A | N/A |
| | Saturation, % | N/A | N/A | N/A |
| | Void Ratio | N/A | N/A | N/A |
| | Diameter, in. | 2.42 | 2.42 | 2.42 |
| | Height, in. | 1.00 | 1.00 | 1.00 |
| At Test | Water Content, % | N/A | N/A | N/A |
| | Dry Density, pcf | | | |
| | Saturation, % | | | |
| | Void Ratio | | | |
| | Diameter, in. | | | |
| | Height, in. | | | |
| | Normal Stress, psf | 1000 | 2000 | 3000 |
| | Peak Stress, psf | 1135 | 1915 | 3134 |
| | Strain, % | 0.7 | 0.8 | 0.7 |
| | Residual Stress, psf | 1135 | 1915 | 3134 |
| | Strain, % | 0.7 | 0.8 | 0.7 |
| | Strain rate, in./min. | 0.00 | 0.00 | 0.00 |

**Sample Type:**
**Description:**

**LL=** **PL=** **PI=**
**Assumed Specific Gravity=**
**Remarks:**

**Client:**

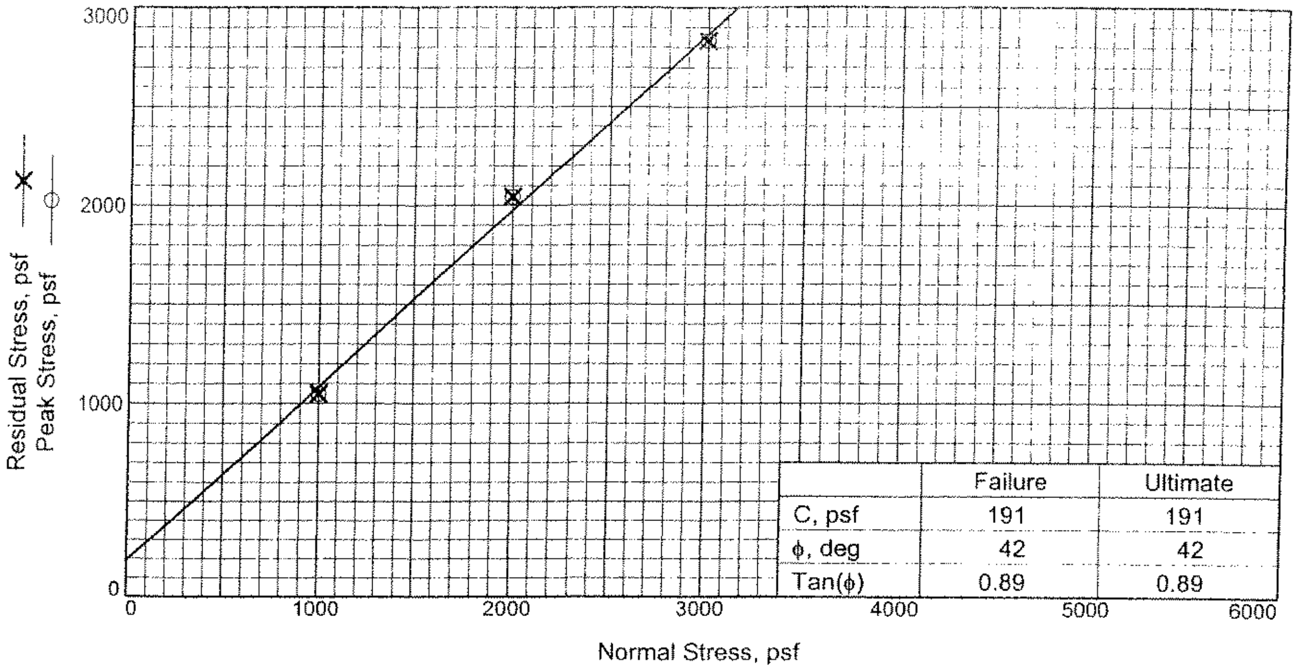
**Project:** 4433 KAHALA AVENUE RESIDENCE

**Source of Sample:** 1 **Depth:** 3.5
**Sample Number:** 2
**Proj. No.:** 05-0079 **Date:**

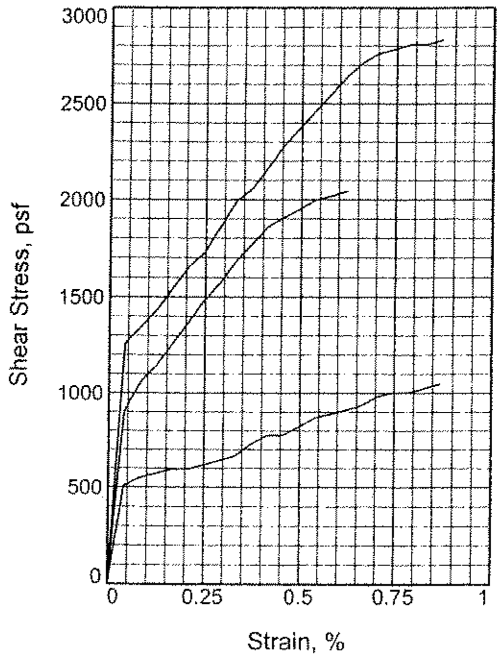
DIRECT SHEAR TEST REPORT

## Shinsato Engineering, Inc.

**PLATE** 13



| | Failure | Ultimate |
|---|---|---|
| C, psf | 191 | 191 |
| φ, deg | 42 | 42 |
| Tan(φ) | 0.89 | 0.89 |



| | Sample No. | 1 | 2 | 3 |
|---|---|---|---|---|
| Initial | Water Content, % | N/A | N/A | N/A |
| | Dry Density, pcf | N/A | N/A | N/A |
| | Saturation, % | N/A | N/A | N/A |
| | Void Ratio | N/A | N/A | N/A |
| | Diameter, in. | 2.42 | 2.42 | 2.42 |
| | Height, in. | 1.00 | 1.00 | 1.00 |
| At Test | Water Content, % | N/A | N/A | N/A |
| | Dry Density, pcf | | | |
| | Saturation, % | | | |
| | Void Ratio | | | |
| | Diameter, in. | | | |
| | Height, in. | | | |
| | Normal Stress, psf | 1000 | 2000 | 3000 |
| | Peak Stress, psf | 1047 | 2044 | 2830 |
| | Strain, % | 0.9 | 0.6 | 0.9 |
| | Residual Stress, psf | 1047 | 2044 | 2830 |
| | Strain, % | 0.9 | 0.6 | 0.9 |
| | Strain rate, in./min. | 0.00 | 0.00 | 0.00 |

**Sample Type:**

**Description:**

**LL=** **PL=** **PI=**

**Assumed Specific Gravity=**

**Remarks:**

**Client:**

**Project:** 4433 KAHALA AVENUE RESIDENCE

**Source of Sample:** 3 **Depth:** 6.5

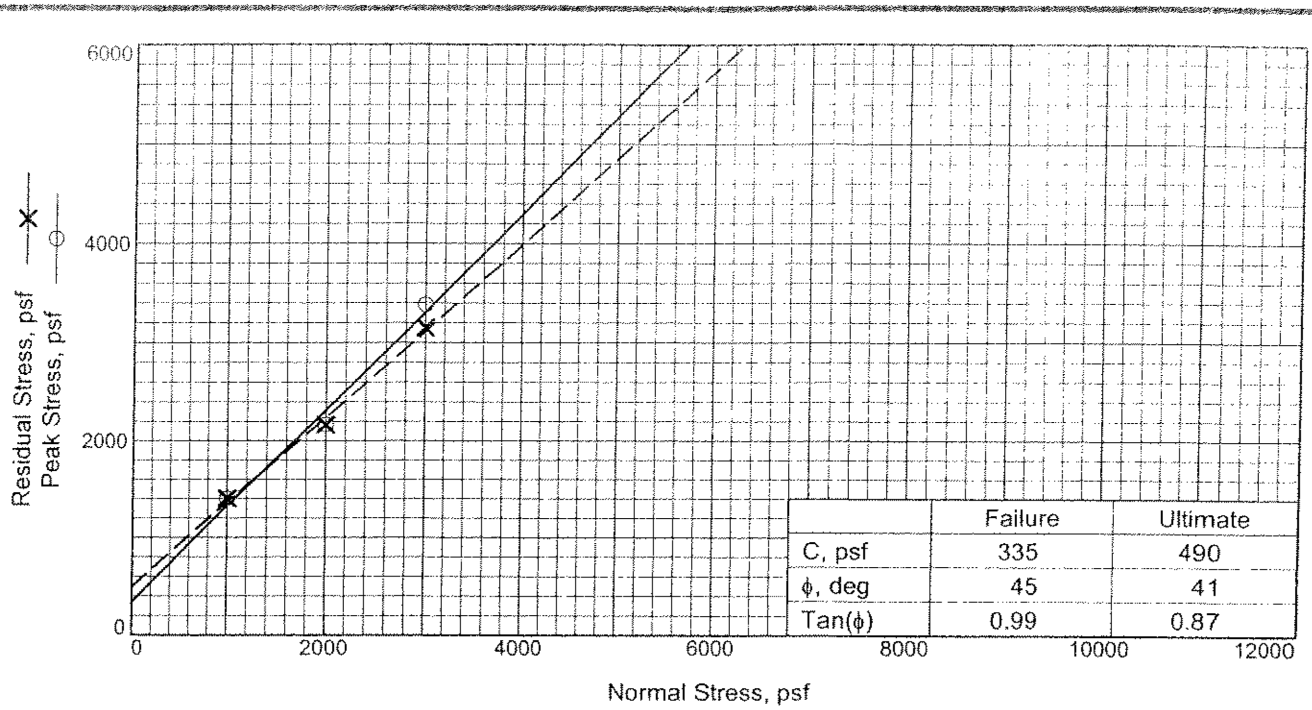
**Sample Number:** 3

**Proj. No.:** 05-0079 **Date:**

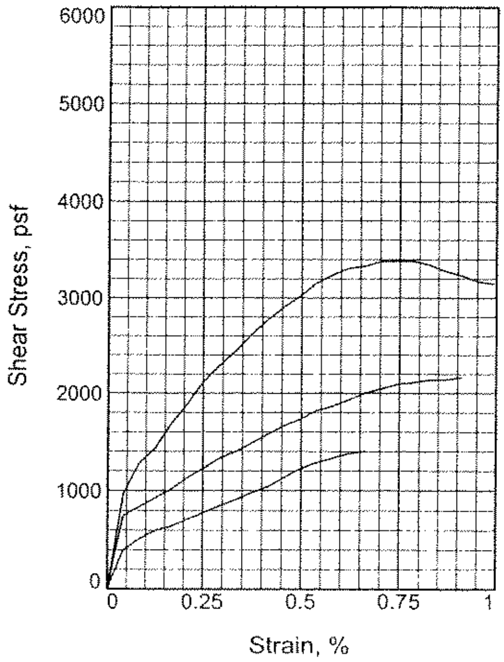
DIRECT SHEAR TEST REPORT

Shinsato Engineering, Inc.

PLATE 14



| | Failure | Ultimate |
|---|---|---|
| C, psf | 335 | 490 |
| ϕ, deg | 45 | 41 |
| Tan(ϕ) | 0.99 | 0.87 |



| | Sample No. | 1 | 2 | 3 |
|---|---|---|---|---|
| Initial | Water Content, % | N/A | N/A | N/A |
| | Dry Density, pcf | N/A | N/A | N/A |
| | Saturation, % | N/A | N/A | N/A |
| | Void Ratio | N/A | N/A | N/A |
| | Diameter, in. | 2.42 | 2.42 | 2.42 |
| | Height, in. | 1.00 | 1.00 | 1.00 |
| At Test | Water Content, % | N/A | N/A | N/A |
| | Dry Density, pcf | | | |
| | Saturation, % | | | |
| | Void Ratio | | | |
| | Diameter, in. | | | |
| | Height, in. | | | |
| | Normal Stress, psf | 1000 | 2000 | 3000 |
| | Peak Stress, psf | 1400 | 2163 | 3380 |
| | Strain, % | 0.7 | 0.9 | 0.7 |
| | Residual Stress, psf | 1400 | 2163 | 3147 |
| | Strain, % | 0.7 | 0.9 | 1.0 |
| | Strain rate, in./min. | 0.00 | 0.00 | 0.00 |

**Sample Type:**
**Description:**

**LL=** **PL=** **PI=**
**Assumed Specific Gravity=**
**Remarks:**

**PLATE** 15

**Client:**

**Project:** 4433 KAHALA AVENUE RESIDENCE

**Source of Sample:** 6 **Depth:** 5.5
**Sample Number:** 3
**Proj. No.:** 05-0079 **Date:**

DIRECT SHEAR TEST REPORT

Shinsato Engineering, Inc.

# Appendix C

# Justification for Shoreline Setback Variance Under Revised Ordinances of Honolulu (ROH) §23-1.8(b)(3), Hardship Standard

## ROH §23-1.8(3), Hardship

The application for a shoreline setback variance fulfills the three criteria for a "hardship" variance set forth in ROH Sec. 23-1.8(b)(3). The owner of the subject property will suffer a hardship if the seawall support is not constructed and other minor improvements are not allowed.

1. **The applicant would be deprived of reasonable use of the land if required to comply fully with the shoreline setback ordinance and shoreline setback rules.**

   Parcel 10 currently has a nonconforming seawall. If the proposed support were not allowed, future storm waves could undermine the seawall and cause it to fail. This, in turn, would lead to a substantial loss of land as the shoreline continued to erode. Subsequent erosion of the land would threaten the foundations of the planned residences and eventually economically viable use of the land.

   Other proposed improvements include side fence walls, two dry-wells, and a shower and foot wash. The fence walls on either side of the property are needed for security. The dry wells are needed to improve drainage on the site. The shower and foot wash are needed to maintain health and cleanliness. These are minimal improvements accessory to residential use. The applicant also proposes to demolish existing decks and other hardscape within the shoreline setback. The net result would be more landscape planting and a greater amount of permeable surface near the shoreline.

2. **The applicant's proposal is due to unique circumstances and does not draw into question the reasonableness of this chapter or the shoreline setback rules.**

   Kahala Beach has been undergoing coastal erosion since before the 1960s, evidenced by the construction of seawalls along much of the Kahala shoreline. The reason for the proposed support structure is to prevent further undermining and eventual failure of the nonconforming seawall on parcel 10.

3. **The proposal is the practicable alternative which best conforms to the purpose of this chapter and the shoreline setback rules**

   The Coastal Engineering Evaluation analyzed a number of alternative measures. A no action alternative would lead to eventual undermining and failure of the seawall resulting in large quantities of soil, sand, and debris to be scattered along the shoreline.

Beach nourishment demands careful planning for an entire reach of shoreline. It would affect many properties and require permits for work in State and Federal jurisdictions. Such a project is beyond the capability of a single property owner.

Replacing the seawall with a rock revetment would have substantial construction impacts, would occupy a large land area, and would create structural and erosion problems for the flanking vertical seawalls on either side. Simply another form of shoreline hardening, building a revetment would have little positive impact on the shoreline.

Installing large geotextile sandbags is typically used as a temporary emergency measure. Placing sandbags seaward of the seawall would, among other results, have a negative impact on lateral shoreline access.

As stated in the Coastal Engineering Evaluation, seawall repair – i.e., the construction of foundation support – is the preferred alternative. A properly constructed seawall is a proven, low maintenance, and long lasting shore protection method. Repairing the existing seawall will not change the existing shoreline or other environmental conditions.