DEPARTMENT OF LAND UTILIZATION
90/SV-2, 3, 4, 5(BWM)

CHAPTER 343, HRS
ENVIRONMENTAL ASSESSMENT/DETERMINATION
NEGATIVE DECLARATION

Lanikai Revetment

Recorded Owners/Applicants	:	Philip K. Binney (Parcel 78); Lanikai Associates, Limited Partnership (Parcel 79); W&E Baxter Revocable Trust (Parcel 88); WDI Partners (Parcel 108)
Agent	:	Philip K. Binney (Parcel 78); Wendelin L. Campbell (Parcels 79, 88, and 108)
Location	:	Lanikai, Kailua, Oahu
Tax Map Key	:	4-3-04: Parcels 78, 79, 88 and 108
Request	:	Construction of Concrete Rubble Masonry Revetment, side yard walls and fences, and drainage pipes, all within the Shoreline Area. Portions of the revetment are proposed within areas under State jurisdiction.
Determination	:	Environmental Impact Statement (EIS) Not Required

Attached and incorporated by reference is the environmental assessment prepared by the applicant for the project.

On the basis of the environmental assessment, we have determined that an Environmental Impact Statement is not required.

Dated at Honolulu, Hawaii, this 5th day of June, 1990.

APPROVED Donald A. Clegg
DONALD A. CLEGG
Director of Land Utilization
City & County of Honolulu
State of Hawaii

DAC:sl
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1990-06-23-OA-FEA
Lanikai Revetment

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COASTAL ENGINEERING EVALUATION
AND ENVIRONMENTAL ASSESSMENT
FOR RECONSTRUCTION OF SHORE PROTECTION
AT LANIKAI, OAHU, HAWAII
(TMK: 4-3-04: 78, 79, 88, 108)

DECEMBER 7, 1989

1.0 LOCATION AND PROBLEM DEFINITION

The project site is located along four (4) contiguous parcel shorefronts at Lanikai, at the southeast end towards Wailea Point (TMK: 4-3-04: 78, 79, 88, 108). Figure 1 shows the general site location and Figure 2 is a reduced copy of a portion of the shoreline and topographic survey of the parcels prepared by Control Point Surveying and Engineering, Inc.

Three of the four parcel shorefronts are protected with rock masonry seawalls. The remaining parcel shorefront is adjacent to a Lanikai Association right-of-way (TMK: 4-3-04:96) and is protected with a rock riprap slope. All shore protection structures were constructed without obtaining a variance from the Shoreline Setback Rules and Regulations and are therefore in violation of the regulations.

In order to remedy these violations for the existing shore protection, after-the-fact shoreline setback variances are required for the four parcels. However, since an after-the-fact shoreline setback variance was not approved for the existing seawall at TMK:4-3-04:88, and in consideration of the recommendations of the City & County Department of Land Utilization, a new sloping rock revetment is proposed to be constructed to provide appropriate and more suitable shore protection to these parcels. The revetment will be continuous across the four parcel shorefronts to provide a more cost-efficient, durable, and aesthetically acceptable structure.

This coastal engineering evaluation and environmental assessment is prepared in support of an application for a Shoreline Setback Variance for the revetment, and in accordance with Ordinance No. 4631 Shoreline Setback Rules and Regulations.

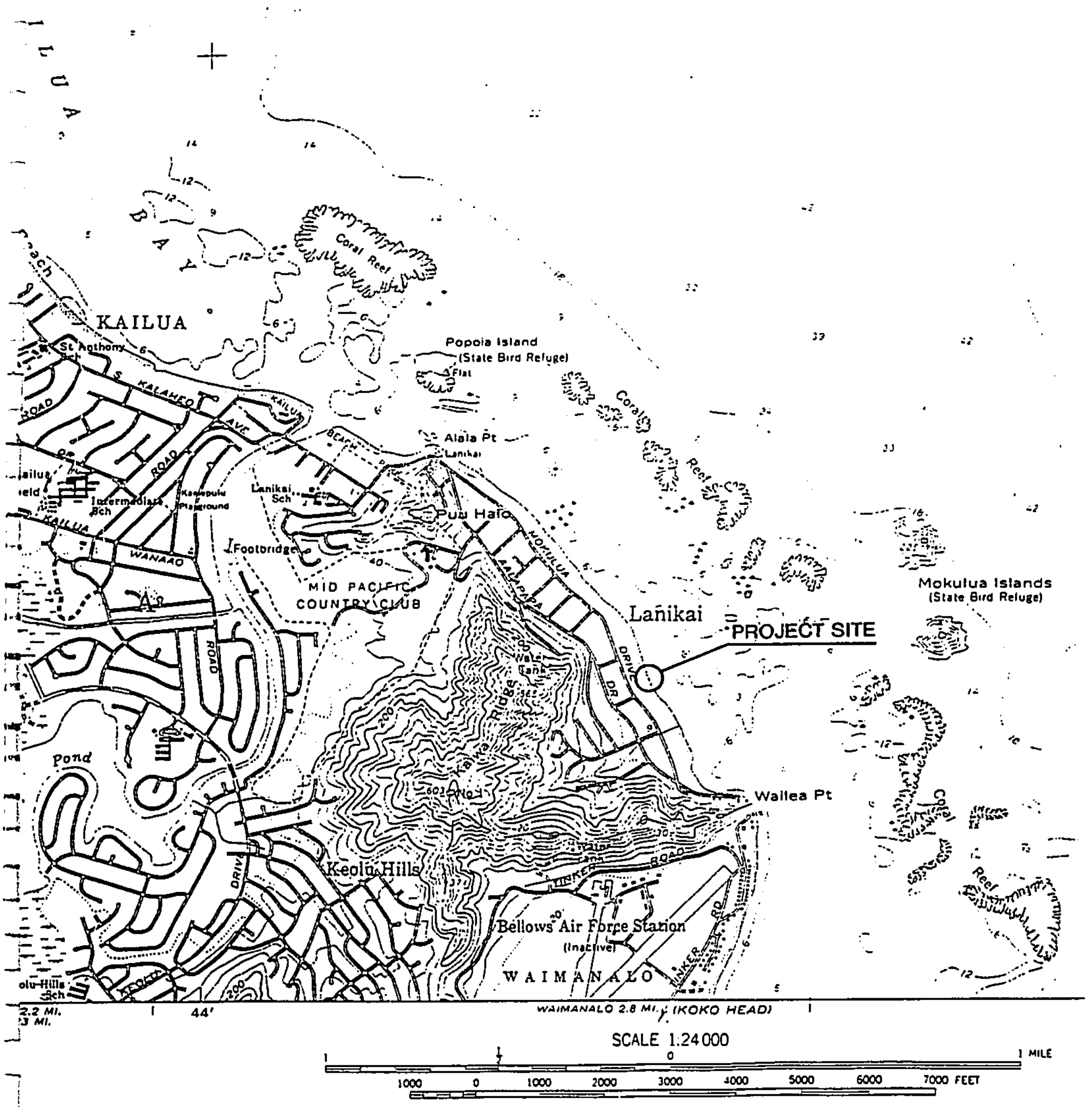

FIGURE 1. LOCATION MAP

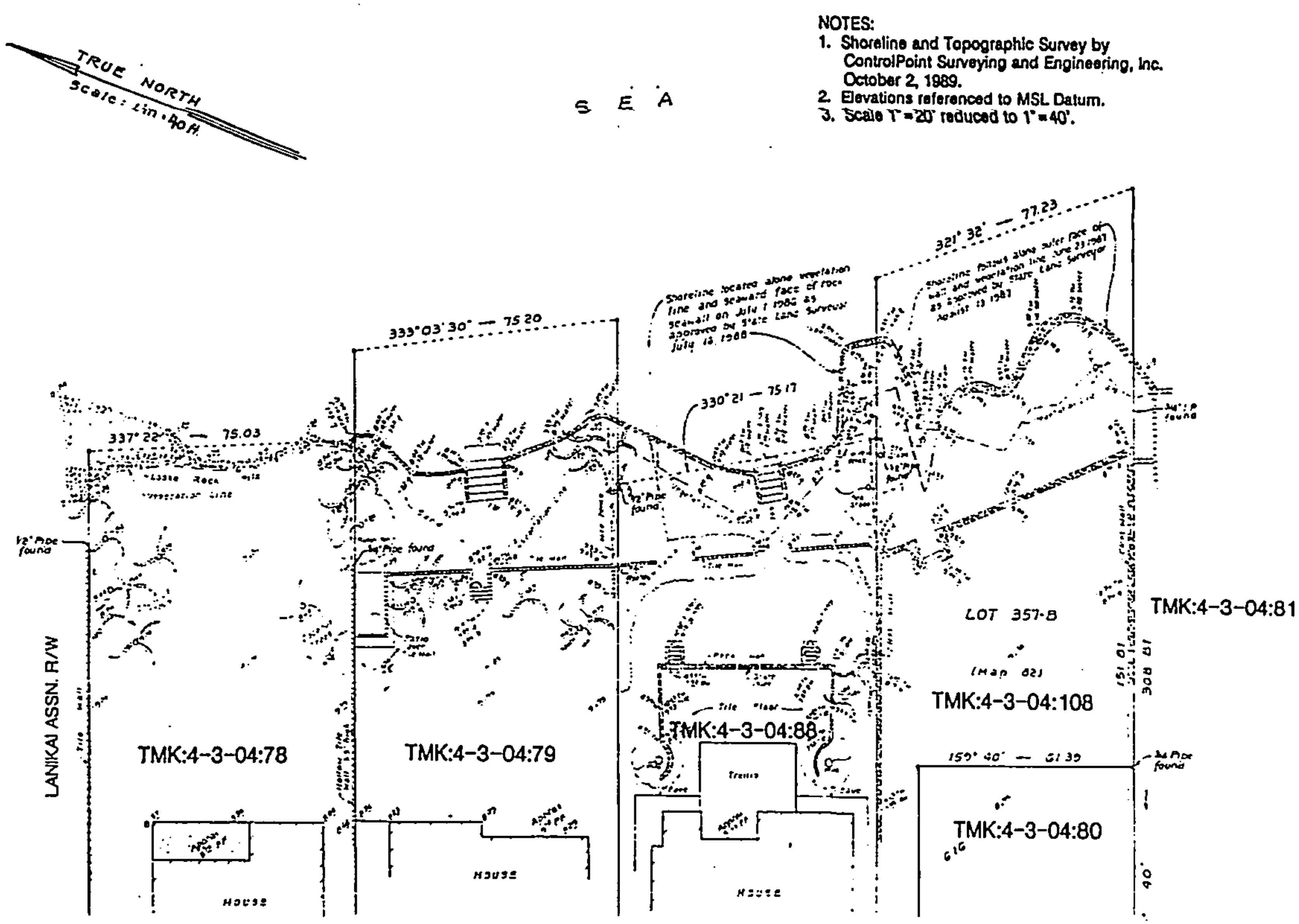

FIGURE 2. PORTION OF SHORELINE AND TOPOGRAPHIC SURVEY

2.0 COASTAL SETTING

2.1 Shoreline Characteristics

The coastal reach from the project site southeastward to Wailea Point is presently devoid of dry beach. Photos 1 through 8 show photos of the existing shoreline along the project reach. Various types of seawalls and revetments protect the entire +2,000 foot stretch of shoreline south of the project site (Photo 9). Dry beach exists northwestward of the project site along a 3,000 foot stretch of shoreline in the central portion of the Lanikai coast. Few shore protection structures presently exist along this reach (Photo 10). Further northwestward towards Alala Point, approximately 1,000 feet of shoreline is devoid of dry beach and protected with various types of seawalls and revetments.

The wave climate along the Lanikai shoreline is relatively mild because of the protection afforded by the shallow offshore fringing reefs and islands. Large deepwater waves initially break on the shallow reefs and what energy remains propagates to the shoreline as reformed waves which break at the shore. Typical nearshore wave heights are 1 foot or less, with typical maximum wave heights less than 2 feet. Maximum storm waves which can attack the shoreline are limited by the nearshore water depth. Maximum breaking wave height at the shoreline during an extreme storm is estimated to be 4.8 feet at the project site.

The nearshore wave approach patterns are complex due to interactions between the wave trains and the irregular offshore reefs and islands. For the project site, longshore transport is estimated to be northwestward during typical northeasterly tradewind wave conditions due to refraction and diffraction effects caused by the Mokulua Islands and the offshore reef flat.

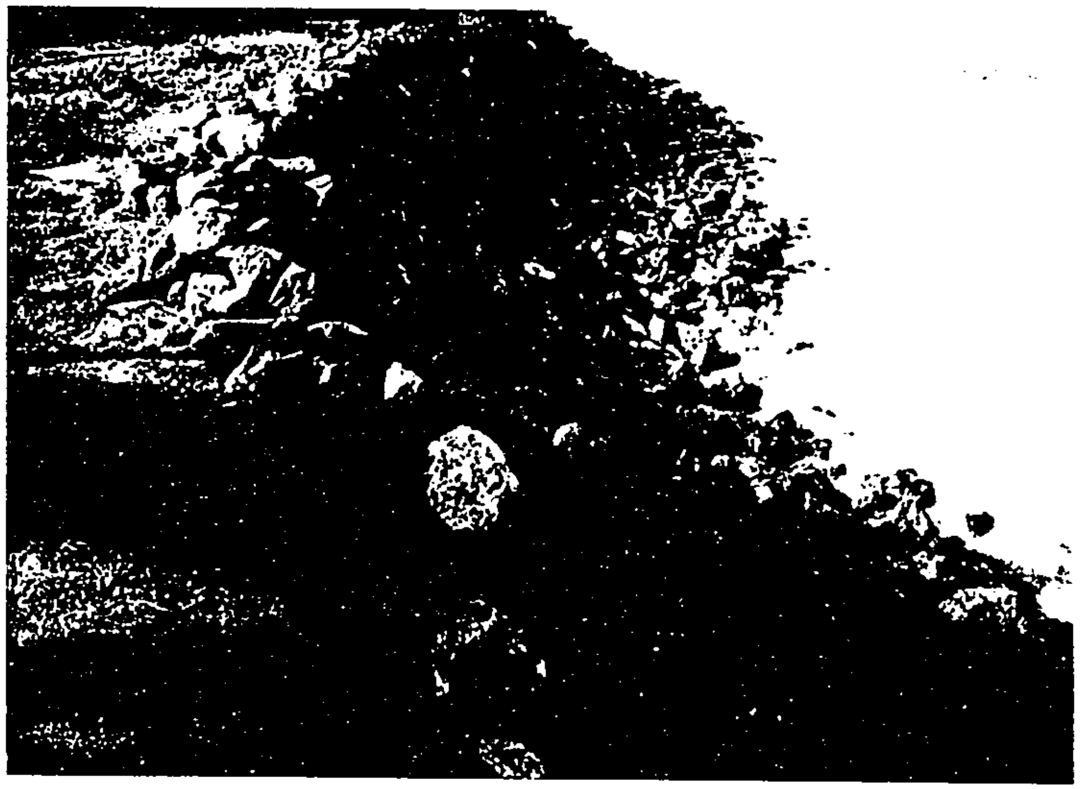

PHOTO 1. VIEW SOUTHWARD FROM NORTH CORNER OF TMK:4-3-04:78.

PHOTO 2. EXISTING RIPRAP SLOPE FRONTING TMK:4-3-04:78.

PHOTO DATE 10/8/89, TIDE APPROX. 0.0 MSL

PHOTO 3. EXISTING CRM WALL
FRONTING TMK:4-3-04:79.

PHOTO 4. CRACKS IN CRM WALL,
SOUTH CORNER OF TMK:4-3.04:79.

PHOTO DATE 10/8/89, TIDE APPROX. 0.0 MSL

PHOTO 5. EXISTING CRM WALL
FRONTING TMK:4-3-04:88.

PHOTO 6. DAMAGED CRM WALL,
SOUTH CORNER OF TMK:4-3.04:88.

PHOTO DATE 10/8/89, TIDE APPROX. 0.0 MSL

PHOTO 7. EXISTING CRM WALL FRONTING TMK:4-3-04:108.

PHOTO 8. SINKHOLE AT SOUTH CORNER OF TMK:4-3-04:108.

PHOTO DATE 10/8/89, TIDE APPROX. 0.0 MSL

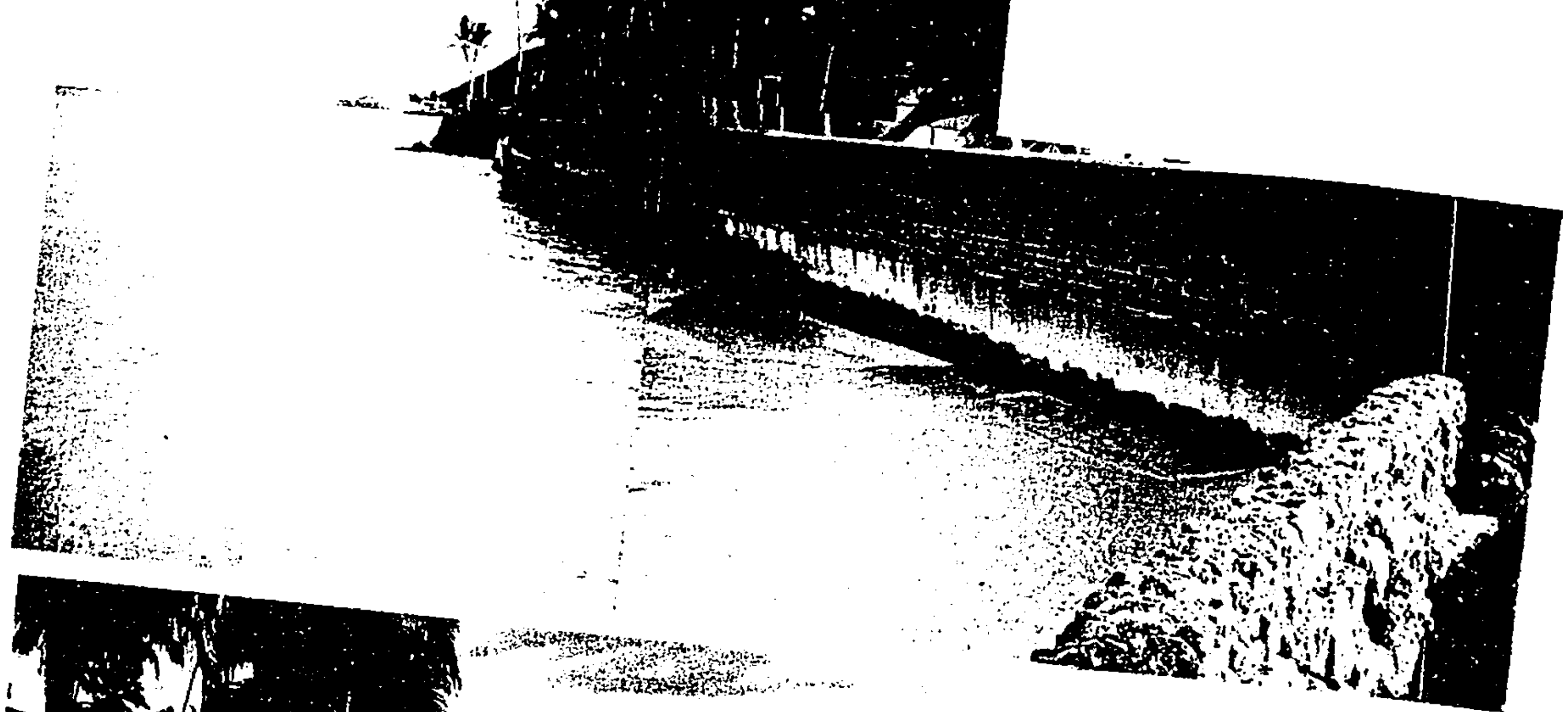

PHOTO 9. SHORELINE SOUTH OF TMK:4-3-04:108.

PHOTO 10. SHORELINE NORTH OF TMK:4-3-04:78. (Vertical brick wall borders the north side of the public right-of-way.)

PHOTO DATE 10/8/89, TIDE APPROX. 0.0 MSL

Because there is a deficit of sand at the southeast end of Lanikai, there is typically no dry sand beach in front of the project site. During the winter months when northerly swell can occur, southeastward longshore transport of sand from the beach areas north of the project site can result in some buildup of sand along the project reach. However, with the return of the predominant tradewind waves, much of this sand will return to the beachfront north of the project site. The high reflectivity of the existing seawalls along the southeast Lanikai shoreline also tends to hasten the longshore transport of sediments from the area because of the increased turbulence at the base of the walls. The turbulence keeps sand in suspension, allowing the longshore currents to carry these sediments away from the area.

Because the existing seawalls are apparently footed on sandy foundation materials, scouring at the base of the walls have caused differential settlement and cracking problems. Leaching of backfill through the cracks have resulted in large voids or sinkholes on all three parcels.

2.2 Coastal Processes

The project site is at the southeast end of Lanikai, within 1,000 feet northwest of the Lanipo Drive drainage channel. This southeast end of Lanikai had experienced considerable accretion and subsequent erosion over a long-term period from 1950 to the 1980s. Figure 3a shows the average cumulative movement of the shoreline over a 2,500 feet length along the southern third of the Lanikai coastline.[1] Between 1950 and 1970, this shoreline reach accreted substantially, a maximum of about 200 feet near

[1]Based on analysis of historical aerial photos as described in the study report, "HAWAII SHORELINE EROSION MANAGEMENT STUDY, Overview and Case Study Sites (Makaha, Oahu; Kailua-Lanikai, Oahu; Kukuiula-Poipu, Kauai)", prepared by Edward K. Noda and Associates Inc. and DHM Inc., for the Hawaii Coastal Zone Management Program, Office of State Planning, June 1989. Refer to this study for a detailed discussion of the littoral processes and long-term changes along the entire Lanikai shoreline.

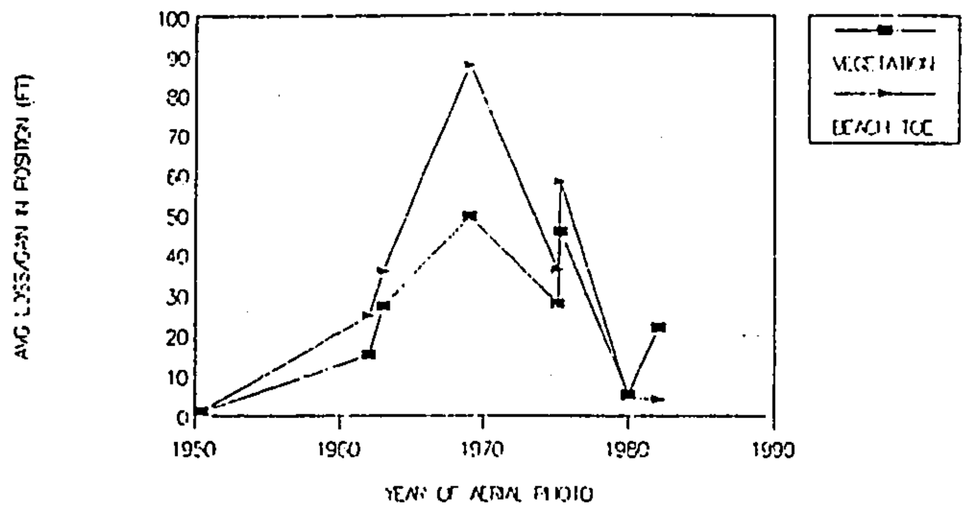

FIGURE 3a. Average cumulative movement for a 2,500-foot stretch of shoreline from Wailea Point northward past the project site.

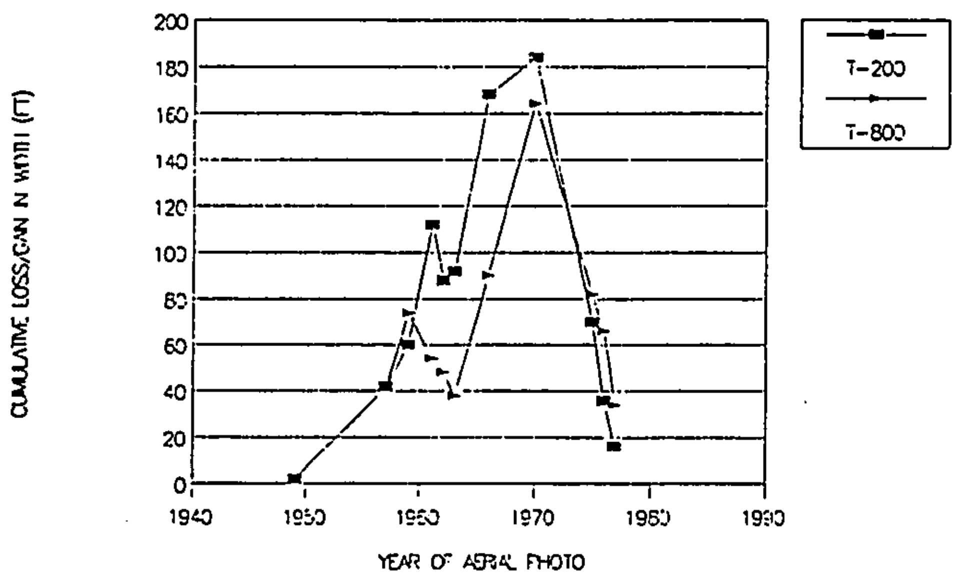

FIGURE 3b. Cumulative movement of the shoreline at Kailua Beach Park at locations 200' and 800' from the boat ramp.

(From "HAWAII SHORELINE EROSION MANAGEMENT STUDY, Overview and Case Study Sites - Makaha, Oahu; Kailua-Lanikai, Oahu; Kukuiula-Poipu, Kauai", by Edward K. Noda and Associates, Inc. and DHM Inc., for the Hawaii Coastal Zone Management Program, June 1989.)

the drainage channel. Many of the property owners (including the owners of two of the subject properties) legally extended their property boundaries seaward by claiming these accreted fastlands. From 1970 to the early 1980s, the shoreline eroded back to the approximate 1950s position. Most of the seawalls were constructed in response to this erosion cycle. Presently, the entire +2,000-foot reach at the southeast end of Lanikai is armored with shore protection structures.

The long-term accretion and erosion cycle was a natural process, possibly caused by shifts in wind and wave patterns. The southern Lanikai shore displayed similar historical accretion-erosion trends as the Kailua Beach Park shoreline (which was and still is unprotected). Figure 3b shows the historical shoreline movement at Kailua Beach Park. The Lanikai seawalls were constructed in response to the erosion cycle to protect existing residential improvements, and were not the cause of the erosion trend. Their influence now, however, is to discourage sand buildup if there is a return to an accretionary phase of the cycle. With the increase in reflectivity due to the seawalls, there is little chance for sediment to be re-deposited and for the beach to build back naturally in the near future.

There is an ample beach width over the middle segment of the Lanikai coastline. Because the shoreline has been relatively stable along this central reach throughout the +30 year period from 1950 to the early 1980s, there is a relative absence of shore protection structures.

The project site is in the transition zone between the southeastern end of Lanikai that historically has undergone a dramatic accretion-erosion cycle, and the middle segment of Lanikai that historically has been relatively stable. There is presently no dry beach fronting the subject parcels. A normally dry beach is found just to the north of the project site, which continues for a distance of about 3,000 feet over the central Lanikai coastline.

Northerly waves during the winter season can result in longshore transport from the central Lanikai beach area towards the southeast along the project shoreline, resulting in occasional buildup of the beachfront. However, the predominant tradewind waves result in net transport northwestward, causing a deficit of beach sand from the project site southeastward.

3.0 CONSIDERATION OF ALTERNATIVES

Removal of the existing CRM seawalls without constructing replacement shore protection structures is not a viable alternative, since the unprotected shoreline will likely experience erosion damage. The project site is in the transition zone between the extreme southeast Lanikai shoreline which has experienced a net long-term erosion cycle since 1970, and the central Lanikai shoreline which has been relatively stable in the long-term over the past 30 years or so. Deficit of sand along the southeast Lanikai shoreline may be causing a gradual shift of the erosion trend towards the shoreline reach north of the project site. There is evidence of a wave-cut escarpment fronting the property on the north side of Parcel :78 next to the Lanikai Association right-of-way, and rocks have been placed along the escarpment in efforts to mitigate the erosion damage.

Beach nourishment and stabilization with structural measures to protect the beach fill would be the preferred alternative for the entire southeast end of Lanikai. Unfortunately, this alternative is costly and not realistic to implement for the individual residential landowner.

An offshore breakwater structure would be a suitable alternative to mitigate continued erosion damage if the seawalls were demolished. The breakwater would dissipate the incoming wave energy, thereby forming a protective area in the lee of the structure. Since littoral sediment transport processes require breaking wave energy to transport the littoral materials at the shoreline, a reduction of the incident wave energy will directly reduce erosion in the lee of the breakwater. In addition, longshore transport of sediments into the shadow zone of the breakwater will usually result in a seaward accretion of the shoreline. However, offshore breakwater construction is costly and carries a higher risk than onshore construction. Repair or maintenance of the structure, if damaged due to an extreme storm event, is also very costly due to difficulty in accessing the structure with conventional land equipment.

For individual residential landowners, seawalls and revetments are the most viable methods of protecting a shoreline from wave attack. Vertical impermeable seawalls are generally not appropriate on sandy shorelines because of their high reflectivity, which causes scouring of the sand in front of the structure and can lead to undermining at the base of the wall. For beach environments, sloping rock revetments are more effective in dissipating wave energy and are therefore more conducive to beach accretion. Seawalls may be appropriate for some sandy shorelines provided that the seawall footing can be keyed to a suitable hard foundation, such as beachrock, or adequate toe protection is provided to prevent scouring and undermining of the seawall. In some cases, an existing seawall can be faced with a rock slope to reduce the scouring and damage due to differential settlement. While not a revetment in the traditional sense, such a quasi-revetment structure would certainly improve the stability of the shore protection structure as well as be more conducive to beach accretion.

It must be emphasized that long-term accretion and erosion patterns are caused by environmental factors such as winds, waves, and offshore sand supply. Revetments and seawalls do not alter these environmental factors. Their purpose is to protect an already eroding shoreline. Therefore, while a revetment is more likely to allow sand to build up on the beach than seawalls, a revetment cannot reverse erosion processes.

Revetments that are constructed on unprotected shorefronts typically consist of several layers of rock placed on a shoreline slope. The armor layer must be designed to resist dislocation by wave attack and the slope of the revetment must resist slumping. One or more underlayers beneath the armor layer are required to prevent leaching of the foundation or backfill material through the rock layers. One common cause of revetment failure is the leaching of materials from beneath the armor layer, resulting in slumping or unraveling of the rock face. Similar consideration must be given to the revetment toe, to prevent scouring and undermining at the base of the rock slope. Revetments may also display a tendency to accelerate the erosion of the fronting beach due to wave reflection and downrush turbulence, but not as seriously as with a vertical-faced structure. Permeable rock revetments are effective in dissipating wave energy and are more conducive to beach accretion than vertical impermeable seawalls. If properly designed and constructed, rock revetments are durable and not prone to catastrophic damage due to its flexibility. The disadvantages are the requirement for heavy equipment and special skills to place the large stones used for the armor layer, in addition to the cost to quarry and haul the large stones to the site.

4.0 DESCRIPTION OF PROPOSED ACTION

The existing vertical seawalls have sustained damage due to differential settlement and cracking, resulting in potential for collapse of some sections and large sinkholes in the backshore areas. Substantial wave overtopping of lower sections of the seawall, primarily fronting Parcel :108, has caused scouring and erosion of backshore areas. The existing riprap slope on Parcel :78 is also inadequate to prevent continued wave damage, as slumping and overtopping is evident.

Therefore, a new rock revetment is proposed to be constructed to replace the existing shoreline structures with more adequate protection against future erosion damage. Figure 4 shows two alternative revetment typical sections.

Figure 4a is a revetment constructed on a 1V:2H slope. The armor slope consists of a single layer of 900-1600 pound armor stones (nominal diameter 2 feet). While a single layer of armor stones is generally not recommended, the typically mild wave climate and cost factor justifies using a single armor layer. The armor stones are placed on a 3-foot thick underlayer of spalls to 12-inch stone, with the larger stones on the outer surface. The extended toe of the revetment is underlain with a 1-foot thick bedding layer of spalls to 12-inch stone. The revetment toe should be excavated to place the bedding layer below the existing grade, to a minimum elevation of -1.0' MSL. An additional armor stone is placed at the toe to provide a measure of safety in the event of scouring or erosion at the base of the revetment. The additional armor stone will settle into the scour hole and mitigate slumping of the upper slope. The crest elevation at +8.0' MSL would sustain only minor overtopping during storm conditions.

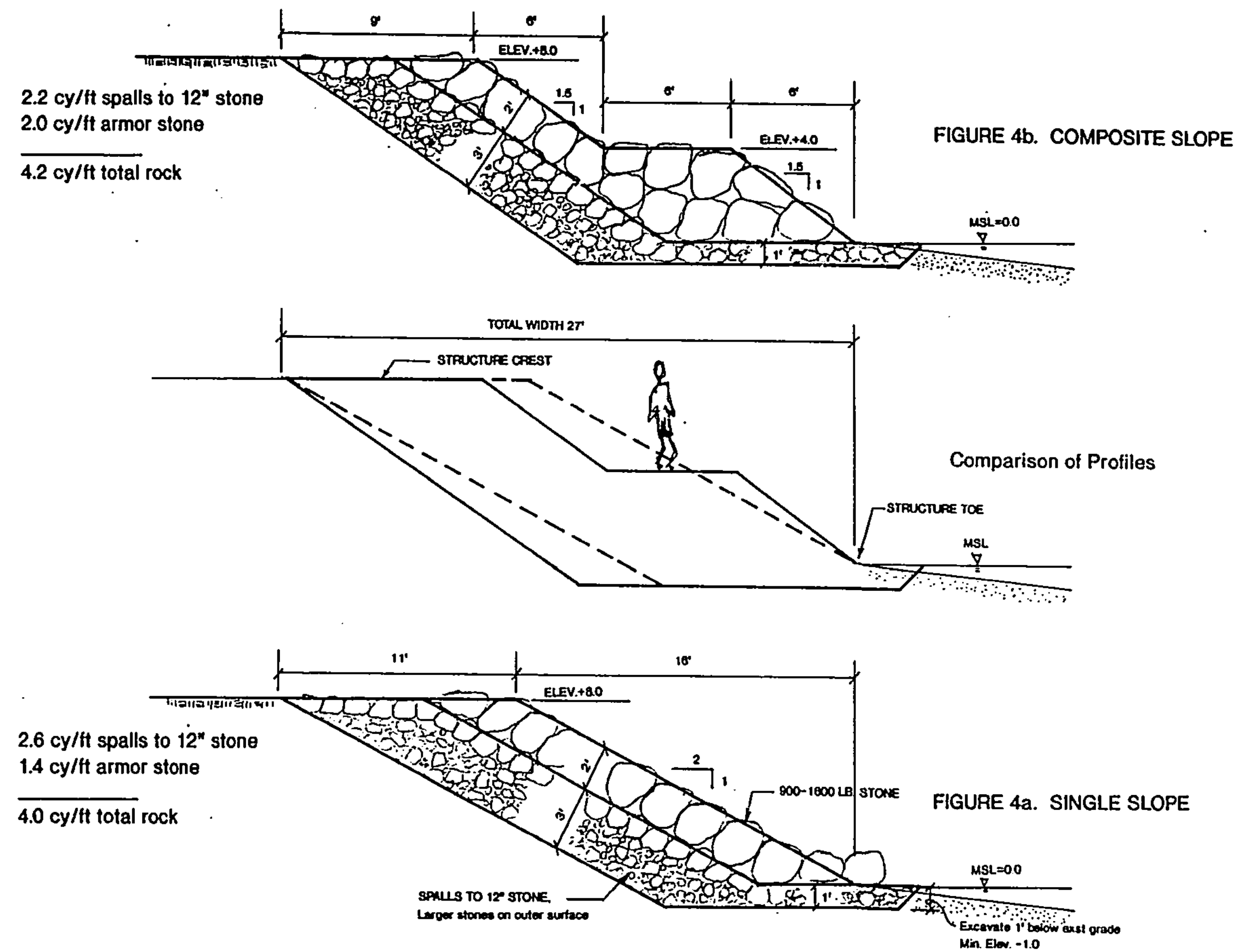

FIGURE 4. ALTERNATIVE REVETMENT TYPICAL SECTIONS
(Approx. Scale 1"=6')

Figure 4b is a revetment with a composite slope. A 6-foot wide armor stone bench is provided at elevation +4.0' MSL. The upper and lower side slopes are 1V:1.5H. The equivalent seaward slope (from the crest to the toe) is flatter than 1V:2H. The armor layer is underlain with a 3-foot thick layer of spalls to 12-inch stone, and the toe is underlain with a 1-foot thick bedding layer of spalls to 12-inch stone, similar to the single slope revetment.

Both revetment configurations take up the same horizontal width on the shoreline, a total of 27 feet from the toe to the landward edge of the crest. Both require approximately the same quantity of rock, a total of 4.0 cubic yards (cy) per linear foot for the single slope and 4.2 cy per linear foot for the composite slope. The composite slope structure would be more costly to construct because of the multiple slopes and the greater quantity of large armor stones relative to the single slope structure. However, although more costly, the composite slope revetment has several advantages which make it the preferred configuration:

- <u>The composite slope revetment is technically superior.</u> This configuration reduces wave runup and wave reflection, as well as increases the stability of the rubble slope under storm wave attack. One frequent cause of revetment damage is the dislocation of armor stones near the base of the slope caused by the downrush of large waves, which not only causes scouring at the toe but can "pull" stones out of the slope by the hydraulic action of the downwash. The 6-foot wide armor stone bench dissipates the downrush, reduces scouring, and provides a greater safety factor by allowing the armor stones in the bench to settle into any potential scour hole without damaging the integrity of the upper revetment slope.

- <u>The composite slope revetment maintains lateral public access.</u>
  Since this shoreline reach is frequently devoid of dry beach, the public must wade into the water to traverse this entire stretch from the project site southeastward. The 6-foot wide bench would provide an elevated walkway to permit public access along the shoreline. While shoreline access south of the project site will still be affected by the existing seawalls, it is hoped that over time those structures will be modified in a similar manner to provide public access along this entire shoreline reach.

- <u>The composite slope revetment is conducive to sand buildup.</u>
  The composite slope configuration will be more conducive towards beach accretion than the single slope configuration. The design elevation of the bench is equivalent to the runup height of typical waves on the dry beach north of the project site. Thus, wave energy will be more effectively dissipated on the 6-foot wide bench than a continuous slope, and waves would therefore deposit more sediment onto the bench. Moreover, if the beach accretes substantially such that a dry beach is formed, the bench will be buried beneath the sand beach.

Three alternative layout plans for the revetment are presented. Each alternative places the revetment structure at different positions relative to the existing shoreline. Because of the uneven alignment of the existing seawalls and shoreline boundaries, construction of the revetment will necessarily require straightening and realignment of the shoreline. Depending on the specific alignment, portions of the existing seawall will extend seaward of the proposed revetment and will require demolition, while other sections of seawall will be covered by the proposed revetment and therefore may be left intact.

Due to the horizontal width of the proposed revetment, and the fact that the Parcels :78 and :88 seaward property lines are far more landward than the other two parcels, it would not be reasonable or equitable to require that the revetment be situated entirely landward of the existing shoreline. Figure 5 illustrates this point. Note the considerable land area that would be lost by the property owners if the revetment toe line is placed entirely landward of the existing shoreline at any location. Mature trees indicate that the shoreline portions extending furthest seaward were fastlands prior to the construction of the seawalls. Whereas, the unplanted central areas on the parcels may have been more susceptible to storm wave erosion. If the seawalls were constructed after storm wave damage, then the present location of the seawalls in the central areas on each parcel would be landward of the normal pre-storm shoreline and would not be representative of the vegetation line or upper reach of the wash of waves during normal conditions prior to seawall construction. Therefore, it is not reasonable that the revetment toe be placed at the landward-most position of the existing shoreline. Figure 6 shows a more equitable revetment location, and is therefore the recommended layout.

The recommended layout shown in Figure 6 is based on the composite slope revetment configuration, which would be more costly for the landowners to construct but which would be more conducive to sand buildup and would provide enhanced public access along the shorefront. The seaward edge of the revetment crest (i.e. top of the revetment slope) is situated at the property line on Parcel :88. The landward edge of the bench (i.e. bottom of the upper slope) is situated at the property line on Parcel :78. The alignment of the revetment on Parcel :79 ties into these two and the revetment on Parcel :108 continues along

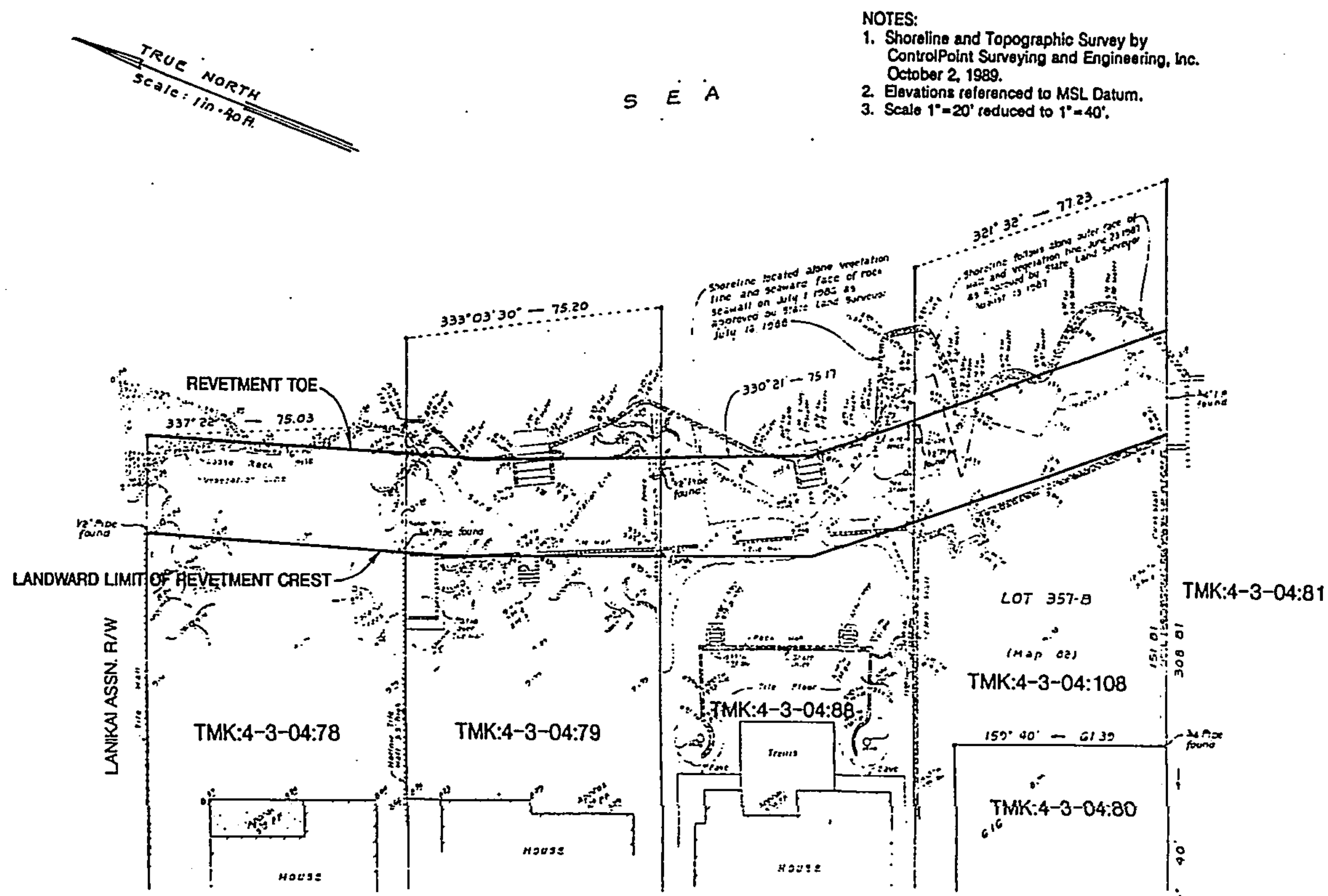

FIGURE 5. ALTERNATIVE LAYOUT PLAN FOR REVETMENT ENTIRELY LANDWARD OF SHORELINE

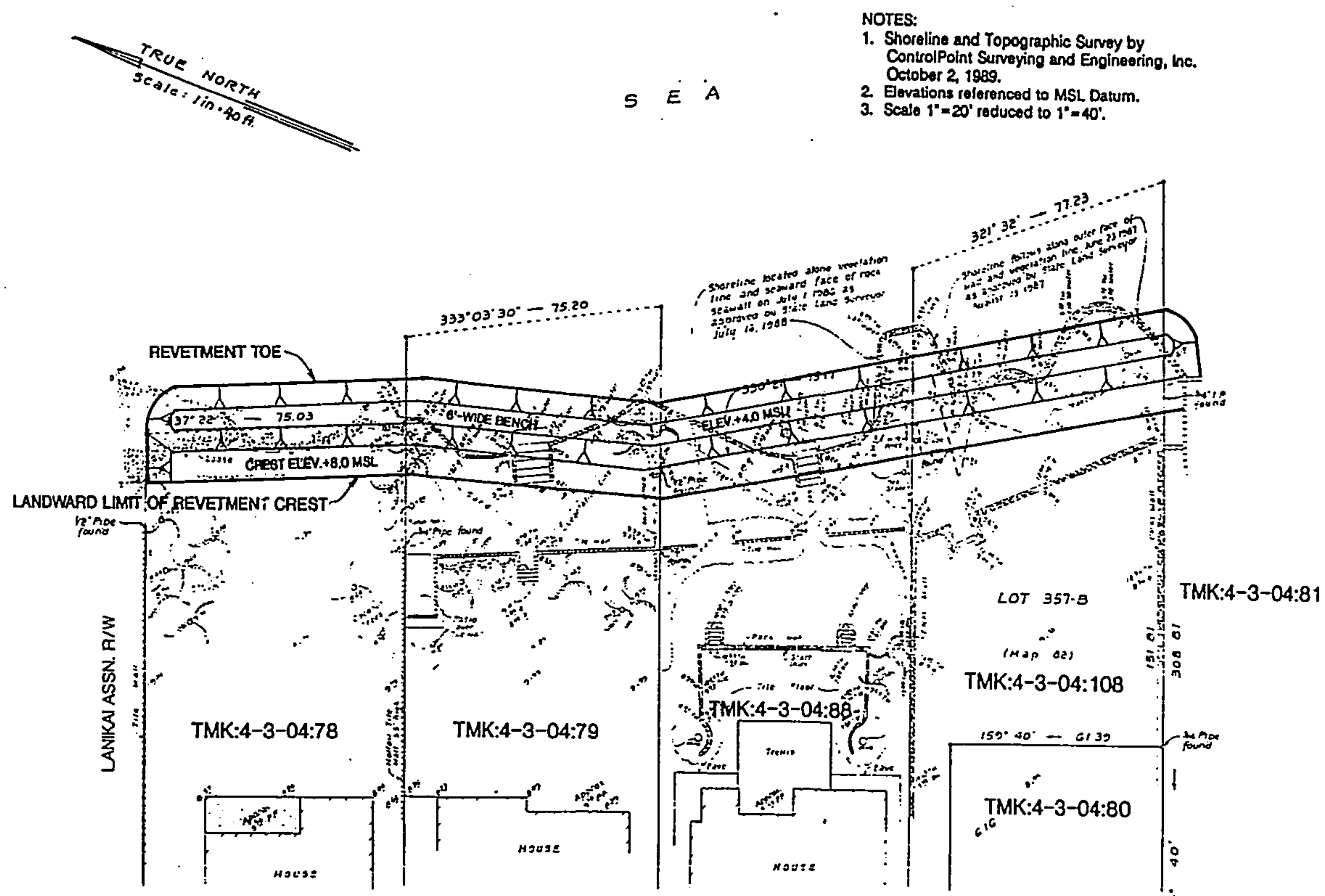

FIGURE 6. RECOMMENDED ALTERNATIVE LAYOUT PLAN FOR REVETMENT

the same alignment as on Parcel :88 and ties into the seawall on the adjacent parcel. This layout would result in revetment construction on State conservation lands seaward of the present shoreline. Because the owners of Parcels :78 and :88 did not extend their property boundaries seaward when the shoreline was historically in an accreted state (as did the owners of Parcels :79 and :108 as well as numerous other landowners along the southeastern Lanikai shoreline), the revetment alignment shown in Figure 6 would result in the revetment extending seaward of their property boundaries as well. For Parcels :79 and :108, the revetment would not extend seaward of their property boundary, although portions of the revetment would extend seaward of their present shoreline.

The proportion of State versus private land areas affected by the recommended revetment layout in Figure 6 is 1:1.3, as detailed in

Table 1.
Affected Land Areas Due to Figure 6 Revetment

Parcel	Affected Land Area (sq.ft.) / % of Total Area		
	State	Private	Total
78	900 / 44%	1125 / 56%	2025
79	940 / 46%	1085 / 54%	2025
88	1350 / 67%	675 / 33%	2025
108	360 / 17%	1760 / 83%	2120
81	80 / 50%	80 / 50%	160
Total	3630 / 43%	4725 / 57%	8355

For Parcels 78 & 88: Private lands include areas landward of the property boundaries.

For Parcels 79, 108, & 81: Private lands include areas landward of the existing seawalls.

Table 1. The rationale for this alignment is that it collectively minimizes loss of usable property to the landowners, while it provides the public with enhanced access along the shorefront. The proportion of land area occupied by the bench and lower slope of the revetment versus the area occupied by the upper slope and crest is about the same as the proportion of State versus private land areas collectively affected by the revetment. Moreover, this recommended design layout is preferable since access would actually be hindered if a revetment with a conventional single slope is constructed.

Figure 7 shows a third alternative layout which is a straight alignment from one end of the project reach to the other. From an engineering and construction perspective, a straight alignment would be simplest and least expensive to design and construct. In addition, this alignment would require the least amount of land excavation and demolition work to remove the existing seawalls. However, such an alignment would place the revetment

Table 2.
Affected Land Areas Due to Figure 7 Revetment

Parcel	Affected Land Area (sq.ft.) / % of Total Area		
	State	Private	Total
78	1013 / 50%	1012 / 50%	2025
79	1460 / 72%	565 / 28%	2025
88	2475 / 100%	0 / 0%	2475
108	570 / 28%	1500 / 72%	2070
81	80 / 50%	80 / 50%	160
Total	5598 / 64%	3157 / 36%	8755

For Parcels 78 & 88: Private lands include areas landward of the property boundaries.

For Parcels 79, 108, & 81: Private lands include areas landward of the existing seawalls.

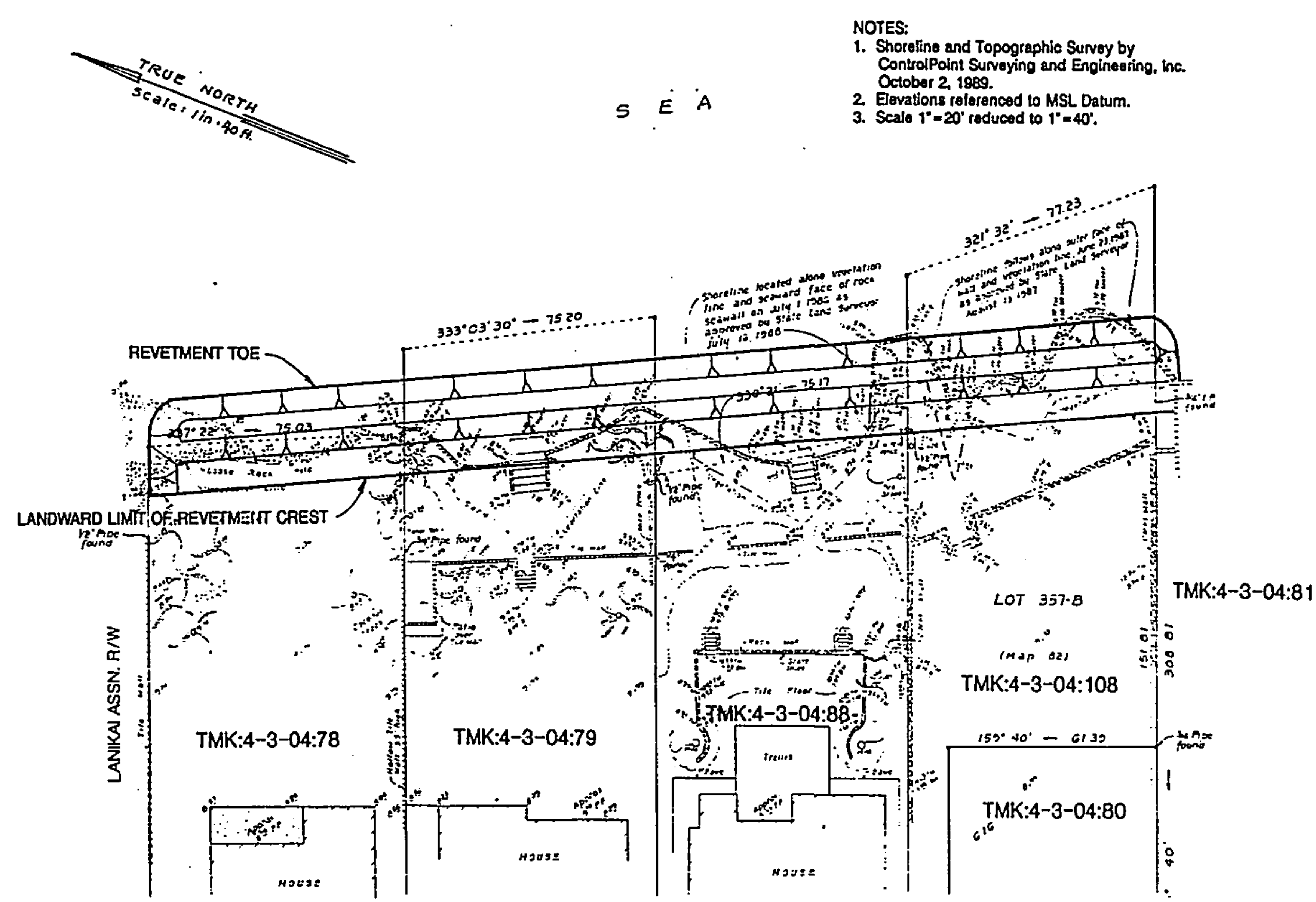

FIGURE 7. MOST COST-EFFICIENT LAYOUT PLAN FOR REVETMENT

entirely seaward of the property line on Parcel :88, and is therefore likely to be unacceptable from a regulatory or public policy perspective. The proportion of State versus private land areas affected by this alternative is 1.77:1, as detailed in Table 2.

5.0 PROBABLE IMPACTS

The proposed revetment construction will have no adverse effect on existing coastal processes or on the surrounding environment. The revetment would in fact improve the coastal environment by dissipating wave energy more effectively than the existing vertical seawalls on the project shoreline and south of the project site, thus being more conducive to beach accretion. The proposed revetment would also enhance public access by providing an elevated bench part way up the revetment slope. The 6-foot wide bench can be used as a walkway when there is no dry beach, which is most of the time during the summer season. And during the winter season when the beach may be built up or if there is a return to a long-term accretion cycle, the bench would be covered with sand. The proposed revetment would not impact the existing Lanikai Association right-of-way adjacent to Parcel :78.

The construction activities will result in temporary noise and traffic impacts to the residential community due to trucks and heavy equipment working on site. However, due to the fact that the revetment will be constructed by the property owners collectively, and since Parcel :108 is vacant, the impacts will be minimized. The extent of the construction impacts will be largely dependent on the alignment of the new revetment and the amount of demolition and land excavation required.

Demolition and site preparation activities for the new revetment will result in the most shoreline impacts. The seaward-most alignment shown in Figure 7 would require the least demolition and land excavation activities, while the Figure 5 alignment would result in the greatest demolition and land excavation activities. Demolition of the existing seawall will likely result in increased turbidity in nearshore waters due to the disturbance of the land-sea interface. Land excavation will further increase turbidity and water quality impacts. The exposed shoreline would be susceptible to wave erosion activity until the exposed slope is faced with the revetment. The rocks from the demolished seawall can be stockpiled and reused in the revetment construction, thereby reducing the quantity of rock material trucked in from offsite. However, if the Figure 5 alignment is required, then the considerable quantity of the backshore materials that need to be excavated for the revetment slope (which is about two times the volume of rock required for the revetment) will have to be hauled offsite for disposal. Whereas, for the Figure 7 alignment, it is estimated that all of the existing shoreline materials from the seawall demolition and backshore excavation activities can be reused in the new revetment construction. For the Figure 6 alignment, approximately 700 cubic yards of excess material must be hauled offsite for disposal.

The project site is located within a coastal flood hazard zone designated Zone AE (base flood elevation 6 feet) on the federal Flood Insurance Rate Map (FIRM), as indicated in Figure 8. The revetment construction may have a mitigating effect on the flood characteristics since the revetment crest elevation is 2 feet higher than the base flood elevation.

There are no known rare, threatened, or endangered species nor their habitats located in or near the project site.

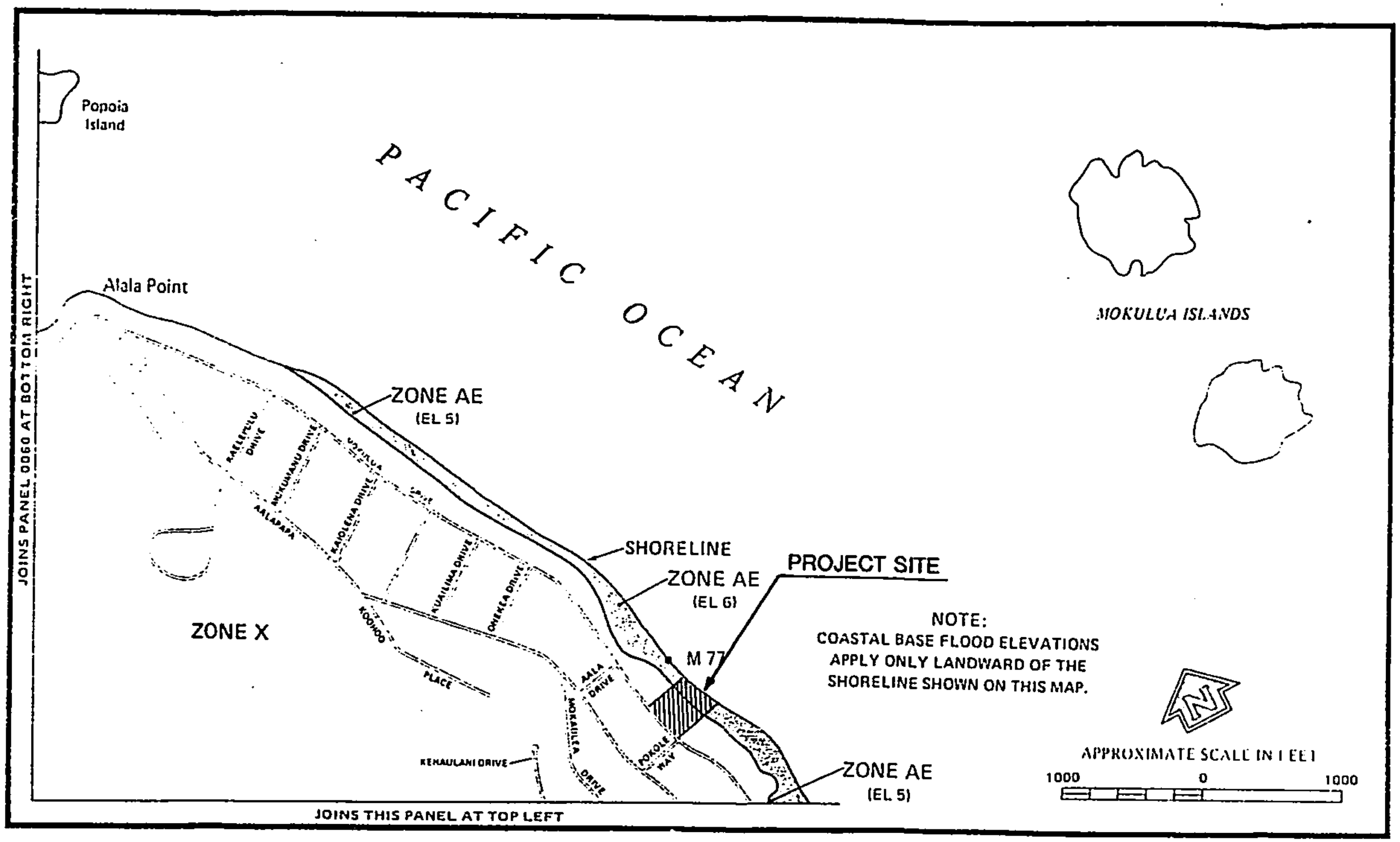

FIGURE 8. PORTION OF FEMA FLOOD INSURANCE RATE MAP (FIRM), PANEL NO. 150001 0095B, REVISED SEPTEMBER 4, 1987

This report has been prepared by:

Elaine E. Tamaye

Elaine E. Tamaye
Coastal Engineer

Edward K. Noda
and
Associates, Inc.

Oceanographic
Engineers
and
Environmental
Consultants

Engineering
Planning
Surveys
Computer
Modeling

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ELAINE E. TAMAYE OCEAN ENGINEER

EDUCATION

University of Hawaii, M.S. Ocean Engineering, 1977
Specializing in Coastal Engineering
University of Hawaii, B.S. General Engineering, 1974
Specializing in Marine Environmental Engineering

EXPERIENCE

o Ocean Engineer
Edward K. Noda and Associates
1983 to present

Ms. Tamaye is the senior coastal engineer responsible for coastal design analysis and oceanographic criteria evaluations. Her major programs and studies have included:

o OTEC 40-MW Pilot Plant Program: The OTEC Pilot Plant Program was funded by the U.S. Department of Energy. As part of the program, oceanographic design criteria were established for the preliminary design of the Land Based Containment System (LBCS), including evaluation of the typical and extreme wave and current conditions, hydrodynamic loads on the LBCS, and potential impacts on littoral processes.

o Hurricane Vulnerability Study for Honolulu, Hawaii and Vicinity: The Hurricane Vulnerability Study for Honolulu was prepared for the U.S. Army Corps of Engineers. As part of the study, inundation limits due to hurricane wave exposure were determined for the south shore of Oahu. A unique computer model was developed which determines the overland flooding effects due to hurricane waves. The model incorporates wave refraction, wave breaking, wave setup, wave runup/overtopping effects, and determines the overland flooding limits.

o Hawaii Ocean Science and Technology (HOST) Park: As part of the planning and design for the HOST Park project, oceanographic criteria were developed for the cold water intake pipeline, including design waves and currents in the nearshore zone.

o Leone Harbor Study for the American Samoa Government: This study evaluated the feasibility of constructing a harbor facility at Leone Bay, based on estimated costs of construction versus anticipated economic benefits to be derived from the harbor. Following the feasibility study, a comprehensive Environmental Assessment was prepared for the proposed harbor.

o Hawaii Shoreline Erosion Management Study: This study was prepared for the State Coastal Zone Management Office, to provide an overview of the erosion processes, discussion of shoreline protection measures and existing regulatory measures for controlling and managing erosion problems, and recommendations for improving erosion management in Hawaii. Three case study sites were evaluated: Makaha and Kailua-Lanikai on Oahu, and Kukuiula-Poipu on Kauai.

o Ke'ehi Lagoon Recreation Plan: This program for the State Harbors Division included initial conceptual planning and design for boating improvements in Ke'ehi Lagoon related to the America's Cup Race. Subsequent efforts included updating the entire recreation master plan for Ke'ehi Lagoon and preparation of an Environmental Impact Statement for the proposed development of the lagoon.

Elaine E. Tamaye (Continued)

- Civil/Hydraulic Engineer
  U.S. Army Corps of Engineers, Pacific Ocean Division
  1977 to 1983

  Served as hydraulic engineer performing coastal engineering planning and design studies, 1977-1982. Responsible project manager for design of navigation and shore protection projects, preparation of planning/project reports, and plans and specifications for construction. Involved in numerous coastal projects throughout the Pacific Basin, including Hawaii, Guam, Commonwealth of the Northern Mariana Islands, and American Samoa. Her numerous projects included:

  - Hawaii: Planning/design for beach restoration at Kualoa Regional Park (Oahu), planning/design for Barbers Point Deep Draft Harbor (Oahu), design/construction of revetments at Kekaha (Kauai) and Kahului Wastewater Treatment Facility (Maui), planning study for shoreline protection at Iroquois Point Naval Housing Area (Oahu).
  - American Samoa: Planning/design/construction of shore protection for the Pago Pago International Airport Runway, planning/design of shore protection of Matafao School and Masefau Village, design inspection during construction of small boat harbors at Tau and Aunuu-Auasi, and Coastal Zone Management (CZM) coordination activities.

  Served as civil engineer with the Tripler Resident Office, performing a full range of contract administration functions for the Tripler Army Medical Center construction project, 1982-1983. Responsible for preparing change orders, negotiating and processing contract modifications, and evaluating contractor claims.

- Graduate Student
  Department of Ocean Engineering, University of Hawaii
  1975 to 1977

  Assisted on a bathymetric survey off Keahole Point, Hawaii, in conjunction with OTEC program, 1977. Served as marine apprentice technician on a 3-month oceanographic cruise to obtain geological/geophysical data in the Western Pacific, 1977. Co-authored two technical papers, 1976.

AFFILIATIONS

Society of Naval Architects and Marine Engineers
Society of Sigma Xi

LU 5/90 3025

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SUPPLEMENT

to the report:

COASTAL ENGINEERING EVALUATION

AND ENVIRONMENTAL ASSESSMENT

FOR RECONSTRUCTION OF SHORE PROTECTION

AT LANIKAI, OAHU, HAWAII

(TMK: 4-3-04: 78, 79, 88, 108)

MAY 7, 1990

BACKGROUND

A coastal engineering evaluation and Environmental Assessment (EA), dated December 7, 1989, was prepared in support of the Shoreline Setback Variance (SV) application for proposed reconstruction of shore protection at Lanikai, Oahu, for four (4) contiguous parcels (TMK: 4-3-04: 78, 79, 88, 108).

This Supplement describes the proposed alignment and final design for the new revetment shore protection, as depicted in the construction plan prepared and sealed by Yuji Kasamoto. This supplement also addresses concerns raised by the City and County Department of Land Utilization (DLU) in their letter dated April 17, 1990, based on comments received on the EA. Comment letters are included as Attachments to this Supplement.

PROPOSED ALIGNMENT AND REVETMENT DESIGN

The construction plan prepared by Yuji Kasamoto, project structural engineer, in consultation with Elaine Tamaye, project coastal engineer, depicts the proposed alignment and final design for the new revetment. The construction plan represents the proposed project for which the SV application is submitted.

Exhibit 1 shows the revetment alignment copied from the construction plan. This revetment alignment is a compromise between the alignments shown on Figures 5 and 6 in the EA, whereby the revetment crest is situated entirely landward of the existing seawalls and shoreline along its full length. The proportion of State versus private land areas affected by the proposed revetment is as follows:

	AFFECTED LAND AREA (SQ.FT.)				
PARCEL	State	Private crest	Private seaward of crest	Private Total	TOTAL State + Private
78	750	675	570	1245<1>	1995
79	800	675	550	1225<2>	2025
88	1190	675	160	835<3>	2025
108	190	675	1350	2025<2>	2215
81	80	40	20	60<2>	140
TOTAL	3010	2740	2650	5390	8400

<1> Landward of property boundary.
<2> Landward of seawall.
<3> Landward of property boundary or seawall, whichever is furthest landward.

The revetment design is a composite slope structure as depicted in Figure 4b of the EA. Stairways are provided at both ends of the revetment to provide easy access to the 6-foot wide bench between the upper and lower slopes of the revetment. The 6-foot wide bench will serve as an elevated walkway for the public across the shore frontage. At the present time, there is normally no dry beach fronting the subject parcels and the public must wade through the water and waves to traverse this shoreline reach. The proposed revetment construction will enhance public access along this shore frontage.

COMMENTS FROM THE C & C DEPT. OF PUBLIC WORKS

1. Comment: The C & C Department of Public Works (DPW) is planning to construct overflow swales through the beach right-of-ways along this Lanikai shoreline reach. They are concerned about possible impacts that the revetment may have on the construction of the overflow swale through the right-of-way next to Parcel 78.

<u>Response:</u> This matter was coordinated with Mr. Ken Kwock of Kwock Associates, the engineering consultant to the C & C DPW for the design of the overflow swales. It was concurred that the proposed revetment will have no adverse impact on the proposed construction of the overflow swale. The present design for the overflow swale consists of constructing containment walls along the boundaries of the right-of-way to channel the runoff through the right-of-way. The overflow swale stops at Sta. 2+40, and does not extend as far seaward as the existing CMU wall along the northern boundary of Parcel 78. Exhibit 2 shows a portion of the plan for the overflow swale, prepared by Kwock Associates, on which the proposed revetment has been drawn in. Because the overflow swale stops short of the revetment location, and the revetment does not intrude into the right-of-way, the projects can be constructed independently of each other and neither project will have an impact on the other.

2. <u>Comment:</u> A question was whether there is bedrock in the area and whether the proposed revetment toe can be extended to the bedrock.

<u>Response:</u> If bedrock (or hard limestone beachrock) exists at a shallow depth below the existing grade, then ideally the revetment toe should be excavated and placed on the bedrock foundation. However, we have no knowledge of whether bedrock exists along this reach, nor how deep we would have to excavate to reach bedrock if it does exist. Test borings or test excavations would be necessary to obtain this information. As a worst case, we must assume that there is no bedrock close to the ground surface. If the Contractor encounters bedrock during his excavation for the revetment toe, then he will be instructed to place the armor stones directly on the hard foundation.

COMMENTS FROM THE U.H. ENVIRONMENTAL CENTER

1. Comment: It was suggested that the revetment be constructed at a location between that shown on Figures 5 and 6 in the EA.

   Response: The construction plan places the revetment alignment at a location between that shown on Figures 5 and 6 in the EA.

2. Comment: It was recommendated that a separator or filter cloth be used beneath the revetment to prevent erosion of material under the structure.

   Response: The multiple rock layers in the design is intended to provide sufficient filter characteristics to prevent leaching of materials through the rock layers. The design specifies a 3-foot thick bedding layer of spalls to 12-inch stone, with the larger stones placed on the outer surface. An alternative design would be to use filter cloth and to provide a thinner bedding layer (1-foot thick) beneath the armor stone layer. The thin bedding layer placed over the filter cloth would provide a cushion for the large overlying armor stones so that they do not over stress and tear the filter cloth. The filter cloth must be carefully installed to insure that it functions properly. Any gaps between the filter cloth panels or any tearing of the fabric during construction will allow leaching of material through the revetment slope and possible damage to the structure. From a constructability standpoint, it is generally preferable to design for filtering using multiple rock layers than filter cloth, since rock layers are easier to place and are not subject to the strict tolerances of filter cloth. Without the assurance of a full-time inspector on site during construction, a less complicated design is better assured of being built in accordance with the plans and specifications.

3. Comment: There is a concern that the 1-foot thick bedding layer beneath the extended toe may not be adequate, and it was recommended that additional toe protection be provided.

Response: The construction plan calls for a minimum 1-foot thick bedding layer excavated beneath existing grade, with a minimum excavated depth of -1.0' MSL. Because certain reaches will be situated seaward of the shoreline with existing grade below MSL elevation (estimated water depths about 1-2 feet below MSL at the toe), the depth of excavation at the toe could be 2-3 feet below MSL, which is below the anticipated scour depth for typical waves. Certain reaches that are situated landward of the shoreline with existing grade above MSL would require considerable excavation to place the bedding layer at -1.0' MSL. Because it is difficult to accomplish controlled excavation in sand below the water surface, a minimum amount of excavation is specified. As stated in the EA, the composite slope design increases the stability of the revetment slope under storm wave attack. The 6-foot wide armor stone bench dissipates wave downrush, reduces scouring, and provides a greater safety factor by allowing the armor stones in the bench to settle into any potential scour hole without damaging the integrity of the upper revetment slope. In essence, the 6-foot wide bench functions as an extended toe for the revetment slope. Therefore, toe protection for the revetment slope is considered adequate.

4. <u>Comment:</u> It was suggested that beach nourishment would be an economical alternative for protection of the applicants' parcels.

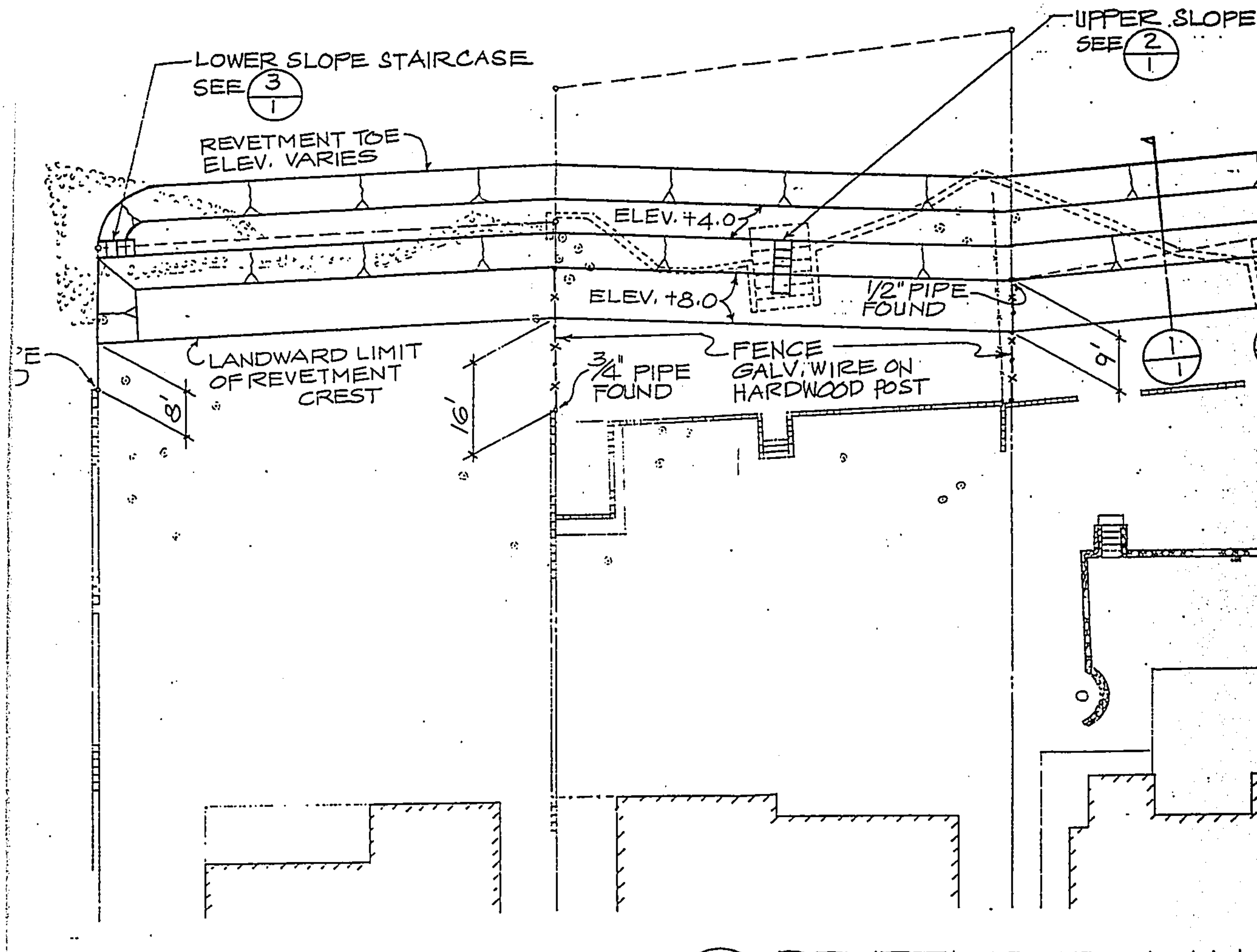
<u>Response:</u> While the recent statutory changes make the option of beach nourishment using offshore sand sources more economically viable than before, it is still a costly endeavor and beyond the financial resources of the individual property owner. There are engineering costs associated with finding a suitable offshore source of sand and accomplishing environmental impact studies for the submarine sand mining and placement of sand along the shoreline, high mobilization and construction costs for specialized marine equipment to mine the sand, and the possible need for periodic re-nourishment if beach stabilization structures are not included in the initial construction of the beach fill. Beach nourishment projects may be economically viable for the individual property owner only if it can be undertaken similar to an Improvement District. In this case, engineering costs would be subsidized by a government agency and area-wide fee assessments to property owners would make construction costs affordable to individuals.

<u>COMMENTS FROM THE U.S. ARMY CORPS OF ENGINEERS, PLANNING DIVISION</u>

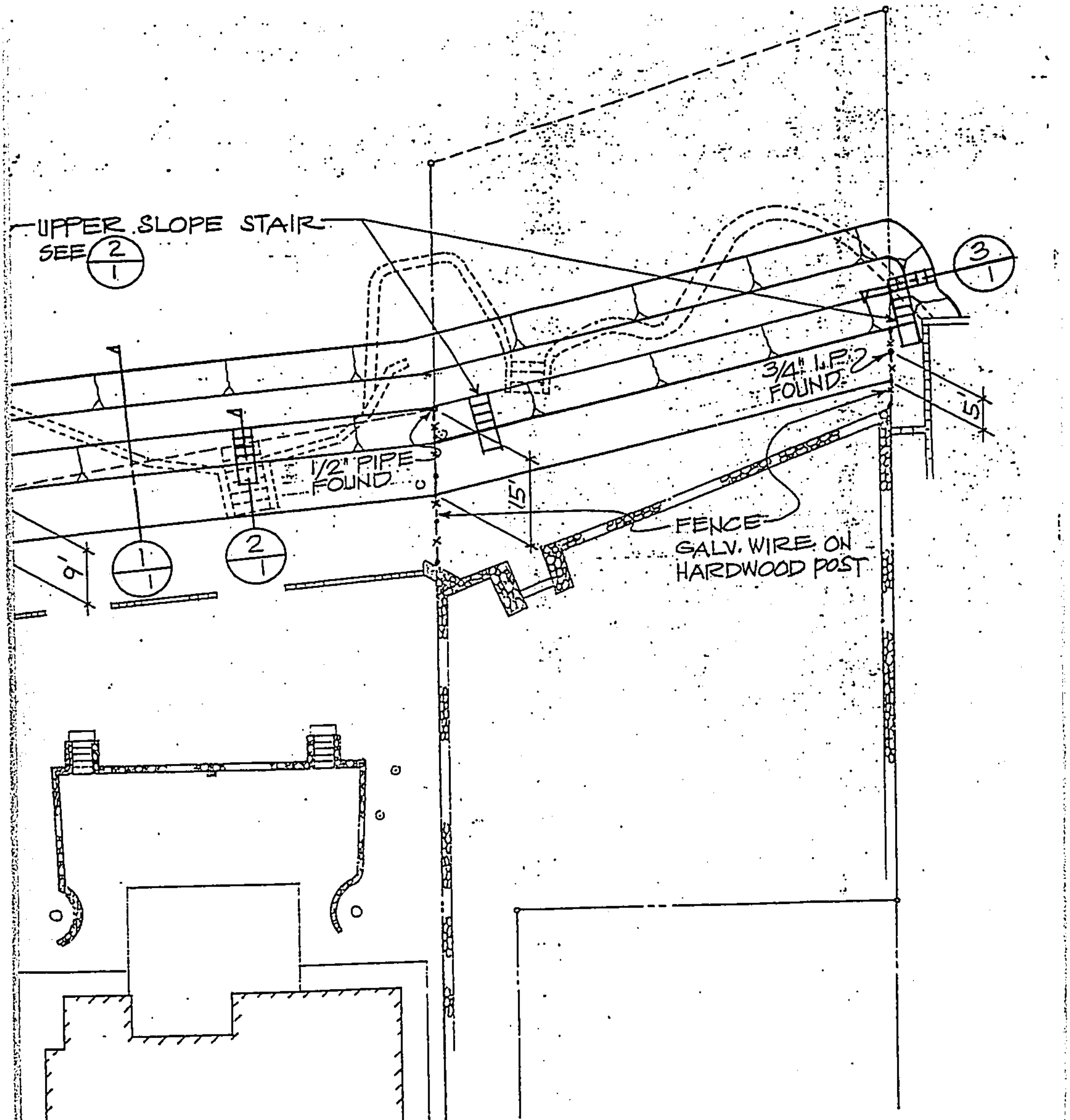
1. <u>Comment:</u> The proposed structure will require a Department of the Army (DA) permit.

<u>Response:</u> Based on further coordination with the U.S. Army Corps of Engineers, Operations Division, it was determined that the proposed structure is authorized by the Corps Nationwide permit authority in accordance with Federal

Regulations at 33 CFR 330.5(a)(13) and that no further Department of the Army processing is necessary.

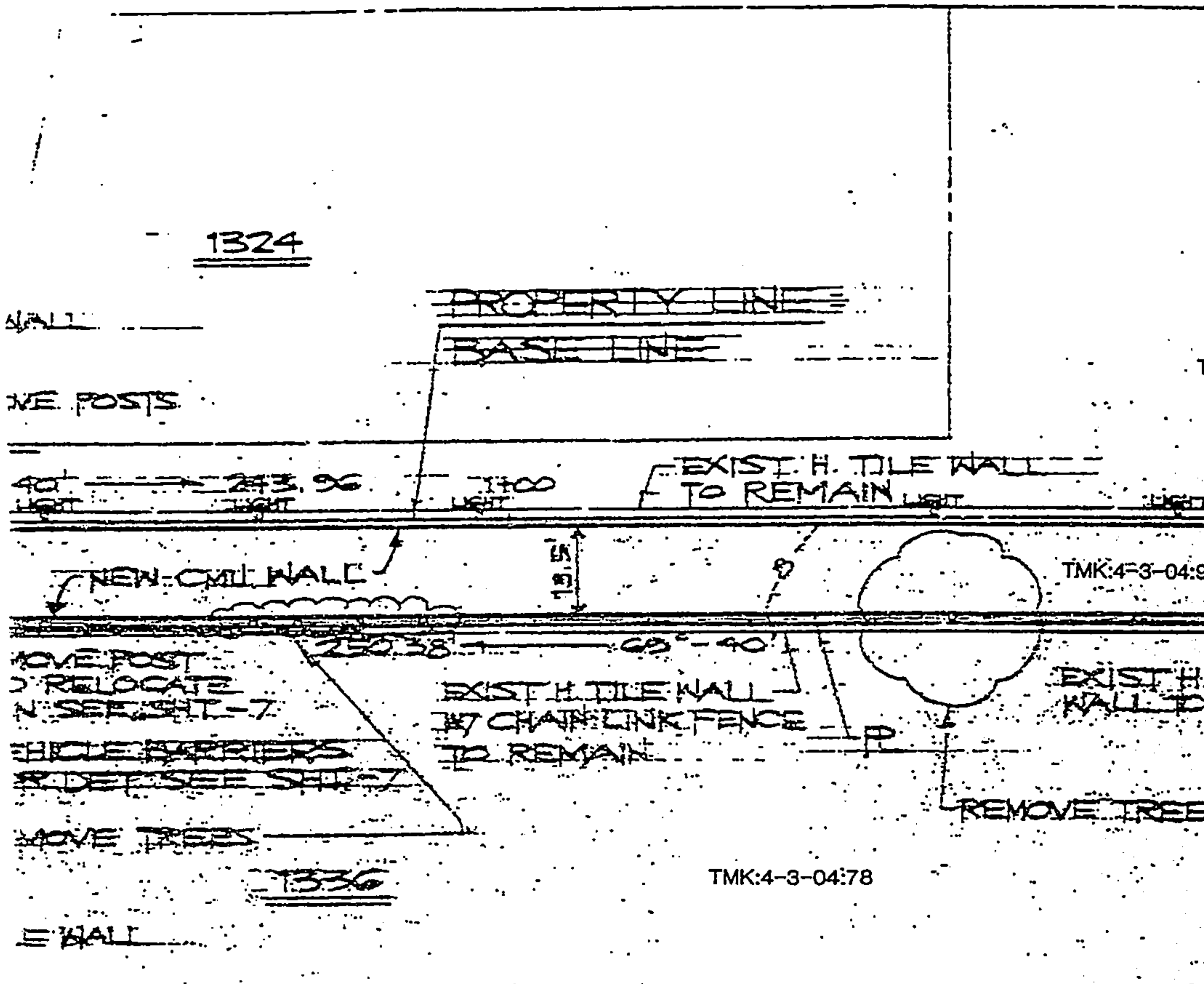


C/1 REVETMENT PLAN
Scale: 1" = 20'

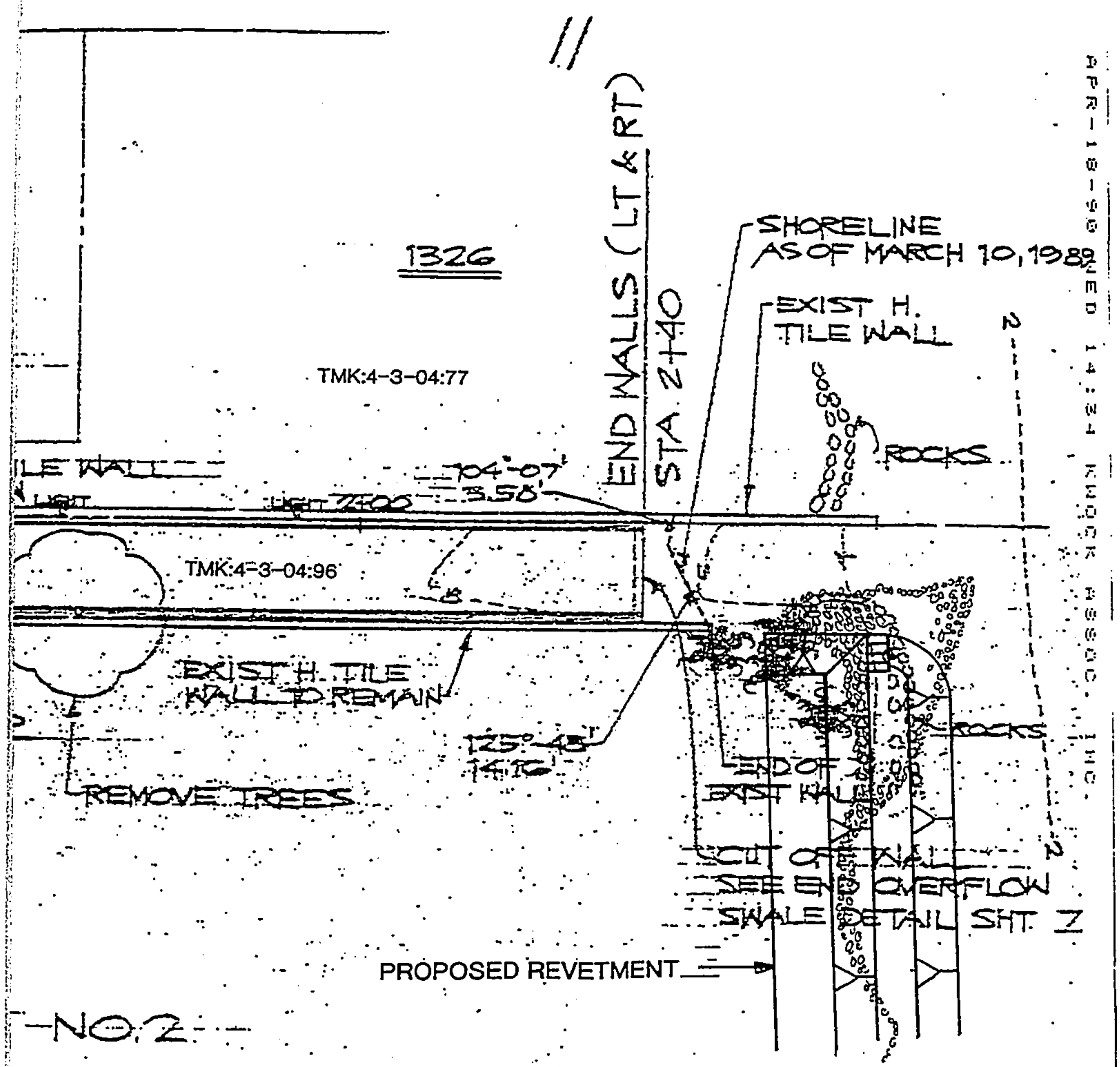


NT PLAN

EXHIBIT 1



OVERFLOW SWALE NO. 2
PLAN
SCALE: 1"=20'



1326
TMK:4-3-04:77
END WALLS (LT & RT)
STA 2+40
SHORELINE
AS OF MARCH 10,1989
EXIST H.
TILE WALL
ROCKS
TMK:4-3-04:96
EXIST H. TILE
WALL TO REMAIN
REMOVE TREES
END OF
EXIST WALL
CUT OFF WALL
SEE END OVERFLOW
SWALE DETAIL SHT. 2
ROCKS
PROPOSED REVETMENT
NO. 2
APR-18-96 WED 14:34 KNOCK ASSOC. INC.

EXHIBIT 2

COMMENT LETTERS

ATTACHMENTS 1 THRU 4

LU 5/90-1808

DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

SAM CALLEJO
DIRECTOR AND CHIEF ENGINEER

C. MICHAEL STREET
DEPUTY DIRECTOR

In reply refer to:
ENV 90-59(449)

'90 MAR 19 AM 10 08

March 15, 1990

MEMORANDUM

TO: DONALD A. CLEGG, DIRECTOR
DEPARTMENT OF LAND UTILIZATION

FROM: SAM CALLEJO, DIRECTOR AND CHIEF ENGINEER

SUBJECT: ENVIRONMENTAL ASSESSMENT (EA)
LANIKAI REVETMENTS (SHORELINE SETBACK)
TAX MAP KEY: 4-3-04: 78, 79, 88 AND 108

We have reviewed the subject EA and have the following comments:

1. Although the subject EA (page 14) states that the proposed revetment will not impact on the existing beach right-of-way adjacent to Parcel 78, we wish to point out that Department of Public Works is planning to construct overflow swales along the beach right-of-way as a part of the Lanikai Flood Control Project. We suggest that the EA should address whether the revetment will have any impact on the overflow swales.

2. Is there bedrock in the area? Can the proposed revetment toe be extended to the bedrock?

SAM CALLEJO
Director and Chief Engineer

ATTACHMENT 1

LU 3/90 1969

'90 MAR 27 AM 8 38

University of Hawaii at Manoa

Environmental Center
Crawford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7361

March 20, 1990
RN:0249

Mr. Donald Clegg, Director
Department of Land Utilization
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Clegg:

Environmental Assessment/Negative Declaration
Lanikai Revetments
Lanikai, Kailua, Oahu

The above document proposes the construction of a continuous seawall along four contiguous parcels of shorefronts at Lanikai.

The Environmental Center has reviewed this document with the assistance of Hans-Jurgen Krock, Ocean Engineering; Ralph Moberly, Geology and Geophysics; and Carolyn D. Cook, Environmental Center.

General Comments

It is proposed that the revetment will prevent further erosion of the shoreline due to wave action. However, dikes, seawalls, and related coastal structures are not acceptable alternatives to adequate long-range planning. The erosion-related problems currently being experienced along the Lanikai shoreline in this project are in part due to the poorly designed seawalls that were constructed without permits. It is well known that shoreline structures may adversely affect adjacent properties and beaches, exacerbating erosion problems. Seawalls interfere with the natural movements of sand along the shoreline, and cause both short- and long-term effects. The intensified turbulence at their base places sand in suspension, and the reflected wave energy carries this suspended sediment offshore, thereby preventing the deposit of sand.

Location

The preferred location for the seawall (figure 6) is on approximately half public land and half private land. The proposed alternative layout

ATTACHMENT 2

plan in figure 5 uses less public land than the layout in figure 6. It seems most appropriate that the seawall be constructed as much on private land as possible. Since mature trees exist on a portion of the figure 5 proposal, proving its historical existence as fastland, perhaps a location between that of figure 5 and the one in figure 6 would be equitable.

Project Design

The proposed composite slope design of the wall is one of the better methods of constructing sea walls. Figure 4b, the composite slope, illustrates the construction design preferred by reviewers, and we recommend that the Department of Land Utilization require this design to be used if a permit is issued. We are not able to determine from the information provided whether or not a separator or filter cloth will be installed. If not, it is recommended that one be used beneath the rock revetment to keep the water from eroding the area under the wall. The extended toe of the revetment is to be underlain with a 1-foot thick bedding layer of spalls to 12-inch stone and placed -1.0'MSL. This may not be adequate. Additional toe protection for the seawall is recommended.

Although we have provided some recommendations for design and location, it is unfortunate that the beach nourishment alternative using off shore sources of sand has not been more fully evaluated. The recent statutory changes make beach replenishment for offshore sand sources far more viable economically.

Yours truly,

Jacquelin Miller

Jacquelin N. Miller
Associate Environmental Coordinator

cc: OEQC
L. Stephen Lau
Hans-Jurgen Krock
Ralph Moberly
Carolyn Cook

LU 3/90 1970

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

'90 MAR 27 AM 8 37

... LAND UTILIZATION
... HONOLULU

REPLY TO
ATTENTION OF:

March 26, 1990

Planning Division

Mr. Donald A. Clegg
Director of Land Utilization
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Clegg:

We have reviewed the Environmental Assessment (EA) for proposed reconstruction of shore protection at Lanikai, Oahu. The following comments relate only to the Corps of Engineers' regulatory program and to floodplain information from the Federal Emergency Management Agency:

a. The proposed structure will require a Department of the Army (DA) permit. The consultant will be advised regarding DA permit requirements via separate letter from Operations Division. For further information regarding the Corps' regulatory program, please contact Operations Division at 438-9258.

b. The flood zone designation (Zone AE) cited on page 15 of the EA is correct.

Sincerely,

C Fuyu

Kisuk Cheung
Director of Engineering

ATTACHMENT 3

LU 2/90 1709

BUILDING DEPARTMENT

CITY AND COUNTY OF HONOLULU

HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

HERBERT K. MURAOKA
DIRECTOR AND BUILDING SUPERINTENDENT

PB 90-190

'90 MAR 15 AM 8 00

March 13, 1990

MEMO TO: DONALD A. CLEGG, DIRECTOR
DEPARTMENT OF LAND UTILIZATION

FROM: HERBERT K. MURAOKA
DIRECTOR AND BUILDING SUPERINTENDENT

SUBJECT: ENVIRONMENTAL ASSESSMENT, CHAPTER 343 HRS
PROJECTS WITHIN THE SHORELINE SETBACK
PROJECT NAME: LANIKAI REVETMENTS
LOCATION : 1336, 1344, 1352, 1360 MOKULUA DRIVE,
LANIKAI, KAILUA, OAHU
TAX MAP KEY : 4-3-04:78, 79, 88, AND 108

We have reviewed the subject project and have no comments regarding the EIS Determination or the Shoreline Variance.

Thank you for the opportunity to review the Coastal Engineering Evaluation and Environmental Assessment for Reconstruction of Shore Protection at Lanikai, Oahu, Hawaii.

Herbert K. Muraoka

HERBERT K. MURAOKA
Director and Building Superintendent

cc: J. Harada

ATTACHMENT 4