PASEO DE SUSANA
SHORE PROTECTION
TERRITORY OF GUAM

DRAFT
DETAILED PROJECT REPORT
AND ENVIRONMENTAL STATEMENT

US Army Corps
of Engineers
Honolulu District

JUNE 1983

PASEO DE SUSANA SHORE PROTECTION
TERRITORY OF GUAM

MAIN REPORT

PASEO DE SUSANA SHORE PROTECTION
AGANA, GUAM

DRAFT

DETAILED PROJECT REPORT
AND
ENVIRONMENTAL ASSESSMENT

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I. INTRODUCTION

1. PURPOSE

The purpose of this study was to determine the need for and feasibility of providing shore protection measures at the Paseo de Susana Park in Agana, Territory of Guam.

2. STUDY AUTHORITY

This study was accomplished under the authority provided by Section 103a of the River and Harbor Act of 1962, as amended. Pertinent excerpts from the authority are included in Appendix A.

The Paseo de Susana Shore Protection Study was initiated following a written request from the Governor of Guam dated 11 July 1979. Based upon this request, a reconnaissance was completed by the U.S. Army Corps of Engineers, Honolulu District on 12 February 1982. Preparation of a detailed project study for the Paseo de Susana Park was approved by the Chief of Engineers on 23 February 1982. Initiation of the detailed project report was begun in April 1982.

3. STUDY AREA AND LOCATION

Guam is a territory of the United States, and is the largest and southernmost of the Mariana Islands chain. Other major islands within the chain include Saipan, Tinian, and Rota. The island of Guam encompasses 209 square miles and is approximately 30 miles long and 4 to 8.5 miles wide. Guam is located about 3,800 miles west of Honolulu and 1,500 miles south of Tokyo. United States military reservations occupy most of the northern half of the island. Major civilian population centers are concentrated in central Guam and with scattered communities along the southern coastline regions.

The Paseo de Susana public park is a man-made peninsula formed from the rubble of the city of Agana after World War II, and is located adjacent to the Agana boat basin. This 33-acre landfill extends seaward approximately 1,500 feet from the natural shoreline to within 300 feet of the reef fringing Agana Bay. The park is located approximately midway between Adelup Point and Oca Point along the Agana Bay shoreline. The project study area and location are shown in Figures 1 and 2, respectively.

4. SCOPE OF THE STUDY

This study identified and evaluated the problems and needs associated with providing shore protection measures at the Paseo de Susana Park, and the impacts upon the overall environmental (economic, social, cultural, and recreational) resources of the area. Alternative plans were developed, and the costs and benefits associated with implementing these measures were evaluated.

Studies conducted included site investigations, archaeological and cultural studies, hydrographic and topographic surveys, geologic, foundations and materials investigations, fish and wildlife studies, oceanographic and meteorological studies, engineering design, economic evaluations, and environmental assessment.

The Detailed Project Report (DPR) , upon approval by the Chief of Engineers, provides the construction authority for the U.S. Army Corps of Engineers small projects under the continuing authorities program.

5. STUDY PARTICIPANTS AND COORDINATION

The U.S. Army Corps of Engineers, Honolulu District, was responsible for conducting and coordinating the overall study and preparing the study report. Studies and investigations were performed with the assistance of government agencies (Federal, Territorial, and local). Community groups and private interests were contacted during the study to help identify study concerns, to obtain pertinent study information, and to develop and evaluate alternative plans. A list of those contacted, and the Public Involvement Program are presented in Appendix B.

6. REPORT PREPARATION

This document consists of a main report and a series of appendices. The main report is a self-contained document which describes the planning process and includes the environmental impact statement. The appendices contain technical and detailed information and background data to support the information contained in the main report.

Appendix A, Plan Formulation Criteria and Compliance Reports, contains specific information regarding the study authority, legislative requirements, planning criteria and constraints, and local cooperation requirements that contribute to the plan formulation process of the study. Also included in this appendix are the evaluation reports required by Executive Order 11988, Section 404 of the Clean Water Act, and the Coastal Zone Management Act.

Appendix B, Public Involvement Program, describes the public involvement program and contains pertinent correspondence received during the study and evaluation period.

Appendix C, Fish and Wildlife Coordination, contains the U.S. Fish and Wildlife Service report prepared in accordance with the Fish and Wildlife Coordination Act of 1958 (Public Law 85-624).

Appendix D, Engineering Investigations and Design Analysis, contains the engineering analyses and data relevant to the design of the proposed shore protection improvements. This appendix also provides information concerning geology, foundations and materials investigations, and cost estimates.

Appendix E, Economic Analysis, contains the economic background, data, and analyses for determining the benefits and costs associated with each alternative plan.

7. PRIOR STUDIES

The U.S. Army Corps of Engineers, Honolulu District, completed a negative reconnaissance report on erosion along the western shoreline of the Paseo de Susana Park in October 1972. The report recommended no action until completion of the adjacent Agana small boat harbor and study of its effect upon the shoreline erosion.

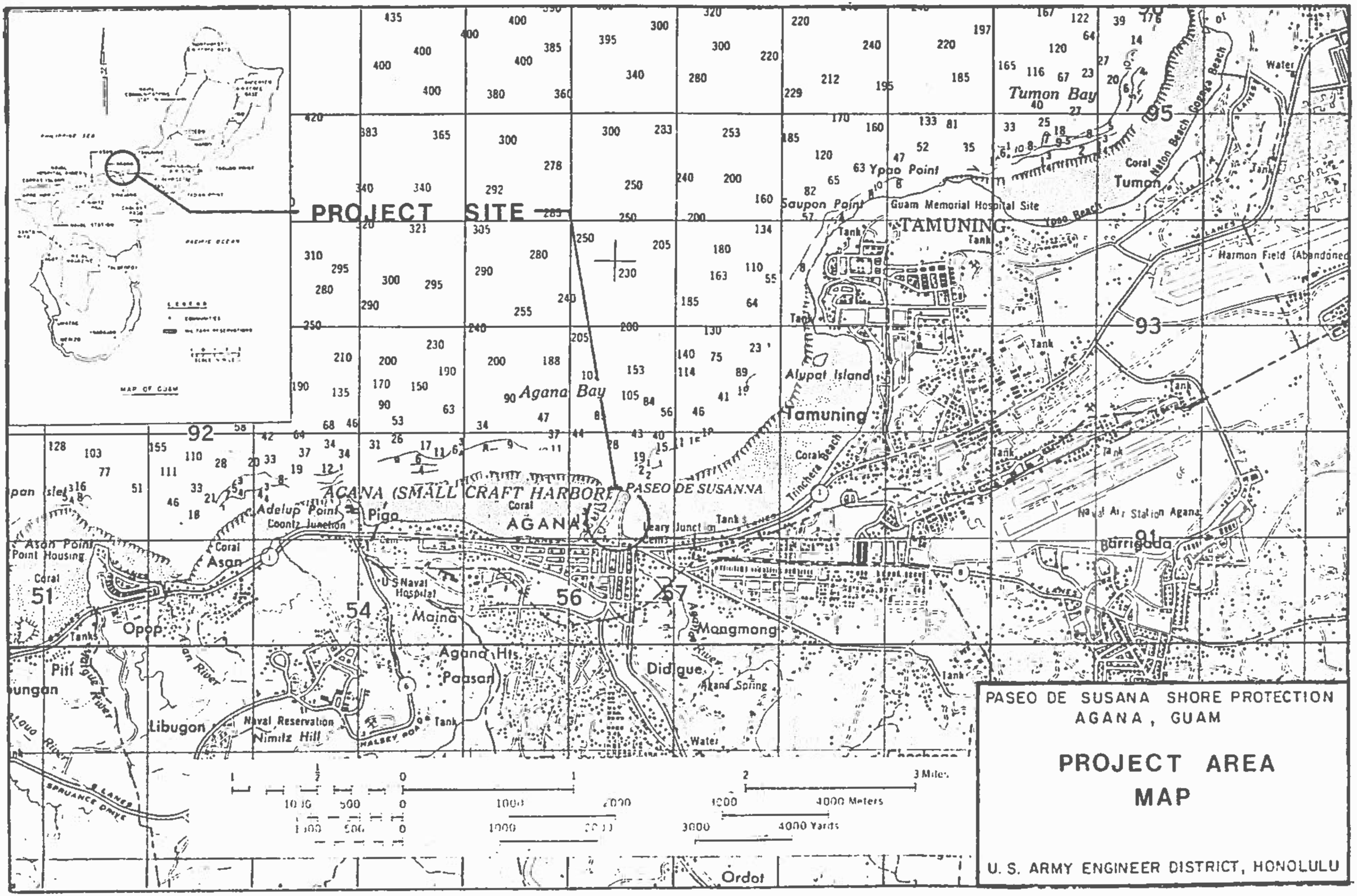
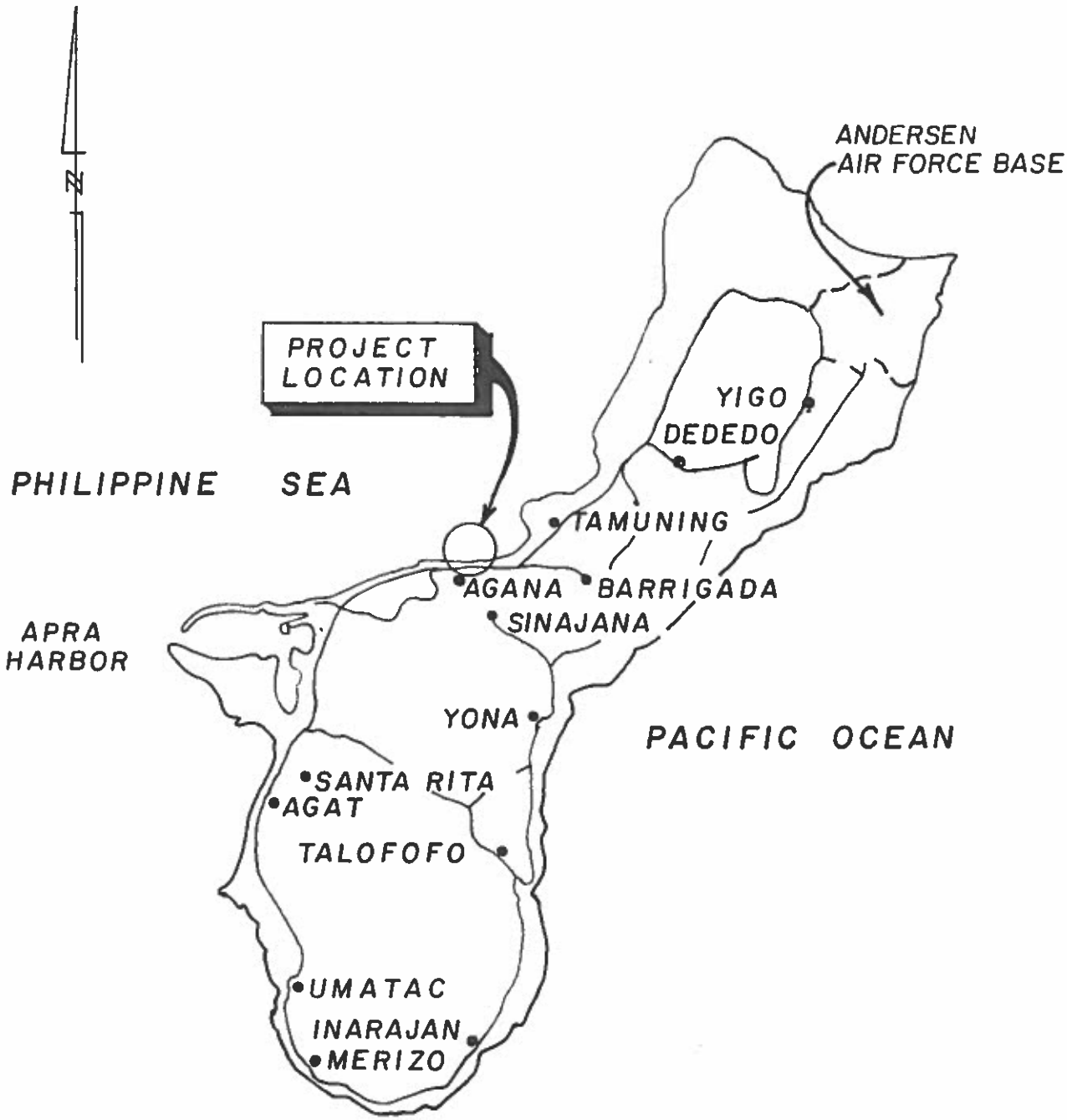

PROJECT SITE
PASEO DE SUSANNA
AGANA (SMALL CRAFT HARBOR)
AGANA
Agana Bay
Tumon Bay
Tumon
Ypao Point
Saupon Point
Guam Memorial Hospital Site
TAMUNING
Tamuning
Alupat Island
Harmon Field (Abandoned)
Naval Air Station Agana
Barrigada
Adelup Point
Asan Point
Asan
Piga
Opop
Maina
U S Naval Hospital
Agana Hts.
Mongmong
Didigue
Agana Spring
Naval Reservation
Nimitz Hill
Libugon
Piti
Ordot
3 Miles
4000 Meters
4000 Yards
PASEO DE SUSANA SHORE PROTECTION
AGANA, GUAM
PROJECT AREA
MAP
U. S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 1



PASED DE SUSANA SHORE PROTECTION
AGANA, GUAM

PROJECT LOCATION MAP

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 2

II. PROBLEM IDENTIFICATION

1. PURPOSE

The purpose of this section is to define the study area and the problems to be addressed in the study. This includes describing the base conditions, identifying public concerns, establishing planning criteria, and analyzing the problems. Public concerns which relate to water and related land resource problems are identified and then refined, based on national and local policies.

National planning policies are prescribed by the Water Resource Council's Principles and Standards (18 CFR Part 711 et seq), the National Environmental Policy Act of 1969 (Public Law 91-190), Section 122 of the River and Harbor and Flood Control Acts of 1970 (Public Law 91-611), the Water Resources Development Act of 1974 (Public Law 93-251), the Clean Water Act of 1977 (Public Law 95-217), and the Corps of Engineer's policy guidelines (ERs).

To help determine resource management 1/ problems, the base condition of the study area is initially defined. The base condition is the existing economic, social, and environmental characteristics of the area. Future conditions are then projected and analyzed to determine the "most probable future" 2/ which would prevail over the area without any changes to existing resource management plans. This analysis describes the "without condition" criterion. Planning objectives 3/ are then formulated based on the problems and needs of the area related to the "without condition" criterion.

2. NATIONAL OBJECTIVES

The Water Resource Council Principles and Guidelines (P&G) for planning water and related land resources define the national objectives of national economic development and environmental quality. National objectives are a means of measuring the effectiveness of possible solutions. The national economic development (NED) objective is achieved by increasing the value of the nation's output of goods and services, and improving national economic efficiency. The environmental quality (EQ) objective provides for the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems in the study area.

1/ "Resource management" involves the development, conservation, enhancement, preservation, and maintenance of water and related land resources to achieve the goals of society, expressed nationally and locally.

2/ "Most probable future" is the projection of basic demographic, economic, social, and environmental parameters, which is used as the basis for defining the "without condition" and the planning objectives for a particular study.

3/ "Planning objectives" are the national, state, and local, water and related land resource management needs (opportunities and problems) specific to a given study area that can be addressed to enhance National Economic Development or Environmental Quality.

During the formulation of alternative plans, the NED contributions are maximized consistent with the EQ objective. For any plan to be considered for implementation, the total beneficial contributions accruing from the project must exceed the total adverse impacts of the project. The P&G also require that the impacts of a proposed action be measured in terms of regional economic development (RED) and other social effects (OSE). Contributions to the RED account are determined by establishing a proposal's effects on a region's income, employment, population, economic base, environment, and social development. Contributions to the OSE account are determined by establishing a proposal's effects on real income, security of life, health and safety, education, cultural and recreational opportunities, and emergency preparedness.

3. PROFILE OF EXISTING BASE CONDITIONS

The cultural, physical, environmental, and economic characteristics of Guam are briefly described below. The appendices contain more detailed descriptions relevant to the planning and design of shore protection improvements.

a. History and Culture.

The ancient Chamorros, remote ancestors of the present-day Guamanians, were the original settlers on the island of Guam. The Chamorros migrated to Guam from southeast Asia in approximately 500 B.C. Ferdinand Magellan's discovery of Guam and other islands in the Northern Marianas chain in 1521 marked the beginning of Spanish influence on the Chamorro people.

Since the western discovery in 1521, the Marianas have come under various rules. The Spanish Dominion from 1521 to 1898 left significant cultural and religious influences that remain to this day. Following the Spanish-American War in 1898, the island was ceded to the U.S., and came under the administration of the U.S. Navy. The passage of the Organic Act in 1950 initiated the modern era for Guam by the lifting of the Navy's security clearance requirements for entry, thereby creating the stimulus for economic and political growth.

b. Physical and Environmental Setting.

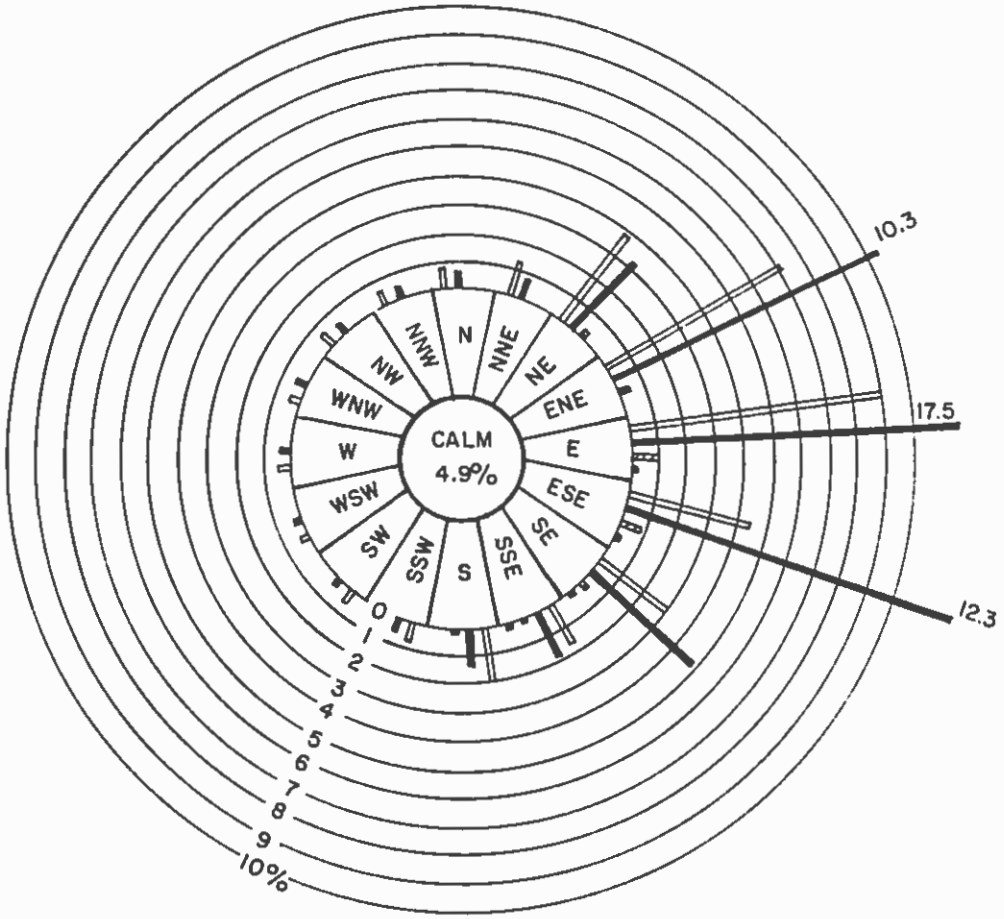
(1) Physical Features. Guam is the southernmost major island in the Marianas chain, a 500-mile-long archipelago in the Western Pacific. It is approximately 30 miles long, ranges from 4 to 8.5 miles in width, and has a land area of about 209 square miles. The island is approximately 3,800 statute miles west of Hawaii.

(2) Climate. The island of Guam has a tropical climate, with warm and humid conditions throughout the year. Average temperatures on Guam range between 75°F and 86°F, and the humidity varies between 75 percent and 82 percent. There are two distinct seasons, defined by variations in wind and rainfall. The dry season extends from January through May, and the wet season from July through November. Easterly trade winds occur throughout the year, but are dominant during the dry season. From July through October, winds become variable and the frequency of occurrence of typhoons increases. The mean annual rainfall on Guam varies from less than 90 inches on the coastal plains, to over 110 inches on the higher mountain areas.

SURFACE WIND DIAGRAM

AGANA FIELD FLEET WEATHER CENTRAL

GUAM, MARIANA ISLANDS



LEGEND

- 1-6 KNOTS
- 7-16 KNOTS
- 17-21 KNOTS
- OVER 21 KNOTS

CONVERSION: 1 KNOT = 1.1516 MPH

10%=TOTAL % OF THE YEAR

PERIOD OF RECORD

1945-1967

SOURCE

NATIONAL WEATHER SERVICE
HONOLULU, HAWAII
DATA COMPILED BY U.S. AIR FORCE
ENVIRONMENTAL TECHNICAL
APPLICATION CENTER,
ASHEVILLE, N.C.

PASEO DE SUSANA SHORE PROTECTION
AGANA, GUAM

SURFACE WIND DIAGRAM

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 3

(3) Astronomical Tides. The tides on Guam are semi-diurnal with pronounced diurnal inequalities. Tidal data from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Survey, shows that the mean tide range is 1.7 feet, and the diurnal (spring tide) range is 2.4 feet. The nearest tidal gauge to the study site is at Apra Harbor, Guam, approximately 13 miles distant, and the data from this gauge is considered reasonably applicable to the study area. Tidal data for the 19-year period between 1949-1967 at Apra Harbor is as follows:

	Feet
Highest tide observed	3.3
Mean higher high water	2.4
Mean high water	2.3
Mean tide level	1.45
Mean sea level	1.4
Mean low water	-0.6
Mean lower low water	-0.0
Lowest tide observed	-1.9

All elevations in this report are referenced to mean lower low water (MLLW) datum.

(4) Terrestrial Biota. Terrestrial flora within the park consists primarily of coconut palms (Cocos nucifera), grasses (Naupaka sp.) and false ironwood (Casuarina equisetifolia). There are no listed or candidate threatened or endangered terrestrial species in the project area. The project area contains the usual exotic species of urban birds and mammals. Dogs, cats, and rats in the area may be attracted to the area by the nearby "farmers market."

(5) Marine Biota. Estuarine species inhabit the Agana River which discharges at the eastern base of the park peninsula. Mackerel, jacks, snappers and tataga (unicorn fish) are among the fish caught by enthusiasts who periodically line the Paseo and basin both day and night. Some net fishing is also done on the reef flat to the west of the boat harbor. According to the Guam Division of Fish and Wildlife, the nearshore Agana Bay site of the Agana Small Boat Harbor is not a highly productive area, however, areas 300 feet shoreward of the reef front have good growths of live coral in pockets.

(6) Geology. The islands of the Marianas chain are of volcanic origin, and represent the peaks of volcanic ridges. The island of Guam is the largest in the chain. Its geologic and topographic features essentially divide the island into northern and southern sections. The northern section is composed of a broad limestone plateau fringed by steep coastal cliffs. The soil on the northern limestone plateau is highly permeable. Streams are absent, as rainfall drains downward to numerous sinkholes and fissures forming a basal freshwater lens. The southern portion of the island is mountainous, with broad, relatively impervious areas of volcanic rock marked by deeply incised valley perimeters and floors.

The Paseo de Susana Park is a man-made peninsula formed from Agana's rubble after World War II. The park is situated on an extensive fringing reef flat adjacent to the Agana Boat Harbor.

(7) Seismicity. The island of Guam is situated within a seismically active zone and is classified as a seismic zone 3. Many earthquakes of low and moderate magnitude occur throughout the year.

c. Human Resources.

(1) Population. Guam's population since the official census began in 1901 is shown in Table 1.

TABLE 1. HISTORICAL POPULATION OF GUAM

Year	Total Population
1901	9,676
1910	11,806
1920	13,275
1930	18,509
1940	22,290
1950	59,498
1960	67,044
1970	84,996
1980	105,816

Source: U.S. Department of Commerce, Bureau of Census and the Guam Department of Commerce.

Projections for Guam envisage a continued growth for the foreseeable future. Projections by the Guam Department of Commerce estimate a population expansion to 136,200 by the year 2000. An extension to the year 2030 assumes a 1/4 of one percent annual growth. The total population projection assumes a constant of 5,000 for nonimmigrant aliens and 20,000 for military personnel and dependents. Population projections for Guam are shown in Table 2.

TABLE 2. GUAM POPULATION PROJECTION

Year	Total Population Projection
1990	119,000
2000	136,000
2010	140,000
2020	143,000
2030	147,000
2035	149,000

d. Economic Development.

Statistics on gross island product are not available for Guam. The gross business receipts, an indicator of gross island product, show a remarkable average increase of 21 percent per annum between 1963 ($82.9 million) and 1973 ($563 million). This trend was hampered in 1975 and 1976 by the world

recession and typhoon disasters. In 1977 the increase was only 6 percent. By 1978 the increase had climbed to 17 percent per annum. Once, mostly dependent on the military, local government, and the construction industry, the emergence of the tourist industry and related activities has broadened Guam's economic base for future growth. Table 3 shows the growth rate of major industries on Guam between 1970 and 1980.

TABLE 3. GROWTH RATE OF MAJOR INDUSTRIES ON GUAM, 1970-1980

	1970 Earnings or Value ($ Millions)	1980 Earnings or Value ($ Millions)	1970 - 1980 Average Annual Growth (Percent)
Gross Sales			
Retail	91.1	352.6	14.0
Wholesale	29.8	92.6	7.7
Manufacturing	6.3	340.3	52.8
Agriculture	NA	3.7	-
Services	26.7	141.6	15.7
Transportation	0.1	24.4	89.6
Insurance, Real Estate Finance	19.7	75.9	17.0
Foreign Trade			
Exports	5.8	61.0	
Imports	96.4	544.2	
Construction	53.1	80.6	9.7
Government			
Local			
Revenue	17.7	128.7	7.7
Expenditure	48.9	140.1	11.9

Source: Guam Annual Economic Review 1982, Department of Commerce, Government of Guam.

Guam experienced a high level of employment since World War II and had no unemployment problems until recently. However, increasing immigration and dependence on relatively cheap imported (alien) labor are changing the employment picture and may cast the island into a situation of severe unemployment in the future. Trends toward unemployment are revealed in total employment increases of 15 percent in 1972 and again in 1973 but only 2 percent in 1974. The May 1975 unemployment statistics show a rate of 8.3 percent and increased a year later to 13.3 percent in May 1976. Following this period, the disaster of Typhoon Pamela raised the unemployment significantly. Total paid employment on the payrolls of all licensed business establishments and governmental agencies during first quarters of March 1979, 1980, and 1981 is summarized by industry in Table 4.

TABLE 4. EMPLOYMENT BY INDUSTRIES AND PERCENT DISTRIBUTION
(MARCH 1979, 1980, 1981)

Industry	Total Employment			Percent Distribution
	1979	1980	1981	1981
Agriculture	100	200	100	0.25
Construction	4,900	2,300	2,100	5.21
Manufacturing	1,200	1,100	1,200	2.98
Transportation & Public Utilities	2,700	2,700	2,700	6.70
Wholesale & Retail Trade	6,800	6,700	6,400	15.88
Finance, Insurance & Real Estate	1,200	1,200	1,200	2.98
Service	8,400	9,000	9,700	24.07
Government				
Federal	6,600	6,600	6,400	15.88
Local	9,600	9,300	10,500	26.05
TOTALS	41,500	39,100	40,300	100.00

Source: Annual Economic Review (Statistical Abstract), Guam 1982 Economic Research Center, Department of Commerce, Government of Guam, August 1982.

Government, construction and wholesale and retail trade employ about 63 percent of the total labor force. Government is the largest employer on the island and will continue to be a major factor in the economy of Guam. Employment by the local government is expected to increase with population and needs of an expanding economy.

The construction industry employed 6 percent of the island's labor force in 1981.

The wholesale and retail trade industry employs more than 19 percent of the island's labor force. Guam's natural resources for industrial development are limited, thereby making the economy service-oriented. This service is expanding to accommodate the influx of visitors and is evident by the growing number of new businesses.

The phenomenal growth of the visitor industry since 1970 as shown in Table 5 is attributed to the rising Japanese investment in Guam. In 1981, some 79 percent of all visitors were from Japan. To accommodate the visitors, hotels, especially around the Tumon Bay area, were constructed at an accelerated rate, with capital provided primarily by Japanese investors. The number of visitors to Guam is expected to grow. The growth, as estimated by the Government, is shown on Table 6. Continued development of the visitor industry will have a definite impact on related services, both in the private and public sector. This industry appears to have the greatest potential for growth.

TABLE 5. TOURIST AND VISITOR ARRIVALS AND ESTIMATED EXPENDITURES (1960 - 1981)

Year	Tourist 1/	Visitor 1/	Estimated Expenditure
1960	200	3,500	--
1965	500	3,000	$600,000
1970	46,581	73,723	15,000,000
1971	84,885	119,174	30,000,000
1972	139,833	185,399	50,000,000
1973	187,471	241,146	90,000,000
1974	233,909	260,568	130,000,000
1975	128,241 2/	239,695 2/	180,000,000
1976	105,954	201,344	102,000,000
1977	150,118	240,467	120,000,000
1978	148,523	231,975	116,000,000
1979	173,102	264,326	Not Available
1980	203,784	291,129	118,000,000
1981	232,808	312,862	190,000,000

Source: Economic Research Center, Department of Commerce, Government of Guam; Guam Visitors Bureau (GVB).

1/ Tourists are travelers arriving for pleasure. Visitors are all people entering Guam whose permanent address is outside of Guam.

2/ Data not available from September to December 1975.

TABLE 6. PROJECTED VISITORS

Year	Projected Visitors
1981	321,000
1982	343,500
1983	367,500

Source: Guam Visitors Bureau, June 8, 1978.

e. Cultural Resources.

There are no historical/cultural sites listed on the Guam or the Federal Register of Historic Places for the Paseo de Susana project area. Because the Paseo de Susana is a man-made promontory built of coral rubble material and damaged masonry from the World War II era, no cultural or historic sites exist in the project area. Modern cultural features erected in the park consist of a reduced size replica of the Statue of Liberty located near the end of the

peninsula, and a memorial dedicated to the memory of fallen members of the Marine Corps, which secured Guam in 1944. Padre Palomo Park, the original pre-war site of the Padre Palomo School, is located on the opposite bank of the Agana River near the shoreline. Pillboxes from World War II are located along the old shoreline along Marine Drive.

f. Recreational Resources.

The Paseo de Susana Park is a popular recreational site for local residents, as well as tourists, to engage in various sports activities such as baseball, tennis, volleyball, soccer, and field hockey. The park also has a youth center and a picnic area, and is a popular fishing site for shoreside fishermen being seasonally one of the most heavily fished locations on Guam. Many surfers use this park for access to surfing sites adjacent to the Agana Harbor entrance channel, just off the tip of the park. Because of the anticipated heavy influx of tourists and the expanding resident population, every effort must be made to preserve and protect this valuable outdoor resource. Due to its ideal location, it will continue to provide a major portion of the recreational opportunities to the people of Guam.

g. Land Use.

Agana is the government and commercial trade center of Guam. Governmental and commercial land uses typify most of downtown Agana. The Paseo de Susana Park, along the Agana Bay waterfront, is the city's main recreational center for spectator and participant sports.

4. "WITHOUT CONDITION" PROFILE

If no Federal action is taken to provide shoreline protection improvements, the lack of adequate protection will further reduce valuable park space and will constrain full recreational use of the ocean, as well as the park's resources for fishing, surfing, picnicking, and other activities. The Paseo de Susana Park is a popular site among island residents, and attracts many tourists as well. Although there are other parks on the island, the Paseo de Susana Park, because of its centralized location within the urban district of Agana, must be able to cope with the anticipated increase in demand for open recreational space within Agana. Since there is limited park space within Agana, the Paseo de Susana Park will continue to be the focal point of recreational activities. In order to avoid disruption of any of these activities, shoreline areas must be protected in order to prevent further reduction of valuable park space.

5. SHORELINE PROBLEMS AND NEEDS

The study problem is erosion of lands along the eastern and western shorelines of the Paseo de Susana Park. Up to approximately 2,500 feet of the park shoreline has eroded as much as 40-50 feet inland at various locations within the park since the original construction of the park landfill after World War II. The Office of the Governor of Guam, in a letter dated 11 July 1979, requested that an assessment of the erosion at the Paseo de Susana Park be completed, and a structural remedy be formulated to prevent further erosion of the park.

Field investigations for this study indicated that 500 feet along the east park shoreline and 970 feet along the west (Agana Harbor) shoreline are presently undergoing the severest erosion. Erosion of the east park tip appears to be due to its proximity to the reef fringing Agana Bay, while erosion of the west shoreline appears to be due to travel of storm waves up the Agana Harbor entrance channel. A detailed analysis of shoreline erosion at the park is included in Appendix D. Photographs of the affected shoreline are shown following this page.

6. SHORELINE HISTORY

Protective revetments for the Paseo de Susana Park were first constructed by the Navy at the tip of the park. Since this construction, an additional 250' long shoreline revetment has been placed along a portion of the western shoreline as a wave absorber for the U.S. Army Corps of Engineers Agana Harbor project. This revetment was constructed to minimize wave energy entering the entrance channel and berthing areas. This structure also serves to prevent further erosion of the existing shoreline and dampens any wave reflection from the shoreline. At the present time, there are no protective structures along the eastern shoreline of the park.

7. PLANNING OBJECTIVES

The planning objectives for shore protection measures at the Paseo de Susana Park in Agana, Guam are based on the identification and analysis of shoreline erosion problems and needs, as well as environmental and human resources. The following planning objectives were adopted to guide the formulation and evaluation of alternative project plans:

a. Mitigate shoreline erosion at the Paseo de Susana Park at Agana, Guam.

b. Enhance fishing, as well as other recreational and leisure opportunities for the people of Guam.

c. Preserve and enhance the visual/aesthetic qualities of the park and shoreline.

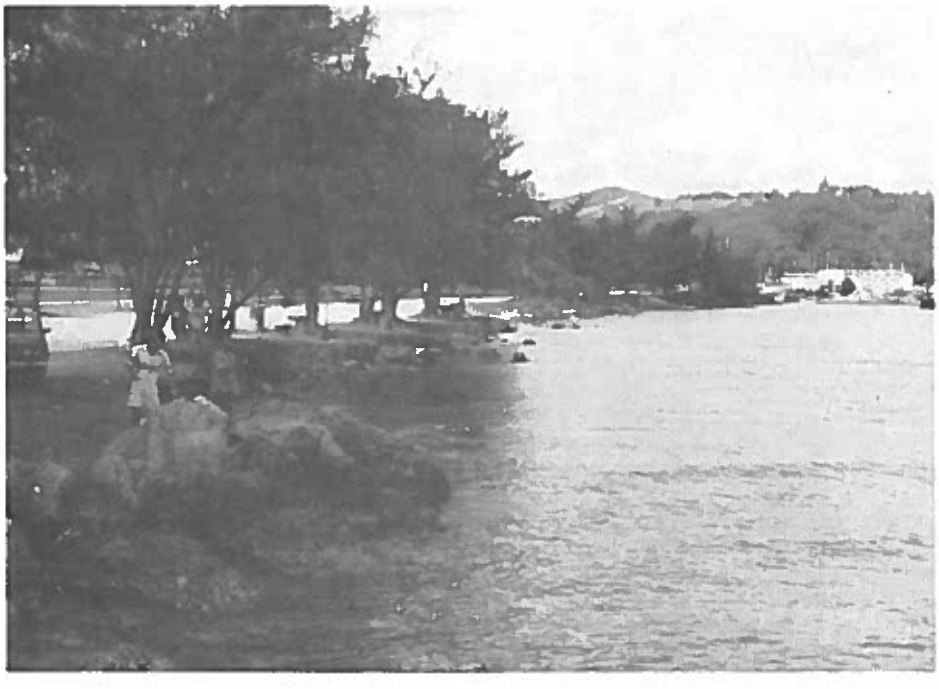
Photograph #3 East park shoreline near Station 10+00 looking north.

Photograph #4 East park shoreline near Station 9+00 looking south.

Photograph #1 East park shoreline near Station 3+00 looking north.

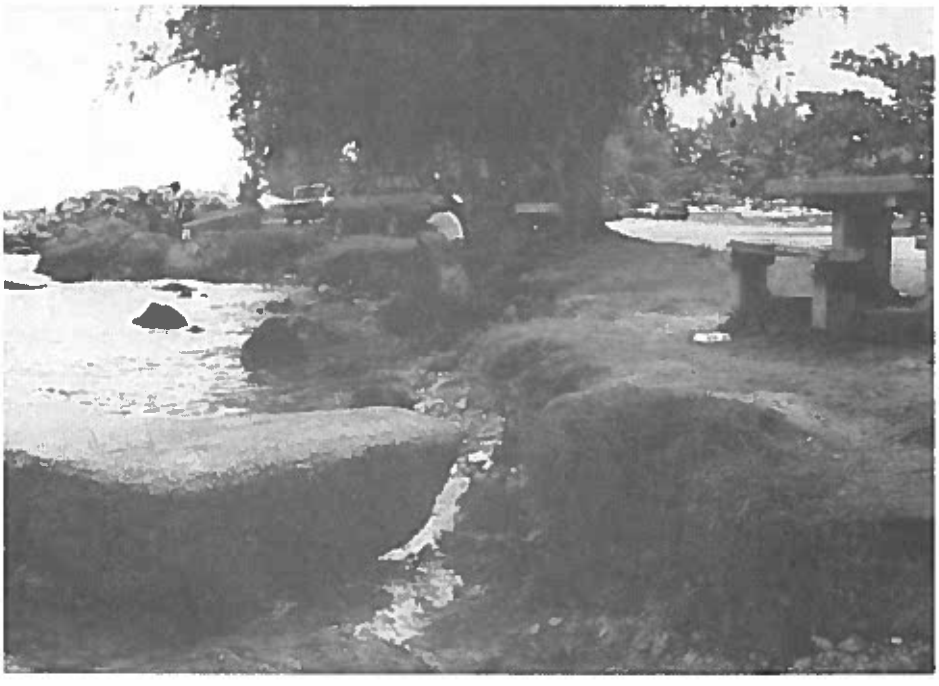
Photograph #2 East park shoreline near Station 4+50 looking north.

Photograph #5 West park shoreline near
Station 7+00 looking north.



Photograph #6 West park shoreline near
Station 3+00 looking south.

Photograph #7 West park shoreline near Station 2+00 looking south.



Photograph #8 West park shoreline near Station 1+00 looking north.

III. FORMULATION OF ALTERNATIVE PLANS

1. FORMULATION AND EVALUATION CRITERIA

This section of the report is directed toward the development and evaluation of alternative measures to resolve the problems and needs of the study area and to fulfill the planning objectives defined in the previous section. The initial step in the formulation process is the identification of a broad range of institutional and technical measures available to resolve problems and needs. These available measures are then evaluated to formulate a plan which best addresses or resolves the present and future problems and needs of the study area. The formulation and analysis of alternative solutions to achieve the planning objectives was based on the Water Resources Council's Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G). The evaluation and assessment of economic, social, and environmental effects also followed the guidelines of Section 122 of the River and Harbor Act of 1970 (Public Law 91-611) and the National Environmental Policy Act of 1969 (NEPA), as well as pertinent Corps of Engineers regulations and guidelines. The formulation and evaluation of alternative plans of improvement was guided by the following technical, economic, and environmental criteria.

a. Technical Criteria.

The following technical criteria were established for plan formulation:

(1) Alternative measures should protect the eastern shoreline of the study site from the selected 6.4-foot high breaking wave.

(2) Alternative measures should protect the Agana Harbor basin shoreline of the study site from the selected 4.0-foot high non-breaking wave.

(3) Alternative measures should be compatible with present and future uses of the Paseo de Susana Park.

(4) Alternative measures should be compatible with the operation of the adjacent Agana Harbor.

(5) Alternative measures should be designed for a 50-year project life.

b. Economic Criteria.

The following economic criteria were established for plan formulation:

(1) Quantifiable benefits should exceed project economic costs.

(2) Each alternative should be developed such that the excess of benefits over costs, or net benefits is maximized. The best plan economically is the one with the greatest net benefits. Also, non-quantifiable or intangible benefits as well as costs should be thoroughly considered and accounted for.

c. Environmental and Social Criteria.

The following environmental and social criteria were established for plan formulation:

(1) Alternative measures should not degrade visual and aesthetic qualities of the shoreline.

(2) Alternative measures should not adversely affect the social well-being, health, or safety of park users.

(3) Alternative measures should protect and enhance the water quality and fish and wildlife resources of the study area.

(4) Alternative measures should protect existing features along the shoreline which may be of interpretative value.

2. PRELIMINARY SCREENING OF POSSIBLE SHORE PROTECTION MEASURES

A wide range of possible nonstructural and structural solutions or measures is available to manage or prevent shoreline erosion. These measures are identified and described with discussion of the applicability and viability of these measures to resolve the specific problems and meet the particular needs of the study area.

a. Nonstructural Measures.

(1) No Action. Although "no action" is not truly a management measure, it has been discussed under the nonstructural category as a management option for erosion control of the study area. "No action" is interpreted for the purposes of this report as "no action by anyone," or leaving the existing situation unchanged.

The "no-action" alternative is not considered an acceptable or viable solution to the problems and needs of the study area since it does not solve any problems nor fulfill identified needs of the study area. Under this measure, the shoreline of Paseo de Susana Park would continue to erode, resulting in further loss of park lands.

The extent to which erosion will continue to progress inland cannot precisely be predicted. Erosion has progressed an average of 40 feet inland from the original shoreline position since the park was constructed in 1946. Utilizing a linear projection method to estimate future inland erosion on the basis of the historical erosion rate of the study area, it is expected that erosion will progress an additional 54 feet inland within another fifty years. With very limited available information of shoreline erosion rates within the study area, it is not possible to predict accurately if or when shoreline conditions would stabilize, or what configuration the shoreline would have in the future. Due to the fact that the Paseo de Susana Park is a man-made peninsula consisting of wartime rubble from Agana, it is doubtful that the shoreline will reach a stabilized condition if left to natural forces without any artificial protection.

(2) Vegetative Barriers: In order to successfully implement this measure, the shoreline would have to be specially prepared for seeding or planting. The type of vegetation planted or seeded would have to be tolerant of recurring salt water inundation, in order to quickly develop a sufficient amount of root biomass to resist erosive and physical damage due to wave action.

This measure may be considered an acceptable alternative for shorelines not under continued wave action, such as the Agana Harbor shore of the park. Vegetative barriers are not sufficient to protect the shore from anticipated overtopping waves and can only be considered a partial solution or a measure to be used in conjunction with other measures. Consequently, maintenance of a vegetative barrier must incorporate complete reconstruction after major storms, such as typhoons. Maintenance of this measure under these conditions can be considered a periodic nourishment analogous to beach replenishment.

(3) Shoreline Management: Shoreline management at Paseo de Susana Park would involve planning for shoreline uses which would be compatible with the recognized erosion risk. Open-space park use is considered compatible with such recognized risk, however, under shoreline management, a setback zone would be established along the shoreline, in which no damageable structures would be constructed. All future damageable structures would be confined to interior areas where erosion would not threaten them. Existing facilities within the recognized setback zone would be reconstructed to withstand erosion or relocated to the interior area.

This alternative does not prevent erosion nor improve safety for park users who may utilize the erosion setback area. Furthermore, the close proximity of the shoreline is a primary attraction to users of a shoreside park such as Paseo. Establishment of the erosion setback area would be very difficult due to the problems associated with estimating the future configuration or width of erosion area. It is likely that more liberal amounts of land would have to be set aside to allow for the uncertainty of estimating the limits of erosion-prone areas. Since the erosion would not be reduced, existing facilities and structures located within this setback zone may be damaged or lost unless reconstructed or relocated inland.

b. Structural Measures.

(1) Offshore Breakwater: An offshore breakwater is a structure designed to protect an area from wave action. This structure is usually constructed to intercept the movement of littoral material by dissipating the wave forces that would normally move it. In the same manner, an offshore breakwater can provide shoreline protection by dissipating wave energy that would normally strike the shore and cause erosion. Offshore breakwaters may be built as low profile structures, or to a height sufficient to prevent overtopping under design wave conditions, depending on the degree of protection desired. They can be continuous for long distances or segmented with passages between to allow exchange of water and are generally of rubble mound construction.

An offshore breakwater is not considered an acceptable solution to the problems and needs of the study area since the navigable areas of Agana Harbor would be drastically reduced. This measure would not eliminate shoreline erosion, however, the rate of erosion would be reduced. Based on the significant adverse impact this measure would have on navigation in Agana Harbor, this measure was not considered a viable alternative, nor evaluated in further detail.

(2) Bulkhead. A bulkhead is a structure which retains or prevents sliding of land and protects land against erosion damages. Precast concrete sheet pile, steel sheet pile, or timber pile can be installed in a vertical position along the shoreline and held in that position by tie-rods anchored to concrete blocks buried in the inland area.

A bulkhead would retain the greatest area of usable land for Paseo de Susana Park since its vertical geometric configuration would require very little space for installation. However, this alternative has certain significant disadvantages, which do not conform with planning objectives and evaluative criteria. Construction of the bulkhead includes extensive excavation to back-shore land areas for installation of the "deadman" anchoring system. This would require removal of all structures of the park within an approximate 50-foot distance from the shoreline. Excavation for installation of the anchoring system would greatly restrict the use of the park and shoreline. The impermeable vertical face of a bulkhead would not absorb or dissipate wave energy, but instead, would reflect wave energy back to the harbor, possibly creating navigational hazards to ships in the entrance channel. In addition, a bulkhead along the harbor front would present potential safety hazards to park users and appears to be less visually acceptable than a stone structure. The cost of a bulkhead is very high compared to a gravity seawall or a stone revetment, primarily due to the extensive concrete "deadman" anchoring system which requires a massive excavation operation. On the basis of the high cost of construction and the large-scale impact on park usage during construction, this alternative was not considered as a viable alternative for further detailed consideration.

(3) Seawall: A seawall is a structure separating land and water areas, primarily designed to prevent erosion and other damages caused by wave action. Seawalls are similar to the gravity retaining walls used on dry land. The stability of a seawall against wave and earth forces depends on its massive weight. The facing is generally vertical or a steep slope.

The vertical or near-vertical geometric configuration of a seawall allows maximum use of land areas within the park. Cement-rubble masonry (CRM) seawalls would be more aesthetically pleasing than a solid concrete structure. However, disadvantages associated with a seawall are the poor wave energy dissipation capability due to an impermeable vertical face, and potential safety hazard to park users, as with the bulkhead measure.

(4) Revetment: A revetment is a facing of stone, concrete blocks, sandbags, or other materials, built to protect a scarp, embankment, or shore structure against erosion caused by wave action. Revetments can be permeable or impermeable depending on the choice of materials.

Of the structural alternative measures considered, a revetment appears to best meet the planning objectives and technical criteria set forth in this section. A permeable sloping revetment has an excellent capacity for dampening wave energy. Although the sloping face of a revetment requires an amount of usable land area from the park for implementation, it would be visually compatible with the existing revetments in the study area. Cost of revetment construction is low compared to those of other shore structures, primarily as a result of ease of construction. Although there are many types of revetments and many kinds of materials available for construction, a stone revetment is the most practical and feasible type on the basis of cost, constructibility, availability of materials, durability, and maintenance.

3. ALTERNATIVE SHORE PROTECTION PLANS

Based on the identified problems and needs, the planning objectives, and the formulation and evaluation concepts, three alternative shore protection plans were developed for the Paseo de Susana Park.

All three of the plans require construction of a rubble mound revetment along the tip of the park and the seaward reach of the east shoreline. The alternatives vary in the method of protecting the west shoreline of the park.

a. Plan Description.

(1) Plan 1: This plan requires the construction of a 500 foot long rubblemound revetment along the eastern park shoreline and a 970 foot long rubblemound revetment along the west park shoreline. The sloping face of the revetment and the voids between the stones will provide the capacity to dampen and dissipate wave energy. The design crest elevation of the east shoreline revetment is 10 feet above MLLW, and the design crest elevation of the west shoreline revetment is 7 feet above MLLW. Construction of this plan will require keying the new east revetment to the existing revetment along the northern tip of the park. Construction of the west revetment will require keying the new structure to the existing Corps of Engineers wave absorber. Plan 1 is shown on Figures 4 and 5, with typical sections shown on Figures 8 and 9.

(2) Plan 2: This plan requires the construction of 500 feet of rubblemound revetment along the east park shoreline, and 590 feet of rubblemound revetment along the west park shoreline. This plan is identical to Plan 1, save for a reduction of the length of west shoreline revetment. The inland 380 feet of revetment are deleted from this plan due to the apparent greater stability of this reach of shoreline as a result of the existing vegetation. The west shore revetment would effectively act as a 590 foot long extension of the existing 250 foot wave absorber, thereby reducing the wave heights affecting the remaining 380 feet of shoreline. Futher, this plan eliminates impacts to the older portion of the Paseo landfill, the seaward limit of which is delineated by the circa World War II concrete bunker located midway along the west shoreline. Plan 2 is shown on Figures 4 and 6, with typical sections shown on Figures 8 and 9.

(3) Plan 3: This plan requires the construction of 500 feet of rubblemound revetment along the east shoreline of the park, and vegetating 970 feet of the west shoreline of the park. The west shoreline vegetation component will require backfill along the shoreline on slopes varying from 5.0 to 3.5 horizontal to 1.0 vertical, with soil to match the existing park soils, and planting with beach morning glory or similar plant species. The portions of the shoreline subject to tidal action will be filled with coarser materials, such as gravels and cobbles. This plan will have a lower degree of permanence than Plans 1 and 2, and will require more frequent maintenance by the local sponsor, corresponding to a periodic nourishment, Plan 3 is shown on Figures 4 and 7, with typical sections shown on Figures 8 and 10.

4. EVALUATION AND ASSESSMENT OF ALTERNATIVE PLANS

a. Estimated Benefits and Costs

(1) Benefits. Benefits accruing from each plan were derived from recreational benefits. Economic evaluations were conducted in accordance with procedures and standards prescribed by the Water Resources Council and Corps of Engineers' policy. Detailed analyses are presented in Appendix E.

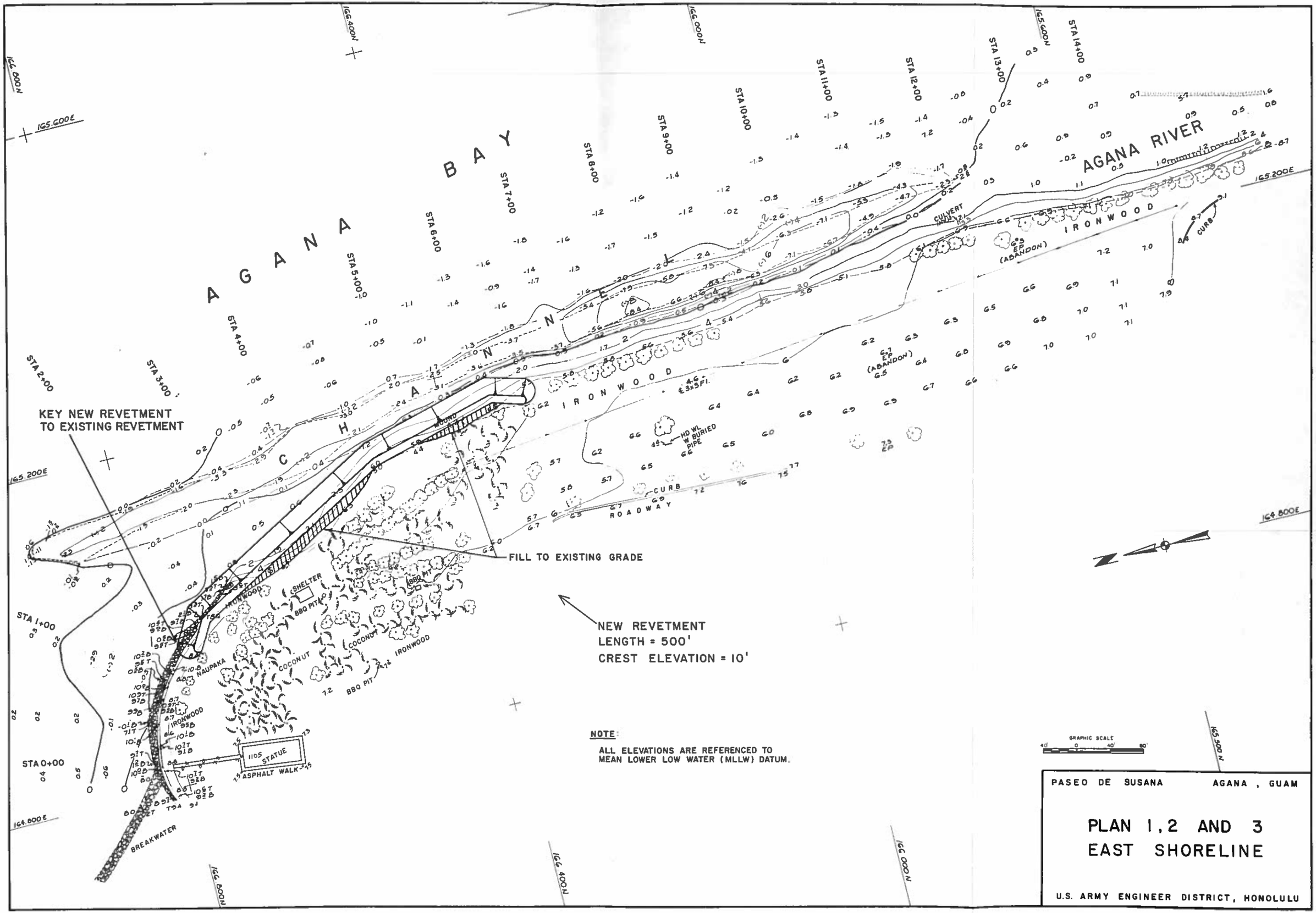
(2) Costs. Estimated project first costs were developed from June 1983 price levels and assumptions based on the prevailing physical conditions and construction methods suitable to the project area. The average annual cost for the purposes of the benefits to cost comparisons include interest (7-7/8%) and amortization (50-years) of the project first cost and the estimated annual maintenance costs. Cost breakdowns and estimating assumptions are provided in Appendix D (Cost Estimate Section of the Engineering Investigations and Design Analysis Appendix).

(3) Benefit to Cost Comparison. Table 7 presents a summary of the estimated average annual beneifts to average annual costs associated with each plan. This comparison represents the degree of tangible economic justification for each plan.

TABLE 7. COST-BENEFIT SUMMARY
(Jun 83 Price Levels - $1,000)

Item	PLANS 1	2	3
Total First Cost 1/	$1,564	$1,255	$755
Average Annual Cost	$ 132	$ 105	$ 77
Average Annual Benefit	$ 283	$ 206	$283
Net Benefits	$ 151	$ 101	$206
Benefit to Cost Ratio	2.1	2.0	3.7

1/ The apportionment of costs does not include other non-federal costs (self-liguidating) associated with the assurances of local cooperation as required in Section 221 of the River and Harbor Act of 1970. Provisions required in the local cooperation agreement are detailed in the following section.



NOTE:

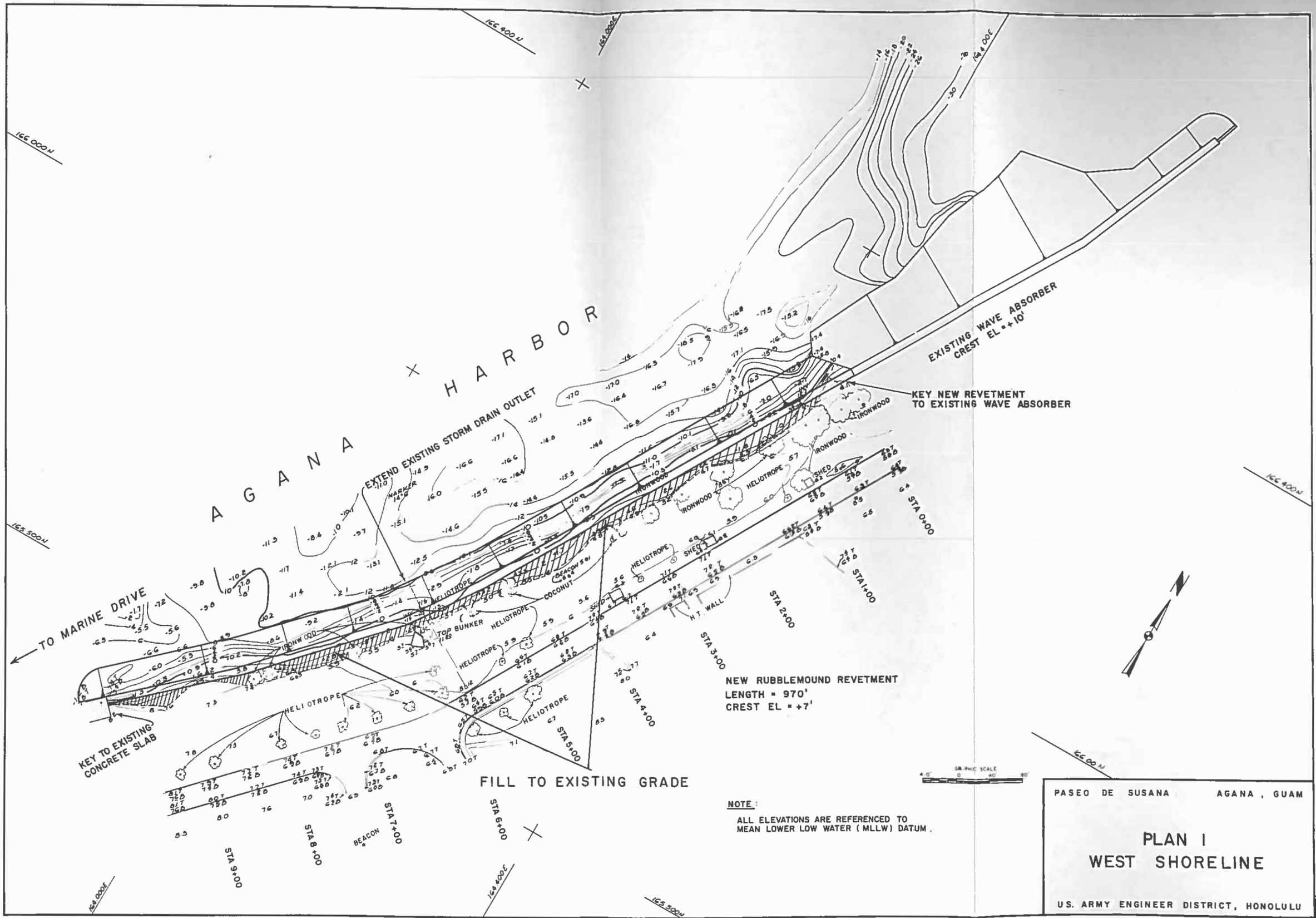
ALL ELEVATIONS ARE REFERENCED TO MEAN LOWER LOW WATER (MLLW) DATUM.

PASEO DE SUSANA AGANA , GUAM

PLAN 1, 2 AND 3
EAST SHORELINE

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 4



NOTE :

ALL ELEVATIONS ARE REFERENCED TO MEAN LOWER LOW WATER (MLLW) DATUM .

PASEO DE SUSANA AGANA , GUAM

PLAN I
WEST SHORELINE

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 5

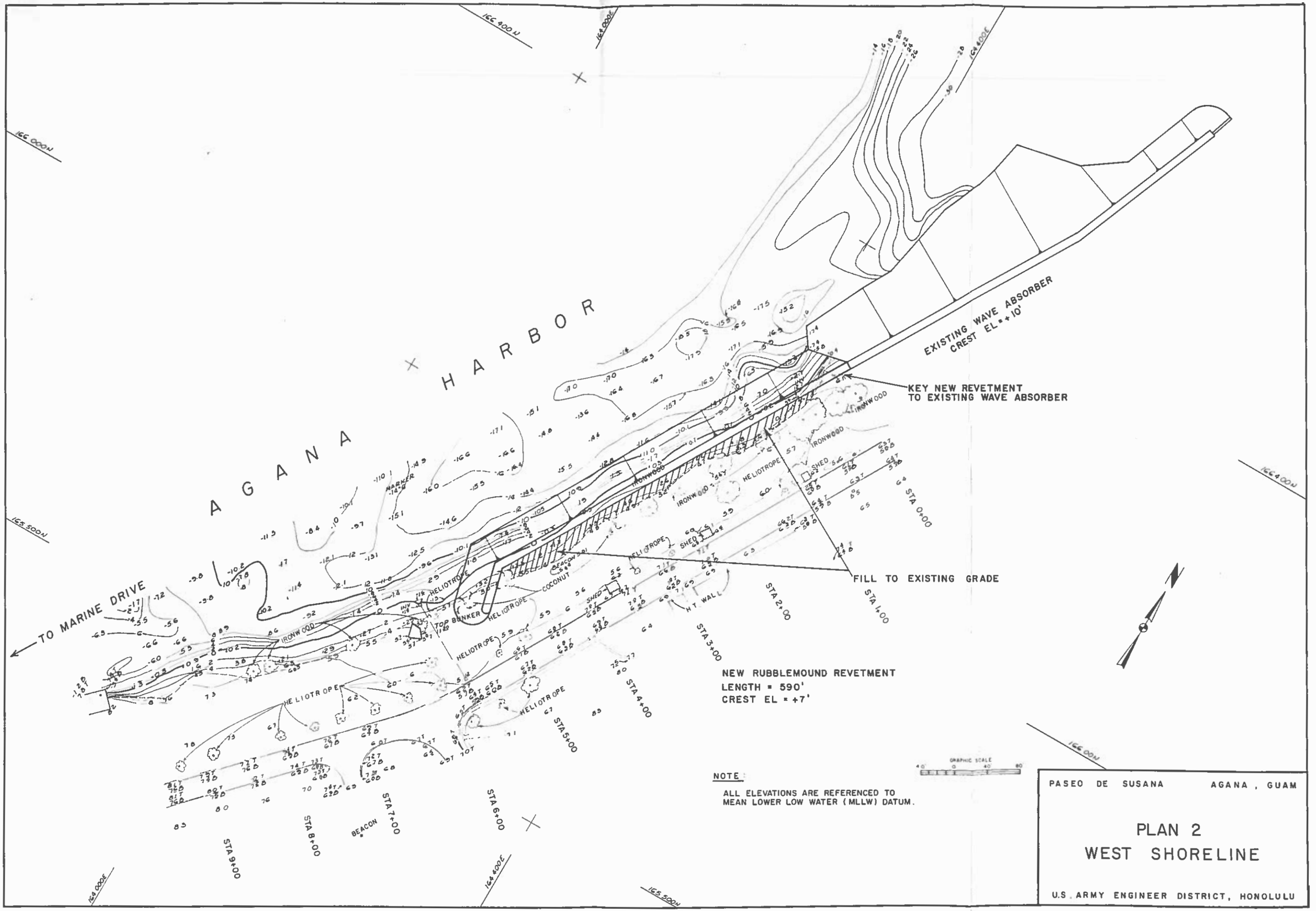

166 400 N
164 000E
166 000N
HARBOR
AGANA
EXISTING WAVE ABSORBER
CREST EL.=+10'
KEY NEW REVETMENT
TO EXISTING WAVE ABSORBER
IRONWOOD
HELIOTROPE
SHED
BEACON
MARKER
COCONUT
TOP BUNKER
HT WALL
STA 0+00
STA 1+00
STA 2+00
STA 3+00
STA 4+00
STA 5+00
STA 6+00
STA 7+00
STA 8+00
STA 9+00
FILL TO EXISTING GRADE
TO MARINE DRIVE
NEW RUBBLEMOUND REVETMENT
LENGTH = 590'
CREST EL = +7'
GRAPHIC SCALE
40 0 40 80
NOTE
ALL ELEVATIONS ARE REFERENCED TO
MEAN LOWER LOW WATER (MLLW) DATUM.
164 400E
165 200N
166 000N
PASEO DE SUSANA AGANA, GUAM
PLAN 2
WEST SHORELINE
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 6

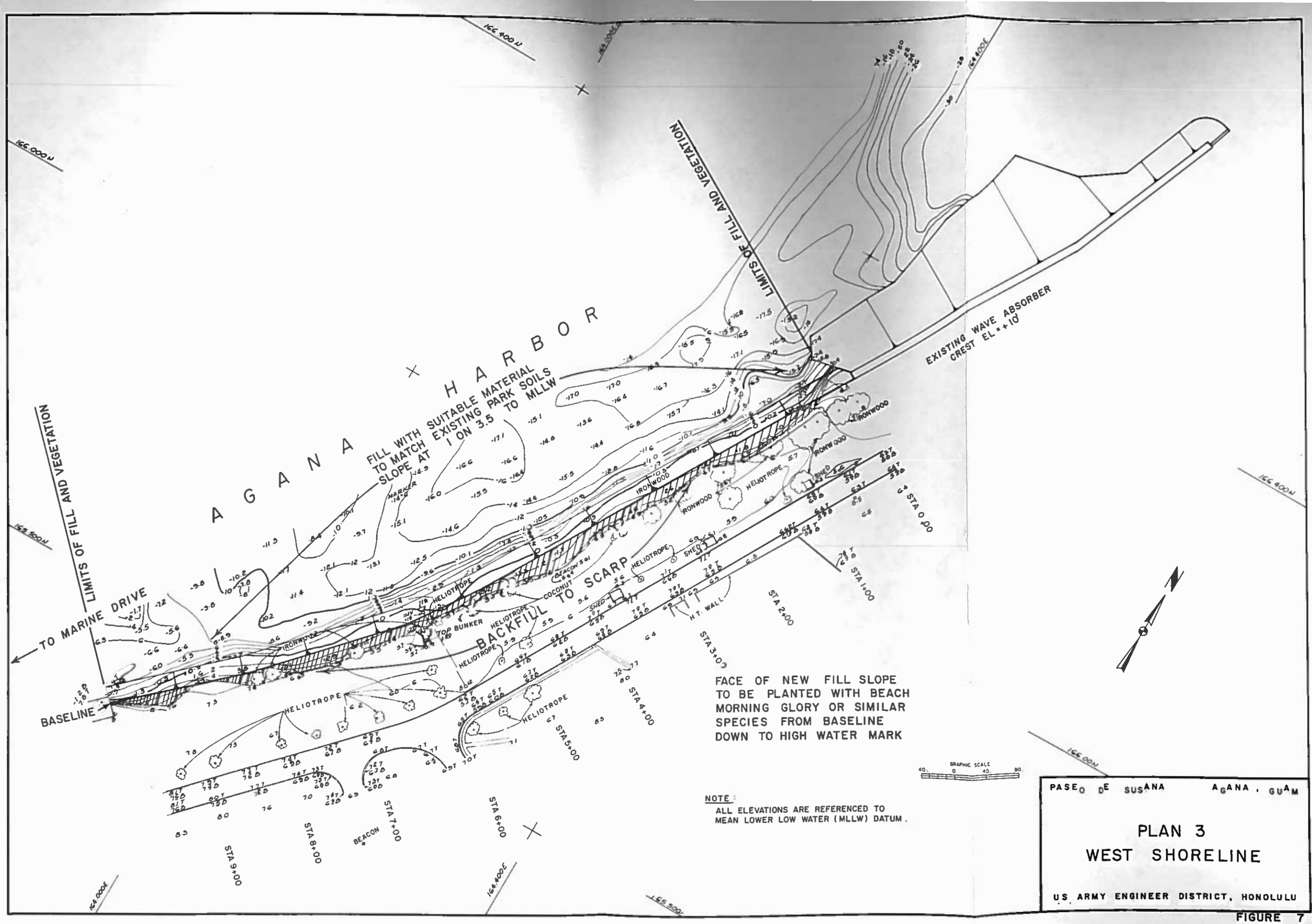
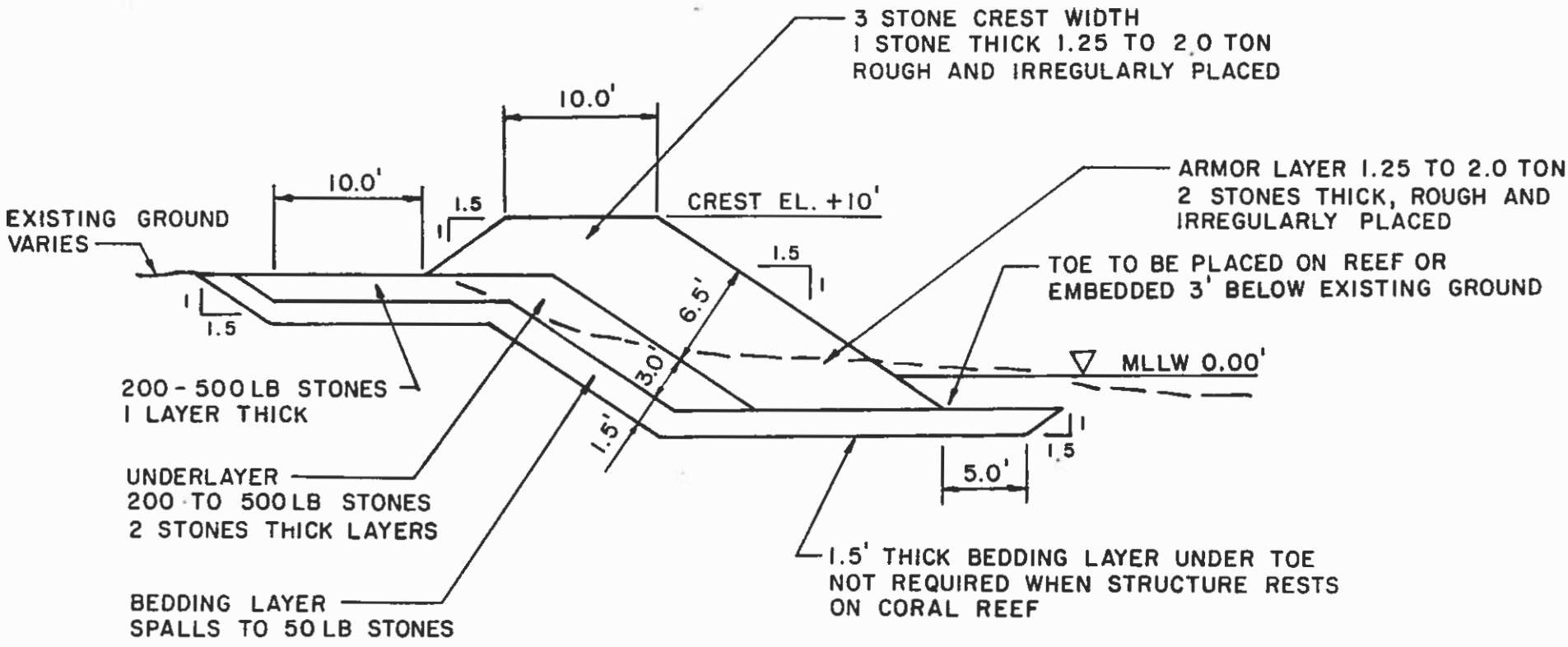

166,400 N
166,000 N
164,000 E
164,400 E
LIMITS OF FILL AND VEGETATION
EXISTING WAVE ABSORBER
CREST EL. + 10'
FILL WITH SUITABLE MATERIAL
TO MATCH EXISTING PARK SOILS
SLOPE AT 1 ON 3.5 TO MLLW
BACKFILL TO SCARP
TO MARINE DRIVE
BASELINE
HARBOR
AGANA
IRONWOOD
HELIOTROPE
COCONUT
BEACON
HT. WALL
SHED
STA 0+00
STA 1+00
STA 2+00
STA 3+00
STA 4+00
STA 5+00
STA 6+00
STA 7+00
STA 8+00
STA 9+00
FACE OF NEW FILL SLOPE TO BE PLANTED WITH BEACH MORNING GLORY OR SIMILAR SPECIES FROM BASELINE DOWN TO HIGH WATER MARK
GRAPHIC SCALE
40 0 40 80
NOTE:
ALL ELEVATIONS ARE REFERENCED TO MEAN LOWER LOW WATER (MLLW) DATUM.
PASEO DE SUSANA AGANA, GUAM
PLAN 3
WEST SHORELINE
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 7



GRAPHIC SCALE

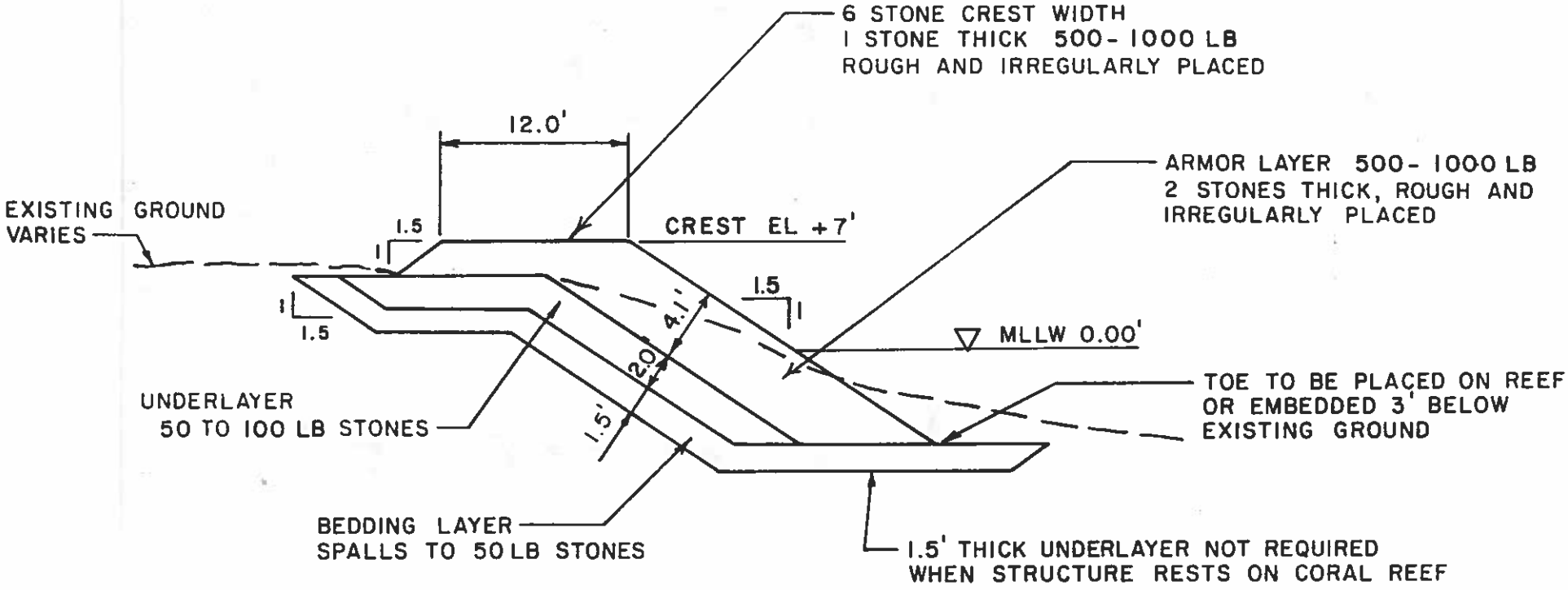
16' 5' 0 16'

PASEO DE SUSANA SHORE PROTECTION
AGANA, GUAM

TYPICAL SECTION
EAST SHORELINE

US ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 8



GRAPHIC SCALE

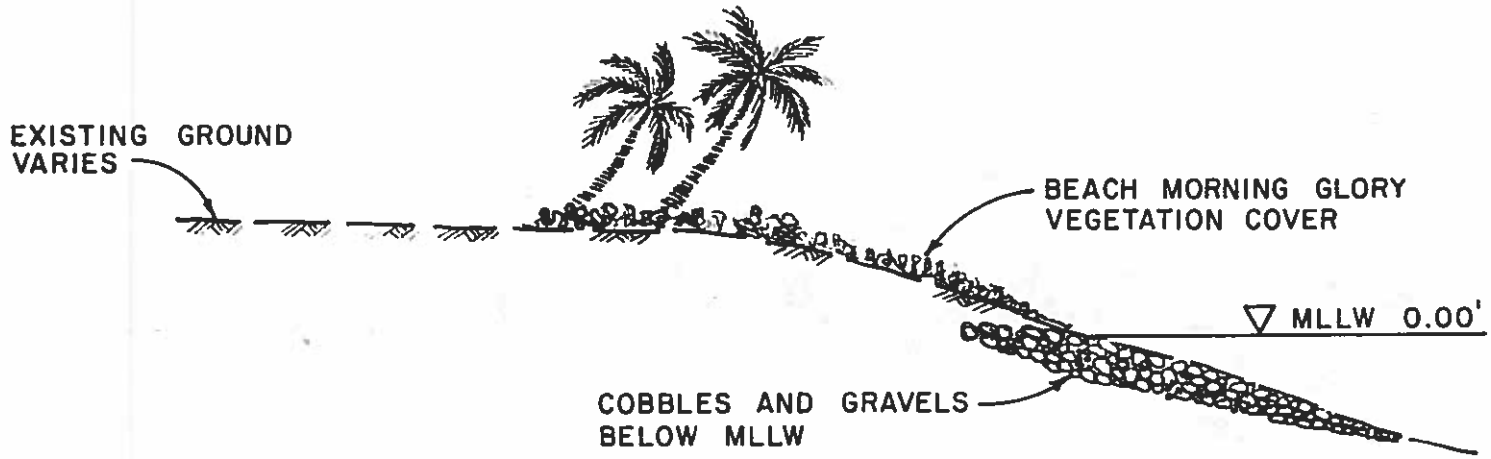
10' 5' 0 10'

PASEO DE SUSANA SHORE PROTECTION
AGANA, GUAM

TYPICAL SECTION WEST SHORELINE

U S ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 9



PASEO DE SUSANA SHORE PROTECTION
AGANA, GUAM

TYPICAL SECTION
WEST SHORELINE
VEGETATIVE COVER

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 10

TABLE 16. SUMMARY COMPARISON OF ALTERNATIVE PLANS AND SYSTEMS OF ACCOUNTS

	NO IMPROVEMENT "WITHOUT" CONDITION	PLAN 1	PLAN 2	PLAN 3
A. PLAN DESCRIPTION	No shore protection measures implemented. Shoreline continues to erode.	500' stone revetment along east shoreline with 970' stone revetment along west shoreline.	500' stone revetment along east shoreline with 590' stone revetment along west shoreline.	500' stone revetment along east shoreline. 970' along west shoreline graded and vegetated.
B. SIGNIFICANT IMPACTS				
1. Economic				
Local Govt Finance*	No Change.	No Impact.	No Impact.	No Impact.
Land Use	No Change.	No Impact.	No Impact.	No Impact.
Public Facilities and Services	No Change.	No Impact.	No Impact.	No Impact.
Regional Growth*	No Change.	No Impact.	No Impact.	No Impact.
Employment*	No Change.	No Impact.	No Impact.	No Impact.
Business and Industrial*	No Change.	No Impact.	No Impact.	No Impact.
2. Environmental				
a. General				
Marine Environment	No impact to the shallow reef flat environment. Varying bottom substrate sand, coral, rubble and reef rock.	Increase in berthic and intertidal habitat.	Same as Plan 1.	Same as Plan 1.
Terrestrial Environment	No Change.	No Impact.	No Impact.	No Impact.
Fish & Wildlife	No change to existing conditions.	Loss of some sub and intertidal habitat. Temporary displacement of motile organisms during construction. Rapid recovery anticipated. (1, 6, 9)	Same as Plan 1.	Same as Plan 1.
Water Quality*	No change. Presently good shoreline reef flat water quality.	Temporary turbidity during construction. No significant long term effect except for impacts associated with boat operation. (1, 6, 9)	Same as Plan 1.	Turbidity during construction and during establishment of vegetation.
Circulation & Flushing	No change from existing conditions.	No Impact.	No Impact.	No Impact.
Air Quality*	No Change.	No Impact.	No Impact.	No Impact.

Table 16 Continued.

	NO IMPROVEMENT "WITHOUT" CONDITION	PLAN 1	PLAN 2	PLAN 3
2. Environmental				
Natural Resources*	Natural, unaltered shoreline and reef flat.	Will commit 27,000 tons of quarried stone for protective structures.	Will commit 20,700 tons of quarried stone for protective structures.	Will commit 10,000 tons of quarried stone for protective structures.
Man Made Resources*	No change from existing conditions.	Preserve park land and facilities from erosion.	Same as Plan 1.	Same as Plan 1.
3. Social				
Noise*	No change from existing conditions.	Temporary increase during construction, no long term change. (1, 5, 9)	Same as Plan 1.	Same as Plan 1.
Population*	No Impact.	No Impact.	No Impact.	No Impact.
Aesthetic Values*	No Change.	Enhances appearance of shoreline and does not impair any viewing corridors.	Same as Plan 1.	Same as Plan 1.
Historic Cultural and Archaeological Resources	No Change.	No Impact.	No Impact.	No Impact.
Recreation Opportunities	No Change.	Restores and increases recreational area and opportunities.	Same as Plan 1.	Restricts usage of west shoreline
Health, Safety and Community Well Being	No Change.	Enhances health, safety and community well being by eliminating erosion and restoring hazardous shore areas.	Same as Plan 1.	Same as Plan 1.
Community Growth and Cohesion*	No Change.	Contributes to community cohesion through enhancement of recreation activities and opportunities.	Same as Plan 1.	Same as Plan 1.
C. PLAN EVALUATION				
1. Contributions to Planning Objectives				
Mitigate shoreline erosion		Yes	Yes	Yes
Entrance recreational and leisure opportunities		Yes	Yes	Yes
Preserve and enhance visual/aesthetic qualities		Yes	Yes	Yes

Table 16 Continued.

	NO IMPROVEMENT "WITHOUT" CONDITION	PLAN 1	PLAN 2	PLAN 3
C. PLAN EVALUATION				
2. Response to Formulation Criteria				
Technical				
Protect east shoreline from design wave	No	Yes	Yes	Yes
Protect west shoreline from design wave	No	Yes	Yes	Yes
Compatible with park uses	N/A	Yes	Yes	Yes
Compatible with harbor operation	N/A	Yes	Yes	Yes
50-year project life	N/A	Yes	Yes	Yes, with periodic nourishment of West Shoreline.
Economic				
Benefits exceed costs	N/A	Yes	Yes	Yes
Net benefits maximized	N/A	Yes	Yes	Yes
Environmental and Social				
Maintain visual qualities of shoreline	N/A	Yes	Yes	Yes
No adverse effects on social well being, health or safety	N/A	Yes	Yes	Yes
Enhance water quality and fish and wildlife resources	N/A	Yes	Yes	Yes
Protect features of interpretive value	N/A	Yes	Yes	Yes
3. Relationship to National Accounts				
National Economic Development (NED)				
Average Annual Benefits	N/A	$283,000	$206,000	$283,000
Average Annual Costs	N/A	$132,000	$105,000	$ 77,000
Net Annual Benefits	N/A	$151,000	$101,000	$206,000
Benefit to Cost Ratio (B/C)	N/A	2.1	2.0	3.7
Environmental Quality	SEE ITEM B.2 ON THIS TABLE.			

Table 16 Continued.

	NO IMPROVEMENT "WITHOUT" CONDITION	PLAN 1	PLAN 2	PLAN 3
C. PLAN EVALUATION				
3. Relationship to National Accounts				
National Economic Development (NED)				
Social Well Being	SEE ITEM B.3 ON THIS TABLE.			
Regional Development	SEE ITEM B.1 ON THIS TABLE.			
4. Response to Associated Evaluation Criteria				
Acceptability	Not Acceptable.	High	Medium	Medium
Completeness	N/A	Complete as described.	Same as Plan 1.	Same as Plan 1.
Effectiveness	N/A	Highly Effective.	Highly Effective.	Effective.
Efficiency	N/A	Highly Efficient.	Highly Efficient.	Efficient.
Reversibility	N/A	Irreversible commitment of monetary rock and environmental resources.	Same as Plan 1.	Same as Plan 1.
Stability	N/A	High	High	Medium
D. IMPLEMENTATION RESPONSIBILITIES				
1. Corps of Engineers		Provide estimated project first cost share of $842,000 design and construction of revetments.	Provide estimate project first cost share of $687,000 design and construction of revetments.	Provide estimated project first cost share of $437,000 design and construction of revetment and earthwork.
2. Territory of Guam		Provide estimated local first cost share of $722,000. Provide assurances and cooperation and maintenance.	Provide estimated local first cost share of $568,000. Provide local assurances and cooperation and maintenance.	Provide estimated local first cost share of $318,000. Provide local assurances and cooperation and maintenance.

INDEX OF FOOTNOTES:

TIMING
1. Impact is expected to occur prior to or during implementation of the plan.
2. Impact is expected within 5 years following plan implementation.
3. Impact is expected in a longer time frame (15 or more years following implementation).

UNCERTAINTY
4. The uncertainty associated with impact is 50% or more.
5. The uncertainty is between 10% and 50%.
6. The uncertainty is less than 10%.

EXCLUSIVITY
7. Overlapping entry: Fully monetized in NED account.
8. Overlapping entry: Not fully monetized in NED account.

ACTUALITY
9. Impact will occur with implementation.
10. Impact will occur only when specific additional actions are carried out during implementation.
11. Impact will not occur because necessary additional actions are lacking.

(*) Item specifically required in Section 122, Public Law 91-611 and ER 1105-2-240.

(4) Apportionment of Costs. The apportionment of costs between federal and non-federal interests corresponds to Section 103a of the River and Harbor Act of 1962, as amended, which prescribes the cost of sharing. This law limits federal participation to a monetary maximum of $1 million..

TABLE 8. APPORTIONMENT OF COSTS
($1,000)

	PLANS		
	1	2	3
Total Project First Cost	$1,564	$1,255	$755
Corps of Engineers First Cost Share 1/	$ 842	$ 687	$437
Non-Federal First Cost Share 2/	$ 722	$ 568	$318

1/ Excluding $120,000 preauthorization cost.
2/ All future maintenance of the project is a local cost.

b. Summary Comparison of Alternative Plans. The evaluation of the economic, social, and environmental effects of each alternative plan is displayed in Table 9 (Summary Comparison of Alternative Plans and System of Accounts). This table displays the significant contributions, the beneficial and adverse effects, and the extent to which various planning objectives and evaluation criteria are met by each plan.

c. Compliance Requirements.

(1) Copies of the report will be circulated to Federal and Government of Guam agencies as well as to interested groups and individuals. Copies will also be made available to the residents of Agana, Guam. The mailing list is provided in Appendix B.

(2) As part of the public involvement program, a public meeting will be held in July 1983 in Agana, Guam. Public notices will be sent to the general public and media as well as to Federal and Government of Guam elected officials and governmental agencies. The meeting will give the public the opportunity to express their views concerning the proposed alternatives as well as on the effects of "discharge of fill material in the navigable waters of the US" and the "development of Federal activities within the base floodplain" under Section 404 of the Clean Water Act of 1977 and Executive Order 11988 (Flood Plain Management, dated 24 May 1977), respectively. Additional evaluation reports required by these acts are provided in Appendix A of this draft report. A transcript of the public meeting will be provided in Appendix B.

(3) In accordance with the Fish and Wildlife Coordination Act of 1958, as amended, the US Fish and Wildlife Service has provided a draft Section 2(b) report. A copy of this report is provided as Appendix C.

(4) The Government of Guam Historic Preservation Officer, the Interagency Archaeological Service of the Heritage Conservation and Recreation Service, U.S. Department of the Interior and the U.S. Advisory Council on Historic Preservation will be afforded the opportunity to review the adequacy of the study and findings under the National Historic Preservation Act of 1966 and the Archaeological Recovery Act of 1960 as amended.

d. Summary of Comments Received. The Public Involvement Appendix B will include a summary of all the pertinent comments received regarding the Draft Detailed Project Report and Environmental Assessment. Letters received will also be reproduced in Appendix B under Pertinent Correspondence. Comments and responses pertaining to the Draft Environmental Assessment will also be summarized in the Final Environmental Assessment.

IV. THE TENTATIVELY SELECTED PLAN

1. RATIONALE FOR SELECTION

Based on maximizing net benefits, Plan 3 is designated the NED plan and the tentatively selected plan. The final plan selection will follow a review of this draft report and environmental assessment. Following the formal public meeting and comment period, public input will be documented and considered in the final evaluation.

2. PLAN DESCRIPTION

a. General Plan

The tentatively selected plan of improvement consists of a 500-foot long rubble mound revetment along the east seaward tip of the Paseo de Susana Park, with a 970-foot long reach of regrading and vegetation along the west (Agana Harbor) shore of the park.

b. Apportionment of Costs

Based on June 1983 price levels, the apportioned costs for the tentatively selected plan is shown below:

Apportionment of Costs for the Tentatively Selected Plan
(June 1983 Price Levels)

Total Project First Cost	$755,000
Non-Federal First Cost Share	$318,000
Corps of Engineers First Cost Share1/	$437,000

1/ All future maintenance is the responsibility of the local sponsor.

c. Plans and Specifications

In the event the Government of Guam wishes to initiate construction of the selected plan at the Paseo de Susana Park, plans and specifications will be prepared. During this stage the following will be incorporated:

(1) subsurface (borings) investigations

(2) updated site bathymetric and topographic surveys

(3) final design and coordination

(4) construction drawings and plans

(5) real estate permits and rights-of-way

(6) local assurances in accordance with Section 221 of the River and Harbor Act of 1970

(7) compliance documents and certificates as necessary

3. PLAN IMPLEMENTATION

a. Construction Schedule

The work schedule for preparation of plans and specifications is approximately 6 months. Construction would be accomplished by contract and will require approximately 5 months to complete.

b. Maintenance

The Government of Guam will maintain the project in its entirety. The estimated annual maintenance cost of the project is $16,000.

c. Local Cooperation

Section 221 of the River and Harbor Act of 1970 (P.L. 91-611) requires that the local sponsor shall enter into a written agreement to furnish the required cooperation conditions prior to commencement of construction. Under the legislation and administrative policy of Section 103a of the River and Harbor Act of 1962, as amended, these conditions are:

(1) Provide without cost to the United States all necessary lands, easements, rights-of-way, or other real estate interests, as well as any relocations, disposal areas, or drainage improvements required for construction of the project;

(2) Hold and save the United States free from damages which may result from construction, operation and subsequent maintenance of the project, except damages due to the fault or negligence of the United States or its contractors;

(3) Assure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based during the economic life of the Project;

(4) Assure maintenance and repair during the economic life of the project as required to serve the intended purposes;

(5) Provide and maintain necessary access roads, open and available to all on equal terms;

(6) Comply with the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646);

(7) Comply with Title VI of the Civil Rights Act of 1964 (PL 88-352); and

(8) Subject to the Federal limitation of $1,000,000, provide a cash contribution equivalent to 50 percent of the total construction costs of the project, with the final amount to be determined after all costs have been determined.

The Government of Guam must provide a letter assuring cooperation for the selected plan, following final plan selection. Upon receipt of this assurance, the study can then proceed for review by the Office of the Chief of Engineers.

d. Compliance Documents and Certificates

All necessary Federal and local certifications for consistency and conformance to environmental (water quality, discharge, etc.) and land-use regulations must be completed prior to any construction.

e. Federal Funding

The preparation of plans and specifications and the initiation of construction must be approved and authorized by the Chief of Engineers. The U.S. Army Corps of Engineers' priority for funding of construction under the Small Projects authority is based on the needs and merit of similar projects nation-wide and the availability of funds.

V. CONCLUSIONS AND RECOMMENDATIONS

The District Engineer's conclusions and recommendations will be completed after the public review of the Draft report.

PASEO DE SUSANA SHORE PROTECTION
TERRITORY OF GUAM

ENVIRONMENTAL ASSESSMENT

ENVIRONMENTAL ASSESSMENT
FOR
PASEO DE SUSANA SHORE PROTECTION STUDY
AGANA, TERRITORY OF GUAM

1. NEED FOR THE PROJECT

a. Authority. The Paseo de Susana shore protection study is authorized by Section 103a of the River and Harbor Act of 1962.

b. Need for Proposed Action.

(1) Shoreline erosion is a recurring problem due to the lack of shore protection and erosion control measures. Chronic erosion ranging from intermediate to severe is occurring along certain portions of the Pasaeo shoreline. In the last 36 years, about 40-50 feet of the penninsula has eroded. Because the site serves as a heavily used and very important recreational resource for the Agana area protection of this valuable resource is necessary.

c. Previous Studies. The site of the proposed action overlaps that of the Agana Small Boat Harbor on the west side of the Paseo de Susana peninsula. The small boat harbor project, which has since been constructed, was assessed in a Final Environmental Statement prepared by the Pacific Ocean Division on 23 Februray 1973 and submitted to the U.S. Council on Environmental Quality on 11 May 1973. It was supplemented twice: first in August 1975 and then in March 1976. Many of the same descriptions of environmental conditions and construction impacts are similar to those of the present shore protection project and FEIS and its supplements are incorporated by reference herein.

2. ALTERNATIVES

a. Proposed Plans.

(1) Three plans are proposed for assessment and evaluation. All three plans have a common component which is to provide a 500-foot-long rubblemound revetment on the northeast tip of the Paseo de Susana peninsula (Figure 4, Main Report). This revetment would have a crest elevation of +10 feet above mean lower low water (MLLW) and would rise about four feet above ground elevation. It will slope 1.5 to 1 with an armor layer of 1.25 to 2 ton stones. Stones for all revetments considered here would be quarried from an approved quarry site on Guam. Each revetment would also be backfilled to the existing escarpment with fertile soil and with landscaping.

(2) Plan 1 would also provide a rubblemound revetment 970 feet along the western bank or side of the Paseo peninsula (Figures 4 and 5, Main Report). It would have a crest width of 12 feet and a crest elevation of +7 feet (MLLW), the approximate average ground level of the park.

(3) Plan 2 would provide for a shorter version of the Plan 1 revetment (Figures 4 and 6) with a length of 590 feet, but otherwise similar characteristics.

(4) Plan 3 would provide for regrading the western bank of the Paseo with suitable soil materials on a 1 to 3.5 slope to the MLLW level. This bank would be stabilized with suitable plantings such as beach morning glory or Alahai tasi (Ipomoea pes caprae) (Figures 4 and 7).

b. Other Alternatives.

(1) Vertical seawalls were considered in early stages of the planning process, but were not given further attention because of the danger of wave reflection undercutting the toe of the structure, causing adverse wave conditions within the small boat harbor, and providing poor marine intertidal habitat.

(2) No Action would result in major, intermittent erosion to the existing slopes of the Paseo de Susana peninsula soon resulting in an undercutting of the pathway around the tip of the peninsula. In the western bank of the peninsula an undercutting of ten to fifteen park trees would soon occur together with the potential loss of concrete picnic tables and benches during a major storm event. Paseo de Susana is one of the most heavily used parks in Guam by local residents and tourists alike. Continued erosion will result in less recreational space and could result in potential safety hazards near the existing revetment on the tip of the peninsula.

3. ENVIRONMENTAL CONDITIONS

a. Site Description.

(1) Guam is the largest island of the Mariana chain at approximately 30 miles long and 4 to 8.5 miles wide with a current (1980) population of 106,700 (Figure 1, Main Report). The 33-acre Paseo de Susana is a man-made peninsula and public park jutting about 1500 feet northward from Agana Bay shoreline in central Guam (Figure 2, Main Report). Agana has been Guam's governmental and commercial trade center since the Spanish occupation. The Agana shoreline and waterfront stretches approximately 3.5 miles, from Adelup Point at the west end eastward to Dungcas Beach and Alupat Island. The current mix of commerical and industrial enterprises, public facilities, and residences has all been rebuilt since the city was completely destroyed during World War II.

(2) The Paseo de Susana peninsula (called hereafter as "the Paseo") is bordered on the west by the Agana Marina or small boat harbor and the Agana Sewage Treatment Plant and on the east by the present mouth of the Agana River. Most of the peninsula is dedicated to public park use including a wooded picnic area covering the outer tip, a new concrete stadium in the middle, and bordering along Marine Drive (west to east) is a new temporary building housing the fishermen's cooperative; a defunct, traditional Chamorro village complex; lunch stands offering Chamorro take-out food; the Agana District Commissioner's office; and the Paseo (traffic) loop adjacent to Agana River mouth.

(3) Paseo de Susana was transferred from Federal to Government of Guam ownership in July 1960 through Congressional enactment of PL 86-664 which states that the properties shall be used solely for civic, park and recreational uses or will revert back to Federal ownership.

(4) The Paseo peninsula's shoreline consists mostly of scattered and crumbling riprap, dead coral boulders and rubble, and coarse sand along the east and west sides. Banks are undercut in several locations. The seaward tip of the peninsula consists of concrete and riprap. A stub breakwater extends from the northwestern tip of the peninsula and protects the entrance to Agana boat channel. The eastern shore is strewn with rusting debris from old machinery.

b. Historical Background.

(1) General. Agana has been the administrative center of Guam for over 300 years and most certainly was a significant habitation area in the prehistoric era which and could date to the second millenium B.C. Nearly all of the peninsula known today as Paseo de Susana is composed of rubble from World War II destruction of Agana in July 1944 by Allied bombing of Japanese positions. The eastern half of the peninsula, except for the tip, was filled in the late 1950's or early 1960's. Based on the type of machinery parts observed by Corps personnel in the western eroded bank and knowledge of pre-war Agana, much of the bulk forming the Paseo probably came from the Agana Power Plant, which was located near the present-day corner of Soledad Avenue and Castillo Lane and from the Agana Navy Yard, which was located immediately seaward of the power plant. Portions of the southwest quadrant of the Paseo are underlain by the old Agana River delta and could contain valuable prehistoric cultural sediments and material.

(2) Japanese Pillbox. The site of a Japanese pillbox, dating from the World War II era, probably marks the seaward extent of the original delta. The pillbox is similar to other pillbox features along the coast of Guam, but the only one still extant on the shoreline of Agana Bay. As the only one such military feature among others in western Guam, the pillbox could be considered possibly eligible for inclusion on the National Register of Historic Places as a thematic nomination. By itself, the feature is not significant, but nevertheless should be preserved. Advice will be sought from the Guam Historic Preservation Officer regarding the significance of the pillbox feature.

c. Marine Environment.

(1) Sources. Description of the marine biological resources of the study area is based primarily on Planning Aid Letter prepared for the project in September 1982 by the U.S. Fish and Wildlife Service (see Appendix C) and is supplemented by Corps staff observations and field coordination with the Guam Department of Parks and Recreation and Division of Aquatic Resources, Department of Agriculture in March 1983.

(2) General. Agana Bay is fringed by shallow reef flat ranging from 1200 to 2700 feet in width (west to east). At mean lower low water (MLLW) the outer reef flat is covered by only inches of water which ranges shoreward to about 3 feet depth in the moat or inner reef flat. At the Paseo, the reef flat is 2000 feet wide. The outer tip of the peninsula lies on the outer reef flat, but the western side of the peninsula slopes steeply down to -9 to -16 feet (MLLW) in the boat channel and turning basin. The bank on the eastern side slopes more gradually across a 20-foot-wide wading area then steeply down into a man-made channel ranging from about -4 to -8 feet (MLLW).

(3) Benthos. According to the U.S. Fish and Wildlife Service, benthic habitat along the edges of the two channels consists principally of dead coral rubble and concrete blocks overlain by substantial amounts of silt. Observed on the shoreline were bits of Sargassum sp algae and occasional invertebrates such as sea cucumber (Holothuria), small limpets and strombs, Trochus sp. shells, and hermit and grapsid crabs. Off the northeast tip of the peninsula on the outer reef flat are widely-scattered patches of the coral Porites lutea. On the reef margin is an algal mat of mostly Amphiroa, Sargassum and Caulerpa and again, widely scattered P. lutea corals. The small boat harbor channel slope is composed of rubble, gravel and sand interspersed with rocky outcroppings and coral knobs. The corals Millepora dichotoma, Pocillopora damicornis, and P. lutea were observed there. The conclusions to be drawn from this description is that the marine margins of Paseo de Susana are not highly productive areas.

(4) Fishing. The Agana boat channel is probably the single most important hook-and-line sports fishery in Guam, particularly when seasonal catches of atuli (jacks and other caranginids) and manahac (rabbit-fish and blennies) are abundant. The atuli season runs for four to five months between August and November and then manahac season runs from about March to June in the last quarter of the moon. Periodically during these seasons, the waters of the channel may be teeming with fish and the banks are teeming with people both day and night. The manahac are also caught by net fishermen operating on the front reef flat. Manahac predators such as skipjack, tuna and barracuda are caught in large numbers during good manahac runs by fishermen concentrating their efforts at the mouth of the boat channel. When the manahac and atuli run, people day camp in Paseo and on Bayfront Beach, near the Marina. This sports and subsistence fishing activity, focused on the west bank of Paseo, is the most important environmental resource opportunity in the study area. The Aquatic and Wildlife Resources Division of the Guam Department of Agriculture, using inshore reel censuses conducted year-around, roughly estimates that over 16,000 fishermen per year may be fishing here.

(5) Water Quality. The Guam Environmental Protection Agency (GEPA), Territory of Guam Water Quality Standards, as most recently adopted on November 16, 1981, designate the waters around the Paseo de Susana (and all of Agana Bay) as M-2. Marine Water Category M-2 is good, calling for uses to protect the propagation and survival of a balanced and indigenous population of marine organisms, particularly shellfish and coral reefs. Other important and intended uses include mariculture activities, aesthetic enjoyment and compatible recreation inclusive of whole body contact and related activities. According to unpublished GEPA water quality measurements taken off Padre Paloma Park (immediately east of the Paseo peninsula), 9 of 51 (17.6%) measurements in 1980 and 8 of 57 (11%) in 1981 exceeded Guam water quality standards. At a station located within Agana Marina, results were similar with 16 percent of measurements exceeding the standards in 1980 and 14.3 percent exceeding in 1981. Each incidence of the standards being exceeded resulted in the waters nearby being closed to swimming for a week. Most incidents of poor water quality in Agana Bay are caused by storm-water runoff through point-source discharges. There is a point-source discharge into the Agana Marina, and the Agana River is the source of runoff from a large inland area.

d. Terrestrial Wildlife. The U.S. Fish and Wildlife Service reports that vegetation along the shore above the beach consists of scattered ironwood (Casuarina equisetifolia), "nanaso" (Scaevola taccada), "alahai tasi" (Ipomoea pes-caprae), "hunek" (Messerschmidia agrentea), coconut palm (Cocos nucifera), "binalo" (Thespesia populnea), beggar's stick (Bidens pilosa), Wedelia sp., Lippia nodiflora, and several species of grasses. Observations by Corps personnel also reveal an active population of field mice living among the roots of shoreline trees along the eroding bank near the Marina which feed off picnic leavings.

e. Endangered or Threatened Species. Avian biologists from the Aquatic and Wildlife Resources Division report observing the locally-endangered Micronesian Starling (Aplonis opacus) in coconut trees adjacent to the small boat harbor. Nevertheless, neither the U.S. Fish and Wildlife Service nor the U.S. National Marine Fisheries Service have reported any resident threatened or endangered species, listed or proposed, present in the proposed project area. The National Marine Fisheries Service did note that green turtles (Chelonia mydas), which are Federally listed as threatened, may be occasionally sighted in the vicinity, but they had no confirmed reports of such activity at Paseo.

f. Recreation and Other Park Activities.

(1) Paseo de Susana Park. The 33-acre park is under the jurisdiction and responsibility of the Guam Department of Parks and Recreation. The Paseo is used increasingly as a center for organized sports, fishing, picnics and as a tourist destination. Guam's warm climate permits year-around use of the new stadium for baseball, football and other sports. Fishing, mentioned above, is conducted mostly along the boat channel but also some occurs on the eastern side of the peninsula. Noon picnickers from the nearby downtown Agana administrative offices often enjoy their lunches under the shady trees along the western bank and at the tip of the peninsula. About ten small fast-food stands offer local fare to Guamanians and tourists alike. The marine exposure, the statues of the ancient Chamorro Chief Quipuha and a minature "Statue of Liberty" attract thousands of tourists each year. Nearly all the 225,000 Japanese tourists now (1980) visiting Guam stop by the Paseo on the regular tours around the island, according to sources at the Guam Visitors Bureau.

(2) For the past five years, a Government of Guam sponsored public market operated along Marine Drive, just within the park. The market structure burned down in mid 1982 and has not been rebuilt. The Department of Commerce which managed the market has recently relinquished its support of the activity, but food stands continue to operate there. There is also an open-air, traditional shelter named the Sagan Dinana ("Place of Togetherness") which was constructed by the local government to serve as a centralized civic meeting place for community activities, but it is not frequently used because of nearby traffic noise from Marine Drive.

(3) The Agana Bay Urban Waterfront Redevelopment Plan, issued in 1981, identified a number of problems resulting from the increased demand for Paseo de Susana Park. These include (a) insufficient picnic shelters and tables, (b) insufficient landscaping, (c) disrepair of roads, (d) shoreline erosion, and (e) seawall deterioration. There are three concrete picnic tables immediately adjacent to the eroding west bank of Paseo facing the boat channel. The lack of landscaping mainly refers to a large open area east of the stadium and along the eastern bank. Another problem, revealed by conversations with local residents picnicking near the seaward tip of the peninsula, is a lack of outdoor lighting which may contribute to robberies during evening hours.

(4) Surfing. Surfing on both sides of the new entrance channel to Agana Marina is a popular activity. According to surveys conducted in 1971 among the Agana surfers as reported in the Corps' 1973 Final ES for the Agana Small Boat Harbor, both sides of the mouth of the old entrance channel are good to excellent for surfing about 50 percent of the year with an average of six-foot waves. In March 1983, ten surfers were observed using the boat channel site during the early evening of a Wednesday and on a Saturday. Access to and from the entrance channel is from the end of the stub breakwater off the tip of Paseo and from the existing wave absorber and the small beach in the lee (south) of the stub breakwater. According to local windsurfers, access to the entrance channel and seas outside for them is mainly from west side of Paseo, both off the existing wave absorber and the currently eroded bank. No windsurfers were observed in March 1983.

(5) Agana Marina. The present small boat harbor, completed by the Army Corps of Engineers in 1977, has not yet been fully developed by the Government of Guam Department of Parks and Recreation, under whose control it operates. The Agana Marina Master Plan's ultimate development stage would site a fuel dock and chandlery on Paseo at approximately Station 8+00. At present, however, the Guam Fishermen's Cooperative has erected a one-story, 1600-square foot Butler-type building in the same area (Stations 6+50 to 8+00) to house in its offices a market and freezing equipment.

g. Section 122 Resources. Section 122 of the River and Harbor Act of 1970 supplements the provisions of the National Environmental Policy Act of 1969 by requiring that all Corps projects take into consideration at least 17 special, possible adverse economic, social and environmental effects relating to any proposed project, the cost of elimination or minimizing such adverse effects, and the need for flood control, navigation and associated actions. The minimum list of 17 "effects" are desirable regional growth, employment/labor force, local governmental finance, business and industrial activity, displacement of people or farms, desirable community growth, population, public services, public facilities, aesthetic effects, community cohesion, noise, air pollution, water pollution, natural resources, and man-made resources. Public facilities, aesthetic effects, water quality, natural and man-made resources are treated in the above paragraphs. Ambient levels of noise and air pollution are relatively high due to the proximity of Paseo de Susana to the road intersections along Marine Drive highway having the highest volume of vehicular traffic in Guam. These levels have not been empirically measured, but must certainly decline as one moves seaward. The remaining effect categories are discussed under the Environmental Effects section of the EA.

h. Areas of Particular Concern. The Guam Coastal Management Program designates areas of particular concern (APC's) to consider in planning any activity in Guam. Of the nine categories of APC's, three are applicable to Paseo de Susana: flood hazard areas, the Agana Bay Urban Waterfront, and shoreline development areas including boating and fishing, park areas and surfing areas. The latter two are discussed above. The questions of flood hazards will be discussed in part in Appendix C of this report. Storm waves are causing the present damage to the existing revetment and natural banks of the Paseo peninsula. Flooding from storm surge, which often accompanies storm waves, is believed to be able to reach an elevation of about 10 feet above sea level during a 100-year storm event. Under the present conditions at Paseo, such a flood event could inflict heavy damage on the existing park facilities.

4. ENVIRONMENTAL EFFECTS

a. Historic Sites. No sites or other cultural material of prehistoric or historical significance will be affected by implementation of any of the three alternative plans. The revetment under Alternative Plan 1 and the vegetative planting under Plan 3 will skirt the Japanese pillbox, but there will be no adverse effects on the structure and perhaps a long-term beneficial effect by preventing it being undercut by erosion. There is some rusting machinery, perhaps dating from pre-war Agana eroding out of the west bank of the Paseo, but these historic reminders of old ways would be preserved by backfill and rocks being placed on top and around them. The debris and other material making up the part of the northeast tip of the peninsula which would be revetted was placed there in the latter 1950's or early 1960's according to an analysis of maps and aerial photographs. Visual inspection of that area in March 1983 found mostly vehicular parts of no significance.

b. Biological and Water Quality Effects.

(1) Benthos and Water Quality. The U.S. Fish and Wildlife Service Planning Aid letter indicated that no significant long-term impacts to the marine or terrestrial environments were anticipated as a result of shore protection improvements at Paseo de Susana. Adverse effects to water quality and adjacent benthic habitats will probably be limited to the construction phase of project implementation. During construction, grading and cutting the existing shore and placement of fill material will generate turbid plumes due to introduction of suspended fine sediments into nearshore waters. If these plumes are not contained to the immediate project area, they may stress corals in adjacent waters. Placement of stone riprap along the shoreline will bury some sub- and intertidal habitat. However, the resulting surfaces will be suitable for colonization by algae and invertebrates. Any alterations in normal water circulation patterns around the peninsula by the proposed project are expected to be slight, and not of sufficient magnitude to significantly affect the distribution and abundance of marine life in surrounding waters.

(2) Fishing. Construction will temporarily limit access to the shoreline for recreational fishing. Because of the very significant value the west bank of Paseo has for sports and subsistence fishing, every attempt will be made to schedule construction there to occur between late November and early March, period of the year when the atuli and manahac are not running. The numbers of fishermen that periodically crowd the west bank of the Paseo should not be significantly affected by the existence of a revetment as proposed by

Alternative Plans 1 and 2. The natural bank may permit fishermen to stand nearly shoulder-to-shoulder, if need be, but the revetment would allow them to stagger themselves, one standing higher on the rock face and the other standing lower so that just as many could be accommodated. Moreover, during time of slack fishing, the crevices in the revetment face would permit the fishermen to easily stick one's pole or poles into a crevice, allowing the fishermen to sit back and relax. A design variation which may be considered would be to construct a lip or shelf, just above mean higher high water, which could allow greater density of fishermen, when the occasion demanded it. The flatter (1:3.5) and thus wider slope required by Plan 3 would present the fishermen with an obstacle keeping them from effective casting into the boat-channel waters and a higher likelihood of snagging one's hook on the vegetated bank than on large rocks. During periods of high use, the crowds of fishermen would likely trample down the vegetation, thus destroying its effectiveness. Thus, the plans containing rock revetments would seem to benefit the fishermen and Plan 3 with a vegetated bank could interfere with these activities.

(3) Water Pollution. Placement of rocks (all plans) and soil (Plan 3 only) onto the banks of Paseo de Susana peninsula, shallow-water reef flat, and deep (to -12 feet MLLW) channels will cause temporary and intermittent rises in levels of ambient turbidity and other suspended materials. These perturbations are not expected to have long-term adverse effects on nearby benthos and fishes. The effects will be significantly greater if Plan 3 is implemented and may extend into the post construction phase for this plan. As noted above, it is anticipated that fishermen will trample any vegetation planted on the soil revetment. This should lead to erosion of the soil material into adjacent waters during rain events or as a result of high waves. For this alternative, efforts to implement the U.S. Fish and Wildlife Services recommendation to confine suspended materials to the immediate project area during construction will be difficult to achieve. Stone revetments are not expected to experience any such difficulties. Water pollution effects are also discussed in the Section 404 Evaluation in Appendix A.

(4) Terrestrial Wildlife. Only one park tree, a coconut at Station 5+25 under Plan 2, would require removal under any of the alternative plans. The affected tree would be transplanted. Fill material used in Plans 1 and 3 would be placed around six trees and two trees under Plan 2, thus saving them from imminent loss due to on-going erosion. The mice habitats among the roots of these trees may be smothered during fill operations, but given the amount of picnic leavings continually available, new mice populations will probably be attracted to the picnic area. If Plan 3 were implemented, the mice habitat would probably increase and the mice could change from being a sideshow to a nuisance.

(5) Endangered or Threatened Species. No territorial or Federally-listed endangered or threatened species of plants or animals will be affected by implementation of any of the alternatives.

c. Effects on Recreation and Scenic Resources.

(1) Park Activities. None of the recreational and other activities now occurring in Paseo de Susana Park will be significantly affected by implementation of any of the alternatives, except for perhaps the effect of the vegetated bank under Plan 3 on recreational fishing, as noted above. No matter when construction of any of the plans does take place, it will interfere with year-around recreational fishing and will preclude safe picnicking near the areas under construction. The noise of trucks and a crane will also disturb park users. During construction, the numbers of park users may temporarily decline, but when the revetment or vegetated bank is completed, park usage should return to previous levels or perhaps increase.

(2) Park Facilities and Aesthetics. Of the five overall problems notes by the Agana Bay Urban Redevelopment Waterfront Plan (see Paragraph 3f(3) above), the shore protection project only directly addresses two of them: shoreline erosion and seawall deterioration. New landscaping will be limited to replacing in kind or transplanting affected plants. There are three sets of concrete picnic tables and benches on the west bank which may be affected by construction activities. These park facilities, however, are relocatable and thus must be the responsibility of the local sponsor to relocate or replace. On the other hand, the low height of the revetment on the west bank--only an average of three feet above the park ground level--will provide new surface to sit on or lie aganist. The visual intrusion of the stone revetment may be greater than the vegetated one, but regular park users are accustomed to the existing stone structure so a new one extending from it may not be much of a surprise.

(3) Surfing. There should be no effect of any of the alternatives on board or wind surfing activities. Observations made of surfers returning to shore showed no particular preference for a landing site between choosing the existing stone revetment or the natural bank.

(4) Relationship to Agana Marina. None of the alternative plans adversely affect the current operations of the small boat harbor or would be incompatible with the ultimate development of the marina. There is a sloping, unpaved lane to the water's edge at Station 4+00 which has served from time to time as an informal boat ramp. The loss of the ramp is not viewed as an adverse effect to the operations of the harbor because there is already a concrete ramp available within the present boat basin. There are, at present, no known plans to construct a pier alongside the new Guam Fishermen's Cooperative building, but should one be needed, permanent stability would be given to the existing bank only by the stone revetment proposed as Plan One.

d. Section 122 Effects. The following effects have been fully considered with respect to possible adverse economic, social and environmental effects resulting from implementing any of the alternative plans.

(1) Desirable Regional Growth. None of the proposed alternative plans would have any effect on changing the patterns of residential or economic growth in Guam. Protecting the facilities of one of the most heavily used parks in Guam may, in the long-term, encourage more people to enjoy Paseo de Susana Park.

(2) Employment/Labor Force. Implementation of any of the alternative plans would provide short-term employment for a small insignificant number of laborers and supervisors. No long-term or even short-term significant changes will occur in overall Guam employment and labor force levels.

(3) Public Facilities and Services. These effects are fully described in the paragraphs above. No unusual services such as water, electricity, garbage disposal or protective/health services should be affected by this project.

(4) Business and Industrial Activity. There should be no significant effect on business and industrial activity except for the construction firm which would build one of the alternatives. During construction, the unavailability of some picnic areas could adversely affect the levels of business done by the small local foodstands located adjacent to Marine Drive. After construction is complete, this business could reach higher levels than present due to higher numbers of picnickers possibly using the revetment for a resting place.

(5) Displacement of People or Farms. No people or farms will be displaced or otherwise affected by implementation of any of the three alternatives.

(6) Desirable Community Growth. As discussed in Paragraph 4d(1) above, this project will have no effect on patterns of local community growth.

(7) Aesthetic Effects. As noted in Paragraph 4c(2) above, all alternatives will be visual intrusions into the sparsely forested landscape of Paseo de Susana, particular the stone revetments. Regular park users should be able to easily accommodate themselves to the new man-made scenes.

(8) Community Cohesion. Fishermen are the only sub-community likely to be concerned about the effects of building a stone or vegetated soil revetment along their favorite stretch of fishing grounds. If construction on the west bank of Paseo can be accomplished mostly during the off-season for fishing (late November to early March), discontentment among fishermen and the general public will probably be held to a minimum. Construction of the stone revetments is believed to create the least probable discontent.

(9) Air and Noise Pollution. Adverse impact to ambient air and noise conditions in the project area would be temporary and intermittent during construction. These impacts would be significantly lower if the vegetated-soil revetment was was constructed. Noise from the construction equipment should not significantly affect the locally threatened Micronesian starling due to the already relatively high ambient noise from Marine Drive traffic. All equipment will comply with applicable Federal and local regulations governing air and noise pollution.

(10) Water Pollution. Water pollution effects of the alternatives on water pollution is discussed above in Paragraph 4b(3).

(11) Natural Resources. Effects of the alternatives on natural resources are discussed above in Paragraph 4b.

(12) Man-Made Resources. Effects of the alternatives on man-made resources are discussed above in Paragraphs 4a and 4c.

e. Areas of Particular Concern.

(1) General. Flood hazard areas and the Agana Bay urban waterfront are the only two officially promulgated areas of particular concern (APC's) affected by the proposed project. Considered unofficially under the Guam Coastal Management Program for the study area is the category of shoreline development which includes concerns for boating, fishing, parks and surfing areas. This latter category of effects has been discussed above in Paragraph 4c.

(2) Flood Hazards. Construction of Plan 1 would have the most beneficial effect on reducing possible damage to park facilities from high storm waves and storm surge. Plans 2 and 3 would probably have lesser beneficial effects, respectively. During a major typhoon, however, wind damage and flooding from Agana River could offset much of the protection offered by the revetments to park resources such as trees and other plantings and various structures. The relationship of the alternatives to local flood hazard regulations is treated in detail in Appendix A.

(2) Agana Bay Urban Waterfront. Implementation of any of the alternative plans would be compatible with the objectives and some of the recommendations of the 1981 plan.

f. U.S. Fish and Wildlife Service Recommendations.

(1) The Service suggests that the Corps adopt certain measures to mitigate construction-related impacts and enhance recreational use of the park during project planning.

(a) Efforts should be taken to confine suspended sediments to the immediate project area during construction. Dredged, cut or graded material should be protected from erosion, and only clean water should be allowed to runoff into the harbor and bay.

(b) If practicable, construction of the western (harbor) side improvements should begin at the close of the annual atulai season (December), and should be completed as soon as possible. Safe shoreline access should be provided for fishermen at Paseo de Susana to the maximum extent possible during construction.

(c) The project area should be revegetated with indigenous strand and shade plants and trees to enhance the educational and aesthetic value of the park.

(2) Discussion of USFWS Recommendations.

(a) The Corps would require the construction contractor to maintain all the most recently adopted Territory of Guam Water Quality Standards.

(b) Construction scheduling will take into consideration the seasonally heavy fishing from the park shoreline.

5. DATA SOURCES

a. Agencies Consulted.

Guam Bureau of Planning

Guam Department of Parks and Recreation (including State Historic Preservation Officer staff).

Guam Department of Agriculture, Aquatic and Wildlife Resources Division

Guam Environmental Protection Agency

Guam Visitor Bureau

U.S. Fish and Wildlife Service, Department of the Interior

U.S. National Marine Fisheries Service

b. Individuals Consulted

Anonymous group of student picnickers at Paseo de Susana

c. Other Sources

PASEO DE SUSANA SHORE PROTECTION
TERRITORY OF GUAM

PLAN FORMULATION CRITERIA
AND
COMPLIANCE REPORTS

APPENDIX A

APPENDIX A

PLAN FORMULATION CRITERIA
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I. STUDY AUTHORITY

SHORE PROTECTION PROJECT AUTHORITY

a. Legislative Authority.

Section 103a of the River and Harbor Act of 1962, as amended by Section 310 of the River and Harbor Act of 1965, Sections 112 and 208 of the River and Harbor Act of 1970, and Section 133(a) of the Water Resources Development Act, approved 22 October 1976, states:

> "The Secretary of the Army is hereby authorized to undertake construction of small shore and beach restoration and protection projects not specifically authorized by Congress, which otherwise comply with section 1 of this Act, when he finds that such work is advisable, and he is further authorized to allot from any appropriations hereafter made for civil works, not to exceed $25,000,000 for any one fiscal year for the Federal share of the costs of construction of such projects: Provided, That not more than $1,000,000 shall be allotted for this purpose for any single project and the total amount allotted shall be sufficient to complete the Federal participation in the project under this section including periodic nourishment as provided for under section 1(c) of this Act: Provided further, That the provisions of local cooperation specified in section 1 of this Act shall apply: And provided further, That the work shall be complete in itself and shall not commit the United States to any additional improvement to insure its successful operation, except for participation in periodic beach nourishment in accordance with section 1(c) of this Act, and as may result from the normal procedure applying to projects authorized after submission of survey reports."

II. PLANNING CRITERIA AND CONSTRAINTS

Institutional Policies. Several institutional policies of the Federal government affect the design and decisions for local and Federal participation. Executive policies are issued through the Office of Management and Budget (OMB), the Water Resources Council (WRC) and the Council of Environmental Quality (CEQ). Legislative policies are expressed by various legislative enactments of Congress which has developed a body of laws establishing national concerns regarding the nation's natural resources.

Design/Benefit Criteria. In developing justification for Federal participation, technical and economic evaluation policies, standards, principles, and procedures are established in determining a benefit to cost comparison. All projects must have a benefit to cost comparison. Projects must usually have a benefit to cost comparison of one or greater to be eligible for federal participation.

Regulatory/Environmental Requirements. A number of statutory and regulatory requirements of the Federal government must be complied with during the planning process. These requirements largely relate to the assessment and evaluation of possible impacts on the environment resources of the project area.

Archaeological and Historic Preservation Act of 1974 (Public Law 93-291) as amended. The Act, also known as the Reservoir Salvage Act, provides for the preservation of historical and archaeological data which might be otherwise destroyed by flooding or other alteration of the terrain and authorizes up to one percent of the total amount authorized for appropriation for the project to be spent on recovery, protection and preservation of data. This act will be utilized only for sites eligible for or listed on the National Register of Historic Places. Applicability of this act to the project will be assessed in Appendix C and the EIS.

Clean Air Act, as amended (42 USC 7401 et seq.). As it applies to Corps studies and construction projects, this act requires that all federal projects must conform to EPA approved or promulgated state implementation plans. Compliance with this act will be addressed in the EIS.

Estuary Protection Act (Public Law 90-454). The act requires that Federal agencies in planning for use or development of water and land resources, give consideration to estuaries and their natural resources and that if estuaries may be affected, the Secretary of the Interior shall be given an opportunity tc evaluate the effects of the project on the estuary. There are no estuaries in the study area.

Federal Water Project Recreation Act (Public Law 89-72, as amended). This act requires that full consideration be given to project opportunities for outdoor recreation and fish and wildlife enhancement; that planning based on coordination for use with existing and planned Federal and local public recreation developments; that the views of governmental agencies concerned with recreation and wildlife, including the USFWS and Heritage Conservation and Recreation Service (HCRS) be included in the report.

Land and Water Conservation Fund Act of 1965 (16 USC 4601-4 et seq). As it applies to Corps studies and project, this act requires that Corps recreation planning be coordinated with the State plan developed pursuant to the Act. For Guam this is the Guam Comprehensive Outdoor Recreation Plan. Moreover, the non-Federal cost for the project may not be paid out of LWCFA funds.

Rivers and Harbors Appropriation Act of 1899, as amended (33 USC 401 et seq.). This statute, which established Corps' regulatory responsibilities and generally prohibited a wide range of actions which might obstruct navigable waters of the United States, does not impose any requirements on projects that are affirmatively authorized by Congress.

Watershed Protection and Flood Prevention Act, as amended (16 USC 1001 et seq.). This statute which authorized the Soil Conservation Service to construct dams and other works in upstream watersheds, imposes no requirements on Corps projects.

National Environmental Policy Act of 1969 (Public Law 91-190). The National Environmental Policy Act (NEPA) requires an environmental statement in every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment.

Clean Water Act of 1977 (Public Law 95-217). This act was formerly known as the Federal Water Pollution Control Act Amendments of 1972. The requirement is to evaluate discharge effects of dredged or fill materials into waters of the United States.

Coastal Zone Management Act of 1972 (Public Law 92-583). This act requires that the project must comply with the federal law as well as be consistent with the Coastal Management Program for the Territory of Guam (Guam E.O. 78-37: Compliance with the Guam Coastal Management Program Policies).

Endangered Species Act of 1973 (Public Law 93-205). The implementing agency shall coordinate with the appropriate federal wildlife agency to determine the presence of listed endangered or threatened species or their critical habitat may be present in the area of proposed action. The results of the assessment shall be contained in the EIS.

Fish and Wildlife Coordination Act of 1958 (Public Law 85-624). This act requires any federal agency proposing to impound, divert, or modify the channel of any stream or other body of water to consult with the Department of Interior, U.S. Fish and Wildlife Service (USFWS) and the head of the state or territorial agency exercising control over fish and wildlife resources, concerning the impacts of such action. The USFWS shall recommend, in a 2(b) report, methods to mitigate impacts of the proposed action and to conserve fish and wildlife resources.

Marine Protection, Research, and Sanctuaries Act of 1972 (Public Law 92-532). This act regulates the evaluation of the need and transportation of dredged material for the purpose of dumping in ocean waters. In the case of this project, there is no specific need to provide an ocean dump site for excess construction materials.

National Historic Preservation Act of 1966 (Public Law 89-635). Section 106 of this act requires that federal agencies shall, prior to the approval of the expenditure of any funds on an undertaking, or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any property included in, or eligible for inclusion in the National Register and shall afford the Advisory Council on Historic Preservation a reasonable opportunity to comment with regard to such undertaking. The Commonwealth Historic Preservation Officer must also be given a reasonable opportunity to comment on the undertaking.

Executive Order on Floodplain Management (EO 11988). This order requires that agencies avoid the base floodplain unless it is the only practicable alternative. For potential action in the floodplain, an evaluation of effects on floodplain values, a description of other practicable alternative actions outside the floodplain, and adequate dissemination of the action to the public must be undertaken.

Executive Order on Protection of Wetland, (EO 11990). This order requires the agency to analyze potential impacts to existing wetlands and associated values and to give the public early public review of proposed actions.

Wild and Scenic Rivers Act of 1968 (Public Law 90-542). This act requires agencies to identify potential impacts to designated wild and scenic rivers and to coordinate action and obtain concurrence with the U.S. Department of the Interior.

III. PRESIDENTIAL EXECUTIVE ORDER 11988 ON FLOODPLAIN MANAGEMENT EVALUATION REPORT

1. The purpose of this supplemental report is to present the results of additional studies required by Executive Order 11988, Flood Plain Management, dated 24 May 1977. The objective of EO 11988 is to avoid to the maximum extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. The Order requires Federal agencies to:

a. Avoid use of the base floodplain unless it is the only practicable alternative;

b. Reduce the hazard and risk of flood loss;

c. Minimize the impact of floods on human safety, health, and welfare; and

d. Restore and preserve the natural and beneficial floodplain values.

2. PROCEDURE

The basic determinations necessary to implement EO 11988 are stated in Section 2 of the EO and are summarized in the following paragraphs:

a. Determine whether the proposed action is the base floodplain. The base floodplain is defined in Section 6 of EO 11988 as the area inundated by a flood with a 1 percent chance of occurrence in any given year.

b. Determine whether there is a practicable alternative to locating the action in the base floodplain. The "action" is any Federal activity including (1) acquiring, managing, and disposing of Federal lands and facilities; (2) providing federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

c. Identify adverse impacts due to the action and any induced development and identify losses of natural and beneficial values of the floodplain.

d. If the proposed action induces development in the base floodplain, determine if there is a practicable alternative to the development. The decision on whether a practicable alternative exists is to be based on the advantages and disadvantages of floodplain and non-floodplain sites. Factors to be considered include water resources; conservation; economics; aesthetics, natural and beneficial values served by the floodplains; impacts of floods on human safety; locational advantage relative to availability of housing, education, and work force; the functional need for locating the development in the flood plain; historic values; fish and wildlife habitat values; endangered and threatened species; support of municipal infrastructure; energy conservation; cost effectiveness; enhancement of work opportunities for economically disadvantaged minorities; and in general the needs and welfare of the people.

e. Determine viable methods to minimize the adverse impacts of the action and any induced development and methods to restore and preserve the natural and beneficial values of the floodplain.

f. Advise the general public if the proposed action will be located in the floodplain.

g. Recommend the most desirable plan responsive to the established planning objectives and consistent with the requirements of the Executive Order.

DESCRIPTION OF FACTORS FOR THE SELECTED PLAN

1. PROPOSED ACTION LOCATION

The proposed action in the area is located within the base floodplain limits. The base floodplain is defined as the one percent (1%) exceedance frequency floodplain.

2. EXISTING FEDERAL ACTIVITIES ON GUAM

a. Floodplain management services are available from the U.S. Army Corps of Engineers under the authority of Section 206 of the Flood Control Act of 1960 (Public Law 86-645). These services include providing flood hazard data, maps and technical assistance and studies.

b. A flood insurance program is available by the U.S. Federal Emergency Management Agency (FEMA) through the Federal Insurance Administration under the authority of the National Flood Insurance Act of 1968, as amended. The Government of Guam is in the emergency phase of the flood insurance program, which requires them to establish some building permit review process.

c. The U.S. Department of Housing and Urban Development (HUD) has minimum building standard requirements for federally subsidized housing projects administered by the agency.

d. Emergency and disaster operations, when in effect are administered by FEMA. Disaster recovery assistance includes protection of life and property, damage surveys, restoration of public services, and technical assistance. This assistance was given for the effects of Typhoon Pamela in 1976.

e. Relocation assistance for persons displaced as a result of federal and federally-assisted programs are authorized by the Uniform Relocations Assistance and Real Property Acquisition Act of 1970 (Public Law 91-646). This statute provides moving and related expenses to insure fair and equitable treatment of displaced persons.

f. The U.S. Army Corps of Engineers is currently conducting an overall planning effort under the Guam Comprehensive Study. Among the water resource problems and needs addressed by this study are regional harbors, water supply, floodplain management, shore protection and beach erosion. The study was initiated in FY 1979 and is expected to extend over a five-year period.

3. POTENTIAL FLOODPLAIN DEVELOPMENT WITH THE PROJECT

The project is not expected to contribute to further development of adjacent floodplain lands in Agana.

4. POTENTIAL LOSSES TO THE NATURAL AND BENEFICIAL RESOURCES

All the natural resources present are subject to flood damage and are not dependent upon the flood occurrences for their continued survival. Potential loss of habitats is not considered to be significant to affect productivity or diversity of any existing ecosystem.

The shore protection structures will require dredging and the placement of fill and armor stones. A minor loss of intertidal and wash zone marine life will result by burial from fill. The revetment will provide rocky intertidal and interstitial habitat possibly creating an increase in species and habitat density. Coastal strand vegetation along the shoreline will be cleared for access and operations during construction resulting in a minimal loss of vegetative habitat.

5. DESCRIPTION OF THE BEST NON-FLOOD ALTERNATIVE FOR POTENTIAL DEVELOPMENT

The no-action plan would be inconsistent with the study planning objectives. The inherent nature of shore protection measures requires action in floodplains.

6. DESCRIPTION OF WHY THE PROPOSED ACTION WHICH WILL HAVE SOME NEGATIVE ENVIRONMENTAL IMPACTS AND ADDED FLOOD DAMAGE POTENTIAL DUE TO INDUCED DEVELOPMENT IN THE FLOODPLAIN IS THE PREFERRED SOLUTION

Guam is typical of many Pacific Islands characterized by limited low-lying areas and steep high rising cliffs and mountains in the interior areas. Quite often the only areas suitable for development are in the low-lying floodplains. Development of this proposed action in the floodplains would help meet the needs identified by this study. This project would outweigh the anticipated environmental losses and added potential flood damage resulting from this action.

7. DESCRIPTION OF ACTIONS THAT WILL BE CONSIDERED PRIOR TO CONSTRUCTION TO MINIMIZE DAMAGE TO BOTH THE NATURAL VALUES OF THE FLOODPLAIN AND DAMAGES TO DEVELOPMENT INDUCED BY THE PROJECT

a. The design of the shore protection structures would minimize adverse drainage characteristics and losses to marine life within the project area.

b. The Government of Guam will be advised of existing Federal Floodplain Management policies, current recommended minimum building requirements for flood areas and general water resource planning assistance available to them for development in the Agana shorefront area.

c. Any proposed action will be in conformance to all applicable Federal and local land-use, water and related resources regulations and laws.

8. ADVISEMENT OF THE GENERAL PUBLIC THAT THE PROPOSED ACTION WILL BE LOCATED IN THE FLOODPLAIN

The general public will be informed of this action by public notice and will have the opportunity to address and comment on this action during a formal public meeting.

9. RECOMMENDATION OF THE MOST DESIRABLE PLAN RESPONSIVE TO THE ESTABLISHED PLANNING OBJECTIVES CONSISTENT TO THE REQUIREMENTS OF THE EXECUTIVE ORDER

Plan 3 is the tentatively recommended plan because it maximizes net benefits. Table A-1 summarizes the advantages and disadvantages of utilizing the floodplain.

IV. EVALUATION OF THE EFFECTS OF THE DISCHARGE OF DREDGED OR FILL MATERIAL INTO WATERS OF THE U.S. USING U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) SECTION 404 (b) GUIDELINES

1. Project Description.

a. Description of the material proposed discharge.	
(1) General Characteristics of the Material.	Quarried limestone ranging in size from spall to 1 ton boulders and indigenous soils.
(2) Quantity of Material to be Discharged.	Plan 1 - 13,600 cubic yards. Plan 2 - 10,400 cubic yards. Plan 3 - 9,600 cubic yards.
(3) Source of the Material.	Existing quarries on Guam
b. Description of the proposed discharge site.	
(1) Location.	Paseo de Susana Park.
(2) Type of discharge site.	Nearshore reef site and shoreline location.
(3) Method of discharge.	Material will be used to construct shoreline protective structures at the discharge site. The material will be placed by cranes and bulldozers to form the revetments or soil embankment.
(4) Date and length of time when discharge will occur.	The project will be implemented within 2 years. Plans will take approximately 5-12 months to construct.
(5) Life of the discharge site.	Revetment component of plans has an economic life of 50 years.

2. Physical Effects.

a. Potential Destruction of Wetlands.	Site is not considered a wetland.
b. Other Physical Effects.	
(1) Area of bottom covered by discharge.	Plan 1 - 0.8 acre Plan 2 - 0.5 acre Plan 3 - 0.1 acre

2. Physical Effects. (Cont)

(2) Changes in bottom geometry and substrate composition.	The bottom substrate consists of coralline material and sands derived from old terrestrial fill material.
(3) Water circulation and flushing.	The protective structures will have no effect on water circulation in Agana Bay.
(4) Salinity distribution and gradients.	No alterations are anticipated because discharge does not involve a release of high or low salinity waters or materials.
(5) Natural drainage characteristics, and flood and stormwater storage.	Site involves no drainage basin modifications; site has no flood or stormwater storage capability. The existing storm drainage system will not be affected.
(6) Groundwater levels and recharge.	The site is not known as a groundwater recharge area, and the discharge is not expected to alter groundwater levels.

3. Chemical-Biological Interactive Effects.

a. The material proposed for discharge meets EPA exclusion criteria and no bioassay testing is required. The material to be discharged is larger than silt size, similar in composition to the substrate at the project sites, and is obtained from sources removed from pollution point-sources.

b. Impacts on the Water Column.

(1) Reduction in light transmission.	Temporary increase in water turbidity is anticipated as dust may be washed from the quarried limestone by wave action and as dredged coral material is placed as fill.
(2) Degradation of water aesthetic values.	Only temporary effects.

3. Chemical-Biological Interactive Effects. (Cont)

(3) Direct destructive effects on nektonic and planktonic populations.	Temporary distrubance and displacement during construction. Minor permanent loss of existing water column habitat.
(4) Are contaminants found in the material?	None anticipated.
(5) Concentration of contaminants released from sediment to the water column. (Results of elutriate testing).	Material exempt from chemical and bioassay testing.
(6) Comparison of constituent concentrations with applicable water quality standards.	Not applicable.
(7) Size of mixing zone.	Not applicable.
c. Impacts on Benthos.	
(1) Area of benthic community covered by material.	Plan 1 - 0.8 acres Plan 2 - 0.5 acres Plan 3 - 0.1 acres
(2) Changes in community structure and function.	Fill raises bottom elevation creating terrestrial, intertidal, and rocky interstitial marine habitat. Changes in community structure and function are localized and involve replacement of habitat.
(3) Effects of chemical constituents on benthos.	None anticipated.

4. Impacts of the Discharge at the Discharge Site (see Section II, Appendix D).

a. Need for the proposed action.	The discharge is needed to construct protective structures.
b. Availability of alternate discharge sites and alternate methods of discharge.	None (see Paras. 11 and 12, EIS).

4. Impacts of the Discharge at the Discharge Site. (Cont)

c. Evaluation of Impacts.

(1) Chemical, physical and biological integrity of the aquatic ecosystem.	Discharge is localized in effect, and will not affect availability of biological resources. The fill will not alter the chemical integrity and the aquatic ecosystem. Minimal destruction of habitat is anticipated. There will be an increased habitat diversity created by the rocky substrate.
(2) Food chain and tropic level.	No effect anticipated.
(3) Diversity of plant and animal species.	A localized increase in habitat and species diversity is anticipated.
(4) Obstruction of movement into and out of feeding, spawning, breeding and nursery areas.	Not applicable.
(5) Wetlands having significant functions of water quality maintenance.	Not applicable.
(6) Natural highwater or flood water storage.	Not applicable.
(7) Degradation of Water Quality.	Temporary increase in water turbidity anticipated during construction.
d. Methods to minimize turbidity.	Possible use of silt screens.
e. Methods to minimize degradation of aesthetic, recreational and economic values.	See 4d.
f. Methods investigated to minimize possible harmful effects.	See 4d.
g. Impacts on water uses.	
(1) Municipal water supply intakes.	None.
(2) Shellfish	Possible temporary adverse effect.
(3) Fisheries	Negligible effect anticipated.
(4) Wildlife	None.
(5) Recreation Values	Improves recreational use of shoreline and idle time diversion.

(6)	Threatened and endangered species.	None.
(7)	Benthic life.	Plans will cover 0.1 - 0.8 acres of benthic area and will create a minor acreage of rocky intertidal habitat.
(8)	Wetlands.	None affected.
(9)	Submerged vegetation.	None affected.
(10)	Size of disposal site.	Total enclosed area of Plan
(11)	Coastal Zone Management Program.	Conforms with Guam Coastal Management Program.

5. Determination.

a. An ecological evaluation has been made following the guidance in 40 CFR 230.4 in conjunction with the evaluation considerations in 40 CFR 230.5 (40 CFR 230.3(d)).

b. Appropriate measures have been identified and incorporated into the proposed plan (see Paragraphs 24 and 29 of Section II, Appendix D) to minimize adverse effects on the aquatic environment as a result of the discharge (40 CFR 230 (d)(1)).

c. Consideration has been given to the need for the proposed activity, the available of alternative sites, methods of discharge that are less damaging to the environment, and such water quality standards as are appropriate and applicable by law (40 CFR 230.5).

d. No wetlands are affected by the proposed action.

V. FEDERAL COASTAL ZONE MANAGEMENT CONSISTENCY DETERMINATION

The following consistency determination is prepared in accordance with the Coastal Zone Management (CZM) Act of 1972 (Public Law 92-583) and the regulations on Federal Consistency with approved Coastal Management Program (15 CFR 930). Federal activities must be consistent to the maximum extent practicable with approved State/Territorial CZM program. In September 1979 the Government of Guam's (GOVGUAM) Coastal Management Program, prepared by the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, and the Bureau of Planning, Government of Guam, was approved by the Federal government.

The determination, as documented below, specifically addresses the impacts of preliminary plans of improvement for shore protection at Paseo de Susana Park, Agana, Guam, on the Guam Coastal Management Program (GCMP). The GCMP policies were made effective 15 November 1978, GOVGUAM Executive Order 78-37 (Guam Land-Use Policies). The component items of Executive Order 78-37) are documented in the Final Environmental Impact Statement and Coastal Management Program for the Territory of Guam, July 1979. The term "project" in this consistency determination document refer to the construction of any one of four shore protection designs at Paseo de Susana unless otherwise specified.

GOVERNMENTAL PROCESS POLICY

1. Objective: Provide an efficient, effective administration of natural resources.

2. Policy: Effectively administer the program, policies, and laws through regulatory revisions, improved interagency coordination, and improved educational and technical programs for local government personnel.

3. Consistency: The proposed project would not alter existing laws, programs, and policies.

DEVELOPMENT POLICIES

1. Shore Area Development.

a. Objective: Assure the environmental compatibility of uses on the shore area.

b. Policy: The location of any designated use within the shore area shall enhance, shall be compatible, and shall not generally detract from the surrounding coastal area's aesthetic, environmental quality, and beach accessibility. In addition, the dependence on the location and the lack of feasible alternative sites shall be demonstrated.

c. Consistency: The proposed project would intrude on the visual seascape, would temporarily degrade environmental quality, but would not affect beach accessibility. Suitable alternative sites do not exist.

2. Urban Employment.

a. Objective: Permit development of urban type facilities only in urban designated areas.

b. Policy: Commercial, multi-family, industrial, resort/hotels, and associated support facilities shall be concentrated within urban districts as outlined in the Land-Use District Map.

c. Consistency: The proposed project should not impact on urban development.

3. Rural Development.

a. Objective: Permit uses of rural designated areas consistent with its development.

b. Policy: Rural districts shall be designated in which only low-density residential and agricultural uses will be acceptable. Minimum lot size for these uses should be one-half acre until adequate infrastructure, including functional sewering, is provided.

c. Consistency: The proposed project should not impact on any rural district.

4. Major Facility Setting.

a. Objective: The location of major utility, fuel, and transport facilities shall consider national interests.

b. Policy: The Territory shall recognize the national interest in siting of major facilities including those associated with electric power production and transmission, petroleum refining and transmission, port and air installations, solid waste disposal, sewage treatment, and major reservoir sites.

c. Consistency: The proposed project would not affect potential sites nor affect any existing major utility, fuel, or transport facility.

5. Hazardous Areas.

a. Objective: Development of hazardous areas shall be consistent with the degree of risk to the community health and welfare.

b. Policy: Identified hazardous lands including floodplains, erosion-prone areas, air installation crash and sound zones, and major fault lines shall be developed only to the extent that such development does not pose unreasonable risks to the health, safety, or welfare of the people of Guam, and complies with land-use regulations.

c. Consistency: The proposed project is located in a designated flood hazard area, however, the existing land usage as a public park is consistent with the degree of hazard, and will not be altered.

6. Housing.

a. Objective: Promote efficient and safe housing design and development locations.

b. Policy: The Government shall encourage efficient design of residential areas, restrict such development in areas highly susceptible to natural and manmade hazards, and recognize the limitations of the island's resources to support historical patterns of residential development.

c. Consistency: The project would not affect the design or development of housing.

7. Transportation.

a. Objective: Promote environmentally acceptable transportation systems.

b. Policy: The territory shall develop an efficient and safe transportation system while limiting adverse environmental impacts on primary aquifers, beaches, estuaries, and other coastal resources.

c. Consistency: The proposed project may temporarily and intermittently disrupt patterns on Marine Drive during construction.

8. Erosion and Siltation.

a. Objective: Development shall be controlled in areas subject to erosion.

b. Policy: Development shall be limited in areas of 15 percent or greater slope by requiring strict compliance with erosion, sedimentation, and land-use district guidelines, as well as other related land-use standards for such areas.

c. Consistency: The proposed project does not impact the development of steep and erodible areas.

RESOURCES POLICIES

1. Conservation of Natural Resources - Overall Policy.

a. Objective: The natural resources of Guam shall be preserved and conserved.

b. Policy: The value of Guam's natural resources such as recreational areas, critical marine and wildlife habitats, the major source of drinking water, and the foundation of the island's economy, shall be protected through policies and programs affecting such resources.

c. Consistency: The proposed project would not affect any designated critical marine habitats, but would enhance outdoor recreation opportunities on the northwestern shore of Guam.

2. Air Quality.

a. Objective: Control activities to insure high air quality.

b. Policy: All activities and uses shall comply with all local air pollution regulations and all appropriate Federal air quality standards in order to ensure the maintenance of Guam's relatively high air quality.

c. Consistency: During construction the proposed project could cause temporary increases in dust and particulates in the immediate vicinity of the project. The contractor will be required to implement suitable measures to control all releases to an acceptable level.

3. Water Quality.

a. Objective: Maintain high water quality of potable and recreational waters and watersheds.

b. Policy: Safe drinking water shall be assured, and aquatic recreation sites shall be protected through the regulation of uses and discharges that pose a pollution threat to Guam's waters, particularly in estuarine, reef, and aquifer areas.

c. Consistency: Construction of the proposed plan would temporarily increase turbidity and discharge suspended solids in the reef-flat and nearshore Agana Bay waters. The contractor will be required to control such discharges so as to maintain Guam Water Quality Standards for the construction area. Drinking water will not be affected by the proposed project.

4. Fragile Areas.

a. Objective: Significant cultural, terrestrial, and wildlife habitats shall be protected.

b. Policy: Development in the following types of fragile areas shall be regulated to protect their unique character: historic and archeologic sites, wildlife habitats, pristine marine and terrestrial communities, limestone forests, and mangrove stands and wetlands.

c. Consistency: Unique and significant cultural and wildlife sites are not expected to be affected by the proposed project.

5. Living Marine Resources.

a. Objective: Marine life shall be protected in waters of Guam.

b. Policy: All living resources within the territorial waters of Guam, particularly corals and fish, shall be protected from overharvesting and, in the case of marine mammals, from any taking whatsoever.

c. Consistency: Shoreline excavation and fill activities will destroy some coral reef habitat and modify other reef habitat.

6. Visual Quality.

a. Objective: Scenic resources and visual quality shall be promoted and protected.

b. Policy: Preservation and enhancement of, and respect for the island's scenic resources shall be encouraged through increased enforcement of the compliance with sign, litter, zoning, subdivision, building, and related land-

use laws; visually objectionable uses shall be located to the maximum extent practicable, so as not to degrade significantly views from scenic overlooks, highways, and trails.

c. Consistency: The proposed project shall affect the existing shoreline landscape. The views from no designated scenic overlooks, highways or trails should be affected by the project.

7. Recreation Areas.

a. Objective: The implementation of suitable recreational and scenic facilities shall be promoted.

b. Policy: The Government of Guam shall encourage development of varied types of recreation facilities located and maintained so as to be compatible with the surrounding environment and land uses; adequately serve community centers and urban areas, and protect beaches and such passive recreational areas as wildlife and marine conservation areas, scenic overlooks, parks, and historic sites.

c. Consistency: The existing land usage is as a public park. The proposed project will both protect and enhance recreational opportunities.

8. Public Access.

a. Objective: Public access to the shoreline and other recreational and scenic areas shall be promoted.

b. Policy: The public's right of unrestricted access shall be ensured to all non-federally owned beach areas and all Territorial recreation areas, parks, scenic overlooks, designated conservation areas and other public lands; and the agreements shall be encouraged with the owners of private and Federal property for the provisions of reasonable access to, and use of, resources of public nature located on such land.

c. Consistency: The proposed project will not impair access to the shoreline. One secondary effect of the project would be to enhance opportunities to visit designated recreation and conservation areas by the sea which would not otherwise be easily accessible.

9. Agricultural Lands.

a. Objective: Agricultural lands shall be preserved for agricultural activities.

b. Policy: Critical agricultural lands shall be preserved and maintained for agricultural use.

c. Consistency: The proposed project should have no effect on existing agricultural lands in Agana District.

TABLE A-1. EXECUTIVE ORDER 11988 - EVALUATION OF FLOODPLAIN SITE

Factor	Advantage of Floodplain Site	Disadvantage of Flood Plain Site
National Economic Development (NED)		
Functional Need	Water-related recreational activities are dependent upon coastal locations.	None
Relationship to Existing/Proposed Development	Human activities are concentrated in the coastal zone.	None
Benefits		Periodic flooding damage.
Environmental Quality (EQ)		
Wildlife Habitat Values	Does not affect upland habitats.	Affects and impacts upon coastal habitat.
Endangered or Threatened Species	Not Applicable	Not Applicable
Commercial or Recreational Species	Enhances commercial and recreational fishing opportunities.	None
Natural Reserve Area	None	None
Historic & Recreational Values, Historical & Archaeological Resources	None	Some potential for disturbance.
Parks & Recreational Area	Improves water-contact recreational opportunities.	Facilities exposed to flood hazards.
Water Resource Values Water Supply & Conservation	None	None
Water Quality	None	May temporarily degrade water quality during construction, which would place stress upon coastal habitats.
Agricultural & Food Production	Does not affect agricultural lands.	None

TABLE A-1. EXECUTIVE ORDER 11988 - EVALUATION OF FLOODPLAIN SITE (Cont)

Factor	Advantage of Floodplain Site	Disadvantage of Flood Plain Site
Social Well-Being (SWB)		
Safety	None	Coastal area exposed to flood hazards.
Locational Advantage	Water-related recreational activities are dependent on coastal location.	Coastal area exposed to flood hazards.
Community Welfare		None
Aesthetic Values	Coastal zone location of park may enhance recreational experience.	May degrade aesthetic appeal of an open coastline.

PASEO DE SUSANA SHORE PROTECTION
TERRITORY OF GUAM

PUBLIC INVOLVEMENT PROGRAM

APPENDIX B

APPENDIX B

PUBLIC INVOLVEMENT PROGRAM APPENDIX

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I. PUBLIC INVOLVEMENT PROGRAM

OBJECTIVES.

To insure that the desires and needs of the public were identified and considered, a public involvement program as developed. The public, as broadly interpreted by the U.S. Army Corps of Engineers, is any affected or interested non-Corps of Engineers entity; other federal and territorial government entities and officials; public and private organizations, and individuals. The public participation program is directed to maintaining information flow, achieving a mutual understanding and acceptance of the problems and opportunities, and attainment of interest level for proper decision making.

The objectives of the public participation program are:

a. To inform citizens of the current Corps of Engineers planning process and direction.

b. To surface key planning issues and concerns so that they are given full consideration.

c. To help formulate and review potential plans and improvement.

d. To offer technical, historical, and localized information pertinent to the study.

e. To provide a communicative forum between the Corps, local agencies, advocacy groups, and interested citizens on the subject plan and problems.

TECHNIQUES.

The types of public participation forms in this study are small meetings, workshops, and formal meetings:

a. Informal Meetings.

These meetings are of less than 10 persons with specific invited agency personnel, group representatives, or citizens. These meetings are undertaken at various intervals throughout the study to help the planners obtain information and address certain issues.

b. Workshops.

These meetings are informal exchange sessions open to the general public and usually numbering from 10 to 50 persons. The purpose is to promote the full airing of various views in recognition of current Corps' planning efforts. Public information notices and fact sheets are issued to all interested parties prior to the meeting.

c. Public Meeting.

A formal public meeting will be held at key points in the study effort. The purpose is to notify all interested parties of the planning effort to date and to obtain specific views on various items of the agenda. The meeting, presided by the District Engineer, will include a summary of findings to date an informal question and answer period, a presentation of formal statements by others, and tentative conclusions. A public notice of the meeting is issued to the media and the general public invited. All information and statements are documented as part of the planning record.

ACTIVITIES CONDUCTED.

Detailed studies of possible shore protection measures at the Paseo de Susana Park were initiated in early 1982 at the request of the Government of Guam. A public workshop was held on 18 November 1982 to obtain public views and comments on preliminary alternative plans for shoreline protection measures. A Draft Detailed Project Report and Environmental Statement will be circulated to Federal and local government agencies, elected officials, and interested groups and individuals for their review and comments. A public meeting will be held in the Summer of 1983.

FUTURE COORDINATION.

The Final Detailed Project Report and Environmental Statement will be distributed for public review after approval by the Office of Chief of Engineers (OCE). OCE will file the Final Environmental Statement with EPA who in turn will publish a Notice of Availability of the Final EIS in the Federal Register. After a thirty-day review period a "record of decision" will be documented by OCE.

II. PUBLIC WORKSHOP

A public workshop was held on 18 November 1982 in the Pacific Daily News Building, Agana, Guam. Public notices were sent to Federal and local agencies, as well as to the public through local newspapers.

ATTENDANCE AT THE PUBLIC WORKSHOP
18 November 1982

Federal, Corps of Engineers

Mr. George Young

Government of Guam

Mr. Daniel L. Guerrero, Asan/Maina Village Commissioner

Mr. Robert D. Anderson, Department of Agriculture, Division of Aquatic and Wildlife Resources

Ms. Christie Anderson, Guam Environmental Protection Agency

Ms. Betty S. Guerrero, Director, Bureau of Planning

Government of Guam (Cont)

Mr. Cliff Kindel, Bureau of Planning

Mr. Willie Aguon, Bureau of Planning

Mr. Fred Carl Santos, Department of Commerce

Mr. Jerry C. Perez, Department of Commerce

Mr. Tony Quinata, Public Utility Agency of Guam

Mr. Tony Ramirez, Department of Parks and Recreation

Individuals

None attending

SUMMARY.

The Corps of Engineers reviewed the study background and process and briefed the participants on its current status. An open discussion on the need for shore protection measures at the park and their impact on the marine and shoreline environment. No objections were raised over the implementation of structural as opposed to nonstructural shore protection measures. Concerns were voiced over compatability of shore protection measures with both existing and proposed uses of the park shoreline.

III. MAILING LIST

PASEO DE SUSANA SHORE PROTECTION
AGANA, TERRITORY OF GUAM

TERRITORY OF GUAM

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Honorable Edward D. Reyes
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Document Center
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Honolulu, HI 96813

University of Hawaii Library
Serial Records
2550 The Mall
Honolulu, HI 96822

PASEO DE SUSANA SHORE PROTECTION
TERRITORY OF GUAM

FISH AND WILDLIFE COORDINATION

APPENDIX C

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 A LA MOANA BOULEVARD
P. O. BOX 50167
HONOLULU, HAWAII 96850

Colonel Alfred J. Thiede
U.S. Army Engineer District, Honolulu
Building 230
Fort Shafter, Hawaii 96858

Re: Coordination Act Report
Paseo De Susana Shore
Protection Study

Dear Colonel Thiede:

This is the Service's Draft Coordination Act Report regarding the Honolulu District's plans to construct shore protection at Paseo De Susana, Guam. This report has been prepared under the authority of and in accordance with the provisions of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as ammended; 16 U.S.C. 661, et seq.) and other authorities mandating Department of Interior concern for habitat resources. It is also consistent with the intent of the National Environmental Policy Act. Our comments herein are preliminary and subject to revision. Additional Service comments and recommendations will be provided in a Final Coordination Act Report.

This report is based upon available data and scientific literature, and the observations made during a brief, joint-agency field survey conducted by John Ford and Maridell Foster in July 1982. This letter was prepared by John Ford.

DESCRIPTION OF THE PLANNING AREA

The Paseo De Susana peninsula forms the southwestern boundary of Agana Bay, Guam (Figure 1). It is situated immediately east of the Agana Boat Basin and the Agana Sewage Treatment Plant (Figure 2). Most of the peninsula seaward of Marine Drive has been dedicated to public park use; however, a public market and fishermen's coop, a stadium and carnival grounds are also situated in this area.

Paseo De Susana park is entirely filled land. The shoreline consists mostly of scattered and crumbling rip-rap, dead coral boulders and rubble, and coarse sand along the east and west sides (Figures 3 - 5 in our Planning Aid letter of September 9, 1982). Banks are undercut in several locations. The seaward tip of the peninsula consists of concrete and rip-rap. A stub breakwater extends from the northwestern tip of the peninsula and protects the entrance to Agana boat channel. The eastern shore

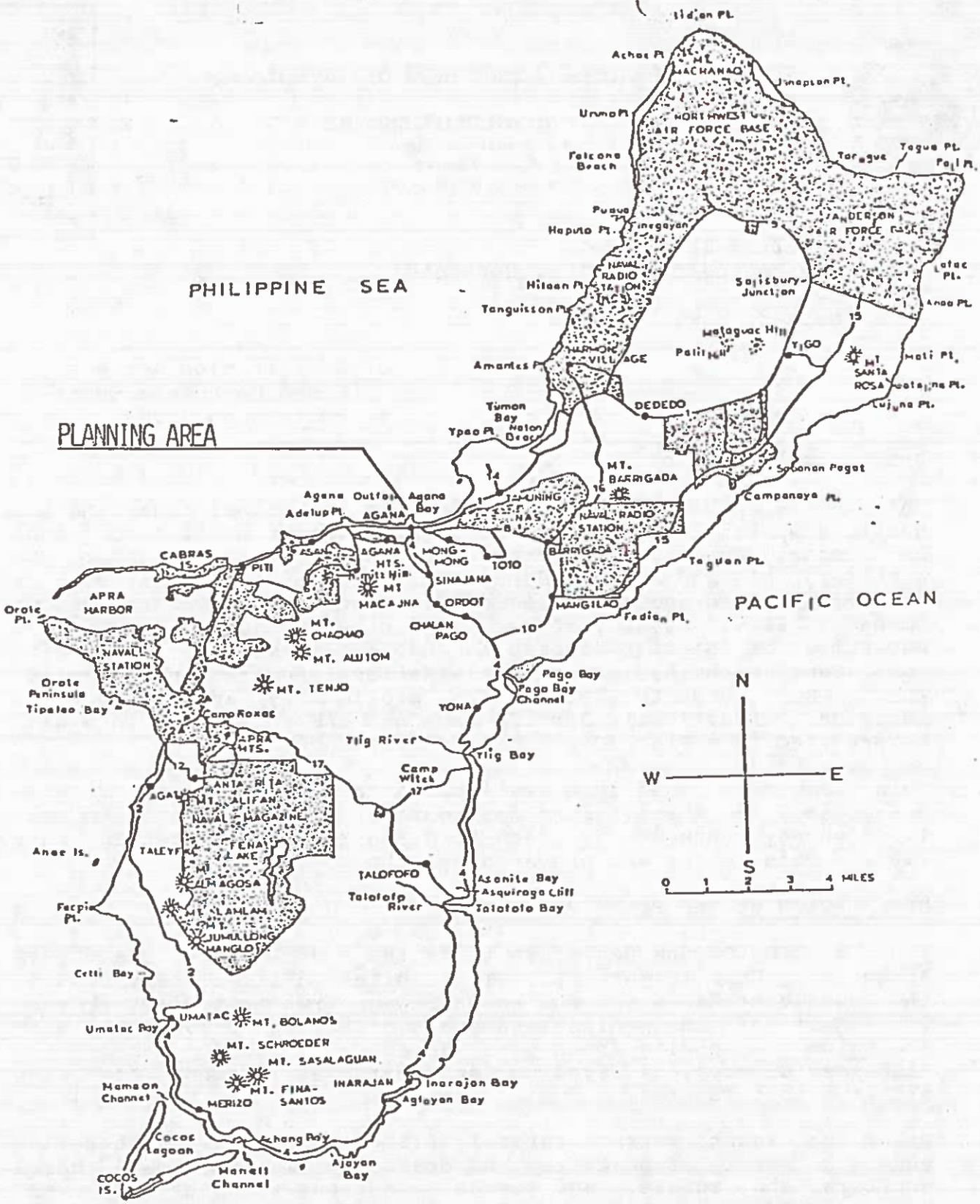

Figure 1. Island of Guam. Shaded areas indicate military lands. Source: Randall and Holloman 1974.

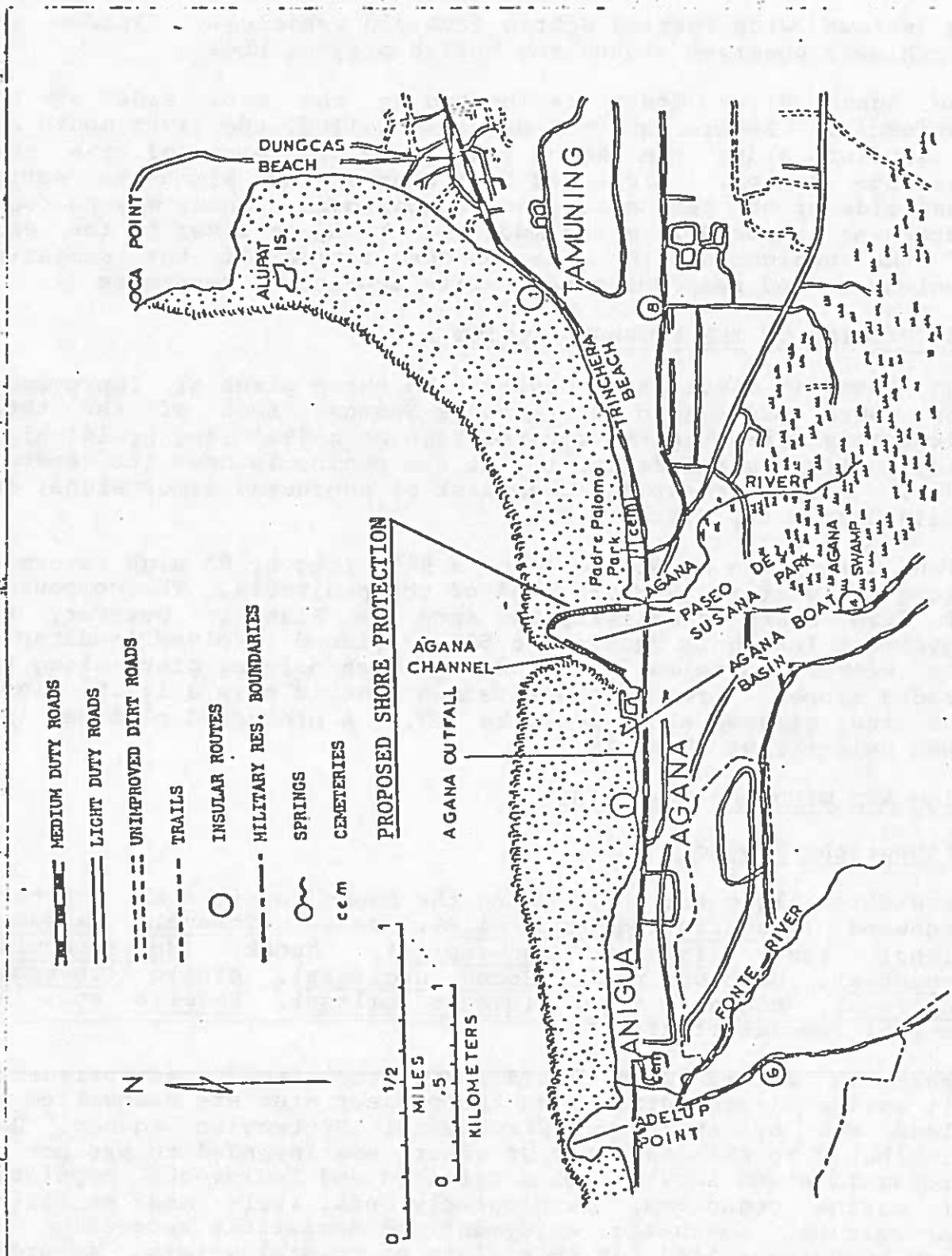

Figure 2. Paseo De Susana Peninsula, Guam. Note fringing reef platform offshore. Source: Randall and Holloman, 1974.

is strewn with rusting debris from old vehicles. Flotsam and trash were observed around the entire project area.

The Agana River mouth is located on the east side of the peninsula. Before the park area was filled, the river mouth and a section along the Agana boat basin were part of the same drainage system. A dredged boat channel runs along the entire west side of the peninsula, and a shallower channel may be found extending seaward from the mouth of the Agana River to the east of the peninsula. A detailed description of the submarine geology at and near the project site appears in Reference 3.

DESCRIPTION OF THE PROPOSED ACTION

The Honolulu District is considering three plans of improvement for shore protection at Paseo De Susana. Each of the three alternatives involve the construction of a 590' long by 10' high, sloping revetment from the tip of the peninsula down its eastern edge. The revetment would consist of ungrouted armor stone, and would have a top width of 8'.

Plan 1 involves construction of a 940' long by 8' high revetment along the western (harbor) side of the peninsula. The components of Plan 2 are essentially the same as Plan 1; however, the revetment length is reduced to 500'. Plan 3 involves landscaping the western shoreline and planting beach morning glory along the graded slope. Armor stone revetments would have a 1:1.5 slope, and the grassed slope would be 1:3. A preferred plan has not been selected at this time.

FISH AND WILDLIFE RESOURCES

Without the Project

Vegetation along the shore above the beach consists of scattered ironwood (*Casuarina equisetifolia*), nanaso (*Scaevola taccada*), alahai tasi (*Ipomoea pes-caprae*), hunek (*Messerschmidia argentea*), coconut palm (*Cocos nucifera*), binalo (*Thespesia populnea*), beggar's tick (*Bidens pilosa*), *Wedelia sp.*, and several species of grasses.

Nearshore waters were turbid during the field reconnaissance. All marine waters surrounding the project area are classified as Class M-2 by the Guam Environmental Protection Agency. Uses attributed to this category of waters are intended to protect the propagation and survival of a balanced and indigenous population of marine organisms, particularly coral reefs and shellfish. Mariculture, aesthetic enjoyment and compatible recreation are also uses identified for this class of coastal waters. According to current Guam Water Quality Standards, concentrations of suspended matter (at any point) shall not be increased more than 10% from ambient at any time, and should not exceed 80 mg/l except when due to natural conditions (such as experienced during our field survey.)

Descriptions of intertidal and nearshore marine habitat may be found in References 1, 2, and 4. Benthic habitat along the edges of the project area adjacent to the two channels consists principally of dead coral rubble and concrete blocks. A substantial amount of silt exists on the surface of the rubble and within interstices. Bits of Sargassum sp. lay washed up along the shore in this area. Invertebrate animals observed during our field reconnaissance include sea cucumbers (Holothuria), small limpets and strombs, Trochus sp. shells, hermit and grapsid crabs. Juvenile fishes observed represented the pipefishes (Sygnathidae), blennies (Bleniidae), surgeonfishes (Acanthuridae), gobies (Gobiidae), rabbitfishes (Siganidae), and damselfishes (Pomacentridae). Generally, our observations revealed a greater diversity of organisms along the western (harbor) side of the Paseo De Susana peninsula.

A depressed reef flat consisting of a narrow reef-rock pavement exists between the outer tip of the peninsula and a slightly elevated inner reef margin zone (Figure 3, Reference 2). This area is dominated by strong longshore currents which sweep toward Agana channel. Corals are mostly absent from this area except for widely scattered patches of Porites lutea. An inner reef margin lies seaward of the reef flat. An algal mat, consisting primarily of Amphiroa, Sargassum and Caulerpa, dominates this habitat. Porites lutea is the only species of coral which has been reported from this area.

To the west of the stub breakwater lies a rubble platform which slopes downward to the face of the boat channel slope. Reference 2 reports that corals are inconspicuous in this area, with the exception of a few patches of Millepora dichotoma and Porites lutea. Larger boulders and blocks show small colonies of encrusting Montipora sp. and Pocillopora sp. The face of the boat channel slope is composed of rubble, gravel, and sand interspersed with rocky outcroppings and coral knobs. Millepora dichotoma, Porites lutea, and Pocillopora damicornis may be found in this habitat.

Reference 4 lists algae and corals found along a short transect to the west of the Agana Sewage Treatment Plant island. Table 1 lists fishes observed along a reef flat transect in central Agana Bay in 1977 and 1978 (Reference 1). This information may be of value for comparative purposes.

No fishing or fishermen were observed during our field survey. However, recreational fishing occurs year round in the park. Seasonally intensive fishing occurs along the western (harbor) side of the peninsula for "atulai" (Selar crumenopthalmus). Atulai runs generally occur during the period from August through November. Hook and line fishing is permitted with no take limits. Net fishing for atulai in the Agana Boat basin is limited to the hours of 3 a.m. to 7 a.m. Each year during the peak atulai runs, conflicts arise between net and pole fishermen in the boat basin as the net fishermen may capture the fish schools before the reach the shore. Net fishermen may also

Table 1. Estimated Abundance of fishes (no. per m^2) in reef flat zones on Agana Bay, April 1977 and March 1978. A=Inner Reef Flat--Sand Subzone; B=Inner Reef Flat--Scatterred Coral Subzone. (Adapted from Amesbury 1978).

FAMILY NAME Genus Species	A (0-220m)	B (220-310m)
ACANTHURIDAE		
Naso sp. (juvenile)	.01	
APOGONIDAE		
Apogon novemfasciatus	.01	.01
ATHERINIDAE		
unidentified atherinids	.01	
BALISTIDAE		
Pseudobalistes		.01
BLENNIIDAE		
unidentified blennids	.01	.01
BOTHIDAE		
Bothus	.01	
CANTHIGASTERIDAE		
Canthigaster solandri	.06	.01
CHAETODONTIDAE		
Chaetodon auriga		.01
C. trifascialis		.01
C. trifasciatus		.01
GOBIIDAE		
unidentified gobiids	.02	.01
HOLOCENTRIDAE		
Flammeo sp.		.04
LABRIDAE		
Halichoeres marginatus		
H. trimaculatus	.01	.13
Stethojulis bandanensis	.01	.01
juvenile labrids	.01	.01
MULLIDAE		
Parupeneus barberinus	.01	.01

Table 1. (Continued)

POMACENTRIDAE		
Dascyllus aruanus	.06	
Eupomacentrus albifasciatus		.31
E. lividus	.01	.07
E. nigricans		.01
Plectroglyphidodon leucozona	.01	
juvenile pomacentrids	.01	.01
SIGANIDAE		
Siganus spinus	.08	.05
SYNGNATHIDAE		
unidentified syngnathids	.01	
Total No. Species	17	18
Total Fish Abundance (no./m^2)	.35	.73

obstruct the entrance channel while surrounding schools of atulai. Reported annual harvest of atulai on Guam (total island-wide catch) may be as high as 20,000 kg. Runs of "manahac", juvenile rabbitfish (Siganus spp.) also occur across the shallow reef flats at Paseo De Susana in the spring.

There are no listed endangered or threatened species of animals or plants known to inhabit or frequent the project area.

With the Project

No significant long-term impacts to the marine or terrestrial environments are anticipated as a result of implementing Plans 1 or 2 at Paseo De Susana. Adverse effects to water quality and adjacent benthic habitat will probably be limited to the construction phase of project implementation. Plan 3 may result in long-term degradation of water quality due to gradual erosion of the grassed slope by wave action and continuous foot traffic.

During construction of any alternative, grading and cutting the existing shore and placement of fill material will generate plumes of turbid water due to introduction of suspended fine sediments. If these plumes are not contained to the immediate project area, they may stress corals in adjacent areas. Placement of stone rip-rap along the shoreline will bury some sub- and intertidal habitat. However, the resulting surfaces will be suitable for colonization by algae and invertebrates. Impacts of alterations in normal water circulation patterns around the peninsula on fish and wildlife resources by the proposed project are expected to be slight.

Construction will temporarily inhibit access along the shoreline for recreational fishing. However, no long-term changes in fishing success are anticipated as a result of project implementation.

RECOMMENDATIONS

The Service suggests that the Corps incorporate the following measures to mitigate construction-related impacts and enhance recreational use of the park project design:

1) Efforts should be taken to confine suspended sediments to the immediate project area during construction. Dredged, cut or graded material should be protected from erosion, and only clean water should be allowed to run off into the harbor and bay.

2) If practicable, construction of the western (harbor) side improvements should begin at the close of the annual atulai season (December), and should be completed as soon as possible. Safe shoreline access should be provided for fishermen at Paseo De Susana to the maximum extent possible during construction.

3) The project area should be revegetated with indigenous strand and shade plants and trees to enhance the aesthetic value of the park.

Sincerely yours,

John I. Ford
Acting Project Leader
Office of Environmental Services

Enclosure: Bibliography

cc: NMFS-WPPO
GAWR
RD, FWS, Portland, OR (AE)

BIBLIOGRAPHY

1. Amesbury, S. S. 1978. Studies on the biology of the reef fishes of Guam. Part I: Distribution of fishes on the reef flats of Guam. University of Guam Marine Laboratory Tech. Rept. No. 49.

2. Randall, R. H. and L. G. Eldredge. 1976. Report on the coral survey of the Agana Bay reef flat. Rept. for US Army Engineer Division, Pacific Ocean, Contract No. DACW84-76-M-0283.

3. Randall, R. H. and J. Holloman. 1974. Coastal survey of Guam. University of Guam Marine Laboratory Tech. Rept. No. 14.

4. Rowley, D. M. 1981. First annual report on the marine benthic algae and coral communities at nine biological stations around Guam. Guam Environmental Protection Agency.

PASEO DE SUSANA SHORE PROTECTION
TERRITORY OF GUAM

ENGINEERING INVESTIGATIONS
AND
DESIGN ANALYSIS

APPENDIX D

APPENDIX D

ENGINEERING INVESTIGATIONS AND DESIGN ANALYSIS

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APPENDIX D

SECTION I. DESIGN ANALYSIS

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I. DESIGN ANALYSIS

GENERAL

A shore protection design analysis requires the determination of the following elements:

a. Function and Limitations

(1) Structure Use and Shape
(2) Structure Location and Dimensions
(3) Characteristics of Adjacent Land

b. Weather and Hydraulic Conditions

(1) Wind
(2) Waves
(3) Tides

EROSION PROCESSES

The reef fringing Agana Bay provides protection from wind-generated waves to the Paseo de Susana Park shoreline throughout the year except during periods of high storm water elevations. Site visits to the park in April, August, and November 1982, all during fair weather periods, indicated no direct wave attack upon the park shoreline during these periods. These site inspections essentially confirmed assessments made of the Paseo shoreline in the Guam Comprehensive Study Shoreline Inventory completed by the Honolulu District in September 1980. Erosion reaches are shown in Figure D-1.

Reach 1 extends for 1,000 feet along the east park shoreline seaward from the mouth of the Agana River and appears generally stable. A 2- to 3-foot high scarp is present in the seaward 500 feet of the reach, but is vegetated, indicating that erosion is not chronic.

Reach 2 extends for 240 feet from the seaward end of Reach 1 to the eastern end of the existing rubble revetment along the park tip. Chronic erosion is occurring throughout this reach, ranging from intermediate at the south end to severe at the north end.

Reach 3 consists of 400 feet of the existing limestone revetment along the tip of the park. Critical erosion is occurring in the east 50 feet of the revetment adjacent to Reach 2. Thirty feet of the revetment has failed due to piping of the material behind the armor stones.

Reach 4 consists of 600 feet of limestone boulder revetment protected by the Agana Harbor east breakwater at the extreme northern tip of the park. The inner 250 feet of this revetted reach are protected by the Agana Harbor wave absorber. This reach is generally stable and protected by the Agana Harbor structures.

Reach 5 consists of 970 feet of shoreline between the south end of the existing Corps wave absorber and the Agana Boat Basin. Intermediate to critical erosion is occurring throughout this reach, as evidenced by a 2- to 3-foot wave cut scarp in the backshore.

The most severe erosion is centered in the 590 feet of the reach adjacent to the wave absorber.

PROBLEM ANALYSIS

The most critical need for shore protection, based on the previous section, occurs at the northeastern tip of the park, and along the entire unprotected west side of the park. The susceptibility of the park tip to erosion is primarily due to its being within 300 feet of the Agana Bay reef margin and its resultant greater exposure to storm waves. The susceptibility of the west shoreline to wave attack is primarily due to its exposure to waves traveling up the Agana Harbor entrance channel.

For these two areas of most critical erosion, the direction of wave attack is not perpendicular to the shoreline, but rather at a slight angle nearly parallel to the shore. Placement of an energy-absorbing shoreline structure at the seward end of park shoreline would serve to dampen a portion of the wave energy that might otherwise travel farther inland.

Based on this information, the most suitable method for protecting the eastern shoreline appears to be 500 feet of boulder revetment which would overlap both the failure area in Reach 3 and the critically eroding area in Reach 2. The entire 970 feet of the west shoreline requires stabilization, however, placement of a boulder revetment in the more critical 590 feet adjacent to the existing wave absorber could similarly reduce wave energy passing farther inside the Agana Boat Basin.

WATER LEVELS

a. TIDES. The nearest tidal benchmark to the study site is at Apra Harbor. Tidal data for the 19-year period between 1949-1967 is as follows:

	Feet
Highest tide (observed)	3.3
Mean higher high water	2.4
Mean high water	2.3
Mean tide level	1.45
Mean sea level	1.4
Mean low water	-0.6
Mean lower low water	0.00
Lowest tide (observed)	-1.9

All elevations are referenced to mean lower low water (MLLW).

b. ASTRONOMICAL TIDE (S_a).

The astronomical tide is estimated to be equivalent to the mean higher high water of 2.4 feet.

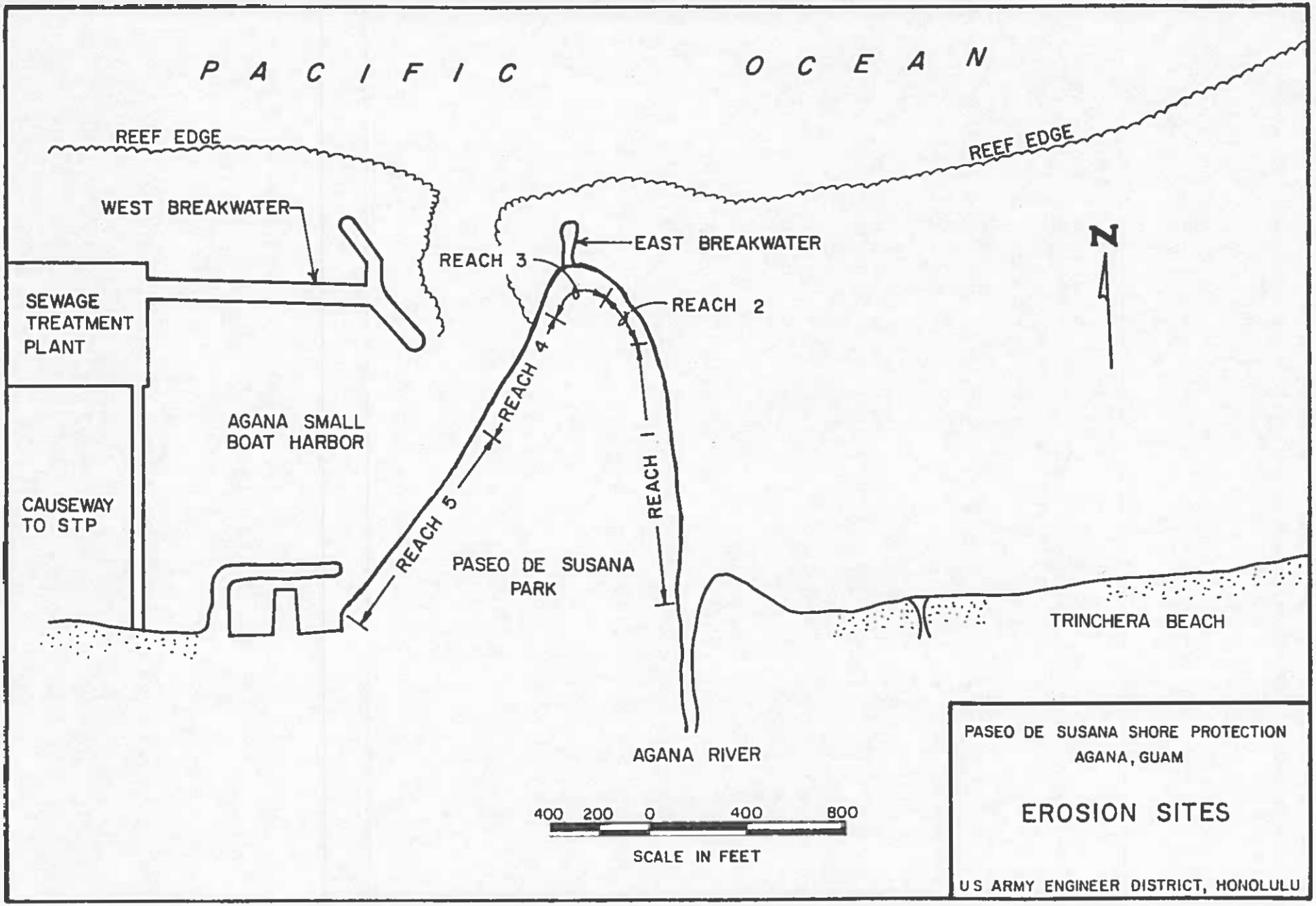

PACIFIC OCEAN
REEF EDGE
REEF EDGE
WEST BREAKWATER
EAST BREAKWATER
REACH 3
REACH 2
REACH 4
REACH 5
REACH 1
N
SEWAGE TREATMENT PLANT
AGANA SMALL BOAT HARBOR
CAUSEWAY TO STP
PASEO DE SUSANA PARK
TRINCHERA BEACH
AGANA RIVER
400 200 0 400 800
SCALE IN FEET
PASEO DE SUSANA SHORE PROTECTION
AGANA, GUAM
EROSION SITES
US ARMY ENGINEER DISTRICT, HONOLULU

FIGURE D-1

c. ATMOSPHERIC PRESSURE DROP (S_p).

The water level rise due to atmospheric pressure is calculated by:

$S_p = 1.14 (P_n - P_o) (1 - e^{-R/r})$ EQ. 3-85, SPM [1/]

P_n = 29.92 inches

P_o = 27.47 inches

R = 20 nautical miles

r = 1 nautical miles

S_p = 3.1 feet

d. STORM SURGE (S_s).

The water level rise due to storm surge is calculated by:

Storm surge = S_j, which is the incremental rise in water level due to wind stress perpendicular to the bottom contour.

$$S = \frac{540K\ U_R^2\ X}{\bar{d}}$$ (TR-4, 1-64) [2/]

X = total distance in N.M.

$K = 3.0 \times 10^{-6}$

U_R = 62 knots

X = incremental distance in N.M.

$\bar{d}$ = mean depth over increment (FT)

d_i = initial depth

Storm surge in the study area is estimated at 1.2 feet.

e. WAVE SETUP, S_w. Wave setup is estimated from calculated theoretical values, considering that the location of the primary protective structure is not in the zone of maximum wave setup. Under certain wave conditions, the structure may be in a zone of wave setdown, resulting in a relatively lower water level. For engineering calculations, a value of 0.5 feet is selected for S_w.

1/ US Army Coastal Research Center, Shore Protection Manual, 3d Edition, 1977.

2/ US Army Coastal Research Center, Technical Report No. 4, 3d Edition, 1966.

f. DESIGN STILLWATER LEVEL. The design stillwater level (SWL) is defined as the level of water above the elevation datum plane, when no waves are present. Components of the SWL are astronomical tide level (S_a), atmospheric pressure drop (S_p), storm surge (S_s), and wave setup (S_w). Stillwater level components are calculted as follows; assuming the components are additive functions.

SWL = Design still water level

$SWL = S_a + S_p + S_s + S_w$

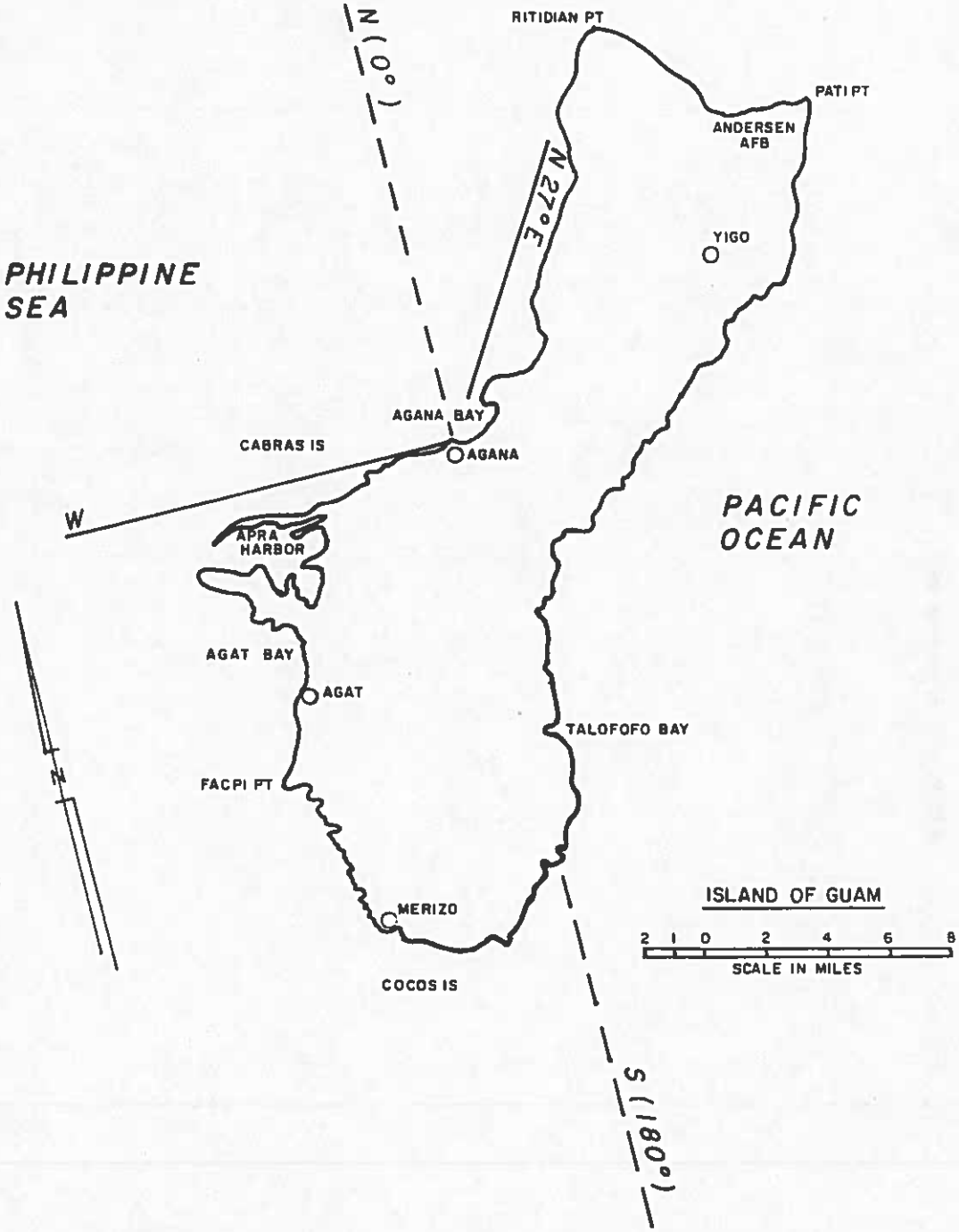
SWL = 2.4' + 3.1' + 1.2' + 0.5'

SWL = 7.2 feet

WAVE CLIMATE

The study area is sheltered by the island mass from the prevailing easterly waves. The geometric exposure to deepwater waves, assuming a straight line approach, is from approximately west clockwise to north-northeast. Figure D-2 depicts the exposure to deepwater waves, and Figure D-3 shows the surface winds. Hindcasts of tropical storms and typhoons in the Western North Pacific during the period 1975-1979 were performed and the number of hours of wave activity affecting Guam within given wave height, direction, and period classes were cumulated. Yearly statistics were developed by dividing by the number of hours in the year and converting to percent. This data indicates a greater incidence of waves approaching from the exposed sector than indicated by data contained in the Summary of Synoptic Meteorological Observations (SSMO) prepared by the National Climatic Center.

The SSMO data, obtained through direct synoptic observation by shipboard personnel, represents average local wind wave conditions (sea), while the hindcasted storm wave data represents storm generated waves (swell). Table D-1 summarizes the annual percent of occurrence of deepwater wave height versus direction and Table D-2 summarizes the annual percent of occurrence of wave period versus direction for the project site. The data represents only the percent of occurrence for the directions south clockwise to north, but does not preclude the percentage of time when deepwater waves approach Guam from other directions. Simultaneous occurrence of local wind waves from the easterly direction and storm generated swell from the westerly directions is probable.



PASEO DE SUSANA SHORE PROTECTION
AGANA, GUAM

DEEPWATER WAVE EXPOSURE

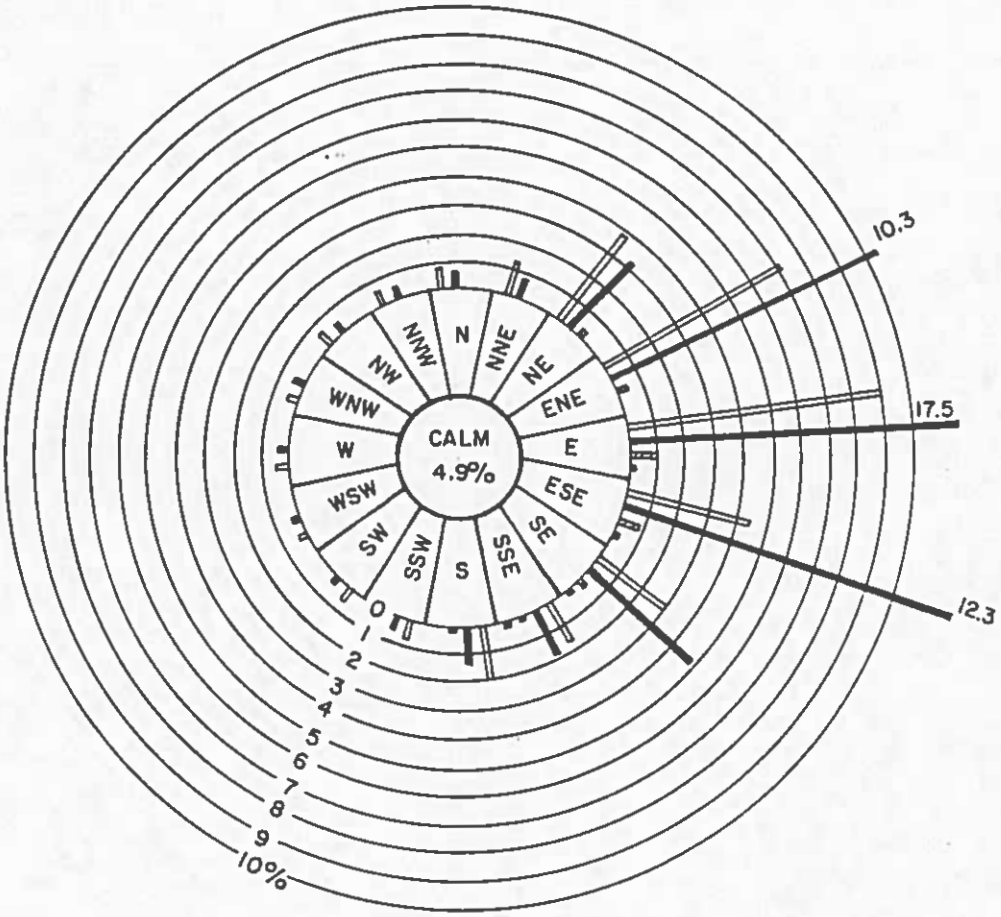
U. S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE D-2

SURFACE WIND DIAGRAM

AGANA FIELD FLEET WEATHER CENTRAL

GUAM, MARIANA ISLANDS



LEGEND

- 1-6 KNOTS
- 7-16 KNOTS
- 17-21 KNOTS
- OVER 21 KNOTS

CONVERSION: 1 KNOT = 1.1516 MPH

10%=TOTAL % OF THE YEAR

PERIOD OF RECORD

1945-1967

SOURCE

NATIONAL WEATHER SERVICE
HONOLULU, HAWAII
DATA COMPILED BY U.S. AIR FORCE
ENVIRONMENTAL TECHNICAL
APPLICATION CENTER,
ASHEVILLE, N.C.

PASEO DE SUSANA SHORE PROTECTION
AGANA, GUAM

SURFACE WIND DIAGRAM

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE D-3

TABLE D-1

ANNUAL PERCENT OF OCCURRENCE OF WAVE HEIGHTS[1/]
VERSUS DIRECTION

WAVE HEIGHT (FT)	WAVE DIRECTION (FROM WHICH WAVES APPROACH)										TOTAL
	S		SW		W		NW		N		
	SEA[2/]	SWELL[3/]	SEA	SWELL	SEA	SWELL	SEA	SWELL	SEA	SWELL	
0-2	2.0	0.1	1.8	0.3	1.9	6.5	1.2	9.4	2.9	2.7	28.8
2-4	1.5	0	2.1	0	0.9	3.1	0.5	4.1	2.1	1.5	15.8
4-6	0.8	0	0.8	0	0.5	2.2	0.3	3.3	1.5	2.1	11.5
6-8	0.7	0	0.9	0	0.5	1.7	0.1	2.3	0.9	1.1	8.2
8-10	0.1	0	0	0	0	1.5	0	1.7	0.1	0.8	4.2
10-12	0	0	0.1	0	0.2	1.8	0	1.7	0.1	0.4	4.3
12-14	0.1	0	0.1	0	0.1	0.4	0	0.7	0.1	0.5	2.0
14-16	0	0	0	0	0	0.9	0	0	0	0	0.9
16	0	0.5	0	0	0	0.3	0	0.3	0	0	1.1
TOTAL	5.2	0.6	5.8	0.3	4.1	18.4	2.1	23.5	7.7	9.1	
	5.8		6.1		22.5		25.6		16.8		76.8

1/ The sea and swell are assumed to be mutually exclusive. This is conservative, as there will be some joint occurrence.

2/ Data Source: Summary of Synoptic Meteorological Observations (SSMO), Hawaii and selected North Pacific island coastal marine areas, Volume 5, Area 15, prepared by the National Climatic Center.

3/ Data Source: Hindcasts of tropical storms and typhoons in the Western North Pacific, 1975-1979, based on data obtained from Annual Typhoon Reports published by US Fleet Weather Central.

TABLE D-2

ANNUAL PERCENT OF OCCURRENCE OF STORM WAVE PERIOD VERSUS DIRECTION[1/]

WAVE PERIOD (Sec)	WAVE DIRECTION (FROM WHICH WAVES APPROACH) S	SW	W	NW	N	TOTAL
0-6	0	0.3	11.4	18.0	6.9	36.6
6-8	0	0	3.1	4.5	1.6	9.2
8-10	0	0	1.8	4.0	2.1	7.9
10-12	0	0	2.4	3.8	2.1	8.3
12-14	0	0	4.0	5.2	1.8	11.0
14-16	0	0	2.4	2.9	1.4	6.7
16-18	0	0	1.1	1.8	0.8	3.7
18	0	0.2	2.4	2.3	0.8	5.7
TOTAL	0	0.5	28.6	42.4	17.6	89.1

1/ Data Source: Hindcasts of tropical storms and typhoons in the Western North Pacific, 1975-1979, based on data obtained from Annual Typhoon Reports published by the US Fleet Weather Central.

DESIGN WAVE HEIGHTS

Based on the wave climate data, the highest one percent of waves affecting the site have a height of 16 feet and a period of 18 seconds. Since the structures would be located on the reef flat, the design of the structural elements was based on controlling depth criteria to determine the maximum wave height to which a structure might reasonably be subjected.

Because of the wide, fringing reef fronting Agana Bay, the large incident waves will break completely seaward of the structures since they are located well landward of the reef edge. The maximum wave on the inner reef flat is 6.4 feet based on a controlling depth of 8.2 feet, and a slope, M = 0.00.

The reef gap at the mouth of the Agana Harbor entrance channel and the protective structures at the harbor entrance provide a double diffractive effect on incident waves propagating into the harbor entrance channel. Based on previous analysis peformed for similar projects and model studies, it is estimated that incident wave heights will be reduced by 50% before reaching the harbor entrance. Based on an entrance channel depth of 15 feet and maximum still water level of 7.2 feet, it is assumed that the maximum wave incident to the channel entrance is a reformed wave of 16 feet. Therefore, the maximum wave at the harbor entrance would be 8.5 feet. The Agana Harbor design analysis indicates that wave diffraction around the structures at the

harbor entrance will reduce wave heights to levels between 6 feet at the landward end of the existing Corps wave absorber and 2 feet at the Agana Marina. A design wave height of 4.0 feet is used for structures along the Agana Harbor shore of the park.

PROTECTIVE STRUCTURES DESIGN

Stability Requirements. The Coastal Engineering Research Center's (CERC) Shore Protection Manual (SPM) design formulas were used to determine the weight of the stones and the thickness of the stone layers required for stability. The following factors were used in the armor layer design computations:

		East Revetment	West Revetment
Unit weight of stone, pcf:	W_r	147	147
Design wave height, feet:	H_b	6.4	4.0
Stability coefficient:	K_D	3.5	4.0
Specific gravity of armor unit relative to seawater:	S_r	2.3	2.3
Cotangent of structure slope:	cot a	1.5	1.5
Layer coefficient:	k	1.15	1.15
Layer thickness:	n	2	2

Armor stone size:

$$W = \frac{W_r H_b^3}{K_D (S_r - 1)^3 \ \text{Cot a}}$$

An acceptable range of armor stone size is generally ±25% of the calculated weight. Additional armor stones in the range of 1.25W to 1.50W are used at the toe of the revetment for additional protection.

$$\text{Armor layer thickness} = nk \ \frac{(W)^{1/3}}{(W_r)^{1/3}}$$

The underlayer stone size is based on approximately one tenth the weight of the armor stone and the underlayer thickness was calculated using the layer thickness formula. The bedding layer is based on 1/400 the weight of the armor stone graded to minimize piping of the fill material which is being protected. The bedding layer thickness is set at a minimum of 1.5 feet for constructibility purposes. Table D-3 summarizes the stone weight and layer thickness required for stability.

TABLE D-3 - STONE WEIGHT AND LAYER THICKNESS

Revetment Type	Stone Weight (pounds)	Layer Thickness (feet)
East Revetment		
Armor	2,500-4,000	6.5
Underlayer	200-400	3.0
Bedding Layer	1-50	1.5
West Revetment		
Armor	500-1,000	4.1
Underlayer	50-100	2.0
Bedding Layer	1-50	1.5

The crest width was calculated using the same formula for determining armor layer thickness and a 3-stone crest width, n = 3 and k = 1.15:

$$\text{Crest width} = nk \frac{(W)}{(W_r)}^{1/3}$$

This calculation yields a crest width of 10 feet for the east shoreline revetment. Using n = 6 and k = 1.15 for the west shoreline yields a calculated crest width of 12 feet.

Runup and crest elevations. The maximum runup occurs when the incident wave crests approach parallel to the structure. When the wave strikes at an angle to the structure, the effective surface area available for wave energy dissipation is increased, thereby decreasing the wave runup. Based on the refraction analysis for the Agana Harbor, incident waves will strike the east shoreline of the Paseo de Susana at an angle of 68 degrees or greater from normal to the shoreline. Therefore, a wave striking a structure with a 1V on 1.5H slope at this location will run up on an effective slope of 1V on 4H or flatter. Based on the diffraction analysis for the Agana Harbor, waves will travel up the harbor entrance channel and diffract around the harbor structures, striking the west shoreline at an angle of approximately 58 degrees from normal. Waves striking a structure at this location with a 1V on 1.5H slope will runup on an effective slope of 1V on 3H.

The runup computations were based on criteria contained in the SPM and further refined by data contained in CERC's Coastal Engineering Technical Aid (CETA) publications 78-2 and 79-1 and data obtained from model tests conducted for similar structures. Based on a breaking wave height of 6.4 feet, wave period of 8 seconds, stillwater level of +7.2 feet MLLW, and an effective side slope of 1V on 4H, the runup was computed at 4.2 feet. The non-overtopping crest elevation would be equal to the runup plus stillwater level or 11.4 feet. The runup based on a nonbreaking wave height of 4.0 feet, wave period of 8 seconds, stillwater level of +7.2 feet MLLW, and effective side slope of 1V on 3H, was computed at 3.1 feet. The non-overtopping crest elevation would be equal to the runup plus stillwater level of 10.3 feet.

Taking into consideration the aesthetics and desirability of an unrestricted view of Agana Bay for the park users, as well as the inland location of the nearest potentially damageable park structures, it is desirable to minimize the crest elevation of any protective structure placed along the park shoreline. The crest elevation of the east shoreline revetment was set at +10 feet to match that of both the existing revetment and wave absorber. The crest elevation of the west shoreline revetment was set at +7 feet to roughly correspond to the average elevation of the backshore land.

At these crest elevations, the 6.4-foot design wave will overtop the east revetment by 1.4 feet, and the 4.0-foot design wave will overtop the west revetment by 3.3. feet. In order to mitigate the effects of these levels of overtoping, the east revetment 200-400-pound underlayer stones are extended 10 feet inland beyond the armor layer, and the west revetment crest width is set at 6 armor stones or 12 feet for absorption of the overtopping wave energy.

APPENDIX D

SECTION II. COST ESTIMATES

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1. BASIS FOR ESTIMATE

a. A Guam-based contractor will perform the construction.

b. Blasting and excavation of reef rock will not be required.

c. Revetment stone and quarry run is priced from the Hawaiian Rock Products quarry.

d. Fill for Plan 3 will be from excavated material.

e. Construction Period:

(1)	Plan 1	12 months
(2)	Plan 2	10 months
(3)	Plan 3	5 months

f. June 1983 price levels are used.

2. COST ESTIMATES

a. Plan 1

(1) Construction

	Quantity	Unit Cost $	Total Cost $
Mobilization and Demobilization	1	Job	$ 30,000
Revetment			
Excavation	14,500 cy	7.50	108,800
Armor			
1.25 - 2.0 ton	4,800 tons	40.00	192,000
500# - 1,000#	7,820 tons	40.00	312,800
Underlayer			
200# - 500#	2,120 tons	30.00	63,600
50# - 100#	3,870 tons	30.00	116,100
Bedding spall - 50#	8,420 tons	26.00	218,900
			$1,042,200
		25% Contingency	260,600
TOTAL DIRECT CONSTRUCTION COST			$1,302,800

(2) Engineering and Design

FEDERAL	
Detailed Project Report (preauthorization study costs)	$ 120,000
Plans and Specifications	50,000
Engineering During Construction	6,000
NON-FEDERAL	0
TOTAL ENGINEERING AND DESIGN COST	$ 176,000

(3) Supervision and Administration

FEDERAL	$ 75,000
NON-FEDERAL (Indirect Administrative Costs)	10,000
TOTAL S&A COST	$ 85,000
TOTAL PROJECT FIRST COST	$1,564,000
TOTAL FEDERAL COST	$ 842,000
TOTAL NON-FEDERAL COST (based on 50% sharing of construction costs, excluding preauthorization study costs)	$ 722,000
ANNUAL MAINTENANCE COST	
1% of armor stone cost	$ 6,000

b. Plan 2

(1) Construction

	Quantity	Unit Cost $	Total Cost $
Mobilization and Demobilization	1 Job		$ 30,000
Revetment			
Excavation	11,400 cy	7.50	85,500
Armor			
1.25 - 2.0 ton	4,800 tons	40.00	192,000
500# - 1,000#	4,910 tons	40.00	196,400
Underlayer			
200# - 500#	2,120 tons	30.00	63,600
100# - 200#	2,430 tons	30.00	72,900
Bedding spall - 50#	6,430 tons	26.00	167,200
			$ 807,600
	25% Contingency		201,900
TOTAL DIRECT CONSTRUCTION COST			$1,009,500

(2) Engineering and Design

FEDERAL	
Detailed Project Report (preauthorization study costs)	$120,000
Plans and Specifications	50,000
Engineering During Construction	5,000
NON-FEDERAL	0
TOTAL ENGINEERING AND DESIGN COST	$175,000

(3) Supervision and Administration

FEDERAL	$ 60,000
NON-FEDERAL (Indirect Administrative Costs)	10,000
TOTAL S&A COST	$ 70,000
TOTAL PROJECT FIRST COST	$1,255,000
TOTAL FEDERAL COST	$ 687,000
TOTAL NON-FEDERAL COST (based on 50% sharing of construction costs, excluding preauthorization study costs)	$ 568,000
ANNUAL MAINTENANCE COST 1% of armor stone cost	$ 4,000

c. Plan 3

(1) Construction

	Quantity	Unit Cost $	Total Cost $
Mobilization and Demobilization	1 Job		$ 30,000
Revetment			
Armor 1.25 - 2.0 ton	4,800 tons	40.00	192,000
Underlayer 100# - 200#	2,120 tons	30.00	63,600
Bedding sp - 100#	3,100 tons	26.00	80,600
Fill	4,600 cy	11.60	53,400
Beach Morning Glory (Plants @ 5' o.c.)	30,000 sf	0.50	15,000
			$ 434,600
	25% Contingency		108,700
TOTAL DIRECT CONSTRUCTION COST			$ 543,300

(2) Engineering and Design

FEDERAL	
Detailed Project Report (preauthorization study costs)	$ 120,000
Plans and Specifications	50,000
Engineering During Construction	3,000
NON-FEDERAL	0
TOTAL ENGINEERING AND DESIGN COST	$ 173,000

(3) Supervision and Administration

FEDERAL	$ 29,000
NON-FEDERAL (Indirect Administrative Costs)	10,000
TOTAL S&A COST	$ 39,000

TOTAL PROJECT FIRST COST	$755,000
TOTAL FEDERAL COST	$437,000
TOTAL NON-FEDERAL COST (based on 50% sharing of construction costs, excluding preauthorization study costs)	$318,000
ANNUAL MAINTENANCE COST	
1% of armor stone cost	$2,000
Grading and vegetation of west shoreline component by local sponsor every 5 years	$14,000
	$16,000

APPENDIX D

SECTION III. GEOLOGY, FOUNDATIONS AND MATERIALS

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III. GEOLOGY, FOUNDATIONS AND CONSTRUCTION MATERIALS

Regional Geology. Guam is the southernmost and largest island of the Mariana Islands. This group of limestone and volcanic islands are located in the western Pacific Ocean roughly 1,200 miles east of the Philippine Islands and 1,300 miles south of Japan. The Mariana Island chain forms the high (land) points of the submerged Marianas Ridge separating the Philippine Sea from the Pacific Ocean. The Marianas Ridge was uplifted from the ocean floor as a result of rock masses beneath the Pacific Ocean being thrust under rock masses of Philippine Sea. The zone of underthrust or subduction is called the Mariana Trench and is located 70 miles east and southeast of Guam. Consequently, the Mariana Islands have experienced a geologic history rich in seismic activity and volcanism. Although volcanic activity has been absent on Guam since the Miocene epoch of geologic time (21 million years ago), it continues to the present in the north Mariana Islands. The shallow seas created by uplift and volcanism and having been warmed as a result of the 10° to 20° latitude of the Marianas Ridge have made ideal conditions for extensive coral growth.

Two geomorphic provinces make up Guam. The north half of the island is a coralline limestone plateau which has grown as a thin mantle on thick volcanic deposits. The south portion of the island is composed primarily of volcanic rocks (ash deposits, tuffs and weathered lava basalts). Both geomorphic provinces of Guam have fringing reefs.

Site Geology. Paseo de Susana Park is located on the southwestern side of the limestone plateau (north) geomorphic province of Guam. The park consists of fills derived, at least in part, from the post-war reconstruction. The park is a triangular shaped peninsula with the base abutting the shoreline of the City of Agana and the apex pointing north into Agana Bay. The fills cover a fringing reef and beach deposits. On the east side of the park, the Agana River empties onto the reef and into Agana Bay. The west edge of the park borders the channel for the Agana Small Boat Harbor (located west of the base of the triangular shaped peninsula). A 225-foot breakwater extending north from the apex of the peninsula and 500-foot wave absorber near the Agana channel entrance are two features constructed at Paseo de Susana Park as part of the Agana Small Boat Harbor project. The Agana (SBH) Channel is suspected of being the former channel for the Agana River. Construction of Paseo de Susana Park diverted the Agana River away from the original channel. The ancient river channel through the fringing reef was formerly used as a mooring facility and natural harbor for Agana's fishing industry.

As previously mentioned, Paseo de Susana Park is founded on fringing reef. Borings made for the Agana Small Boat Harbor show the outer reef to consist of hard to moderately hard coral limestone and limestone breccia and the surface of the inner reef to consist of unconsolidated clastic sediments (calcareous sand). Although sand-filled vugs and voids can occupy up to 50% of the total volume of reef rock, the reef generally has good strength characteristics. No failures in the foundation of breakwaters, sewage treatment plant, wave absorbers and revetted causeway around the Agana Small Boat Harbor have been observed or reported.

The fill materials which make up Paseo de Susana Park consist of silty coralline sand, gravel, cobbles and boulders mixed with concrete and steel debris. Subsurface materials covering the shorelines in the areas of improvements are shown on the Geologic Map, Figure 1 and Generalized Cross Sections, Figures 2 and 3. Cross sections were developed from field observations made of the surface materials. Materials at depth and their horizontal and vertical attitudes are assumed (based upon Agana Small Boat Harbor borings). The sections show generally good toe foundation conditions for proposed shore protection structures exist over nearly all of the west side of the park and over at least half of the east side. Some minor dredging for the toe of breakwaters may be required on the east side of the park.

SUBSURFACE INVESTIGATIONS

No subsurface exploration relative to the proposed shore protection project was conducted during this phase of study. Information from the Agana Small Boat Harbor supported with field observations have been used to develop the geotechnical data presented within this report. The need remains to verify toe-foundation conditions for the proposed shore protection. Such an exploratory investigation shall require a minimum of four (4) core holes for improvements on both east and west sides of Paseo de Susana Park. The exploratory holes shall extend to a maximum depth of 20 feet unless at least 10 feet of rock core is recovered to define the limits of materials suitable for the founding of shore protection structures. Borings would not be required for the west shoreline component of Plan 3.

SEISMICITY

The seismic regime of Guam has been well documented. A tabulation obtained from the Guam observatory lists 83 earthquakes of magnitudes 6 and greater which occurred between 1902 and 1975. From the total years of record, two earthquakes with an intensity of VIII to IX have occurred. Since the area is seismically active, it is reasonable to assume that earthquakes of this intensity will occur again. Government Design Manual TM 5-809-10, dated February 1982, indicates Guam is located in seismic probability Zone 3. For design purposes, maximum acceleration of 0.33g should be used with a corresponding approximate earthquake magnitude of 7 on the Richter scale. Gutenberg and Richter (1954) report magnitudes for earthquakes between 1904 and 1950. Four of these are significant, occurring in 1912, 1932, and October and November 1936. Magnitudes were in the range of 6 to 7 and focal depths were in the range of 60 to 70 kilometers. The most recent significant earthquakes occurred in November 1, 1975. The reported magnitude was in the range of 6 to 7 and the depth is reported as 113 kilometers. It was centered a few kilometers north of Guam. All of the significant earthquakes, for which focal depth estimates are available, indicate that the active zone is the underthrust which is believed to dip eastward at about 45 degrees beneath the island.

The seismic observatory on Guam does not have strong motion recording equipment. For dynamic analyses, which requires an earthquake spectrum, spectra from seismically active areas will have to be reviewed and modified for the geologic conditions on Guam.

SOURCES OF CONSTRUCTION MATERIALS

Rocks for construction purposes are generally mined in the northern half of Guam because of their high quality and availability. The thick layer of soil and earthly residual deposits over most of the southern half of the island preclude the possibility of finding and developing igneous rocks for construction purposes. Commercial sources of rock which is suitable for revetment purposes are summarized as follows:

Hawaiian Rock Products. This company owns and operates the largest quarry on Guam. It is located off highway 15 at Taguan Point in Barrigada approximately 10 miles from Paseo de Susana Park. Rock from this quarry was used to construct breakwaters for the Agana Small Boat Harbor. The rock available from this quarry consists of compact, recrystallized massive coral limestone and limestone breccia. It breaks in angular blocks with sizes up to 20 ton pieces. Its bulk specific gravity ranges from 2.3 to 2.5. Rock from this quarry appears to be the most suitable source of revetment rock on Guam.

Perez Brothers. This company operates several quarries on Guam mainly for the purpose of fill materials and road base-course materials. Of these quarries, only the quarry at Barrigada (near Hawaiian Rock Products quarry) is capable of producing large size rock for revetment. Rock from this quarry is similar to the rock produced at the Hawaiian Rock Products quarry (located 1 mile north) since both are taken from the same limestone formation. This quarry is located approximately 9 miles from the project. This quarry was formerly called the Fadian Point Quarry and was previously owned and operated by the Government of Guam.

Hyundai Quarry. This quarry is small, locally owned and is operated as the demand for materials dictates. The rock is generally of the same quality as the two previous quarries mentioned since it is also within the same geologic formation. The quarry is located near Mount Santa Rosa on Highway 15, approximately 15 miles from the project site.

Cabras Island. Although this is not a commercial quarry, it is important to mention that this quarry contained the source rock for the Glass Breakwater at Apra Harbor. The rock quality of Cabras Island is considered good, however, the quarry is reserved for future development by the U.S. Navy for maintenance of the Glass Breakwater and other uses.

UNDEVELOPED SOURCES

Large pieces of armor rock could be quarried near the coast in cliff tops at Orotes Point, Amantis Point, Taguan Point, and at several other cliff-headed lands. Development of quarries at these locations may be economical if large quantities of rock are required. The potential armor rock is massive, compact, recrystallized coral limestones which will require drilling and blasting for excavation.

PASEO DE SUSANA SHORE PROTECTION
TERRITORY OF GUAM

ECONOMIC ANALYSIS

APPENDIX E

APPENDIX E

ECONOMIC ANALYSIS

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GENERAL

Benefits credible to Paseo shore protection result from an increase in the quality of recreation activity and preventing damages to trees. Benefits are the measured difference between conditions with and without a shore protection project and are expressed as an equivalent annual value, using a discount rate of 7-7/8 percent and a 50-year project life.

PROJECTION OF PARK VISITS

Projections of annual visits to the Paseo multi-purpose recreational park were made using records of counts from permits, interviews, and field counts. Visitors were projected in two categories, the local residents and the tourist visitors. Development of the park use for the 50-year period beginning at the base year 1985 and extending to 2035 is presented in the following paragraphs:

Park Use Activities - Paseo Park is the recreational center of Guam, offering nearly all of the facilities for active and passive recreation. The park is circumferenced by a large grassy area, has a ball park area, and an area for indoor sports. A list of popular activities (Table E-1) was gathered during a recent interview.

TABLE E-1. LIST OF POPULAR ACTIVITIES AT PASEO PARK

Picnic Area	Fairground	Cultural Art Classes	School Excursions
Scenic Site	Clubhouse	Shoreside Fishing	Major League Camp
Concession	Public Market	Net Fishing	Boat Basin Channel
Softball	Chief Quipuha	Liberation Day Festival	Volleyball
Stadium Site	Segandinana	4th July Festival	Lineman Trng Ground
Basketball	Meeting Place	Mini Soccer	Bicycling
Boxing	Pavilion	Mini Hockey	Commissioner's Ofc
Jogging	Parking Area	Marathon Begin & End Pts	Recreational Div HQ

Field Count of Visitors - A field count of use of the grassed areas of the park was conducted in late April of 1982. During the four-day period, morning, noon and afternoon hours of the day were chosen for the counts. Results of the counts indicate heaviest use during the late morning, and afternoon hours. All tour buses stop at this park, with all visitors from the buses spending some time at the shoreline. Table E-2 summarizes results of the field count.

TABLE E-2. FIELD COUNT OF VISITS TO PASEO PARK GRASSED AREAS

Date	Time	Parked Cars	Tour Bus	Local People	Tourist People	Gift Shop People	Maint People	Other People
Apr 2 (Tues)	8:50 a.m.	28	0	3	12	10	0	0
	FR 10:10 a.m. to 11:30 a.m	30	18	42	738 1/	17	1	6 surfers
	4:30 p.m.	22	0	66	8	0	0	0
Apr 28 (Wed)	6:10 a.m.	4	0	2	0	0	0	0
	5:30 p.m.	31	0	83	8	6	1	4 surfers
Apr 29 (Thur)	9:00 a.m.	26	0	6	2	14	0	3 surfers
Apr 30 (Fri)	6:30 a.m.	6	0	0	0	0	0	0
	8:00 a.m.	15	0	0	0	8	0	5 surfers

1/ The average bus carries 41 passengers.

Visits by Local Population - Estimated counts of visitors to Paseo Park by the local population were based on interviews with the Recreation Administrators of Guam and custodians at the park. There are no records of daily count of visitors to the park. Estimates were based on permits issued for special events, scheduled events not requiring permits, patterns of family visits, and visual observation. An estimate of all local visits to the park was calculated, however, only those visits affected by the study area are considered. An annual estimate of 230,000 visits (73,000 + 157,123 = 230,000) in 1982 from Table E-3 is considered for the benefit analysis.

TABLE E-3. ESTIMATED ANNUAL VISITS TO PASEO PARK BY LOCAL POPULATION IN 1982

Source	Grassed Areas	Ball Park	Building Area	Other
Recreation Offices			1,300	
Commissioners Office			2,600	
Paseo Open Stadium		55,504		
Softball		8,344		
Tennis Court Area			3,972	
Boxing Arena			4,660	
Carnival Grounds		42,000		
Farmers' Market			109,534	
Voting Poll			1,251	
Boat Basin				27,415
Jogging	18,250			
Job Testing		2,000		
Pavilion			11,300	
Chief Quipuha Statue			3,650	
Statue of Liberty Replica	54,750			
Harbor Park		27,375		
Ocean Park		21,900		
TOTAL	73,000	157,123	138,267	27,415

Visits by Tourist Visitors - As noted in earlier chapters, the rising Japanese investment in Guam has resulted in a phenomenal growth of the visitor industry since 1970. The estimate by the Government of Guam for 1982 is 343,000 visitors. Although growth is expected in this sector, major development of additional hotel rooms is required. Every tourist makes at least one visit to Paseo Park as it is a center of attraction to visitors.

Projected Visits to Paseo Park - In 1982, there were 230,000 visits to Paseo Park by the local population. It is projected that these visits will grow at the same rate as population growth. Projected visits by the local population are tabulated in Table E-4. In 1982, there were 343,000 visits to Paseo Park made by tourist visitors. Although this number may increase in the future, no growth is projected for this study. Total projected annual visits to Paseo Park is tabulated in Table E-4.

TABLE E-4. PROJECTED VISITS TO PASEO PARK

Year	Local Visitors	Tourist Visitors	Total
1982 (Historical Estimates)	230,000	343,000	573,000
1985	238,000	343,000	581,000
1990	253,000	343,000	596,000
2000	290,000	343,000	633,000
2010	298,000	343,000	641,000
2020	305,000	343,000	648,000
2030	313,000	343,000	656,000
2035	317,000	343,000	660,000

RECREATIONAL BENEFITS

Using criteria from Principles and Guidelines, a judgment factor matrix was developed to estimate the increase in the value of recreation activity resulting from the proposed project (Table E-5). Two different point totals are derived using this judgment approach to compare the existing (without project) recreational value of Paseo Park use to the value of the park use with the proposed shoreline project.

A brief discussion of the rationale or logic applied in rating the various criteria for the assessment of recreational values follows, for with- and without-project conditions.

Recreation Experience - Under existing conditions, several general activities including picnicking, hiking, and fishing are available. In addition, there are cultural art classes of high quality value at the park. However, with shoreline stability, recreational quality unmatched by any other site on Guam will be available. Other high quality activities will be enhanced such as Guamanian cultural festivities. The improvement reflects an increase in score value for this particular criterion.

Availability of Opportunity - With or without the improvement opportunities for similar activities are within 30 minutes to an hour travel time. Therefore, there is no change in score for this criterion.

TABLE E-5. JUDGMENT FACTOR MATRIX

Criteria	Judgment Factors				
a. Recreation Experience	Two general activities 3/	Several general activities	Several general activities; one high quality value activity 4/	Several general activities; more than one high quality activity	Numerous high quality value activities; some general activities
Total Points: 30 Point Value:	0-4	5-10	11-16	17-23	24-30
b. Availability of Opportunity 7/	Several within 1 hour travel time; a few within 30 min. travel time	Several within 1 hour travel time; none within 30 min. travel time	One or two within 1 hour travel time; none within 45 min. travel time	None within 1 hour travel time	None within 2 hour travel time
Total Points: 18 Point Value:	0-3	4-6	7-10	11-14	15-18
c. Carrying Capacity 1/	Minimum facility development for public health and safety	Basic facilities to conduct activity(ies)	Adequate facilities to conduct without deterioration of the resouce or activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected alternative
Total Points: 14 Point Value:	0-2	3-5	6-8	9-11	12-14
d. Accessibility	Limited access by any means to site or within site	Fair access, poor quality roads to site; limited access within	Fair access, fair road to site; fair access, good roads within site	Good access, good roads to site; fair access, good roads within site	Good access, high standard road to site; good access within site
Total Points: 18 Point Value	0-3	4-6	7-10	11-14	15-18

TABLE E-5. JUDGMENT FACTOR MATRIX (Contd)

Criteria	Judgment Factors				
e. Environmental Quality	Low aesthetic factors 5/ exist that significantly lower quality 6/	Average aesthetic quality; factors exist that lower quality to minor degree	Above average aesthetic quality; any limiting factors can be reasonably rectified	High aesthetic quality; no factors exist that lower quality	Outstanding aesthetic quality; no factors exist that lower quality
Total Points: 20 Point Value:	0-2	3-6	7-10	11-15	16-20

1/ Value should be adjusted for overuse.
2/ Value for water-oriented activities should be adjusted if significant seasonal water level changes occur.
3/ General activities include those that are common to the region and that are usually of normal quality. This includes picnicking, camping, hiking, riding, cycling, and fishing and hunting of normal quality.
4/ High quality value activities include those that are not common to the region and/or Nation and that are usually of high quality.
5/ Major aesthetic qualities to be considered include geology and topography, water, and vegetation.
6/ Factors to be considered in lowering quality include air and water pollution, pests, poor climate, and unsightly adjacent areas.
7/ Likelihood of success at fishing and hunting.
8/ Intensity of use for activity.

Carrying Capacity - There are adequate facilities at Paseo Park to conduct activities without deterioration of the resource or activity experience. No change in score is indicated.

Accessibility - There is good access to, as well as good roads within the site. No change in score is indicated.

Environmental Quality - The shoreline of this park within the plan of improvement is in very poor condition. The existing shoreline is strewn with debris, and is severely eroded. A restored shoreline would enhance the overall aesthetic quality of the park and would also provide for greater safety to persons using the waterfront areas. This difference is indicated in the evaluation matrix.

The point value totals for conditions without project and with project conditions are based on the average value assigned for the judgment factor selected. The results are tabulated as follows:

Criterion	Judgment Factor Score Without	With
Recreation Experience	16	23
Availability of Opportunity	3	3
Carrying Capacity	6	6
Accessibility	11	11
Environmental Quality	3	7
TOTAL SCORE	39	50

The point score increases from 39 to 50 by improving conditions along the park shoreline. As shown below, the point value generated by the judgment factor matrix can be from 0 to 100 and can be used as an index to estimate a change in user-day value within the currently established range of $1.60 to $4.80 (Water Resource Council, Principles, Standards and Procedures for Water Resources Planning (Level C) FY 1983)).

Point Value	0	10	20	30	40	50	60	70	80	90	100
Recreation Value per User Day	1.60	1.90	2.10	2.40	3.00	3.40	3.70	3.90	4.30	4.60	4.80

The existing recreational value of the park based on the judgment factor score is $2.94 per user day. The recreational value of park with the shoreline restored and protected is $3.40 per user day or an increase of $0.46 per user day over the without-project conditions.

Estimated average annual recreation benefits are shown in Table E-6 based on an interest rate of 7-7/8 percent, an economic life of 50 years, and a base year of 1985.

TABLE E-6. AVERAGE ANNUAL RECREATION BENEFITS

Period	Projected Annual Visits	Increment	Equivalent Factor	Average Annual Visits
Base Year	581,000	581,000	1.00000	581,000
5	596,000	15,000	.86113	13,000
10	633,000	37,000	.48671	18,000
10	641,000	8,000	.21578	2,000
10	648,000	7,000	.08883	0
10	656,000	8,000	.02934	0
5	660,000	4,000	.00607	0

Equivalent annual visits	614,000
Average annual value ($3.40/visit) under improved condition	$2,088,000
Average annual value ($2.94/visit) under condition without project	$1,805,000
Average annual recreation benefits	$283,000

Damage Prevention Benefits

Eleven ironwood trees averaging thirty feet in height front the shoreline facing the harbor will be toppled and destroyed within the next 5 years if erosion continues. Two rows of seven ironwoods, averaging eight feet in height, will be lost along the eastern shore. The first row of trees will be destroyed in 10 years and the second in 15 years if erosion continues. With shoreline improvements, these trees will remain and continue to provide the shade enjoyed by visitors to the park.

Assuming replacement value per tree is $300 each, the average annual saving due to preventing damages to trees is $260 (rounded to thousand = $0.00).

Summary of Benefits

The average annual benefits occuring from the proposed plans of improvement are summarized in Table E-7. Plan 1 and Plan 3 provide essentially comparable recreation and athletic improvements to be the same. Plan 2, however, does not upgrade some 380 feet of the 1470 feet of shoreline which is in deteriorated condition. This is some 25 percent of the deteriorated shore. With Plan 2, slight erosion will continue along this 380 feet and prevent natural healing of the landscape. Therefore the point enhancement for Plans 1 and 3 (11 point net gain) is reduced by 25 percent to an 8 point (rounded) net gain for Plan 2. This reduced the benefits for Plan 2 to $206,000.

TABLE E-7. SUMMARY OF BENEFITS

Item	Average Annual Benefit	
	Plan 1 and 3	Plan 2
Recreation	$283,000	$206,000
Damage Prevention (Trees)	0	0
	$283,000	$206,000