87-0169F



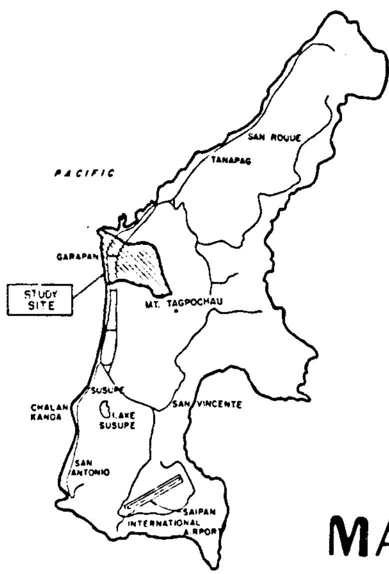
# GARAPAN

# FLOOD CONTROL STUDY

SAIPAN, COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

*Final*

***Detailed Project Report and Environmental Impact Statement***




**US Army Corps of Engineers**
Honolulu District

MAY 1986

## ADDENDUM

### COST AND BENEFIT UPDATE

Cost and benefit figures for the recommended plan (Plan E) that have been updated from those presented in the report (July 1985 price levels at 8-3/8 percent) to October 1986 price levels at an interest rate of 8-7/8 percent are summarized below.

FLOOD REDUCTION BENEFITS

| | |
|---|---|
| Total Average Annual Benefits | $696,000 |

SUMMARY OF PROJECT COSTS

| | |
|---|---|
| Total Project First Cost (Less Preauth Cost) | $6,790,000 |
| Interest During Construction | 585,000 |
| Total Investment Cost | 7,375,000 |
| Annualized Investment Cost | 664,000 |
| Annual Operation and Maintenance | 7,900 |
| Total Average Annual Cost | $671,900 |

COMPARISON OF NED BENEFITS AND COSTS

| | |
|---|---|
| Benefit Cost Ratio | 1.04 |
| Net Benefits | $24,100 |

### COST APPORTIONMENT

The apportioned costs for Federal and non-Federal interests presented below reflect pertinent legislation enacted in the Water Resources Development Act of 1986 (HR 99-662). The Act provides for an increased statutory Federal limit of $5,000,000 for flood control improvements per project, a local cost sharing waiver of $200,000 for territorial projects, and other changed cost sharing options, as noted.

| | | |
|---|---|---|
| Total Federal First Cost | | $4,171,400 |
| Total Non-Federal First Cost | | 2,618,600 |
| Cash (5 percent) | 339,500 | |
| LERR | 2,279,100 * | |
| Total Project First Cost | | 6,790,000 |

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* Of this amount, $581,600 may be financed by the Corps of Engineers. Repayment with interest by non-Federal interests may be made over a period not to exceed 15 years.

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FT. SHAFTER, HAWAII 96858

# GARAPAN FLOOD CONTROL STUDY
# SAIPAN, COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

## FINAL
## DETAILED PROJECT REPORT
## AND
## ENVIRONMENTAL IMPACT STATEMENT

MAY 1986

(REVISED FEBRUARY 1987)

# GARAPAN FLOOD CONTROL
# SAIPAN, CNMI

## MAIN REPORT

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# 1 INTRODUCTION

## 1.1 STUDY AUTHORITY

By letter dated December 31, 1982, the Governor of the Commonwealth of the Northern Mariana Islands (CNMI) requested the U.S. Army Corps of Engineers initiate a restudy for flood control improvements in the Garapan area. An earlier detailed study was terminated in November 1980 due to a lack of local support for the alternative plans developed. The purpose of this report is to reevaluate the extent of the flood problem and to determine the feasibility and justification of Federal participation in providing flood mitigation measures in the Garapan area.

The study and report were accomplished under the authority of Section 205 of the 1948 Flood Control Act, as amended:

> *"The Secretary of the Army is authorized to allot from any appropriations heretofore or hereafter made for flood control, not to exceed $30,000,000 for any one fiscal year, for the construction of small projects for flood control and related purposes not specifically authorized by congress, which come within the provisions of Section 1 of the Flood Control Act of June 22, 1936, when in the opinion of the Chief of Engineers such work is advisable. The amount allotted for a project shall be sufficient to complete Federal participation, in the project. Not more than $4,000,000 shall be allotted under this section for a project at any single locality. The provisions of local cooperation specified in Section 3 of the Flood Control Act of June 22, 1936, as amended, shall apply. The work shall be complete in itself and not commit the United States to any additional improvement to ensure its successful operation, except as may result from the normal procedure applying to projects authorized after submission of preliminary examination and survey reports."*

Section 502 of the Covenant Act to establish the Commonwealth of the Northern Marianas (PL 94-241) provided that the U.S. Army Corps of Engineers' continuing authorities for small projects are also applicable to the islands of the Northern Marianas.

## 1.2 SCOPE OF STUDY

The Northern Mariana Islands are a chain of 16 islands in the Western Pacific approximately 3,800 miles west of Hawaii (Figure 1). Saipan, the capital and population center, is the largest island in the Northern Mariana Islands. The island is about 13 miles long, between 1-1/2 and 7 miles wide and has an area of 48 square miles (Figure 2).

The purpose of this document is to present the reevaluation of engineering and economic analyses which will serve as the basis for the selection of a feasible plan for alleviating the flood problem in Garapan. The study focused on an evaluation of this flood problem, development of conceptual measures for protecting the flood-prone areas, and preventing flood damages, and the costs, benefits, and environmental impacts associated with implementing these measures.

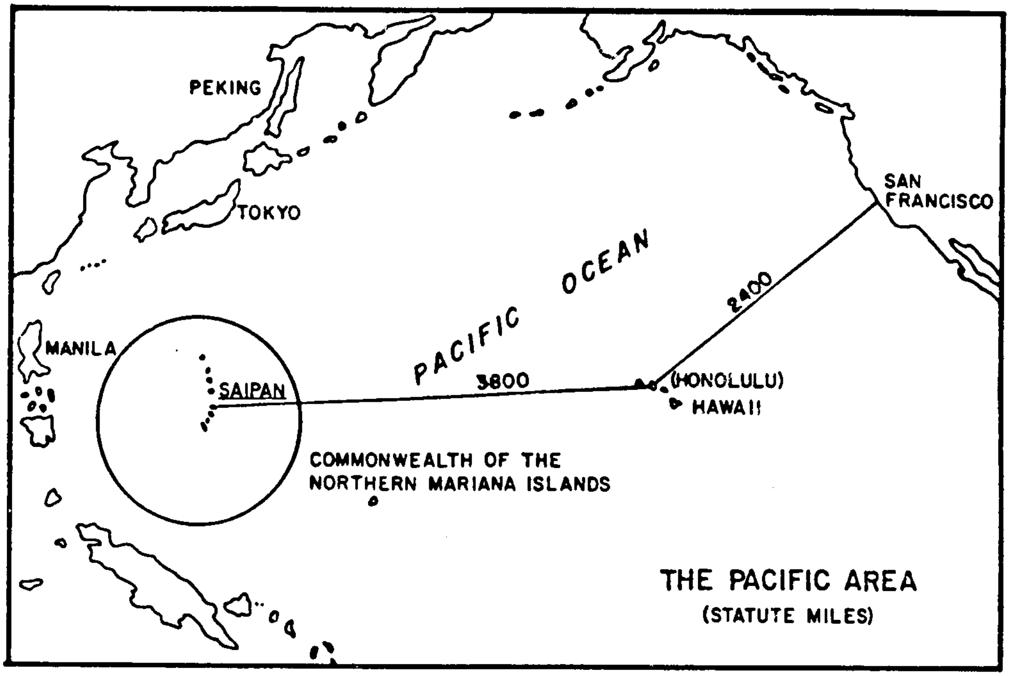



FIGURE 1

## 1.3 STUDY PARTICIPANTS AND COORDINATION

The U.S. Army Corps of Engineers, Honolulu District, was responsible for conducting and coordinating the study and for preparing the report. The Commonwealth of the Northern Mariana Islands (CNMI) is the local sponsor for this study. Studies and investigations were performed with the assistance of the Department of Public Works and the Mariana Island Housing Authority (MIHA), both of the Government of the Northern Marianas.

Study contributions were submitted throughout the planning process by private organizations, Federal and Commonwealth Government agencies, and individuals.

During the previous investigation, initial coordination meetings and a public workshop were conducted in March 1979. These meetings focused on identification of the flooding problem and solicitation of the needs and desires of the general public as well as local officials. In conjunction with the draft report circulation, a public meeting was conducted in July 1980. During the current study, a public meeting and a workshop were held in Saipan. The public meeting, in conjunction with the current draft report circulation, was held in July 1984. The workshop held in April 1985 presented the nearly finalized study results. The participants of these public gatherings and concerns are found in Appendix F, Public Involvement.

## 1.4 PERTINENT STUDIES

The previous investigation produced a reconnaissance report and a draft Detailed Project Report (DPR) and Environmental Impact Statement (EIS). The reconnaissance report, recommending that detailed studies be undertaken to determine the feasibility of providing flood control improvements for Garapan, was completed in November 1978 by the Corps of Engineers. The draft DPR and EIS for the same area and under the same study authority was completed and submitted for public review in July 1980. Structural plans presented for review were trapezoidal channels sized for the 2 percent (50- year flood) level of protection. However, following receipt of comments, none of the plans received local agency support for potential implementation. This investigation was terminated in November 1980.

The present investigation has produced a draft Detailed Project Report (DPR) and Environmental Impact Statement (EIS). This draft DPR and EIS was completed and submitted for public review in June 1984. The comments and concerns received on the draft report are incorporated into this final report.

## 1.5 THE REPORT

This document consists of a main report which includes the environmental statement, and a series of supporting appendices. The main report is a self contained document which describes the planning effort and includes the Environmental Impact Statement. The appendices contain technical and detailed information and background data to support the information presented in the main report:

The appendices are:

Appendices Title
A .......Hydrology
B .......Geology and Soils
C .......Design and Cost Estimates
D .......Economics
E .......Social Resources
F .......Public Involvement
G .......Compliance Documents
H .......Analysis of Groundwater and Environmental Concerns

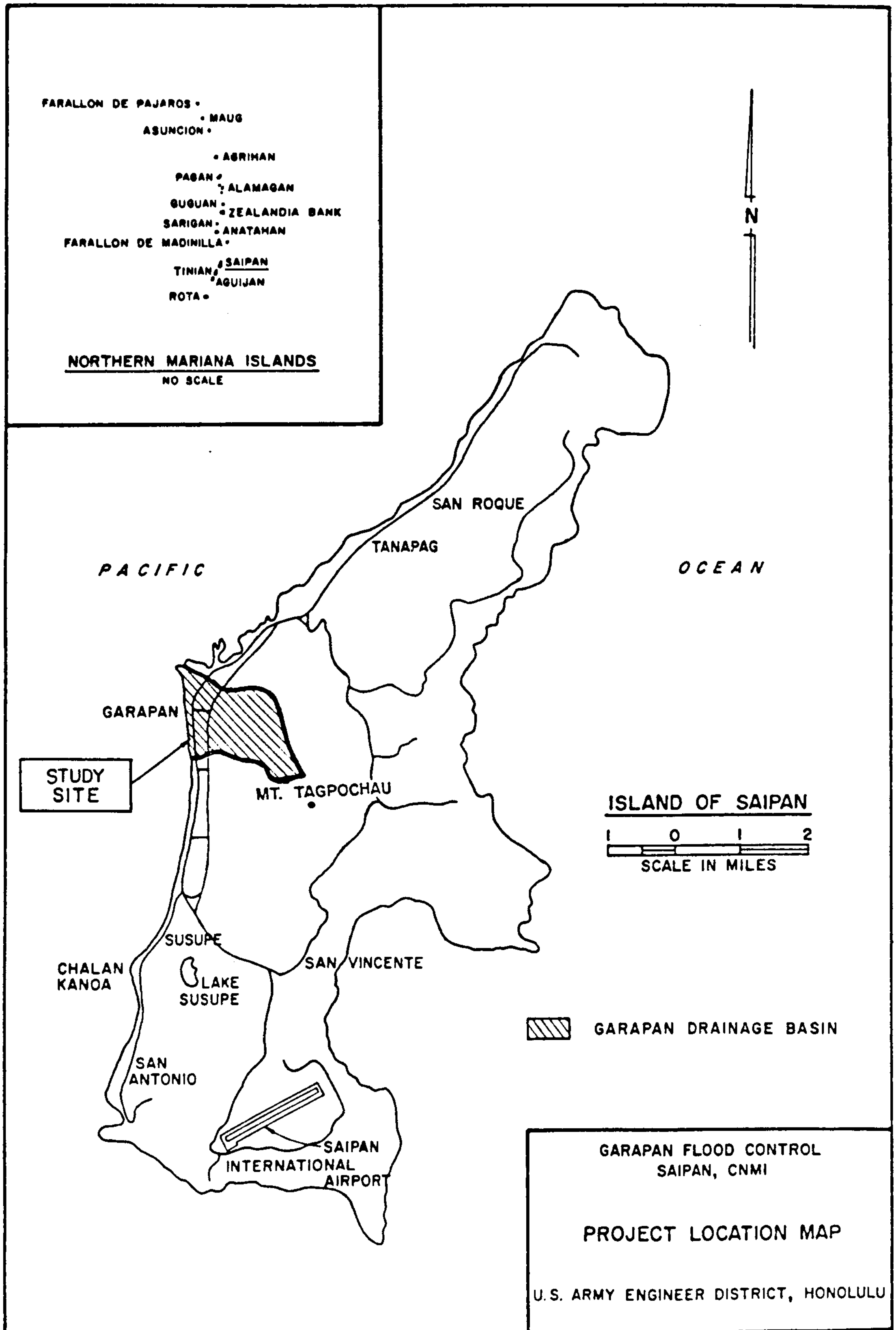

FARALLON DE PAJAROS
MAUG
ASUNCION
AGRIHAN
PAGAN
ALAMAGAN
GUGUAN
ZEALANDIA BANK
SARIGAN
ANATAHAN
FARALLON DE MADINILLA
SAIPAN
TINIAN
AGUIJAN
ROTA
NORTHERN MARIANA ISLANDS
NO SCALE
N
PACIFIC
OCEAN
SAN ROQUE
TANAPAG
GARAPAN
STUDY SITE
MT. TAGPOCHAU
ISLAND OF SAIPAN
1 0 1 2
SCALE IN MILES
SUSUPE
CHALAN KANOA
LAKE SUSUPE
SAN VINCENTE
GARAPAN DRAINAGE BASIN
SAN ANTONIO
SAIPAN INTERNATIONAL AIRPORT
GARAPAN FLOOD CONTROL
SAIPAN, CNMI
PROJECT LOCATION MAP
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 2

# 2 PROBLEM IDENTIFICATION

## 2.1 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.

## 2.2 NATIONAL OBJECTIVES

The Water Resources Council Principles and Guidelines (P&G) for Water and Related Land Resources define the national objective of national economic development (NED). The NED objective is achieved by increasing the value of the nation's output of goods and services and improving national economic efficiency. The Federal objective is to contribute to NED consistent with protecting the nation's environment pursuant to national environment statutes, applicable executive orders, and other Federal planning requirements.

The P&G also state that various alternative plans are to be formulated in a systematic manner to insure that all reasonable alternatives are evaluated. A plan that reasonably maximizes the NED benefits, consistent with the Federal objective, is to be formulated. Other plans which reduce net NED benefits in order to further address other Federal, State, local, and international concerns not fully addressed by the NED plan may be formulated. A plan recommending Federal action is to be the alternative plan with the greatest economic benefit, unless the Secretary of a department or head of an independent agency grants an exception to this rule.

Four accounts are established to facilitate evaluation and display of effects of alternative plans. The national economic account is required. Other information that is required by law or that will have a material bearing on the decision making process should be included in the other accounts or in some other appropriate format used to organize information on effects.

a. The NED account displays changes in the economic value of the national output of goods and services.

b. The environmental quality (EQ) account displays effects on ecological, cultural, and aesthetic attributes of significant natural and cultural resources.

c. The regional economical development (RED) account registers changes in the distribution of regional economic activity that results from each alternative plan. Evaluations of regional effects are to be carried out using nationally-consistent projections of income, employment, output, and population.

d. The other social effects (OSE) account registers plan effects from perspectives that are relevant to the planning process but are not reflected in the other three accounts.

## 2.3 PROFILE OF BASE CONDITIONS

### 2.3.1 Physical Setting

The study area (Figure 2) is located on the west-central coast of Saipan. The 1.9-square-mile rectangular basin is about 1-1/2 miles long and averages about 1-1/4 miles in width. Garapan Village is located on the western coastal plain. This relatively flat coastal plain varies form 1,000 to 3,000 feet in width and is composed essentially of limesand or artificial fill over limesand. Upland of the coastal belt are steep axial uplands, characterized by a succession of nearby flat benches and vertical scarps of limestone. Slopes in the uplands vary from about 30 percent to nearly vertical.

Saipan's climate is tropical marine characterized by warm and humid conditions throughout the year. Wind and rainfall are the most variable elements with humidity, temperature, and barometric pressure remaining fairly constant. Average temperature in Saipan is 81.5 degrees F (27.5 degrees C) and humidity averages 83 percent.

During 22 years of recorded data, annual rainfall extremes recorded at Garapan ranged from 59.8 inches to 115.1 inches. Annual rainfall over this same period averaged about 83 inches. Records indicate that the heaviest rainfall occurs from July through October.

Trade winds are the dominant feature of the wind regime on Saipan. Trade winds are pronounced from January through May, blowing from the northeast and east-northeast direction more than 90 percent of the time. Wind directions are far more variable during the remaining months. Average wind velocity throughout the year is 10.5 miles per hour.

Two principal kinds of storms contribute to the climatic character of Saipan: localized thunderstorms and squalls, and cyclonic tropical storms and typhoons. Saipan is located in a part of the Western Pacific that is frequently crossed by tropical storms and typhoons. These low pressure systems are accompanied by high winds (sometimes in excess of

150 miles per hour) and heavy rains. Historically, the heaviest rains have occurred during tropical storms and typhoons. During Supertyphoon Pamela in 1976, 27 inches of rainfall were recorded in a 24-hour period in Guam, located about 120 miles south of Saipan. Although the recorded frequency of typhoons affecting Saipan is irregular, statistics show that one typhoon a year affects Saipan significantly.

### 2.3.2 Human Resources

In 1980, the population of Garapan represented about 14 percent of the total island population of 14,600. Today, Chamorros, Carolinians, and Micronesians comprise over 80 percent of the total island population. Alien labor, U.S. expatriates and tourists comprise the remainder of the population.

Since western discovery by Magellan in 1521, Saipan has come under various rules. Saipan was originally inhabited by Chamorros who migrated from southeast Asia in approximately 500 B.C. Under Spanish rule (1521-1898), the Chamorros were forced to relocate to Guam but later resettled on Saipan during the 1800's. It was also during the 1800's that several hundred Carolinians established settlements in Saipan. Following the Spanish-American War in 1898, Germany obtained administration of the island. By World War I, Japan which dominated trade in the region during the German rule, had obtained administration of Saipan. By 1930, the total population of Saipan was about 45,000 of which less than 10 percent were native (Chamorro and Carolinian). Under the Japanese administration, sugar production was developed on a large scale. Garapan became the center of population and commerce. Saipan was captured by the U.S. during World War II and in 1947 the United Nations granted trusteeship to the U.S. Until recently, the Northern Marianas were part of the Trust Territory of the Pacific Islands. On 9 January 1978, under the terms of the Covenant Act (Public Law 94-241), the President of the United States approved establishment of the Commonwealth of the Northern Mariana Islands.

### 2.3.3 Development and Economy

Approximately 25 percent of the total labor force on Saipan is employed by the Government. The most significant industries in terms of employment and wage distribution are personal services (tourism and tourism-related); wholesale and retail trade; and transportation and public utilities. Tourism is and will continue to be a significant economic base. In 1983, more than 120,000 tourists visited Saipan, with over 80,000 originating from Japan. It is estimated that in 1983, $65.5

million was added to the economy through the visitor industry. Presently, there are six first class hotels on Saipan with a total of approximately 960 rooms. Three of these hotels are located in the study area. According to the CNMI Overall Economic Development Strategy Report, 1983, CNMI commercial imports for FY 1982 totalled over $58.4 million, with foodstuff and POL products comprising 38.7 percent and 19.5 percent, respectively.

Existing land uses in the Garapan study area include residential development along both sides of Beach Road, an elementary school, and three of Saipan's largest hotels (Figure 3). At the northern end of the study area is the American Memorial Park, which is a 133-acre area set aside for public use as a memorial to American and Marianas people who were killed or wounded in the Marianas Campaign during World War II. Also, located north of the study area are the island's only dock and port facilities and an industrial area.

Because of the various governmental administrations on Saipan over the years, land records are extremely complex. Land and land ownership play a major role in the culture and values of the people of the Northern Mariana Islands. Land ownership is closely tied with family solidarity and a sense of group responsibility. It is often considered solemn duty to retain land within the family, especially among those of Carolinian heritage. This reluctance to sell land generalized land tenure for the study area.

## 2.4 CONDITIONS WITHOUT FEDERAL PROJECT

### 2.4.1 Land Use

The Physical Development Master Plan of 1978 presented a proposed land use plan for the Garapan area (Figure 3). The proposed plan is based on the concept that Garapan will grow as an independent urban community. It should be recognized that Garapan is already experiencing the fastest residential growth in Saipan. Many factors contribute to Garapan being an ideal site for growth. These include the availability of easily developable land, the presence of water, sewer, and power service, and the probable development of a number of public facilities in the area.

The Master Plan presented a number of proposals for public facilities on the Garapan study area. These are:

a. Reconstruction of the Garapan Sugar Dock into a fishing village complex. In conjunction with the proposed fishing village, the Legislature of the Commonwealth of the Northern Mariana Islands requested the U.S. Army Corps of Engineers to study the feasibility of

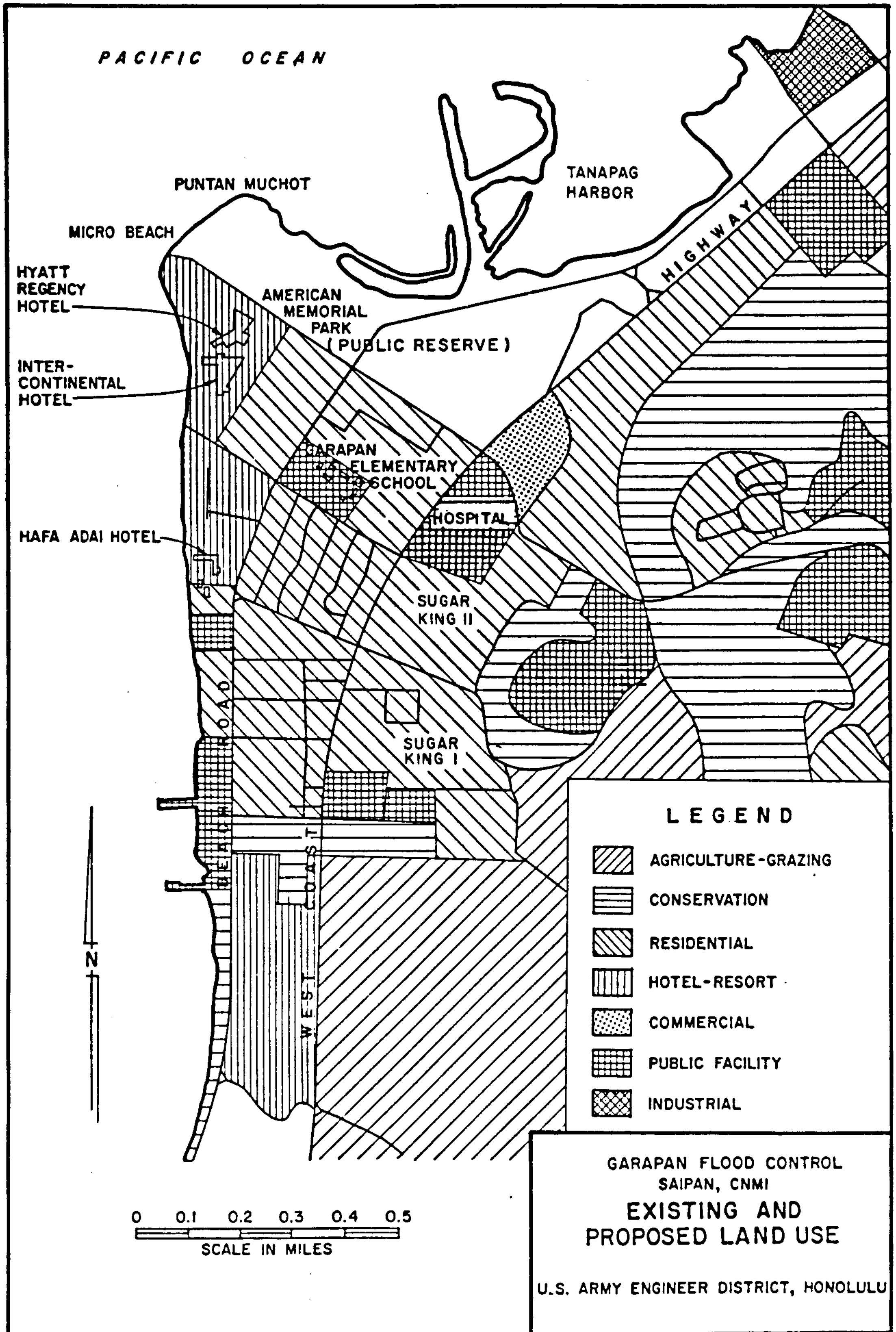
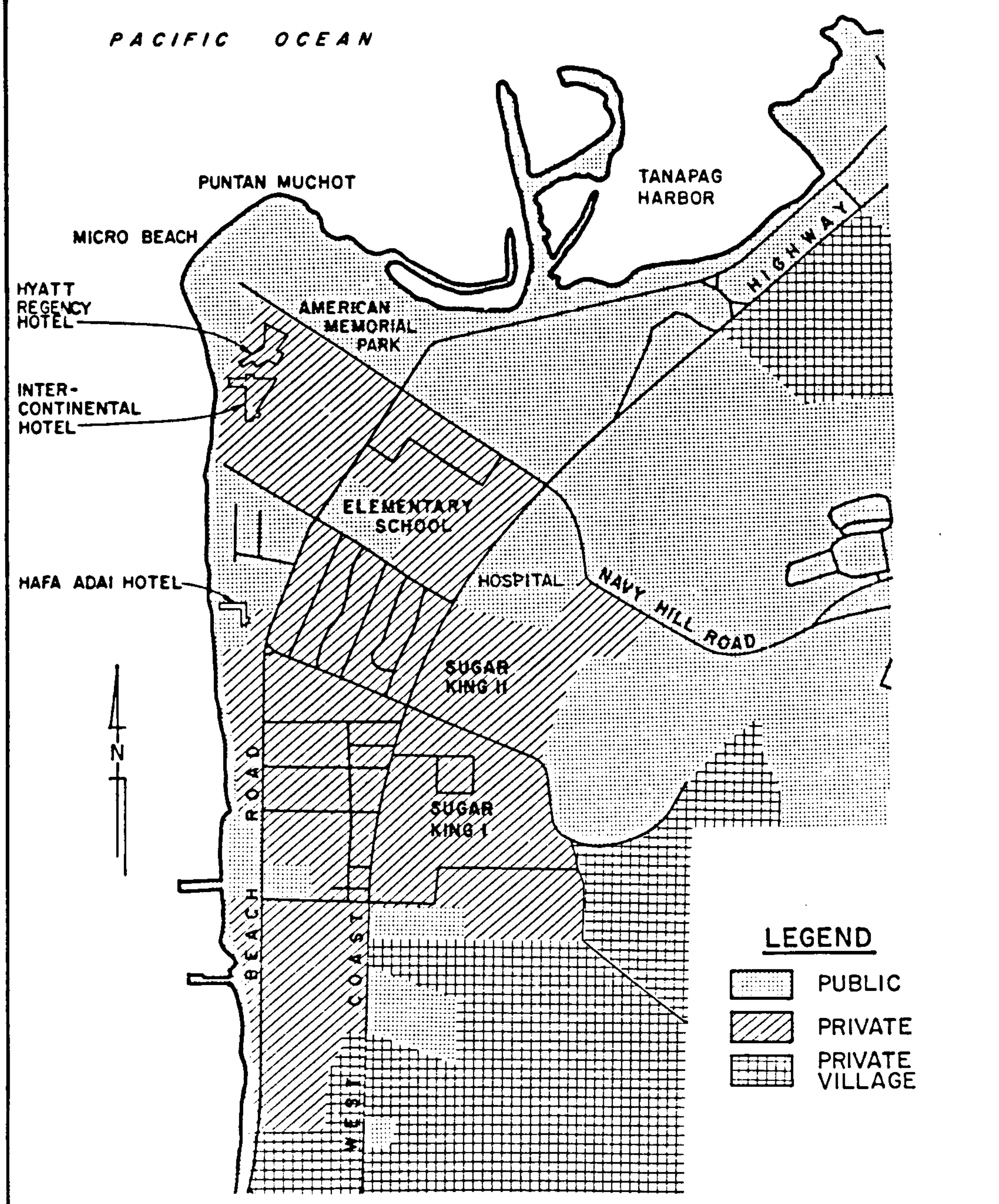

PACIFIC OCEAN
TANAPAG HARBOR
PUNTAN MUCHOT
MICRO BEACH
HYATT REGENCY HOTEL
AMERICAN MEMORIAL PARK (PUBLIC RESERVE)
INTER-CONTINENTAL HOTEL
HIGHWAY
GARAPAN ELEMENTARY SCHOOL
HOSPITAL
HAFA ADAI HOTEL
SUGAR KING II
SUGAR KING I
BEACH ROAD
WEST COAST
N
0 0.1 0.2 0.3 0.4 0.5
SCALE IN MILES
LEGEND
AGRICULTURE-GRAZING
CONSERVATION
RESIDENTIAL
HOTEL-RESORT
COMMERCIAL
PUBLIC FACILITY
INDUSTRIAL
GARAPAN FLOOD CONTROL
SAIPAN, CNMI
EXISTING AND PROPOSED LAND USE
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 3




SOURCE:
PHYSICAL DEVELOPMENT MASTER PLAN FOR THE COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS, JANUARY, 1978.

0 0.1 0.2 0.3 0.4 0.5
SCALE IN MILES

GARAPAN FLOOD CONTROL
SAIPAN, CNMI

LAND TENURE
(GENERALIZED)

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 4

providing a small boat harbor in this area. However, the project site for a small boat harbor is the Tanapag site which was authorized in December 1980 under the authority of Section 107 of the Rivers and Harbors Act of 1960, as amended.

b. New residential construction. Garapan is undergoing rapid residential growth. Phase I of the Sugar King II subdivision consisting of 106 housing units has been completed. Ultimately, this development will add more than 200 new houses in the study area.

c. Construction of an acute care hospital on Navy Hill Road. However, final site selection changed the site to the vicinity of the intersection of Navy Hill Road and West Coast Highway.

In addition, the Physical Development Master Plan suggested the possible expansion of tourist accommodations by the construction of another hotel in the coastal strip between the Hafa Adai Hotel and Saipan Intercontinental Hotel. A new hotel was completed in early 1985. A community commercial center, to be located just north of the hospital site, is also proposed.

Commercial activities include personal service uses such as banks, grocery stores, insurance offices, gift and souvenir shops, laundromats, barber shops, bakeries, restaurants, and other similar uses. In conjunction with the commercial center, a multiple family residential area is proposed in the area surrounding the commercial center. Other proposals for the near vicinity but not with the study area are port and dock facilities improvements and upgrading the industrial park, both located in Garapan and Tanapag.

### 2.4.2 Economy

Tourism and agriculture are expected to play major roles in the development of the Commonwealth. Construction is also expected to increase. A more limited role is projected for manufacturing and services and trade. Government is still expected to employ the majority of the work force even with the relocation of the Trust Territory Government headquarters to Ponape.

The visitor industry is expected to be the leading industry for development in the immediate future. With the expanding tourist industry, related services such as restaurants, tourist agencies, sports fishing, car rental, and souvenir shops should be enhanced.

Garapan, because of its beautiful beaches, will remain a popular tourist destination. Popular hotels, such as the Saipan Hyatt Regency, the Saipan Intercontinental, and the Hafa Adai are located within the project area.

## 2.5 PROBLEMS AND NEEDS

### 2.5.1 The Flood Problem

Saipan is located in a part of the Western Pacific that is frequently crossed by tropical storms and typhoons. These low pressure systems are accompanied by high winds (sometimes in excess of 150 miles per hour) and heavy rains. Historically, the heaviest rains have occurred during tropical storms and typhoons. During Supertyphoon Pamela in 1976, 27 inches of rainfall was recorded in a 24-hour period in Guam, located 120 miles south of Saipan. Although the recorded frequency of typhoons is irregular, statistics show that one typhoon a year significantly affects Saipan. Although the flood history has not been documented, floods are a common occurrence in the lower Garapan area. Many long time residents have stated that flooding is experienced almost yearly. Because of the relatively flat terrain in the lower basin and the lack of a suitable outlet channel, severe ponding problems occur following moderate as well as heavy rainfall. Developments within the basin which are subject to flooding include an extensive number of residential structures, some small stores, and moderate sized commercial establishments. Photographs of flooding in Garapan on file with MIHA were reviewed by members of the Honolulu District during field investigations. The photos included floods of August 1976, September 1977, August 1978, and October 1982.

Although the Garapan area is frequently plagued by flooding problems, detailed records are not available except for the flood of August 1978 resulting from Tropical Storm Carmen, the worst flooding in Garapan in recent years recalled by local residents. Flooding from this storm caused extensive damage to private dwellings, public facilities, and agricultural crops in Saipan. Most of the damages were to newly-built private dwellings at the time in the Annex I, Annex II, and Puntan Muchot subdivisions. The maximum flooded area was about 90 acres. Depths of inundation ranged up to 1-1/2 feet of essentially low to non-velocity flooding. The bulk of damages resulted when silt-laden stormwaters entered houses and damaged home contents. Furthermore, stormwaters remained ponded over a period of days within the housing areas, hindering cleanup efforts and daily activities. On August 18, 1978, President Carter, acting on a request from Governor Carlos Camacho, declared the Commonwealth of the Northern Marianas a Federal disaster area. The August 1978 flood is estimated to have a recurrence interval of about 30 years. See photos 1 through 4 for typical flooded areas as a result of Tropical Storm Carmen.

Damages resulting from Tropical Storm Owen in October 1982, renewed the local interest for further investigations in a flood control study. Based on information from local interests, approximately a third of the flood prone areas has been flooded since 1980. Lack of suitable flood control facilities in the Garapan Village has been the source of public concern over the last decade of extensive development. Without improvements to alleviate flooding, damages are expected to reoccur at regular intervals.

### 2.5.2 Analysis of the Flood Problem

Flooding in lower Garapan can be attributed to two primary factors. The first factor is the lack of a suitable outlet channel to effectively convey runoff to the ocean. Under Japanese rule prior to World War II, shallow open drainage channels conveyed runoff from the As Rapugan and As Felipe hills, through Garapan, to the ocean. However, post World War II residential and commercial developments obliterated most of the ditches and channels, causing storm runoff to flow overland as sheetflow. The second factor is the relatively flat topography in the area. This factor compounds the flood problem. The elevation range of the Garapan area is approximately 3 to 8 feet above mean sea level. Consequently runoff which enters lower Garapan spreads over the coastal plain and remains ponded in low-lying areas. Furthermore, construction of the Saipan Hyatt Regency and Saipan Intercontinental Hotels on fill added to the problem by preventing water from flowing to the ocean and keeping stormwaters confined within the subdivision area.

The most critical area is located between the hotel resort area (Hyatt Regency and Intercontinental Hotels) and the West Coast Highway. The area is designated Area 3A on Plate A-1 of Appendix A. Area 3A is the site of the residential subdivision developed by MIHA. There is no natural drainageway in Garapan. The only remaining drainageway constructed by the Japanese occupational forces is a concrete rip-rap lined ditch which runs from the West Coast Highway to the ocean along Island Power Road. It has an estimated capacity of 225 cfs, approximately a 2-year recurrence interval flood. Due to the land slopes and the lack of drainageways, floodwaters flow essentially in a northwestern direction.

Discharges from Area 1 (see Plate A-1) would flow along the highway towards Area 2. However, because of the limited culvert and swale capacities, discharges greater than 25 cfs generally overflow across the highway and flow into Area 1A.

Discharges form Area 2 would concentrate at a culvert crossing at the West Coast Highway, where seven 24-inch diameter pipes are located. The crossing feeds water into the Japanese-built ditch.

Discharges From Area 3 flows over the low point of West Coast Highway in that vicinity and into the problem area, Area 3A. The drainage system in Area 3A consists of a local depression area west of the highway and an open concrete ditch below the Beach Road. According to MIHA, the depression area has the capacity of retaining localized runoff but not flows originating from the upstream area east of the highway. The concrete ditch outlet is normally blocked by sand at the shoreline.

Discharges from Area 4 will collect in the swale just above the West Coast Highway and then flow into the American Memorial Park area, Area 4A.

Figures 6 and 6A reflect the flood limits of the study area under existing conditions.

### 2.5.3 Related Problems and Needs

The related water resource problems have been identified in conjunction with this flood control study: offshore water quality and interior drainage. Saipan Lagoon is located on the western side of Saipan, enclosed by a barrier reef located approximately 800 to 1,500 yards offshore. Within the lagoon, water depths range from a few inches to about 30 feet. Water clarity and water quality, for the most part, are excellent. Based upon public input, water quality of the lagoon and its effects on the beaches are of concern to the community. The Coastal Land and Water Use Plan also emphasizes the aesthetic and recreational value of Saipan Lagoon.

The second related problem is interior drainage. The local drainage pattern and capacity for the area below the West Coast Highway channel improvement for the structural plans have been analyzed. It was determined that the structural plans would decrease interior ponding by cutting off surface runoff in the lower problem area. While a plan of improvement would convey most of the basin runoff through Garapan, resolution of interior drainage problems is a local responsibility.

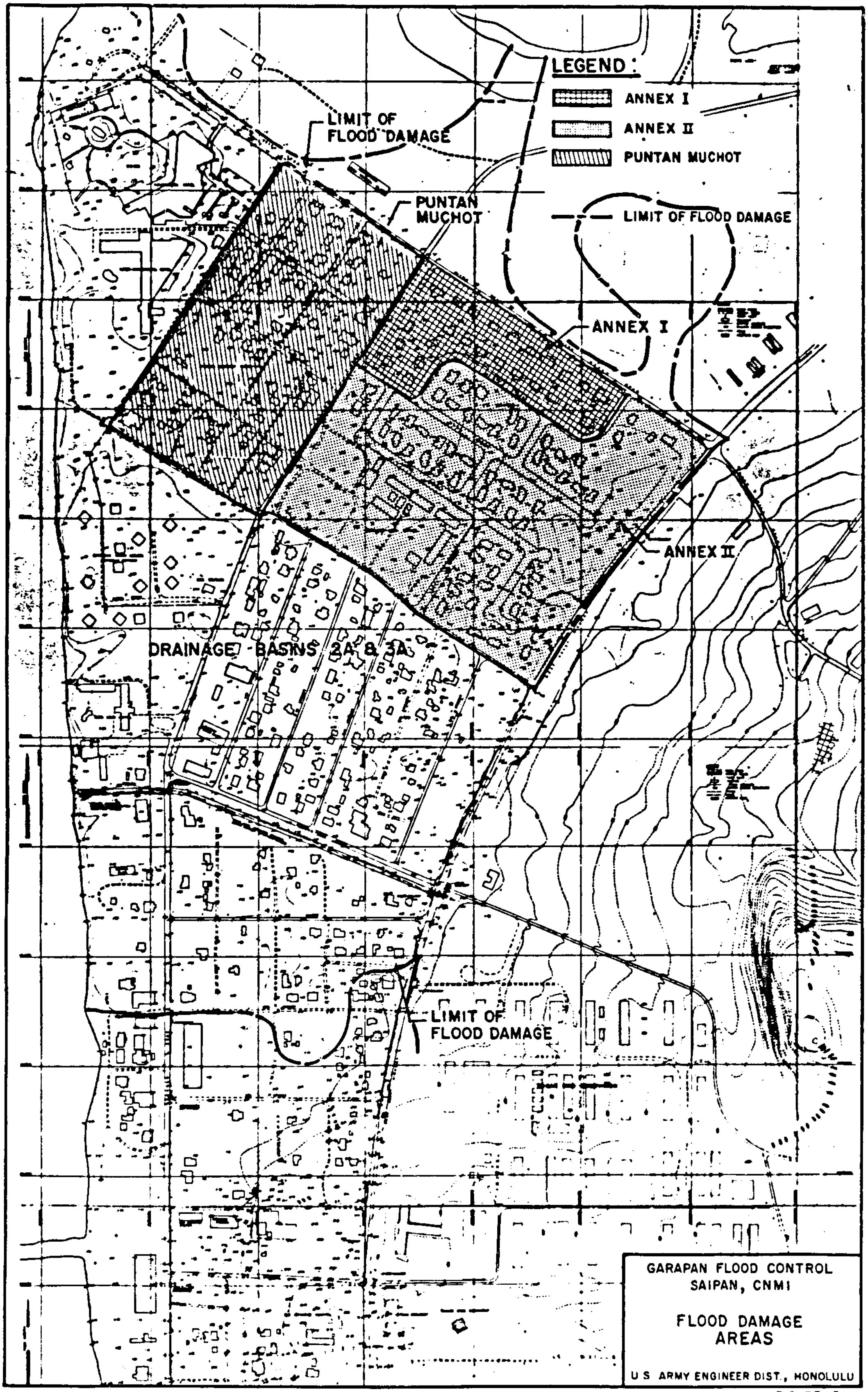
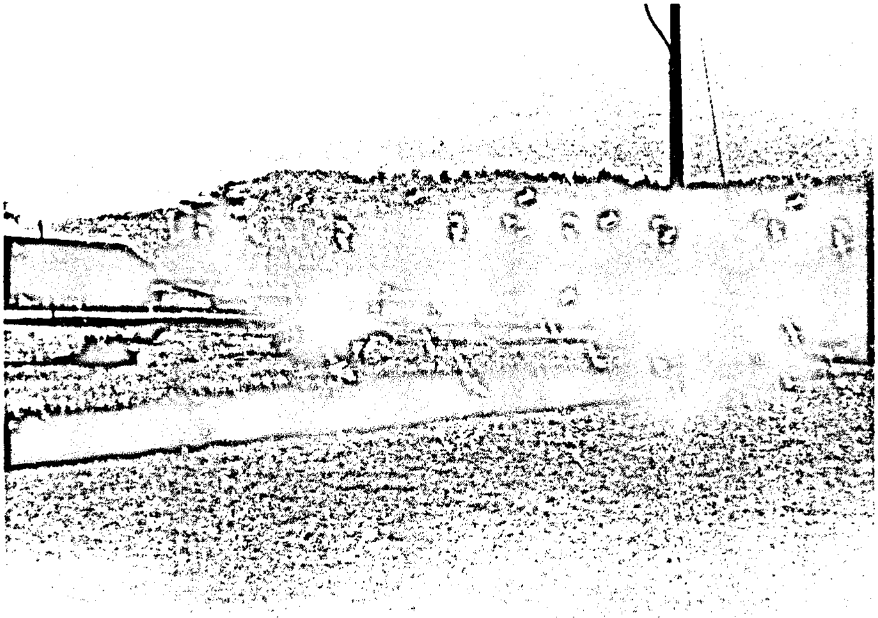

LEGEND:
ANNEX I
ANNEX II
PUNTAN MUCHOT
LIMIT OF FLOOD DAMAGE
LIMIT OF FLOOD DAMAGE
PUNTAN MUCHOT
ANNEX I
ANNEX II
DRAINAGE BASINS 2A & 3A
LIMIT OF FLOOD DAMAGE
GARAPAN FLOOD CONTROL
SAIPAN, CNMI
FLOOD DAMAGE AREAS
U S ARMY ENGINEER DIST., HONOLULU

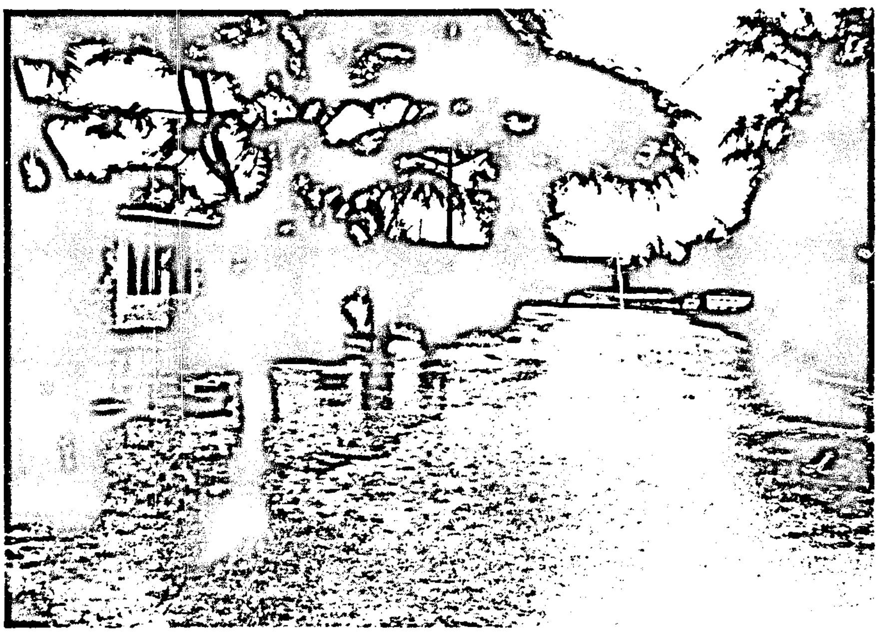
FIGURE 5

TROPICAL STORM CARMEN (AUGUST 1978)



VIEW OF GARAPAN ELEMENTARY SCHOOL

PHOTO 1

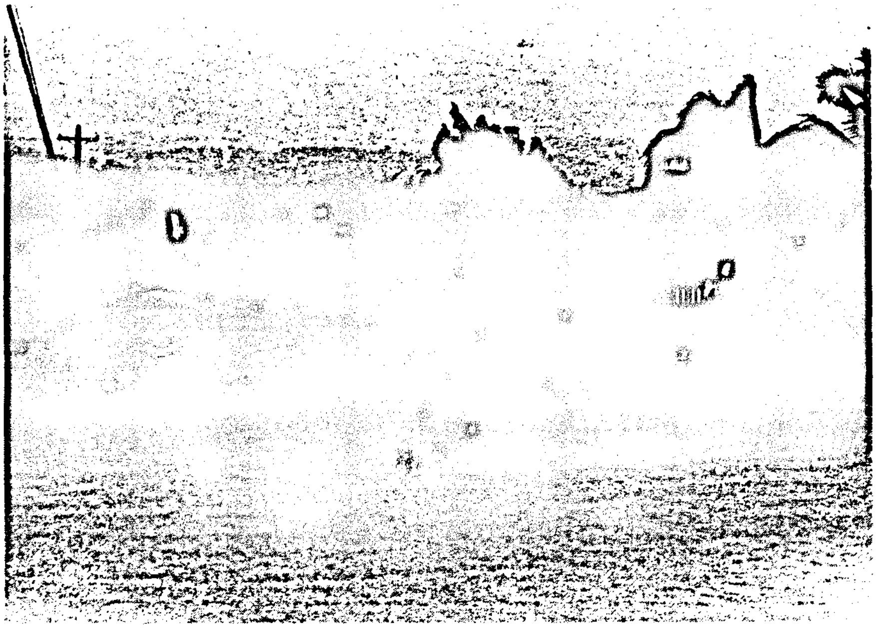


VIEW FROM GARAPAN ELEMENTARY SCHOOL ENTRANCE

PHOTO 2

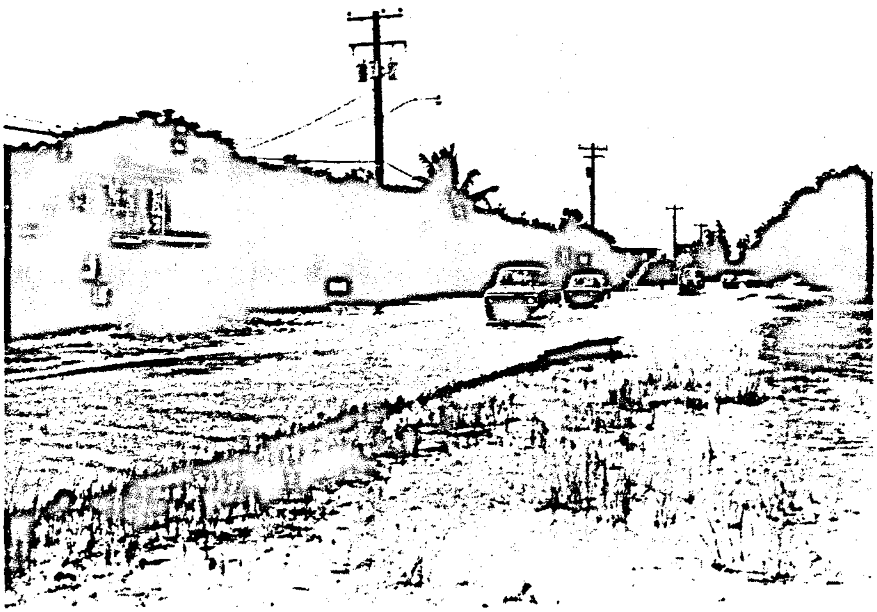
PHOTOS COUTESY OF NICK GUERRERO, CNMI CIVIL DEFENSE

TROPICAL STORM CARMEN (AUGUST 1978)



BEACH ROAD FACING NORTHWEST TOWARDS MICRO BEACH ROAD

PHOTO 3

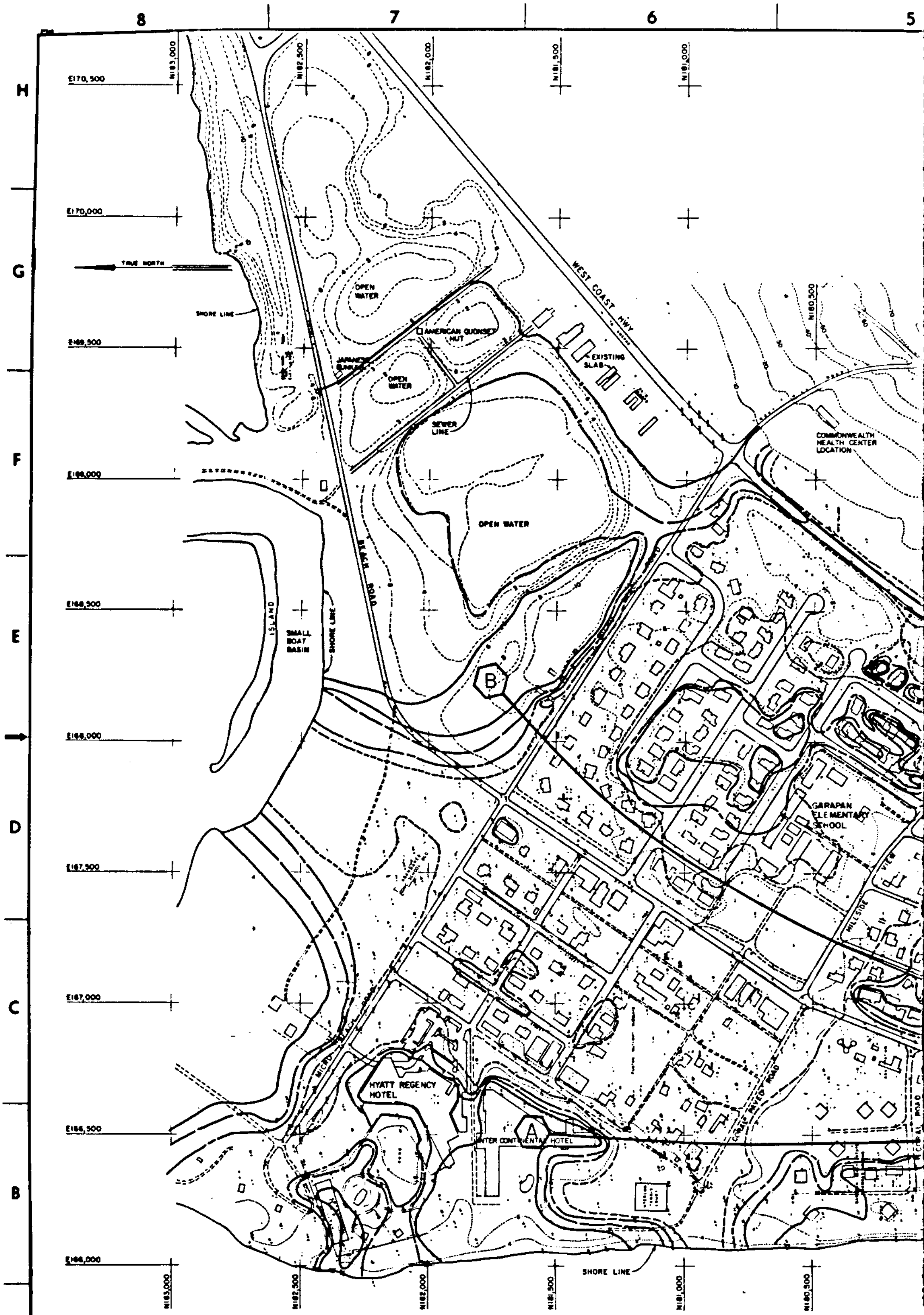


VIEW OF BEACH ROAD FACING NORTH

PHOTO 4

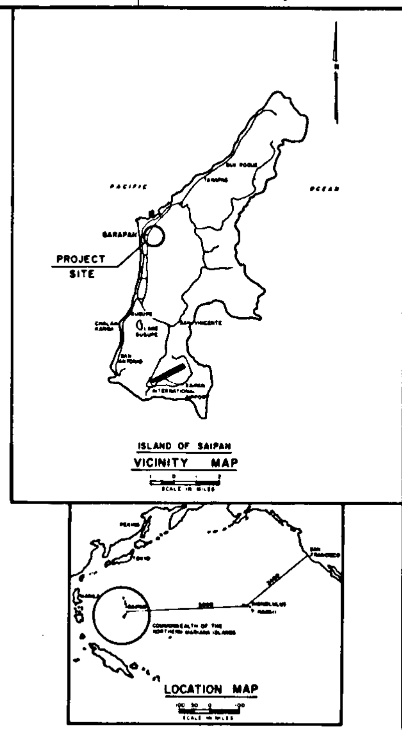
PHOTOS COURTESY OF NICK GUERRERO, CNMI CIVIL DEFENSE

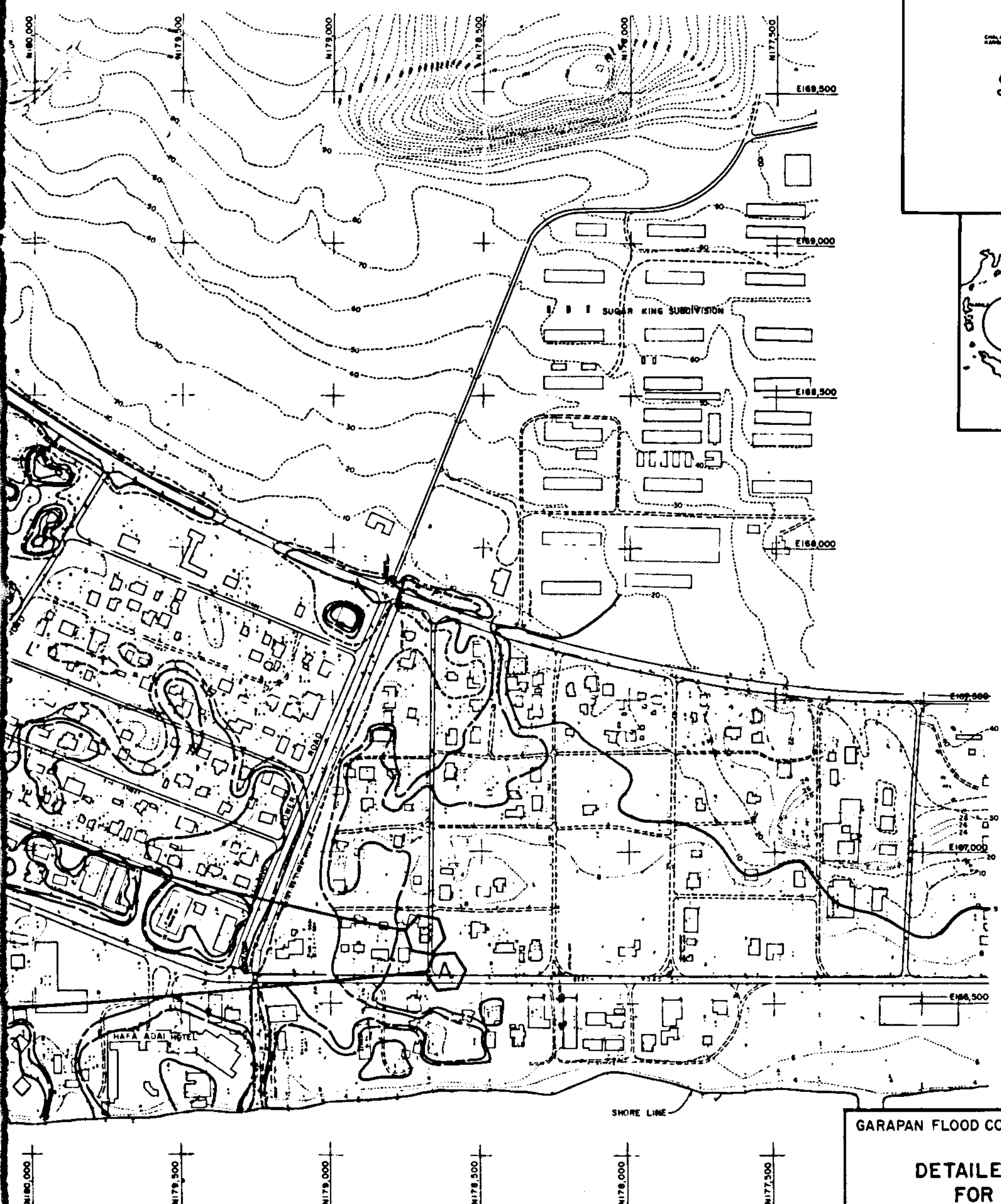
1




NOTES:

1. COORDINATES BASED ON MARIANA ISLANDS PLANE COORDINATE SYSTEM OF 1966.
2. ELEVATIONS ARE IN FEET BASED ON MEAN SEA LEVEL DATUM.




CROSSECTION (A)

| FREQUENCY | AVERAGE DEPTH (ft) |
|---|---|
| 2-YEAR | 1.0 |
| 25-YEAR | 2.0 |
| 100-YEAR | 2.2 |
| 500-YEAR | 2.5 |
| FREQ | AVERAGE VELOCITY FPS |
| 2-YEAR | 1.0 |
| 25-YEAR | 1.4 |
| 100-YEAR | 1.6 |
| 500-YEAR | 1.3 |

CROSSECTION (B)

| FREQUENCY | AVERAGE DEPTH (ft) |
|---|---|
| 2-YEAR | 1.2 |
| 25-YEAR | 2.2 |
| 100-YEAR | 2.6 |
| 500-YEAR | 2.8 |
| FREQUENCY | AVERAGE VELOCETY FPS |
| 2-YEAR | 0.60 |
| 25-YEAR | 0.70 |
| 100-YEAR | 0.70 |
| 500-YEAR | 0.80 |

LEGEND:

- 2 YEAR FLOOD OUTLINE
- 25 YEAR FLOOD OUTLINE
- 100 YEAR FLOOD OUTLINE
- 500 YEAR FLOOD OUTLINE

GRAPHIC SCALE
200' 100' 0 200' 400'
SCALE IN FEET

GARAPAN FLOOD CONTROL SAIPAN, CNMI

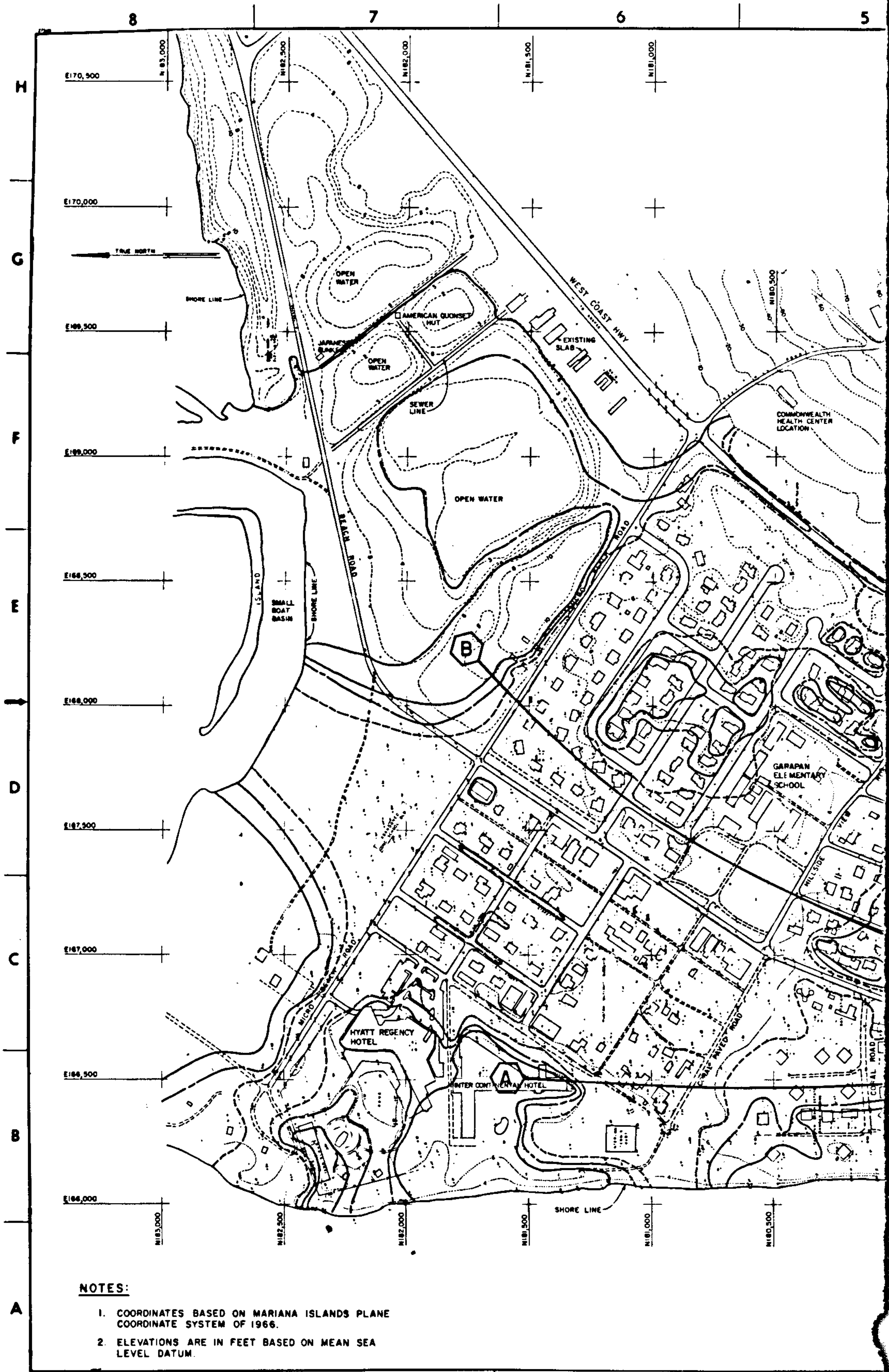
DETAILED PROJECT REPORT
FOR FLOOD CONTROL

# FLOOD LIMITS
# EXISTING CONDITIONS

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 6

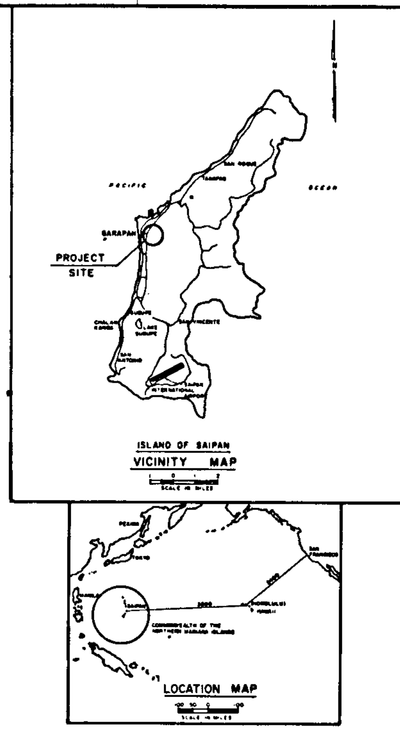
1

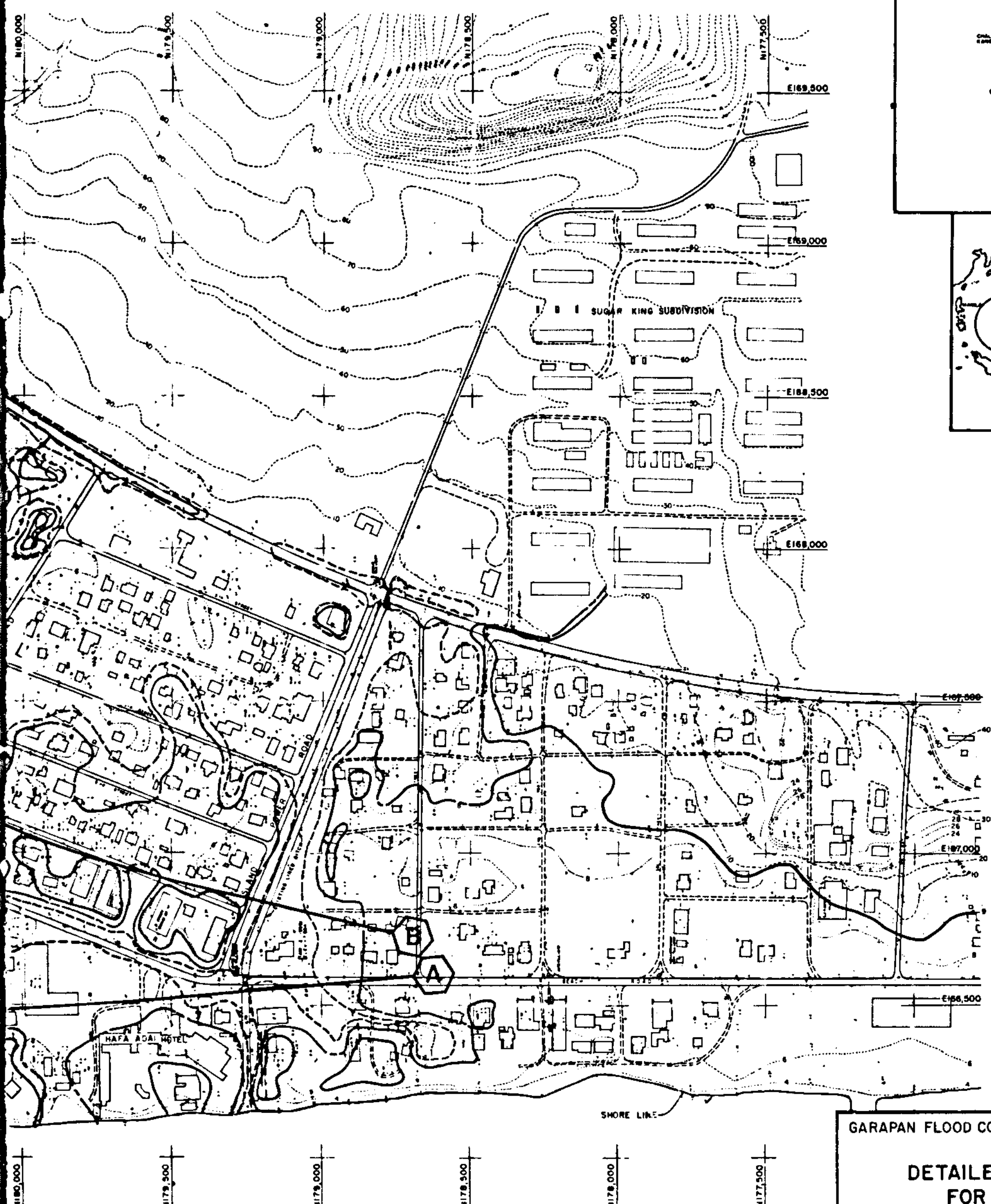



NOTES:

1. COORDINATES BASED ON MARIANA ISLANDS PLANE COORDINATE SYSTEM OF 1966.
2. ELEVATIONS ARE IN FEET BASED ON MEAN SEA LEVEL DATUM.

2




CROSSECTION (A)

| FREQUENCY | AVERAGE DEPTH (ft) |
|---|---|
| 10-YEAR | 1.8 |
| 50-YEAR | 2.2 |
| SPF | 2.2 |

| FREQUENCY | AVERAGE VELOCITY FPS |
|---|---|
| 10-YEAR | 1.2 |
| 50-YEAR | 1.5 |
| SPF | 1.7 |

CROSSECTION (B)

| FREQUENCY | AVERAGE DEPTH (ft) |
|---|---|
| 10-YEAR | 1.8 |
| 50-YEAR | 2.4 |
| SPF | 2.8 |

| FREQUENCY | AVERAGE VELOCETY FPS |
|---|---|
| 10-YEAR | 0.6 |
| 50-YEAR | 0.7 |
| SPF | 0.8 |

LEGEND:

10 YEAR FLOOD OUTLINE
50 YEAR FLOOD OUTLINE
SPF FLOOD OUTLINE

GRAPHIC SCALE
200' 100' 0 200' 400'
SCALE IN FEET

GARAPAN FLOOD CONTROL SAIPAN, CNMI

DETAILED PROJECT REPORT
FOR FLOOD CONTROL

# FLOOD LIMITS
# EXISTING CONDITIONS

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 6A

## 3 PLANNING OBJECTIVES

Based on the analysis of social, economic, and environmental aspects of the study area, and an identification of problems and needs, the following planning objectives have been developed to guide the formulation and evaluation of alternative plans of improvement for reducing flood damages in Garapan.

a. Contribute to the reduction in floodwater damages in Garapan during the 1990-2040 period of analysis;

b. Preserve (or minimize detrimental effects to) the environmental resources of the study area; and

c. Contribute to the efficient use of lands consistent with socioeconomic and cultural needs and desires of the study area residents as well as with long-range development plans for the study area.

# 4 FORMULATION OF PRELIMINARY PLANS

## 4.1 GENERAL

This section of the report is directed toward the development and evaluation of alternative flood control measures to resolve the problems and needs of the study area. This process is a multi-disciplinary evaluation and assessment involving an examination of the environmental impacts, technical adequacy, economic efficiency, and social acceptability of possible solutions within the framework of national and local planning objectives. Preliminary screening of possible solutions would eliminate obviously inappropriate plans. Those considered to be feasible, would be carried into detailed planning and design.

The formulation and evaluation of the alternative measures were based on the Water Resources Council's Principles and Guidelines, statutory and regulatory requirements of the Federal Government, and related Corps of Engineers regulation.

## 4.2 POSSIBLE MANAGEMENT MEASURES

In accordance with Corps of Engineers' planning policies and regulations, various types of management measures must be examined for applicability and feasibility, depending on the study area and problem. They may also be used in combination of ways to complement each other. Local desires may also dictate the possible utilization of various measures as one measure may be more desirable by one community or individual homeowner. Management measures are usually classified as either nonstructural or structural and are identified and described in the following section.

## 4.3 STRUCTURAL AND NONSTRUCTURAL MEASURES

Structural alternatives within the context of flooding are alternatives used to alleviate or reduce the extent of flooding by the construction of such structures as levees, reservoirs, diversion works or channel modifications. These measure can include:

-Storing water in reservoirs or ponding areas for gradual release after the threat of flooding has passed;

-Improving flow conditions by channel modifications so that flood stages can be reduced; and

-Diverting flood flows away from property by constructing a diversion channel.

Nonstructural alternatives have usually been described as utilizing measures other than structural ones described above. These alternative measures do not control the flow of water but rather remove, floodproof, or prohibit specific damageable property within the flooding zone. Typical measures which have been termed nonstructural include but are not limited to:

-Incorporating floodplain restrictions on construction and use of lands;

-Improving maintenance and efficiency of existing flood control and drainage structures;

-Relocating flood damageable structures or property outside the floodplains;

-Utilizing flood forecasting and warning for evacuation;

-Implementing flood insurance programs;

-Floodproofing existing structures; and

-Permanent evacuation and relocation.

## 4.4 PRELIMINARY SCREENING OF POSSIBLE SOLUTIONS

An initial screening of possible solutions was conducted and a preliminary elimination of alternatives was made on the basis that some plans were either technically inapplicable, or obviously too costly compared to the benefits to be accrued.

### 4.4.1 NONSTRUCTURAL MEASURES

#### 4.4.1.1 Floodplain Restrictions

Restriction of future development in the floodplain by land use controls such as zoning, subdivision regulation, building codes, development policies, and designated floodways can lessen future damaging effects of floods. Floodplain regulation relies on local government's adoption and use of legal tools to control the extent and type of development which would be permitted in these areas. The Federal Flood Insurance Program gives residents the opportunity to purchase flood insurance to cover losses from flooding. However, Saipan is presently not eligible to participate in the Flood Insurance Program, as authorized by the National Flood Insurance Act of 1968 and the Flood Damage Protection Act of 1973. Although a floodplain restriction policy will reduce future potential damages, it will not relieve the flood hazard for those who are in the floodplain.

4.4.1.2 Maintenance

Maintenance is a regularly instituted program of repairing stream channel structures and removing sediment, obstructive material and other debris from the channel to optimize the efficiency of existing drainage systems. The Garapan floodplain has no defined watercourse thus storm runoff will generally be discharged as sheet flow. The only existing drainage system that exists in the study area is a lined trapezoidal ditch with a base width of about 21 feet and a maximum height of about 2 feet. This ditch has a bankfull capacity of about 200 cfs. The feeder swale capacity in this area has a capacity of about 120 cfs. Flow exceeding this capacity will cause flooding. Regular maintenance and repair of this existing system would be recommended to complement any structural or nonstructural alternative.

4.4.1.3 Flood Forecasting, Warning, and Temporary Evacuation

The effectiveness of these measures is a direct function of the reaction time coupled with floodplain residents' confidence in the accuracy of the forecast or warning. This confidence is most often based on past experience with floods. Consequently, the primary aim of forecasting and warning is to save lives. While lives can be saved, little can usually be done to reduce flooding of homes unless some type of floodproofing has been incorporated. Flood warnings can warn people of possible flood hazard conditions and provide time to implement floodproofing measures to their homes.

4.4.1.4 Flood Insurance

This measure does not reduce the flood hazard of associated damages but rather lessens the economic burden of flooding and encourages floodplain restrictions. The Federal Flood Insurance Program gives residents the opportunity to purchase flood insurance to cover losses from flooding. However, Saipan is presently not eligible to participate in the Flood Insurance Program, as authorized by the National Flood Insurance Act of 1968 and the Flood Damage Protection Act of 1973.

4.4.1.5 Floodproofing

The alteration of a structure or conditions surrounding the structure to prevent damage by floodwaters is known as floodproofing. Typical methods are (1) raising the building above the flood level; (2) installing waterproof panels and sealing around openings; and (3) providing walls or levees around the building. While the function of these methods is essentially the same, to preclude floodwaters from entering the building's interior, each one has different limitations. Raising the structure is often uneconomical and impractical for structures constructed on a slab. Raising structures is also limited to a maximum raising height because of stability. Sealing and waterproofing are only applicable to buildings that can sustain the hydrostatic pressure and the drag force exerted by floodwater. Using walls of levees to floodproof an individual property can be unsightly and expensive due to the necessity of providing interior drainage. Thus floodproofing could best be utilized in a flood damage reduction plan when complemented by another nonstructural measure or a structural measure.

#### 4.4.1.6 Permanent Evacuation and Relocation

This measure for reducing potential damages in flood-prone areas is the physical removal of all damageable structures located in the floodplain and converting the land to a use that is compatible with the degree of flood risk. This measure in itself could prove to be very expensive due to the high cost of relocation. The social acceptance of relocation is also a negative factor. This measure could be acceptable and economically acceptable when complemented by other nonstructural or structural measures.

### 4.4.2 STRUCTURAL MEASURES

#### 4.4.2.1 Channel Improvements

The Garapan floodplain has no defined watercourse. An existing drainage system does exist within the study area which consists of a trapezoidal ditch and a feeder channel. This system consists of a trapezoidal outlet channel and feeder channel which has a capacity of about 200 cfs for the outlet channel and a capacity of about 120 cfs for the feeder channel. The outlet channel is aligned along Island Power Road. The possibility of improving this system will be further discussed.

#### 4.4.2.2 Storing/Detaining Floodwaters

The function of ponding basins is to store a portion of the floodflow in such a way as to reduce the flood flows in the areas to be protected. Ideally, ponding basins should have high permeability for effective infiltration. Preliminary assessments indicate that reservoirs or detention ponds alone could not provide flood protection as economically as could other alternatives or in combination with other alternatives. Because the Garapan basin has no defined watercourse a ponding basin in the upper reaches of the study site is not practical without its combination with a channel outlet. Also, the scarcity and high cost of land coupled with the topography of the upper reaches of the watershed (30% to nearly vertical) preclude the sole use of ponding basins. The possibility of ponding basins with the combination of flood flow diversion will be further studied to determine feasibility.

#### 4.4.2.3 Diverting the Flood Flows

This measure consists of diverting the flood flows into another system. Because the Garapan floodplain has no defined watercourse, storm runoffs will generally be discharged as sheet flows. The sheet flows must be intercepted and directed to an outlet channel which will discharge flows to the ocean. This measure is best suited to the characteristics of the watershed and will be further investigated along with combinations of other structural measures.

### 4.5 SUMMARY

It appears that the most feasible nonstructural measures for further investigation are floodproofing individual structures with possible relocation of non floodproofable structures. The most feasible structural measures are possible combinations of flood flow diversions with detaining floodwaters and channel improvements.

# 5 DEVELOPMENT OF DETAIL PLANS

## 5.1 GENERAL

This section of the report is directed toward the development of detailed design and evaluation for analyzing specific plans and configurations for alternatives previously determined to be the most feasible solutions. The formulation of design plans was guided by specific technical, economic, and environmental criteria and guidelines which are documented in the supporting appendices.

Because the Garapan floodplain has no defined watercourse, storm runoffs will generally be discharged as sheetflow. Structurally, this type of flooding situation is best handled by interception of these sheet flows, and diversion to an outlet channel discharging to the ocean. The most suitable location to intercept flows is along the West Coast Highway (also known as Chalan Pale Arnold Highway) which is located just above most of the residential, commercial, municipal, and hotel developments in Garapan. Therefore, channel improvements at West Coast Highway should be a common element to all structural measures.

Based on the preliminary evaluation and screening, the following structural plans were further considered and developed in greater detail. Preliminary sensitivity analysis of the five structural alternatives indicates that economic optimization occurs between the 25 and 60-year flood level of protection. Therefore, to best represent comparison between the different alternatives developed, the 50-year flood level of protection was detailed for each of the following plans.

1. Plan A, Channel through American Memorial Park wetland with Tanapag Harbor outlet.

2. Plan B, Channel with outlet along Hillside View Road.

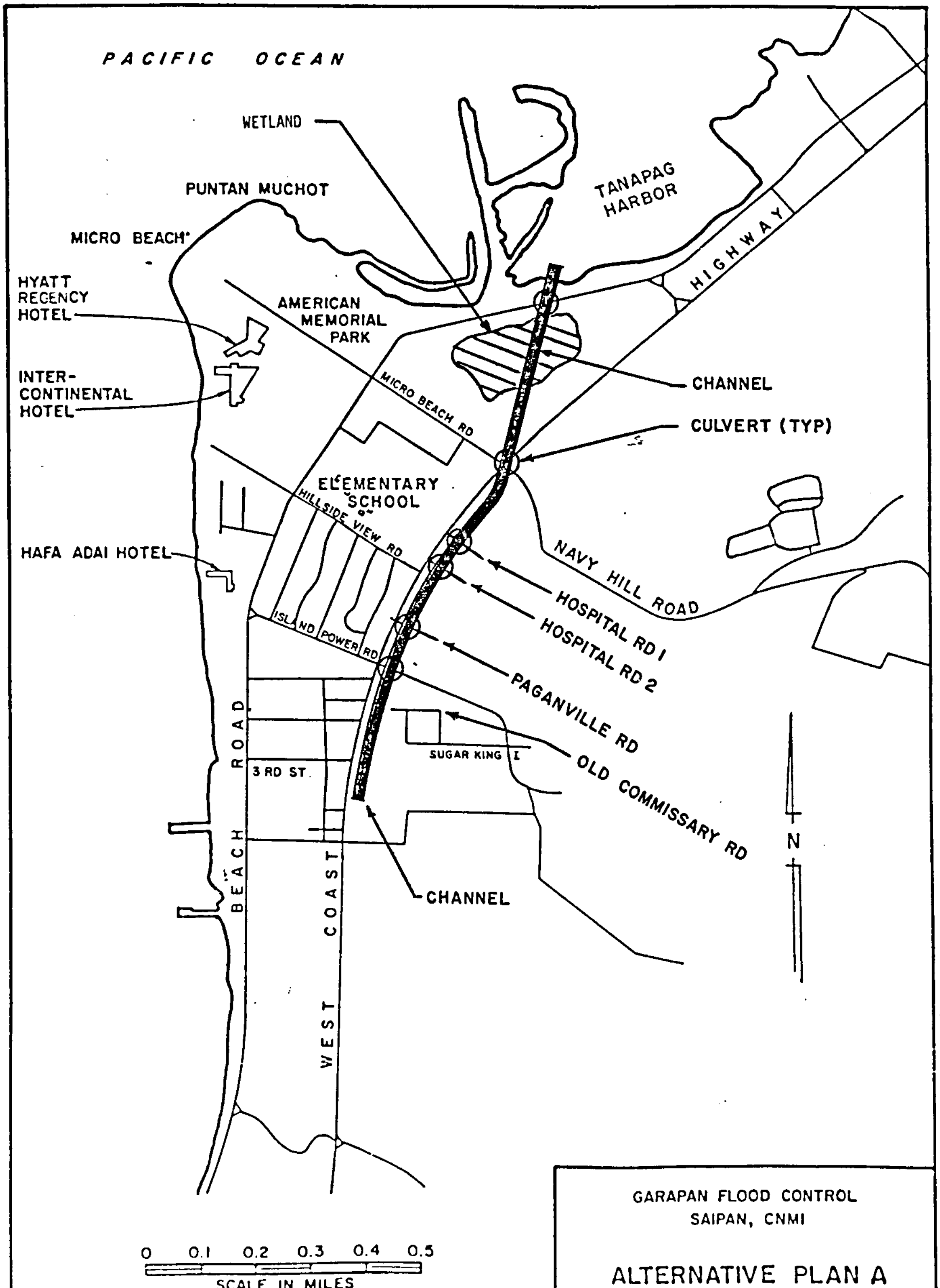
3. Plan C, Channel with outlet along Island Power Road.

4. Plan D, Channel using American Memorial Park wetland as storage and Tanapag Harbor outlet.

5. Plan E, Channel around the American Memorial Park wetland with Tanapag Harbor outlet.

The existing use and proposed zoning (Figure 3) of the Garapan floodplain are primarily residential. This coupled with the floodplain and flood flows characteristics indicate that an essentially nonstructural plan may be feasible. Based on this a nonstructural plan was further considered and developed for a 50-year frequency flood.

6. Plan F, Nonstructural floodproofing and relocation.




GARAPAN FLOOD CONTROL
SAIPAN, CNMI

ALTERNATIVE PLAN A

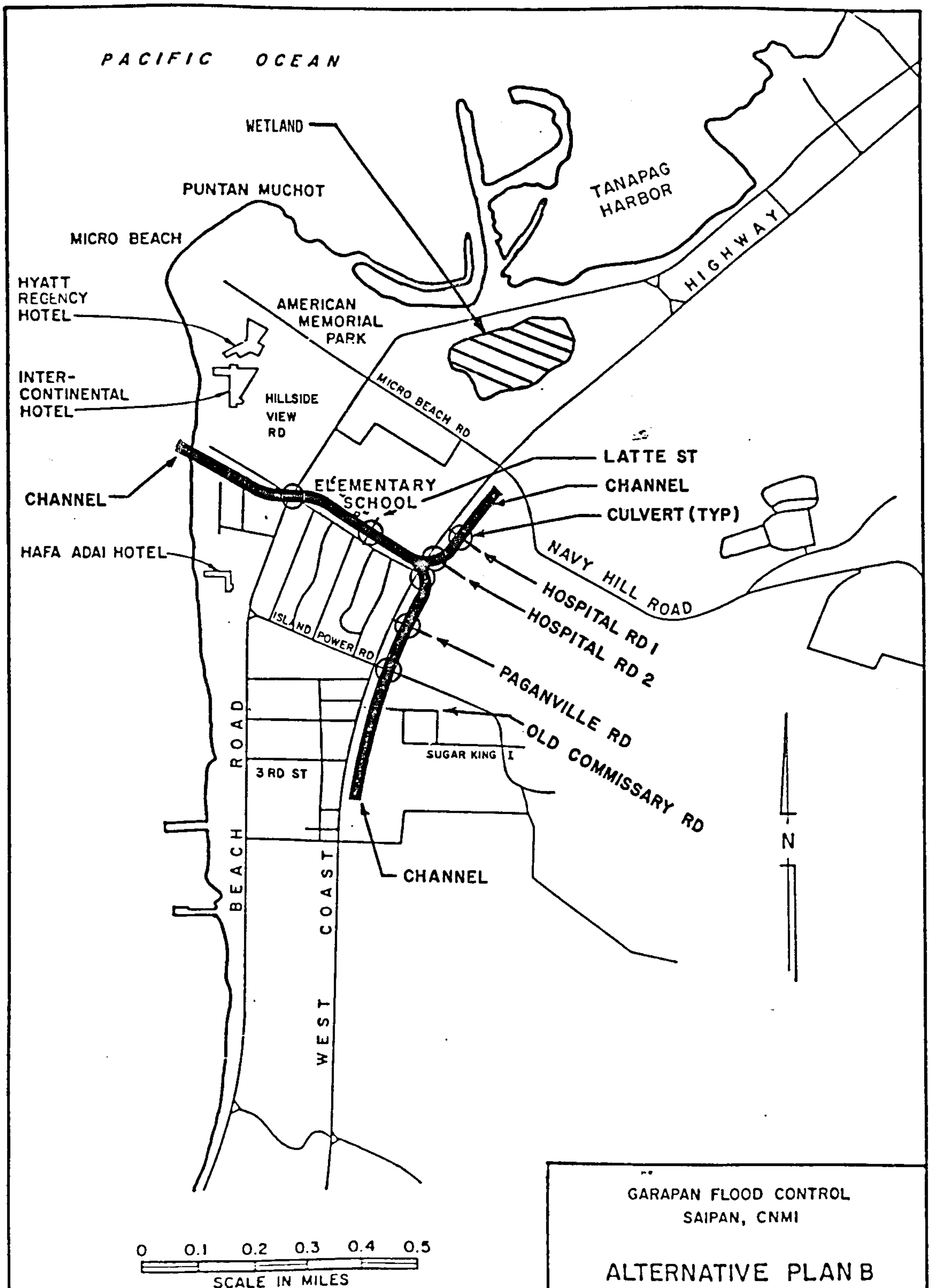
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 7

## 5.2 ALTERNATIVE PLAN A

Channel through the American Memorial Park wetland with Tanapag Harbor outlet.

Alternative Plan A is shown on Figure 7 and consists of channel improvements which would convey flows transversely through the floodplain upland of the West Coast Highway and which would then cross the West Coast Highway and Micro Beach Road intersection passing through a downland wetland reach to the ocean. The channel improvements will be trapezoidal in shape with riprap lining as needed. The length of flood control improvements is about 5,440 feet. This alternative plan would provide for ditches and spillway inlets to convey upland flows to the interceptor channel. This plan would also require construction of culverts along the channel alignment at six road crossings. The six road crossings include Beach Road, Micro Beach Road and West Coast Highway intersection, Hospital Roads 1 and 2, Paganville Road, and Island Power Road. The existing Old Commissary Road would be closed to through traffic at the West Coast Highway for all structural alternatives. Water and sewer utilities would require relocations at these crossings. In lieu of channel transitions and culvert, bridges were considered and were found to be more costly. No relocation of homes or businesses would be required. However, Plan A would displace about 4.2 acres of wetlands and mitigative measures would be required. Mitigation would most probably involve excavating additional areas lost as a result of channel construction. The proposed location of the replacement acreage is in the north-easterly portion of the American Memorial Park. Mitigative measures would also include removal of portions of the existing fill areas thus creating two larger open water areas. For a horizontal relationship between alternative Plan A and the existing American Memorial Park wetland, see Figure 3 in the U.S. Fish and Wildlife Service's 2b coordination report in Appendix G.




GARAPAN FLOOD CONTROL
SAIPAN, CNMI

ALTERNATIVE PLAN B

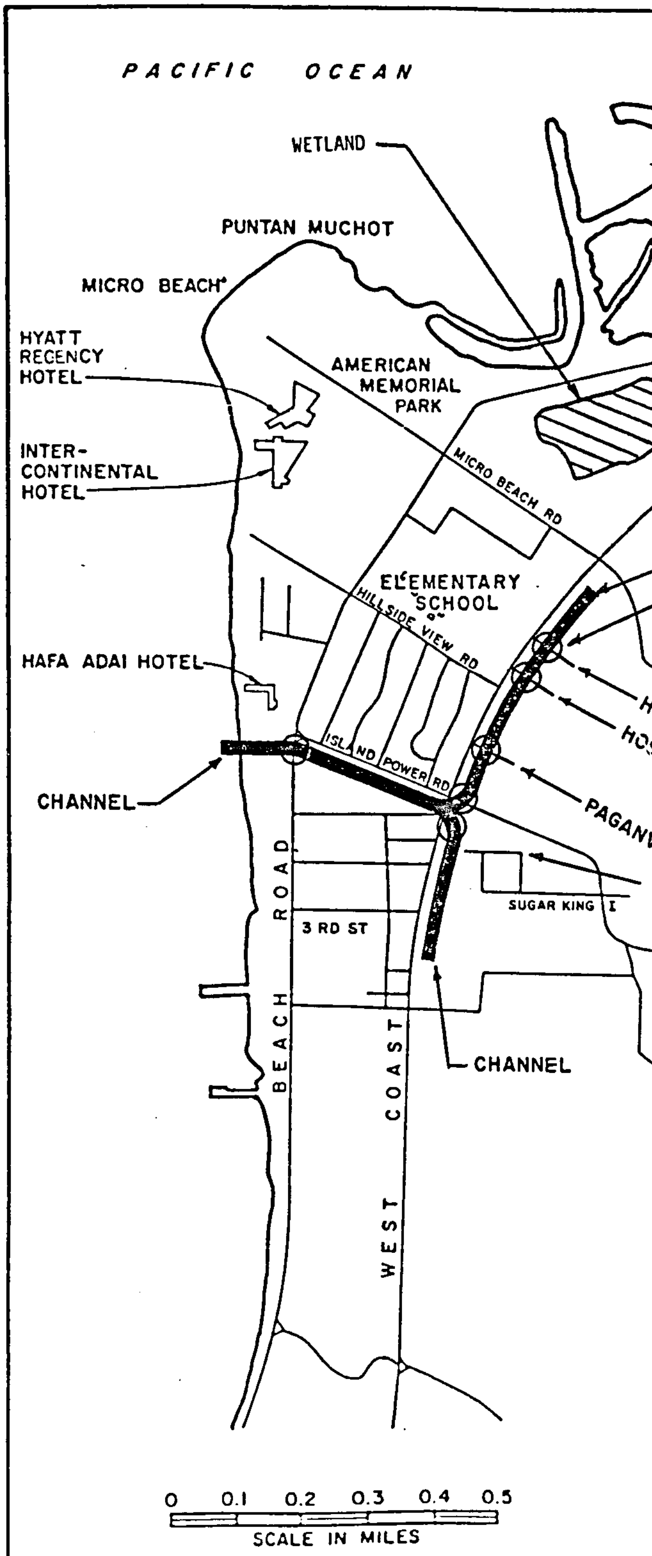
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 8

## 5.3 ALTERNATIVE PLAN B

Channel with outlet along Hillside View Road.

Alternative Plan B shown on Figure 8 is similar in concept to Plan A except for the location of the outlet channel and the change in flow direction along the northeast branch of the outlet channel. The upland channels would be at the same locations as in Plan A. The length of the northeast channel branch is about 1,270 feet. The southwest channel branch has a length of about 2,650 feet. The outlet channel is located just north of Hillside View Road and would extend a length of about 2,450 feet to convey the combined flows from the channel branches to the ocean. The outlet channel starts in the vicinity of the West Coast highway, passes through the frontage of Garapan Elementary School, crosses Latte Street, and diagonally crosses the Hillside View Road and Beach Road intersection enroute to the ocean. The channel improvements would be trapezoidal in shape with riprap lining as needed. Alternative design to the outlet channel using steel sheet pile channel walls with concrete cover was considered and found to exceed costs by about $910 per linear foot of channel improvement. Smooth transitions with horizontal curves would be used to connect the channel branches to the outlet channel. Use of right angle transitions was considered and found to require a longer outlet channel and wider inlet structures resulting in a cost increase of about $370,000. Plan B would require construction of culverts along the alignment at eight road crossings and relocation of utilities at these structures. The eight crossings include the Beach Road and Hillside View Road intersection, Latte Street, West Coast Highway (2 branches) Hospital Roads 1 and 2, Paganville Road, and Island Power Road. In addition relocation of 4 homes between the West Coast Highway and Latte Street would be required along the channel improvements. For a horizontal relationship between alternative Plan B and the existing American Memorial Park wetland, see Figure 4 in the U.S. Fish and Wildlife Service's 2b coordination report in Appendix G.




GARAPAN FLOOD CONTROL
SAIPAN, CNMI

ALTERNATIVE PLAN C

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 9

## 5.4 ALTERNATIVE PLAN C

Channel with outlet along Island Power Road.

Alternative Plan C is shown on Figure 9 and is similar in concept to alternative Plan B with differences in lengths of the left and right channel branches and the location of the outlet channel. The left and right channel branches have lengths of about 1,380 feet and 2,570 feet respectively. The outlet channel for Plan C is located where an existing ditch lies just south of Island Power Road and is about 1,800 feet in length from the vicinity of West Coast Highway to the ocean. The flood control channel would be trapezoidal in shape and riprap lined as needed. The existing lined ditch is trapezoidal in shape with a base width of about 21 feet and a maximum height of about 2 feet. This ditch has a bankfull capacity of about 200 cfs. However the highway feeder swale capacity in this area is about 120 cfs. For Plans A, B, D, and E, the lined ditch would be utilized for localized flows below the highway. For Plan C, the lined ditch would be replaced by the outlet channel. Plan C would require construction of culverts along the channel improvements at seven road crossings and relocation of utilities at these crossings. The seven crossings include Beach Road, the West Coast Highway (2 branches), Hospital Road 1 and 2, Paganville Road, and Island Power Road. Plan C land requirements would affect 27 private lots and relocation of 5 residences. For a horizontal relationship between alternative Plan C and the existing American Memorial Park wetland, see Figure 5 in the U.S. Fish and Wildlife Service's 2b coordination report in Appendix G.

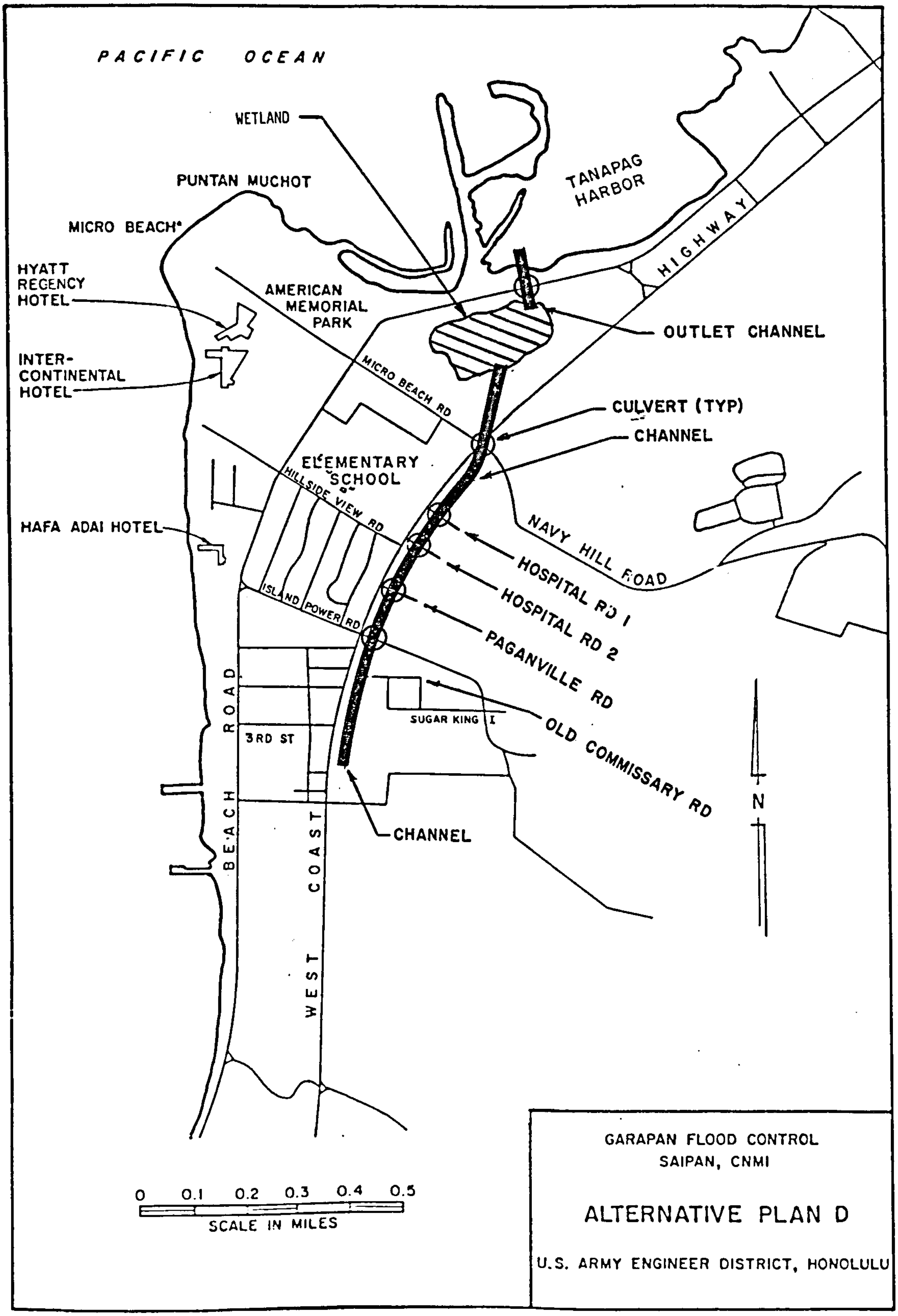

PACIFIC OCEAN
WETLAND
PUNTAN MUCHOT
MICRO BEACH
HYATT REGENCY HOTEL
AMERICAN MEMORIAL PARK
INTER-CONTINENTAL HOTEL
TANAPAG HARBOR
HIGHWAY
OUTLET CHANNEL
MICRO BEACH RD
CULVERT (TYP)
CHANNEL
ELEMENTARY SCHOOL
HILLSIDE VIEW RD
HAFA ADAI HOTEL
NAVY HILL ROAD
HOSPITAL RD 1
HOSPITAL RD 2
ISLAND POWER RD
PAGANVILLE RD
SUGAR KING
OLD COMMISSARY RD
3RD ST
BEACH ROAD
WEST COAST
CHANNEL
N
0 0.1 0.2 0.3 0.4 0.5
SCALE IN MILES
GARAPAN FLOOD CONTROL
SAIPAN, CNMI
ALTERNATIVE PLAN D
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 10

## 5.5 ALTERNATIVE PLAN D

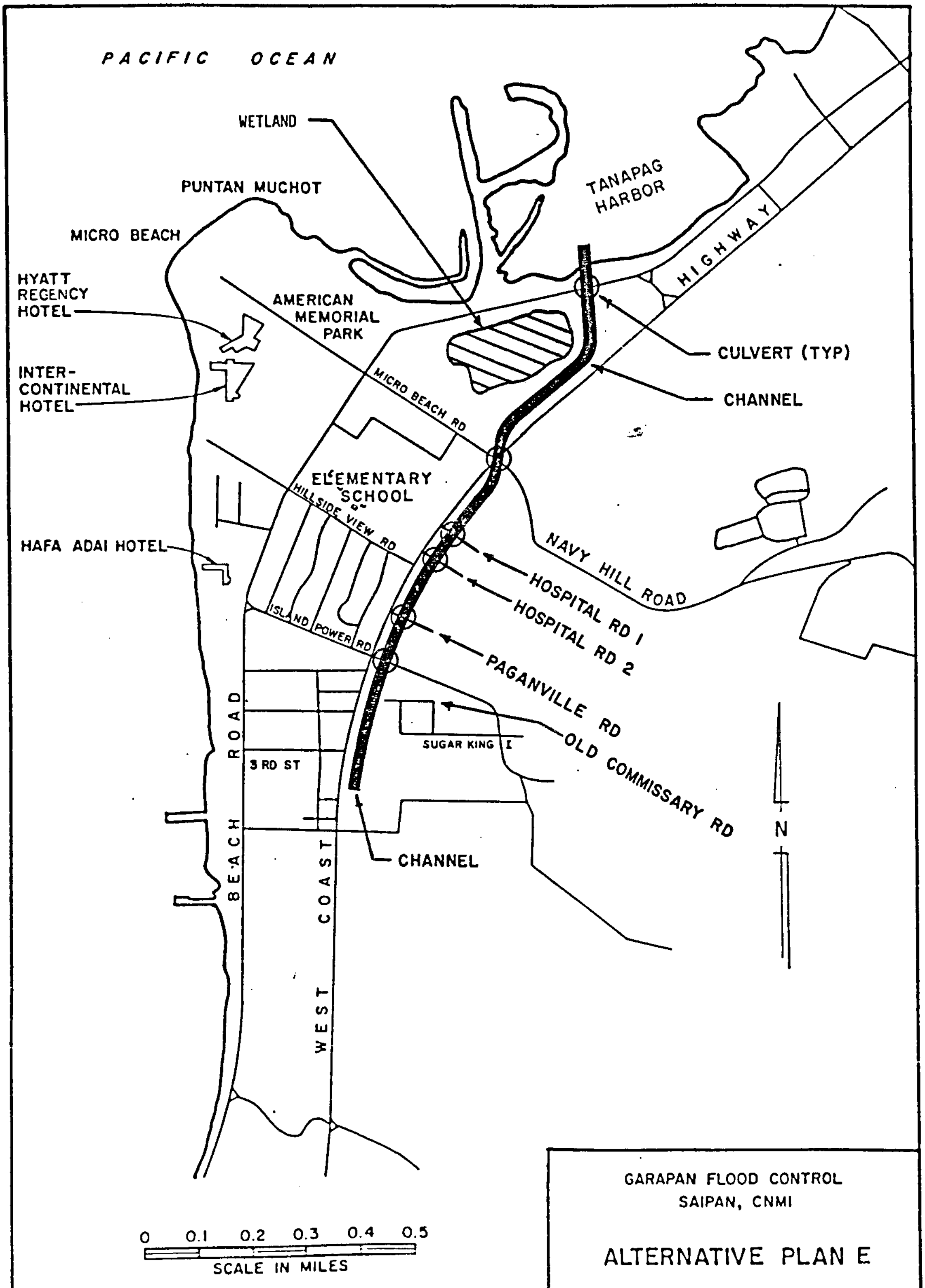
Channel using the American Memorial Park wetland as storage and Tanapag Harbor outlet.

Alternative Plan D is shown on Figure 10. This plan is identical to Plan A within the upland channel reach. The downland area below the West Coast Highway consists of a wetland reach which lies within the areas bordered by the West Coast Highway, Micro Beach Road, and Beach Road. This area is vegetated raw land in appearance and would be used under alternative Plan D as a ponding area for flood flows. The inflow channel would be about 780 feet in length and would end at the wetland pond. The lowest roadway elevation is +5.90 feet mean sea level along the Beach Road. The maximum storage capability within this area is about 112 acre-feet over an area of 43 acres. The design outflow control elevation is established at elevation +2.00 feet mean sea level to maintain the wetland water level estimated at the same elevation. Flows above this elevation would be discharged over a weir into an excavated channel and through four new 10' X 4' box culverts at Beach Road enroute to the ocean. The outlet channel extends about 450 feet in length from the pond to the ocean. Table 1 provides information on wetland flood storage for various flow frequencies. The outflow time would range from 3.7 to 5.0 hours.

TABLE 1. Plan D Flood Storages

| FLOW FREQUENCY (YEAR) | MAX PONDING ELEVATION (MSL) | MAXIMUM STORAGE (ACRE-FT) | STORAGE AREA (ACRES) | MAX OUTFLOW (CFS) |
|---|---|---|---|---|
| 2 | 2.70 | 18 | 16.4 | 260 |
| 10 | 3.21 | 31 | 22.5 | 520 |
| 25 | 3.79 | 42 | 25.4 | 760 |
| 50 | 4.13 | 50 | 27.0 | 1340 |
| 100 | 4.22 | 52 | 27.5 | 1690 |
| 500 | 4.39 | 56 | 28.5 | 2330 |
| SPF | 5.08 | 73 | 33.1 | 2900 |

The discussion under Plan A regarding culverts, ditches, and relocations also applies to Plan D. For a horizontal relationship between alternative Plan D and the existing American Memorial Park wetland, see Figure 6 in the U.S. Fish and Wildlife Service's 2b coordination report in Appendix G.




GARAPAN FLOOD CONTROL
SAIPAN, CNMI

ALTERNATIVE PLAN E

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 11

## 5.6 ALTERNATIVE PLAN E

Channel around the American Memorial Park wetland with Tanapag Harbor outlet.

Alternative Plan E is shown on Figure 11. This plan is also identical to Plan A within the upland channel reach. Within the downland channel reach below the West Coast Highway, Plan E is similar to Plan A except that the outlet channel would be about 500 feet longer and would detour around and not encroach upon the American Memorial Park (AMP) wetland areas. The total length of channel improvement under Plan E is about 5,960 feet. The discussion under Plan A regarding culverts, ditches, and relocations are also applicable to this plan. For a horizontal relationship between alternative Plan E and the existing American Memorial Park wetland, see Figure 7 in the U.S. Fish and Wildlife Service's 2b coordination report in Appendix G.

## 5.7 ALTERNATIVE PLAN F

Nonstructural floodproofing and relocation.

There are approximately 400 structures in the Garapan area. These structures prone to flooding would need to be floodproofed or relocated depending on the type and condition of the structure. A detailed assessment of the feasibility of flooding has been conducted to determine the technical and economic potential of floodproofing and/or relocating structures (approximately 182 structures) subject to flooding. A computer program was developed to calculate the most economical and appropriate floodproofing plan for each structure individually. The nonstructural plan at a 50-year level of protection would include a flood warning system plus the following breakdown of floodproofing methods:

TABLE 2. Plan F Summary

| Floodproofing Method | Number of Structures |
|---|---|
| Temporary/permanent closures | 41 |
| Raising the structure | 12 |
| Raising of damageable property | 33 |
| Rebuilding structures | 96 |
| TOTAL | 182 |

These totals were based on the most economical solution given the constraints placed on the analysis of each structure affected by the various frequency events. The proposed methodologies may vary after coordinating with the owners of the affected parcels.

# 6 ASSESSMENT AND EVALUATION OF ALTERNATIVE PLANS

## 6.1 GENERAL

The purpose of this section is to evaluate the flood control alternatives developed in the previous section, to determine which alternative plan best satisfies national and local planning objectives, community desires, and economic criteria to determine the National Economic Development (NED) plan, as specified by P&G.

## 6.2 ESTIMATED BENEFITS AND COSTS

### 6.2.1 Benefit Analysis

Benefits accruing from each alternative plan were derived by estimating damages prevented from flooding to structures and contents and a reduction in emergency relief costs and damages to public property and utilities. Economic evaluations were conducted in accordance with procedures and standards prescribed by the Water Resources Council and the Corps of Engineers' policy. Computations of tangible benefits were based on an interest rate of 8-3/8 percent, a 50-year project life, July 1985 price levels, and 1990 base year. Components of the annual average benefits include:

a. Inundation reduction benefits including residential and commercial and public;

b. Freeboard benefits;

c. Affluence benefits; and

d. Emergency relief cost reduction benefits.

Detailed information on the estimation of damages and benefits analyses including methodology, explanation, and calculations are included in Appendix D.

### 6.2.2 Costs

Estimated project first costs were developed with July 1985 price levels and assumptions based on the prevailing physical conditions and construction methods suitable to the project area. The determination of the average annual cost for the purposes of the benefit to cost comparisons includes interest (8-3/8%) and amortization (50 years) of the project first costs and the estimated annual maintenance costs associated with maintaining operations and maintenance (O&M) program. Estimating assumptions are provided in Appendix C.

### 6.2.3 Benefit to Cost Comparison

Table 3 presents a summary of the estimated costs and benefits associated with each plan. The benefit to cost ratios (B/C) are the arithmetic proportions of the average annual benefits to average annual costs insofar as these factors can be expressed in monetary terms. The comparisons represent the degree of tangible economic justification for each alternative plan.

## 6.3 COST APPORTIONMENT

Flood damage reduction works must conform to regulations on cost sharing between Federal and non-Federal interests. These requirements apply to project costs which include construction first costs, acquisition of lands, easements and rights-of-way, relocations including utilities and bridges, and engineering and administration costs. The apportionment of project costs is based on new cost sharing requirements implemented by the Department of the Army, which reflects the construction cost sharing provisions agreed to by the Administration and the Senate Majority Leadership. Under the category of flood control (local protection projects), the non-Federal sponsor is assigned the responsibility of providing lands, easements, rights-of-way and relocations (LERR), plus a cash contribution equivalent to five (5) percent of the total project first cost. This LERR + 5% share of the cost is applicable for Garapan where the estimated cost of LERR exceeds 20% of the project first cost. In addition, Federal participation in small flood control projects under the Continuing Authorities Program is limited to a maximum of $4 million, as prescribed by Section 205 of the 1948 Flood Control Act, as amended. Included in this Federal limit is the pre-authorization study costs. Table 4 summarizes the cost sharing requirements under these guidelines for the five structural alternative plans plus the non-structural plan.

## 6.4 COMPARISON OF ALTERNATIVE PLANS

The evaluation of the economic, social, and environmental effects of each alternative plan is displayed in Table 5 (Summary Comparison). 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 alternative plan.

TABLE 3. Benefit and Cost Summary

| ITEM | PLAN A | PLAN B | PLAN C | PLAN D | PLAN E | PLAN F |
|---|---|---|---|---|---|---|
| | ($) | ($) | ($) | ($) | ($) | ($) |
| TOTAL PROJECT FIRST COST [1] | 6,750,000 | 9,160,000 | 7,970,000 | 6,930,000 | 6,580,000 | 11,700,000 |
| INTEREST DURING CONSTRUCTION | 549,000 | 745,000 | 648,000 | 563,000 | 535,000 | 951,000 |
| TOTAL INVESTMENT COST | 7,299,000 | 9,905,000 | 8,618,000 | 7,493,000 | 7,115,000 | 12,651,000 |
| ANNUALIZED INVESTMENT COST [2] | 622,000 | 845,000 | 735,000 | 639,000 | 607,000 | 1,079,000 |
| ANNUAL OPERATION AND MAINTENANCE | 7,600 | 8,300 | 8,000 | 8,600 | 7,600 | 20,000 |
| TOTAL AVERAGE ANNUAL COST | 629,600 | 853,300 | 743,000 | 647,600 | 614,600 | 1,099,000 |
| TOTAL AVERAGE ANNUAL BENEFITS | 659,600 | 659,400 | 658,500 | 659,600 | 659,600 | 394,000 |
| BENEFIT TO COST RATIO | 1.0 | 0.8 | 0.9 | 1.0 | 1.1 | 0.4 |
| NET BENEFITS [3] | 30,000 | (193,900) | (84,500) | 12,000 | 45,000 | (705,000) |

[1] Excludes preauthorization cost.
[2] Based on an interest rate of 8-3/8% amortized over 50 years.
[3] () Indicate negative values.

TABLE 4. Cost Apportionment

| ITEM | PLAN A | PLAN B | PLAN C | PLAN D | PLAN E | PLAN F |
|---|---|---|---|---|---|---|
| | ($) | ($) | ($) | ($) | ($) | ($) [2] |
| TOTAL PROJECT COST | $6,750,000 | $9,160,000 | $7,970,000 | $6,930,000 | $6,580,000 | $11,700,000 |
| FEDERAL COST SHARE [1] | $3,453,000 | $3,453,000 | $3,453,000 | $3,453,000 | $3,453,000 | $9,360,000 |
| NON-FEDERAL COST SHARE | $3,297,000 | $5,707,000 | $4,517,000 | $3,477,000 | $3,127,000 | $2,340,000 |

[1] Includes $4,000,000 Federal statutory limit less preauthorization
[2] Cost apportionment for the nonstructural plan is based on a 80%/20% Federal/non-Federal split.

TABLE 5. Summary Comparison

| ITEM | WITHOUT CONDITIONS | WITH CONDITIONS: PLAN A CHANNEL WITH TANAPAG HARBOR OUTLET | PLAN B CHANNEL WITH GARAPAN SCHOOL OUTLET | PLAN C CHANNEL WITH SAIPAN LAGOON OUTLET | PLAN D WETLAND STORAGE WITH HARBOR OUTLET | PLAN E CHANNEL OUTSIDE WETLAND WITH HARBOR OUTLET | PLAN F FLOODPROOFING |
|---|---|---|---|---|---|---|---|
| A. PLAN DESCRIPTION | NO PROJECT | TOTAL OF 5,440 FEET OF CHANNEL ROUTED THROUGH THE AMERICAN MEMORIAL PARK WETLAND AND DISCHARGING INTO TANAPAG HARBOR | TOTAL OF 6540 FEET OF CHANNEL DISCHARGES INTO SAIPAN LAGOON NEAR SCHOOL | TOTAL OF 5660 FEET OF CHANNEL DISCHARGES INTO SAIPAN LAGOON FROM ISLAND POWER RD | TOTAL OF 4,710 FEET OF CHANNEL UTILIZING THE AMERICAN MEMORIAL PARK WETLAND AS STORAGE AND DISCHARGING INTO TANAPAG HARBOR | TOTAL OF 5,960 FEET OF CHANNEL ROUTED AROUND THE AMERICAN MEMORIAL PARK WETLAND AND DISCHARGING INTO TANAPAG HARBOR | ABOUT 182 STRUCTURES TO BE FLOOD PROOFED |
| | | ALL CHANNEL PLANS HAVE TRAPEZOIDAL CROSS-SECTION, RIPRAP OR GRASSED LINING AND PROVIDE 50-YEAR PROTECTION. | | | | | |
| B. SIGNIFICANT IMPACTS & PLAN RELATIONSHIPS TO NATIONAL ACCOUNTS | | | | | | | |
| 1. ECONOMIC (NED) | | | | | | | |
| a. PROPERTY VALUES | INCREASING AT PREVAILING REAL ESTATE MARKET RATE | SAME AS WITHOUT CONDITIONS | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | INCREASE LIKELY |
| b. PUBLIC FACILITIES | DAMAGES TO FACILITIES AND INTERRUPTION OF SERVICES DURING FLOODING | NO SIGNIFICANT IMPACT | NO SIGNIFICANT IMPACT | NO SIGNIFICANT IMPACT | NO SIGNIFICANT IMPACT | NO SIGNIFICANT IMPACT | SHORT-TERM SIGNIFICANT DISRUPTION LIKELY |
| c. DESIRED REGIONAL GROWTH | ADVERSE EFFECT IN FLOODPLAIN | BENEFICIAL, BUT DISRUPT PARK DEVELOPMENT | BENEFICIAL IMPACT IN FLOODPLAIN | SAME AS PLAN B | SAME AS PLAN A | SAME AS PLAN A | LONG-TERM GROWTH MAYBE ENHANCED |
| d. BUSINESS/INDUSTRIAL ACTIVITIES | DISRUPTION DURING FLOODING | MINIMIZES DISRUPTION DURING FLOOD FLOW ON ROADS | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | INDIRECT DISRUPTION LIKELY DEPENDING ON RELOCATION SITE |

TABLE 5. Summary Comparison

| ITEM | WITHOUT CONDITIONS | WITH CONDITIONS PLAN A CHANNEL WITH TANAPAG HARBOR OUTLET | PLAN B CHANNEL WITH GARAPAN SCHOOL OUTLET | PLAN C CHANNEL WITH SAIPAN LAGOON OUTLET | PLAN D WETLAND STORAGE WITH HARBOR OUTLET | PLAN E CHANNEL OUTSIDE WETLAND WITH HARBOR OUTLET | | | PLAN F FLOODPROOFING |
|---|---|---|---|---|---|---|---|---|---|
| e. FARM DISPLACEMENT | DISRUPTION DURING FLOODING | NONE | NONE | NONE | NONE | NONE | | | DISPLACEMENT NOT LIKELY |
| f. QUANTITATIVE ANALYSIS | | 50 yr | 50 yr | 50 yr | 50 YR | 10 yr | 50 yr | SPF | 50 yr |
| (1) AVERAGE ANNUAL BENEFITS | N/A | 659.6 | 659.4 | 658.5 | 659.6 | 629.5 | 659.6 | 667.7 | 394.0 |
| (2) AVERAGE ANNUAL COST | N/A | 629.6 | 853.3 | 743.0 | 647.6 | 592.5 | 614.6 | 638.0 | 1098.9 |
| (3) NET AVERAGE ANNUAL BENEFITS | N/A | 30.0 | -193.9 | -84.5 | 12.0 | 37.0 | 45.0 | 29.7 | -704.9 |
| (4) BENEFIT TO COST RATIO | N/A | 1.0 | 0.8 | 0.9 | 1.0 | 1.1 | 1.1 | 1.1 | 0.36 |
| 2. ENVIRONMENTAL | | | | | | | | | |
| a. TERRESTRIAL ENVIRONMENT | INSIGNIFICANT CHANGE | 10 ACRES MODIFIED | 11.4 ACRES MODIFIED | 9.9 ACRES MODIFIED | 13.2 ACRES MODIFIED | 20.7 ACRES MODIFIED | | | UNKNOWN, NEW RESIDENTIAL DEVELOPMENT ELSEWHERE |
| b. MARINE ENVIRONMENT | INSIGNIFICANT CHANGE | 2 ACRES CREATED, 400 S.F. DREDGED | 3.4 ACRES CREATED, 480 S.F. DREDGED | 1.9 ACRES CREATED, 300 S.F. DREDGED | 1 ACRE CREATED, 400 S.F. DREDGED | 2 ACRES CREATED, 400 S.F. DREDGED | | | NO EFFECT |
| c. ENDANGERED SPECIES | INSIGNIFICANT CHANGE | NO SIGNIFICANT EFFECT | NO EFFECT | NO EFFECT | NO SIGNIFICANT EFFECT | NO SIGNIFICANT EFFECT | | | NO EFFECT |

TABLE 5. Summary Comparison

| ITEM | WITHOUT CONDITIONS | WITH CONDITIONS: PLAN A — CHANNEL WITH TANAPAG HARBOR OUTLET | PLAN B — CHANNEL WITH GARAPAN SCHOOL OUTLET | PLAN C — CHANNEL WITH SAIPAN LAGOON OUTLET | PLAN D — WETLAND STORAGE WITH HARBOR OUTLET | PLAN E — CHANNEL OUTSIDE WETLAND WITH HARBOR OUTLET | PLAN F — FLOODPROOFING |
|---|---|---|---|---|---|---|---|
| d. WATER QUALITY | INSIGNIFICANT CHANGE | TEMPORARY TURBIDITY AND SUSPENDED SEDIMENTS DURING CONSTRUCTION; WATER QUALITY IN THE OUTLET CHANNEL WILL BE LOWER THAN IN THE LAGOON | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | NO EFFECT ANTICIPATED |
| e. HISTORIC | INSIGNIFICANT CHANGE | POSSIBLE DAMAGE TO UNKNOWN SUBSURFACE FEATURES | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | NO EFFECT ANTICIPATED |
| f. WETLANDS | POSSIBLE ENHANCEMENT WITH DEVELOPMENT OF AMERICAN MEMORIAL PARK | POSSIBLE DAMAGE WITH CONSTRUCTION THROUGH WETLAND | NO EFFECT | NO EFFECT NET INCREASE IN MANGROVES NEAR OUTLET CHANNEL. | POSSIBLE DAMAGE WITH CONSTRUCTION AND DEBRIS SETTLEMENT AFTER STORM DISCHARGE | POSSIBLE MINIMAL EFFECT DUE TO SALTWATER INTRUSION NET INCREASE IN MANGROVES NEAR OUTLET CHANNEL. | NO EFFECT |
| g. RECREATION | POSSIBLE PUBLIC FACILITIES FOR ACTIVE RECREATION TO BE DEVELOPED IN AMERICAN MEMORIAL PARK | FISHING OPPORTUNITIES INCREASED; POSSIBLE DISRUPTION TO AMERIAN MEMORIAL PARK | FISHING OPPORTUNITIES INCREASE | SAME AS PLAN B | SAME AS PLAN A | SAME AS PLAN A BUT REQUIRES RELOCATION OF PROPOSED FACILITIES IN PARK | GARAPAN AREA OPEN TO OPEN SPACE DEVELOPMENT |
| 3. SOCIAL (SWB) | | | | | | | |
| a. HEALTH, SAFETY, AND COMMUNITY WELL-BEING | DEGRADED DURING AND AFTER FLOODING-SEWAGE OVERFLOW OCCURS | FLOOD-RELATED HEALTH AND SAFETY IMPROVED; COMMUNITY WELL-BEING ENHANCED | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A EXCEPT FLOOD RELATED HEALTH PROBLEMS MAY CONTINUE |

TABLE 5. Summary Comparison

| ITEM | WITHOUT CONDITIONS | WITH CONDITIONS PLAN A CHANNEL WITH TANAPAG HARBOR OUTLET | PLAN B CHANNEL WITH GARAPAN SCHOOL OUTLET | PLAN C CHANNEL WITH SAIPAN LAGOON OUTLET | PLAN D WETLAND STORAGE WITH HARBOR OUTLET | PLAN E CHANNEL OUTSIDE WETLAND WITH HARBOR OUTLET | PLAN F FLOODPROOFING |
|---|---|---|---|---|---|---|---|
| b. AESTHETIC VALUES | DEGRADATION OF LAND AND WATER QUALITY DURING AND AFTER FLOODING | NEW VISUAL INTRUSION TO CHANGING AESTHETIC CHARACTER OF AREA | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | VISUAL INTRUSION LESS; VARIED BY INDIVIDUAL STRUCTURES |
| c. AIR AND NOISE | GRADUAL RISE ASSOCIATED WITH COMMERCIAL GROWTH IN AREA | TEMPORARY DURING CONSTRUCTION | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A |
| d. DISPLACEMENT | DISPLACEMENT OF FAMILIES IN FLOODPLAIN DURING FLOOD | NO HOMES OR BUSINESSES DISPLACED | FOUR HOMES DISPLACED | FIVE HOMES DISPLACED | SAME AS PLAN A | SAME AS PLAN A | RAISING/REBUILDING 108 STRUCTURES; 19 STRUCTURES RELOCATED |
| e. COMMUNITY COHESION | POSSIBLE DETERIORATION AS COMMERCIALISM PREVAILS | NO CHANGE | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | DISRUPTED WITH RELOCATION |
| 4. REGIONAL DEVELOPMENT | ADVERSE EFFECT ON DEVELOPMENT WITH FLOODPLAIN | IN CONFORMANCE WITH REGIONAL DEVELOPMENT PLAN | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A |
| C. PLAN EVALUATION | | | | | | | |
| 1. CONTRIBUTION TO PLANNING OBJECTIVES | | | | | | | |
| a. CONTRIBUTION TO THE REDUCTION OF FLOOD WATER DAMAGE DURING THE 1990-2040 PERIOD OF ANALYSIS | CONTINUED FLOODING AND FLOOD DAMAGES | REDUCTION IN FLOOD DAMAGES | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A |

TABLE 5. Summary Comparison

| ITEM | WITHOUT CONDITIONS | WITH CONDITIONS PLAN A | PLAN B | PLAN C | PLAN D | PLAN E | PLAN F |
|---|---|---|---|---|---|---|---|
| | | CHANNEL WITH TANAPAG HARBOR OUTLET | CHANNEL WITH GARAPAN SCHOOL OUTLET | CHANNEL WITH SAIPAN LAGOON OUTLET | WETLAND STORAGE WITH HARBOR OUTLET | CHANNEL OUTSIDE WETLAND WITH HARBOR OUTLET | FLOODPROOFING |
| b. PRESERVE THE NATURAL RESOURCES OF THE AREA DURING THE 1990-2040 PERIOD OF ANALYSIS | NO CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | MOST CONTRIBUTION |
| C. CONTRIBUTE TO USE OF LANDS CONSISTENT WITH DEVELOPMENT PLANS | NO CHANGE | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | MOST CONTRIBUTION |
| 2. RESPONSES TO ASSOCIATED EVALUATION CRITERIA | | | | | | | |
| a. ACCEPTABILITY | N/A | PUBLICLY NOT ACCEPTABLE DUE TO THE DISRUPTION OF THE AMERICAN MEMORIAL PARK WETLAND | PUBLICLY ACCEPTABLE TO A DEGREE; DISPLACEMENT OF HOMES NOT ACCEPTABLE | SAME AS PLAN B | SAME AS PLAN A | PUBLICLY ACCEPTABLE TO A DEGREE; CONTINUED RESERVATIONS BY FWS, CRMO AND DEQ | PUBLICLY NOT ACCEPTABLE |
| b. EFFECTIVENESS | N/A | EFFECTIVE | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A |
| c. EFFICIENCY | N/A | ECONOMICALLY EFFICIENT | NOT ECONOMICALLY EFFICIENT | NOT ECONOMICALLY EFFICIENT | ECONOMICALLY EFFICIENT | MOST ECONOMICALLY EFFICIENT | LEAST ECONOMICAGLLY EFFCIENT |
| d. NED B/C RATIO | N/A | SEE ITEM B.1.f(4) | | | | | |
| 3. IMPLEMENTATION | | | | | | | |
| a. CORPS OF ENGINEERS | N/A | PROVIDE ESTIMATED PROJECT FIRST COST SHARE OF $3,453,000, DESIGN, AND CONSTRUCTION OF THE FC IMPROVEMENTS | PROVIDE ESTIMATED PROJECT FIRST COST SHARE OF $3,453,000, DESIGN, AND CONSTRUCTION OF THE FC IMPROVEMENTS | PROVIDE ESTIMATED PROJECT FIRST COST SHARE OF $3,453,000, DESIGN, AND CONSTRUCTION OF THE FC IMPROVEMENTS | PROVIDE ESTIMATED PROJECT FIRST COST SHARE OF $3,453,000, DESIGN, AND CONSTRUCTION OF THE FC IMPROVEMENTS | PROVIDE ESTIMATED PROJECT FIRST COST SHARE OF $3,453,000, DESIGN, AND CONSTRUCTION OF THE FC IMPROVEMENTS | PROVIDE ESTIMATED PROJECT FIRST COST SHARE OF $9,360,000, DESIGN, AND CONSTRUCTION OF THE FC IMPROVEMENTS |
| b. CNMI GOVERNMENT | N/A | PROVIDE ESTIMATED LOCAL FIRST COST SHARE OF $3,297,000; PROVIDE LOCAL ASSURANCES, COOPERATION, AND MAINTENANCE | PROVIDE ESTIMATED LOCAL FIRST COST SHARE OF $5,707,000; PROVIDE LOCAL ASSURANCES, COOPERATION, AND MAINTENANCE | PROVIDE ESTIMATED LOCAL FIRST COST SHARE OF $4,517,000; PROVIDE LOCAL ASSURANCES, COOPERATION, AND MAINTENANCE | PROVIDE ESTIMATED LOCAL FIRST COST SHARE OF $3,477,000; PROVIDE LOCAL ASSURANCES, COOPERATION, AND MAINTENANCE | PROVIDE ESTIMATED LOCAL FIRST COST SHARE OF $3,127,000; PROVIDE LOCAL ASSURANCES, COOPERATION, AND MAINTENANCE | PROVIDE ESTIMATED LOCAL FIRST COST SHARE OF $2,234,000; PROVIDE LOCAL ASSURANCES, COOPERATION, AND MAINTENANCE |

## 6.5 PROJECT SCALING

Alternative Plan E, maximizes economic efficiency based on its high net benefit as shown in Table 3. Although Plans A and D also display approximate net economic benefits, Plan E was chosen for further detailed studies based on the following:

1. Plan A is very similar to Plan E in concept except that the lower reaches of the channel passes through a portion of the American Memorial Park wetland, thus creating significant environmental impacts. The project first cost for Plan A (as shown in Table 3) does not reflect costs for mitigation of the wetlands destroyed as a result of Plan A channel construction. The additional cost for mitigation (approximately $400,000) added to the project first cost in Table 3 would further lower the net benefits of this alternative. Thus the decrease in net benefits due to mitigation coupled with the availability of more environmentally desirable plans eliminated Plan A from further scaling.

2. The upper reaches of Plan D are very similar to Plan A and E. The lower reaches differ in that the American Memorial Park wetland is used as a flood storage area. The Corps feels that use of the wetland as a dedicated flood storage basin may jeopardize it as habitat for the endangered Mariana Gallinule as well as other existing flora and fauna. Use of the wetland in a flood storage capacity would introduce large, concentrated amounts of sediment and foreign debris into the wetland at the first sizeable flood flow. This the Corps feels may degrade the existing habitability of the wetland. Use of this area as a flood storage basin would also preclude any type of future use of this area and restrict the master planning and development of the American Memorial Park. Therefore Plan D was eliminated from further project scaling.

Because of the apparent solidity of the channel alignment of Plan E in relation to project functionality as well as environmental preference, project scaling for Plan E was restricted to studying designs at different levels of protection. The levels of protection detailed were the 10-year, 50-year, and SPF floods. Table 6 summarizes Plan E scaled costs and benefits.

TABLE 6. Plan E Scaling, Summary of Costs and Benefits By Level Of Protection

| COMPONENT OF COST | 10-YR | 50-YR | SPF |
|---|---|---|---|
| | ($) | ($) | ($) |
| Total First Cost | 6,340,000 | 6,580,000 | 6,830,000 |
| Interest During Construct | 515,000 | 535,000 | 555,000 |
| Total Investment Cost | 6,855,000 | 7,115,000 | 7,385,000 |
| Annual Investment Cost [1] | 585,000 | 607,000 | 630,000 |
| Annual O & M | 7,500 | 7,600 | 8,000 |
| Total Annual Cost | 592,500 | 614,600 | 638,000 |
| Total Annual Benefits | 629,500 | 659,600 | 667,700 |
| Benefit to Cost Ratio | 1.06 | 1.07 | 1.05 |
| Net Benefits | 37,000 | 45,000 | 29,700 |

[1] Based on 8-3/8% interest amortized over a 50 year period.

## 6.6 DESIGNATION OF THE NED PLAN

Alternative Plan E at the 50-year level of protection maximizes net economic benefits as shown in Table 6. Consequently, Alternative Plan E (50-year) is designated as the National Economic Development (NED) Plan.

## 6.7 THE RECOMMENDED PLAN

Recommend that Alternative Plan E at the 50-year level of protection be implemented based upon its economic efficiency. The combined beneficial NED and environmental effects outweigh the combined NED and environmental effects of the other alternative plans.

Of the three plans that display positive net benefits and above unity benefit to cost ratios (Plans A, D, and E), Plan E, (outlet channel routed around the American Memorial Park wetland) appears to impose the least environmental impact on the wetland, as well as providing the most flexibility for future management of the American Memorial Park. The American Memorial Park wetland, which has habitat merits for the endangered Mariana Gallinule, as well as other residents has been a major preservation concern throughout the planning process of this study. Thus, response to Plan E from Federal and local CNMI agencies have been highly favorable. Though the U.S. Fish and Wildlife Service's final 2b coordination report questions the future salinity of the wetland with this alternative, the Corps believes, based on additional hydraulic, hydrologic, and environmental research and evaluation that the implementation of alternative Plan E would not significantly impact the wetland's habitat merit (further detailed discussions on wetland salinity can be found in the EIS and Appendices E, G, and H). Based on this and the NED maximization analysis, Plan E, at the 50-year level of protection is recommended for implementation.

# 7 THE SELECTED PLAN

## 7.1 RATIONALE FOR SELECTION

The selection of the most desirable flood control plan involved comparison among the alternative plans. Ranking of the alternative plans was performed on the basis of (1) beneficial and adverse effects of each alternative; (2) relative contribution to the planning objectives; and (3) response to associated evaluation criteria as listed in Table 5. A key criterion pertinent to the selection of Plan E at the 50-year level of protection was that this plan has the highest net NED benefits of the alternatives evaluated.

Based on the comments received during coordination and review of the draft Detailed Project Report with Federal and CNMI agencies, and during the public meeting conducted on July 26, 1984 and the Workshop of April 17, 1985, Plan E is the most desirable (see Appendix F). The 50-year level of protection being the most attractive level of protection offering the best return on investment of Federal and local dollars. Considerable attention and input received during the entire planning process also focused on the importance of preserving the American Memorial Park wetland.

In view of the cost-effectiveness, environmental considerations, desires of the sponsor, and other local and Federal agencies, Plan E at the 50-year design level of protection is selected for implementation.

## 7.2 PLAN DESCRIPTION

Plan E (see Figure 12) consists of 5,960 feet of channel improvements. The channel's upper reaches starts on the easterly side of West Coast Highway between 3rd and 4th streets and runs north-easterly, parallel to West Coast Highway. The channel then crosses the West Coast Highway and Micro Beach Road intersection, detours around the American Memorial Park wetland then outlets to the ocean. Ditches will be provided along the right bank just beyond the channel limits to direct flows from upland areas to five "spillway inlet" structures. This plan requires construction of culverts along the channel alignment at six road crossings. The six road crossings are Beach Road, Micro Beach Road and West Coast Highway intersection, Hospital Roads 1 and 2, Paganville Road, and Island Power Road. The existing Old Commissary Road would be closed to through traffic at the West Coast Highway. Access to all residences upland of the West Coast Highway are now from roadway branches of either Island Power Road or the Paganville Road, therefore there would be no cutoff of access. No relocation of homes or businesses would be required. Further detailed design discussion and detailed cost estimates for this plan are provided in Appendix C. The recommended Plan E is shown in figure 12 along with residual flooding areas.

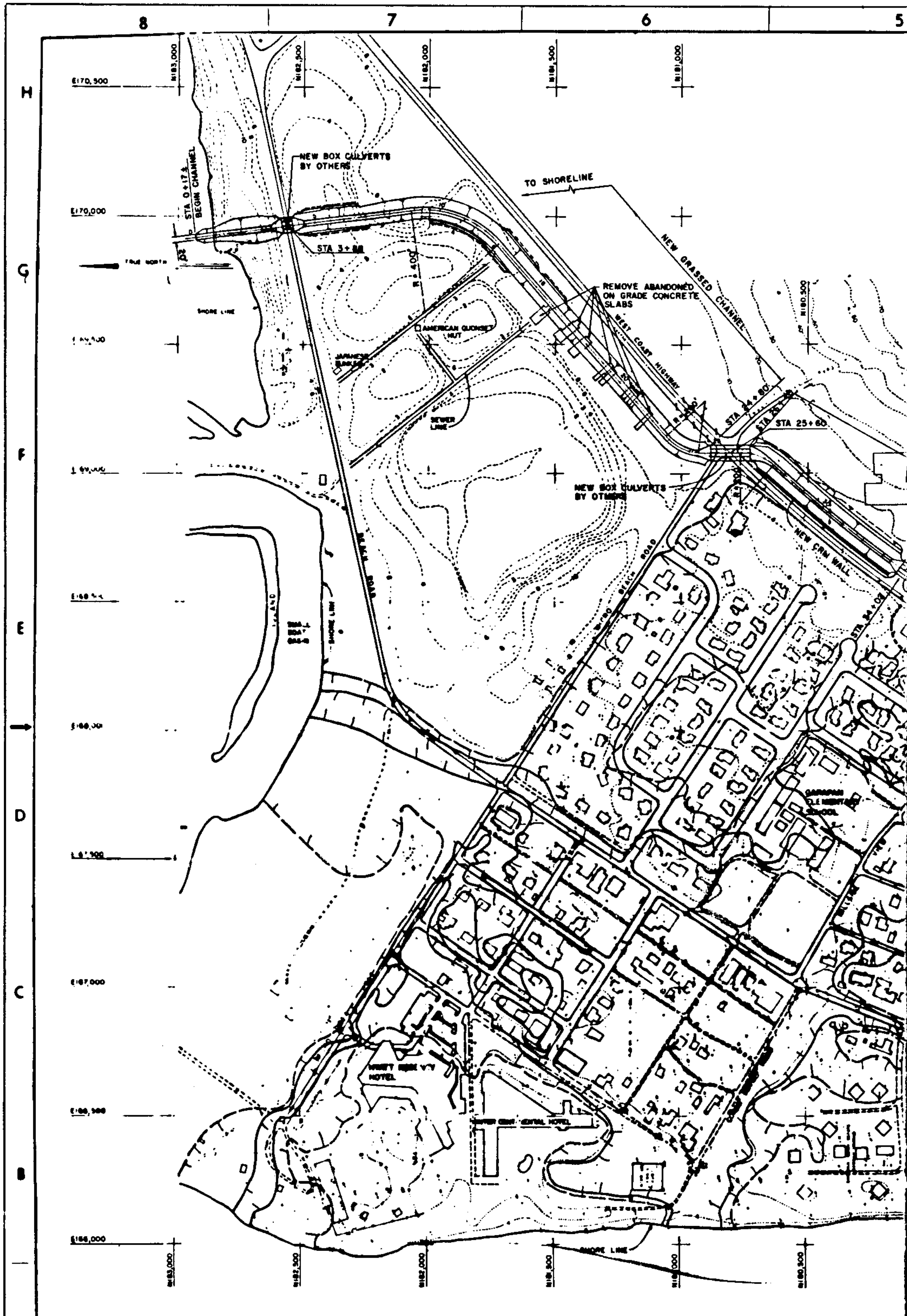
## 7.3 APPORTIONMENT OF COSTS

Based on the new cost sharing requirements as explained in section 6.3, the Federal portion of the project first cost is more than the maximum statutory limit of $4 million as prescribed by Section 205 of the Flood Control Act of 1948, as amended. Hence, cost in excess of the statutory Federal limitation will be assumed by the non-Federal sponsor, which amount is currently estimated to be $727,000. This amount is greater than the 5% cash contribution for project cost-sharing by $398,000. The summary of apportioned project first costs and the required non-Federal cash contributions is shown in Table 7. Table 8 shows the summary of apportioned project investment costs.

TABLE 7. Summary of Apportioned Project First Costs

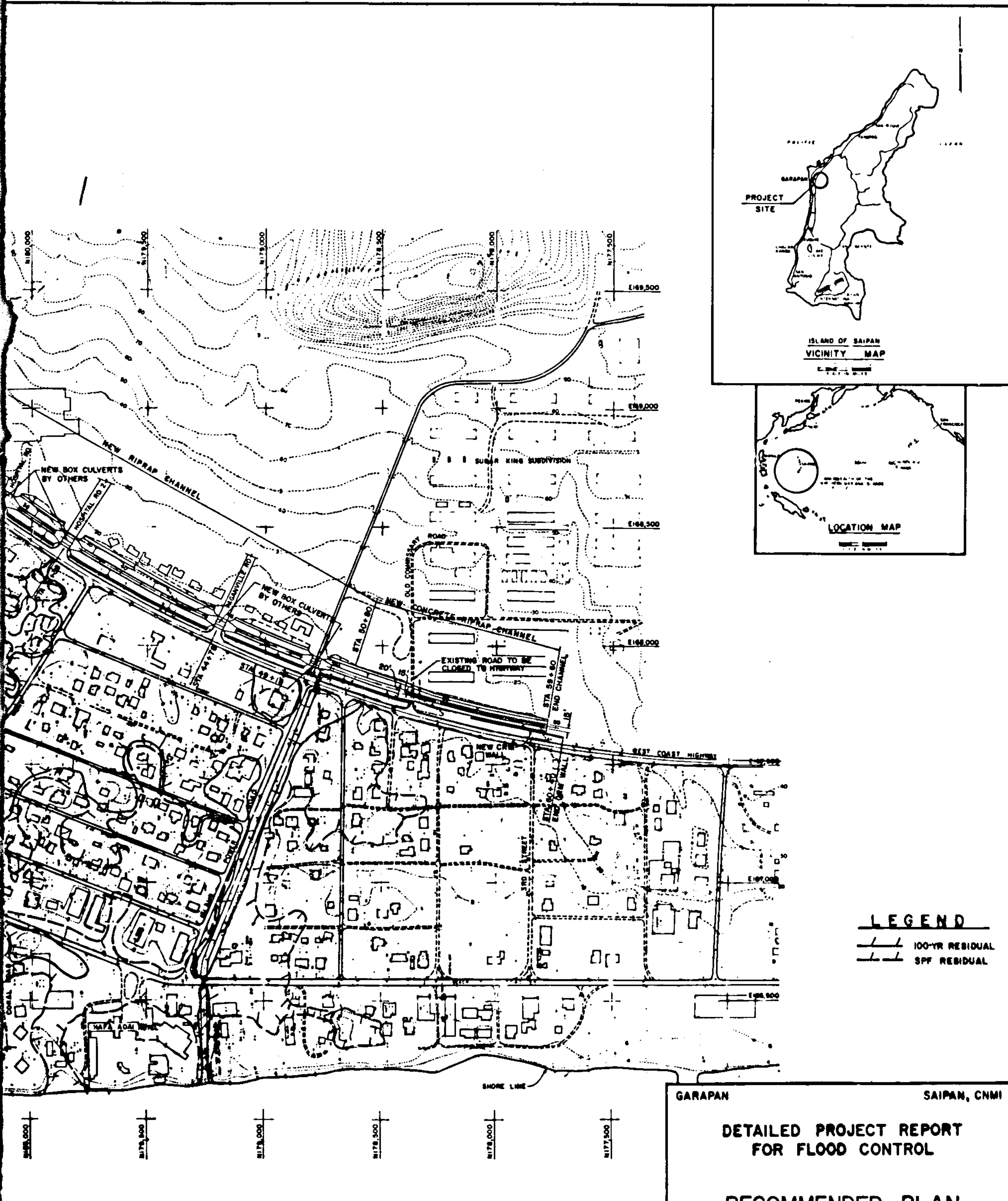
| ITEM | COSTS |
|---|---|
| FEDERAL COSTS | |
| Direct costs | 3,680,000 |
| Engineering and Design | 200,000 |
| Supervision and Administration | 300,000 |
| Preauthorization Cost | 547,000 |
| Subtotal Federal Costs | 4,727,000 |
| Total Federal Costs Subject To Statutory Limit | 4,000,000 |
| Total Federal First Cost Less Preauthorization Cost | 3,453,000 |
| NON-FEDERAL COSTS | |
| Lands Easements and Rights-Of-Way | 270,000 |
| Culverts and Relocations | 1,910,000 |
| E&D and S&I Costs | 220,000 |
| Cash Reimbursement for Federal Costs In Excess of Statutory Limit | 727,000 |
| Total Non-Federal First Cost | 3,127,000 |
| TOTAL PROJECT FIRST COST LESS PREAUTHORIZATION COST | 6,580,000 |

1




NOTES:

1. COORDINATES BASED ON MARIANA ISLANDS PLANE COORDINATE SYSTEM OF 1966.
2. ELEVATIONS ARE IN FEET BASED ON MEAN SEA LEVEL DATUM
3. FOR PROFILE AND TYPICAL SECTIONS, SEE PLATES C-2 AND C-3.




GRAPHIC SCALE

SCALE IN FEET

GARAPAN SAIPAN, CNMI

DETAILED PROJECT REPORT FOR FLOOD CONTROL

RECOMMENDED PLAN

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 12

TABLE 8. Summary of Apportioned Project Investment Costs

| ITEM | COST ($) |
|---|---|
| **FEDERAL COSTS** | |
| Project First Costs | 3,453,000 |
| Interest During Construction | 280,000 |
| Total Federal Investment Cost | 3,733,000 |
| **NON-FEDERAL COSTS** | |
| Project First Costs | 3,127,000 |
| Interest During Construction | 250,000 |
| Total Non-Federal Investment Cost | 3,377,000 |
| **TOTAL PROJECT INVESTMENT COSTS** | 7,110,000 |

## 7.4 PLAN IMPLEMENTATION

### 7.4.1 Plans and Specifications

Construction plans and specifications will be prepared by the U.S. Army Corps of Engineers upon approval and allocation of funds by the Chief of Engineers.

### 7.4.2 Project Approval and Construction Funding

When plans and specifications are sufficiently complete, project approval and construction funding will be requested. The request will be accompanied by a draft copy of the Local Cooperation Agreement (LCA includes, but is not limited to, the provisions of a Section 221 agreement). Upon project approval, the LCA will be executed between the U.S. Army Corps of Engineers and the CNMI Government. When the Chief of Engineers approves project construction, authority will be given to advertise for bids. After bids are opened and a successful bidder determined, construction funds would be provided.

### 7.4.3 Construction Schedule

Construction will be accomplished by contract awarded to a private construction firm through competitive bidding under U.S. Army Corps of Engineers supervision, and will require approximately 24 months for completion.

### 7.4.4 Maintenance

The CNMI Government, Department of Public Works will be responsible for all maintenance requirements of the completed project.

# 8 CONCLUSIONS AND RECOMMENDATIONS

## 8.1 CONCLUSIONS

In view of the overall public interest, I have considered all significant aspects, pertinent information, and stated views of local interests on various practical solutions for alleviating the flooding problems in the study area. The alternative plans considered and consequences of each were examined for economic, environmental and social effects, and engineering feasibility. Based on the flood problem, the needs and desires of the community, the expected costs and benefits, and the environmental impacts of the alternatives investigated; Alternative Plan E was selected as the recommended plan for implementation.

The proposed plan is economically justified as the NED Plan as demonstrated by the benefit-to-cost (B/C) ratio of 1.1 and net NED benefits of about $45,000. The Commonwealth of the Northern Mariana Islands has agreed to provide the necessary local cooperation agreements. A letter stating the intent of the Commonwealth of the Northern Mariana Islands to perform the requisite obligations for the project has been received. A copy of this letter is included in Appendix F.

## 8.2 RECOMMENDATIONS

I recommend that the plan for flood control improvements, Alternative Plan E as presented in this report be authorized for implementation as a Federal project, with such modifications as in the discretion of the Chief of Engineers may be advisable; at a project first cost presently estimated at $6,580,000 consisting of $3,453,000 in Federal sharing and $3,127,000 in non-Federal sharing and with annual operation, maintenance and replacement costs presently estimated at $7,600; provided that prior to implementation local interests agree to perform the following items of cooperation:

a. Provide without cost to the United States all lands, easements (including flowage easements), and rights-of-way necessary for implementation and subsequent maintenance of the project; including spoil disposal and borrow, and access thereto required for project implementation and maintenance;

b. Hold and save the United States free from damages due to implementation and maintenance of the project, not including damages due to the fault or negligence of the United States or its contractors;

c. Maintain and operate the project in accordance with regulations prescribed by the Secretary of the Army;

d. Provide without cost to the United States all relocations and alterations of buildings, utilities, streets, bridges, storm drains, and other structures and improvements made necessary by the project;

e. Assume all costs in excess of the $4.0 million statutory Federal limitation for the flood control improvements and related works.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgetary priorities inherent in the formulation of a national civil works program nor the perspective of higher review levels. Consequently, the recommendations may be modified before they are transmitted to the Chief of Engineers as proposals for approval and/or implementation funding.

Michael M. Jenks
Colonel, Corps of Engineers
District Engineer
Deputy

GARAPAN FLOOD CONTROL
SAIPAN, CNMI

ENVIRONMENTAL IMPACT STATEMENT

# FINAL

# ENVIRONMENTAL STATEMENT

## GARAPAN FLOOD CONTROL PROJECT, SAIPAN, COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

The responsible Commonwealth agency is the Coastal Resources Management Office. The lead Federal agency is the U.S. Army Corps of Engineers, Honolulu District. The cooperating Federal agency is the U.S. Fish and Wildlife Service, Pacific Islands Office.

Abstract: Saipan is the main island in the Commonwealth of the Northern Mariana Islands. The Honolulu District, U.S. Army Corps of Engineers, has investigated public concerns regarding flood protection in the village of Garapan on Saipan. An earlier detailed study was initiated in 1978. The results of the study were presented in a Draft Detailed Project Report and Environmental Statement circulated in July 1980. The study was terminated in November 1980 due to lack of local support for the alternatives developed. A subsequent significant flood event prompted a reevaluation of the flood problem. The results of the most recent analysis are presented in this document. Channelizing the floodflow and permanent evacuation and relocation and flood protection measures are the alternative concepts being studied. The channel alternatives include a common channelized section along the eastern edge of the West Coast Highway. The outlet channel alignments all differ. The alignment for Plan A conveys water through the proposed American Memorial Park and would affect an existing wetland and endangered species. The outlet alignment for Plan B is adjacent to an existing roadway alongside Garapan Elementary School. The alignment for Plan C involves the discharge of stormwater into Saipan Lagoon near the Hafa Adai Hotel. Plan D would discharge stormwater directly into the American Memorial Park wetland and ultimately into Tanapag Harbor. Plan E would direct stormwater around the wetland east and then north into Tanapag Harbor. A nonstructural plan (Plan F) involves relocation and other floodproofing measures for all damageable structures located in the floodplain. Plan E is the Recommended Alternative.

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| Name | Discipline/Expertise | Experience | Role In Preparing EIS |
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# 1 SUMMARY

## 1.1 Major Conclusions

Plan E is designated the NED and recommended plan because it has the largest net economic benefits of all plans considered. Plan F is the nonstructural alternative and is designated the least environmentally-damaging plan because it preserves the floodplain, and disturbs neither wetlands or historic sites in the Garapan area. However, Plan F would be socially disruptive, by requiring temporary relocation of 182 families during modification of their homes. All the structural plans have the potential of degrading water quality in the lagoon due to the discharge of stormwater runoff. In addition, standing water in the outlet channels is expected to be lower in quality than the lagoon waters. Plans A and D would physically modify the wetland in the American Memorial Park (AMP). Plan E is designed to avoid all wetlands. Plan E has also been designed to avoid known surface historic sites, but the potential of disturbing unknown subsurface sites would require that prior to project implementation, test corings be made along the proposed channel alignment and analyzed to determine the presence or absence of valuable subsurface cultural deposits in the project area. The discharge of fill material to line the channels is specified through the application of the U.S. Environmental Protection Agency, Section 404(b)(1) guidelines. Section 7, Endangered Species Consultation, has culminated in a Biological Opinion that none of the alternative plans would jeopardize the continued existence of endangered species.

## 1.2 Areas of Controversy

The U.S. Fish and Wildlife Service (FWS), Office of Environmental Services differ with the Corps in their assessment of the degree of potential degradation of habitat value for the endangered Mariana gallinule associated with the recommended plan. However, the U.S. Fish and Wildlife Service, Endangered Species Office, after reviewing potential project impacts in light of recent changes in the regulations governing Section 7 of the Endangered Species Act, concluded in their letter dated 24 November 1986 that none of the project alternatives would jeopardize the continued existence of the Saipan population of the Mariana gallinule. The Commonwealth of the Northern Mariana Islands (CNMI), Coastal Resource Management Office (CRMO) has not yet concurred with the Corps CZM consistency determination and has reservations about Plan E similar to those of the FWS, Office of Environmental Services. Similarly the CNMI Department of Public Health and Environmental Services (DHES), Division of Environmental Quality (DEQ) may have reservations about the project's effects on water quality; a Section 401 certification will eventually be needed from DEQ.

TABLE EIS-1. RELATIONSHIP OF THE PLANS TO ENVIRONMENT PROTECTION STATUTES AND OTHER ENVIRONMENTAL REQUIREMENTS

| Federal Statutes | Plan A | Plan B | Plan C | Plan D | Plan E | Plan F |
|---|---|---|---|---|---|---|
| Archaeological and Historic Preservation Act (See section 6.7 and 7.2) | Partial | Partial | Partial | Partial | Partial | Full |
| Clean Air Act | Full | Full | Full | Full | Full | Full |
| Clean Water Act (see Section 6.2) | Full | Full | Full | Full | Full | Full |
| Coastal Zone Management Act (see Section 7.2) | Full | Full | Full | Full | Full | Full |
| Endangered Species Act (see Section 6.6) | Full | Full | Full | Full | Full | Full |
| Estuaries Protection Act | NA | NA | NA | NA | NA | NA |
| Federal Water Project Recreation Act | Full | Full | Full | Full | Full | Full |
| Fish and Wildlife Coordination Act | Full | Full | Full | Full | Full | Full |
| Land and Water Conservation Act | NA | NA | NA | NA | NA | NA |
| Marine Protection, Research and Sanctuaries Act | NA | NA | NA | NA | NA | NA |
| National Historic Preservation Act (See Section 6.7 and 7.2) | Partial | Partial | Partial | Partial | Partial | Full |
| National Environmental Policy Act | Full | Full | Full | Full | Full | Full |
| Rivers and Harbors Act | Full | Full | Full | Full | Full | Full |
| Watershed Protection and Flood Prevention Act | NA | NA | NA | NA | NA | NA |
| Wild and Scenic Rivers Act | NA | NA | NA | NA | NA | NA |

TABLE EIS-1. RELATIONSHIP OF THE PLANS TO ENVIRONMENT PROTECTION STATUTES AND OTHER ENVIRONMENTAL REQUIREMENTS

| Executive Orders, Memoranda | Plan A | Plan B | Plan C | Plan D | Plan E | Plan F |
|---|---|---|---|---|---|---|
| Flood Plain Management | Full | Full | Full | Full | Full | Full |
| Protection of Wetlands | Full | Full | Full | Full | Full | Full |
| Environmental Effects Abroad of Major Federal Actions | NA | NA | NA | NA | NA | NA |
| Analysis of Impacts on Prime and Unique Farmlands | NA | NA | NA | NA | NA | NA |
| CNMI Policies | | | | | | |
| CNMI Coastal Zone Management Program | Full | Full | Full | Full | Full | Full |

NOTES: a. Full (Full Compliance). Having met all requirements of the statute, Executive Order or other environmental requirements for the current stage of planning (either pre- or post-authorization).

b. Partial (Partial Compliance). Not having met some of the requirements that normally met in the current stage of planning. Partial compliance entries should be explained in appropriate places in the report and/or EIS and referenced in the table.

c. Noncompliance. Violation of a requirement of the Statute, Executive Order, or other environmental requirement. Noncompliance entries should be explained in appropriate places in the report and/or EIS and referenced in the table.

d. NA (Not Applicable). No requirement for the Statute, Executive Order or other environmental requirement for the current stage of planning.

### 1.3 Unresolved Issues

See Paragraph 1.2.

### 1.4 Relationship to Environmental Requirements

See Table EIS-1.

## 2 NEED FOR AND OBJECTIVE OF THE ACTION

### 2.1 Study Authority

The Garapan Flood Control Study was conducted under the authority of Section 205 of the Flood Control Act of 1948, as amended. The Flood Control Act authorized Federal assistance in providing flood protection to a limit of $4,000,000.

### 2.2 Public Concerns

a. The study was requested by the Governor of the Commonwealth of the Northern Mariana Islands. The request indicated a desire to alleviate flooding problems in the Garapan village area of Saipan. Investigations were performed with the assistance of the Commonwealth Department of Public Works and Mariana Islands Housing Authority.

b. The flood problem in Garapan Village is discussed in detail in the main report (pp 8-10). Flood occurrences are common in the coastal areas of Garapan. Factors contributing to the flood problems experienced in Garapan include extensive urban development in a flood prone area, lack of gradient which prevents adequate drainage, and the lack of drainage outlets. While records of past flood damages on Saipan are lacking, tropical storm Carmen, August 1978, caused an estimated $2,000,000 in damages on Saipan to residences, public facilities and crops. In the Garapan area, the total damage was about $200,000, involving 85 newly constructed private dwellings in the Annex II and Puntan Muchot subdivisions of Garapan (see Figure 5 of Main Report). On 18 August 1978, President Carter declared the Commonwealth area a disaster area as a result of the storm. Damages resulting from Tropical Storm Owen in October 1982 renewed interest for further investigations. Based on CNMI estimates, approximately $0.5 million in damages resulted from the storm. Supertyphoon Kim caused additional flood damage at Garapan in December 1986. Based on information from local interests, approximately a third of the flood prone areas has been flooded since 1980. Lack of suitable flood control facilities in the Garapan village has been the source of public concern over the last decade of extensive development. Without improvements to alleviate flooding, damages are expected to recur at regular intervals.

## 2.3 Planning Objectives

The following planning objectives were employed in plan formulation.

a. Contribute to the reduction of floodwater damage during the 1990-2040 period of analysis.

b. Preserve (or minimize detrimental effects to) the natural resources of the area; and

c. Contribute to the efficient use of lands consistent with socioeconomic and cultural needs and desires of the study area residents as well as with long-range development plans for the study area.

# 3 ALTERNATIVES INCLUDING THE PROPOSED ACTION

## 3.1 Plans Eliminated From Further Study

Possible management measures for flood mitigation in the Garapan area can be separated into two broad categories, nonstructural measures and structural measures. The effectiveness of these measures in alleviating the flood problem and their economic feasibility and compatibility with existing and desired socioeconomic and environmental conditions in Garapan are discussed in the following paragraphs. The alternative of "No Development" would result in continued damages from flooding and restriction of land use in the floodplain. This action would not be responsive to the study area's needs and was therefore eliminated as an alternative.

a. Nonstructural Measures. Nonstructural measures would not reduce or eliminate the occurrence of floods. They are intended to minimize loss of life and damages when floods occur through implementation of various programs. These include flood warning and evacuation, flood insurance, floodproofing, relocation, and regulation of future development in floodplain areas through zoning ordinances and building codes.

(1) Because the existing use and proposed zoning of the Garapan floodplain are primarily residential, preliminary analysis indicated that an essentially nonstructural plan is possible and would partially meet the planning objectives. A nonstructural plan consisting of floodproofing or relocating all existing damageable structures together with a program for local floodplain management has been carried out in the analysis. This plan is discussed further in subsequent sections. Analyses of other nonstructural measures showed that application of these measures would not provide a practical solution to the problems and needs of the Garapan area.

(2) Flood prediction, warnings, preparation of temporary flood protection measures and temporary evacuation would help to decrease the flood damages. Because of the uncertainty of predicting hydrologic variables over a small drainage area, these methods of damage reduction for Garapan are not considered suitable. Floodproofing by raising structures above the flood level was found to be impractical in view of the large number of homes (nearly 182) of which the majority is the concrete block and slab type. The concept of floodproofing was assessed on the basis of providing floodwalls, floodshields, and water-proofing coatings for these structures. The large number of property owners in the affected area, together with other nonstructural steps such as preparation to minimize inundation damages, temporary evacuation and reoccupation, would present many social and economic problems for the affected residents. Although floodplain regulation would control future development and thereby eliminate or reduce damages, this approach will not alleviate the existing flood problems in the developed areas.

b. Structural Measures. Various structural methods for alleviating the flood threat and preventing flood damages were considered. These included detention ponding; creating channelways; and combinations of the above. Consequently, alternative flood protection plans for Garapan consisting of diversion and outlet channels were developed for further consideration.

## 3.2 Plans Considered in Detail

a. Common Features of Channel Alternatives (Plans A to E) (see figures in Main Report and Appendix C). Five structural channel plans which would provide protection for Garapan were investigated. Under each of these plans, an interceptor channel located above West Coast Highway would be provided to convey floodwaters to an outlet channel which would discharge the flow into the ocean. These alternative plans are shown in Appendix C and on Figures 7 through 11 of the main report. Total length of channel improvements varies from 5,660 feet for Plan C to 5,960 feet for Plan E. Common to all five plans is the 15- to 20-foot base width of the interceptor channel. The outlet channel base width for Plan A, D and E would be 20 feet, Plan B at 40 feet, and 40 feet for Plan C. All alternative plans provide for ditches and spillway inlets to convey upland flows to the interceptor channel. The invert elevation for the outlet channel at the shoreline would be 4 to 6 feet below MSL for all plans.

b. Plan A. This plan shown on Figure 7 would be designated so that flows will be one directional from a southwesterly to a northwesterly direction. The diversion channel would start from between 3rd and 4th streets at the south end and extend northeasterly on the east side of West Coast Highway until crossing Micro Beach Road intersection en route through the American Memorial Park wetlands to the ocean. The channel improvements would extend about 5,440 feet in length and this plan would require construction of culverts along the channel alignment at six road crossings and relocation of utilities at these structures. The six crossings include the Beach Road, Micro Beach Road, new Hospital Roads 1 and 2, Paganville Road and Island Power Road. Flows from the interceptor channel would pass through culverts to be located at the Micro Beach Road and the West Coast Highway intersection. The channel receiving flows from the culvert would extend through the wetlands between the ocean and the Micro Beach Road and West Coast Highway intersection and would be trapezoidal with a base width of 20 feet and side slopes of 3-horizontal on 1-vertical.

c. Plan B. This alternative plan shown on Figure 8 would allow flows from two directions along the interceptor channel. At the north end, runoff would flow southwesterly within the channel which would be about 1,270 feet long, beginning about 180 feet south of Navy Hill Road. At the south end, runoff would flow northeasterly within the channel, a distance of about 2,650 feet along the West Coast Highway. This channel would begin at a location between 3rd and 4th Streets and would meet the north channel north of Hillside View Road where a channel receiving the waters would convey the combined flows to the ocean. The combined flows would be channelized a distance of about 2,450 feet proceeding north of Hillside View Road, passing through Garapan Elementary School frontage and crossing under the Hillside View Road and Beach Road intersection to an alignment south of the Coral Paved Road to the ocean. The channel conveying the combined flows from the West Coast Highway to the Beach Road would be trapezoidal in shape. The channel from the Beach Road to the ocean would be trapezoidal with a base width of 40 feet and side slopes of 3 horizontal on 1 vertical. Plan B would require construction of culverts along the channel improvements at eight road crossings and relocation of utilities at these structures. The eight crossings consist of the Hillside View Road and Beach Road intersection, Latte Street, the West Coast Highway (twice), Paganville Road, the new Hospital Road 1 and 2, and Island Power Road. In addition, relocation of four homes along Hillside View Road would be required.

d. Plan C. This plan shown on Figure 9 is similar in concept to Plan B except that the channel on the north end would be about 1,380 feet in length and the channel on the south end would be about 2,570 feet in length. The south channel would meet the north channel south of the Island Power Road and a channel receiving the waters would convey the combined flows to the ocean. The combined flows would be routed along the southside of Island Power Road for a distance of about 1,800 feet, from the vicinity of West Coast Highway to the ocean. The channel conveying the combined flows would be trapezoidal in shape. Plan C would require construction of culverts along the channel improvements at seven road crossings and relocation of utilities at these crossings. The seven crossings consist of the Beach Road, West Coast Highway, Paganville Road, Hospital Roads 1 and 2, and Island Power Road.

e. Plan D. Alternative Plan D shown on Figure 10. This plan is identical to Plan A within the upland channel reach. The area below the West Coast Highway includes a wetland which lies within the areas bordered by the West Coast Highway, Micro Beach Road and Beach Road. This area will be used under alternative Plan D as a ponding area for floodflows. The inflow channel will be about 780 feet in length from the Micro Beach West Coast Highway intersection to the end at the wetland pond. The lowest roadway elevation is +5.90 feet mean sea level along the Beach Road. The maximum storage capability within this area is about 112 acrefeet over an area of 43 acres. The design outflow control elevation is established at elevation +2.00 feet mean sea level to maintain the wetland water level estimated at the same elevation. Flows above this elevation will be discharged over a weir into an excavated channel and through four new 10-foot by 4-foot box culverts at Beach Road en route to the ocean. The outlet channel extends about 450 feet in length from the pond to the ocean. The outflow time will range from 3.7 to 5.0 hours. Under this plan, the wetland fill areas will be graded to connect the ponds thus creating one large pond. The discussion under Plan A regarding culverts and relocation also applies to Plan D.

f. Plan E. Alternative Plan E shown on Figure 11. This plan is also identical to Plan A within the upland channel reach. Within the downland channel reach below the West Coast Highway, Plan E is similar to Plan A except that the outlet channel will be about 500 feet longer and will detour around and not encroach upon the wetland areas. This feature would allow a portion of the storm water conveyed by the flood control channel to flow into the wetland. The total length of channel improvement under Plan E is about 5,960 feet. The discussion under Plan A regarding culverts and relocations are also applicable to this plan. Alternative Plan E is the NED and Recommended Plan.

g. Plan F. Plan F is a nonstructural plan which would include raising 12 structures, providing closures around 41 structures, rebuilding 96 structures, and relocating the damageable goods of 33 structures. A total of 182 structures would be modified. Vacated lands would be retained for other passive uses consistent with the flooding potential.

## 3.3 Comparison of Alternative Impacts

Major differences in the proposed project alternatives are summarized in paragraph 1.1 (Major Conclusions). A detailed comparison of impacts is presented in Table 2 (Summary Comparisons), and in narrative form in Section 6 (Environmental Effects).

TABLE 2. Summary Comparison

| ITEM | WITHOUT CONDITIONS | WITH CONDITIONS: PLAN A — CHANNEL WITH TANAPAG HARBOR OUTLET | PLAN B — CHANNEL WITH GARAPAN SCHOOL OUTLET | PLAN C — CHANNEL WITH SAIPAN LAGOON OUTLET | PLAN D — WETLAND STORAGE WITH HARBOR OUTLET | PLAN E — CHANNEL OUTSIDE WETLAND WITH HARBOR OUTLET | PLAN F — FLOODPROOFING |
|---|---|---|---|---|---|---|---|
| A. PLAN DESCRIPTION | NO PROJECT | TOTAL OF 5,440 FEET OF CHANNEL ROUTED THROUGH THE AMERICAN MEMORIAL PARK WETLAND AND DISCHARGING INTO TANAPAG HARBOR | TOTAL OF 6540 FEET OF CHANNEL DISCHARGES INTO SAIPAN LAGOON NEAR SCHOOL | TOTAL OF 5660 FEET OF CHANNEL DISCHARGES INTO SAIPAN LAGOON FROM ISLAND POWER RD | TOTAL OF 4,710 FEET OF CHANNEL UTILIZING THE AMERICAN MEMORIAL PARK WETLAND AS STORAGE AND DISCHARGING INTO TANAPAG HARBOR | TOTAL OF 5,960 FEET OF CHANNEL ROUTED AROUND THE AMERICAN MEMORIAL PARK WETLAND AND DISCHARGING INTO TANAPAG HARBOR | ABOUT 182 STRUCTURES TO BE FLOOD PROOFED |
| | | ALL CHANNEL PLANS HAVE TRAPEZOIDAL CROSS-SECTION, RIPRAP OR GRASSED LINING AND PROVIDE 50-YEAR PROTECTION. | | | | | |
| B. SIGNIFICANT IMPACTS & PLAN RELATIONSHIPS TO NATIONAL ACCOUNTS | | | | | | | |
| 1. ECONOMIC (NED) | | | | | | | |
| a. PROPERTY VALUES | INCREASING AT PREVAILING REAL ESTATE MARKET RATE | SAME AS WITHOUT CONDITIONS | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | INCREASE LIKELY |
| b. PUBLIC FACILITIES | DAMAGES TO FACILITIES AND INTERRUPTION OF SERVICES DURING FLOODING | NO SIGNIFICANT IMPACT | NO SIGNIFICANT IMPACT | NO SIGNIFICANT IMPACT | NO SIGNIFICANT IMPACT | NO SIGNIFICANT IMPACT | SHORT-TERM SIGNIFICANT DISRUPTION LIKELY |
| c. DESIRED REGIONAL GROWTH | ADVERSE EFFECT IN FLOODPLAIN | BENEFICIAL, BUT DISRUPT PARK DEVELOPMENT | BENEFICIAL IMPACT IN FLOODPLAIN | SAME AS PLAN B | SAME AS PLAN A | SAME AS PLAN A | LONG-TERM GROWTH MAYBE ENHANCED |
| d. BUSINESS/INDUSTRIAL ACTIVITIES | DISRUPTION DURING FLOODING | MINIMIZES DISRUPTION DURING FLOOD FLOW ON ROADS | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | INDIRECT DISRUPTION LIKELY DEPENDING ON RELOCATION SITE |

TABLE 2. Summary Comparison

| ITEM | WITHOUT CONDITIONS | WITH CONDITIONS: PLAN A — CHANNEL WITH TANAPAG HARBOR OUTLET | PLAN B — CHANNEL WITH GARAPAN SCHOOL OUTLET | PLAN C — CHANNEL WITH SAIPAN LAGOON OUTLET | PLAN D — WETLAND STORAGE WITH HARBOR OUTLET | PLAN E — CHANNEL OUTSIDE WETLAND WITH HARBOR OUTLET | | | PLAN F — FLOODPROOFING |
|---|---|---|---|---|---|---|---|---|---|
| e. FARM DISPLACEMENT | DISRUPTION DURING FLOODING | NONE | NONE | NONE | NONE | NONE | | | DISPLACEMENT NOT LIKELY |
| f. QUANTITATIVE ANALYSIS | | 50 yr | 50 yr | 50 yr | 50 YR | 10 yr | 50 yr | SPF | 50 yr |
| (1) AVERAGE ANNUAL BENEFITS | N/A | 659.6 | 659.4 | 658.5 | 659.6 | 629.5 | 659.6 | 667.7 | 394.0 |
| (2) AVERAGE ANNUAL COST | N/A | 629.6 | 853.3 | 743.0 | 647.6 | 592.5 | 614.6 | 638.0 | 1098.9 |
| (3) NET AVERAGE ANNUAL BENEFITS | N/A | 30.0 | -193.9 | -84.5 | 12.0 | 37.0 | 45.0 | 29.7 | -704.9 |
| (4) BENEFIT TO COST RATIO | N/A | 1.0 | 0.8 | 0.9 | 1.0 | 1.1 | 1.1 | 1.1 | 0.36 |
| 2. ENVIRONMENTAL | | | | | | | | | |
| a. TERRESTRIAL ENVIRONMENT | INSIGNIFICANT CHANGE | 10 ACRES MODIFIED | 11.4 ACRES MODIFIED | 9.9 ACRES MODIFIED | 13.2 ACRES MODIFIED | 20.7 ACRES MODIFIED | | | UNKNOWN, NEW RESIDENTIAL DEVELOPMENT ELSEWHERE |
| b. MARINE ENVIRONMENT | INSIGNIFICANT CHANGE | 2 ACRES CREATED, 400 S.F. DREDGED | 3.4 ACRES CREATED, 480 S.F. DREDGED | 1.9 ACRES CREATED, 300 S.F. DREDGED | 1 ACRE CREATED, 400 S.F. DREDGED | 2 ACRES CREATED, 400 S.F. DREDGED | | | NO EFFECT |
| c. ENDANGERED SPECIES | INSIGNIFICANT CHANGE | NO SIGNIFICANT EFFECT | NO EFFECT | NO EFFECT | NO SIGNIFICANT EFFECT | NO SIGNIFICANT EFFECT | | | NO EFFECT |

TABLE 2. Summary Comparison

| ITEM | WITHOUT CONDITIONS | WITH CONDITIONS PLAN A CHANNEL WITH TANAPAG HARBOR OUTLET | PLAN B CHANNEL WITH GARAPAN SCHOOL OUTLET | PLAN C CHANNEL WITH SAIPAN LAGOON OUTLET | PLAN D WETLAND STORAGE WITH HARBOR OUTLET | PLAN E CHANNEL OUTSIDE WETLAND WITH HARBOR OUTLET | PLAN F FLOODPROOFING |
|---|---|---|---|---|---|---|---|
| d. WATER QUALITY | INSIGNIFICANT CHANGE | TEMPORARY TURBIDITY AND SUSPENDED SEDIMENTS DURING CONSTRUCTION; WATER QUALITY IN THE OUTLET CHANNEL WILL BE LOWER THAN IN THE LAGOON | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | NO EFFECT ANTICIPATED |
| e. HISTORIC | INSIGNIFICANT CHANGE | POSSIBLE DAMAGE TO UNKNOWN SUBSURFACE FEATURES | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | NO EFFECT ANTICIPATED |
| f. WETLANDS | POSSIBLE ENHANCEMENT WITH DEVELOPMENT OF AMERICAN MEMORIAL PARK | POSSIBLE DAMAGE WITH CONSTRUCTION THROUGH WETLAND | NO EFFECT | NO EFFECT NET INCREASE IN MANGROVES NEAR OUTLET CHANNEL. | POSSIBLE DAMAGE WITH CONSTRUCTION AND DEBRIS SETTLEMENT AFTER STORM DISCHARGE | POSSIBLE MINIMAL EFFECT DUE TO SALTWATER INTRUSION NET INCREASE IN MANGROVES NEAR OUTLET CHANNEL. | NO EFFECT |
| g. RECREATION | POSSIBLE PUBLIC FACILITIES FOR ACTIVE RECREATION TO BE DEVELOPED IN AMERICAN MEMORIAL PARK | FISHING OPPORTUNITIES INCREASED; POSSIBLE DISRUPTION TO AMERIAN MEMORIAL PARK | FISHING OPPORTUNITIES INCREASE | SAME AS PLAN B | SAME AS PLAN A | SAME AS PLAN A BUT REQUIRES RELOCATION OF PROPOSED FACILITIES IN PARK | GARAPAN AREA OPEN TO OPEN SPACE DEVELOPMENT |
| 3. SOCIAL (SWB) | | | | | | | |
| a. HEALTH, SAFETY, AND COMMUNITY WELL-BEING | DEGRADED DURING AND AFTER FLOODING-SEWAGE OVERFLOW OCCURS | FLOOD-RELATED HEALTH AND SAFETY IMPROVED; COMMUNITY WELL-BEING ENHANCED | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A EXCEPT FLOOD RELATED HEALTH PROBLEMS MAY CONTINUE |

TABLE 2. Summary Comparison

| ITEM | WITHOUT CONDITIONS | WITH CONDITIONS: PLAN A — CHANNEL WITH TANAPAG HARBOR OUTLET | PLAN B — CHANNEL WITH GARAPAN SCHOOL OUTLET | PLAN C — CHANNEL WITH SAIPAN LAGOON OUTLET | PLAN D — WETLAND STORAGE WITH HARBOR OUTLET | PLAN E — CHANNEL OUTSIDE WETLAND WITH HARBOR OUTLET | PLAN F — FLOODPROOFING |
|---|---|---|---|---|---|---|---|
| b. AESTHETIC VALUES | DEGRADATION OF LAND AND WATER QUALITY DURING AND AFTER FLOODING | NEW VISUAL INTRUSION TO CHANGING AESTHETIC CHARACTER OF AREA | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | VISUAL INTRUSION LESS; VARIED BY INDIVIDUAL STRUCTURES |
| c. AIR AND NOISE | GRADUAL RISE ASSOCIATED WITH COMMERCIAL GROWTH IN AREA | TEMPORARY DURING CONSTRUCTION | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A |
| d. DISPLACEMENT | DISPLACEMENT OF FAMILIES IN FLOODPLAIN DURING FLOOD | NO HOMES OR BUSINESSES DISPLACED | FOUR HOMES DISPLACED | FIVE HOMES DISPLACED | SAME AS PLAN A | SAME AS PLAN A | RAISING/REBUILDING 108 STRUCTURES; 19 STRUCTURES RELOCATED |
| e. COMMUNITY COHESION | POSSIBLE DETERIORATION AS COMMERCIALISM PREVAILS | NO CHANGE | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | DISRUPTED WITH RELOCATION |
| 4. REGIONAL DEVELOPMENT | ADVERSE EFFECT ON DEVELOPMENT WITH FLOODPLAIN | IN CONFORMANCE WITH REGIONAL DEVELOPMENT PLAN | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A |
| C. PLAN EVALUATION | | | | | | | |
| 1. CONTRIBUTION TO PLANNING OBJECTIVES | | | | | | | |
| a. CONTRIBUTION TO THE REDUCTION OF FLOOD WATER DAMAGE DURING THE 1990-2040 PERIOD OF ANALYSIS | CONTINUED FLOODING AND FLOOD DAMAGES | REDUCTION IN FLOOD DAMAGES | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A |

TABLE 2. Summary Comparison

| ITEM | WITHOUT CONDITIONS | WITH CONDITIONS: PLAN A CHANNEL WITH TANAPAG HARBOR OUTLET | PLAN B CHANNEL WITH GARAPAN SCHOOL OUTLET | PLAN C CHANNEL WITH SAIPAN LAGOON OUTLET | PLAN D WETLAND STORAGE WITH HARBOR OUTLET | PLAN E CHANNEL OUTSIDE WETLAND WITH HARBOR OUTLET | PLAN F FLOODPROOFING |
|---|---|---|---|---|---|---|---|
| b. PRESERVE THE NATURAL RESOURCES OF THE AREA DURING THE 1990-2040 PERIOD OF ANALYSIS | NO CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | MOST CONTRIBUTION |
| C. CONTRIBUTE TO USE OF LANDS CONSISTENT WITH DEVELOPMENT PLANS | NO CHANGE | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | PARTIAL CONTRIBUTION | MOST CONTRIBUTION |
| 2. RESPONSES TO ASSOCIATED EVALUATION CRITERIA | | | | | | | |
| a. ACCEPTABILITY | N/A | PUBLICLY NOT ACCEPTABLE DUE TO THE DISRUPTION OF THE AMERICAN MEMORIAL PARK WETLAND | PUBLICLY ACCEPTABLE TO A DEGREE; DISPLACEMENT OF HOMES NOT ACCEPTABLE | SAME AS PLAN B | SAME AS PLAN A | PUBLICLY ACCEPTABLE TO A DEGREE; CONTINUED RESERVATIONS BY FWS, CRMO AND DEQ | PUBLICLY NOT ACCEPTABLE |
| b. EFFECTIVENESS | N/A | EFFECTIVE | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A | SAME AS PLAN A |
| c. EFFICIENCY | N/A | ECONOMICALLY EFFICIENT | NOT ECONOMICALLY EFFICIENT | NOT ECONOMICALLY EFFICIENT | ECONOMICALLY EFFICIENT | MOST ECONOMICALLY EFFICIENT | LEAST ECONOMICADLLY EFFCIENT |
| d. NED B/C RATIO | N/A | SEE ITEM B.1.F(4) | | | | | |
| 3. IMPLEMENTATION | | | | | | | |
| a. CORPS OF ENGINEERS | N/A | PROVIDE ESTIMATED PROJECT FIRST COST SHARE OF $3,453,000, DESIGN, AND CONSTRUCTION OF THE FC IMPROVEMENTS | PROVIDE ESTIMATED PROJECT FIRST COST SHARE OF $3,453,000, DESIGN, AND CONSTRUCTION OF THE FC IMPROVEMENTS | PROVIDE ESTIMATED PROJECT FIRST COST SHARE OF $3,453,000, DESIGN, AND CONSTRUCTION OF THE FC IMPROVEMENTS | PROVIDE ESTIMATED PROJECT FIRST COST SHARE OF $3,453,000, DESIGN, AND CONSTRUCTION OF THE FC IMPROVEMENTS | PROVIDE ESTIMATED PROJECT FIRST COST SHARE OF $3,453,000, DESIGN, AND CONSTRUCTION OF THE FC IMPROVEMENTS | PROVIDE ESTIMATED PROJECT FIRST COST SHARE OF $9,310,000, DESIGN, AND CONSTRUCTION OF THE FC IMPROVEMENTS |
| b. CNMI GOVERNMENT | N/A | PROVIDE ESTIMATED LOCAL FIRST COST SHARE OF $3,297,000; PROVIDE LOCAL ASSURANCES, COOPERATION, AND MAINTENANCE | PROVIDE ESTIMATED LOCAL FIRST COST SHARE OF $5,707,000; PROVIDE LOCAL ASSURANCES, COOPERATION, AND MAINTENANCE | PROVIDE ESTIMATED LOCAL FIRST COST SHARE OF $4,517,000; PROVIDE LOCAL ASSURANCES, COOPERATION, AND MAINTENANCE | PROVIDE ESTIMATED LOCAL FIRST COST SHARE OF $3,477,000; PROVIDE LOCAL ASSURANCES, COOPERATION, AND MAINTENANCE | PROVIDE ESTIMATED LOCAL FIRST COST SHARE OF $3,127,000; PROVIDE LOCAL ASSURANCES, COOPERATION, AND MAINTENANCE | PROVIDE ESTIMATED LOCAL FIRST COST SHARE OF $2,234,000; PROVIDE LOCAL ASSURANCES, COOPERATION, AND MAINTENANCE |

## 4 AFFECTED ENVIRONMENT

### 4.1 Environmental Conditions

The PROFILE OF BASE CONDITIONS in the Main Report (pp. 5-6) describes the physical setting, human resources and development and economy of Saipan Islands as a whole. These paragraphs in the EIS focus on the study area in Garapan Village.

a. Garapan village lies in the central coastal area of western Saipan (see Figure 2, Main Report). The present population of the village is 2,063 persons representing about 14.2 percent of the total population on Saipan. However, the Garapan region also includes Saipan's only deepwater port facility and concentration of industry at Tanapag and the villages of Tanapag, San Rogue and Capital Hill. The population of these areas, including Garapan village, represents about 29 percent of the total population on Saipan. The village of Garapan is located in an area adjacent to Puntan Muchot Peninsula, and is presently undergoing population growth more rapid than any other village on Saipan. Garapan estates and two Sugar King subdivisions are expected to double population in the Garapan area. Two of Saipan's most modern hotels and Saipan's best beaches are located at Garapan. The Physical Development Master Plan for Saipan assumes that Garapan will remain a desirable location for new residential growth because of the availability of easily developable land. The plan also provides for a resort-tourist related industry, a recreational-historical park, port and industrial facilities, a new junior high school and elementary school, and a new hospital in the Garapan area. Figure 3 in the Main Report illustrates future land uses in the Garapan area.

b. Garapan may have been either a Chamorro or Spanish village prior to the removal of the native Chamorro population by Spain in 1660. Carolinians resettled Saipan in the 1800's and reestablished Garapan before the Chamorros returned to Saipan. During the Japanese occupation of Saipan, Garapan became the center of government, economy and population on Saipan, and the Japanese population far outnumbered the native population. During World War II, portions of Garapan were destroyed and later rebuilt as a naval port supporting U.S. military operations. The American Memorial Park Wetland (AMPW) at Garapan was also heavily disturbed during this time (see Section 5.4). The native population was relocated to Chalan Kanoa Susupe, but were later allowed to reestablish other villages including Garapan.

c. The Garapan coastal area consists of generally flat filled land and beach material. Alluvial material overlies hardened limestone at the foot of the limestone hills. Vegetation in the Garapan area reflects previous disturbance by man and is basically identified as coastal strand vegetation, urban vegetation (consisting of a mixture of strand, cultivated and upland vegetation), and the tangan tangan vegetation (cultivated during the war to control erosion), and some wetland vegetation at the AMPW. The upland hill areas consist of a mixture of tangan tangan and limestone forest vegetation. Wildlife in the area is dominated by introduced birds. No national shoreline or beach parks, wildlife sanctuaries or refuges, municipal water supply recharge areas, harvestable shellfish beds, or prime agricultural lands are designated in the Garapan project area.

## 5 SIGNIFICANT ENVIRONMENTAL RESOURCES

### 5.1 Groundwater

a. There are two basic sources of groundwater in Saipan; basal and high level water. The basal water, that which lies on top of seawater, is abundant on Saipan. Unfortunately, the freshwater lens is very thin, and overpumping of wells has resulted in water of inferior drinking water quality. Basal sources serve the entire southern part of Saipan, including the villages of San Vicente, Oleai, Chalan Kanoa and San Antonio, as well as the hospital and the International Airport. The high level sources, lying in volcanic formations in the higher mountainous zone, produce a higher quality water which serves the northern villages of Garapan, Tanapag, San Roque, Capitol Hill and Navy Hill.

b. No municipal groundwater supply sources are located in the impact area and the proximity of the ocean suggests that the water is not potable. Northern Garapan is serviced by a sewage collection system which is treated and discharged into Tanapag Harbor near the port facilities. Sewerage systems in southern Garapan consist of cesspools and septic tanks which probably leach into the groundwater. Nitrogen-laden waters are believed to be leaching into the lagoon along the shoreline near the hotels. In the southerly parts of Garapan Village, the ponding from flooding and poor interior drainage often results in surface discharges from overflowing cesspools and privies. During flood conditions, these wastewaters drain into the Saipan Lagoon contaminating nearshore waters.

### 5.2 Water Quality

a. Only intermittent records of marine water quality are available. Since 1983, the Division of Environmental Quality (DEQ) under the CNMI Department of Public Health and Environmental Services has been systematically measuring marine water quality, but only fecal coliform levels are evaluated for nearshore waters (beach sampling stations). Sample Station B23 measures nearshore water quality at Unai Sadog Tase near the Puerto Rico Dump, about 0.2 mile northwest of where the channels under Plans A, D and E would outlet. In a 20 month period from September 1983 to April 1985 (less August and September of 1984), CNMI Class A Water Quality Standards were exceeded (>400 FC per 100 ML if measured only once per month) three times. It is clear that leachate from Puerto Rico dump is the primary influence on bad quality here. The

Coastal Resources Management Office document, Saipan Lagoon Management Plan, noted that coastal waters in the Tanapag area receive runoff from the commercial port, sewage effluent from the sewer outfall south of Charlie Dock, and debris and leachate from the Puerto Rico dump. In addition, water clarity is significantly reduced by high levels of suspended silt.

b. In the lagoonal area where the channels under Plans B and C would outlet, Sampling Stations B15 (Hafa Adai Hotel Beach), B16 (Samoan Housing Beach), and B17 (Hillside View Road Drainage Ditch) best describe nearshore water quality. Of these stations in the same sampling period, nearshore waters in the vicinity of the drainage ditch exceeded CNMI's water quality standards four times between September 1983 and June 1984.

## 5.3 Littoral Processes

No empirically-based information on littoral processes is available for the Garapan area. Aerial photographs and information concerning dredged areas, and preliminary current studies (M&E Pacific, 1980) suggest that there is little significant continuous littoral movement of coastal materials along the lagoonal shoreline at Garapan. The Garapan Dock area, which was dredged in 1944-45 still has a 12-foot depth despite the lack of any maintenance dredging in the interim 40 years. Current surveys indicate that water in the lagoon flows north and south toward an opening in the barrier reef offshore Garapan. However, a sand berm that now blocks an existing drainage channel there suggests that there may be onshore offshore movement of sand related to significant storm events. The Unai Sadog Tase embayment within Tanapag Harbor is shallow and relatively quiescent. Currents are generally weak and are generated primarily by tides.

## 5.4 Wetlands

a. Two wetlands are located in the Garapan area. One is a very small wetland (approximately 0.25 acre) along the west side of West Coast Highway near Micro Beach Road. This wetland is fenced and, according to local sources, now serves as a ponding basin. It was apparently created for this purpose after completion of a residential housing development adjacent to it. Dominant vegetation consists of *Scirpus* sp. and other emergent grasses. The open water area provides nesting and foraging habitat for several species of migratory ducks.

b. The larger wetland is located in the American Memorial Park. The water surface area of this wetland is approximately 27 acres during the wet season. During extended dry periods, the wetted perimeter of the marsh shrinks considerably.

c. Previous disturbance of the Memorial Park wetland area, especially around the perimeter, is evident. There appears to have been extensive filling for construction of Beach Road and for storage yard, warehouses and other facilities observed in old aerial photos and maps. An elevated road runs across the wetland from West Coast Highway to Beach Road. Parallel to this and approximately 100M north, a fill for a sewer pipeline is still intact. A smaller spur road extends perpendicularly from the major road north to the remains of a large bunker-like quonset structure at the edge of the sewerline fill. The two roads and pipeline subdivide the wetland into 4 separate units. The largest unit is located on the southwest side of the wetland. There are relatively large areas of open water (approximately 200M across the long axis), partially separated by a stand of mixed trees and shrubs, possibly on the remnant of another road observed in old photos. The dominant vegetation in the open areas is the marsh fern (Acrostichum aureum) with scattered patches of emergent grasses, mainly sedges.

d. Several species of grass are common in the wetland. Elephant grass (Peunisetum purpureum), California grass (Brachiara mutica) and guinea grass (Panicum maximum) were most abundant along the perimeter of the wetland. Pago (Hibiscus tiliaceus), screw pine (Pandanus sp.) and tangan tangan (Leucaena leucocephalia) are also common around the wetland. Ironwood trees (Casuarina litorea) are scattered throughout the wetland area and dominates the overstory. A few mangrove trees (Brugiera gymmorrhiza) are found in several locations within the wetland.

e. Several birds have been observed in the wetland during the course of the flood control study. These include the Black-crowned Night Heron, Mariana Fruit-doves, Rufous Fronted Fantails and the endangered Mariana Gallinule, and Nightingale Reed Warbler.

f. Two species of fish occur in the wetland; an introduced guppy (Gambusia sp.) and an estuarine fish (Megalops cyprinoides) which probably migrates as a juvenile into the wetland through the existing drainage culvert during flood conditions. Several adult Megalops, approximately 1.5-2 feet in length, were observed in the wetland.

## 5.5 Migratory Shorebirds

Migratory shorebirds prefer open shallow water, open muddy banks, and the expansive tidal flats along the shoreline of the lagoon. Lemke (1983, unpublished) listed six species of wading birds and 14 species of migratory shorebirds known from Saipan. Most of these species utilize the tidal flats of the Unai Sadog Tase embayment as resting and foraging habitat. The U.S. Fish and Wildlife Service (see Appendix G) observed the White Tern, Lesser Golden Plover, Whimbrel and Wandering Tattler in the urban and beach area of Garapan.

5.6 Lagoon Resources

a. A survey of fishery resources in Saipan Lagoon identified 24 fishery habitats and 249 species of fish, recommended preservation of 21 fishery habitats, and identified roughly 24 species of fish of economic important. The habitats along the Garapan shoreline and Memorial Park shoreline were not identified as the habitats with the most significant fish diversity. The richest fish habitats were those associated with the barrier reef, reefs around Managaha Island and the *Acropora* thicket in Garapan channel well offshore from the project area. The habitat along the Garapan shoreline fronting Hafa Adai Hotel, Garapan Dock and Micro Beach was described as an *Enhalus acoroides* seagrass habitat having a fine sand substrate and mixed with other seagrasses and algae. Rabbitfish were most abundant in this habitat, while goatfish and snappers were common. The mid-lagoon habitat further offshore consisted of sand and rubble dominated by algae with few economically important fishes. Mangroves are common along the shoreline near the proposed channel outlet and represent the only important mangrove community in the CNMI.

b. The unimproved small boat basin adjacent to the Memorial Park is a dredged habitat consisting of a silty rubble substrate littered with wreckage that provides shelter and hard substrate above the silt bottom. While the highest counts of silversides were made in the habitat, the abundance of silversides was judged by the investigators to be low. Schools of juvenile jacks were also seen in the dredged channels. None of these areas were identified as important fish spawning or nursery areas.

c. Mangroves are common along the shoeline near the proposed channel outlet and represent one of the few mangrove communities in the Commonwealth of the Northern Mariana Islands.

5.7 Endangered Species

The U.S. Fish and Wildlife Service Endangered Species Office has informed the Corps that the endangered Nightingale Reed Warbler (*Aerocephalus luscinia*) and Mariana Gallinule (*Gallinula chloropus guami*) had been reported from the American Memorial Park wetland area. In October 1984, a survey of the Garapan wetland was conducted by Corps and CNMI Department of Natural Resources biologists to delineate the wetland boundary and obtain additional information on the biological characteristics of the wetland area. During the survey, the Nightingale Reed Warbler was frequently heard and sighted. One or two Mariana Gallinule were heard in two locations within the wetland, but because of its preference for seclusion, were never sighted. In November 1984, U.S. Fish and Wildlife Service and CNMI biologists observed two Mariana Gallinule in the American Memorial Park wetland. Records of additional gallinule sightings in the wetland, between our first surveys in 1979 and the present, bringing the total number of birds sighted to eight.

An estimate of gallinule population densities in the wetland has not been attempted. However, based on available information, it appears that their numbers are low. The greatest population of gallinule on Saipan inhabits Lake Susupe and its surrounding wetlands. In 1981, the Corps of Engineers field survey estimated a population of between 90-120 gallinule in the Susupe wetland. The FWS Micronesian Forest Bird Survey, 1982, stated that this was a reasonable estimate for the numbers around Susupe.

Incidental observations of gallinule outside of the Susupe area were also noted in the FWS Forest Bird Survey. Two birds were found dead on roads near small wetlands, one in Garapan (the AMP wetland) and one in Tanapag. A single gallinule was observed twice in a small tidal channel at Tanapag. Two birds were observed far from known water sources. One of these was seen in the Kagman area, probably in the vicinity of the wetland located there, and the other near the airport crossing the road and entering a dry tangantangan thicket. Although definitive information on gallinule movement patters is lacking, it appears that the gallinule are concentrating in the Susupe wetland during the dry season, from December to July, which coincides with their observed nesting season. During the wet season, some of th gallinule disperse to forage at otehr small or seasonal wetlands located throughout Saipan, including the AMP wetland. In the open water areas, large clumps of the marsh fern (Acrostichum aureum) are abundant. Unlike Susupe, Hagoi and other wetlands in the Northern Mariana Islands, the bulrush (Scirpus littoralis), a primary gallinule nesting habitat, is a minor component of the emergent plant community in the AMP wetland. Instead, the marsh fern dominates. Consequently, if nesting does occur here, it would probably occur in the emergent clumps and thickets of marsh fern. To date, no nesting activity by the Mariana gallinule has been documented in th wetland. In addition to the uncertainty of suitable nesting vegetation the AMP wetland is notably lacking in "edge" vegetation, considered to be another important component of the gallinule habitat. Evidence suggests that its suitability as gallinule habitat is marginal. The wetland is also probably slowly filling in with sediment resulting in additional loss of open water habitat. The AMP wetland would require substantial physical improvement to serve as an important habitat for the gallinule.

## 5.8 Recreation

a. The beaches along the lagoon shoreline provide water-contact recreation opportunities. Unimproved boating facilities are located at the Garapan Dock and in the proposed American Memorial Park. Micro Beach Park, the beach fronting the Intercontinental and Continental and the Hafa Adai Hotels, and the Beach Drive beach park also provide recreational resources. Fishing occurs all along the shoreline and underwater tour operators utilize the lagoon for recreational diving and snorkeling. Surfing is not known to be a significant recreational activity. The Physical Development Master Plan for Saipan proposed in

1978 the development of a Sugar King Historic Park. Village recreational facilities are found at the Village Center, Garapan Elementary School and the Intercontinental Hotel.

b. The American Memorial Park, including the AMP wetland, is a 133-acre area comprising the northern part of the study area (Figure 3, Main Report). It was established in 1978 to honor those American and Commonwealth citizens who died in World War II. The Park is owned by the CNMI Government and administered by a Governor's task force, but is being initially developed and managed by the National Park Service. Their General Management Plan and Comprehensive Design, prepared in September 1983, recommended that there be no disturbance of wetland areas and preservation of nine historic features. The long-range Comprehensive Design calls for maintaining the southern two-thirds of the wetland area as a natural area, crisscrossed with trails. It also recommends the construction of several active recreational facilities along West Coast Highway (see para 6.8b), including ball fields within the northern one-third of the triangular area bordered by the West Coast Highway, Beach Road and Micro Beach Road.

## 5.9 Historic Resources

a. A cultural reconnaissance study was prepared by Pacific Studies Institute for this study in March 1980. Archaeologists walked along the alignment of the diversion channel above West Coast Highway which is common to all structural plans and along the alignment of Plan C parallel to Island Power Road; and in the general vicinity of the Plans A, D, and E alignment through American Memorial Park. Historic site information was based on an earlier archaeological reconnaissance conducted in 1979 for the National Park Service by the same author. No evidence of surface or subsurface sites was found along the Plan C alignment. Several World War II-related historic features were located in American Memorial Park near the channel alignment of Plan A including medium-sized Japanese pillbox (Feature 7) and a large Japanese bunker (Feature 8).

The CNMI Historic Preservation Officer (HPO) (July 30, 1980 letter) and the National Park Service (September 1983 General Management Plan) indicated that these features should be preserved and were probably eligible for inclusion on the National Register of Historic Places. The alignment of Plan B alongside Hillside View Road was not surveyed in 1980, but the HPO indicated in 1980 that there was little likelihood of finding intact subsurface cultural materials there due to modification of the terrain during and after World War II.

b. The Pacific Studies Institute archaeologists also found surface remains (pottery sherds) of a possible prehistoric Latte Phase (A.D. 900-1500) site (Site #1) at the southern corner of Navy Hill Road and West Coast Highway. Subsequent coordination with the CNMI HPO in 1980 initially indicated that the site had been destroyed by construction of sewer and water lines. In reviewing the 1984 DEIS, the U.S. Department of the Interior questioned this conclusion based on a review of Corps borings along West Coast Highway. The Corps archaeologist conducted a field check of the area of potential environmental impact in October 1984 and substantiated the Department of Interior hypotheses. The Corps now believes that the zone immediately above West Coast Highway, which is common to all structural alternative plans, may represent an earlier prehistoric-era shoreline and may contain subsurface cultural materials of unknown significance. The triangular area within American Memorial Park bordered by West Coast Highway, Micro Beach Road and Beach Road is not likely to contain subsurface cultural materials within the areas of potential environmental impact, but previously identified historic surface features may not be accurately located.

## 5.10 Land Use and Social Characteristics

Land use is also described in the Main Report (p. 7). The newest, most modern houses in Saipan are found in Garapan (except for Capital Hill) where only 22 percent lack complete plumbing systems compared to an island average of 46 percent and the median value in 1980 was $35,300 compared with an island average of $11,200. In 1982, there were 287 residential structures in the Standard Project Flood (SPF) floodplain, comprising about 39 percent of the total housing units in the village. Of the total 395 occupied housing units in Garapan in 1980, the Census records that only 42.8 percent are owner occupied, compared with a Saipan average of 58.3 percent. Most of the houses in the floodplain are owned by the Mariana Islands Housing Authority (MIHA). No other population characteristics at the village level except for total population (see Para 4.1a) from the 1980 Census are available. The majority of residents in the area are native to Saipan and own the land on which their homes are built. They also view landownership as a commodity which can be bought, and as a vehicle of family solidarity and responsibility. The desire to own land is strong and results in a high market valuation of land on an island with limited land area. Many conflicts and confusion regarding land-ownership exist because the various land law systems which were imposed by non-native rulers created complex and contradictory sets of land records. Thus, many titles to private parcels are in dispute.

## 5.11 Section 122 (Public Law 91-611) Resources

Section 122 of the River and Harbor Act of 1970 supplements the provisions of the National Environmental Policy Act of 1969. Section 122 requires that at least 17 possible, adverse economic, social and environmental effects relating to any proposed project, be considered in evaluating all Corps water resources projects. The minimum list of 17 "effects" are desirable regional growth, employment/labor force, local governmental finance, business and industrial activity, displacement of people, displacement of farms, desirable community growth, population, public services, public facilities, aesthetic effects, community cohesion, noise, air pollution, water pollution, natural resources, and man-made resources. These are addressed in the Social/Cultural Appendix E.

# 6 ENVIRONMENTAL EFFECTS

## 6.1 Groundwater

The groundwater in the Garapan area is not potable, and no municipal water supplies are located in the floodplain. All outlet channel alternatives would extend tidal waters inland up the channel, but the alternative plans will not affect potable water resources on Saipan. The nonstructural alternative would not modify waterways or tidal waters, and should not affect groundwater resources.

## 6.2 Water Quality

a. All five structural plans would have temporary and long term, albeit intermittant, effects on coastal water quality. The outlet channel under Plan E would require dredging of the reef flat to a maximum distance of 80 feet offshore. The material to be removed would consist of coralline and terrigenous fines, sand and coral rubble. Localized turbidity would result from the dredging activity. The duration of dredging is anticipated to be approximately less than one month. Little of the suspended materials resulting from dredging is likely to reach the popular Micro Beach area. It will probably settle out elsewhere within the Unai Sadog Tase embayment. The Corps will assure that dredging of the outlet channel complies with CNMI water quality standards to the maximum extent practicable.

b. Long-term water quality impacts would be associated with periods of heavy rainfall where the discharge of relatively large volumes of terrestrial runoff would occur in the coastal waters adjacent to the channel outlet. A temporary zone of mixing of unknown dimensions would result within which higher than ambient turbidity and depressed salinity would be the most important parameters. Small amounts of pollutants from terrestrial sources would also occur in the discharge. Because the drainage area is predominantly open land and urban residential area with little, if any, industrial activity, extraneous pollutants contained in the storm runoff would be relatively innocuous and in low concentrations. Moreover, water quality in the Unai Sadog Tase receiving waters is presently degraded with several water quality parameters chronically in exceedance of CNMI standards.

## 6.3 Littoral Processes

None of the alternatives would likely affect existing littoral processes due to the short length of offshore dredging (80 feet) and the relatively stable regime of sand movement (except under extreme ocean storm conditions). The recommended Plan E is sited within a man-modified embayment which should particularly isolate any downstream effects of the outlet channel structures. Whether or not silt and debris-laden flood waters are discharged during rising or falling tidal movements would likely influence the extent and rapidity of dilution and dispersion of storm water runoff within the barrier reef lagoon. Additionally, some erosion of the soft unconsolidated surface layer (20-30 cm) on the reef flat would be anticipated. The fine sediment layer eroded from the surface seaward of the channel and silt-laden flood waters is likely to be redeposited within the Unai Sadog Tase tidal flat and embayment.

## 6.4 Wetlands

a. The 50-foot wide outlet channel of Plan A would pass directly through the American Memorial Park wetland, including the largest open water area within the marsh. Approximately 4.2 acres of wetlands would be lost. Mitigation measures included in this alternative would have consisted of replacement of the wetland area lost and could have included removal of part of the existing fill areas within the wetland, connecting the now separate open water areas and improving overall circulation. During non-flood flow conditions, the channel (invert elevation -6 feet MSL) would contain standing seawater from the outlet into the terminal wetland areas. Depending upon the permeability of materials used to construct the channel, the introduction of higher salinity water may modify the water quality characteristics of the wetland.

b. Plan D would intercept and divert sheet flow runoff from elevated areas southeast of American Memorial Park into the wetland located there. Silt, petrochemical and pesticide residues and other debris carried in the storm water would be discharged into the wetland where much of it would settle out. Petrochemical, pesticide and other toxic material levels in the drainage area are probably low. Most of the drainage area is presently undeveloped and thickly vegetated with the shrub "tangan tangan." Minimal erosion and silt transport during floods would be anticipated. However, sediment infilling of the wetland would accelerate and hasten the wetland's transition to bottomland habitat.

c. The outlet channel for the recommended Plan E will intercept and divert sheet flow runoff from elevated areas east of the American Memorial Park wetland that would normally flow into the wetland during high rainfall conditions. To minimize impacts on the hydrology of the marsh due to loss of water from this source, the channel will include design features providing for the discharge of some storm water into the wetland. Increased sediment discharges and salinity regimes in the vicinity of the outlet channel may encourage expansion of mangrove trees along the lagoon shoreline.

Groundwater seepage is expected into portions of the proposed channel because the channel invert is below the water table elevation along most of the reach. Seepage will continue as long as the water table surface is higher than the level of water in the channel. The water table elevation is approximately two feet between 1000 feet from the ocean end of the channel and STA 26+40 (See Plate C-1, Appendix C). Hence, even during the maximum tide of 1.9 feet, a gradient will exist above the 1000-foot point in the channel so that groundwater will tend to flow into the channel.

The amount of groundwater flow into the channel, roughly estimated using Darcy's law, was between 10,000 and 40,000 gallons per day. This net inflow of freshwater will tend to mix with denser seawater that enters the channel from the ocean and moves up the channel bottom. The state of the tide and rate of groundwater seepage into the channel will influence the mixing rate. Upstream areas of the channel that intersect the water table will experience greater influx from groundwater due to the higher water table elevation. This will tend to cause salinity to decrease in the upstream direction. Also seawater moving up the channel from the shoreline will be mixed and tend to be diluted (exhibiting lower salinity) by the time it reaches the upper channel.

The general area of concern for seawater intrusion is the portion of the channel where the water table elevation is less than the height of the highest tide (STA 0+00 to approximately 1000 feet upstream). Water from the channel would tend to penetrate the ground only during times when the water surface level of the channel exceeds the water table elevation. Whenever the tide reverses, water will tend to flow out of the channel walls. Since the water table elevation is always above sea level, the general period of concern would be during the high tide phase. A zone within the immediate vicinity of the channel walls and invert in the very lower reaches may experience a flushing in and out phenomena daily. However, because the proposed channel skirts around the wetland, there should be minimal effect on the wetland.

d. Plans B and C affect no wetlands.

e. Plan F, the nonstructural plan, will have no effect on wetlands in the project area.

6.5 Lagoon Resources

a. The outlet channels of all plans require excavation of a small area near the shoreline in the lagoon or the Unai Sadog Tase embayment. Construction of Plans B or C would have resulted in about 480 or 300 square feet of habitat destruction, including some Enhalus seagrass. Plans A, D, and E would result in the loss of about 400 square feet. In each case, nutrients exiting the channel during tidal flushing and periods of flow could stimulate growth of seagrass and algae at the mouth of the outlet channel. Fish will colonize the outlet channel and it may become a limited nursery area for certain lagoon dwelling species. The amount of new marine habitat created by each plan is estimated on Table 2. The nonstructural alternative would not affect Saipan Lagoon anywhere.

b. The shallow Unai Sadog Tase intertidal reef flat has been identified by the CNMI Department of Natural Resources and the U.S. Fish and Wildlife Service as an important feeding and resting area for migratory shorebirds and wading birds. The outlet channels of Plans A, D and the recommended Plan E are located in this area. The loss of only 400 square feet there is insignificant compared to the total area available for feeding and resting. In fact, migratory shorebirds may benefit by the creation of some deeper intertidal area within the outlet channels. Cleared, grassed open areas along the channel banks would provide additional resting and feeding habitat for most shorebirds.

Long-term project impacts or nearshore resources in the discharge area are not expected to be significant. Although the area is not known to be widely used by fishermen, any changes in fishing success resulting from the project would most likely be positive. The creation of a limited estuarine environment would increase the use of the area by mullet, milkfish, tarpon, flagtails and other sport and food fish.

Depressed salinity and sedimentation that result from intermittent discharge of stormwater into Tanapag Harbor would not be expected to have adverse long-term effects on seagrass. Because seagrasses are euryhaline (grow in a wide range of salinities), they can acclimate to a changing salinity regime. Many seagrass species can tolerate short-term salinity changes ranging from fresh to 90 parts per thousand (ppt) and maintain osmotic resistance. Temporary salinity changes from storm water discharge would not be expected to adversely affect seagrass beds in the proximity of the outlet channel.

One of the primary functions of seagrass communities is to trap and accumulate particulate matter (fine sediments). Sedimentation is a process that seagrasses are adapted to and ultimately depend on for survival. Normal sedimentation would not be expected to adversely affect seagrasses. Addition of nutrients would probably stimulate growth and increase plant density.

The Unai Sadog tase shoreline is ringed by a narrow strand of mangrove trees (Bruqiera gymnorrhiza). The short-term impact of constructing the channel outlet could result in removal of several mangrove trees, possibly as many as six. In the long run, the flood control channel will create a limited estuarine environment. Such an environment would be favorable to growth and propagation of B. gymnorrhiza, which would be expected to colonize the banks of the unlined flood control channel for some distance inland from the shoreline. The overall long-term effects of the channel would be beneficial to the mangrove community.

## 6.6 Endangered Species

a. Alternative Plans B, C and F would not affect either of the two endangered species found within the project area. Plans A, D and E would remove a limited amount of habitat (trees and shrubs within the channel alignment) for the Nightingale Reed Warbler. None of it is unique habitat, critical to the survival of the species. The Reed Warbler is found throughout large areas of the island in a variety of habitats.

b. Plan A would have removed approximately 4.2 acres of wetland area which would be replaced elsewhere in the wetland to mitigate the loss. The area affected is open water with abundant Acrostichum fern islets, providing the best gallinule nesting habitat within the wetland. During non-floodflow conditions, the channel invert (elevation about -6 feet MSL) will contain standing seawater from the outlet, well into the terminal wetland areas. Depending upon the permeability of materials used to construct the channel, the introduction of saline water may modify the water quality characteristics of the wetland. If the salinity becomes too high, the marsh fern and other existing wetland vegetation may be adversely affected. This in turn could affect the suitability of the marsh as gallinule habitat.

c. Plan D would intercept and divert sheet flow runoff from elevated areas southeast of American Memorial Park into the wetland located there. Water levels in the wetland during storm conditions would rise approximately one foot. This could result in inundation of nests and loss of developing eggs. It is not known at present whether gallinule do nest in the American Memorial Park wetland. No nests or young have been observed there. Thus, it is not possible to predict the degree of adverse impact to the gallinule population attributable to the intermittent increase in water level resulting from the project. Excavation and removal of the existing road and sewerline fill, connecting all four wetland units, are major features of Plan D which would provide increased open water areas, better water circulation, greater available gallinule habitat. Enhancement features--the creation of small nesting islands, areas or channels deeper than +1 foot (MSL)--would have been incorporated in the "corridor" design.

d. Plan E was initially developed in coordination with the National Park Service staff at American Memorial Park to avoid any direct impact on the wetlands there which would preserve one of the central focuses of the Park and which would eliminate adverse effects on the endangered species of birds that have been observed there.

e. The Army Corps of Engineers has carried out formal consultations with the US Fish and Wildlife Service under Section 7 of the Endangered Species Act of 1973 for each of its three alternatives (Plans A, D, and E), the implementation of which could have affected the Mariana

Gallinule and/or the Nightingale Reed Warbler. It was the biological opinion (February 12, 1985) of the US Fish and Wildlife Service that the act of authorizing, and thereby allowing for the the construction and operation of the recommended plan is not likely to jeapordize the continued existence of the either two species. This is because Lake Susupe, a much larger and more important habitat for these two species, is located only a short distance to the south. The present habitat value of the AMP wetland for gallinule appear to be marginal. In refering only to the Mariana Gallinule, the US Fish and Wildlife Service (May 7, 1985) strongly recommended that the Corps adopt Alternative Plan E as having the fewest negative impact to endangered species.

## 6.7 Historic Resources

None of the alternative plans would affect any historic sites that are currently listed or formally determined eligible for inclusion in the National Register of Historic Places. Had alternative Plan A been recommended, the Corps would have sought a determination of eligibility for the Japanese World War II-related features 7 and 8 in American Memorial Park, as recommended by the US Department of the Interior in the letter of September 24, 1984. Under the present circumstances, the Corps will comply with the recommendation of the Department of the Interior in that letter in regard to the potential effects of the recommended Plan E on the suspected subsurface cultural deposits near West Coast Highway. Prior to construction, the Corps will resurvey the alignment of the channel through the American Memorial Park to accurately locate any surface historic features that might have been overlooked previously in the 1977 Pacific Studies Institute reconnaissance. Additionally, archaeological test corings and/or auger samples will be taken at a maximum spacing of 30 meters to determine presence absence of valuable sub-surface cultural deposits. Archaeological test excavations will be conducted around Site #1 and where the test corings indicate the presence of subsurface cultural deposits. All archaeological work will be performed in accordance with research designs. The data will be analyzed and professional quality reports produced. Monitoring of construction may or may not occur, depending on the results of the intensive surveys. The Corps will maintain close coordination with the CNMI Historic Preservation Officer and as required, the National Park Service and Advisory Council on Historic Preservation.

## 6.8 Recreation

a. Village Recreation. Alternatives A, D, and E would have no effect on village recreational facilities, but would pass through the forested open space and wetland, parallel to West Coast Highway, which may be informal play areas for neighborhood children. Alternative C would also interfere with pedestrian movement along the beach near the Hafa Adai Hotel and would require the relocation of the Garapan Community Center building and basketball court.

b. American Memorial Park. Alternatives A, D, and E would have different adverse effects on the American Memorial Park and the various facilities proposed for construction there in the National Park Service's 1983 General Management Plan and Comprehensive Design. The channel outlet of Alternative Plans A, D and E are not expected to interfere with pedestrian movement along the beach because this part of the park would be preserved in not-normally accessible natural area uses. Alternative E, the recommended plan, will avoid the existing wetlands which are planned for interpretation as a natural area, but it will pass directly through the proposed sports field complex. The present planned locations of the following facilities will be affected: play lot, handball court, roofed basketball court, parking lot for 90 cars, tennis courts (8) complex with bleachers (partial), part of the baseball field, park, maintenance yard, and possibly the park ranger residence. Most of the facilities can be resited in the park, but the advantage of siting them along the West Coast Highway for public accessibility and cohesiveness will be lost.

## 6.9 Land Use

Land and structure values in the protected floodplain should rise under each alternative. This will inordinately benefit current residents over residents of other area because structure values in Garapan are already the second highest of any village in Saipan. The rise of these values under Alternative F would vary from structure to structure depending on the type of floodproofing provided (closures, raising the structure, raising damageable property or rebuilding). All the structural alternatives (A, B, C, D and E) would permit current open spaces in the protected floodplain to be developed for additional housing or commercial purposes.

## 6.10 Health and Safety

a. All structural alternatives, including the recommended Plan E, would reduce ponding conditions and sheet flow flooding in lower Garapan. This may decrease health hazards associated with overflowing cesspools and failure of sewer pump stations which sometimes occur during flooding.

b. Pest insects thrive in some standing water environments, but this is not expected to result in any health hazard due to implementation of any of the project alternatives. There will be standing water in the channels, but it will be saline in portions where the invert elevation is below the tidal range. For Plan E, standing water will reach upstream only to the intersection of Navy Hill Road and Micro Beach Road. Pest insects that do successfully colonize the tidal waters should provide a ready food supply for fish, invertebrates and other small marine organisms. Foul odors may occur if overflowing sewer manholes drain into channels.

c. The presence of open channels, which mostly varies from the 5 to 8 feet deep in the residential areas would be a safety hazard to neighborhood children. There would be a particular safety hazard for Alternative B which passes adjacent to Garapan Elementary School. To avoid this situation, 3,345 feet of 6-foot high chain-link fencing will be provided along the channel for Plan E on the upward side of the channel paralleling West Coast Highway.

### 6.11 Community Dislocation and Cohesion

The recommended Plan E will displace no residences, farms or any other structures. Plans B and C would have displaced five and 2 residences, respectively. Plan C would have also passed through part of the Garapan Village (community) Center, destroying the basketball court. None of the alternative would probably cause any community disruption, except during construction, because the channels are sited to pass adjacent to streets. Plan B would have been the most disruptive not only because of the five residences being displaced but also because of taking valuable open playing space at the elementary school. Based on public acceptance of the recommended alternative E, which was suggested at the formal public meeting of July 26, 1984 and presented at a public/agency workshop held on April 17, 1985, it should not result in any significant community dislocation or disruption.

### 6.12 Environmental Control Measures to be Considered for Project Implementation

a. Construction of the entrance channel outlet after the dredging and stabilization of the drainage channel.

b. Use of silt curtains during construction of the outlet channel to minimize turbidity and suspended sediments.

c. Rapid revegetation of cleared areas following construction.

d. Minimizing impacts to mangroves and sea grass beds during construction of the outlet channel.

e. Archaeological test excavation and possible archaeological monitoring of construction.

## 7 PUBLIC INVOLVEMENT

### 7.1 Public Involvement Program

Project detailed design investigations were performed with the assistance of the Commonwealth Coastal Resources Management, Department of Public Works, and Mariana Islands Housing Authority. A survey of damageable property within the floodprone area was conducted on Saipan by Corps personnel. During the initial study of the flood problem at Garapan, a public workshop was held in March 1979 and a public meeting was conducted in July 1980. For the present study, a formal public meeting was held on July 26, 1984 at the Garapan Elementary School, following issuance of the draft DPR/EIS. The currently recommended Plan was presented to CNMI and Federal agencies in a workshop held April 17, 1985, prior to finalizing this EIS and the detailed project report.

## 7.2 Required Coordination

The following coordination needs to be completed prior to finalizing the report and environmental impact statement.

Section 401 Water Quality Certification. A water quality certification must be obtained from the Commonwealth, Division of Environmental Quality (DEQ). An evaluation of the discharge of dredged or fill material was completed using the U.S. Environmental Protection Agency Section 404(b)(1) guidelines (see Appendix G) and has been forwarded to the CNMI Department of Health and Environmental Services for review and issuance of water quality certification. The DEQ response dated 20 October 1986 expressed concerns over the effects of sediment discharge into the lagoon and salinity intrusion into the AMP wetland. The Corps, by letter dated 17 November 1986, addressed DEQ concerns and again requested a Section 401 certification.

Endangered Species Coordination. U.S. Fish and Wildlife Service and the National Marine Fisheries Service had an opportunity to review and comment on the Draft Environmental Impact Statement (EIS). Formal consultation has been conducted under Section 7 of the Endangered Species Act of 1973 to address possible impacts of Plans A, D, and E on the Endangered Nightingale Reed Warbler and Mariana Gallinule. The US Fish and Wildlife Service Biological Opinion of February 12, 1985, May 7, 1985, and November 24, 1986 found that the recommended Plan E would not jeopardize the endangered Nightingale Reed Warbler or Mariana Gallinule (Appendix G).

Fish and Wildlife Coordination. The U.S. Fish and Wildlife Service, National Marine Fisheries Service and the Commonwealth Department of Natural Resources had an opportunity to review and comment on the report/EIS. The U.S. Fish and Wildlife Service prepared a revised draft report (Appendix G), dated September 1983, and has prepared a final report under Section 2(b) of the Fish and Wildlife Coordination Act dated July 1985 expressing their opinion regarding the project and the conservation, preservation or protection of fish and wildlife resources. The report is included in (Appendix G). The Army Corps of Engineers concurs with each of the USFWS recommendations except the following:

Installation of an impervious lining along the entire length of the channel is not justified because it is not feasible and would be too expensive. The recommended plan will not include an impervious lining.

Silt curtains may be used as one of various means to bring dredging operations into compliance with CNMI water quality standards for turbidity in marine waters.

Historic Preservation. For this phase of the Garapan flood control study, there is only partial compliance with the National Historic Preservation Act, as implemented by the Advisory Council on Historic Preservations regulations (36 CFR 800). Reconnaissance level studies were conducted and determinations of no effect were obtained from the CNMI Historic Preservation Officer (HPO) in January 1980 for alternatives affecting the prehistoric Site #1 and on July 20, 1985 for the previously preferred Plan A. However this coordination is no longer valid. According to verbal consultations with the CNMI HPO held on March 7, 1985 (PODED-PV MFR subject "Trip Report for archaeological reconnaissance survey of new proposed channel alignments for the Garapan Flood Control Project, Garapan, Saipan, C.N.M.I.") and the Corps response of May 2, 1985 to the September 24, 1984 US Department of the Interior letter (Appendix F), "in the event that the project is constructed, we (the US Army Engineer District, Honolulu) will accomplish all of the necessary archaeological investigations which would include extensive subsurface testing of the project alignment and appropriate mitigative measures in accordance with Federal Statutes."

Coastal Zone Management. The CNMI Coastal Resources Management Office (CRMO) had an opportunity to review and comment on the draft report/EIS. The Corps prepared a Federal Coastal Zone Management consistency determination for the recommended Plan E and forwarded to the CRMO for review and concurrence. By letter dated August 1986, CRMO did not concur with our determination and raised a number of issues and questions. The Corps prepared a revised consistency determination dated 14 October 1986 to address these concerns and resubmitted it to CRMO for review. The revised consistency determination is included in Appendix G.

Flood plain Management. The public has had an opportunity to review and comment on the effects of the project on the floodplain. An evaluation of the recommended Plan E on the floodplain is included in Appendix G. Non structural alternatives have been evaluated in both the draft and final report and EIS.

## 7.3 Statement Recipients

The following agencies and individuals were provided copies of the draft Detailed Project Report and Draft Environmental statement for review and opportunity to comment.

Federal

U.S. Environmental Protection Agency (Washington & Region IX)
U.S. Department of Commerce
National Marine Fisheries
U.S. Advisory Council on Historic Preservation
U.S. Department of Interior
National Park Service
U.S. Fish and Wildlife Service
U.S. Department of Housing and Urban Development
U.S. Department of Health, Education and Welfare
U.S. Department of Transportation
Federal Highway Administration
U.S. Coast Guard
U.S. Department of Energy

Commonwealth

Office of the Governor
Department of Public Works
Mariana Islands Housing Authority
Commonwealth Historic Preservation Officer
Department of Natural Resources
Officer of Planning and Budget
Mayor of Saipan
Division of Marine Resources Development
Division of Environmental Quality
Office of Coastal Resources Management
Marianas Public Land Corporation
Department of Public Health

## 7.4 Public Views and Responses

Appendix F, Public Involvement Program, contains copies of letters commenting on the draft EIS and responses to those comments. A formal public meeting was held on July 26, 1984 at the Garapan Elementary School to give the public an opportunity to express their views and comments on the alternative plans. Although the general feeling of the attendees at the meeting was one of support, some concerns were raised on aligning the channel of the tentatively recommended plan through the American Memorial (AMP) wetland.

A full range of alternatives was presented at another public workshop held on 19 April, 1985 in Garapan. The newest alternative plan, which consisted of a channel alignment that skirts around the AMP was strongly supported at the meeting because it would not affect the wetland or the Mariana Gallinule. Details of further public involvement can be found in Appendix F.

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15. U.S. Department of the Interior National Park Service, Western Regional Office. General Management Plan and Comprehensive Design: American Memorial Park, Saipan Commonwealth of the Northern Mariana Islands, September 1983.

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## INTRODUCTION

1. Scope. This appendix contains descriptions of studies made to determine the runoff process for various selected concentration points within the Garapan watershed which has a total drainage area of 2.02 square miles (Plate A-1). There are four objectives of this appendix: (a) to present the basic meteorologic and hydrologic characteristics of the study area; (b) to outline the methods and techniques used to determine the runoff process; (c) to present discharge frequency values for the present and future (project and no-project) conditions; and (d) to provide standard project flood, 100-year, and 50-year design discharges for the alternative flood control plans.

2. Alternative Flood Control Plans. Six conceptual schemes were investigated, five plans are structural alternatives and the other a nonstructural alternative. All structural alternatives consist of a diversion channel system above West Coast Highway and an outlet channel in various locations. While all the schemes were hydrologically analyzed, only the results for Alternative E are discussed and displayed graphically. The design concepts for all alternatives are stated in the main report.

## GENERAL DESCRIPTION

3. Hydrologic Data. Due to a paucity of hydrologic information on the Garapan watershed and the island of Saipan, a reliable investigation was deemed possible only with the use of data from other areas which were judged to be hydrologically similar to Saipan and the Garapan watershed. The nearest source of dependable hydrologic information is the island of Guam. Both of the islands belong to the Mariana Island formation, with Guam located 120 miles south of Saipan. Both islands also lie within the same band of typhoon and tropical storm exposure according to the report prepared by the Bureau of Planning, Government of Guam, entitled "Typhoons: Their Nature and Effects on Guam," December 1977. These typhoons and tropical storms produce intense rainfalls and are the primary storm events of the rainy season which occurs from July through October. Since there are similarities between drainage area sizes, topography, geology, and meteorology of the Garapan watershed and the watersheds in Guam, it was assumed that they would also be hydrologically similar.

4. Methodology. Areas 1, 1A, 2, 2A, 3, 3A, 4 and 4A (Plate A-1) are topographically similar to the Guam and Saipan watersheds having recorded hydrologic data. Therefore these areas were analyzed by the direct use of the results obtained in the hydrologic analysis of the recorded data. Discharge-frequency curves were developed by the application of regression equations which were developed from a regression-correlation analysis of peak discharge-frequency data. The Standard Project Flood was constructed by applying unit hydrographs described by Snyder's Unit Hydrograph Parameters to the Standard Project Storm hyetograph.

## SPF FLOOD HYDROGRAPH DERIVATION

5. Unit Hydrographs. Snyder's Unit Hydrograph Parameters, used for the Garapan watershed analysis, were obtained from a report entitled, "Survey of Harbors and Rivers in the Territory of Guam, Ugum River--Derivation of Probable Maximum Flood," 17 November 1978, which was prepared by the US Army Corps of Engineers, Pacific Ocean Division (POD). The report derived a unit

hydrograph by reconstituting the 4 December 1963 flood in the Umatac River watershed, the only watershed in Guam with a recording rain gage and a continuous water-stage recorder. Plate A-2 shows the Hydrograph as well as the derived Unit Hydrograph Parameters. This unit hydrograph was assumed to be representative of the hydrologic response of the watersheds in Guam, and therefore, Saipan. The 1963 storm data were analyzed by HEC-1, a flood hydrograph computer program developed by the Hydrologic Engineering Center (HEC), US Army Corps of Engineers. The following Snyder's Unit Hydrograph Parameters, were computed: $C_p = 0.64$, and $C_t = 0.34$. Regional curves defining the unit hydrograph widths, W75 and W50, were developed by drawing lines parallel to the standard curves shown in EM 1110-2-1405 through points described by the computed unit hydrograph (Peak Q = 2,100 cfs, D.A. = 2.11 square miles, Peak Discharge per square mile = 995 cfs per square mile, W75 = 0.38 hours, and W50 = 0.60 hour). Plate A-3 depicts the regional W75 and W50 curves used to shape the unit hydrographs. The base unit hydrograph in accordance with EM 1110-2-1405, was increased to account for differences noted in past analyses of minor and major floods. A 50 percent increase was selected in this study. By applying the Guam based unit hydrograph data to the physical dimensions of the Garapan drainage areas, 10 minute peaked unit hydrographs for Garpan were developed. A 10-minute time interval was chosen since it provided adequate description of the unit hydrographs. Plates A-4 and A-5 show the unit hydrographs used to develop the SPF for the Garapan watershed. Table A-1 summarizes the unit hydrograph calculations.

6. Unit Hydrographs for Future Conditions. To determine the impact of urbanizaton on peak discharges (see Main Report for Future Land Use Map), unit hydrographs and rainfall runoff hyetographs were first developed for the existing condition and then modified to reflect the future condition. The unit hydrographs for the existing condition were based on the peaked base unit hydrograph for Umatac River and are shown on Plates A-4 to A-5. Since the drainage areas are small, the unit hydrographs for the minor and major floods are not expected to vary considerably. For the future condition, with no project, the ratio of imperviousness was increased based on the projected development in the area (See Table A-1). For the future condition with project, the imperviousness factor and modified unit hydrographs for subareas 2A, 3A and 4A were used. The unit hydrographs are shown on Plate A-6.

TABLE A-1 UNIT HYDROGRAPH PARAMETERS

WATERSHED CHARACTERISTICS - EXISTING CONDITION

| | DA ($MI^2$) | L (MI) | LCA (mi) | $C_t$ | 640 $C_p$ | % Imperviousness |
|---|---|---|---|---|---|---|
| AREA 1 | 0.68 | 1.85 | 1.03 | .244 | 410 | 13 |
| AREA 1A | 0.15 | 0.25 | 0.12 | .244 | 410 | 33 |
| AREA 2 | 0.24 | 0.99 | 0.49 | .244 | 410 | 13 |
| AREA 2A | 0.09 | 0.34 | 0.17 | .244 | 410 | 42 |
| AREA 3 | 0.50 | 1.42 | 0.70 | .244 | 410 | 8 |
| AREA 3A | 0.19 | 0.54 | 0.27 | .244 | 410 | 33 |
| AREA 4 | 0.12 | 0.54 | 0.20 | .244 | 410 | 33 |
| AREA 4A | 0.05 | 0.24 | 0.15 | .244 | 410 | 0 |

## TABLE A-1 UNIT HYDROGRAPH PARAMETERS (CONT)

### UNIT HYDROGRAPHS - EXISTING CONDITION (10-MINUTE)

| | $Q_{pr}$ (cfs) | $t_{pr}$ (MIN) | W-75 (MIN) | W-50 (MIN) |
|---|---|---|---|---|
| AREA 1 | 859 | 19.4 | 17.5 | 27.8 |
| AREA 1A | 499 | 7.3 | 6.1 | 9.8 |
| AREA 2 | 429 | 13.7 | 12.0 | 19.1 |
| AREA 2A | 262 | 8.4 | 7.1 | 11.3 |
| AREA 3 | 747 | 16.4 | 14.6 | 23.2 |
| AREA 3A | 451 | 10.3 | 8.8 | 14.1 |
| AREA 4 | 305 | 9.6 | 13.1 | 8.2 |
| AREA 4A | 160 | 7.6 | 10.2 | 6.4 |

### WATERSHED CHARACTERISTICS - FUTURE CONDITION

| | DA ($MI^2$) | L (MI) | LCA (mi) | $C_t$ | 640 $C_p$ | % Imperviousness |
|---|---|---|---|---|---|---|
| AREA 1 | 0.68 | 1.85 | 1.03 | .244 | 410 | 20 |
| AREA 1A | 0.15 | 0.25 | 0.12 | .244 | 410 | 50 |
| AREA 2 | 0.24 | 0.99 | 0.49 | .244 | 410 | 20 |
| AREA 2A | 0.09 | * 0.17 | 0.17 | .244 | 410 | 63 |
| AREA 3 | 0.50 | 1.42 | 0.70 | .244 | 410 | 28 |
| AREA 3A | 0.19 | * 0.42 | 0.27 | .244 | 410 | 50 |
| AREA 4 | 0.12 | 0.54 | 0.20 | .244 | 410 | 33 |
| AREA 4A | 0.05 | 0.24 | 0.15 | .244 | 410 | 0 |

### UNIT HYDROGRAPHS - FUTURE CONDITION (10-MINUTE)

| | $Q_{pr}$ (cfs) | $t_{pr}$ (MIN) | W-75 (MIN) | W-50 (MIN) |
|---|---|---|---|---|
| AREA 2A | 302 | 7.3 | 6.1 | 9.7 |
| AREA 3A | 478 | 9.7 | 8.3 | 13.2 |

* $L_2 = L_1 \times N_2/N_1$

$L_1$ = Length of the longest watercourse from the outflow point to the upstream watershed boundary--existing conditions

$L_2$ = Length of the longest watercourse from the outflow point to the upstream watershed boundary--project conditions

$N_1$ = Manning's roughness coefficient--existing conditions

$N_2$ = Manning's roughness coefficient--project conditions

## TERMINOLOLOGY

DA: Drainage area of the watershed

L: Length of the longest watercourse from the outflow point to the upstream watershed boundary.

LCA: Length of the longest watercourse from the outflow point to the point nearest the centroid of the watershed.

$C_t$ and $640C_p$: Regional coefficients which represent the basin slopes, stream patterns, basin shape, and other properties.

$Q_{pr}$: Peak discharge of the unit hydrograph.

$t_{pr}$: Time between the mid-point of 1 inch rainfall excess and the peak discharge of the unit hydrograph.

W-75: Width of the unit hydrograph at the ordinate that equals 75% of the peak discharge.

W-50: Width of the unit hydrograph at the ordinate that equals 50% of the peak discharge.

7. Rainfall. The Probable Maximum Precipitation (PMP) for Garapan was also obtained from the Ugum River report. Subsequent review of the report by the Office of the Chief of Engineers recommended that a PMP of 48 inches for a 24-hour period be used for the Ugum River watershed. In accordance with the recommendation, a 24-hour PMP rainfall of 48 inches was selected for the Garapan watershed. The depth-duration curve and depth-area curve for the PMP are shown on Plates A-7 and A-8, respectively.

Since the Standard Project Storm (SPS) rainfall has not been established for either Saipan or Guam, the SPS was assumed to be 50 percent of the PMP. The assumption is within the guidelines of EM 1110-2-1411 and is somewhat justified by past rainfall data on Guam. Super Typhoon Pamela (21 May 1976) produced Guam's highest recorded 24-hour rainfall of 27 inches at the NWS Taguac site. Prior to "Pamela," the highest 24-hour recorded rainfall of 24.5 inches occurred at the Agana Agricultural Experimental Station during the 1 October 1924 typhoon. Although SPS determinations are made using various meteorological factors, the primary governing factor is the highest recorded rainfall (except for very unusual events). A detailed investigation for the SPS rainfall is beyond the scope of this study, but nevertheless, the assumption of a 24-hour SPS rainfall of 24 inches (50 percent of PMP) for the Garapan watershed is deemed reasonable.

Rainfall intensity-duration-frequency curves for Guam or Saipan have not been previously developed. Consequently, storm hyetographs, arranged to produce maximum discharges were derived using available information. For the existing condition the peak discharges for various flood frequencies were determined by the regression-correlation analysis and the unit hydrographs for the drainage areas were derived in the SPF analysis.

The relationship between the two knowns--peak discharge and unit hydrographs--were analyzed to produce the storm hyetographs. The storm hyetographs were determined by a trial and error method which applied various proportions of the SPS hyetograph to the unit hydrograph to match the peak discharges of the regression-correlation equations. Although the computed hyetograph is theoretical in its derivaton, it does compare favorably with the intensity-duration-frequency curves for the Hawaiian Islands.

8. Infiltration Losses. Infiltration losses were assumed to be uniform and were estimated by the Soil Conservation Service method of relating soil types and land use to curve numbers from which rainfall losses can be determined. From an estimation of the soil types of the Garapan watershed, an infiltration loss rate of 0.6 inches per hour for the SPS was used.

9. Flood Routing. Flood hydrographs were routed by the Modified Puls Method using HEC-1. The outflow-discharge relationship was derived using the HEC-2 computer program. The number of routing steps equaled the travel time of the flood wave divided by the routing time step. Routing time steps were made equal to the flood hydrograph time interval of 10 minutes. The travel time of the flood wave was determined by the flood wave celerity method described in EM 1110-2-1408, "Routing of Floods Through River Channels." The ratio of the wave celerity to the mean velocity (Vw/V) of 1.67 (for a wide rectangular channel) was selected. Mean velocities were obtained from HEC-2 computer runs.

10. Standard Project Flood (SPF). The SPF was developed in accordance with the directions and criteria contained in EM 1110-2-1411. Derivation of the SPF was made by applying the unit hydrographs (Plates A-4 and A-5) to the rainfall excesses of the Standard Project Storm (SPS). The rainfall intensity patterns were structured to produce the maximum runoff for the SPF. The SPF hydrographs for the Garapan watershed are shown on Plates A-9 and A-10.

Peak discharges for the various flood frequencies and the SPF at the shoreline were determined by routing the flood hydrographs of the upstream areas (Areas 1, 2, 3 and 4) and combining the routed flood hydrographs with the local drainage flood hydrographs. Plate A-11 shows the hydrograph for the future condition. Plates A-12 to A-14 show the routed and combined hydrographs at the West Coast Highway and the shoreline under with project conditions. SPF and peak discharges for the sub-basins and various concentration points are shown on Table A-2.

TABLE A-2. SUMMARY OF PEAK DISCHARGES

EXISTING CONDITION - (WITHOUT PROJECT) AT WEST COAST HIGHWAY

| Flood | Peak Discharges (cfs) Area 1 | Area 2 | Area 3 | Area 4 |
|---|---|---|---|---|
| 2-year | 510 | 240 | 450 | 140 |
| 10-year | 1,160 | 485 | 900 | 270 |
| 50-year | 2,000 | 760 | 1,380 | 420 |
| 100-year | 2,400 | 900 | 1,620 | 495 |
| 500-year | 3,800 | 1,290 | 2,290 | 725 |
| SPF | 3,800 | 1,300 | 2,505 | 700 |

TABLE A-2. SUMMARY OF PEAK DISCHARGES (CONT)

EXISTING CONDITION - (WITHOUT PROJECT) AT THE SHORELINE

| Flood | Peak Discharges (cfs)** | | | |
|---|---|---|---|---|
| | Area 1 & 1A | Area 2 & 2A | Area 3 & 3A | Area 4 & 4A |
| 2-year | 400 | 315 | 580 | 185 |
| 10-year | 1,100 | 625 | 1,160 | 360 |
| 50-year | 2,150 | 980 | 1,800 | 560 |
| 100-year | 2,800 | 1,150 | 2,100 | 660 |
| 500-year | 5,000 | 1,650 | 2,990 | 970 |
| SPF | 5,100 | 1,470 | 2,675 | 980 |

FUTURE CONDITION AT WEST COAST HIGHWAY

| | Peak Discharges (cfs) | | | | |
|---|---|---|---|---|---|
| | Area 1* | Area 2 | Area 3 | Area 2&3 | Area 4 |
| 2-year | 510 | 245 | 465 | 625 | 140 |
| 10-year | 1,160 | 485 | 900 | 1,230 | 220 |
| 50-year | 2,000 | 760 | 1,380 | 1,900 | 420 |
| 100-year | 2,400 | 900 | 1,620 | 2,250 | 495 |
| 500-year | 3,800 | 1,290 | 2,290 | 3,200 | 725 |
| SPF | 3,800 | 1,305 | 2,545 | 3,850 | 700 |

LOCAL DRAINAGE - EXISTING CONDITION

| Flood | Peak Discharges (cfs)** | | | |
|---|---|---|---|---|
| | Area 1A | Area 2A | Area 3A | Area 4A |
| 2-year | 120 | 110 | 205 | 70 |
| 10-year | 320 | 210 | 395 | 130 |
| 50-year | 600 | 330 | 615 | 200 |
| 100-year | 750 | 390 | 725 | 240 |
| 500-year | 1,250 | 560 | 1,050 | 350 |
| SPF | 1,000 | 535 | 1,105 | 330 |

*Developments are not planned for Area 1.
**Combined and routed discharges at the shoreline.

TABLE A-2. SUMMARY OF PEAK DISCHARGES (CONT)

COMBINED DISCHARGE (FUTURE CONDITION) - WITHOUT PROJECT

| Flood | Peak Discharges (cfs) Area 1 & 1A | Area 2 & 2A | Area 3 & 3A | Area 4 & 4A |
|---|---|---|---|---|
| 2-year | 450 | 340 | 590 | 185 |
| 10-year | 1,150 | 630 | 1,175 | 360 |
| 50-year | 2,200 | 980 | 1,800 | 560 |
| 100-year | 2,850 | 1,150 | 2,100 | 660 |
| 500-year | 5,000 | 1,650 | 2,990 | 970 |
| SPF | 5,100 | 1,520 | 2,760 | 980 |

DISCHARGE - FREQUENCY ANALYSIS

11. Streamgage Data. Discharge-frequency curves were developed by analyzing maximum annual peak discharge streamgage data obtained from U.S. Geological Survey (USGS) publications and employing the Log-Pearson Type III criteria described in the U.S. Water Resources Council's Manual, "Guidelines for Determining Flood Flow Frequency," Bulletin 17A. In accordance with the guidelines of Bulletin 17A, only streamgages with 10 or more years of record were used in the analysis. Nine Guam streamgages and two Saipan streamgages, a total of 11 gages having an average of 20 years of record, were examined. Plates A-15 and A-16 show the streamgage locations. Peak discharges were analyzed by using the "Flood Flow Frequency Analysis" computer program developed by HEC. A summary of the frequency analysis and a brief description of the streamgages are shown on Table A-3.

12. Regression-Correlation Analysis. A regression-correlation investigation, relating known hydrologic characteristics of the gaged watersheds in Guam and Saipan to the calculated peak discharge of various frequencies, was made to develop regional peak discharge equations. The data were analyzed by using the "Multiple Regression" computer program developed by HEC. The selected equations relate peak discharges to drainage area sizes and are listed below:

$$Q - 10 \text{ year} = 1530 \times DA^{0.835}$$
$$Q - 50 \text{ year} = 2230 \times DA^{0.834}$$
$$Q - 100 \text{ year} = 2550 \times DA^{0.834}$$
$$Q - 500 \text{ year} = 3330 \times DA^{0.834}$$

Where Q is in CFS and DA in square miles. The unadjusted determination coefficients ($R^2$) for the 10, 50, 100 and 500 year peak discharge equations are 0.8224, 0.7520, 0.7219, and 0.6600, respectively. The standard error in Log for the 10, 50, 100 and 500 year peak discharge equations are: 0.1723, 0.2121, 0.2293 and 0.2663, respectively.

TABLE A-3

STREAMGAGES ON GUAM AND SAIPAN

| STATION NUMBER | STATION NAME | LENGTH OF RECORD (Years) | DRAINAGE AREA (Sq. Miles) | PEAK DISCHARGE (cfs) Q2 | Q10 | Q100 | MAXIMUM OF RECORD |
|---|---|---|---|---|---|---|---|
| 8083 | Finile Creek at Agat | 19 | 0.28 | 204 | 327 | 482 | 326 |
| 8160 | Umatac River at Umatac | 25 | 2.11 | 2,364 | 5,673 | 11,632 | 7,460 |
| 8210 | Geus River near Merizo | 22 | 0.93 | 773 | 2,261 | 5,453 | 2,940 |
| 8400 | Tinaga River near Inarajan | 27 | 1.89 | 813 | 1,858 | 3,661 | 2,980 |
| 8470 | Imong River near Agat | 19 | 1.95 | 1,830 | 3,106 | 4,794 | 6,100 |
| 8480 | Almagosa Springs near Agat | 19 | 0.70 | 225 | 503 | 972 | 770 |
| 8550 | Ugum River near Talofofo | 19 | 7.13 | 3,087 | 6,964 | 13,574 | 7,660 |
| 8580 | Ylig River near Yona | 27 | 6.48 | 3,087 | 4,413 | 7,316 | 4,900 |
| 8650 | Pago River near Ordot | 27 | 5.67 | 4,258 | 6,638 | 9,555 | 10,090 |
| 8010 | South Fork Talofofo Stream (Saipan) | 10 | 0.69 | 720 | 2,450 | 6,660 | 4,100 |
| 8015 | Middle Fork Talofofo Stream (Saipan) | 11 | 0.35 | 214 | 620 | 1,480 | 840 |

The independent variables used in the analysis but deleted in the final analysis included the mean annual precipitation (AP), slope of the main channel (SL), length of the main channel (CL), mean elevation (EL), forest cover (FC), shape factor (SF), and 1-hour rainfall for the 10, 50, and 100 year storm event (RF). The linear regression equation used in the investigation was of the following form:

$$Q = Cp\ DA^{a}\ AP^{b}\ CL^{c}\ SL^{d}\ EL^{e}\ FC^{f}\ SF^{g}\ RF^{h}$$

It was ultimately reduced to the selected equations which reflected the best combination of correlation, application, and conformance to hydrologic principles.

13. Discharge-Frequency Curves. From the equations selected in the regression-correlation analysis, the peak discharges were computed for various frequencies and then plotted on probability paper. The best fit line of the computed discharges was adjusted to the expected probability curve. The adjustment was made by using N = 20 (the average number of years of record for the streamgages used in the regression-correlation study) in the $P_n$ versus P Table shown in "Statistical Methods in Hydrology," Leo R. Beard, January 1962. Plates A-17 through A-19 show the discharge-frequency curves under existing conditions.

Peak discharges for the future condition were determined by applying the computed hyetographs, modified by lesser infiltration rates to reflect increased imperviousness, to the unit hydrographs developed for the Future Condition. A 33% increase in imperviousness was used and was based on the area planned for future development and the anticipated impervious factors of the future development. Plates A-20 and A-21 show the discharge frequency curves for the future without project conditions. Plate A-22 shows the discharge-frequency curves for the future with project conditions. The peak discharges of the flood hydrographs were used to verify the discharge-frequency curves which were drawn to the expected probability curve by adjusting the exceedance frequency plotting positions. The adjustment was made using N = 20 (the average number of years of record for the stream gages used in the regression-correlation analysis) in the $P_n$ versus P Table shown in "Statistical Methods in Hydrology."

## FLOODPLAIN ANALYSIS

14. General. The probable overflow area is defined as that area most susceptible to overflow based on the areas inundated by historical flood events and existing conditions. Probable overflow limits for the 100-year and standard project flood and the limits of possible overflow were prepared for use in the economic determination of flood damages caused by each return period flood. These limits are delineated for purposes of evaluating potential flood damages for benefit analysis and constitute no assurance that shifting debris would not cause overflow to move to other locations within the gross area subject to inundation.

15. Flood Limits. Flood elevations associated with the peak discharges were determined by the HEC-2 computer program. Manning's Roughness Coefficient, n, of 0.04 to 0.08 was used for overland flow. Garapan is subject to shallow flooding with flood flows in the subcritical flow regime. Velocities are low,

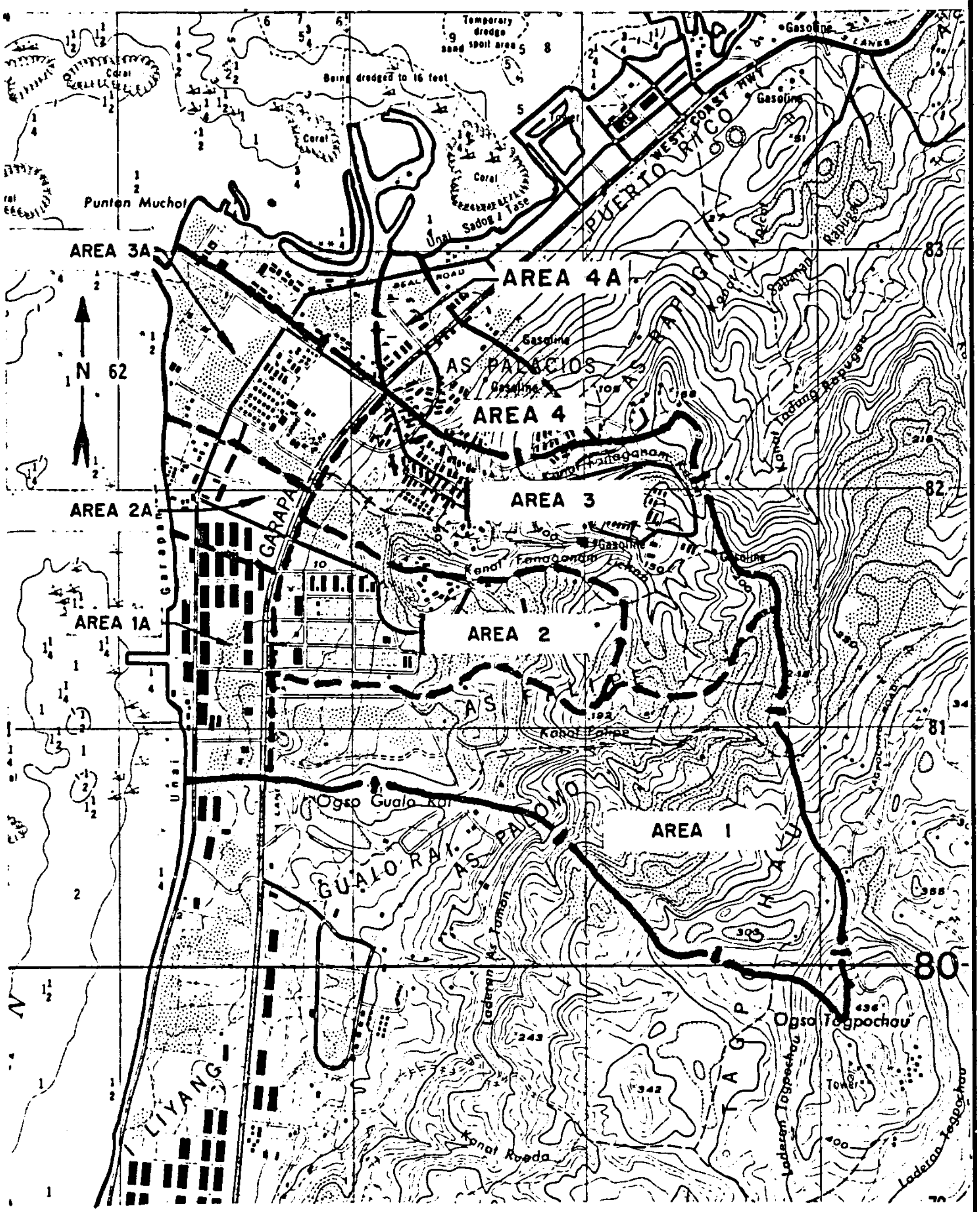
ranging from 2 to 3 feet per second for the 100-year flood. Due to the flat topography of the Garapan area, the flood discharges will cause flood limits of irregular boundaries intermixed with adjacent flood plains. The flood limits for various floods are shown in the Main Report (Figure 6). The water surface profiles for these floods are shown on Data A-23.

## VERIFICATION OF HYDRAULIC MODEL

A study to substantiate the computed results of the hydraulic investigation with observed data is impossible due to the absence of flood data for the Garapan watersheds. The only reliable known flood data for the area are the high water marks surveyed by the USGS for the 8-12 August 1978 flood. Compared against flood elevations computed by the HEC-2 computer program using peak discharges derived in the hydrologic investigation, the 1978 flood was estimated to range between a 10-year and a 30-year flood. The range of flood frequencies is not very significant since the flood elevations of the 10-year and 30-year floods vary by an average of only 0.20 to 0.40 foot. Perhaps the primary reason that the 1978 flood cannot be exactly matched with a flood frequency is the inability of the HEC-2 computer program to accurately model the subtleties of overland flow where local obstructions, dividing flows, intermixing flows, actual flood hydrograph, and splash waves add to its complexity. The surveyed high water marks attest to the irregular nature of overland flow in the Garapan area. In one instance, a difference of 0.4 feet between high water mark elevations was measured in a residential lot. In another, the upstream high water mark elevation was slightly lower than a downstream mark. Surveying errors are very possible and would further distort comparisons between actual and computed flood surface elevations. The 1978 flood was remembered as the most severe flood encountered in the Garapan area by many long-time residents, an account which favors a 30-year flood classification for the 1978 flood. Other flood data such as rainfall intensities, flood stages and peak discharges for the Garapan watershed are not known to exist.

## LOCAL DRAINAGE WITH PROJECT CONDITION

The local drainage pattern and capacity for the area below the West Coast Highway channel improvement for Plan A as well as the other alternative plans have been analyzed and evaluated. Analysis on the drainage system under these plans revealed that interior drainage ponding is negligible and that runoff up to a recurrence interval of 50-years in this area would not flood existing structures. The interior drainage analysis assumes the worst possible condition to exist for this area and is accomplished using a depth-area capacity curve and flood frequency volumes which are expressed as percentages of the Standard Project Flood volume to obtain stage-frequency values. The stage frequency values are used in an economic study model which verified and expresses the same hydraulic findings in economic terms of expected annual damages. Earlier statements from MIHA indicated that they are planning to install an improved drainage system not connected to any of the Corps' structural alternative plans. Local drainage improvements are the responsibility of the local government. The structural alternatives do not increase interior ponding nor alter the existing interior drainage patterns.




GARAPAN FLOOD CONTROL SAIPAN, CNMI

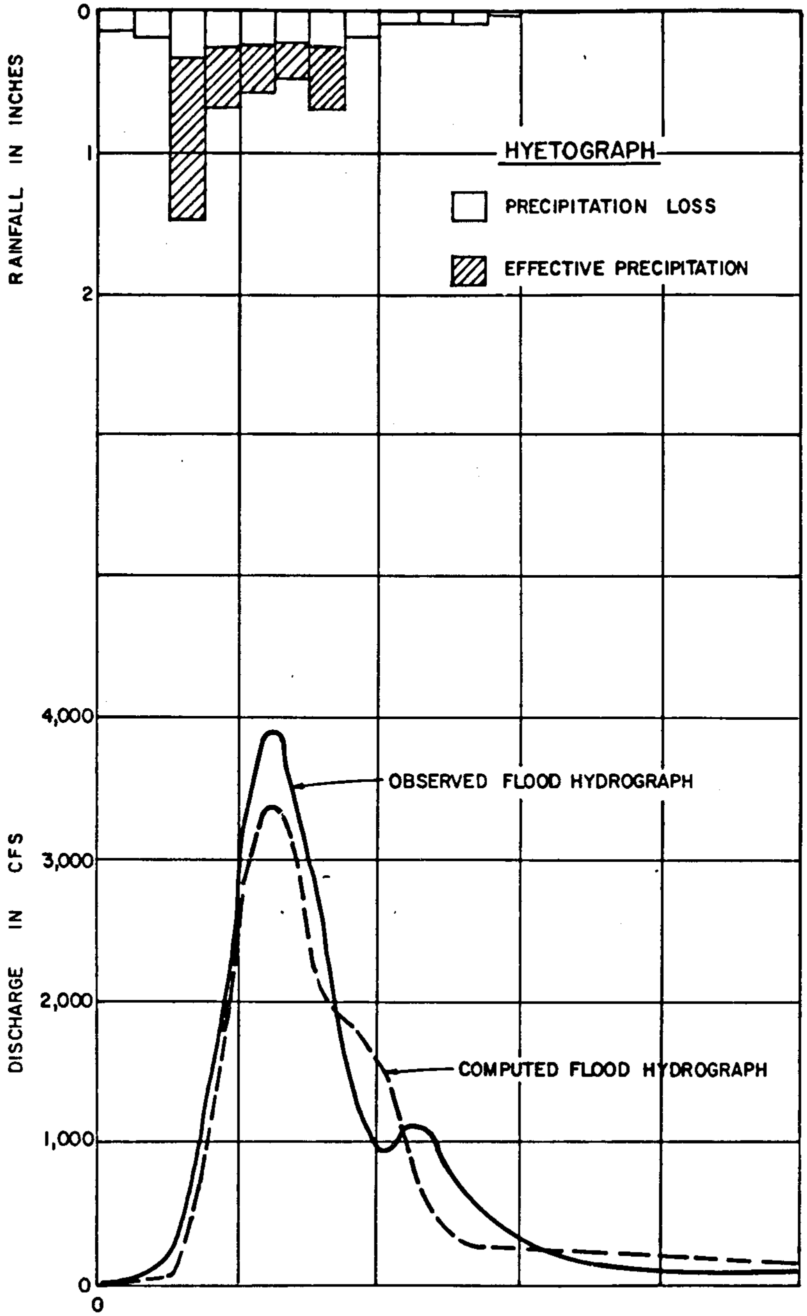
DRAINAGE AREAS

U.S. ARMY ENGINEER DISTRICT, HONOLULU

10 METER CONTOUR INTERVAL

SCALE

0 1/2 1 MILE




HEC I UNIT HYDROGRAPH AND LOSS RATE PARAMETERS

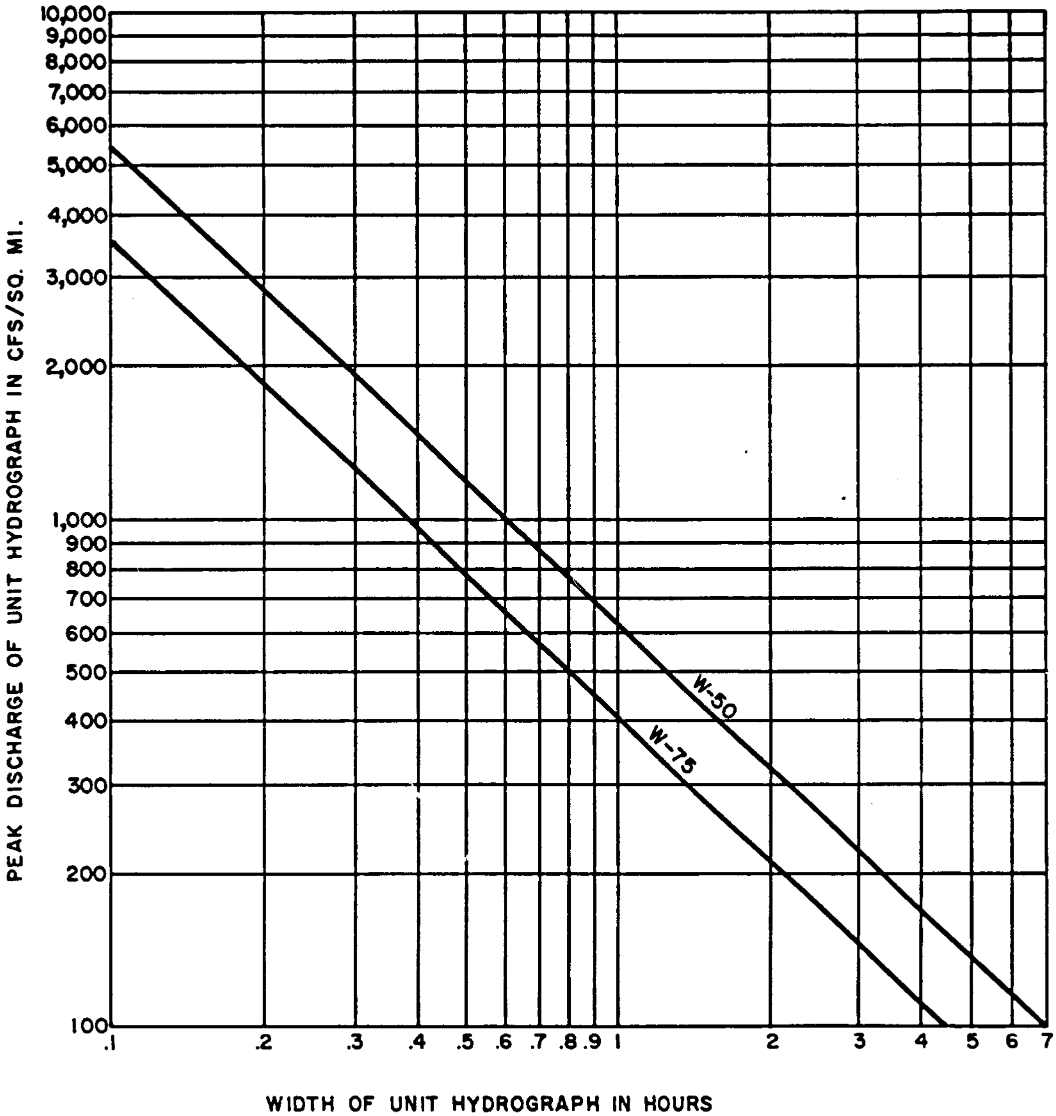
CP = 0.64
LAG = 0.42
STRKR = 0.82
ERAIN = 0.26
DLTKR = 0.79
RTIOL = 1.00

GARAPAN F.C. SAIPAN, CNMI

# FLOOD RECONSTITUTION

UMATAC RIVER AT UMATAC
(FLOOD OF DEC. 4, 1963)

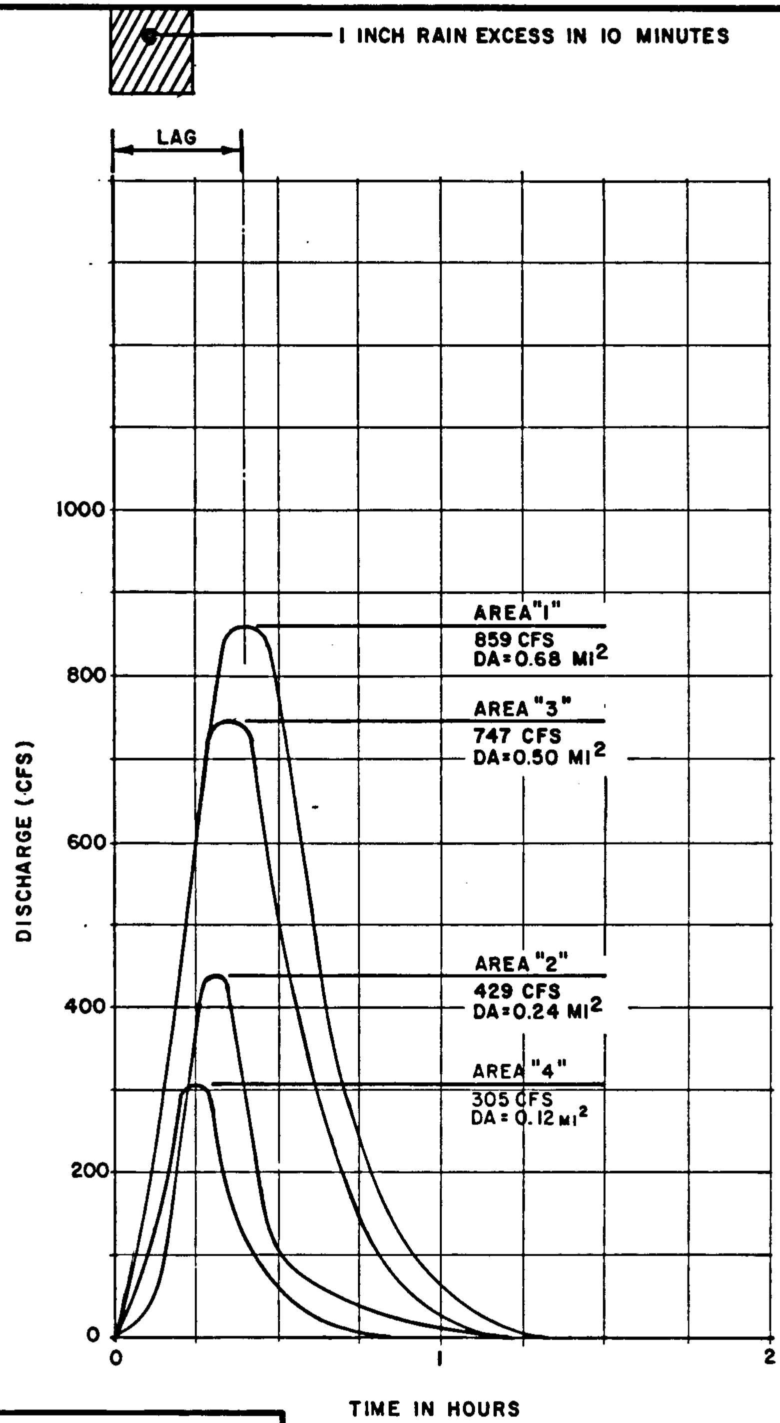
U.S. ARMY ENGINEER DISTRICT, HONOLULU




GARAPAN FLOOD CONTROL SAIPAN, CNMI

UNIT HYDROGRAPH
PEAKS VERSUS WIDTHS

U.S. ARMY ENGINEER DISTRICT, HONOLULU

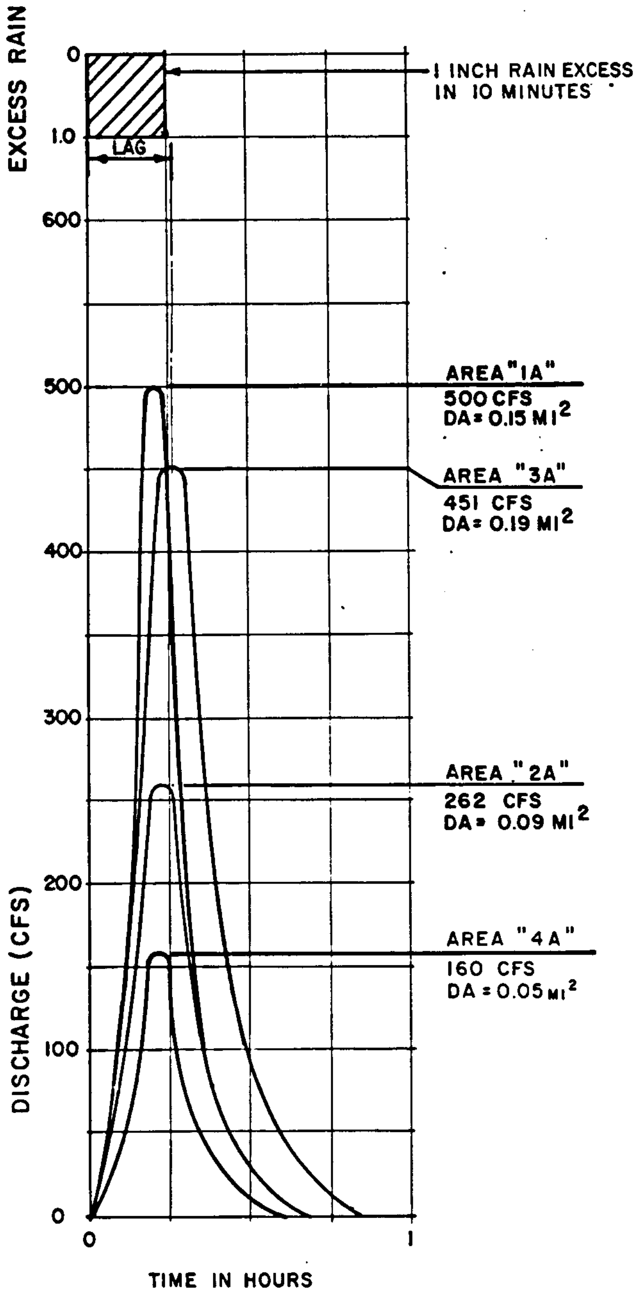



GARAPAN FLOOD CONTROL SAIPAN, CNMI

10 MINUTE UNIT HYDROGRAPHS
PEAK INCREASED BY 50%
EXISTING CONDITION

U.S. ARMY ENGINEER DISTRICT, HONOLULU

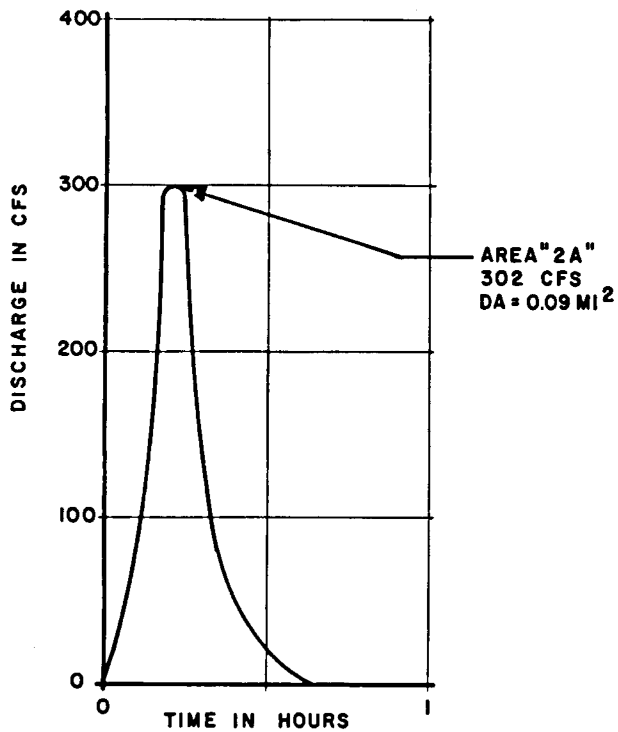
(NOTE:
AREA 2 AND 3 IS DEVELOPED FOR PLAN I (SEE APPENDIX C) AND REPRESENTS A WITH PROJECT CONDITION.)

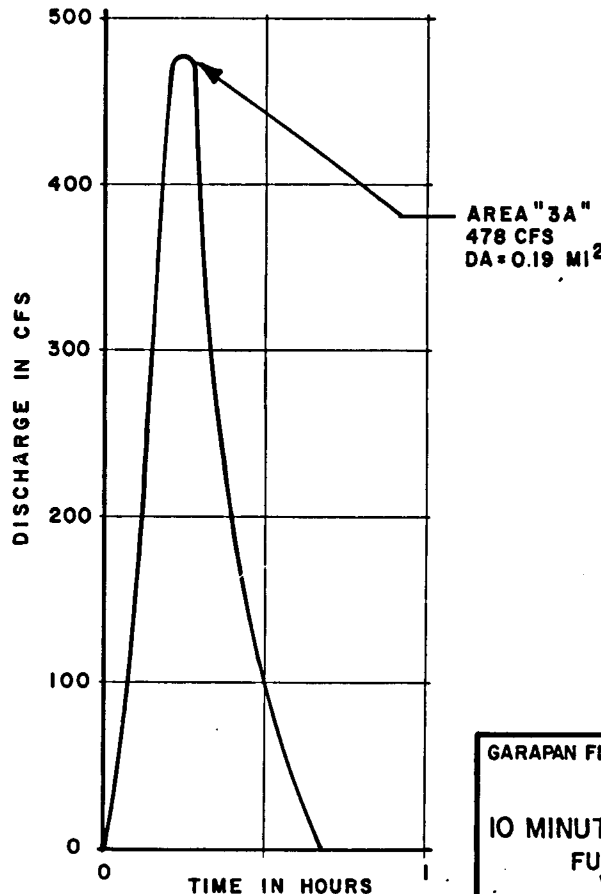



GARAPAN FLOOD CONTROL SAIPAN, CNMI

LOCAL DRAINAGE
10 MINUTE UNIT HYDROGRAPHS
EXISTING CONDITION

U.S. ARMY ENGINEER DISTRICT, HONOLULU




GARAPAN FLOOD CONTROL SAIPAN, CNMI

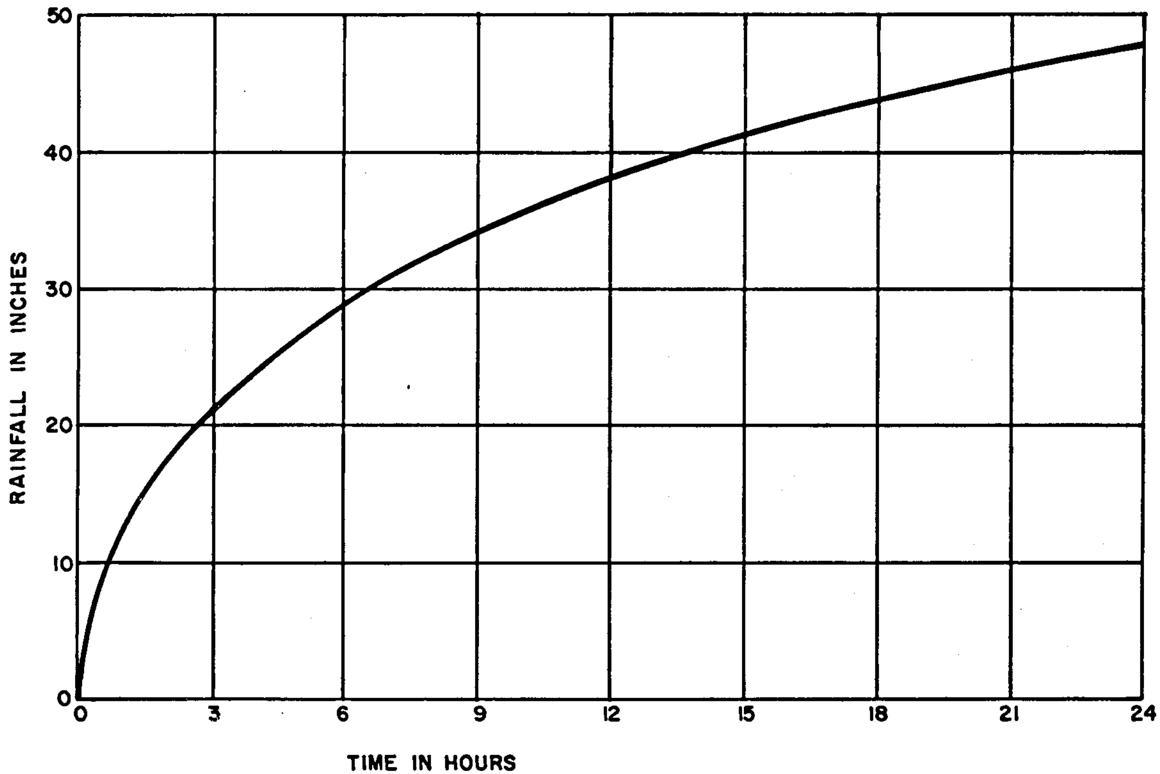
# 10 MINUTE UNIT HYDROGRAPHS

FUTURE CONDITIONS
WITH PROJECT

U.S. ARMY ENGINEER DISTRICT, HONOLULU



PLATE A-6

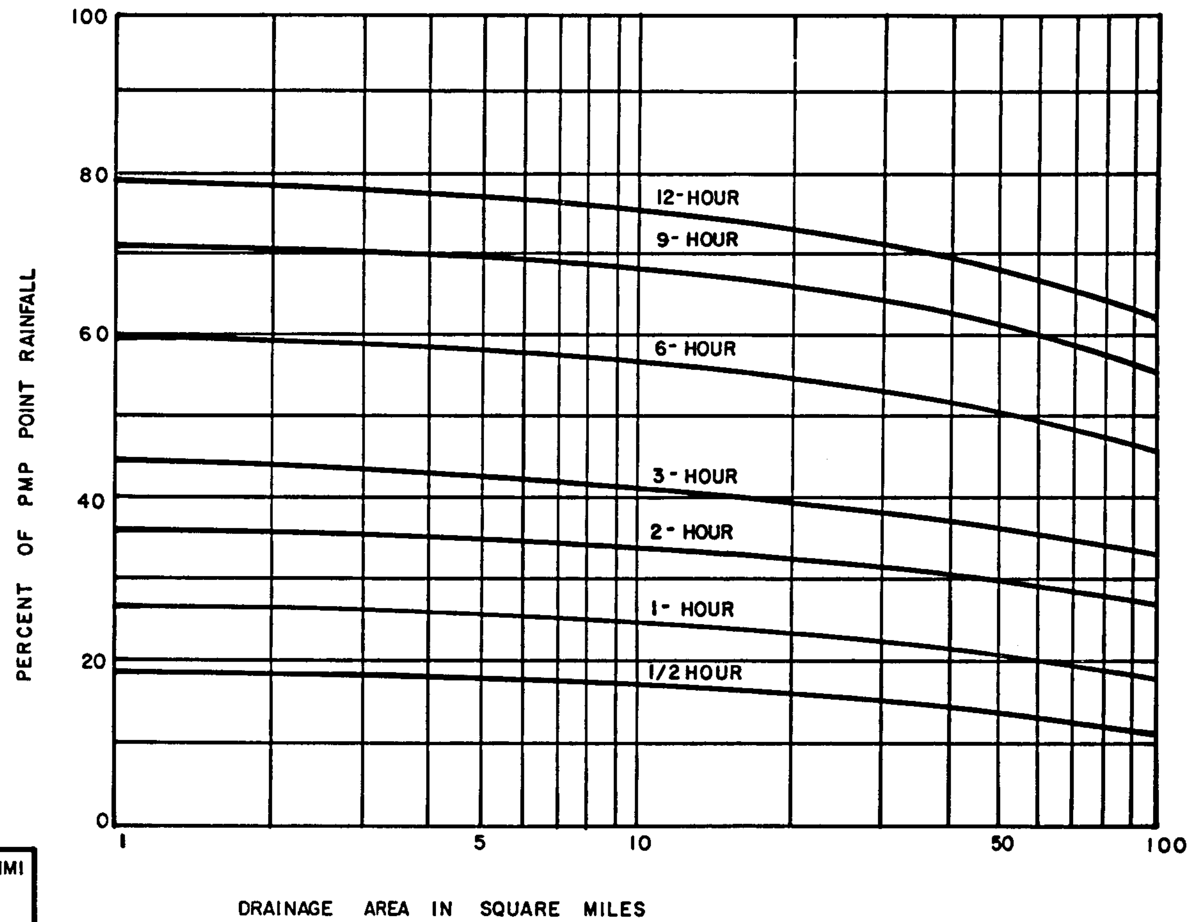



GARAPAN FLOOD CONTROL SAIPAN, CNMI

DEPTH—DURATION CURVE

PROBABLE MAXIMUM PRECIPITATION

U.S. ARMY ENGINEER DISTRICT, HONOLULU



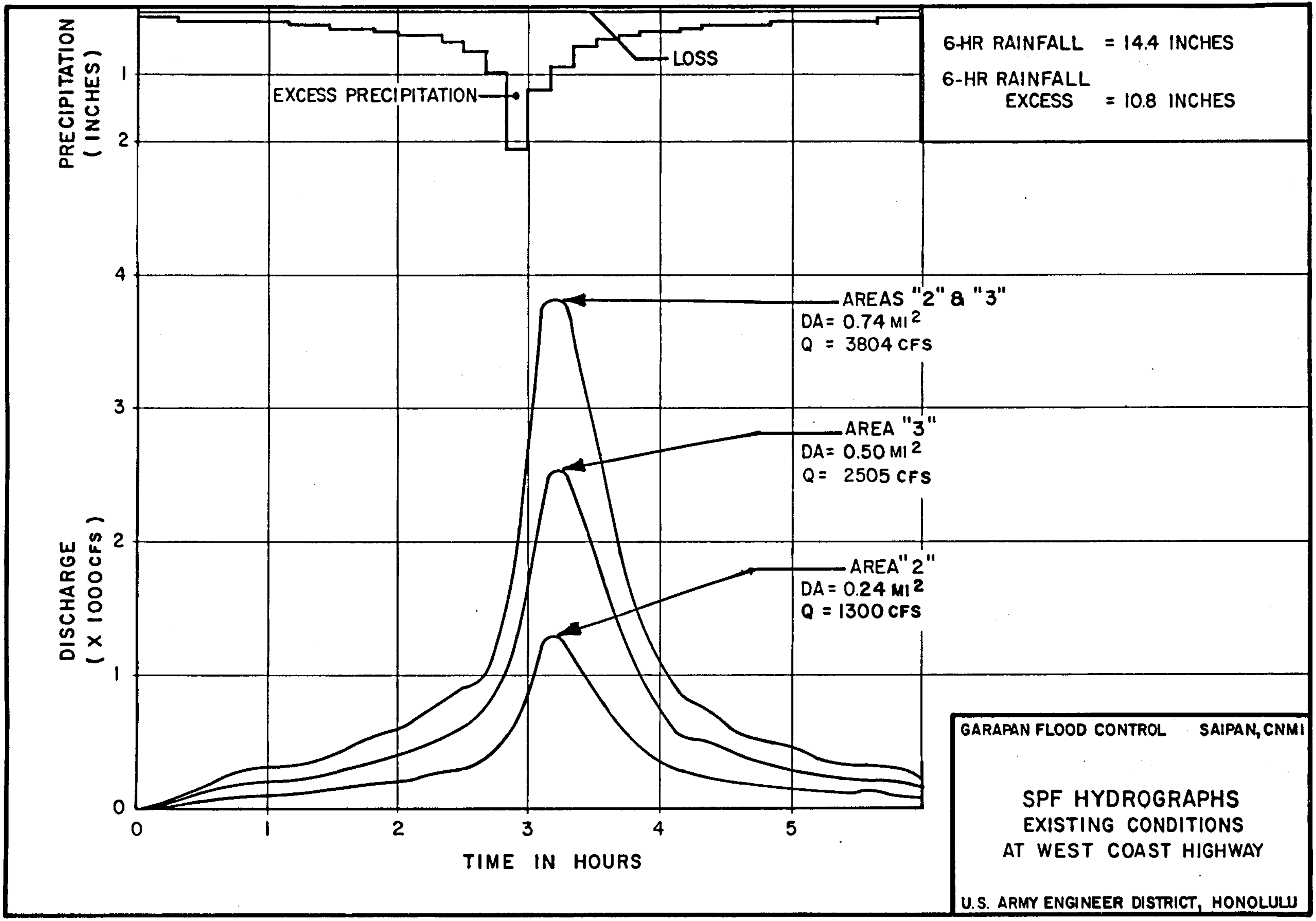

NOTE: 24-HOUR PMP RAINFALL = 48 INCHES

GARAPAN FLOOD CONTROL SAIPAN, CNMI

DEPTH-AREA CURVE
FOR
PROBABLE MAXIMUM
PRECIPITATION

U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE A-8



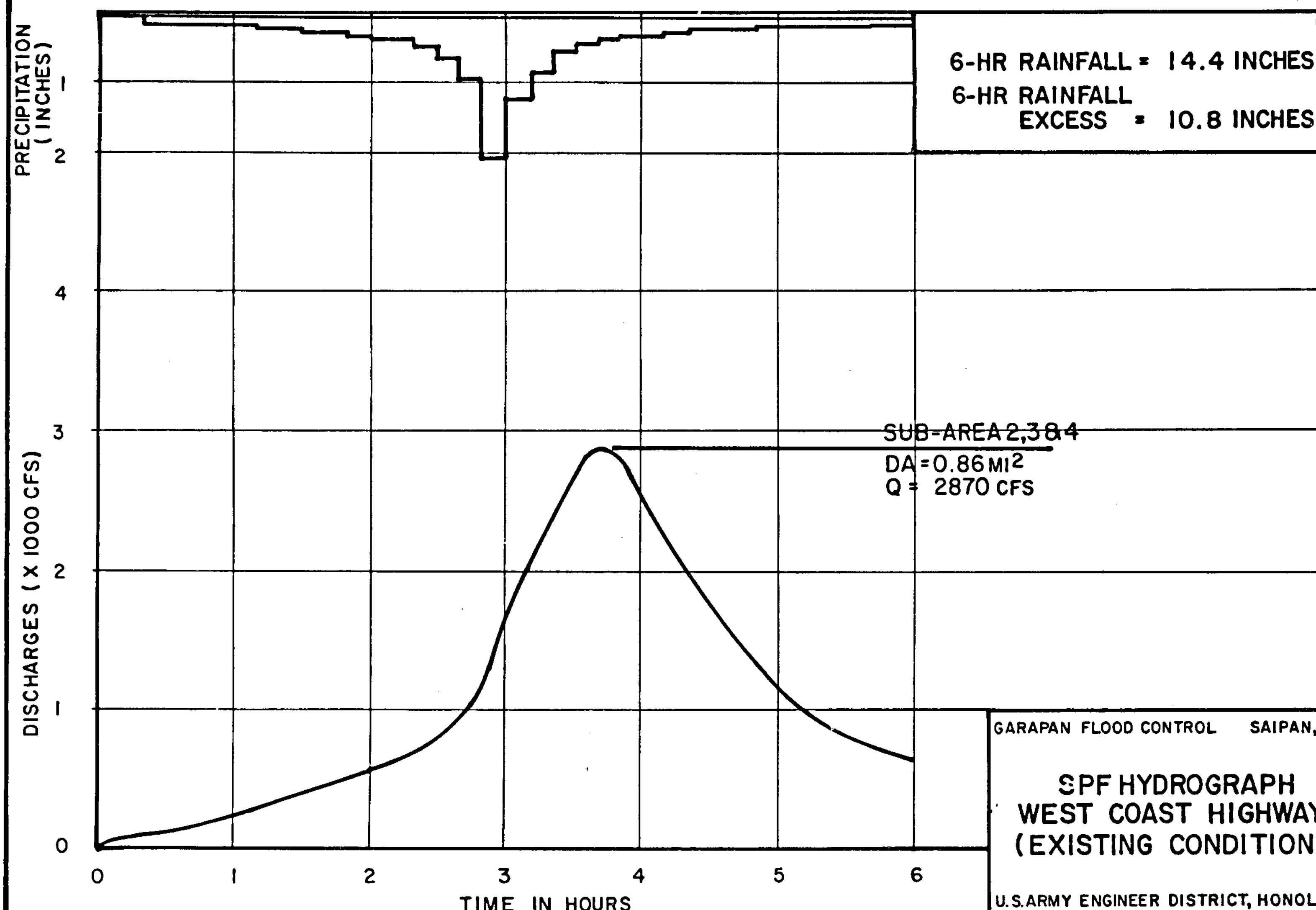

GARAPAN FLOOD CONTROL SAIPAN, CNMI

SPF HYDROGRAPHS
EXISTING CONDITIONS
AT WEST COAST HIGHWAY

U.S. ARMY ENGINEER DISTRICT, HONOLULU



PLATE A-9



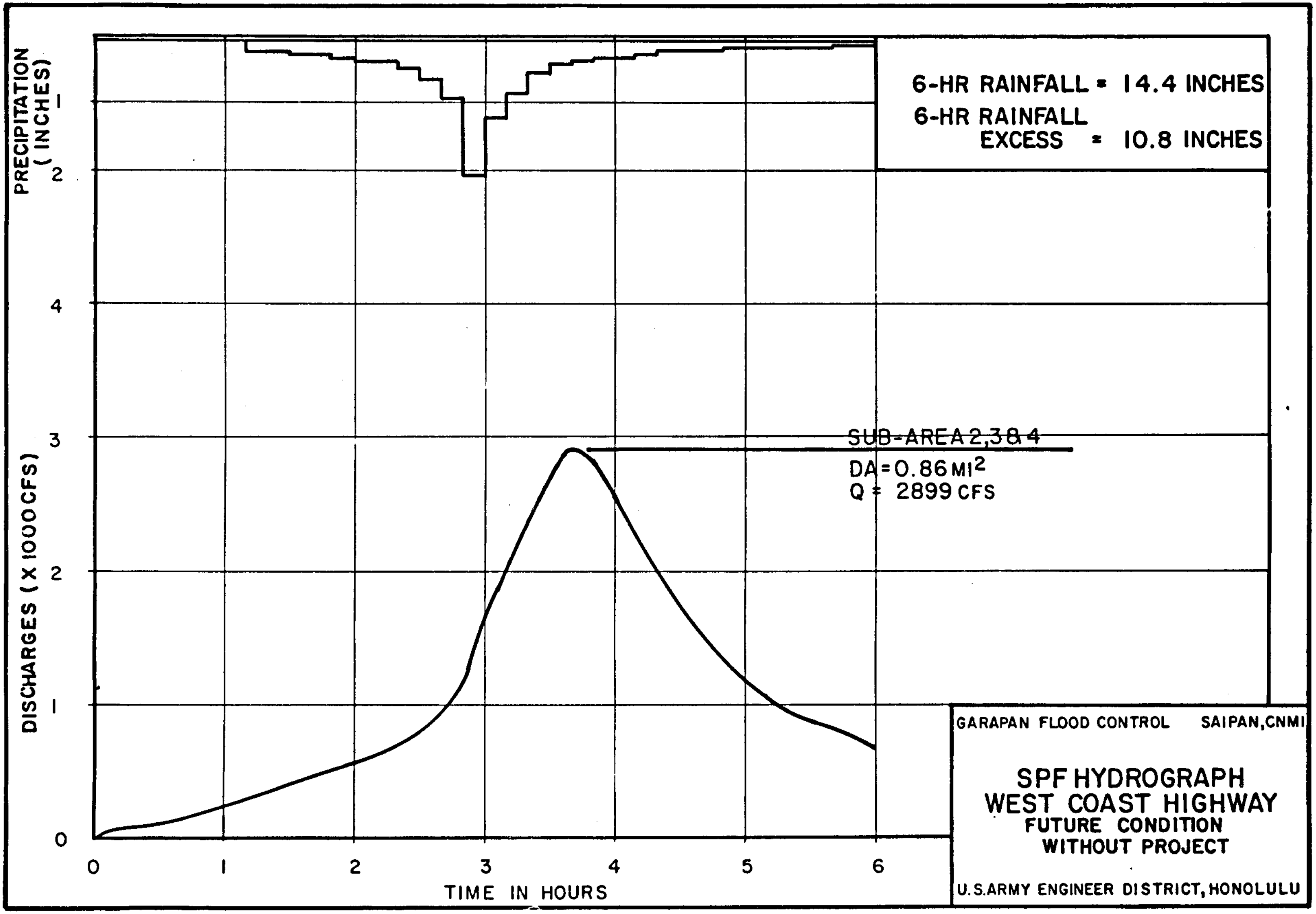

GARAPAN FLOOD CONTROL SAIPAN, CNMI

**SPF HYDROGRAPH WEST COAST HIGHWAY (EXISTING CONDITION)**

U.S. ARMY ENGINEER DISTRICT, HONOLULU



PLATE A-10



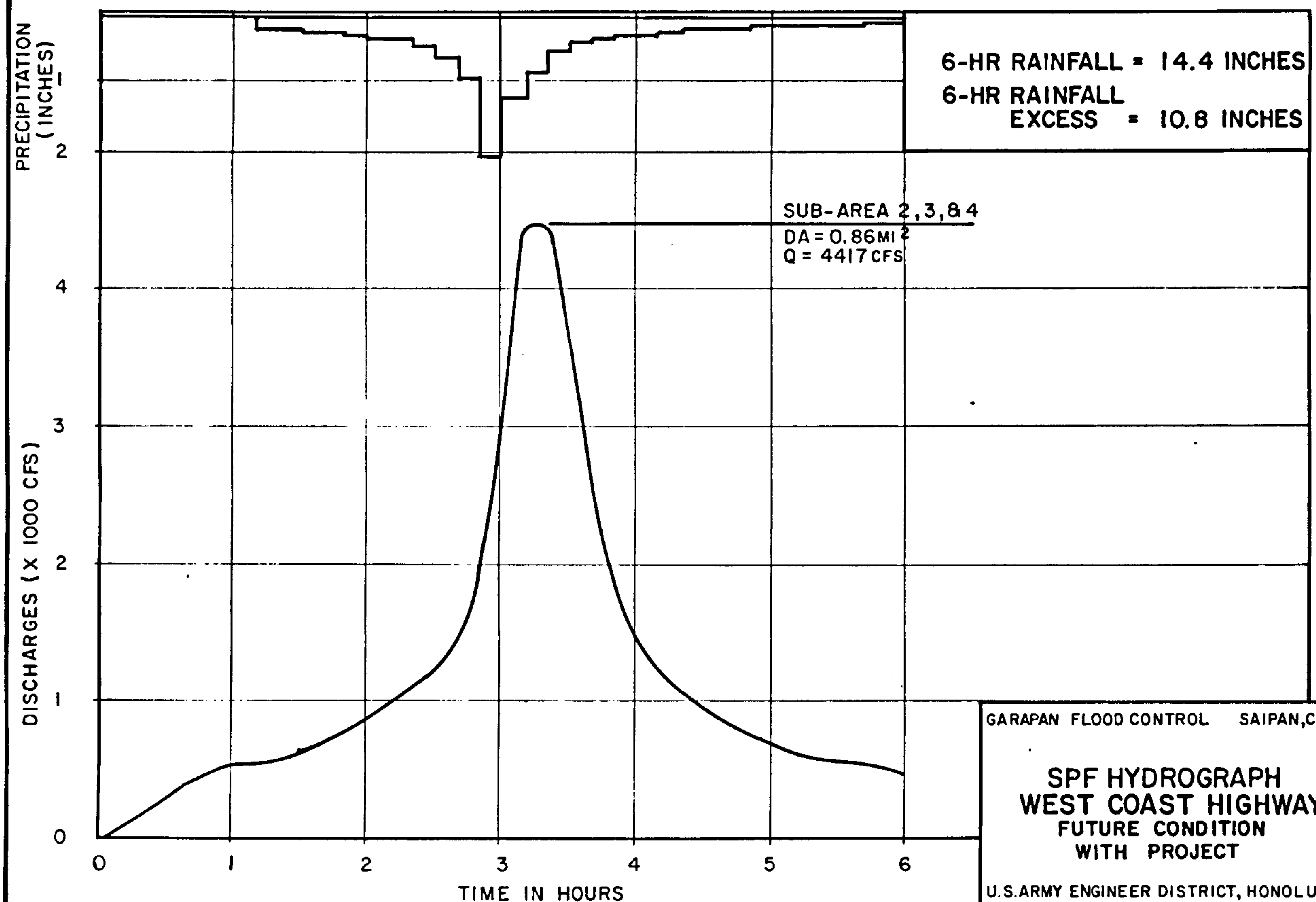

GARAPAN FLOOD CONTROL SAIPAN, CNMI

SPF HYDROGRAPH
WEST COAST HIGHWAY
FUTURE CONDITION
WITHOUT PROJECT

U.S. ARMY ENGINEER DISTRICT, HONOLULU



PLATE A-11



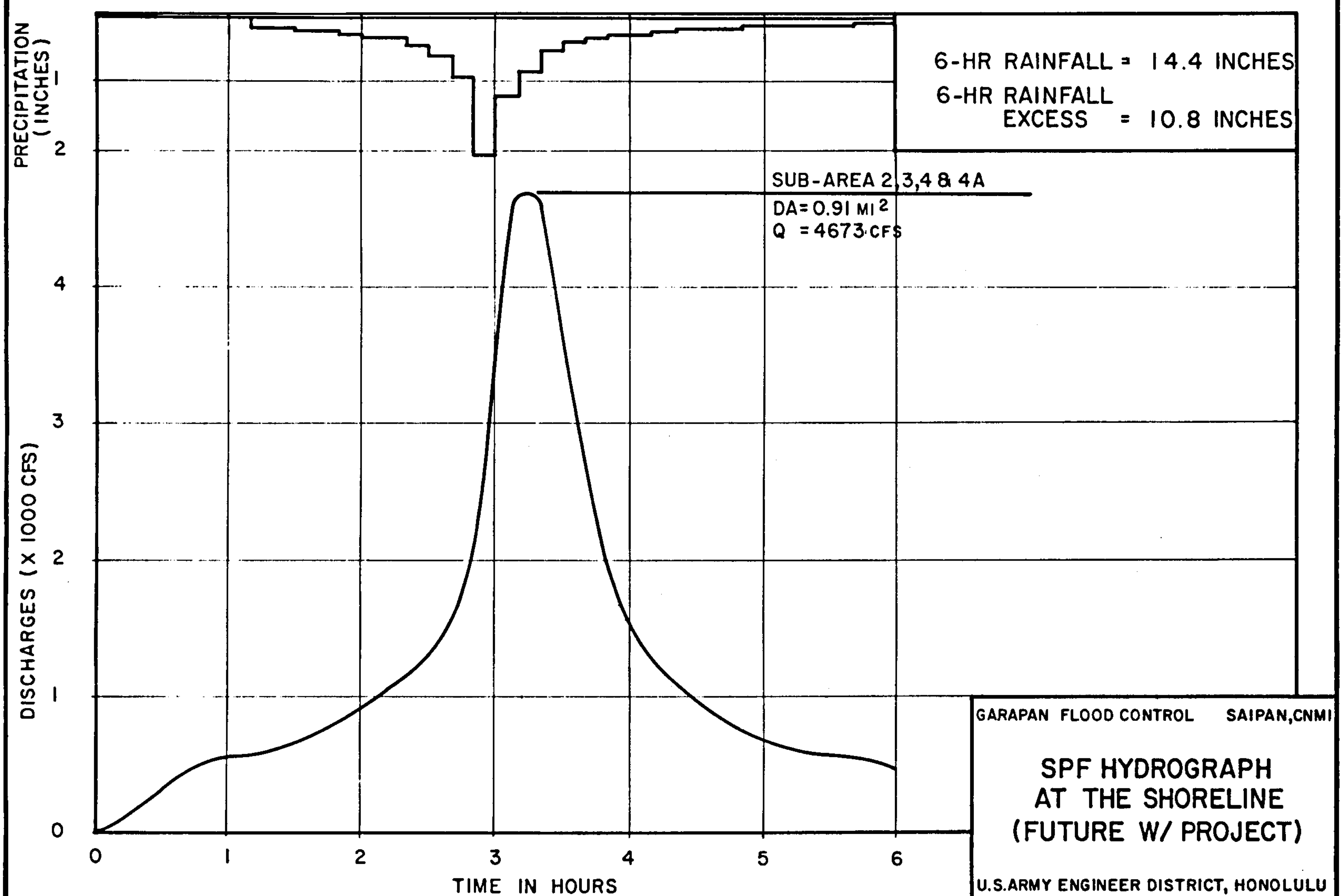

GARAPAN FLOOD CONTROL SAIPAN, CNMI

SPF HYDROGRAPH
WEST COAST HIGHWAY
FUTURE CONDITION
WITH PROJECT

U.S. ARMY ENGINEER DISTRICT, HONOLULU



PLATE A-12

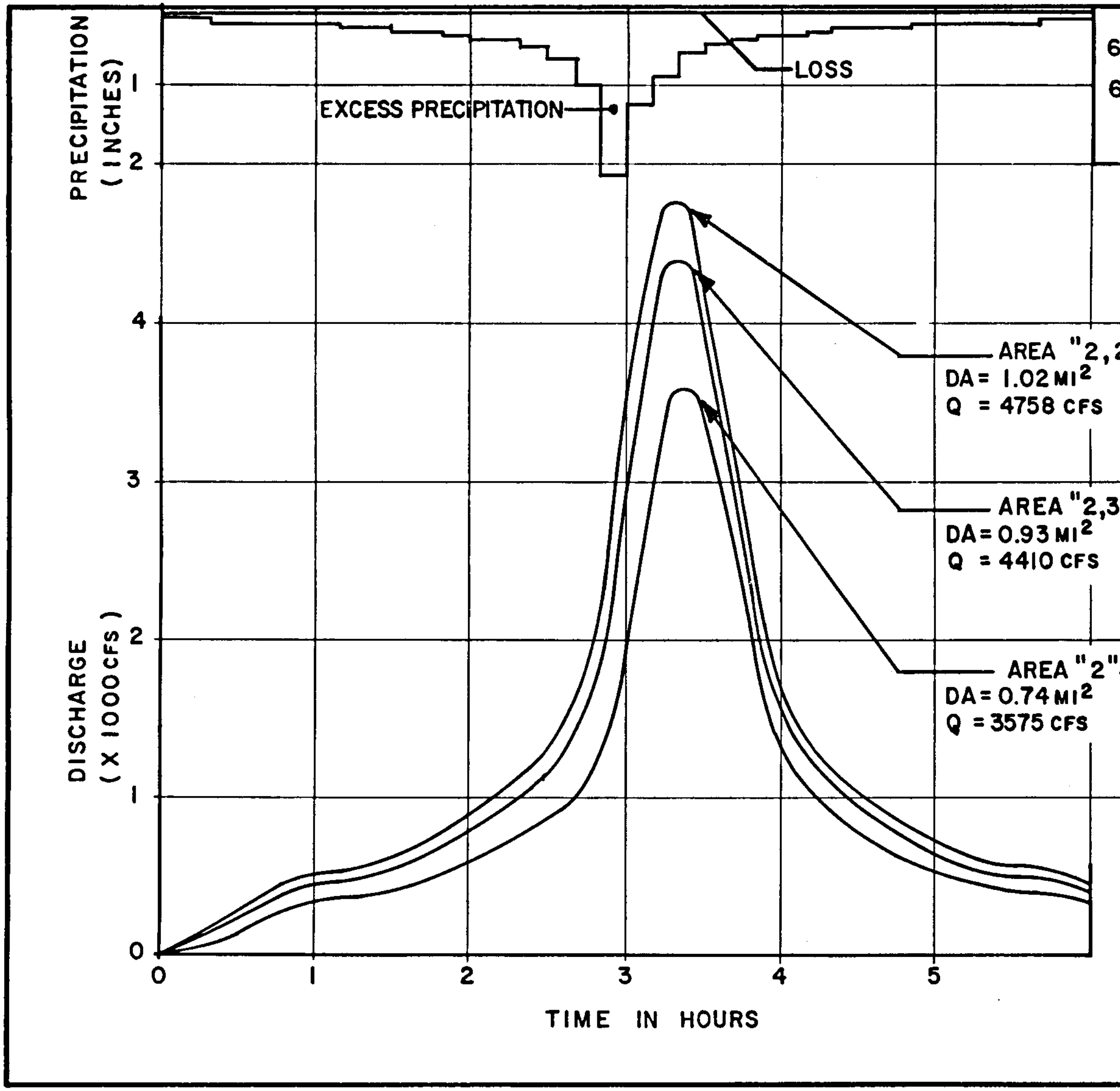



GARAPAN FLOOD CONTROL SAIPAN,CNMI

SPF HYDROGRAPH AT THE SHORELINE (FUTURE W/ PROJECT)

U.S.ARMY ENGINEER DISTRICT, HONOLULU

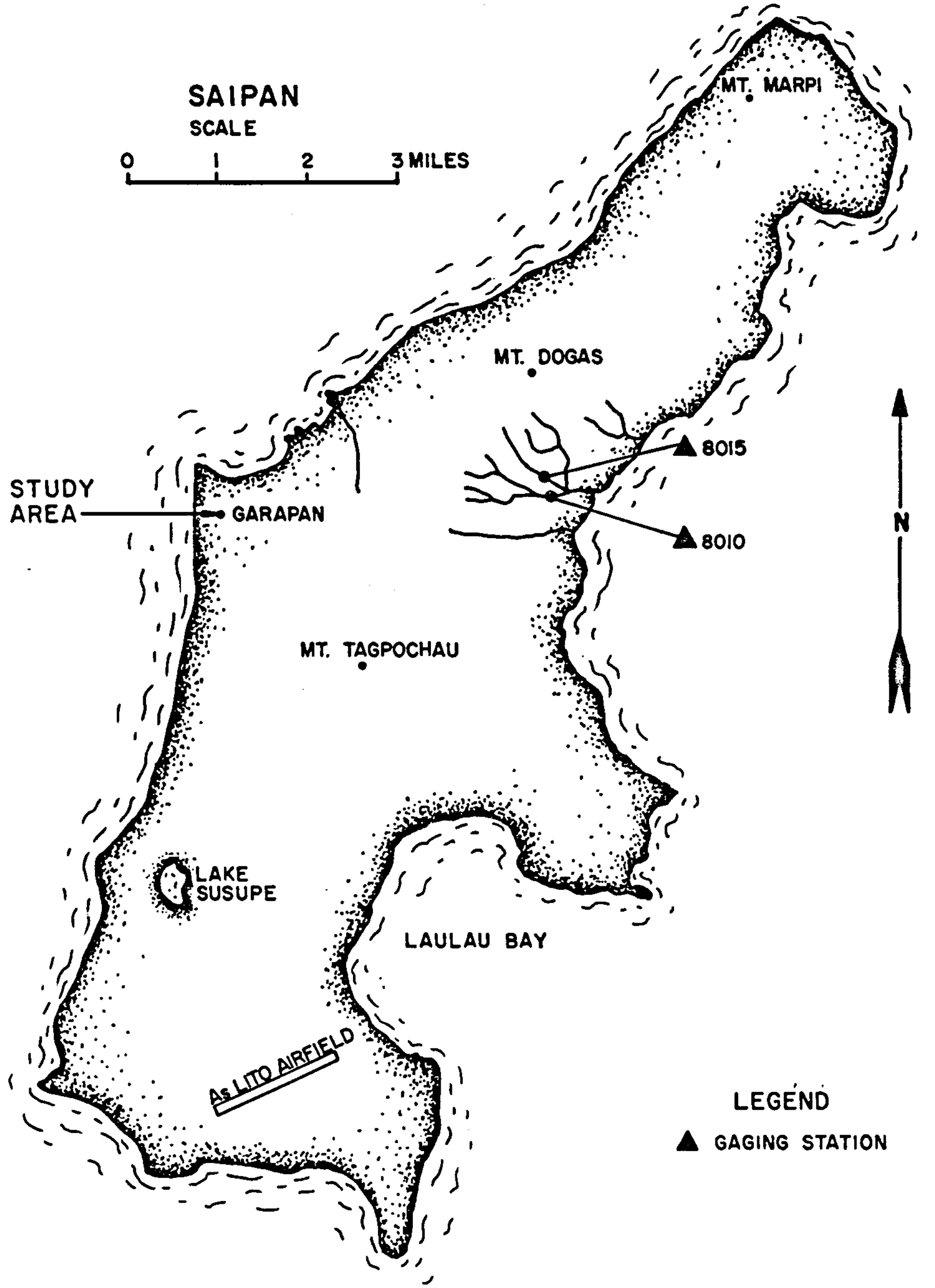
PLATE A-13




GARAPAN FLOOD CONTROL SAIPAN, CNMI

SPF HYDROGRAPHS
AT SHORELINE
FUTURE CONDITIONS
WITH PROJECT

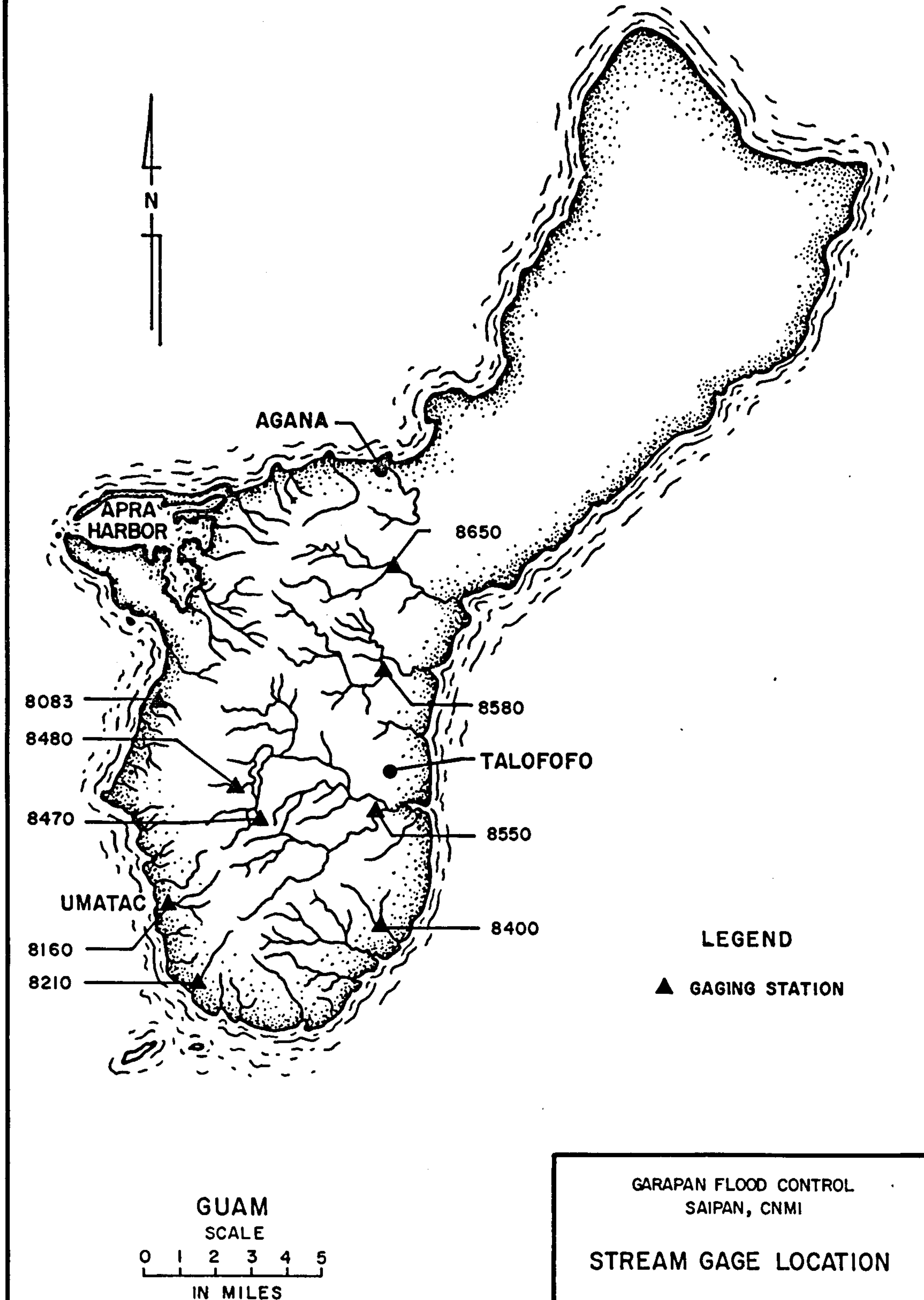
U.S. ARMY ENGINEER DISTRICT, HONOLULU




GARAPAN FLOOD CONTROL SAIPAN, CNMI

STREAM GAGE AND
STUDY AREA LOCATION

U.S. ARMY ENGINEER DISTRICT, HONOLULU

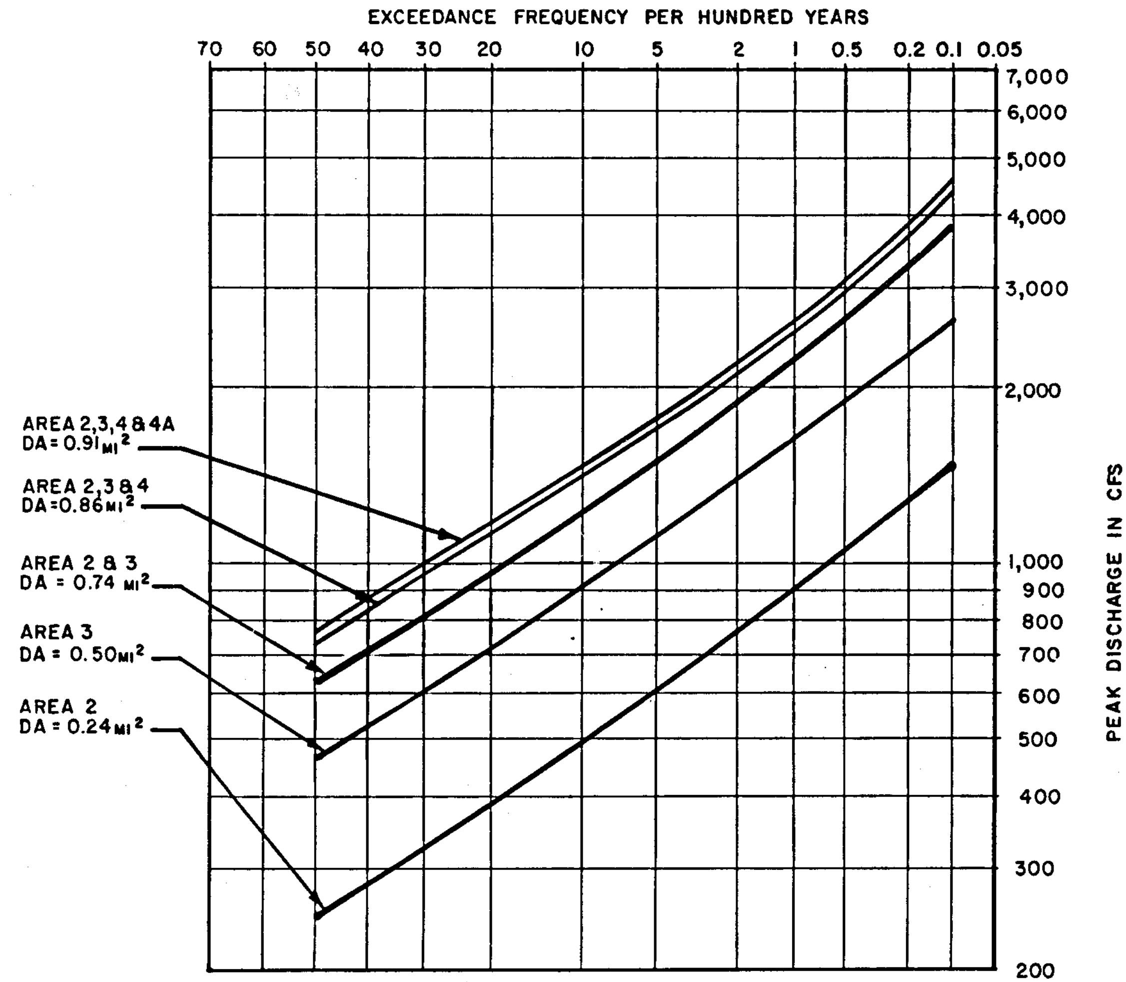



GARAPAN FLOOD CONTROL
SAIPAN, CNMI

STREAM GAGE LOCATION

U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE A-16

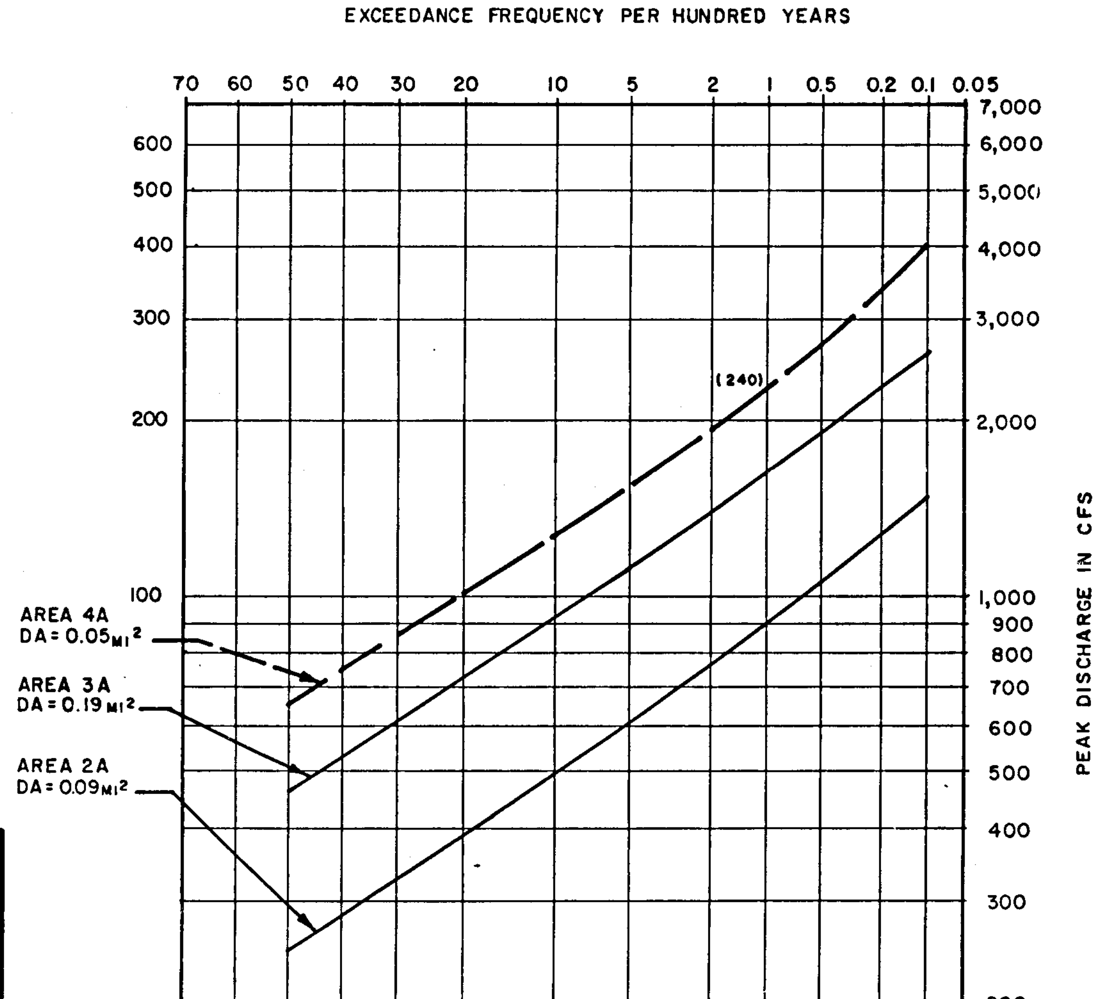



GARAPAN FLOOD CONTROL SAIPAN, CNMI

**WEST COAST HWY DISCHARGE-FREQUENCY CURVES (EXPECTED PROBABILITY) EXISTING CONDITION**

U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE A-17

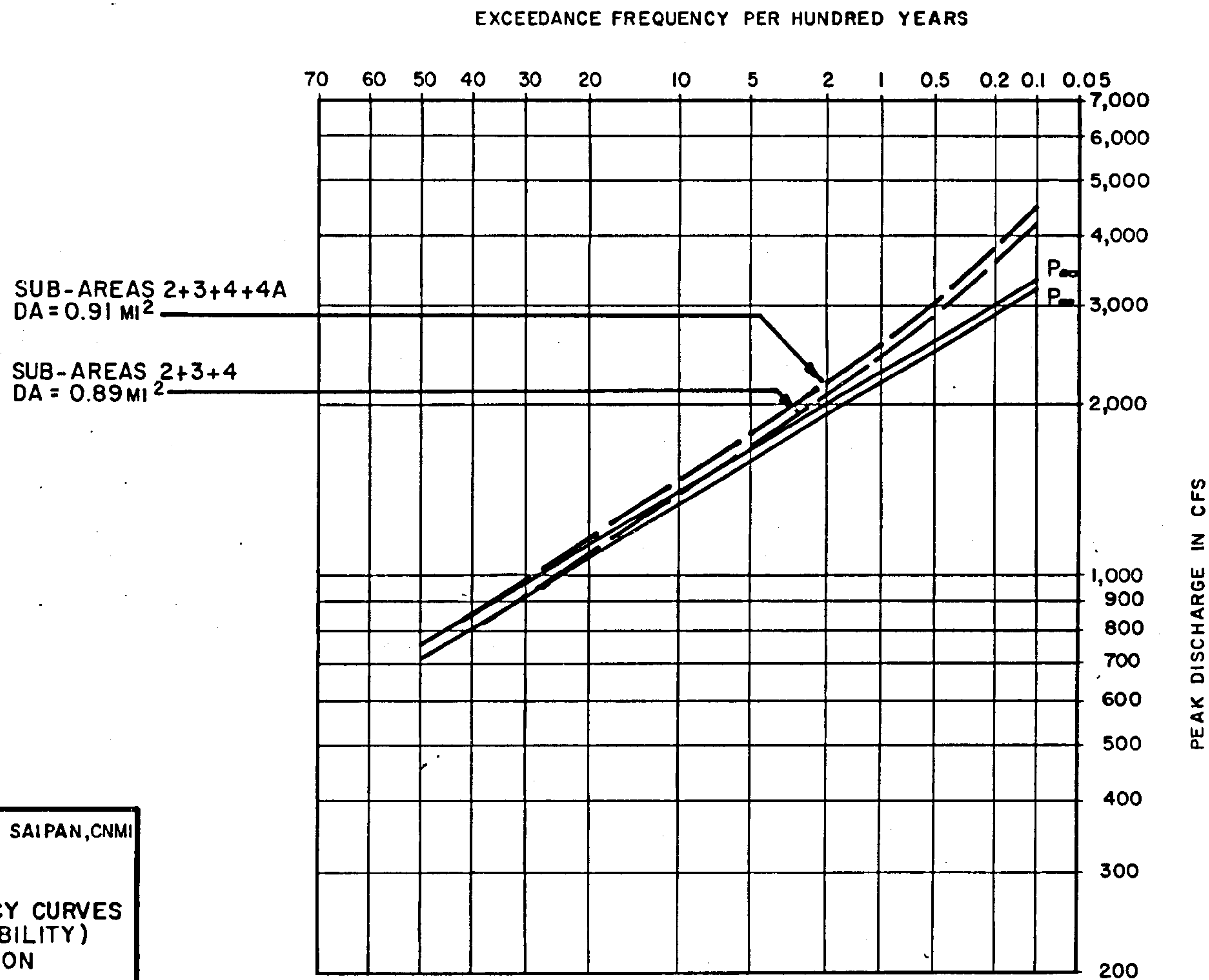



GARAPAN FLOOD CONTROL SAIPAN, CNMI

**DISCHARGE-FREQUENCY CURVES (EXPECTED PROBABILITY) EXISTING CONDITION AT SHORELINE**

U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE A-18

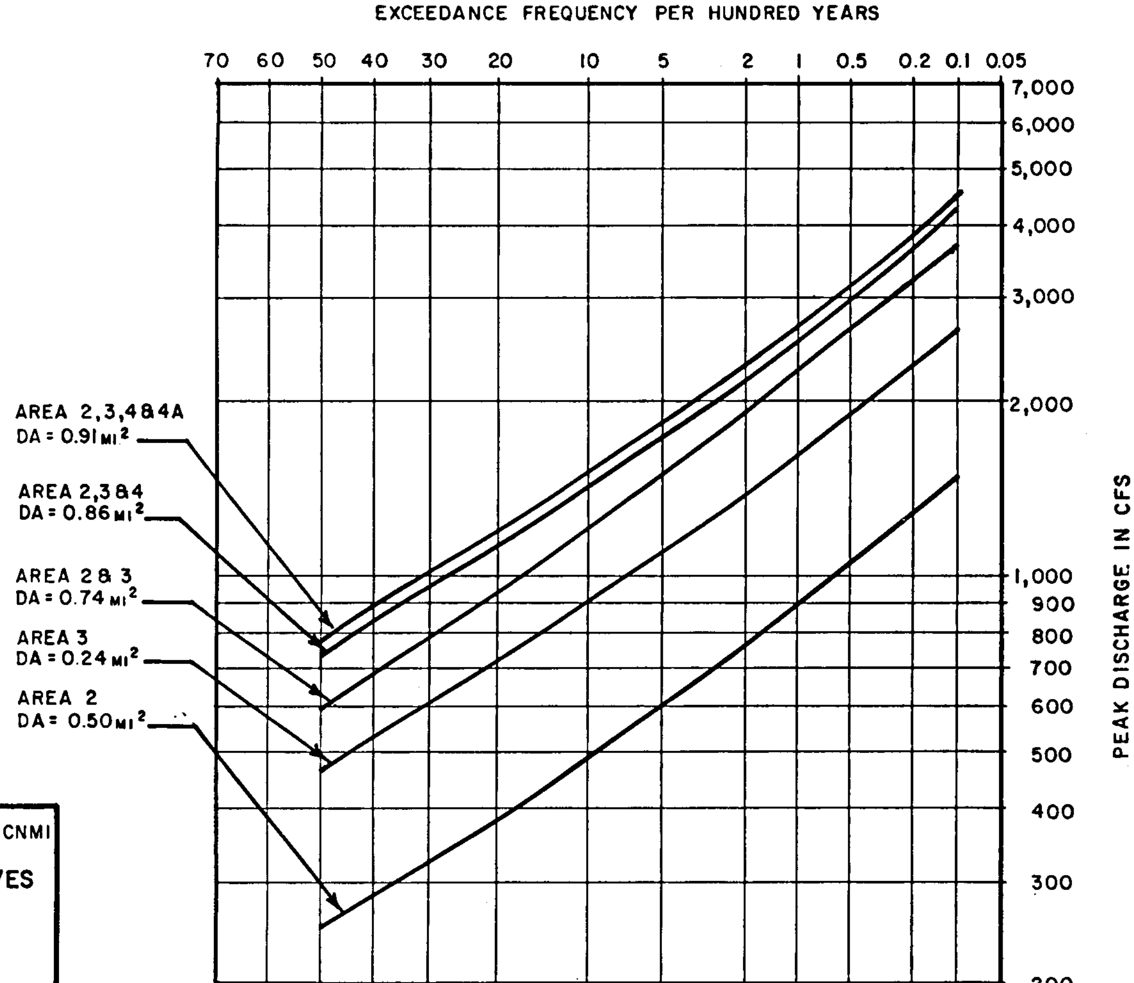



GARAPAN FLOOD CONTROL SAIPAN, CNMI

DISCHARGE-FREQUENCY CURVES
(EXPECTED PROBABILITY)
EXISTING CONDITION

U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE A-19

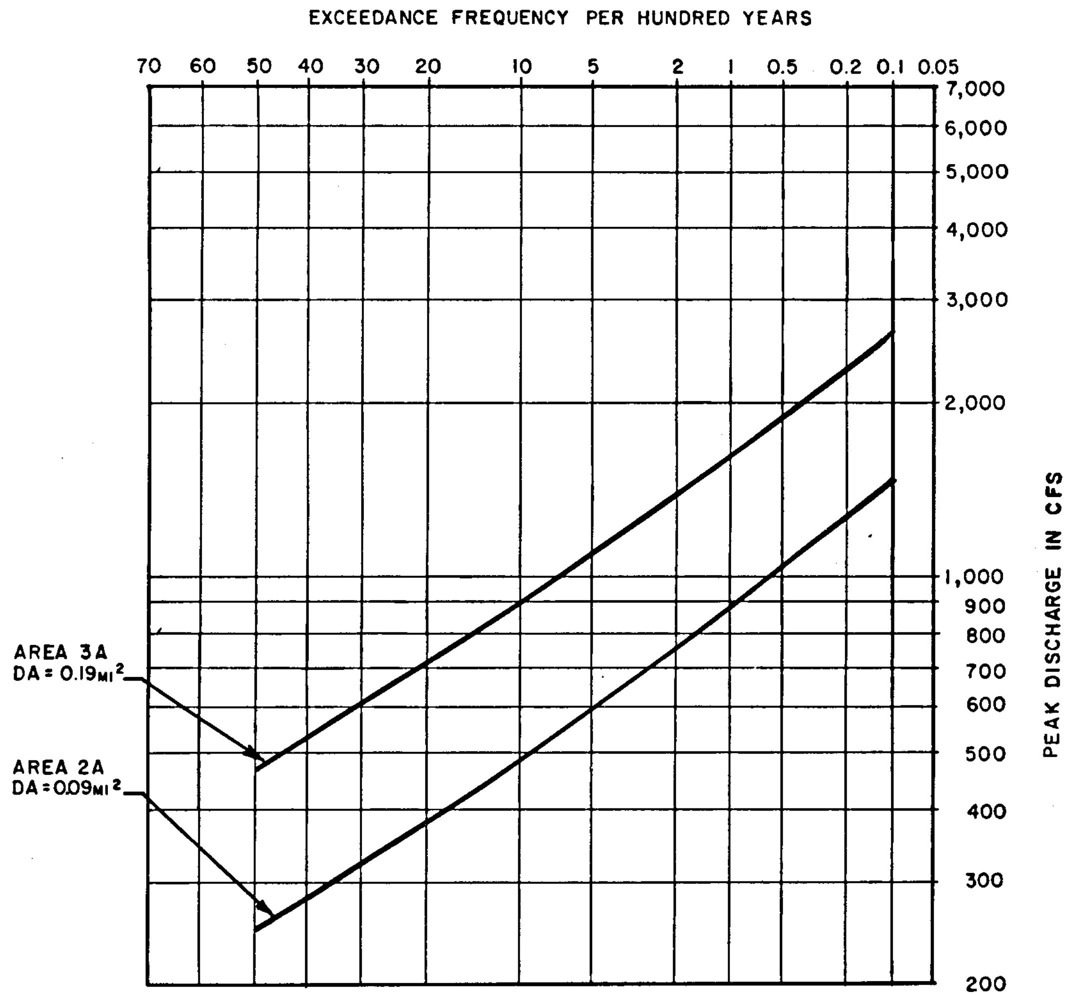



GARAPAN FLOOD CONTROL SAIPAN, CNMI

DISCHARGE-FREQUENCY CURVES
EXPECTED PROBABILITY
FUTURE CONDITION
WITHOUT PROJECT

U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE A-20

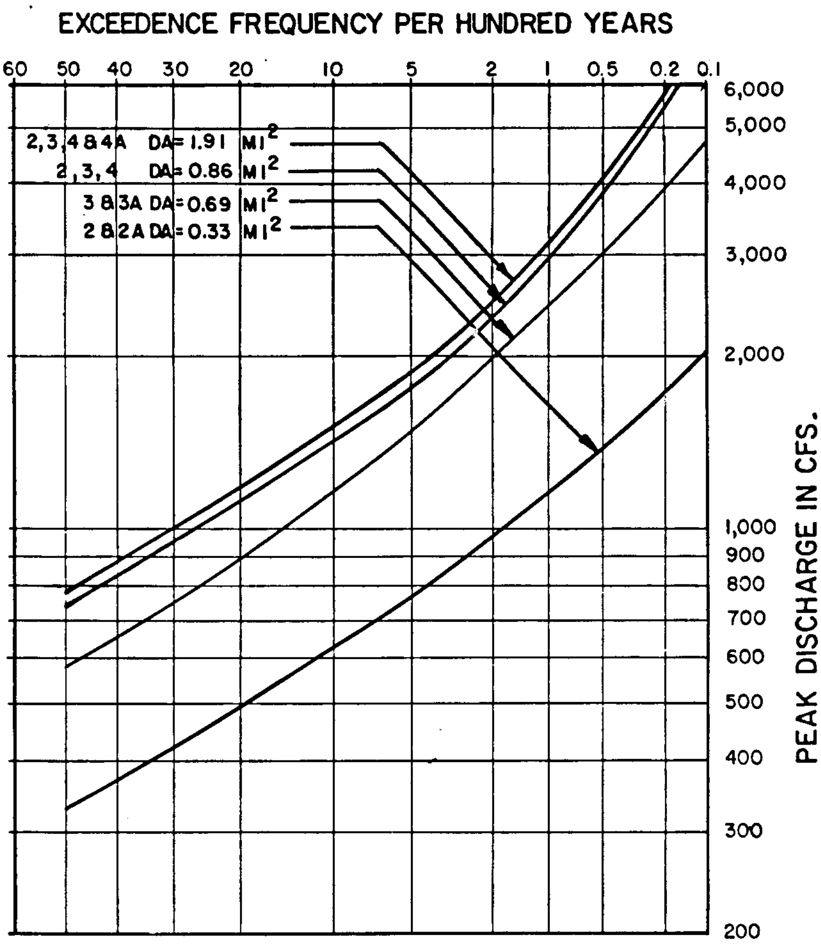



GARAPAN FLOOD CONTROL SAIPAN, CNMI

DISCHARGE-FREQUENCY CURVES
EXPECTED PROBABILITY
FUTURE CONDITION
WITHOUT PROJECT

U.S. ARMY ENGINEER DISTRICT, HONOLULU

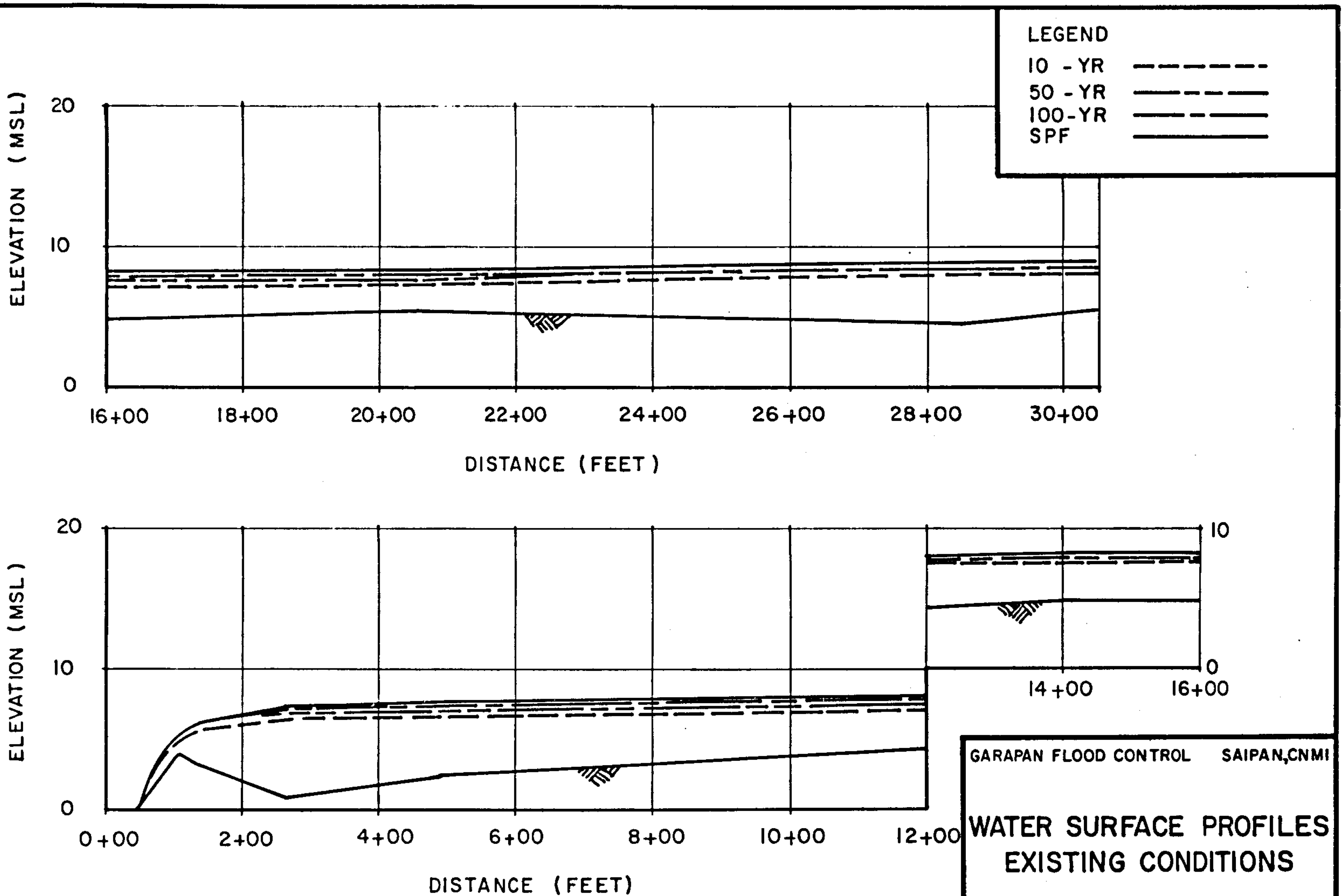
PLATE A-21




GARAPAN FLOOD CONTROL SAIPAN, CNMI

DISCHARGE-
FREQUENCY CURVE
(EXPECTED PROBABILITY AT SHORELINE)
FUTURE CONDITION WITH PROJECT

U.S. ARMY ENGINEER DISTRICT, HONOLULU




GARAPAN FLOOD CONTROL SAIPAN, CNMI

# WATER SURFACE PROFILES EXISTING CONDITIONS

U.S. ARMY ENGINEER DISTRICT, HONOLULU



PLATE A-23

GARAPAN FLOOD CONTROL
SAIPAN, CNMI

# GEOLOGY AND SOILS

## APPENDIX B

APPENDIX B
GEOLOGY AND SOILS

TABLE OF CONTENTS

GEOTECHNICAL APPENDIX
GARAPAN FLOOD CONTROL PROJECT
SAIPAN, COMMONWEALTH OF THE NORTHERN MARIANAS

## REGIONAL GEOLOGY

1. Saipan is the fourth southernmost and second largest island of the Marianas 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 Marianas Islands have experienced a geologic history rich in seismic activity and volcanism. Additionally, the 10° to 20° latitude of the Marianas Ridge with shallow ocean depths have made ideal conditions for coral growth and subsequent reef development.

The island of Saipan is small in size; 13 miles long, 4 miles wide, and comprises 48 square miles of dry land. The dominant topographic feature is an axial ridge, or highland that extends through the northern three fourths of the island and reaches 1,555 feet elevation near the center of the island. Closely spaced and generally deep valleys dissect most of the central portion of the axial ridge to expose volcanic and other igneous rock. A coral limestone barrier reef and lagoon (1/4 to 2 miles wide) borders the island on the west. The barrier reef changes to a fringing reef at both ends of the island. A narrow fringing reef encircles much of the rest of the island.

## SITE GEOLOGY

2. a. Physiography - Topography. The proposed flood control project is located on the Western Coastal Plain which extends along the entire west side of the island. This coastal plain ranges from 3,000 feet to less than 1,000 feet wide, and includes a total area of about four square miles of limesand (also classified as coral limestone sediments, predominantly sand sizes) and artificial man-made sanitary fills, consisting of a heterogeneous mixture of all kinds of coral and man-made debris. Fill material ranges from dredged marine sediments to random and sanitary land fills. The limesands are very fine to very coarse grained with occasional gravelly zones. The limesands consist predominantly of mollusk shells and fossils of Foraminifera. They resemble present beach lagoonal sands except that they are elevated as high as 15 feet or more above present sea level. The sands rest upon a westward-sloping, limestone platform or coral reef complex. This reef complex consists of whole coral colonies (skeletons), weathered and broken coral fragments (sands to gravels), shell fragments and sand-size to microscopic fossils (Foraminifera) and calcareous silt which are cemented in various degrees of lithification (loose to solid).

Except for along the western and eastern boundaries of the project, the topography is level over nearly the entire site and undulates gently in elevation between 6.0 to 8.0 feet MSL. The western boundary is the shoreline which slopes seaward at an average of 6 feet per 100 feet of horizontal distance. The eastern boundary of the proposed site is adjacent to the west coast highway near the base of a hillside which has a general slope of 1 vertical on 10 horizontal. The maximum elevation of the eastern boundary is about 20 feet MSL and the minimum elevation at the eastern boundary is sea level. The land is in residential use with mostly single-family one and two story dwellings.

b. Lithology-Stratigraphy. Subsurface conditions were investigated in February 1984 with 11 borings drilled to various depths between 12 and 25 feet. The locations of the borings are shown on Plate B-1 titled "Location of Borings." Geologic profiles along the project alignments are presented on Plate B-2. The borings indicated that the site, except for a 1,000-foot strip along the shoreline, is overlain with man-made fill consisting of a heterogeneous mixture of silt, sand, shell and coral fragments and topsoil to depths ranging from 1.5 feet to 4.0 feet. From the shoreline for a distance of about 1,000 feet inland, subsurface materials consist of unconsolidated medium to dense, medium grained, calcareous sand from ground surface to depths varying from 10 feet to 24 feet. Inland from borings BH-10-84, the site is underlain by alternating layers of unconsolidated coralline silt, sand, gravel and soft to moderately hard limestone and limestone breccia (coral reef complex) to the depth of the exploration borings. This sequence appears to underlie the nearshore calcareous sand deposit. In the vicinity of boring BH-5-84, it appears that there is an ancient silt-filled channel which appears to be orientated roughly in an east and west direction just southeast of a nearby ravine (see Plate B-1). The existing 21-foot wide riprap-lined, drainage channel in the vicinity of boring BH-5-84 appears to coincide with and support the existence of this buried channel. In boring BH-5-84, dense, sandy silts were present to a depth of 19 feet. These sediments are underlain by the alternating sequence of unconsolidated sand and soft limestone.

The surface layer of fill encountered in most borings was found to be generally stiff where fine grained and medium to dense where coarse grained. The underlying unconsolidated calcareous sand deposit (exposed near the shoreline) is loose to medium dense. In the stratigraphic unit of alternating layers of sand and gravel and limestone, the unconsolidated materials were found to be loose to very dense. The limestone encountered was generally very soft and weakly cemented with occasional thin, hard, well cemented intervals. Boring BH-1-84 located on the northern limits of the project encountered a moderately hard to hard limestone strata from a depth of 6.5 feet to the total depth of the hole at 24 feet. However, high core losses and the fact that no core pieces were longer than 0.5 feet suggest that this limestone strata has a significant amount of very soft limestone or unconsolidated sand/silt present as inter beds or cavity fillings. See Plate B-2 for detailed geologic profiles along the proposed alignments.

c. Groundwater. Groundwater was encountered in most holes at shallow depths (5.0 feet or less) and generally reflect the ground surface topography. Fluctuations in groundwater levels at different recording intervals suggest that the phreatic surface is tidal influenced. Static groundwater levels are shown on the geologic profiles, Plate B-2.

d. Seismicity. Saipan is in a most active seismic area on the eastern edge of the Philippine Plate between the Marianas and Japan trenches on the Cicum Pacific seismic belt. Many earthquakes of low magnitudes occur throughout the year with sufficient energy to cause settlement and consolidation in loose, low-density sediments. The earthquake history of Saipan since 1800 records two major disasters (actual magnitude not available) in 1849 and 1902. The Guam observatory lists 83 earthquakes since 1902 with magnitude of six or greater on the Richter scale. Because the area is seismically active, it is reasonable to assume that earthquakes of this magnitude or greater will occur again. Government design manual TM 5-809-10 dated February 1982 shows Saipan located in seismic probability Zone 3 with a design maximum acceleration of 0.33 g. and a corresponding approximate magnitude of 7 on the Richter scale.

## SUBSURFACE INVESTIGATIONS

3. Subsurface explorations performed for this project consisted of 11 drill holes (BH-1-84 to BH-11-84) drilled during January to February 1984. Locations of these drill holes are shown on Plate B-1 and represent the flood control channel alignment for Alternative Plan B. Borings were not located for portions of Alternative A, C, D, or E.

Six-inch diameter holes were advanced with a trailer-mounted Acker "Hillbilly" drill rig using the rotary wash method with a tri-core bit. Drill holes whose sides caved were cased before proceeding deeper. Standard penetration tests were performed in the drill holes to obtain soil samples for laboratory tests and to evaluate the strength, characteristics and consistency of the in situ soils. In addition, a thin-walled undisturbed sample and 4-inch diameter cores were obtained for the silt and coral limestone, respectively.

## LABORATORY TESTS

4. Representative samples of in situ materials were tested for gradation, Atterberg limits, and specific gravity in accordance with standard ASTM test procedures. One unconsolidated undrained (UU) test was performed on an undisturbed sample of cohesive soil recovered in hole BH-5-84. Individual test results are shown on Plates B-3-1 to B-3-3 and summarized on Plate B-4.

## SUBSURFACE CONDITIONS

5. Alternative Plan B. The flood control channel alignment for Alternative B is basically T-shaped with the bottom of the "T" beginning near the Hotel Intercontinental Tennis Courts running parallel to Hillside View Road, and finally branching slightly east of the West Coast Highway.

a. Outlet Channel. Near surface foundation materials along the outlet channel generally consist of loose to dense calcareous sand overlying a layer of very soft to hard coral limestone with top elevations ranging between (-) 3.3 to (-) 17.5 feet Mean Sea Level. Thickness of the coral limestone layer varies from 3 feet to greater than 15 feet. Coral limestone was not encountered in boring BH-9-84.

b. Alignment alongside Hillside View Road. The near surface foundation materials for the channel alignment consist mainly of coralline sands and gravels with a silty gravelly sand fill in the upper 3 feet. These sands and gravels range in thickness from 10-24 feet and are underlain by a coral limestone rock with extreme degrees of hardness and composition. Since at one time the coral was a living organism, the samples removed varied from hard finger coral with dense sand fillings to very soft and weakly cemented.

c. Alignment alongside West Coast Highway. The subsurface foundation materials for the channel alignment alongside the West Coast Highway are basically the same as the above alignment except for the presence of several silt layers in boring BH-5-84. The origin of these silt layers were the probable result of finer grain particles transported by natural drainage water from the adjacent hillside.

6. Alternative Plan A. The flood control alignment for Alternative Plan A is composed of an alignment located parallel to West Coast Highway, with a diagonal jog at Micro Beach Road, and the rest of the alignment passing through the existing wetland area and beach.

a. Outlet Channel and Alignment through Wetland Area. Although no borings were taken along this portion of the flood control alignment, one can surmise that the foundation materials will not vary drastically from those described for

b. Alignment along West Coast Highway. This alignment is the same as the alignment under Alternative B. Refer to the previous section for the description of the subsurface materials.

7. Alternative Plan C. The flood control alignment for Alternative C is composed of a T-shaped channel alignment similar to Alternative B, but with the bottom of the "T" running parallel to Island Power Road.

a. Outlet Channel and Alignment Along Island Power Road. Although no borings were taken along this portion of the flood control alignment, one can surmise that the foundation materials will not vary drastically from those described for Alternative Plan B.

b. Alignment Along West Coast Highway. This alignment is the same as the alignment under Alternative Plan B. Refer to the previous section for the description of the subsurface materials.

8. Alternative Plan D. The flood control alignment for Alternative Plan D is composed of an alignment located parallel to West Coast Highway until the American Memorial Park, where it then uses the vegetated raw land as a ponding area for flood flows and outlets at the Tanapag Harbor.

a. Outlet Channel and Alignment into Wetland Area. Although no borings were taken along this portion of the flood control alignment, one can surmise that the foundation materials will not vary drastically from those described for Alternative Plan B.

b. Alignment along West Coast Highway. This alignment is the same as the alignment under Alternative Plan B. Refer to the previous section for the description of the subsurface materials.

9. Alternative Plan E. The flood control alignment for Alternative Plan E is composed of an alignment parallel to West Coast Highway, and continuing around the wetland area located in the American Memorial Park and outlets in the Tanapag Harbor.

a. Outlet Channel and Alignment Around Wetland Area. Although no borings were taken along this portion of the flood control alignment, one can surmise that the foundation materials will not vary drastically from those described for Alternative Plan B.

b. Alignment Along West Coast Highway.. This alignment is the same as the alignment under Alternative Plan B. Refer to the previous section for the description of the subsurface materials.

## ADOPTED SOIL VALUES FOR DESIGN

10. The adopted design values for the foundation materials are summarized in Table 1 below:

TABLE 1

| Soil Type | Fill Sand | Silt |
|---|---|---|
| $\gamma$ moist (kcf) | 0.105 | 0.111 |
| $\gamma$ saturated (kcf) | 0.115 | 0.112 |
| C (ksf) | 0 | 1.36 |
| Ø | 30° | 14° |

## DESIGN CONSIDERATIONS AND ANALYSIS

11. a. General. In accordance with EM 1110-2-1913, "Design and Construction of Levees," March 1978, slope stability analysis was performed for various reaches along the three alternative channel alignments. Safe side slopes were recommended based on the results of these analyses.

Since trapezoidal channels will be used in all three alternatives, stone riprap slope protection was designed in accordance with (1) EM 1110-2-1601, "Hydraulic Design Flood Control Channel" and (2) ETL 1110-2-120, "Additional Guidance for Riprap Channel Protection."

b. Outlet Channel. As previously discussed under subsurface conditions, borings at the outlet channel were performed only for Alternative B. Channel excavation will be in sands and gravels to the proposed invert elevation of -10 MSL at the outlet. For the remaining two alternative channel alignments the stability analyses were performed assuming similar foundation conditions.

Only the end of construction case with and without seismic loading (s = 0.10) was evaluated. The sudden drawdown case was not evaluated since the channel side slopes at the outlet are only exposed to tidal fluctuations and not the floodwater. Results from the analysis indicate side slopes no steeper than 1V on 3H will be required. Results are shown on Plates B-5-1 and B-5-2.

c. Interceptor Channel. The channel excavation will be in sands, gravel, fill and coral limestone rock. The quantities and ease of excavation in the coral limestone rock will vary according to the alignment location and invert elevation. No borings were drilled in wetland area for alternative alignments A and D, for the reach along Island Power Road for Alternative C and for the reach around the wetland for Alternative E. For these unexplored reaches the foundation materials were assumed to be similar.

Both the end of construction (with and without seismic loading) and the sudden drawdown case were evaluated along different reaches of the three alternative alignments. Results from the stability analysis indicate side slopes no steeper than 1V:2.5H will be required. Results are shown on Plates B-6-1 through B-6-3.

Channel protection of 12 inches of riprap over 6 inches of bedding will be provided for the interceptor channel for maximum velocities not exceeding 10 feet per second. Below elevation (+)2.0 mean sea level, channel protection will be thickened 50 percent to 18 inches of riprap or 9 inches of bedding where riprap is placed underwater without dewatering. Riprap stones shall have a minimum specific gravity of 2.3. Where the channel invert is in sands and gravels the invert will be protected with riprap lining and shown on Plate B-7. Where competent coral limestone is encountered above invert grade, the invert lining will be deleted and slope lining terminated and keyed into the underlying coral limestone at the point of contact as shown on Plate B-8.

## CONCRETE STRUCTURES

12. For each of the alternative channel alignments multi-cell box culverts will be used at each road crossing.

Excavation into coral limestone rock is anticipated at several locations. In such instances, a 1-foot thick layer of satisfactory excavated coral material can be used as a leveling course prior concrete placement. An allowable bearing value of 4000 psf is recommended.

The remaining excavation will be in coral sands and gravels or silts. Exposed subgrade that is disturbed shall be compacted to a minimum 95% of maximum ASTM D 1557, Method D maximum density for cohesionless materials and 90% of maximum for cohesive materials. An allowable soil bearing value of 2000 psf is recommended.

Lateral active ($K_a$ = 0.33), in-situ ($K_o$ = 0.5) and passive ($K_p$ = 3.0) earth pressures are recommended for use in the structural design of the box culvert and sheet pile I-walls.

# CONSTRUCTION CONSIDERATIONS

## SITE PREPARATION AND FILL COMPACTION

13. Clearing, grubbing and stripping will be required for all existing ground surfaces within the limits of improvements. Areas to receive fill should be benched into firm soils or rock where slopes prior to grading exceed a steepness of 1V on 4H. Fill slopes should not exceed a steepness of the adjacent proposed channel slopes. Following site preparation, fills should be placed in lifts no thicker than 9 inches in loose thickness, moisture conditioned as necessary, and compacted to minimum 95 percent of maximum density as determined by ASTM D 1557, Method D for cohesionless materials and minimum 90 percent of maximum density for cohesive materials.

## CHANNEL EXCAVATION AND RIPRAP CONSTRUCTION

14. Blasting may be required for removal of coral limestone where encountered. Dewatering will not be mandatory for channel excavation and riprap placement. However, the Contractor may elect to dewater to facilitate excavation. Riprap stone protection should be installed as the channel excavation progresses to minimize the exposure of the open excavation to unexpected flood flow. To the extent feasible, excavation and riprap placement should begin at the upstream end of the project and proceed downstream to minimize sediment accumulation in previously completed sections.

## DEWATERING FOR CONCRETE PLACEMENT

15. Dewatering may be required in concrete placement for the box culverts required at the various roadway crossings.

## PHASE CONSTRUCTION FOR BOX CULVERTS

16. Phase construction will be necessary in construction of the various roadway crossings. This is especially critical at Beach Road, the major thoroughfare through the project area. Phase construction can be accomplished by providing a temporary by-pass or constructing one-half of the structure at one time while diverting traffic to the other half.

## PAVEMENT STRUCTURE

17. Pavement structure for roadways would be 2-1/2 inches asphaltic concrete over 8 inches aggregate base course. Prime coat would be applied to the surface of the compacted base course prior to placement of asphaltic concrete. Where asphaltic concrete is proposed for direct application over concrete box culvert structures, tack coat would be applied on the top surface of the concrete culvert.

Base course would be compacted to minimum 100% of maximum density as determined by ASTM D 1557, Method D. Compact the top 6 inches of subgrade in cut and all fill material to minimum 95% of maximum density for cohesionless materials and minimum 90% of maximum density for cohesive materials.

# CONCRETE MATERIALS INVESTIGATION

## GENERAL

18. Type I cement with tricalcium aluminate ranging from 8.2 to 8.5 percent currently available in Guam and Saipan shall be used for constructing all concrete structures including those exposed to seawater. Water-cement ratio of 0.45 will be maintained to insure durability. Type II cement will not be used due to high importation costs.

Trial design batches and testing to meet requirements of the class of concrete specified would be the responsibility of the Contractor. Specifications would indicate the maximum permissible water-cement ratio. Prior to commencing operations the Contractor shall submit for approval the mix proportions of all ingredients that would be used in the manufacture of concrete. The statement shall be accompanied by test reports and all test results, including aggregate gradation and blending, water-cement ratio strength curves, unit weight and slump.

All concrete would be measured and paid on a job price basis, complete, accepted in place, including cement, aggregate, reinforcement, waterstops, forms, finishing, curing and protection.

CEMENTITIOUS MATERIALS

19. Cementitious materials conforming to ASTM C 150, Type I are routinely available in Saipan. Sources of Type I cement are the Kaiser-Permanente Corporation on Guam, Ube and Dragon brand cement from Japan and Philippine cement. Cement would be accepted on the basis of mill test reports and the manufacturer's certification of compliance with the specification. Provisions for check testing by the Government, if desired, will also be included in the contract documents.

ADMIXTURES

20. All concrete shall be air-entrained. At the option of the Contractor a retarding admixture or a water reducing admixture may be used. All admixtures shall conform to ASTM C 494, and the Contractor shall submit for approval certified copies of test reports of the products proposed for use. Provisions for check testing by the Government, if desired, would also be included in the contract documents.

AGGREGATES

21. Aggregates shall conform to ASTM C 33. Coarse aggregate shall be well graded from fine to coarse with a maximum nominal size of 3/4 inch. Coral limestone coarse aggregate meeting the requirements of ASTM C 33 are available at the Black Micro Quarry (Marpi) in maximum nominal size of 3/4 inch and 1 inch. Fine aggregate meeting ASTM C 33 are also available at this quarry. Apparent specific gravity and absorption of the coarse aggregate are approximately 2.60 and 1.5, respectively.

BATCH PLANT REQUIREMENTS

22. The batching plant may be located on site, as approved, or off site. Because of the proximity of a satisfactory commercial batching plant (located at Black Micro's Marpi Quarry) it will be apparently more economical for Contractors to use this source. The plant may be manual, semi-automatic, or better.

Truck mixers conforming to the requirements of ASTM C 94 would be allowed for complete mixing of central-plant materials. Conveying concrete shall be accomplished by methods normally employed for civil works projects.

CONTRACTOR QUALITY CONTROL

23. The Contractor would be required to establish and maintain quality control for the concrete to assure compliance with the contract requirements.

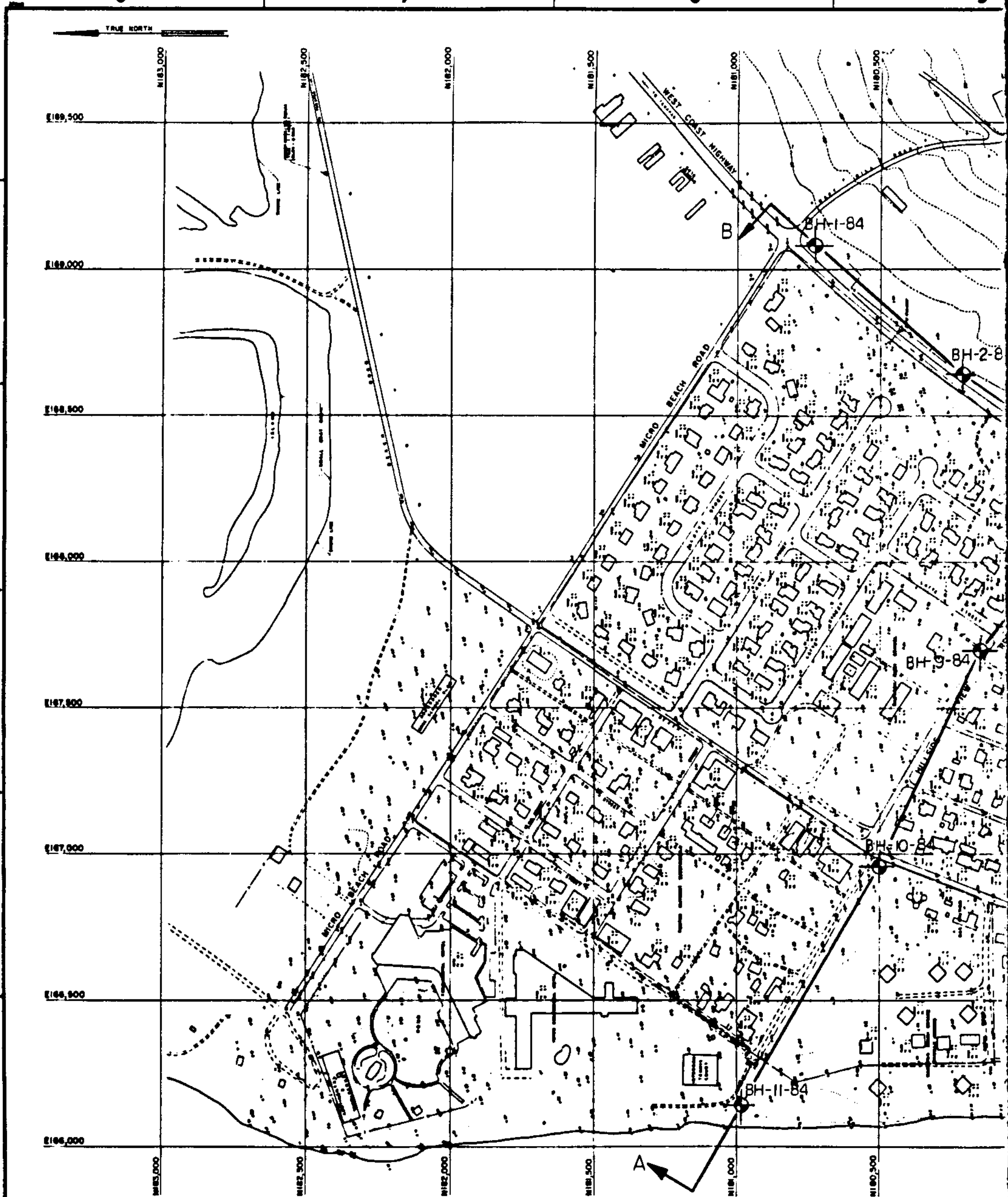
SOURCES OF CONSTRUCTION MATERIALS

24. All borrow pits and quarries on Saipan are controlled by the Commonwealth of the Northern Marianas and are leased for a fixed period (normally five years) on a competitive bid basis. Two quarries presently in operation on Saipan are the Black Micro Quarry at Marpi and the Sablan Quarry on Captial

Hill in Tanapag. The limestone at these two quarries varies from rubble to well-bedded coral limestone breccia. The limestone is white to tan and yellow in color, poorly indurated, fossiliferous and crumbly and requires only a small amount of blasting for removal. The limestone has been irregularly dissolved by water leaving pinnacled solution surfaces. Fresh rock is overlain by residual red or brown clay of high plasticity ranging in thickness from a few inches to more than 10 feet. There is a sharp contact between the clay and the underlying bed rock. A description of materials available at each of the above quarries is described below:

a. Black Micro Quarry at Marpi - This operating quarry is presently the best source for riprap or armor stone on Saipan. It produces a dense coral limestone rock with a bulk specific gravity (BSSD) of about 2.6. Approximately 200 to 300 pieces of stone in sizes ranging from 3 feet to 5 feet are recovered each month of operation. A higher rate of recovery could be obtained by changing the drilling and blasting pattern which is presently tailored for production of concrete aggregrate. Stone less than 3 feet in nominal diameter comprises the bulk of the stone recovered from the quarry. Stones of this size are readily accommodated by the crusher in the production of concrete aggregate. A crushing/screening plant and a concrete plant are located at the site. Concrete aggregate produced meets the requirements of ASTM C 33. However, washing and scrubbing will be required to remove adhered fines.

b. Sablan Quarry in Tanapag - This quarry produces coral limestone aggregate for concrete and asphaltic concrete. A crushing/screening plant, concrete plant and asphalt plant (temporarily out of operation) are located at the site. Stone sizes available at this quarry are generally less than 3 feet. Specific gravity of the stone ranges from 2.1 to 2.5. Quality of the rock varies widely and handling costs involved in sorting out the few acceptable pieces may rule out consideration of this quarry as an economical source of riprap or armor stone.



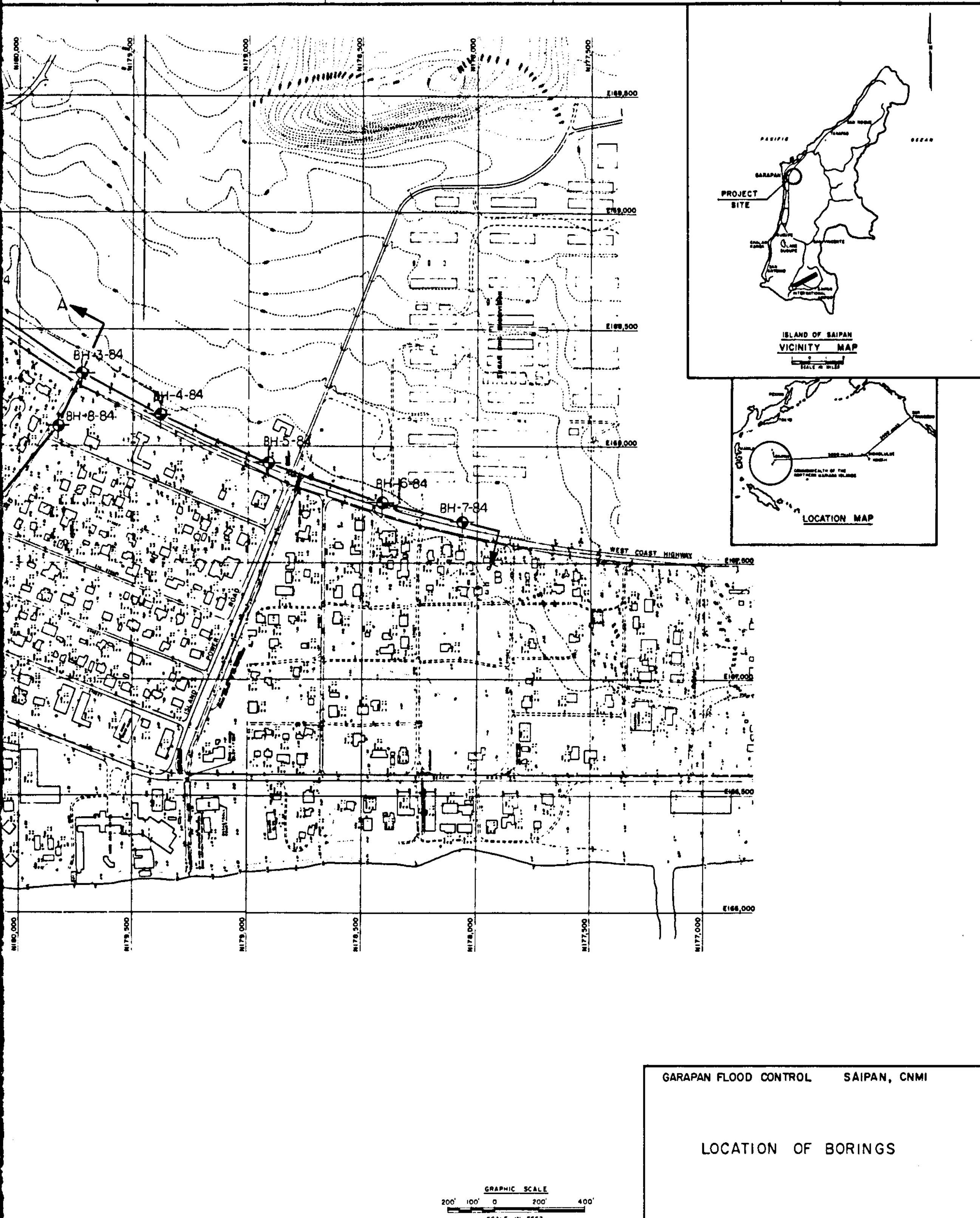

**NOTES:**

1. COORDINATES BASED ON MARIANA ISLANDS PLANE COORDINATE SYSTEM OF 1966.
2. ELEVATIONS ARE IN FEET BASED ON MEAN SEA LEVEL DATUM.

LEGEND

A — A - GEOLOGIC PROFILE A-A

BH-1-84 - BORING LOCATION




GARAPAN FLOOD CONTROL SAIPAN, CNMI

LOCATION OF BORINGS

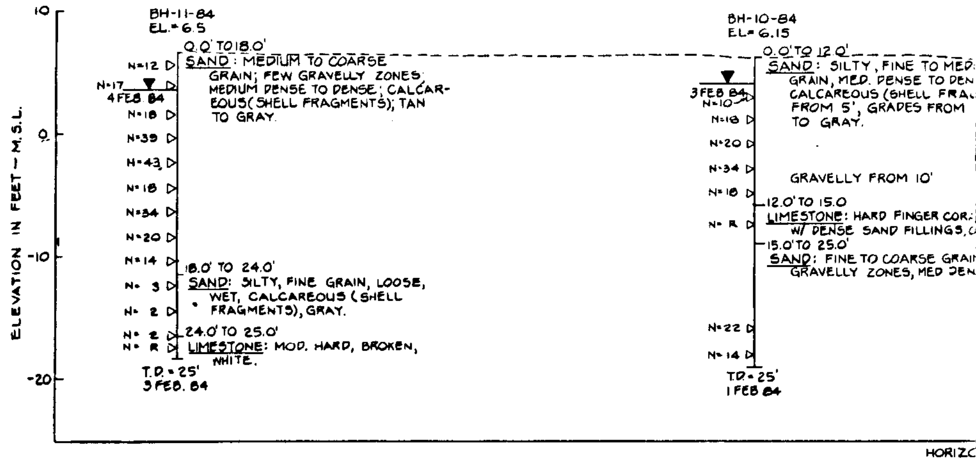
U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE B-1

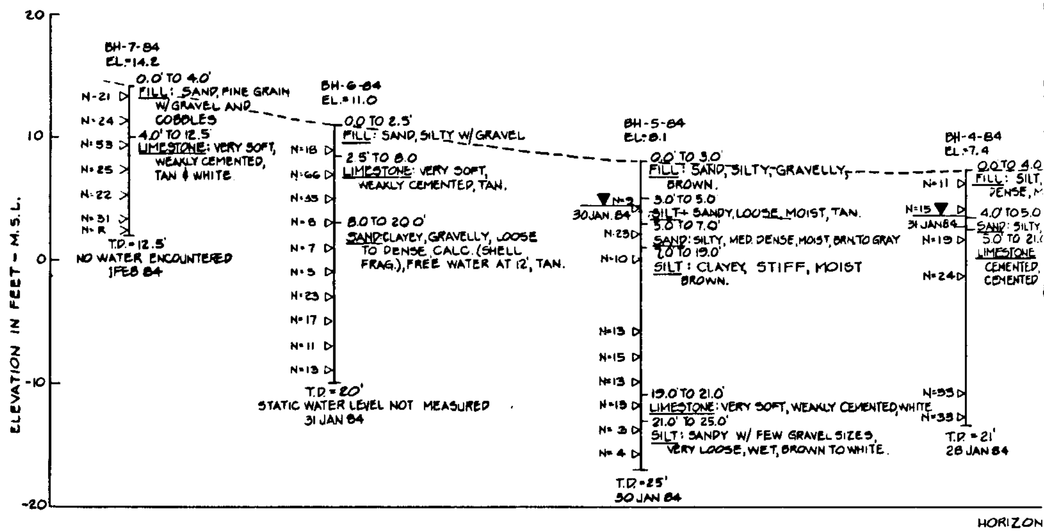
1

| 6 | 5 | 4 |
|---|---|---|

D




C




B

## ABBREVIATIONS

| | | | |
|---|---|---|---|
| BRN. = | BROWN | M.S.L. = | MEAN SEA LEVEL |
| CALC. = | CALCAREOUS | T.D. = | TOTAL DEPTH |
| DIAM. = | DIAMETER | V. = | VERY |
| EL. = | ELEVATION | W/ = | WITH |
| FRAG. = | FRAGMENTS | & = | AND |
| MED. = | MEDIUM | | |

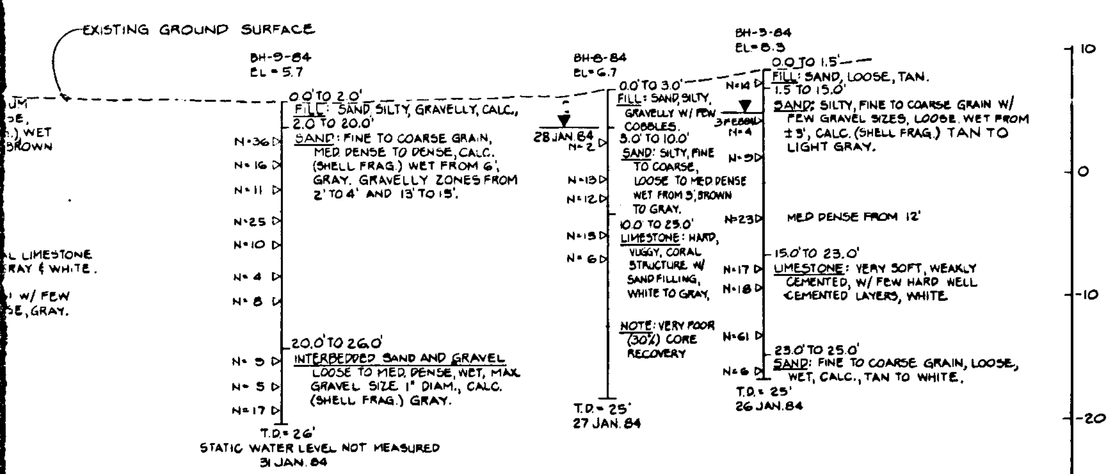
## NOTES:

1. SEE PLATE B1 FOR LOCATION OF PROFILES.
2. SOIL CLASSIFICATIONS ARE VISUAL CLASSIFICATIONS BASED … SOIL CLASSIFICATION SYSTEM AND VISUAL ROCK CLASSIFICATIO… ON THE ARMY CORPS OF ENGINEERS' MANUAL 1110-1-1806.
3. BORE HOLES TENDED TO "CAVE" IN THE UNCONSOLIDATED SAND… THE WATER TABLE.
4. MULTIPLE GROUND WATER MEASUREMENTS IN SAME HOLES INDIC… FLUCTUATION WITH THE TIDE.
5. NOTE EXAGGERATED VERTICAL TO HORIZONTAL SCALE.

A

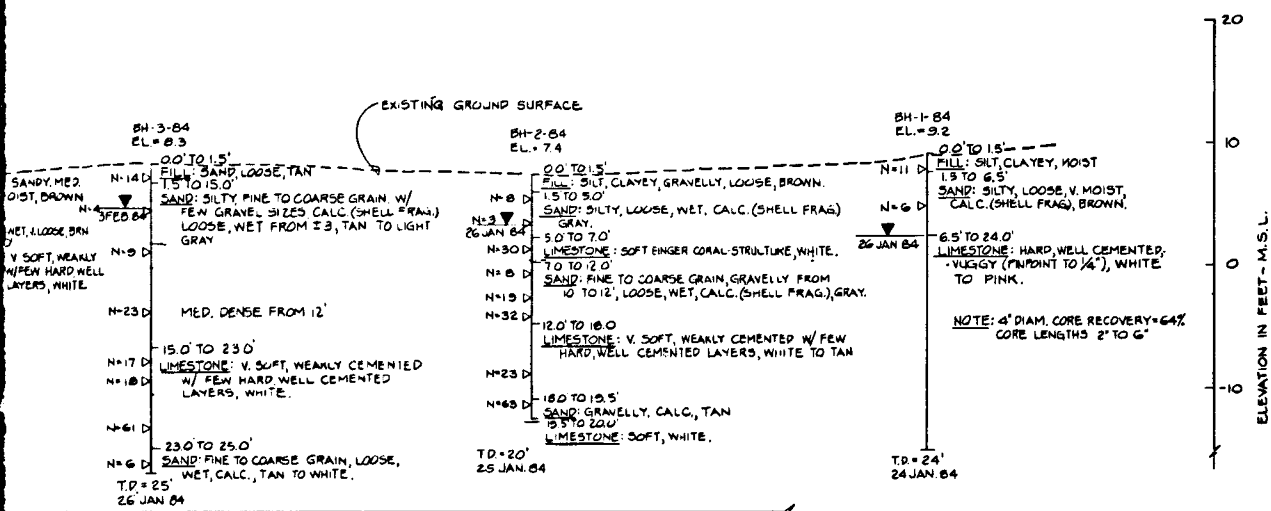
| 6 | 5 | 4 |
|---|---|---|

2




HORIZONTAL SCALE: 1" = 100'   VERTICAL SCALE: 1" = 5'

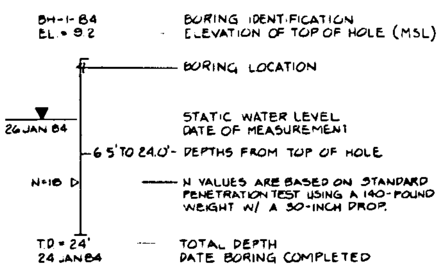
## PROFILE A-A




HORIZONTAL SCALE: 1" = 100'   VERTICAL SCALE: 1" = 5'

## PROFILE B-B

## LEGEND



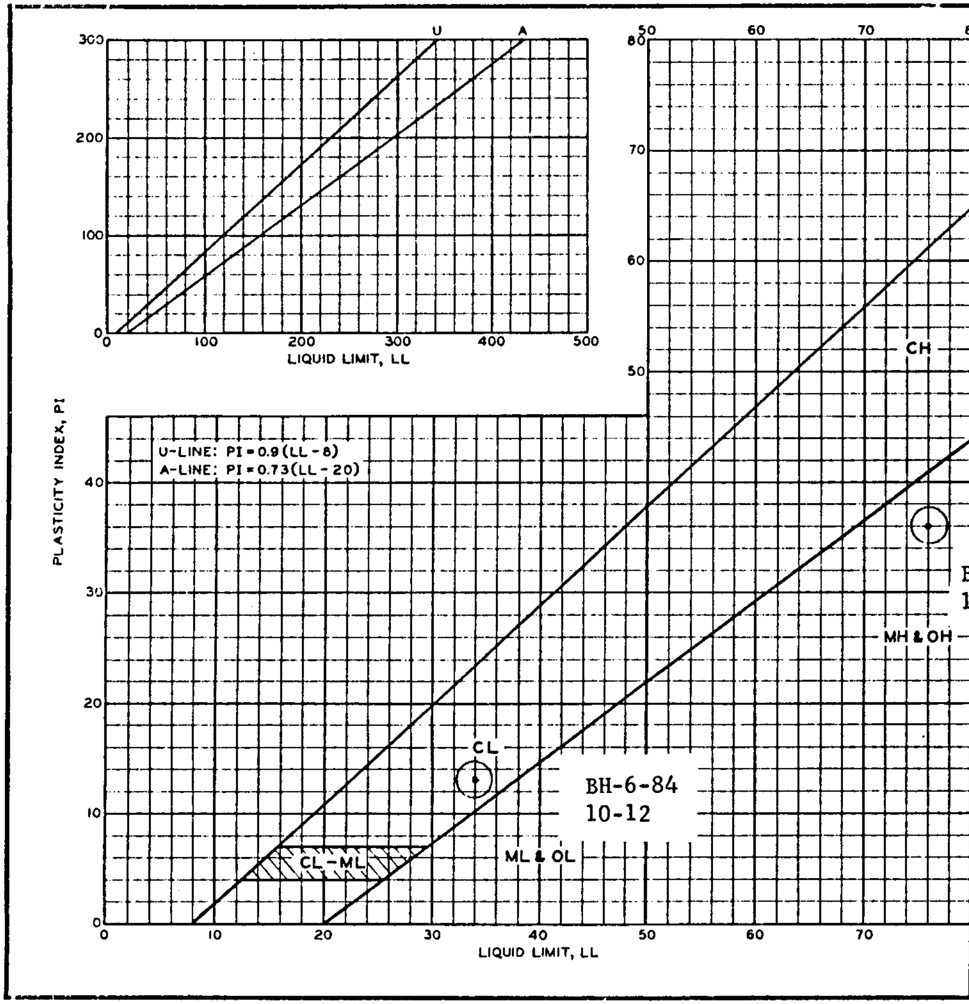

...ON THE UNIFIED ...NS ARE BASED
... AND SILTS BELOW
...ATES GROUND WATER

GARAPAN FLOOD CONTROL   SAIPAN, CNMI

GEOLOGIC PROFILES A-A AND B-B

U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE - B-2

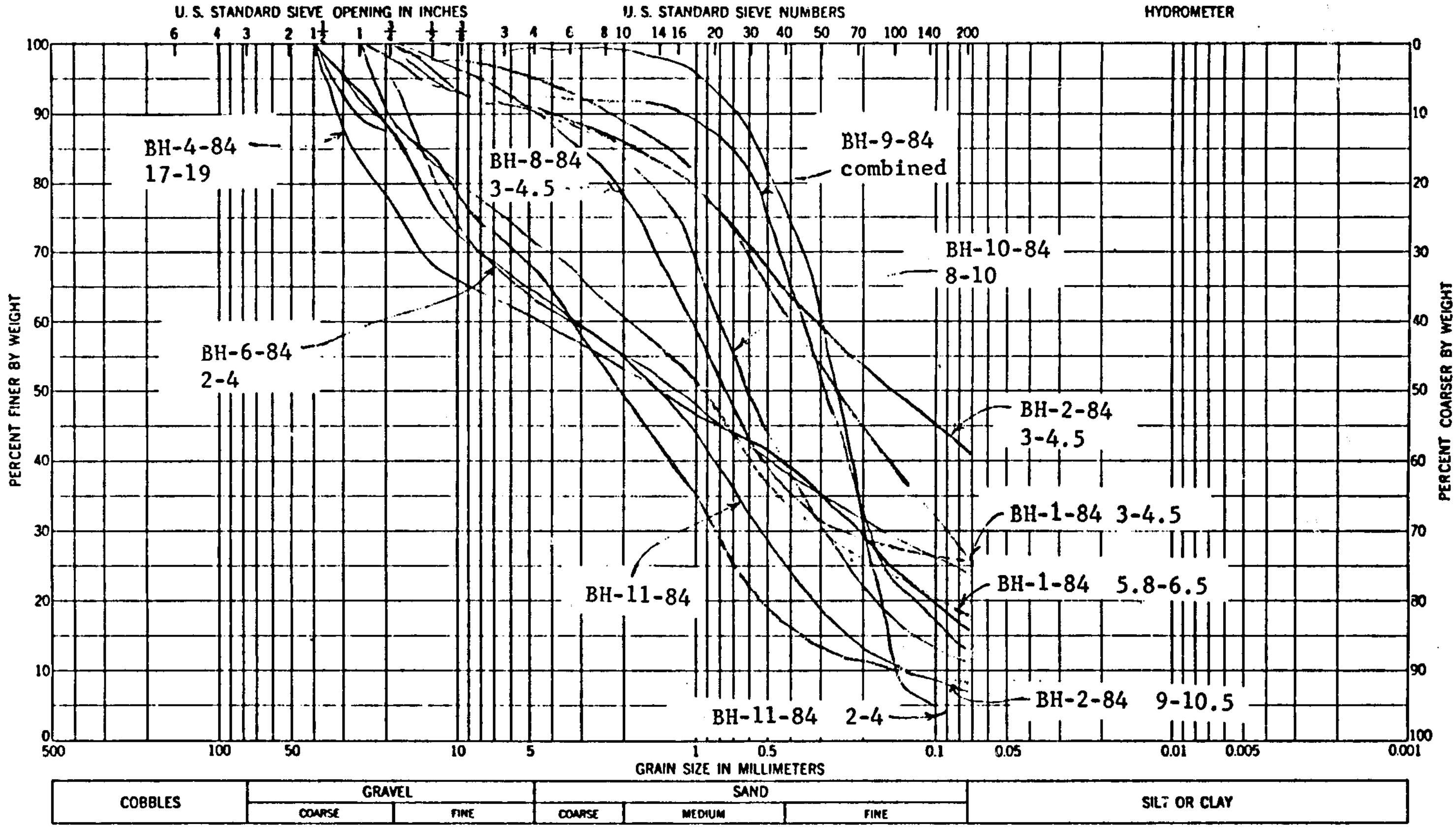



GARAPAN FLOOD CONTROL
Saipan, CNMI
Foundation Materials
May 1984

US ARMY ENGINEER DISTRICT, HONOLULU

PLASTICITY CHART

ENG FORM JUNE 1970 4334 TRANSLUCENT




| Sample No. | Elev or Depth | Classification | Nat w % | LL | PL | PI |
|---|---|---|---|---|---|---|
| | | | | | | |

## GRADATION CURVES

Project GARAPAN FLOOD CONTROL
Saipan, CNMI

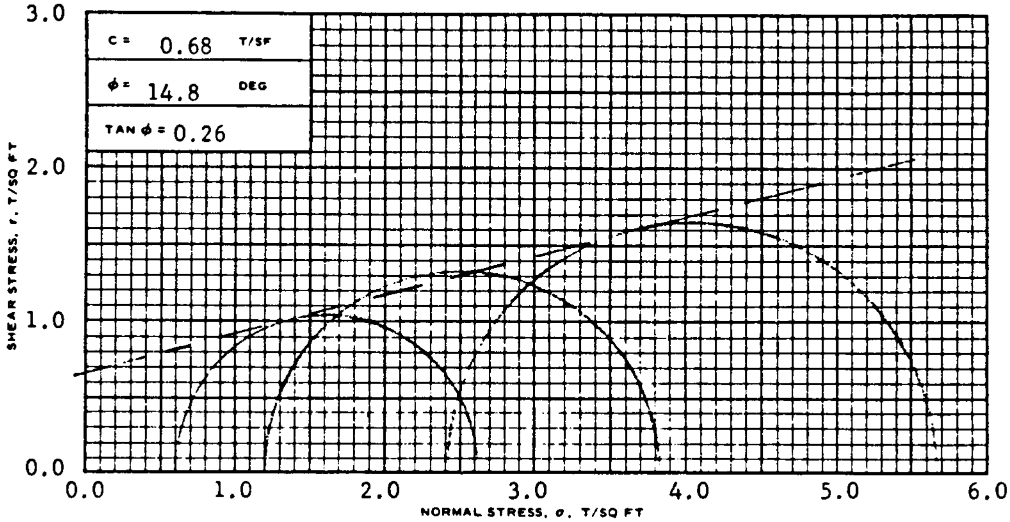
Area Foundation Materials

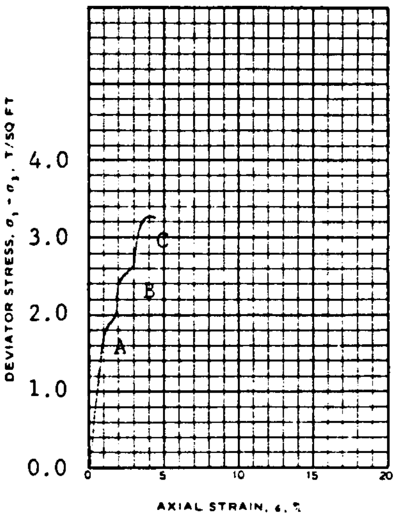
Boring No.

Date May 1984

ENG FORM 1 MAY 63 2087

PLATE B-3-2




| SPECIMEN NO. | | | A | B | C |
|---|---|---|---|---|---|
| INITIAL | WATER CONTENT, % | $w_o$ | 45.7 | | |
| | DRY DENSITY LB/CU FT | $\gamma d_o$ | 76.7 | | |
| | SATURATION, % | $S_o$ | 98.4 | | |
| | VOID RATIO | $e_o$ | 1.332 | | |
| BEFORE SHEAR | WATER CONTENT, % | $w_c$ | — | | |
| | DRY DENSITY LB/CU FT | $\gamma d_c$ | — | | |
| | SATURATION, % | $S_c$ | — | | |
| | VOID RATIO | $e_c$ | — | | |
| | FINAL BACK PRESSURE, T/SQ FT | $u_o$ | — | | |
| MINOR PRINCIPAL STRESS, T/SQ FT | | $\sigma_3$ | 0.6 | 1.2 | 2.4 |
| MAXIMUM DEVIATOR STRESS, T/SQ FT | | $(\sigma_1 - \sigma_3)_{max}$ | 2.02 | 2.63 | 3.26 |
| TIME TO $(\sigma_1 - \sigma_3)_{max}$, MIN | | $t_f$ | 1:45 | 1:00 | 1:15 |
| ULTIMATE DEVIATOR STRESS, T/SQ FT | | $(\sigma_1 - \sigma_3)_{ult}$ | NA | NA | NA |
| INITIAL DIAMETER, IN. | | $D_o$ | 2.87 | 2.90 | 2.91 |
| INITIAL HEIGHT, IN. | | $H_o$ | 6.600 | 6.484 | 6.303 |

CONTROLLED- STRAIN TEST

DESCRIPTION OF SPECIMENS Brown-red brown SILT with decomposing highly weathered black basalt rock (MH)

| | | | | | |
|---|---|---|---|---|---|
| LL 76 | PL 40 | PI 36 | Gs 2.868 | TYPE OF SPECIMEN UNDISTURBED | TYPE OF TEST Q |

| | | |
|---|---|---|
| REMARKS: MULTI-PHASE TEST | PROJECT GARAPAN FLOOD CONTROL | |
| AT NATURAL MOISTURE | SAIPAN, CNMI | |
| CONTENT | BORING NO. BH-5-84 | SAMPLE NO. NA |
| | DEPTH/ELEV 11.5 - 13.0 | |
| | LABORATORY POD | DATE 15 FEB 84 |
| | TRIAXIAL COMPRESSION TEST REPORT | |

ENG FORM NO. 2089 REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE TRANSLUCENT (EM 1110-2-1906)

# TEST DATA SUMMARY

PROJECT GARAPAN FLOOD CONTROL

SHEET ____ OF ____

| BORING NO | SAM NO | DEPTH OR ELEV OF SAMPLE | LABORATORY CLASSIFICATION | MECHANICAL ANALYSIS GRAVEL % | SAND % | FINES % | $D_{10}$ | ATTERBERG LIMITS LL | PL | SPECIFIC GRAVITY G | NAT WATER CONT % | NATURAL DRY DENSITY LBS/CU FT | COMPACTION DATA OPT WATER % | MAXIMUM DRY DENSITY LBS/CU FT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BH-1-84 | S-2 | 3-4.5 | SM | 5 | 69 | 26 | | | | | | | | |
| | S-4 | 5.8-6.5 | SM | 28 | 53 | 19 | | | | | | | | |
| | R-1 | 7-10 | LIMESTONE | | | | | | | 2.295* | | 133.5 | | |
| | R-3 | 11.5-14. | SLIMESTONE | | | | | | | 2.167* | | 123.5 | | |
| | R-5 | 17.5-23 | LIMESTONE | | | | | | | 2.497* | | 150.9 | | |
| BH-2-84 | S-2 | 3-4.5 | SM | 10 | 50 | 40 | | | | | | | | |
| | S-5 | 9-10.5 | SW-SM | 32 | 59 | 9 | | | | | | | | |
| | S-6 | 10.5-12 | GP-GM | 78 | 15 | 7 | | | | | | | | |
| BH-5-84 | SH-1 | 10.5-13 | MH | | | | | 76 | 40 | 2.868 | | | | |
| | S-8 | 13-15 | MH | | | | | 83 | 45 | | | | | |
| BH-6-84 | S-6 | 10-12 | CL | | | | | 34 | 21 | | | | | |
| BH-9-84 | S-2 | 3-4.5 | SM | 10 | 64 | 26 | | | | | | | | |
| | R-1 | 14.5-16. | SLIMESTONE | | | | | | | 1.628* | | 82.2 | | |
| | R-2 | 18.5-25 | LIMESTONE | | | | | | | 2.456* | | 148.9 | | |
| BH-9-84 | combined | | SM | 7 | 79 | 14 | | | | | | | | |
| BH-10-8 | S-5 | 8-10 | SP-SM | 10 | 80 | 10 | | | | | | | | |
| BH-11-8 | S-2 | 2-4 | SP | 1 | 96 | 3 | | | | | | | | |
| | S-6 | S-8 | SP-SM | 36 | 55 | 9 | | | | | | | | |

| BORING NO | SAM NO | SHEAR DATA INITIAL e | DRY DENSITY LBS/CU FT | $w_1$ % | $w_f$ % | $S_1$ % | TYPE TEST | SPECIMEN SIZE INCHES | TEST | $\sigma_m$ T/SQ FT | $\sigma_1$ T/SQ FT | c T/SQ FT | $\phi$ DEGREES | PERMEABILITY e | K FT/MIN | CONSOLIDATION DATA $P_o$ T/SQ FT | $P_c$ T/SQ FT | $C_c$ | $t_{50}$ | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BH-5-84 | SH-1 | 1.332 | 76.7 | 45.7 | 44.5 | 98.4 | UU | 2.87 | 1 | 0.6 | 2.62 | | | | | | | | | |
| | | | | | | | | | 2 | 1.2 | 3.85 | | | | | | | | | |
| | | | | | | | | | 3 | 2.4 | 5.66 | 0.68 | 14 | | | | | | | |

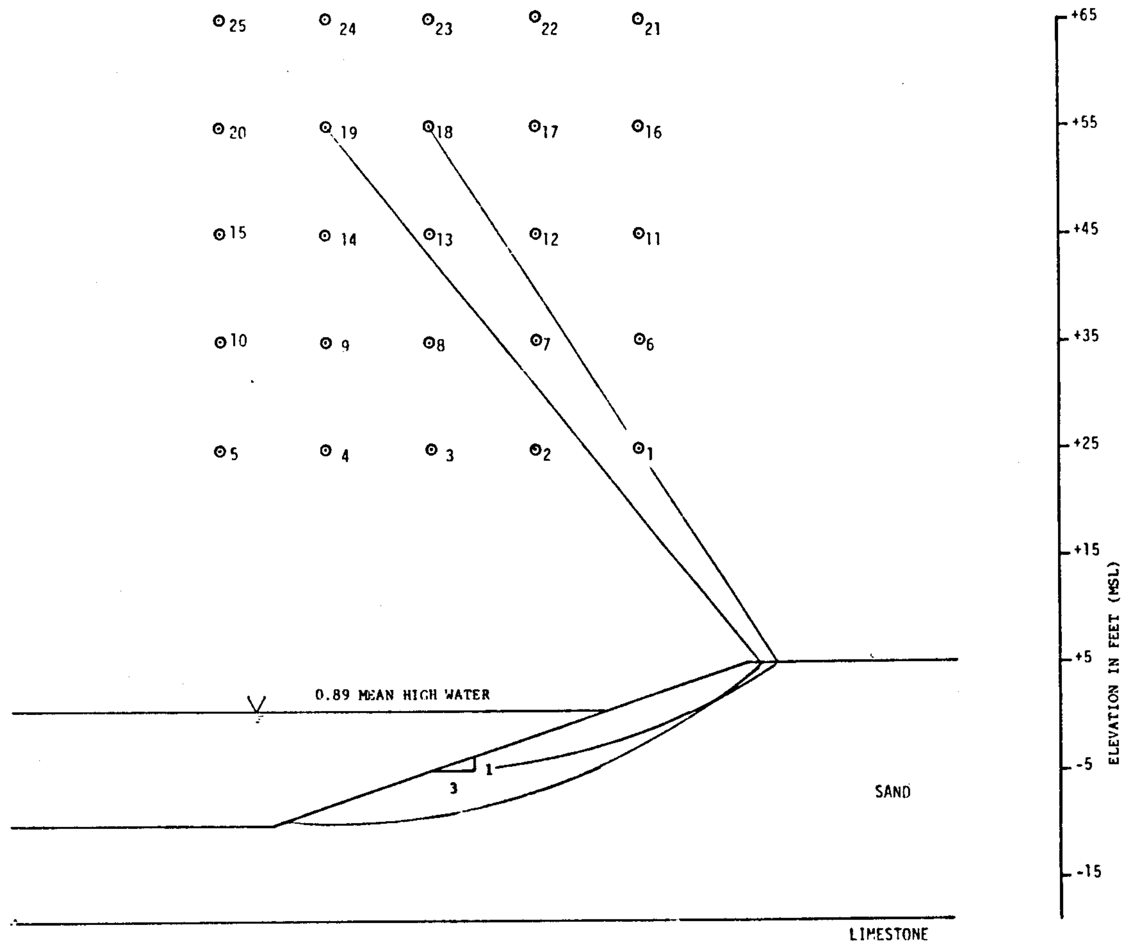
ENG FORM 2086 1 JAN 73 EDITION OF 1 MAR 58 IS OBSOLETE

*SPECIFIC GRAVITY (BSSD)

T – TRIAXIAL COMPRESSION
UC – UNCONFINED COMPRESSION
DS – DIRECT SHEAR
Q – UNCONSOLIDATED UNDRAINED
S – CONSOLIDATED DRAINED
R – CONSOLIDATED UNDRAINED

| ADOPTED DESIGN DATA | | | | |
|---|---|---|---|---|
| SOIL TYPE | $\gamma_M$ (KCF) | $\gamma_{SAT}$ (KCF) | C(KSF) | Ø |
| SAND | 0.105 | 0.115 | 0 | 30 |

| ARC CENTER | FACTOR OF SAFETY | | | |
|---|---|---|---|---|
| | TANG EL-5 | TANG EL-10 | TANG EL-15 | TANG EL-19 |
| 1 | 2.37 | 2.84 | 3.41 | 3.82 |
| 2 | 1.66 | 2.08 | 2.47 | 2.80 |
| 3 | 1.50 | 1.80 | 2.08 | 2.50 |
| 4 | - | 1.82 | 2.52 | 3.00 |
| 5 | - | 1.50 | 4.42 | 5.33 |
| 6 | 2.60 | 2.98 | 3.39 | 3.71 |
| 7 | 1.77 | 2.16 | 2.50 | 2.84 |
| 8 | 1.50 | 1.74 | 2.08 | 2.53 |
| 9 | - | 1.79 | 2.26 | 2.71 |
| 10 | - | 1.50 | 3.65 | 4.32 |
| 11 | 2.60 | 3.08 | 3.44 | 3.70 |
| 12 | 1.77 | 2.27 | 2.61 | 2.93 |
| 13 | 1.50 | 1.82 | 2.17 | 2.62 |
| 14 | - | 1.72 | 2.18 | 2.68 |
| 15 | - | 1.50 | 3.23 | 3.62 |
| 16 | 2.80 | 3.22 | 3.50 | 3.72 |
| 17 | 1.95 | 2.40 | 2.70 | 3.03 |
| 18 | 1.50 | 1.90 | 2.29 | 2.71 |
| 19 | - | 1.68 | 2.21 | 2.72 |
| 20 | - | 1.50 | 2.84 | 3.26 |
| 21 | 3.02 | 3.33 | 3.58 | 3.78 |
| 22 | 2.15 | 2.58 | 2.81 | 3.14 |
| 23 | 1.66 | 2.04 | 2.40 | 2.84 |
| 24 | - | 1.69 | 2.26 | 2.80 |
| 25 | - | 1.58 | 2.58 | 3.15 |



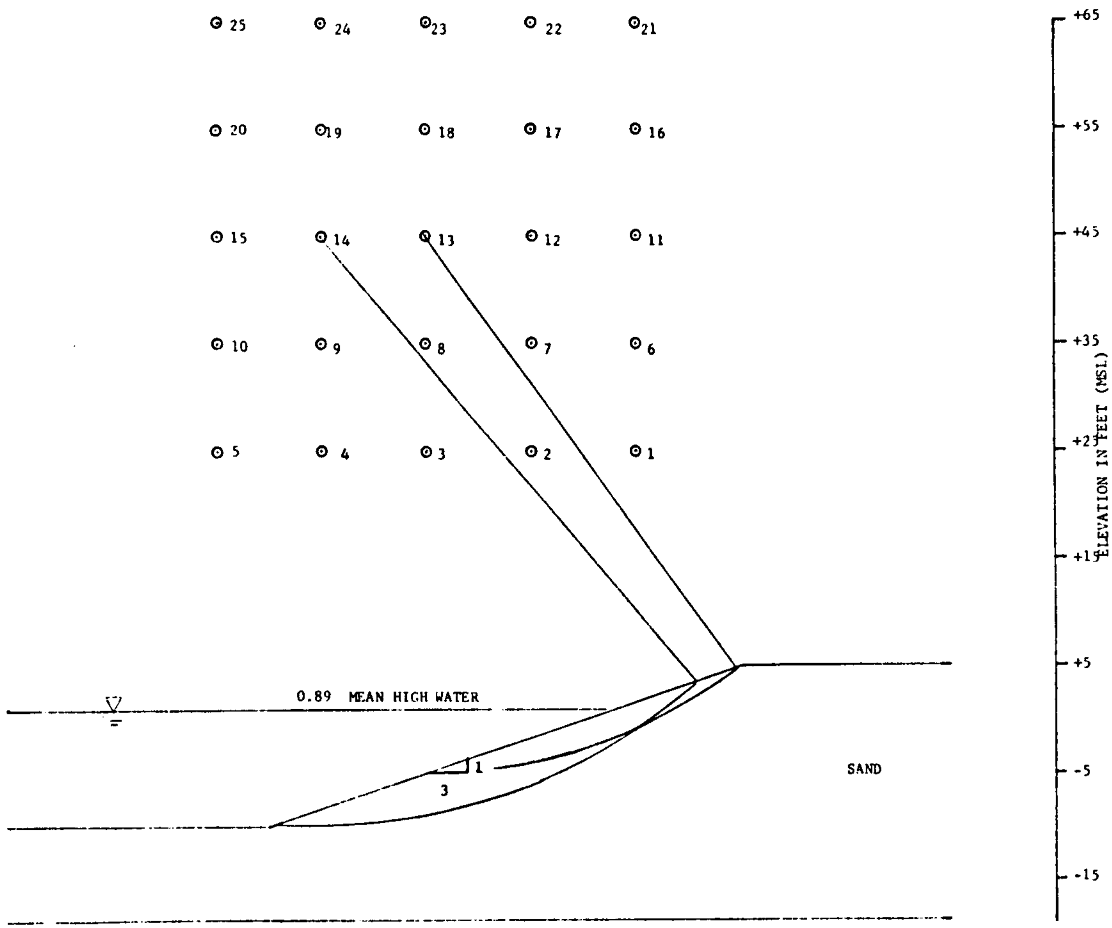

GARAPAN FLOOD CONTROL SAIPAN, CNMI

SLOPE STABILITY ANALYSIS
OUTLET CHANNEL, ALTERNATIVE B-1/B-2
END OF CONSTRUCTION CASE

US ARMY ENGINEER DISTRICT, HONOLULU PLATE B-5-1

| ADOPTED DESIGN DATA | | | | |
|---|---|---|---|---|
| SOIL TYPE | $\gamma_M$ (KCF) | $\gamma_{SAT}$ (KCF) | C(KSF) | Ø |
| SAND | 0.105 | 0.115 | 0 | 30 |

| ARC CENTER | FACTOR OF SAFETY TANG EL-5 | TANG EL-10 | TANG EL-15 | TANG EL-19 |
|---|---|---|---|---|
| 1 | 1.47 | - | - | - |
| 2 | 1.08 | - | - | - |
| 3 | 1.08 | - | - | - |
| 4 | - | - | - | - |
| 5 | - | - | - | - |
| 6 | 1.53 | 1.60 | 1.70 | 1.78 |
| 7 | 1.18 | 1.29 | 1.40 | 1.51 |
| 8 | 1.09 | 1.09 | 1.23 | 1.40 |
| 9 | - | 1.04 | 1.27 | 1.45 |
| 10 | - | 1.50 | 1.61 | 1.78 |
| 11 | 1.58 | 1.62 | 1.69 | 1.75 |
| 12 | 1.24 | 1.32 | 1.42 | 1.52 |
| 13 | 1.02 | 1.12 | 1.26 | 1.42 |
| 14 | - | 1.03 | 1.24 | 1.43 |
| 15 | - | 1.08 | 1.50 | 1.63 |
| 16 | 3.02 | 1.66 | 1.70 | 1.74 |
| 17 | 2.15 | 1.37 | 1.45 | 1.54 |
| 18 | 1.66 | 1.16 | 1.30 | 1.45 |
| 19 | - | 1.04 | 1.26 | 1.44 |
| 20 | - | 1.08 | 1.40 | 1.56 |
| 21 | - | 1.69 | 1.71 | 1.74 |
| 22 | - | 1.42 | 1.48 | 1.56 |
| 23 | - | 1.22 | 1.33 | 1.47 |
| 24 | - | 1.06 | 1.28 | 1.45 |
| 25 | - | 1.01 | 1.35 | 1.53 |



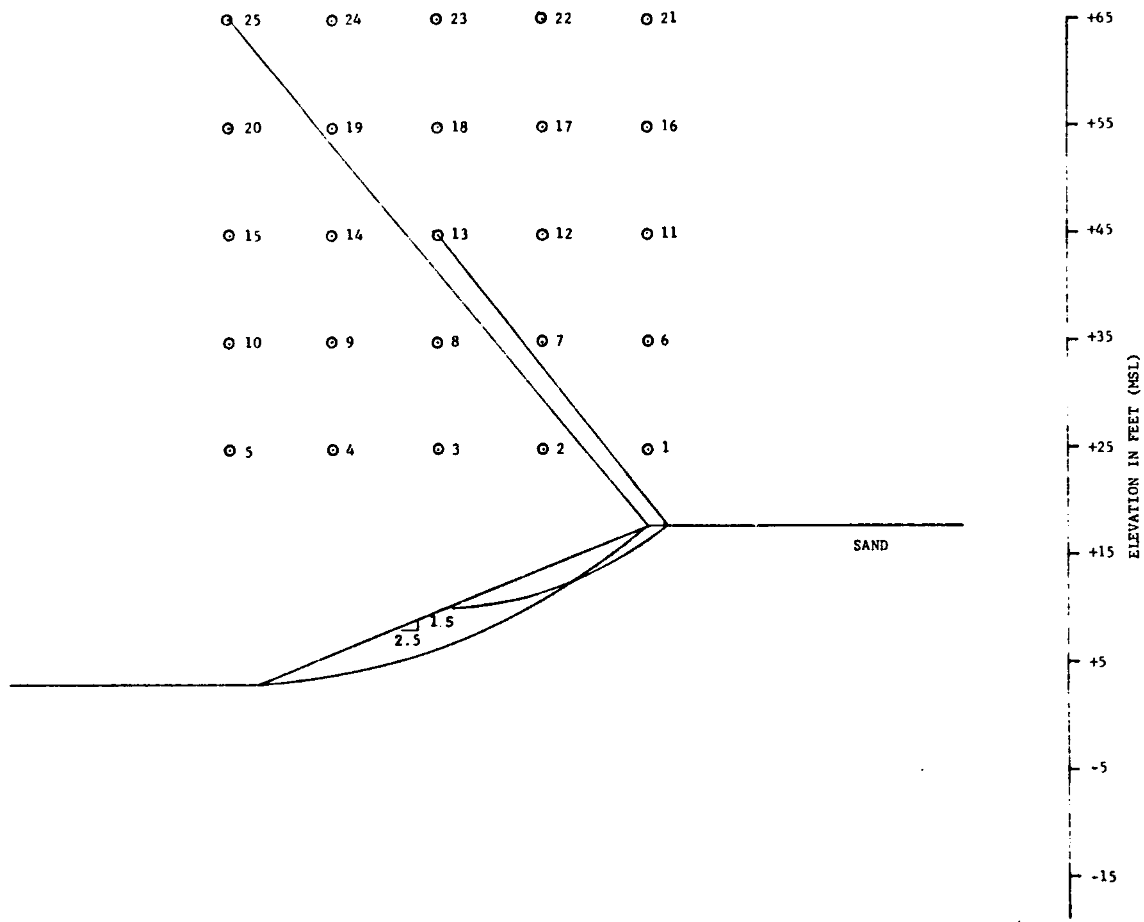

CARAPAN FLOOD CONTROL

SLOPE STABILITY ANALYSIS
OUTLET CHANNEL, ALTERNATIVE B-1/B-2
END OF CONSTRUCTION CASE WITH SEISMIC

US ARMY ENGINEER DISTRICT, HONOLULU PLATE B-5-2

| ADOPTED DESIGN DATA | | | | |
|---|---|---|---|---|
| SOIL TYPE | $\gamma$ M (KCF) | $\gamma$ SAT (KCF) | C(KSF) | Ø |
| SAND | 0.105 | 0.115 | 0 | 30 |

| ARC CENTER | FACTOR OF SAFETY | | | |
|---|---|---|---|---|
| | TANG EL10 | TANG EL3 | TANG EL-10 | |
| 1 | 8.51 | 13.62 | 16.13 | |
| 2 | 2.12 | 3.66 | 4.53 | |
| 3 | 1.50 | 2.15 | 2.96 | |
| 4 | - | 1.73 | 2.83 | |
| 5 | - | 1.50 | 3.95 | |
| 6 | 5.95 | 7.39 | 7.27 | |
| 7 | 2.30 | 3.32 | 3.70 | |
| 8 | 1.50 | 2.10 | 2.79 | |
| 9 | - | 1.67 | 2.60 | |
| 10 | - | 1.50 | 3.02 | |
| 11 | 5.64 | 6.21 | 5.66 | |
| 12 | 2.62 | 3.34 | 3.52 | |
| 13 | 1.50 | 2.20 | 2.80 | |
| 14 | - | 1.65 | 2.59 | |
| 15 | - | 1.50 | 2.77 | |
| 16 | 5.53 | 5.85 | 5.04 | |
| 17 | 2.87 | 3.46 | 3.50 | |
| 18 | 1.76 | 3.36 | 2.89 | |
| 19 | - | 1.75 | 2.65 | |
| 20 | - | 1.50 | 2.72 | |
| 21 | 5.58 | 5.69 | 4.76 | |
| 22 | 3.14 | 3.58 | 3.54 | |
| 23 | 1.99 | 2.50 | 2.98 | |
| 24 | - | 1.87 | 2.74 | |
| 25 | - | 1.50 | 2.75 | |



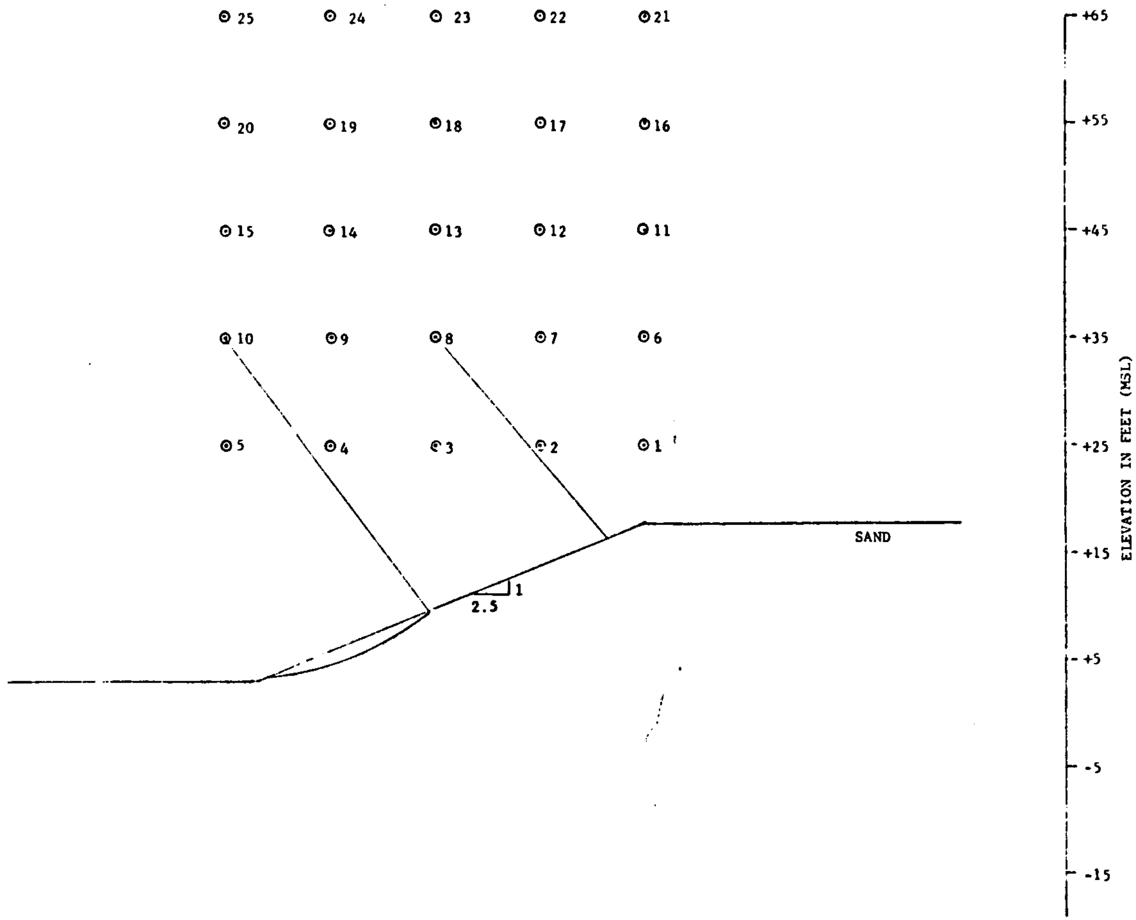

GARAPAN FLOOD CONTROL SAIPAN, CNMI

SLOPE STABILITY ANALYSIS
ALTERNATIVE B-1/B-2, STATION 38+00
END OF CONSTRUCTION

US ARMY ENGINEER DISTRICT, HONOLULU PLATE B-6-1

| ADOPTED DESIGN DATA | | | | |
|---|---|---|---|---|
| SOIL TYPE | $\gamma_M$ (KCF) | $\gamma_{SAT}$ (KCF) | C(KSF) | Ø |
| SAND | 0.105 | 0.115 | 0 | 30 |

| ARC CENTER | FACTOR OF SAFETY | | |
|---|---|---|---|
| | TANG EL10 | TANG EL 3 | TANG EL-10 |
| 1 | 3.93 | 4.97 | 4.83 |
| 2 | 1.58 | 2.41 | 2.60 |
| 3 | 1.50 | 1.61 | 1.97 |
| 4 | - | 1.33 | 1.92 |
| 5 | - | 1.50 | 2.22 |
| 6 | 3.06 | 3.53 | 3.22 |
| 7 | 1.67 | 2.19 | 2.16 |
| 8 | 1.12 | 1.55 | 1.79 |
| 9 | - | 1.26 | 1.70 |
| 10 | - | 1.07 | 1.83 |
| 11 | 2.88 | 3.16 | 2.73 |
| 12 | 1.77 | 2.16 | 2.04 |
| 13 | 1.17 | 1.60 | 1.75 |
| 14 | - | 1.27 | 1.65 |
| 15 | - | 1.08 | 1.69 |
| 16 | 2.85 | 3.00 | 2.51 |
| 17 | 1.91 | 2.18 | 2.00 |
| 18 | 1.33 | 1.66 | 1.76 |
| 19 | - | 1.30 | 1.64 |
| 20 | - | 1.18 | 1.65 |
| 21 | 2.85 | 2.95 | 2.40 |
| 22 | 2.00 | 2.23 | 1.99 |
| 23 | 1.50 | 1.74 | 1.77 |
| 24 | - | 1.38 | 1.66 |
| 25 | - | 1.18 | 1.64 |



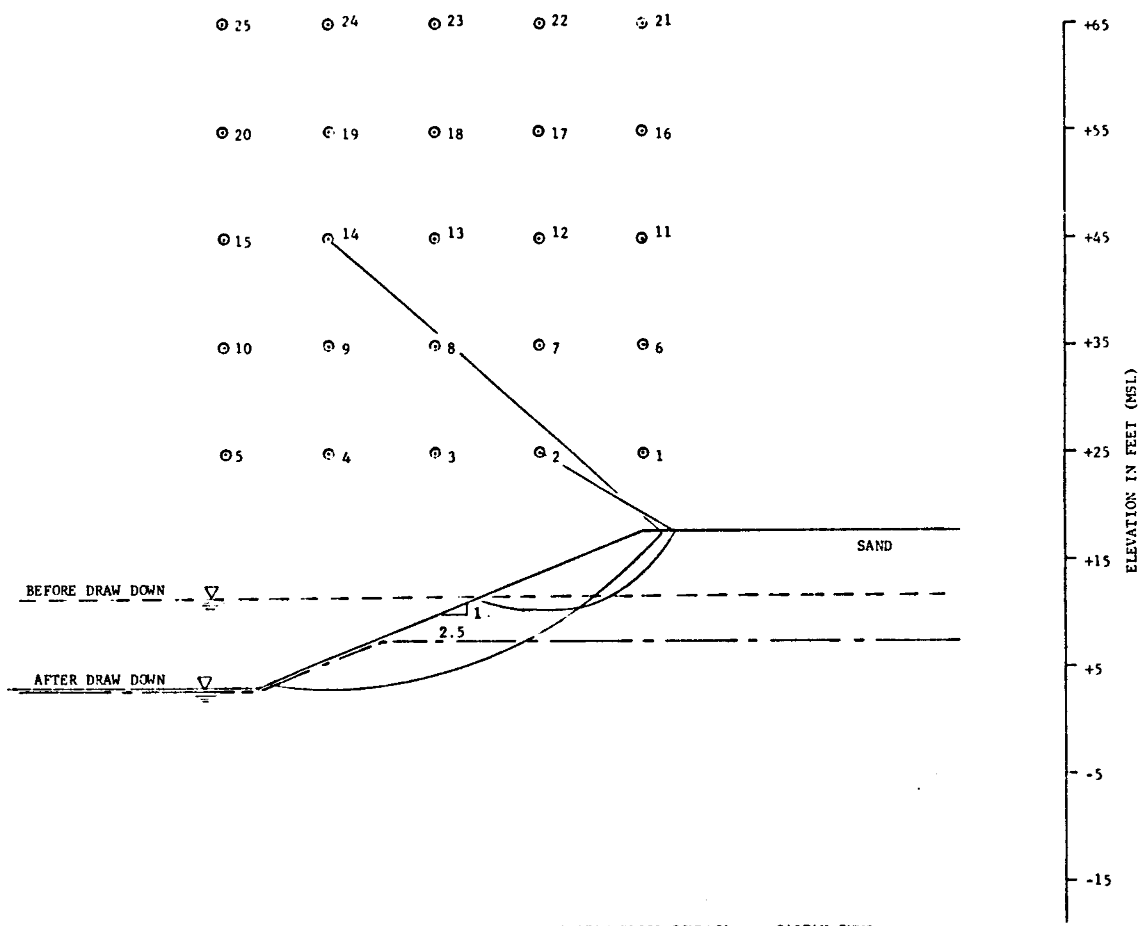

GARAPAN FLOOD CONTROL SAIPAN, CNMI

SLOPE STABILITY ANALYSIS
ALTERNATIVE B-1/B-2, STATION 38+00
END OF CONSTRUCTION WITH SEISMIC

US ARMY ENGINEER DISTRICT, HONOLULU PLATE B-6-2

| ADOPTED DESIGN DATA | | | | |
|---|---|---|---|---|
| SOIL TYPE | $\gamma_M$ (KCF) | $\gamma_{SAT}$ (KCF) | C(KSF) | Ø |
| SAND | 0.105 | 0.115 | 0 | 30 |

| ARC CENTER | FACTOR OF SAFETY | | | |
|---|---|---|---|---|
| | TANG EL10 | TANG EL 3 | TANG EL-10 | |
| 1 | 8.64 | 10.74 | 9.67 | |
| 2 | 1.20 | 3.32 | 3.97 | |
| 3 | 1.85 | 2.10 | 3.28 | |
| 4 | - | 2.41 | 3.60 | |
| 5 | - | 11.96 | 5.55 | |
| 6 | 5.91 | 6.51 | 5.73 | |
| 7 | 2.50 | 3.02 | 3.50 | |
| 8 | 1.62 | 2.04 | 3.03 | |
| 9 | - | 2.02 | 3.22 | |
| 10 | - | - | 4.22 | |
| 11 | 5.47 | 5.46 | 4.77 | |
| 12 | 2.66 | 3.05 | 3.42 | |
| 13 | 1.69 | 2.15 | 3.08 | |
| 14 | - | 1.90 | 3.16 | |
| 15 | - | 4.07 | 3.78 | |
| 16 | 5.45 | 5.22 | 4.41 | |
| 17 | 2.91 | 3.16 | 3.44 | |
| 18 | 1.82 | 2.28 | 3.16 | |
| 19 | - | 1.92 | 3.20 | |
| 20 | - | 2.71 | 3.64 | |
| 21 | 5.50 | 5.11 | 4.28 | |
| 22 | 3.13 | 3.28 | 3.52 | |
| 23 | 2.00 | 2.40 | 3.24 | |
| 24 | - | 2.01 | 3.28 | |
| 25 | - | 2.23 | 3.60 | |




GARAPAN FLOOD CONTROL SAIPAN, CNMI

SLOPE STABILITY ANALYSIS
ALTERNATIVE B-1/B-2, STATION 38+00
SUDDEN DRAW DOWN CASE

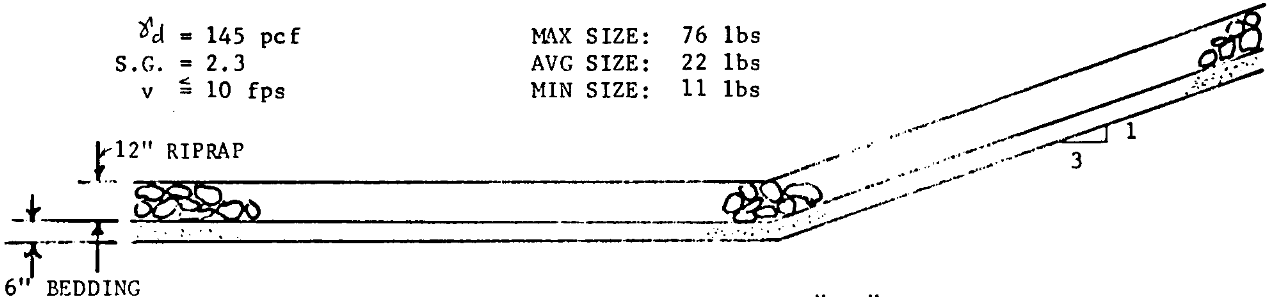
US ARMY ENGINEER DISTRICT, HONOLULU PLATE B-6-3

DESIGN ASSUMPTIONS

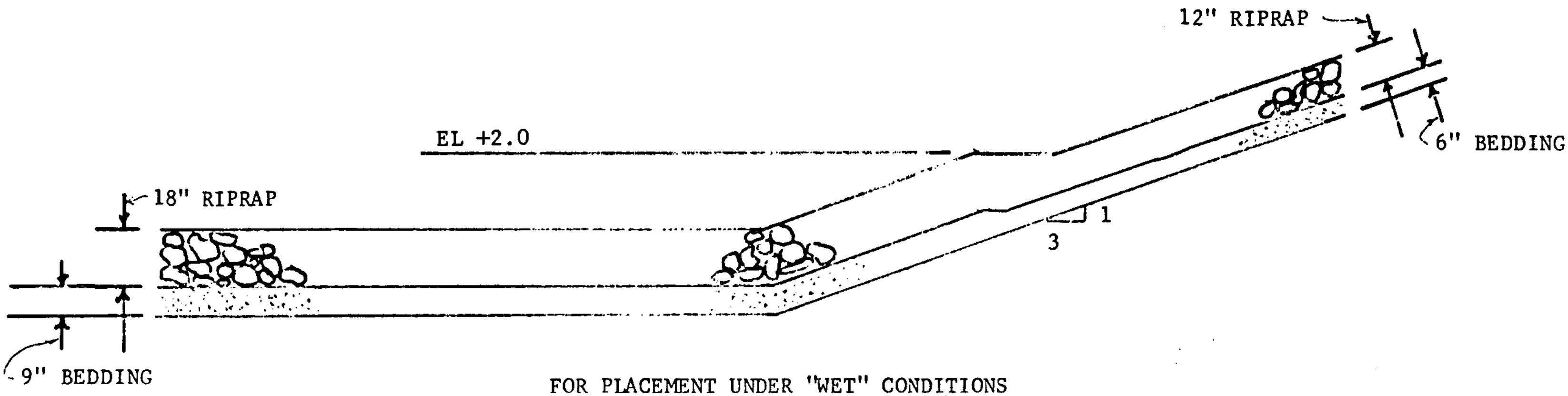
$\gamma_d$ = 145 pcf
S.G. = 2.3
v $\leqq$ 10 fps

RIPRAP GRADATION

MAX SIZE: 76 lbs
AVG SIZE: 22 lbs
MIN SIZE: 11 lbs




FOR PLACEMENT UNDER "DRY" CONDITIONS




FOR PLACEMENT UNDER "WET" CONDITIONS

GARAPAN FLOOD CONTROL SAIPAN, CNMI

TYPICAL RIPRAP SECTION FOR OUTLET CHANNEL

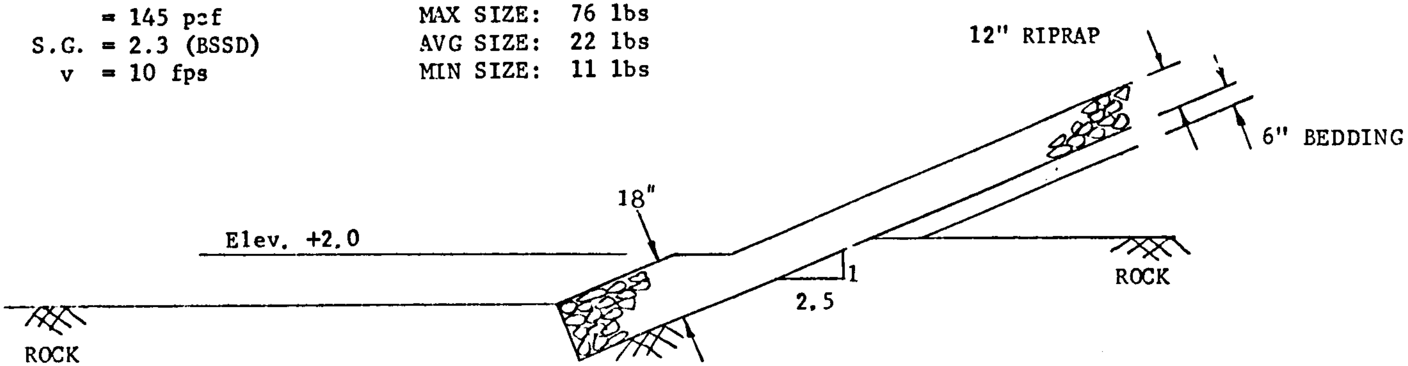
US ARMY ENGINEER DISTRICT, HONOLULU PLATE B-7

DESIGN ASSUMPTIONS

= 145 pcf
S.G. = 2.3 (BSSD)
v = 10 fps

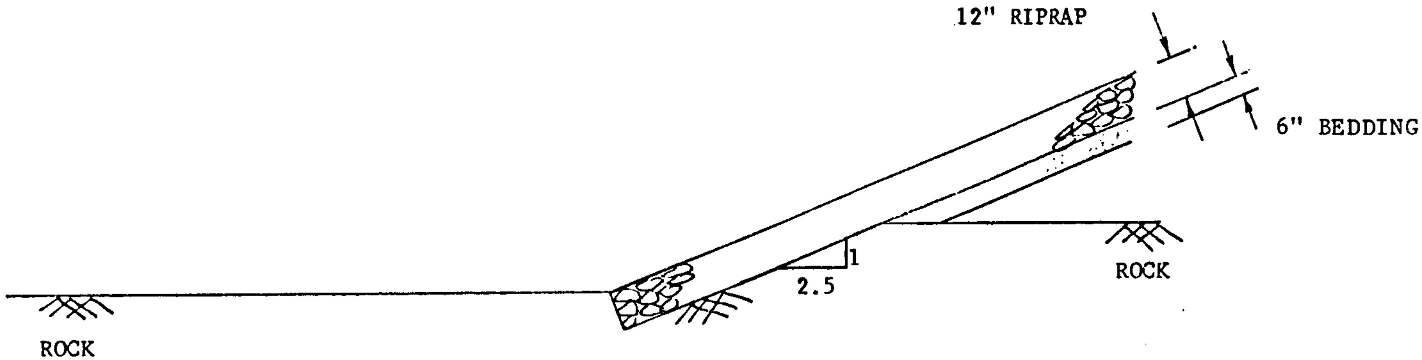
RIPRAP GRADATION

MAX SIZE: 76 lbs
AVG SIZE: 22 lbs
MIN SIZE: 11 lbs




FOR PLACEMENT UNDER "WET" CONDITIONS

WHERE CHANNEL BOTTOM IS IN ROCK




FOR PLACEMENT UNDER "DRY" CONDITIONS

WHERE CHANNEL BOTTOM IS IN ROCK

GARAPAN FLOOD CONTROL
TYPICAL RIPRAP SECTION FOR INTERCEPTOR CHANNEL

PLATE B-8

GARAPAN FLOOD CONTROL

SAIPAN, CNMI

DESIGN AND COST ESTIMATES

APPENDIX C

## APPENDIX C

## DESIGN AND COST ESTIMATE

## TABLE OF CONTENTS



## LIST OF PLATES

# DETAILED PROJECT REPORT FOR FLOOD CONTROL
# GARAPAN, SAIPAN, CNMI

## APPENDIX C

## DESIGN AND COST ESTIMATE

### 1 SCOPE AND EXTENT

Discussions on alternative solutions for flood control are presented in the main report. This appendix is confined to detailed descriptions and technical discussions on the recommended plan of improvement (Plan E), including the basis of design and the project cost estimate.

### 2 RECOMMENDED PLAN OF IMPROVEMENT

The recommended plan for Federal participation for a 50-yr recurrence interval flood control project at Garapan would consist primarily of channel improvements. The channel would be about 5,960 feet in length beginning in the vicinity of Tanapag Harbor and extending southwest to the vicinity of the 3rd Street area. The channel would be trapezoidal in shape and lined with concrete riprap, riprap, or grass as appropriate. Except for the Old Commissary Road, which according to local interests can be blocked to through traffic at the West Coast Highway, all six (6) other road crossings would require multicelled box culverts. The road crossings include the Beach Road, the Micro Beach Road and West Coast Highway intersection, the Hospital Roads 1 and 2, Paganville Road, and the Island Power Road. In addition, there are existing water, sewer and other utilities that are affected by culvert construction and channel improvements and would require relocation. The CNMI Government will be responsible for all culverts and utility relocations that are integral to the project. The project will not require relocation of existing houses or businesses. The recommended plan of improvement is shown on Plate C-1. The profile and typical sections are shown on Plates C-2 and C-3, respectively.

### 3 BASIS OF DESIGN

The design for the plan of improvement is based upon site investigations and topographic information obtained by field surveys and mappings with coordinates referenced to the Mariana Island Plane Coordinate System and with all elevations in feet referenced to mean sea level datum. The design incorporates information on hydrology, and geology and soils, which are presented in Appendices A and B. The design is also based upon environmental and socio-economic concerns and is accomplished in coordination especially with the Federal Highways Administration, the U.S. Fish and Wildlife Service and the local sponsor.

## 4 CHANNEL ALIGNMENT

The West Coast Highway was constructed almost parallel or in line with the shoreline. Rainfall runoff would then flow towards the highway to the ocean. In order to control floodwaters, the channel is situated to collect and convey runoffs originating upland of the channel. The channel alignment generally follows the alignment of West Coast Highway. The channel was designed with a centerline channel to centerline highway offset of approximately eighty feet upland of the highway between Stations 26+90 and 59+60 and with a minimum offset of about one hundred thirty feet between Stations 12+78 and 22+84 downland of the highway. Between Stations 22+84 and 26+90, the improvements would cross the Micro Beach Road and the West Coast Highway intersection. Continuing the channel on the upland side of the highway past the Micro Beach Road would involve major relocation of a recently constructed sewage pumping station and sewer system and would reduce cost effectiveness. Below Station 12+78, the alignment would pass through an area just beyond the fringe of an existing wetland enroute to the ocean. Upland of the highway, the alignment was selected to fit tightly between the existing residential developments and the highway without encroaching on the highway's rights-of-way for a rural primary road system, which according to the Federal Highways Administration would require a minimum of sixty feet right-of-way width, and without relocation of any of the residential buildings along the highway. Upland roadways branching from the Island Power Road and Paganville Road provide access to these residences. Downland of the highway, the channel offset distance from the highway would allow adequate clearance of existing powerlines along the road shoulder. The highway was constructed along a flat two degree curve. This curvature for channel alignment will have minor effects on rise in water surface. Along other locations of the channel alignment, horizontal curves where needed were designed using relatively large curve radii to result in negligible water surface rises of less than 0.5 feet. No special channel treatment will be needed for these minor effects.

## 5 HYDRAULIC DESIGN

Hydraulic design of the selected plan was based on a design flood with a recurrence interval of once in fifty years. Protection against a standard project flood was also analyzed. The following Manning's roughness coefficient were selected and used for the project design:

| Channel Lining | Manning's "n" |
|---|---|
| Grass | 0.035 |
| Riprap | 0.030 |
| Concrete Riprap | 0.025 |
| Concrete | 0.014 |

At the concrete box culverts, cylindrical quadrant walls were used as culvert approach walls within all the channel and culvert transitions with contraction and expansion coefficients of 0.15 and 0.25 respectively. The flow discharge in cubic feet per second (CFS) for the 50-year frequency flood (Q-50) and the standard project flood (Q-SPF) were estimated by reaches as follows:

| | Discharge in CFS | |
|---|---|---|
| Station to Station | Q-50 | Q-SPF |
| 54+00 - 59+60 | 800 | 1,310 |
| 40+00 - 54+00 | 1,380 | 2,540 |
| 22+00 - 40+00 | 1,900 | 3,850 |
| 0+00 - 22+00 | 2,300 | 4,460 |

Hydraulic design was based on guidelines provided in Engineering Manual 1110-2-1601 "Hydraulic Design of Flood Control Channels". Culvert analyses were based on the energy method for Class A flow. Water surface analyses were based on Method I of EM 1110-2-1409 and were accomplished using computer program "CORPS" developed by the US Army Engineer Waterways Experiment Station.

A control depth of elevation +1.9 feet at highest tide level referenced to mean sea level datum was used at the channel outlet to develop the flow profile for subcritical flow conditions. The channel excavated below the West Coast Highway between the channel outlet and Station 24+60 within the undeveloped raw lands would be grass lined. The velocities at this reach are relatively slow with magnitudes below 6 feet per second, and minor erosion should this occur under high flows even at a lower control elevation would be tolerable and would not detract from effective operation of the project. About 40 feet offshore from the channel improvements where flows will be laterally dispersed and depths will be reduced to tidal level, the invert slope is reversed to meet existing ocean ground. Although some sediments will accumulate in the invert in this reach during recession of major storm flows, the deposited material will be resuspended and transported seaward with new channel flows. From photographs and information concerning dredged areas at Garapan, no predominant littoral drift is evident along the shoreline. Similar type channel outlets, that were constructed for other flood control projects in Hawaii, are still in service. However, annual maintenance will include provisions especially for periodic removal of accumulated sediments in this reach. At the upstream limit of the channel improvements, critical depth was selected as control depth for flows entering the channel where supercritical flow conditions will prevail at 2 percent invert slope (see Plate C-2). A mild hydraulic jump with undular flow characteristics would occur between conjugate depths when the velocities are retarded along the flatter invert slope of 0.5 percent further down the channel. Over a range of discharges the hydraulic jump would occur between Stations 50+90 and 52+10 and the channel was designed accordingly to safely accommodate this range. The channel upstream of Station 50+80 would be lined with concrete riprap to withstand the design velocities and the hydraulic jump. The rest of the channel improvements along the West Coast Highway below Station 50+80 and above the outlet grass lined channel would be lined with riprap except for concrete riprap lining at spillway inlet structures shown on Plate C-1. The channel side slope would be 3-horizontal to 1-vertical where the channel invert would be below elevation +1.0 feet and 2.5 horizontal to 1-vertical with the invert above this elevation as shown on the typical sections (see Plate C-3).

The right bank along the highway rises upland and the channel would be generally in cut. Where minor fill is required, the maximum fill height would be about 2.4 feet (between Stations 46+00 and 47+50) and the fill where placed would be compacted and sloped to drain. A 3-foot deep concrete riprap cutoff wall would be placed along the channel top where a 6-foot high chain linked fence would be installed for public safety. Ditches will be provided along the right bank just beyond the channel limits to direct flows from upland areas to five "spillway inlet" structures. These spillway inlet structures will be located at stations 30+50, 36+00, 43+50, 47+00 and 51+00. The volumes of expected inflows at the ditches are as follows:

| | Ditch Inflow (cfs) | |
|---|---|---|
| Station | Inflow Northside | Inflow Southside |
| 30+50 | 320 | 280 |
| 36+00 | 160 | 110 |
| 43+50 | 350 | 50 |
| 47+00 | 90 | 90 |
| 51+00 | 70 | 340 |

Flow velocities within the ditches will vary up to about five feet per second. The maximum ditch capacity is about 165 cubic feet per second. Flows that overtop the ditches would pass over the top of the flood control channel as sheet flows with a maximum depth and velocity of 4" and 1.7 feet per second, respectively for the design flow and 8" and 2.4 feet per second, respectively for the standard project flood flow. Riprap lining at the channel side slopes would be adequate to withstand the velocities expected from the sheet flows. Flows conveyed by the ditches would pass through the channel bank at the spillway locations and into the channel improvements. Flow depths and velocities at the spillway crest and at the channel side slopes below the spillway inlets would be as follows:

| Location | Design Flow | | Standard Project Flood Flow | |
|---|---|---|---|---|
| | Flow Depth (Ft) | Velocity (Ft/Sec) | Flow Depth (Ft) | Velocity (Ft/Sec) |
| Spillway Crest | 1.1 to 1.5 | 5.2 to 6.0 | 1.5 to 2.4 | 5.8 to 7.7 |
| Bottom of Side Slope | 0.6 to 0.9 | 11.1 to 13.8 | 0.8 to 1.3 | 13.0 to 16.1 |

The inflows from the spillway inlets under design conditions would be submerged by the channel flow upon entry and hydraulic losses from side inflows as designed would be minimal and would have negligible effect on the flow profile. The spillway inlets were designed similar in concept to the design of spillway inlets for the Arizona Canal Diversion channel in Phoenix, Arizona by the Los Angeles District. Concrete riprap lining would be provided for the spillway inlet structures from the ditch to the centerline of the flood control channel to withstand the velocities and to protect the integrity of the flood control works. Double metal guardrails would be provided just upland of the ditches to retain debris and avoid flow blockages within the ditches and the flood control channel. Annual maintenance will allow provisions for cleanup along the guardrails. The locations and details of the ditches and spillway inlets are provided on Plates C-1, C-2, and C-3.

At the left bank the channel would adjoin the existing highway and would require a cement rubble masonry (CRM) floodwall with a maximum height above ground of 4.3 feet to insure adequate channel capacity and to separate the highway from the channel. No CRM wall would be required between Stations 53+80 and 56+40 where the channel top design elevations match the highway grades. The CRM floodwall will have a minimum freeboard of 3 feet. Overtopping can be provided along the channel within the undeveloped lands between the Micro Beach Road and the channel outlet by eliminating some fill requirements along the left bank in this reach and by grading the bank areas to allow overtopping into the wetland areas. This consideration will be deferred to the plans and specifications stage when detailed topographic information is available.

The channel improvements will require about 20.7 acres of land to construct the project. Project limits are shown on Plate C-3. The CNMI Government as the local cooperating agency will provide among other assurances all lands, easements, and rights-of-way necessary for this project. No land will be acquired by or at the expense of the United States.

## 6 STRUCTURAL DESIGN

a. General. All soil design values are based upon laboratory testing and analysis of the subsurface materials. Soil parameters for design of structures are discussed in Appendix B. The project structures are designed using applicable portions of the following publications:

(1) ACI 318-83 - Building Code Requirements for Reinforced Concrete
(2) EM 1110-2-2103 - Details of Reinforcing Hydraulic Structures
(3) EM 1110-2-2501 - Floodwall Design
EM 1110-2-2502 - Retaining Walls
(4) ANSI 58.1 - 83
(5) TM 5-809-10 - Seismic Design

b. Design Loads. Design of structures are based on maximum loads that can be expected during the project life. The design loads include the following consideration:

(1) Wind - 80 MPH (including gusts) Velocity, Exposure "C" in accordance with ANSI 58.1-83

(2) Seismic - Zone 2

(3) Vehicular - Equivalent of 2' surcharge on backfill of retaining structures which can be approached by vehicles within a distance equal to or less than 1/3 of the retaining height.

(4) Hydrostatic Pressure - Based on the backfill being saturated to midway between top of stem and weepholes.

c. Design Stresses. Design stresses are provided as follows:

(1) Steel - Reinforcing bars - fy = 40,000 psi

(2) Concrete - fc' = 4,000 psi

Details of steel reinforcement are not provided for this report and will be deferred for the construction plans and specifications stage.

d. Culvert Approach Walls. Inverted tee walls will be provided as culvert approach walls at each bank upstream and downstream of all box culvert road crossings. The design of the wall sections will be based on the condition that movement of the backfill saturation level will lag the peaking and recession levels of the water surface in the channel resulting in rapid drawdown. Under rapid drawdown the backfill water level is assumed at midway between the channel flood stage and the elevation of the weepholes. For this condition of loading, the inverted tee walls are designed using factor of safety of 1.5 against overturning and sliding.

e. CRM Gravity Walls. CRM walls along the West Coast Highway are designed using a factor of safety of 1.5 against overturning and sliding. Walls will also provide for a creep ratio of at least 4:1 to preclude piping under the wall foundations for conditions up to the design flood.

## 7 OPERATION, MAINTENANCE, AND REHABILITATION

The authorizing legislation required that local interests operate and maintain the completed works in accordance with regulations prescribed by the Secretary of the Army. No major components are anticipated to require replacement over the economic life of the project. An operation and maintenance manual will be prepared under Section 208.10(a)(10) of Title 33, Code of Federal Regulations and provided with a set of as-built drawings upon completion of construction to the CNMI Government for future project operation, maintenance and repairs. The manual will include a description of project features, local responsibilities, rules and procedures for semiannual and periodic inspection and reports to be submitted by the CNMI Government to the US Army Engineer District, Honolulu, a discussion of applicable operation and maintenance guidance and regulations, and as-built drawings of the project. The total average annual cost of project operation, maintenance, and repair is estimated at $7,600. Factors to derive operation, maintenance, and repair costs were generally obtained from similar Corps' projects using percentages of the first cost of project features. The factors applied were 0.2 percent for concrete work, 0.3 percent for concrete riprap and cement rubble masonry, and 0.5 percent for riprap. The average annual maintenance for general cleanup including clearing at the channel outlet was estimated at $3,000 and was included in the total average annual operation, maintenance, and repair cost of $7,600.

## 8 COST ESTIMATE

The detailed cost estimate for the project first cost is determined as follows:

a. Unit prices are based on July 1985 price level.

b. Concrete, rock and aggregate are available in commercial quarries in Saipan.

c. All excavation will be of soft material.

d. A Guam based contractor will be constructing the project.

e. Disposal site is within 5 miles of the project area.

f. A construction period of two years is estimated for the recommended plan.

TOTAL PROJECT FIRST COST

FEDERAL FIRST COST

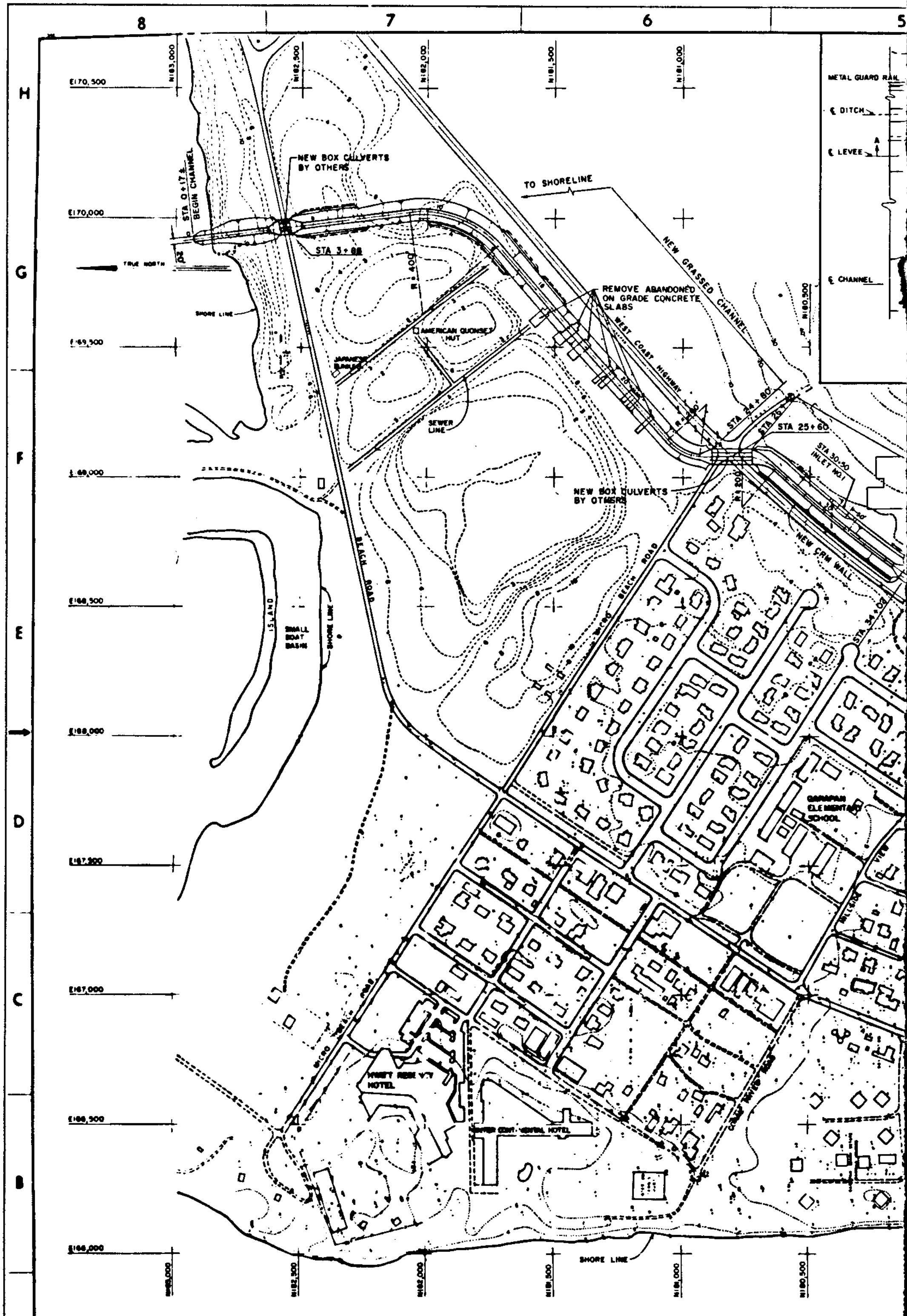
| DESCRIPTION | UNIT | QUANTITY | UNIT COST | TOTAL |
|---|---|---|---|---|
| MOBILIZATION AND DEMOBILIZATION | 1 | JOB | L.S. | $270,000 |
| CLEARING AND GRUBBING(RAW LAND) | Acre | 5.2 | $5,600.00 | $29,120 |
| CLEARING AND GRUBBING | Acre | 9.5 | $1,900.00 | $18,050 |
| EXCAVATION | CY | 137,120 | $7.00 | $959,840 |
| FILL | CY | 2,100 | $5.00 | $10,500 |
| CONCRETE WALLS | CY | 840 | $344.00 | $288,960 |
| CEMENT RUBBLE MASONRY WALLS | CY | 790 | $162.00 | $127,980 |
| CONCRETE RIPRAP | CY | 3,320 | $100.00 | $332,000 |
| RIPRAP | CY | 8,140 | $43.00 | $350,020 |
| BEDDING MATERIAL | CY | 5,810 | $38.00 | $220,780 |
| DEWATERING | 1 | JOB | L.S. | $3,000 |
| METAL GUARD RAILS | LF | 6,600 | $35.00 | $231,000 |
| GRASSING | SF | 216,100 | $0.30 | $64,830 |
| CHAIN LINK FENCE | LF | 3,160 | $12.00 | $37,920 |
| SUBTOTAL | | | | $2,944,000 |
| CONTINGENCY 25% | | | | $736,000 |
| TOTAL DIRECT COSTS | | | | $3,680,000 |
| ENGINEERING AND DESIGN | | | | $200,000 |
| SUPERVISION AND ADMINISTRATION | | | | $300,000 |
| SUBTOTAL FEDERAL FIRST COST [1] | | | | $4,180,000 |

NON-FEDERAL FIRST COSTS

| | |
|---|---|
| LANDS, EASEMENTS AND RIGHTS-OF-WAY | $215,000 |
| CULVERTS AND RELOCATIONS | $1,527,000 |
| CONTINGENCIES 25% | $438,000 |
| E&D AND S&A COSTS | $220,000 |
| SUBTOTAL NON-FEDERAL FIRST COSTS | $2,400,000 |
| TOTAL PROJECT FIRST COSTS | $6,580,000 |

[1] Amount over Statutory Federal cost limitation of $4,000,000 will be non-Federal costs. See apportionment section in Main Report for explanation of local cash contribution.

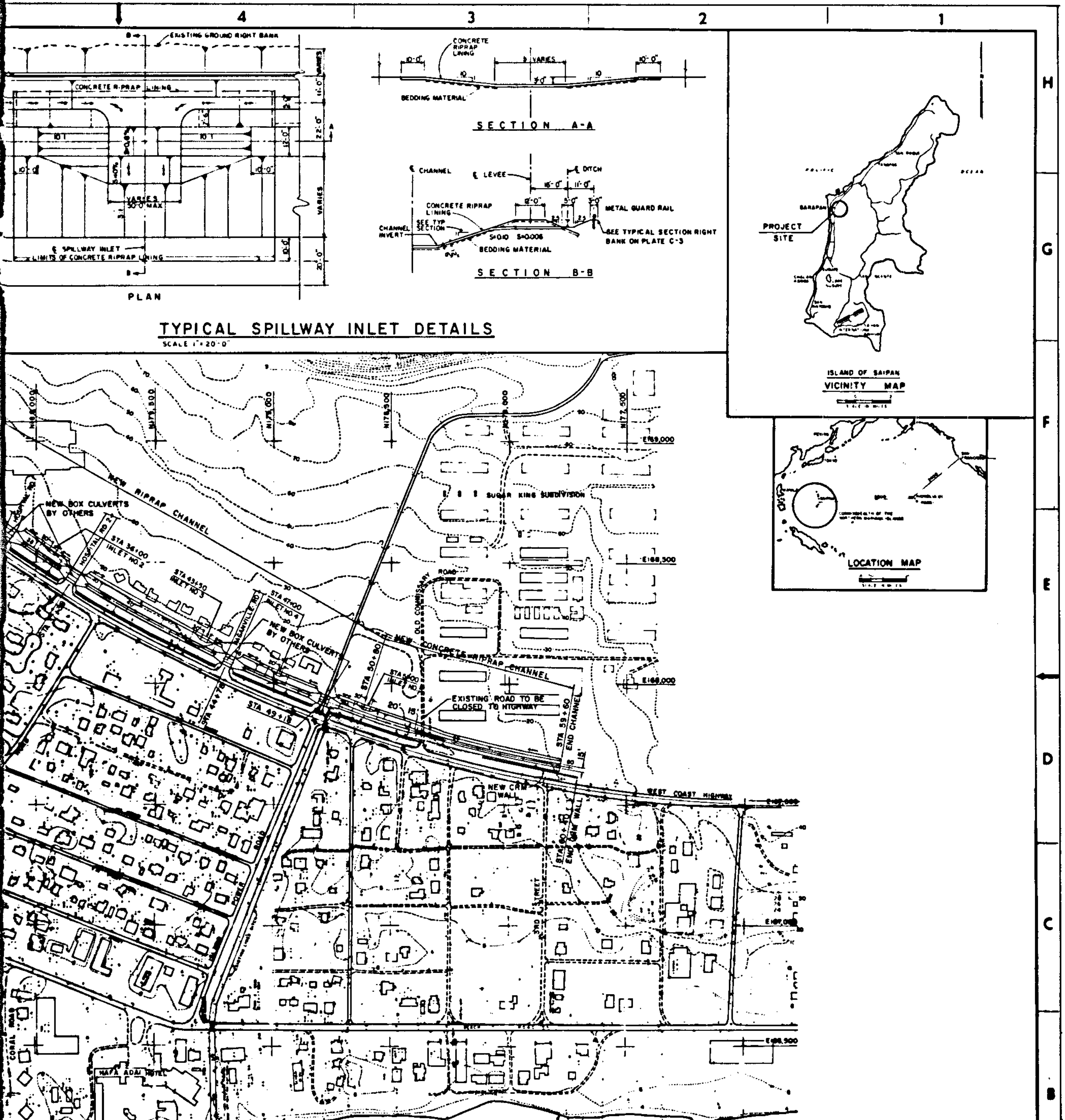
1




NOTES:

1. COORDINATES BASED ON MARIANA ISLANDS PLANE COORDINATE SYSTEM OF 1968.
2. ELEVATIONS ARE IN FEET BASED ON MEAN SEA LEVEL DATUM
3. FOR PROFILE AND TYPICAL SECTIONS, SEE PLATES C-2 AND C-3.

2




GARAPAN SAIPAN, CNMI

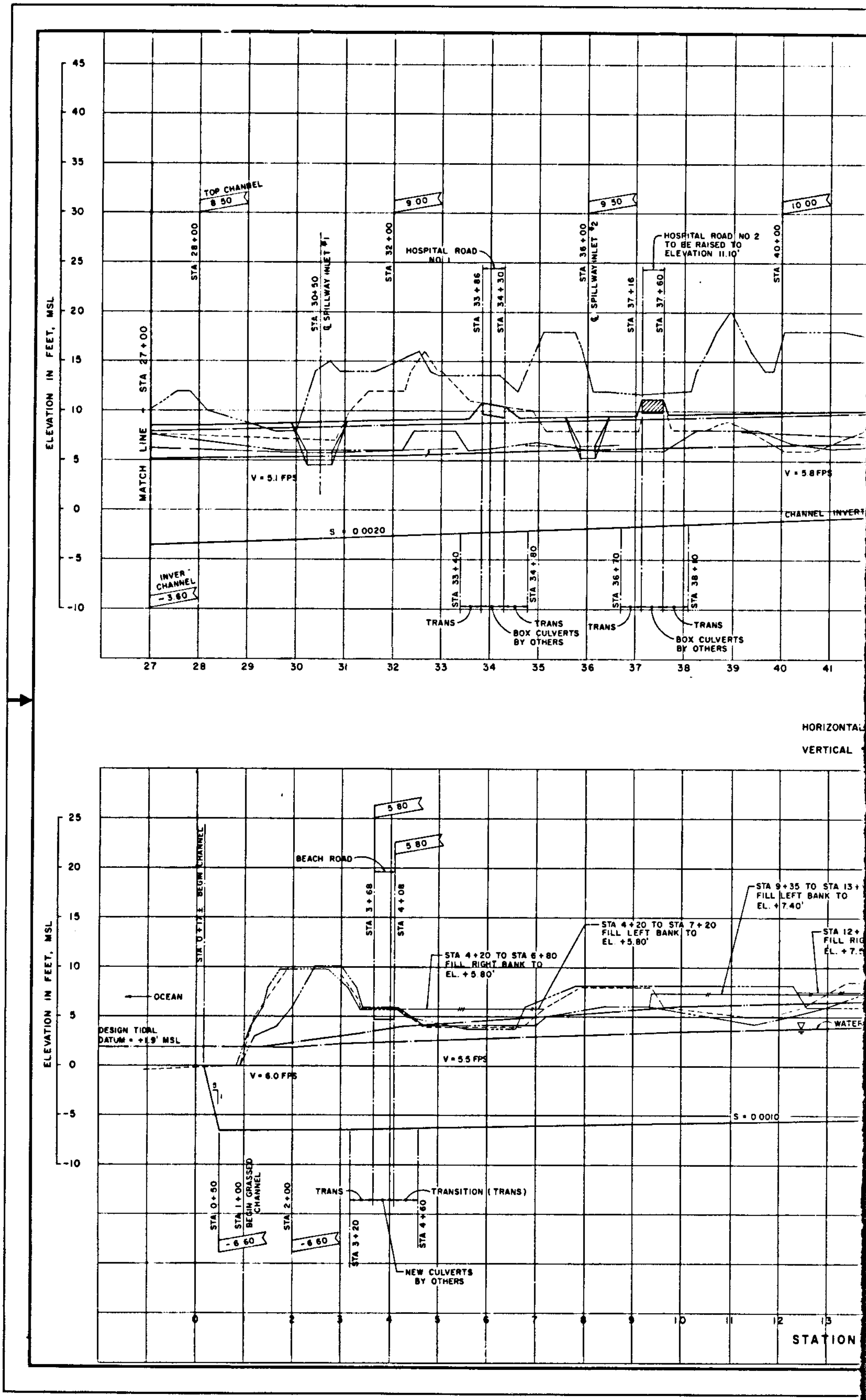
**DETAILED PROJECT REPORT FOR FLOOD CONTROL**

# RECOMMENDED PLAN

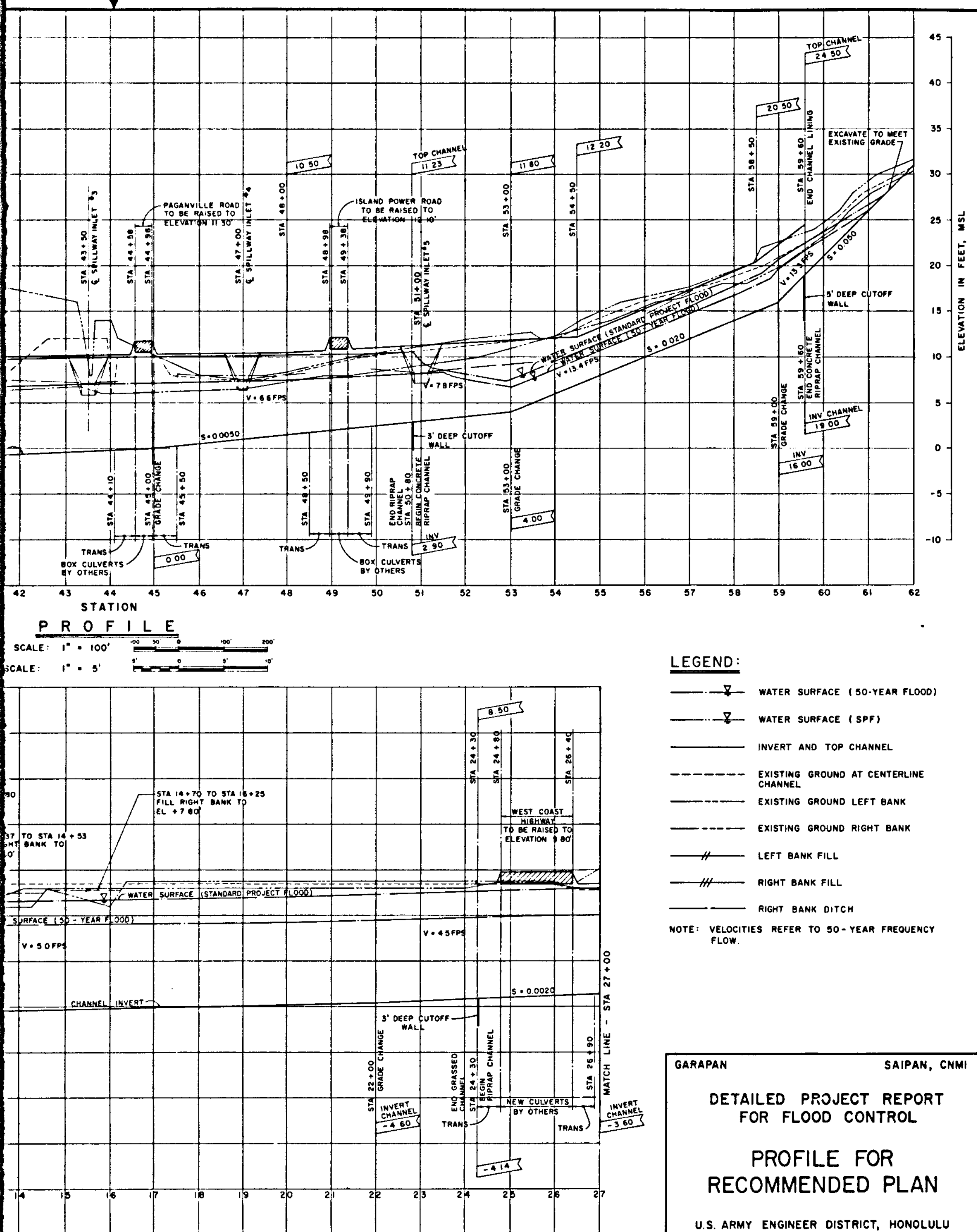
U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE C-1

1



ELEVATION IN FEET, MSL
TOP CHANNEL
8.50
9.00
9.50
10.00
STA 28+00
STA 30+50
℄ SPILLWAY INLET #1
STA 32+00
HOSPITAL ROAD NO. 1
STA 33+86
STA 34+30
STA 36+00
℄ SPILLWAY INLET #2
STA 37+16
STA 37+60
HOSPITAL ROAD NO 2 TO BE RAISED TO ELEVATION 11.10'
STA 40+00
MATCH LINE STA 27+00
V = 5.1 FPS
V = 5.8 FPS
CHANNEL INVERT
S = 0.0020
INVERT CHANNEL
-3.60
STA 33+40
STA 34+80
STA 36+70
STA 38+10
TRANS
BOX CULVERTS BY OTHERS
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
HORIZONTAL
VERTICAL
5.80
5.80
BEACH ROAD
STA 0+17 ℄ BEGIN CHANNEL
STA 3+68
STA 4+08
STA 9+35 TO STA 13+
FILL LEFT BANK TO
EL. +7.40'
STA 4+20 TO STA 7+20
FILL LEFT BANK TO
EL. +5.80'
STA 12+
FILL RIG
EL. +7.5
STA 4+20 TO STA 6+80
FILL RIGHT BANK TO
EL. +5.80'
OCEAN
DESIGN TIDAL DATUM = +1.9' MSL
WATER
V = 6.0 FPS
V = 5.5 FPS
S = 0.0010
STA 0+50
STA 1+00 BEGIN GRASSED CHANNEL
STA 2+00
-6.60
-6.60
TRANS
TRANSITION (TRANS)
STA 3+20
STA 4+60
NEW CULVERTS BY OTHERS
STATION




GARAPAN SAIPAN, CNMI

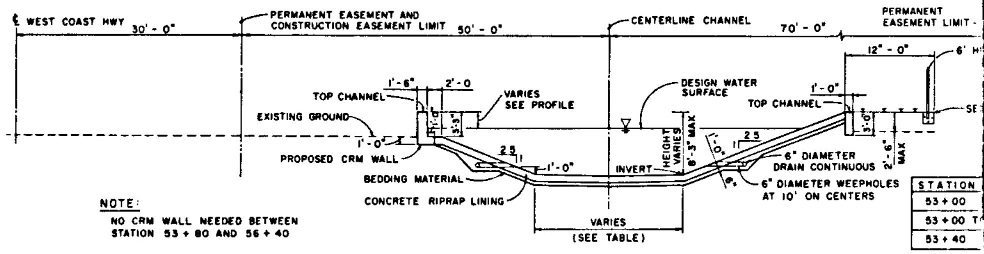
DETAILED PROJECT REPORT
FOR FLOOD CONTROL

PROFILE FOR
RECOMMENDED PLAN

U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE C-2

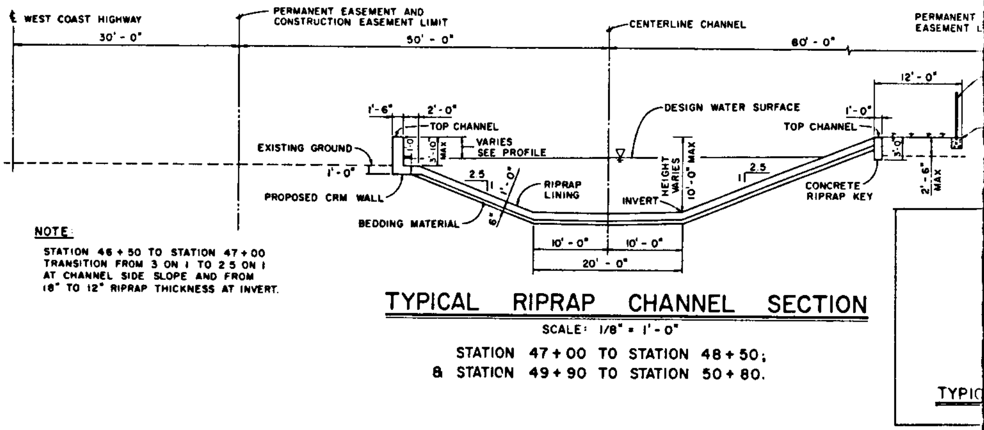
1




## TYPICAL CONCRETE RIPRAP SECTION

SCALE: 1/8" = 1' - 0"

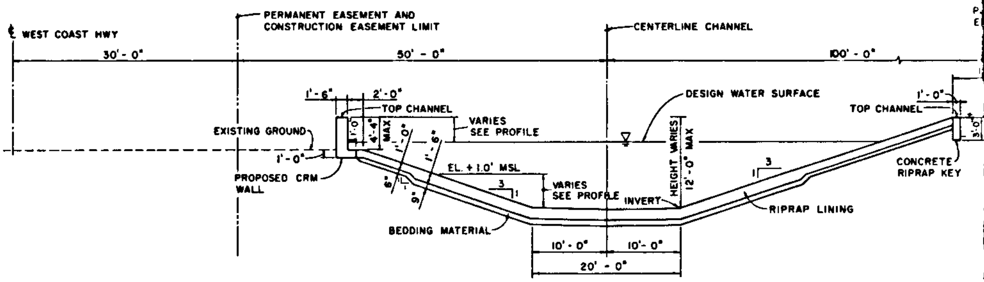
STATION 50 + 80 TO STATION 59 + 60




## TYPICAL RIPRAP CHANNEL SECTION

SCALE: 1/8" = 1' - 0"

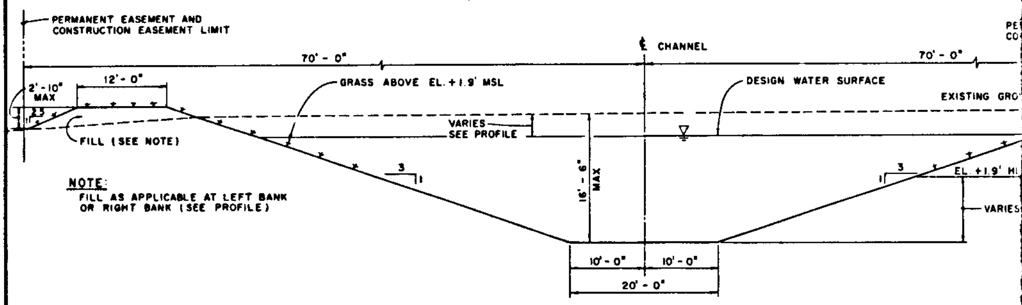
STATION 47 + 00 TO STATION 48 + 50;
& STATION 49 + 90 TO STATION 50 + 80.




## TYPICAL RIPRAP CHANNEL SECTION

SCALE: 1/8" = 1' - 0"

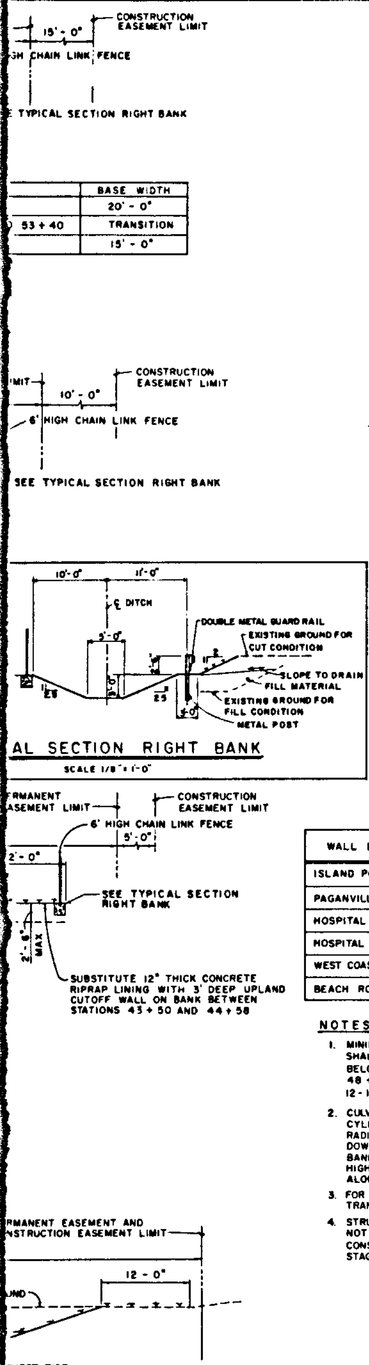
STATION 26 + 90 TO STATION 33 + 40;
STATION 34 + 80 TO STATION 36 + 70;
STATION 38 + 10 TO STATION 44 + 10;
& STATION 45 + 50 TO STATION 46 + 50.

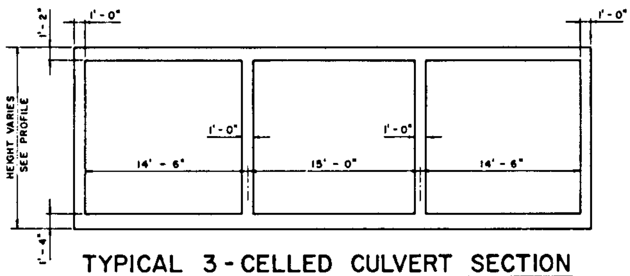



## TYPICAL GRASSED CHANNEL SECTION

SCALE: 1/8" = 1' - 0"

STATION 0 + 17 ± TO STATION 3 + 20;
& STATION 4 + 60 TO STATION 24 + 30

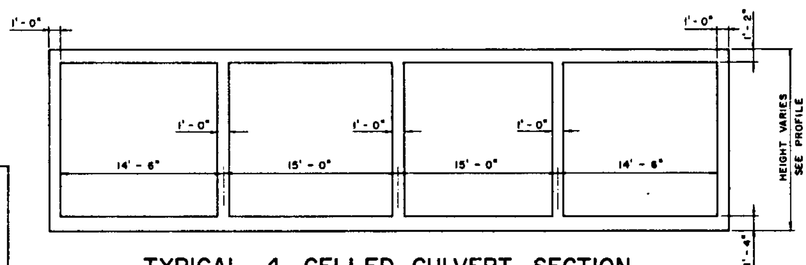



## TYPICAL 3 - CELLED CULVERT SECTION

SCALE: 3/16" = 1' - 0"

PAGANVILLE ROAD STATION 44 + 58 TO STATION 44 + 98,
& ISLAND POWER ROAD STATION 48 + 98 TO STATION 49 + 38.

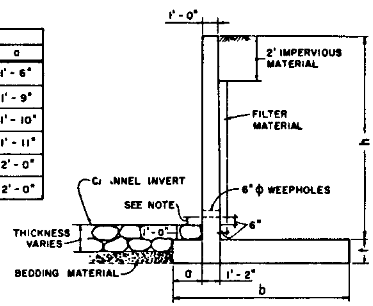



## TYPICAL 4 - CELLED CULVERT SECTION

SCALE: 3/16" = 1' - 0"

BEACH ROAD STATION 3 + 68 TO STATION 4 + 08;
WEST COAST HIGHWAY STATION 24 + 80 TO STATION 26 + 40;
HOSPITAL ROAD 1 STATION 33 + 86 TO STATION 34 + 30;
HOSPITAL ROAD 2 & STATION 37 + 16 TO STATION 37 + 60.

| WALL LOCATION | WALL SYMBOL | | | |
|---|---|---|---|---|
| | h | b | t | a |
| ISLAND POWER ROAD | 9' - 10" | 10' - 6" | 1' - 2" | 1' - 6" |
| PAGANVILLE ROAD | 11' - 5" | 11' - 2" | 1' - 4" | 1' - 9" |
| HOSPITAL ROAD 2 | 12' - 4" | 11' - 6" | 1' - 5" | 1' - 10" |
| HOSPITAL ROAD 1 | 12' - 6" | 11' - 8" | 1' - 5" | 1' - 11" |
| WEST COAST HIGHWAY | 13' - 6" | 12' - 0" | 1' - 6" | 2' - 0" |
| BEACH ROAD | 13' - 3" | 11' - 10" | 1' - 6" | 2' - 0" |



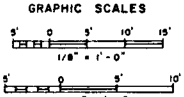

NOTES:

1. MINIMUM WEEPHOLE INVERT ELEVATION SHALL BE + 2.0 FEET MEAN SEA LEVEL BELOW STATION 48 + 00. ABOVE STATION 48 + 00 WEEPHOLE SHALL BE LOCATED 12 - INCHES OVER THE CHANNEL INVERT.
2. CULVERT APPROACH WALLS SHALL BE CYLINDRICAL QUADRANT IN SHAPE WITH RADIUS OF 20 FEET AT ALL LOCATIONS DOWNLAND OF AND ALONG THE LEFT BANK ADJACENT TO THE WEST COAST HIGHWAY, AND WITH RADIUS OF 30 FEET ALONG THE RIGHT BANK.
3. FOR APPROACH WALL AND CHANNEL TO CULVERT TRANSITION LOCATIONS, SEE PLATES C-1 AND C-2.
4. STRUCTURAL REINFORCEMENT DETAILS ARE NOT SHOWN AND ARE DEFERRED FOR CONSTRUCTION PLANS AND SPECIFICATIONS STAGE.

## TYPICAL CULVERT APPROACH WALL SECTION

SCALE: 3/16" = 1' - 0"

GRAPHIC SCALES




GARAPAN SAIPAN, CNMI

DETAILED PROJECT REPORT
FOR FLOOD CONTROL

# TYPICAL SECTIONS

U.S. ARMY ENGINEER DISTRICT, HONOLULU

GARAPAN FLOOD CONTROL
SAIPAN, CNMI

ECONOMICS
APPENDIX D

# APPENDIX D

# ECONOMICS

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## LIST OF TABLES

# ECONOMICS APPENDIX

## 1 GENERAL

Floodplain management, including flood control and prevention, can contribute to the National Economic Development (NED) objective by improving the net productivity of flood prone land resources. This occurs either by increasing the output of goods and services and/or by reducing the cost of using the land resources (improvement in economic efficiency). The benefit standard is the willingness of users of benefiting activities to pay for each increment of output from a plan of improvement.

## 2 EVALUATION BASIS

Each floodplain management plan under consideration is evaluated on a with and without basis. The without plan condition is that most likely to occur without the implementation of the specific Federal plan of improvement and gives proper recognition of the effect of existing and authorized plans, laws, policies and the flood hazard on the probable course of development. For purposes of evaluating structural components of a plan, rational economic use of the floodplain is assumed. Economic rationality assumes that users of the floodplain will attempt to maximize returns, and take actions with full knowledge of the flood hazard unless constrained by laws and policies such as land use regulations.

Estimated project benefits result from a reduction in damages to flood prone activities and the elimination of emergency relief costs.

Activities evaluated in the Garapan floodplain include residential, commercial and public structures and their contents. Estimated project NED costs (Appendix C) include the first construction cost, contingency, interest during construction, indirect costs, land, easements and rights of way costs, and annual operation and maintenance cost. Both costs and benefits are estimated in constant July 1985 dollars and are expressed in an average annual equivalent basis using the current FY85 water resources discount rate of 8-3/8 percent. The project base year, that is, the year the project is expected to become operational, is 1990.

## 3 GENERAL DESCRIPTION OF THE STUDY AREA

### 3.1 Residential

Garapan is undergoing rapid growth as mentioned in the main report. Developments within the study area are well underway. Large tracts of open space for subdivision are no longer available. In 1982, residential housing in Garapan totalled 738, a 6.7 percent annual compound growth rate since 1973. There are presently 287 medium to low value residential structures in the SPF floodplain. All but 4 structures are single family unit dwellings. Table D-1 presents residential structure types and condition within the floodplain.

TABLE D-1 RESIDENTIAL STRUCTURE TYPES AND CONDITION

| STRUCTURE TYPE | Excellent | Fair | Poor | Total |
|---|---|---|---|---|
| Concrete on Slab on Grade | 160 | 21 | 5 | 186 |
| Wood Frame on Slab on Grade | 0 | 17 | 14 | 31 |
| Wood Frame on Post and Beam | 0 | 0 | 3 | 3 |
| Steel on Slab or on Post and Beam | 6 | 32 | 29 | 67 |
| | --- | --- | --- | --- |
| TOTAL | 166 | 70 | 51 | 287 |

## 3.2 Commercial

Commercial activity has grown steadily in Garapan over the last several years. The reason for this growth is two fold: to satisfy rising demands for goods and services by the growing resident population of Garapan, Saipan's population center; and to service the growing tourist industry also centered in Garapan. There are presently 93 commercial buildings located with the floodplain housing 125 distinct commercial units. The diversity of this sector varies from department stores, banks, groceries, fast food and fine dining restaurants, automobile dealership, service repair shops and other retail and services normally centered around a small urban community as well as numerous duty free gift shops located in proximity to the three major hotels which support tourist trade. In FY83, tax returns for the commonwealth indicated that gross business revenues received by all private sector firms totalled $169 million, a striking 20 percent annual compound growth since FY74.

## 3.3 Industrial

Since World War II, industrial growth in Saipan has been limited to tourism, construction and transportation. However, Saipan's recent commonwealth status has provided an incentive to foreign nations to develop light manufacturing firms free of export quotas and duty taxes on shipments of finished goods to the United States. Presently there is only one light manufacturing firm located within the floodplain.

### 3.4 Public and Other

There are presently 19 public structures in the Garapan floodplain. Garapan Elementary School located approximately in the center of the floodplain consists of 12 buildings containing classrooms, office, and cafeteria. Other buildings include the Mariana Islands Housing Authority executive office and warehouse, Department of Public Safety, Headstart program building, YMCA community center, and a church.

### 3.5 Transportation

There are air and sea connections between Saipan and the United States and to nations throughout the Pacific Basin. Saipan International Airport facilitates service by two major air carriers, Continental Air Micronesia and Japan Airlines. Daily connections are available from Saipan to Guam for transfer to flights throughout the Pacific and to the United States. Air carrier entries totalled 7904 at Saipan International Airport in FY83.

By sea, there are about 6 shipping lines servicing the CNMI, which link Saipan with the Far East, the United States, and with nations within the Pacific Basin. Altogether, vessel entries into the Commonwealth were reported to number about 151 during 1983 and cargo through the CNMI ports in that year ran a record total of 98,257 revenue tons. Saipan accounted for 96 percent of this volume.

Automobile transportation is highly developed in the Commonwealth. It is estimated that there are as many as 7,500 vehicles on Saipan and about 6,900 regularly on the road, equivalent to a density of one vehicle for every three people. The CNMI road network consists of an estimated 200 miles of roadways. Although with Commonwealth status, Federal funds have been provided for major road reconstruction projects.

## 4 EXPECTED ANNUAL FLOOD DAMAGES (WITHOUT PROJECT CONDITION)

Annual flood damages were calculated based on a total structure inventory (including structure type, condition, depreciated replacement cost and first floor elevation), a depth-percent damage relationship, and water surface profile data which consists of the computed water surface elevation for six flood frequencies by cross section station number. Non-residential content damages were developed based on a field interview survey conducted in the spring of this year. The survey obtained data on the total depreciated replacement value of contents, i.e., furnishings, machinery and equipment, inventory, etc.; and estimated content damage at three hypothetical flood depths over the first floor elevation: 1 inch, 1 foot, and 3 feet.

## 4.1 Structure Inventory

A ground survey of the Garapan area was performed by Juan C. Tenorio & Associates (Saipan), Inc., between July and August 1979. Spot elevations (ground and first floor) and 2-foot interval contours were drawn. An update of the contour map showing additional structures and spot elevations was performed by M&E Pacific, Inc., between August and September 1983. POD Floodplain Management Section provided the existing floodplain boundaries and stationing of cross sections. Depreciated replacement value was estimated based on structure type and condition.

## 4.2 Depth-Percent Damage Relationship

Approximately 70 percent of the 399 structures in the floodplain are concrete slab on grade, and 86 percent of these are in excellent condition. Typical construction of structures on Saipan are "typhoon proof" in other words made to withstand serious damage in the event of natural disasters which are common place in this area of the Pacific. Field investigation performed by POD in Susupe, Saipan in 1979 indicates that the typical depth-percent damage relationship for low velocity flooding on typical structures in Saipan is markedly less than the standardized curve derived for other areas within Pacific Ocean Division. Table D-2 presents the Depth-Percent Damage Relationship used to estimate flood damage to structures and residential contents in Garapan.

TABLE D-2. DEPTH-PERCENT FLOOD DAMAGE RELATIONSHIP

| DEPTH OF FLOODING OVER FIRST FLOOR (FT) | DAMAGE AS A PERCENT OF TOTAL MARKET VALUE | |
|---|---|---|
| | STRUCTURES | CONTENTS 1/ |
| -1 | 0 | 0 |
| 0 | 1 2/ | 0 |
| +1 | 4 | 26 |
| +2 | 12 | 40 |
| +3 | 18 | 51 |
| +4 | 22 | 61 |
| +5 | 36 | 67 |
| +6 | 39 | 72 |
| +7 | 41 | 76 |
| +8 | 43 | 79 |
| +9 | 45 | 81 |
| +10 | 47 | 83 |

1/ For residential contents only, non-residential content damages are based on field survey data collected for individual establishments.

2/ One percent damage at first floor level accounts for average yard damage and is used for residential structures only. Commercial structures have assumed zero damage at first floor.

4.3 Water Surface Profile Data

Water surface elevations (MSL) were computed for each of the nine cross sections and for seven flood damage recurrence intervals. The without project stage frequency data is presented in Table D-3

TABLE D-3. WITHOUT PROJECT CONDITION WATER SURFACE ELEVATIONS (FT ABOVE MSL) GARAPAN, SAIPAN

| STATION NUMBER | 2-YEAR | 10-YEAR | 25-YEAR | 50-YEAR | 100-YEAR | 500-YEAR | SPF |
|---|---|---|---|---|---|---|---|
| 135 | 4.98 | 5.53 | 5.73 | 6.01 | 6.06 | 6.24 | 6.34 |
| 265 | 5.79 | 6.41 | 6.66 | 6.83 | 7.00 | 7.25 | 7.37 |
| 490 | 5.93 | 6.60 | 6.88 | 7.07 | 7.27 | 7.56 | 7.63 |
| 1415 | 6.47 | 7.12 | 7.41 | 7.61 | 7.83 | 8.12 | 8.07 |
| 1620 | 6.56 | 7.19 | 7.47 | 7.67 | 7.88 | 8.18 | 8.13 |
| 2055 | 6.89 | 7.41 | 7.68 | 7.83 | 8.00 | 8.34 | 8.28 |
| 2640 | 7.54 | 7.95 | 8.16 | 8.30 | 8.32 | 8.74 | 8.62 |
| 2845 | 7.62 | 8.04 | 8.26 | 8.40 | 8.45 | 8.89 | 8.76 |
| 3045 | 7.75 | 8.06 | 8.28 | 8.43 | 8.49 | 8.95 | 8.81 |

TABLE D-4. WITHOUT PROJECT CONDITION DAMAGE-FREQUENCY AND EXPECTED ANNUAL DAMAGES

| RECURRENCE INTERVAL | | TOTAL | | | RESIDENTIAL | | | NON-RESIDENTIAL | |
|---|---|---|---|---|---|---|---|---|---|
| | STRUCTURE | CONTENTS | TOTAL | STRUCTURE | CONTENTS[1] | TOTAL | STRUCTURE | CONTENTS | TOTAL |
| | ($) | ($) | ($) | ($) | ($) | ($) | ($) | ($) | ($) |
| 2.0 | 184,564 | 487,009 | 671,573 | 93,436 | 129,324 | 222,760 | 91,128 | 357,685 | 448,813 |
| 10.0 | 382,854 | 1,079,814 | 1,462,668 | 189,814 | 283,233 | 473,047 | 193,040 | 796,581 | 989,621 |
| 25.0 | 524,195 | 1,393,915 | 1,918,110 | 251,394 | 374,078 | 625,472 | 272,801 | 1,019,837 | 1,292,638 |
| 50.0 | 637,842 | 1,606,760 | 2,244,602 | 299,379 | 434,955 | 734,334 | 338,463 | 1,171,805 | 1,510,268 |
| 100.0 | 757,665 | 1,800,295 | 2,557,960 | 346,409 | 481,838 | 828,247 | 411,256 | 1,318,457 | 1,729,713 |
| 500.0 | 989,479 | 2,204,577 | 3,194,056 | 450,618 | 597,215 | 1,047,833 | 538,861 | 1,607,362 | 2,146,223 |
| EXPECTED ANNUAL DAMAGES | 168,261 | 455,049 | 623,309 | 82,712 | 120,418 | 203,130 | 85,548 | 344,631 | 420,189 |

[1] NOTE: Residential content damage includes the results of affluence and reflect the increased value of residential contents from the study year 1984 to the project base yeat 1990.

## 4.4 Flood Damage Calculation

"Damage", a computer program developed by POD was utilized in calculation inundation damages for Garapan. The program calculates damage resulting from each flood frequency contained in the water surface profile data. Damage computations are done by computing flooding over the first floor of each structure/damage unit and in several instances there are more than one commercial establishment within the same structure. The program computes the damage-exceedance frequency curve using the trapezoidal integration method (i.e., assuming straight line segments between computed points), resulting in an expected annual value amount. Total expected annual inundation damages in Garapan under without project condition are $594,600. Damage frequency data and expected annual damages by activity type are presented in Table D-4.

The total number of units that incur damage for the various flood events and the total value of structures and contents is shown on Table D-5.

TABLE D-5. TOTAL UNITS DAMAGE AND VALUE OF STRUCTURE AND CONTENTS BY FLOOD EVENT

| RECURRENCE INTERVAL (YEARS) | NON-RESIDENTIAL NUMBER | NON-RESIDENTIAL VALUE OF STRUCTURE ($) | NON-RESIDENTIAL VALUE OF CONTENTS ($) | RESIDENTIAL NUMBER | RESIDENTIAL VALUE OF STRUCTURE ($) | RESIDENTIAL VALUE OF CONTENTS ($) |
|---|---|---|---|---|---|---|
| 2 | 64 | 5,683,000 | 2,668,000 | 116 | 4,722,000 | 1,671,700 |
| 10 | 83 | 6,514,000 | 3,972,000 | 149 | 6,188,000 | 2,092,300 |
| 25 | 96 | 11,923,000 | 9,781,000 | 177 | 7,176,000 | 2,465,100 |
| 50 | 101 | 12,058,000 | 12,344,000 | 196 | 7,847,000 | 2,718,100 |
| 100 | 108 | 12,344,000 | 10,067,000 | 207 | 8,200,000 | 2,860,300 |
| 500 | 118 | 12,994,000 | 10,370,000 | 239 | 9,425,000 | 3,296,600 |

## 5 FUTURE DAMAGES UNDER WITHOUT PROJECT CONDITION

As mentioned earlier, Garapan is the center of commercial trade and tourism in Saipan. The number of commercial establishments in the floodplain has increased steadily over the past decade. Garapan qualified for and has undergone the emergency phase of the National Flood Insurance Program. The Federal Emergency Management Administration (FEMA) has provided Garapan with flood hazard boundaries guided by preliminary flood data, though the community does not yet have local floodplain zoning ordinances in effect. However, several entrepreneurs upon establishing their businesses have attempted to raise the first floor elevation above their interpretation of the flood hazard. Their interpretation is usually based upon observed flood elevations from more frequent flooding events recently experienced in the area, rather than the established 100-year recurrence flood elevation. Though locational advantages to locating and/or intensifying commercial activities in the floodplain do exist, location and intensification benefits have not been evaluated in this analysis.

### 5.1 Effect of Future Affluence

In computing flood damages to existing development, the increase in real future damageable property must be considered to reflect fair treatment of what damages would occur. This can be done by increasing the estimated real value of residential contents at a rate that per capita income is expected to grow. However, there is no per capita income series projected for Saipan. Growth in the real value of residential contents is estimated to grow at the same rate of growth as historical average wages and salaries (1967 dollars) for CNMI, (1.4 percent per year). The ratio of wage and salary earners to population in the Commonwealth has grown from 30 percent to 54 percent over the historical period of record 1969-1983. Because it is speculated that this ratio has leveled off, it is deemed more appropriate to project real residential contents value to grow at the same rate as wages and salaries per earner rate than per capita. The existing total value of residential contents as a weighted percent of total value of residential structures is 28.0. Using a 1.4 percent annual compound growth rate, the ratio of value of contents to value of structure would grow from 28 percent to 75 percent in the year 2032. It is assumed that the value of contents will not exceed 75 percent of the value of structure and therefore the growth in value of contents is leveled off in 2032. Table D-6 presents projected average wages and salaries in CNMI and the weighted average value of residential contents by decade over the project evaluation period. Average annual equivalent residential content damages as a result of this increase in the real value of residential contents is estimated at $18,300.

TABLE D-6 PROJECTED AVERAGE WAGES AND SALARIES AND WEIGHTED AVERAGE VALUE OF RESIDENTIAL CONTENTS BY DECADE

| Year | PROJECTED AWS BASED ON 1.4% GROWTH (1967$) | WEIGHTED AVERAGE VALUE OF RESIDENTIAL CONTENTS (May 1984 Price Level and Condition of Development) |
|---|---|---|
| 1969 | $1,770 1/ | -- |
| 1983 | 2,150 1/ | -- |
| 1984 | 2,180 | $15,189 |
| 1990 | 2,370 | 16,509 |
| 2000 | 2,723 | 18,970 |
| 2010 | 3,129 | 21,797 |
| 2020 | 3,595 | 25,045 |
| 2030 | 4,131 | 28,778 |
| 2040 | 4,747 | 29,589 2/ |

1/ Actual

2/ The average value of residential contents will reach 75 percent of the average value of residential structures by the Year 2032, and is held constant thereafter.

Table D-7 displays the undiscounted stream of inundation damages by activity over the project evaluation period and the average annual equivalent.

TABLE D-7. INUNDATION DAMAGES BY DECADE

| ACTIVITY | 1984 | 1990 | 2000 | 2010 | 2020 | 2030 | 2040 | AVERAGE ANNUAL EQUIVALENT |
|---|---|---|---|---|---|---|---|---|
| | ($) | ($) | ($) | ($) | ($) | ($) | ($) | ($) |
| RESIDENTIAL | | | | | | | | |
| STRUCTURES | 82,700 | 82,700 | 82,700 | 82,700 | 82,700 | 82,700 | 82,700 | 82,700 |
| CONTENTS [1] | 113,100 | 122,900 | 141,200 | 162,300 | 186,400 | 214,200 | 220,200 | 146,600 |
| TOTAL | 195,800 | 205,600 | 223,900 | 245,000 | 269,100 | 296,900 | 302,900 | 229,300 |
| NON-RESIDENTIAL | | | | | | | | |
| STRUCTURES | 85,600 | 85,600 | 85,600 | 85,600 | 85,600 | 85,600 | 85,600 | 85,600 |
| CONTENTS | 334,600 | 334,600 | 334,600 | 334,600 | 334,600 | 334,600 | 334,600 | 334,600 |
| TOTAL | 420,200 | 420,200 | 420,200 | 420,200 | 420,200 | 420,200 | 420,200 | 420,200 |
| TOTAL | 616,000 | 625,800 | 644,100 | 665,200 | 689,300 | 717,100 | 723,100 | 649,500 |

[1] Growth in damage to residential contents ends in 2032.

## 6 WITH PROJECT CONDITION

Five structural alternatives and one non-structural alternative have been evaluated in the analysis. They are discussed in the Main Report. Structural alternatives would provide a 50 year level of flood protection, i.e., would eliminate flood damage for all storms with a recurrence of 50 years or less. D-8 displays the computed water surface elevations by station number for Plans A through E.

### 6.1 Residual Damages and Benefits

Plan A, D, and E provides the greatest reduction of flood damages totalling each $633,900, followed by Plan B then Plan C with total inundation reduction benefits of $633,600 and $631,900, respectively. Table D-9 presents residual damages and inundation reduction benefits for the five alternatives.

Average annual benefits by activity for the five structural plans of improvement are presented in Table D-10.

### 6.2 Freeboard Benefit

The freeboard of a channel is the vertical distance measured from the design water surface to the top of the channel. All structural plans evaluated have been designed to include freeboard so as to ensure that the desired degree of protection will not be reduced by unaccounted factors. With freeboard all structural plans with 50-year recurrence storm design would virtually have no residual damages. However, only half of the damages prevented within the freeboard range have been claimed as NED benefit and are included in the Benefit Summary (Table 12).

### 6.3 Emergency Relief Cost Reduction Benefit

Emergency costs associated with flooding include expenditure for territory emergency crews, American Red Cross relief work, territory and Federal investigating teams, police, and rescue crews. The only source of available emergency relief cost records from historical flooding in Garapan is the American Red Cross (ARC). Mass care assistance provided by ARC includes: food, clothing, temporary shelter, medical supplies etc. The last three major storms on Saipan were of such magnitude to implement emergency disaster procedures. Table D-11 provides historical records of emergency relief costs incurred by the ARC for the last three storms.

TABLE D-8. WATER SURFACE ELEVATIONS (FT ABOVE MSL)
FOR 50 YEAR DESIGN PLANS A, B, C, D, AND E

| STATION | PLAN A | | | PLAN B | | | PLAN C | | | PLAN D | | | PLAN E | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NUMBER | 50-YR | 100-YR | 500-YR | 50-YR | 100-YR | 500-YR | 50-YR | 100-YR | 500-YR | 50-YR | 100-YR | 500-YR | 50-YR | 100-YR | 500-YR |
| 135 | 1.00 | 4.65 | 5.22 | 1.00 | 4.54 | 5.39 | 1.00 | 4.68 | 5.38 | 1.00 | 4.65 | 5.22 | 1.00 | 4.65 | 5.22 |
| 265 | 2.50 | 5.55 | 6.37 | 2.50 | 5.52 | 6.54 | 2.50 | 5.60 | 6.56 | 2.50 | 5.55 | 6.37 | 2.50 | 5.55 | 6.37 |
| 490 | 2.30 | 5.85 | 6.71 | 2.30 | 5.81 | 6.89 | 2.30 | 5.90 | 6.91 | 2.30 | 5.85 | 6.71 | 2.30 | 5.85 | 6.71 |
| 1415 | 3.50 | 6.55 | 7.39 | 3.50 | 6.39 | 7.49 | 3.50 | 6.59 | 7.58 | 3.50 | 6.55 | 7.39 | 3.50 | 6.55 | 7.39 |
| 1620 | 3.60 | 6.62 | 7.45 | 3.60 | 6.47 | 7.54 | 3.60 | 6.66 | 7.63 | 3.60 | 6.62 | 7.45 | 3.60 | 6.62 | 7.45 |
| 2055 | 3.90 | 6.78 | 7.59 | 3.90 | 6.66 | 7.66 | 3.90 | 6.81 | 7.75 | 3.90 | 6.78 | 7.59 | 3.90 | 6.78 | 7.59 |
| 2640 | 4.90 | 7.13 | 7.90 | 4.90 | 7.13 | 7.94 | 4.90 | 7.17 | 7.99 | 4.90 | 7.13 | 7.90 | 4.90 | 7.13 | 7.90 |
| 2845 | 4.50 | 7.23 | 8.02 | 4.50 | 7.24 | 8.05 | 4.50 | 7.27 | 8.09 | 4.50 | 7.23 | 8.02 | 4.50 | 7.23 | 8.02 |
| 3045 | 4.20 | 7.33 | 8.14 | 4.20 | 7.36 | 8.17 | 4.20 | 7.38 | 8.19 | 4.20 | 7.33 | 8.14 | 4.20 | 7.33 | 8.24 |

TABLE D-9. RESIDUAL FLOOD DAMAGES AND BENEFITS BY ALTERNATIVE

| RECURRENCE INTERVAL | PLAN A ($) | PLAN B ($) | PLAN C ($) | PLAN D ($) | PLAN E ($) |
|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | 0 |
| 100 | 529,463 | 464,423 | 570,831 | 529,463 | 529,463 |
| 500 | 1,703,901 | 1,859,513 | 1,965,893 | 1,703,901 | 1,703,901 |
| EXPECTED ANNUAL DAMAGES (AT 1990) | 15,047 | 15,397 | 16,999 | 15,047 | 15,047 |
| INUNDATION REDUCTION BENEFITS (AT 1990) | 610,752 | 610,403 | 608,800 | 610,752 | 610,752 |
| INUNDATION REDUCTION BENEFITS W/AFFLUENCE | 633,932 | 633,572 | 631,900 | 633,932 | 633,932 |

TABLE D-10. AVERAGE ANNUAL BENEFITS FOR PLANS A, B, C, D, AND E BY ACTIVITY

| ACTIVITY TYPE | PLAN A ($) | PLAN B ($) | PLAN C ($) | PLAN D ($) | PLAN E ($) |
|---|---|---|---|---|---|
| RESIDENTIAL: | | | | | |
| STRUCTURE | 80,700 | 80,600 | 80,500 | 80,700 | 80,700 |
| CONTENTS | 120,000 | 120,000 | 119,600 | 120,000 | 120,000 |
| AFFLUENCE | 23,200 | 23,200 | 23,100 | 23,200 | 23,200 |
| TOTAL | 223,900 | 223,800 | 223,200 | 223,900 | 223,900 |
| NON-RESIDENTIAL | | | | | |
| STRUCTURE | 83,400 | 83,300 | 83,000 | 83,400 | 83,400 |
| CONTENTS | 326,600 | 326,500 | 325,700 | 326,600 | 326,600 |
| TOTAL | 410,000 | 409,800 | 408,700 | 410,000 | 410,000 |
| TOTAL | 633,900 | 633,600 | 631,900 | 633,900 | 633,900 |

TABLE D-11. AMERICAN RED CROSS EMERGENCY RELIEF COSTS

| STORM | DATE | NO. OF FAMILIES ASSISTED IN SAIPAN | NO OF FAMILIES ASSISTED IN GARAPAN | TOTAL EMERGENCY RELIEF COST 2/ |
|---|---|---|---|---|
| T.S. CARMEN | Nov 78 | 645 | 82 | $271,490 |
| T.S. DIANE | Nov 80 | 750 | 95 1/ | $364,474 |
| T.S. HAZEN | Nov 81 | 408 | 52 1/ | $121,116 |

1/ Estimate based on proportion stated from T.S. Carmen
2/ Reported in 1984$

The average emergency relief cost expended in Garapan for the three tropical storms is estimated at $32,039. Because there is no rain gauge data available on Saipan, it is difficult to estimate the frequency of historical floods in Saipan. It is reasonable to assume that $32,000 in emergency cost incurred approximately every two years. The average annual equivalent emergency relief cost is therefore estimated at $18,100. All five structural plans considered would eliminate emergency relief costs incurred by the ARC, and therefore emergency relief cost savings for Plan A through E is $18,100.

### 6.4 Intangible Benefits

Intangible benefits accrued from the implementation of any of the proposed alternatives include reduction of health hazards associated with flooding, reduction in the disruption of community activity, and the elimination of the threat of loss of human life.

### 6.5 Summary of NED Benefits

Table D-12 presents a summary of the forementioned benefits attributed to the five structural alternative plans of improvement, given a 50-year flood level of protection.

### 6.6 Project Costs

Total annual charges for structural Plans A through E are summarized in Table D-13. Clearly, from an economic perspective Plans A, D, and E provide the greatest degree of benefit at the lowest cost.

### 6.7 Benefit Cost Comparison

Table D-14 provides a comparison of NED benefits and costs for Plans A through E. Comparison include benefit to cost ratio and annual net benefits.

TABLE D-12. SUMMARY OF NED BENEFITS

| BENEFIT CATEGORY | PLAN A ($) | PLAN B ($) | PLAN C ($) | PLAN D ($) | PLAN E ($) |
|---|---|---|---|---|---|
| INUNDATION REDUCTION | | | | | |
| RESIDENTIAL | 200,700 | 200,600 | 200,100 | 200,700 | 200,700 |
| COMMERCIAL AND PUBLIC | 410,000 | 409,800 | 408,700 | 410,000 | 410,000 |
| FREEBOARD | 7,500 | 7,700 | 8,500 | 7,500 | 7,500 |
| AFFLUENCE | 23,200 | 23,200 | 23,100 | 23,200 | 23,200 |
| EMERGENCY RELIEF COST SAVINGS | 18,100 | 18,100 | 18,100 | 18,100 | 18,100 |
| TOTAL AVERAGE ANNUAL | 659,500 | 659,400 | 658,500 | 659,500 | 659,500 |

TABLE D-13. SUMMARY OF PROJECT COSTS

| COST CATEGORY | PLAN A ($) | PLAN B ($) | PLAN C ($) | PLAN D ($) | PLAN E ($) |
|---|---|---|---|---|---|
| TOTAL PROJECT FIRST COST | 6,750,000 | 9,160,000 | 7,970,000 | 6,930,000 | 6,580,000 |
| INTEREST DURING CONSTRUCTION [1] | 548,700 | 744,600 | 647,900 | 563,300 | 534,900 |
| TOTAL INVESTMENT COST | 7,298,700 | 9,904,600 | 8,617,900 | 7,493,300 | 7,114,900 |
| ANNUALIZED INVESTMENT COST | 622,400 | 844,700 | 734,900 | 639,000 | 606,800 |
| ANNUAL OPERATION AND MAINTENANCE | 7,600 | 8,300 | 8,000 | 8,600 | 7,600 |
| TOTAL AVERAGE ANNUAL COST | 630,000 | 853,000 | 742,900 | 647,600 | 614,400 |

[1] IDC calculation assumes an even distribution of monthly cash outlays over 2-year period.

TABLE D-14. COMPARISON OF NED BENEFITS AND COST

| ITEM | PLAN A ($) | PLAN B ($) | PLAN C ($) | PLAN D ($) | PLAN E ($) |
|---|---|---|---|---|---|
| TOTAL ANNUAL BENEFITS | 659,500 | 659,400 | 658,500 | 659,500 | 659,500 |
| TOTAL ANNUAL COSTS | 630,000 | 853,000 | 742,900 | 647,600 | 614,400 |
| BENEFIT COST RATIO | 1.05 | 0.77 | 0.89 | 1.02 | 1.07 |
| NET BENEFITS | 29,500 | (193,600) | (84,400) | 11,900 | 45,100 |

## 7 NON-STRUCTURAL ALTERNATIVES

In addition to the structural alternatives a non-structural plan (Plan F) was developed and evaluated. The non-structural plan is designed to provide for a 50-year level of protection. Each structure in the floodplain with a first floor elevation at or below a water surface elevation from a storm with a 50-year or greater recurrence was analyzed for non-structural measures.

Under without project conditions, there are 297 units that incur damages from a 50-year level recurrence storm (196 residential and 101 nonresidential). Damages to residential properties begin at one foot below the first floor elevation to account for damages to grounds and yard. Of the 196 residential properties damaged from a 50-year level event, 122 structures would have water at or above the structure's first floor elevation. Of the 10 nonresidential units in the 50-year floodplain, there are 60 unique structures (i.e., some of the units share the same structure especially commercial establishments sharing the same building). The distribution of structures by activity with first floor elevations below a 50-year recurrence storm water surface elevation is presented in Table 15.

TABLE 15. DISTRIBUTION OF GARAPAN STRUCTURES BELOW 50-YEAR ELEVATION

| Depth Above First Floor (ft) | Number of Structures Residential | Number of Structures Nonresidential |
|---|---|---|
| 2.01 - 2.50 | 9 | 3 |
| 1.51 - 2.00 | 16 | 14 |
| 1.01 - 1.50 | 23 | 13 |
| .51 - 1.00 | 33 | 12 |
| 0 - .50 | 41 | 18 |
| | --- | --- |
| TOTAL | 122 | 60 |

Plan F combines four flood proofing methods: closures, raising structure, raise contents and rebuilding structure. A breakdown of Plan F by floodproofing measure and activity is presented in Table 16.

TABLE 16. NUMBER OF STRUCTURES BY FLOOD PROOFING METHOD BY ACTIVITY

| Floodproofing Method | Total | Number of Structures Residential | Nonresidential |
|---|---|---|---|
| Temporary/Permanent Closures | 41 | 25 | 16 |
| Raising Structure | 12 | 11 | 1 |
| Raising Damageable Property | 33 | 0 | 33 |
| Rebuilding Structures | 96 | 86 | 10 |
| | --- | --- | --- |
| TOTAL | 182 | 122 | 60 |

Benefits have been calculated based on two conditions: (1) Floodproofing is 100% effective over the evaluation period, (2) Certain floodproofing methods are assumed less than completely effective to account for the possibility of human error or judgement. Table D-17 presents average annual damages and residual damages for the with and without project condition.

TABLE D-17. NON-STRUCTURAL PLAN F. AVERAGE ANNUAL DAMAGES FOR WITHOUT AND WITH NON-STRUCTURAL PLAN BY FLOODPROOFING MEASURE

| | Average Annual Damages ($1000) | | |
|---|---|---|---|
| | | Without Plan | |
| Flood Proofing Measure | Residential | Non-Residential | Total |
| 1. Temporary/Permanent Closures and Panels | 7.2 | 7.2 | 14.4 |
| 2. Raising Structures | 7.6 | 0.2 | 7.8 |
| 3. Raising Damageable | - | 207.6 | 207.6 |
| 4. Rebuilding Structure | 170.0 | 170.6 | 340.6 |
| | ------ | ------ | ------ |
| TOTAL | 184.8 | 385.6 | 570.4 |

| | Average Annual Damages ($1000) | | |
|---|---|---|---|
| | | With Plan | |
| Flood Proofing Measure | Residential | Non-Residential | Total |
| 1. Temporary/Permanent Closures and Panels | 1.2 | 1.6 | 2.8 |
| 2. Raising Structures | 0.7 | 0.1 | 0.8 |
| 3. Raising Damageable | - | 96.5 | 96.5 |
| 4. Rebuilding Structure | 12.8 | 2.6 | 15.4 |
| | ------ | ------ | ------ |
| TOTAL | 14.7 | 100.8 | 115.5 |

The average annual benefits were obtained by taking the difference between the average annual damages for the without project and with project conditions. These average annual benefits for Plan F are presented under conditions 1 and 2 in Table D-18.

TABLE D-18. AVERAGE ANNUAL BENEFITS FOR PLAN F ($1000)

| Floodproofing Measure | Condition 1 | Condition 2 | Assume Effectiveness of Measure |
|---|---|---|---|
| 1. Closures and Panels | 11.6 | 5.8 | 50% |
| 2. Raising Structure | 7.0 | 7.0 | 100% |
| 3. Raising Contents | 111.1 | 55.6 | 50% |
| 4. Rebuilding Structure | 325.2 | 325.2 | 100% |
| TOTAL | $454.9 | $393.6 | |

Condition 2 is used as the most probable future with the floodproofing alternative in place.

Total average annual costs ---------------- $1,099,000
Total average annual benefits ------------- $ 394,000
Total NED Benefit ------------------------- $ -705,000
B/C Ratio --------------------------------- 0.36

## 8 PROJECT SCALING

The Plan E, 50-year design level of protection would eliminate approximately 98 percent of existing inundation damage in Garapan. To determine what is the optimal level of protection, i.e., maximize average annual net benefits, this plan was reevaluated focusing on various alternative degrees of protection.

Water surface elevations were computed for modified Plan E design providing protection for a 10-year, 50-year, and SPF recurrence levels and expected annual damages were computed. Table D-19 presents existing flood damage reduction benefits for Plan E modified with levels of protection for 10-year, 50-year, and SPF.

TABLE D-19. EXISTING FLOOD REDUCTION BENEFITS FOR MODIFIED PLAN E

| Design Level of Protection | Existing Average Annual Flood Damages ($) | Residual Damages With Plan ($) | Flood Reduction Benefit ($) |
|---|---|---|---|
| 10-Year | 625,800 | 53,400 | 572,400 |
| 50-Year | 625,800 | 15,000 | 610,800 |
| SPF | 625,800 | 0 | 625,800 |

Annual costs for each of the modified plans have been estimated and are summarized in Table D-20.

TABLE D-20 PLAN E MODIFIED, SUMMARY OF TOTAL ANNUAL COSTS BY LEVEL OF PROTECTION

| | LEVEL OF PROTECTION | | |
|---|---|---|---|
| COMPONENT OF COST | 10-YR | 50-YR | SPF |
| | ($000) | ($000) | ($000) |
| Total First Cost | 6,340.0 | 6,580.0 | 6,830.0 |
| IDC [1] | 515.4 | 534.9 | 555.2 |
| Total Investment Cost | 6,855.4 | 7,114.9 | 7,385.2 |
| Annual Investment Cost | 584.6 | 606.7 | 629.8 |
| Annual O, M, & R | 7.5 | 7.6 | 8.0 |
| Total Annual Cost | 592.1 | 614.3 | 637.8 |

[1] IDC calculation assumes an even distribution of monthly cash overlays over a 2-year construction period.

Table D-21 presents the summary of total benefits for each modified Plan E scenario.

TABLE D-21 SUMMARY OF BENEFITS FOR PLAN E AT VARIOUS DESIGN LEVELS OF PROTECTION

| BENEFIT CATEGORY | LEVEL OF PROTECTION 10-YR ($000) | 50-YR ($000) | SPF ($000) |
|---|---|---|---|
| Damage Reduction | 572.4 | 610.8 | 625.8 |
| Freeboard | 26.4 | 7.5 | 0.0 |
| Affluence | 21.7 | 23.2 | 23.8 |
| Emergency Cost Savings | 9.0 | 18.1 | 18.1 |
| Total Benefit | 629.5 | 659.6 | 667.7 |

Table D-22 presents a comparison of NED Benefits and Costs for modified Plan E Scenario. The optimum Plan E level of protection (NED Plan) is shown in the main report.

TABLE D-22 COMPARISON OF NED BENEFITS AND COSTS PLAN E - AT VARIOUS DESIGN LEVELS OF PROTECTION

| BENEFIT CATEGORY | LEVEL OF PROTECTION 10-YR ($000) | 50-YR ($000) | SPF ($000) |
|---|---|---|---|
| Total First Cost | 6,340.0 | 6,580.0 | 6,830.0 |
| IDC | 515.4 | 534.9 | 555.2 |
| Total Investment Cost | 6,855.4 | 7,114.9 | 7,385.2 |
| Annual Investment Cost | 584.6 | 606.7 | 629.8 |
| Annual O, M, & R | 7.5 | 7.6 | 8.0 |
| Total Annual Cost | 592.1 | 614.3 | 637.8 |
| Total Annual Benefits | 629.5 | 659.6 | 667.7 |
| Benefit to Cost Ratio | 1.06 | 1.07 | 1.05 |
| Net Benefits | 37.4 | 45.3 | 29.9 |

GARAPAN FLOOD CONTROL
SAIPAN, CNMI

SOCIAL AND CULTURAL RESOURCES

APPENDIX E

# APPENDIX E

## SOCIAL AND CULTURAL RESOURCES

### Table of Contents

## I. INTRODUCTION

1. Identification of historic sites is required by the Reservoir Salvage Act of 1960, as amended, Section 110 of the National Historic Preservation Act of 1966, and executive Order 11593 (1971). The Federal agency must evaluate the significance of potential sites to determine their eligibility for the National Register of Historic Places. If any sites in the project area are determined eligible for or are already listed on the National register, they would be protected by Federal law and regulation to the extent that the Federal agency must consult with the State Historic Preservation Officer and the US Advisory Council on Historic Preservation Officer and the US Advisory Council on Historic Preservation to determine the effects of the Federal project and to identify measures to either avoid or mitigate any adverse effects.

2. Sections II and III summarize the prehistory and history of the study area and describes the procedural steps involved in identifying historic sites and the effects of the alternative plans in relation to the sites.

3. Section IV assesses the social well-being components of the six alternative plans. The Other Social Effects (OSE) component analysis derives from the Water Resources Council's "Economic and Environmental Principles and Guidelines for Water and Related Land Resources," February 3, 1983. These OSE components are not required by the new Principles and Guidelines, but encompasses the social well-being elements that are legally required by Section 122 of the Flood Control Act of 1970 (P.L. 91-611, 84 Stat. 1823) to be addressed in water resources studies. This OSE account consists of (a) urban and community impacts such as income, employment and population distribution and composition; the fiscal condition of the local government, and the quality of community life; (b) life, health and safety; (c) displacement of people, businesses, and farms; (d) long term productivity involving renewable resources; and (e) energy requirements and conservation both during construction and operation of facilities.

## II. PREHISTORY AND HISTORY

4. Based on comparative dates and settlements on nearby Guam, Saipan was probably occupied as early as 1500 B.C., although no firm dates yet exist for Saipan. Most evidence of prehistoric settlement exists today at inland locations, many of which it has been hypothesized were once prehistoric coastal environments. The places along historic shorelines have undergone severe modification by the Japanese and Americans between 1930 and 1945. The shoreline consists of fill material and/or concrete. Thus, the likelihood of finding any prehistoric (archaeological) sites in flat coastal areas is negligible. No historical archaeological sites on Saipan Islands are currently eligible for or listed on the National Register of Historic Places.

5. Saipan was originally inhabited by Chamorros. They were relocated to Guam by the Spanish in 1660. Under Spanish rule, the Chamorro population and culture were nearly obliterated. The decline of the Chamorro population was further influenced by intermarriage with peoples of Spanish, Mexican and Filipino decent, who were present in the islands. Surviving Chamorros resettled on Saipan in the 1900's. However, the native population was a mixed race with a culture and tradition reflecting Spanish colonial influence. They were Catholic, trained in agriculture and their matrilineal system replaced with a patrilineal one, although their extended family ties persisted. Being poor and having no mineral wealth, Saipan and its people attracted little attention from the outside world. The native population consisted of subsistence farmers living in village establishments supplementing their farming with inshore fishing. In the 1800's, several hundred Carolinians established separate villages on Saipan. Their culture was not unlike the old Chamorro culture, but their language and culture set them apart from the native population.

6. Following the Spanish-American War, Germany administered the island, establishing public schools, extending the road network, and organizing an agricultural economy based on copra. However, the Japanese dominated trade in the region and after World War I obtained control of the island. By 1930, the total population on Saipan was about 45,000 of which less than 10 percent were native (Chamorro and Carolinian). Koreans and Okinawans were imported to supplement Japanese labor. Japanese school was mandatory for all on the island. Garapan became the center of population and economy under Japanese administration. Following World War II, all the surviving Japanese on Saipan were expatriated to Japan. The native population previously confined to Chalan Kanoa were allowed to circulate freely and by 1947 subsistence agriculture replaced the previously thriving sugar economy. The native population had to adapt to a new language, a new form of government and new cultural values. Saipan remained under US Navy administration until 1962 when it became part of the Marianas District, Trust Territory of the Pacific Islands (TTPI), a trusteeship of the United Nations administered by the United States. Saipan became the headquarters for the TTPI government, a factor enhancing the presence of other Micronesian cultures on the Island. In 1978, Saipan and 15 other islands in the Marianas District entered into a covenant with the United States forming the Commonwealth of the Northern Mariana Islands (CNMI). The Commonwealth, with a status separate from the Trust Territory of the Pacific Islands, has a closer political and economic association with the United States.

## III. HISTORY OF GARAPAN

7. The village of Garapan, founded by the early 1820's, is the oldest and most important historic-era settlement on the island of Saipan (Figure 1). The history of Garapan is chronicled in the recent monograph by Scott Russell, From Arabwal to Ashes. The village, eventually known as Arabwal, was originally settled by immigrants from the central Carolines and was located along the sandy western shore just south of a point of land called by the settlers "Pien Olong" (view of the sand), known in Chamorro as Puntan Muchot and now called Micro Beach. Oral accounts attribute the site selection to its proximity to a channel in the reef just south of Managaha Island, but just as important may have been combination of a wide, protected lagoon to the west and low swampy areas, well suited for taro gardening, to the east (Russell, 1984). In 1868, the orderly laid-out village was devastated by a strong typhoon with storm waves reportedly nearly three meters high.

8. Garapan grew from a tiny village during the Spanish administration (approximately 1,000 individuals) to become a town of 15,000 residents in the later years of the Japanese administration, the capital and largest town on the island. Under German administration beginning in 1899, Garapan began to grow with the construction of an administration building, a boat landing, a limited island-wide road system, and the development of a water supply system. An attractive homesteading program was successful in attracting Chamorro immigrants, and together with a decrease in the infant mortality rate, the population of the German Marianas increased by 30 percent between 1900 and 1905. Early German efforts at economic development were dealt a crippling blow in 1905 after the island of Saipan was devastated by two powerful typhoons in August and November. Strong winds and high waves leveled the village of Tanapag and and destroyed nearly all public buildings in Garapan. High seas combined with flood waters to destroy bridges, roads, and newly established coconut plantations (Russell, 1984).

9. H.H.L.W. Constenoble, was a Thuringian who emigrated to Saipan in 1903 and apparently lived there with his family for some time. In 1905, he had an article published in the German geography/travel magazine Globus, entitled "Die Marianen" which described the nature, economy and history of the Marianas. In reference to the general project area, he notes (p. 6) that:

> The west side does not have much water. On the northern side there are two fresh water streams, a brackish water outlet toward the middle, although there are a few scattered fresh water brooks in the area; and finally two brackish water bodies of water [Brakwasserlagunen] in the south [translated from the German].

10. Cloud (et.al.) states that Constenoble is probably referring to Lake Susupe and a subsequently filled lake or swamp in the horn of land at Muchot Point). That lake or swamp is the swamp in American Memorial Park.

11. Another description of the project area comes from another German, S.J.M Prowazek, who visited the Marianas in about 1912. He wrote a long monograph (Die Deutschen Marianen Ihre Natur und Geschichte) published in 1913 which fully describes the region. In the monograph is a map of the Marianas Islands, which clearly identified Constenoble's "Brakwasserlagunen" north of Garapan as a lake (Figure 1). In the following two quotes [translated from the German], Prowazek describes the countryside north of Garapan as follows:

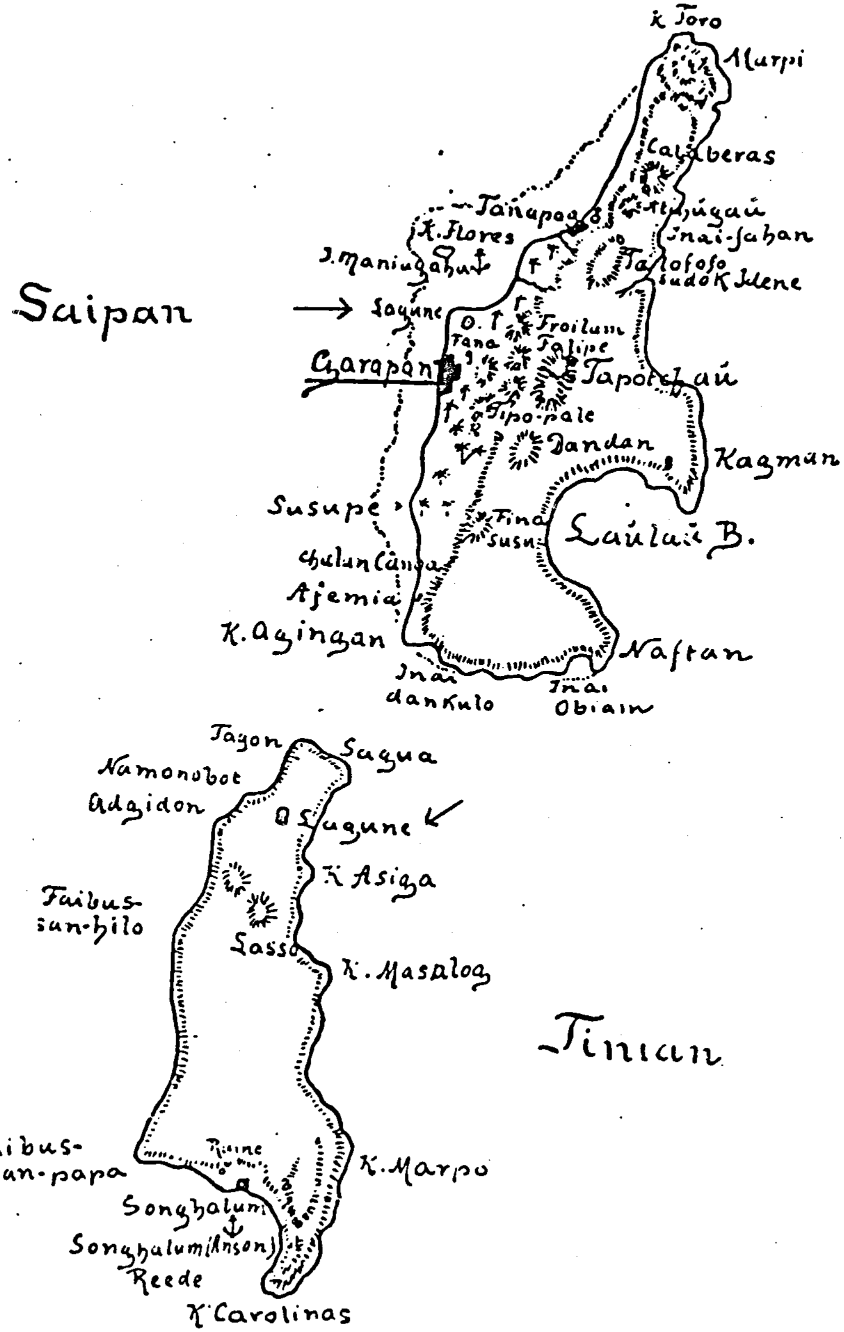
> Saipan distinguishes itself near Garapan through a "Lagune"[1] where a lot of water fowl live; near Fina-susu (Supupe-Mahide) a second body of water is identified...Garapan unfortunately has only brackish "wells" and larger cisterns which are partially replenished by the government. There is a small "well" near Laulau Bay whereas on the east coast between Garapan and Tanapag, brackish water flows outlet into the sea [Prowazek (1913), p. 79].
>
> Botanically speaking, the larger and better known Saipan island is broken up in several way: The sea, tamed by the offshore reefs, offers shelter, even though reluctantly, to the scarce Cladaphora, Bryposis (Blue Grotto), Enteromorpha, and Pavonia; the normally plush mangrove formation, can, because of the scarce brackish water, only be recognized in the "lagune" between Garapan and Tanapag, where the road to Talofofo branches off, and adds a few friendly pictures to the serious looking landscape (p. 105-106).

13. It seems clear that it is the "Lagune" shown in Figure 1 in 1913 is in fact the pond or marsh depicted in Figure 2, a Japanese map of west central Saipan dating from the 1920's. That map names the pond as the Puntan Muchot pond or bog (translated from the Japanese). The map does not show any stream entering the pond; it seems likely that water accumulates there as a result of low-lying topopgraphy, the presence of a high brackish water groundwater table due to the proximity to the ocean/lagoon, and the likelihood of fresh water springs or seeps that are common on Saipan at the junction of the plain and the hills. This interpretation is support by Prowazek's mention of brackish wells near Garapan town and his description of the presence of brackish water flows outlet[ing] into the sea on the east coast between Garapan and Tanapag.

12. The Puntan (Point) Muchot "lagunen" is described by Prowazek as being a habitat for many waterfowl. His subsequent mention of plush mangroves may refer to the marshy area (now much filled in) to the east or rear of Tanapag as much as to the pond or marsh at Puntan Muchot (Figure 3).

---

1/ In Prowazek's monograph, the German word "Lagune" has not been translated because of some ambiguity regarding the meaning of the word. It apparently can be translated loosely as a lake, marsh/swamp or lagoon. In this case, it seems to be used to describe a pond as




Kartenskizze von Saipan und Tinian (kombiniert).

**FIGURE 1**

Reference: Prowazek (1913)

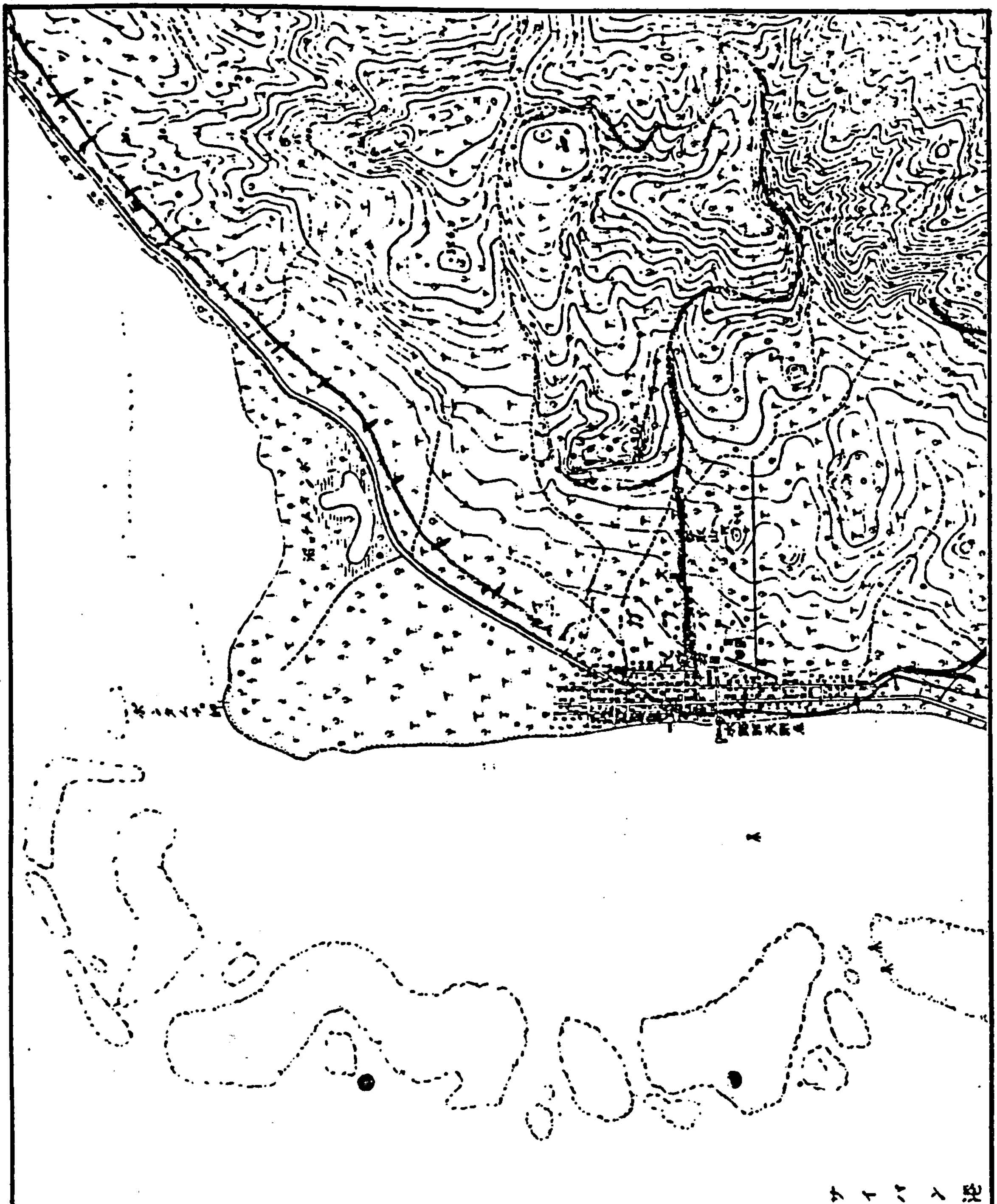


FIGURE 2. JAPANESE MAP OF WEST CENTRAL SAIPAN (1920's).
(From the Files of the Micronesian Area Culture Center)

Reference: Pacific Studies Institute, Inc. (1979)

FIGURE 2

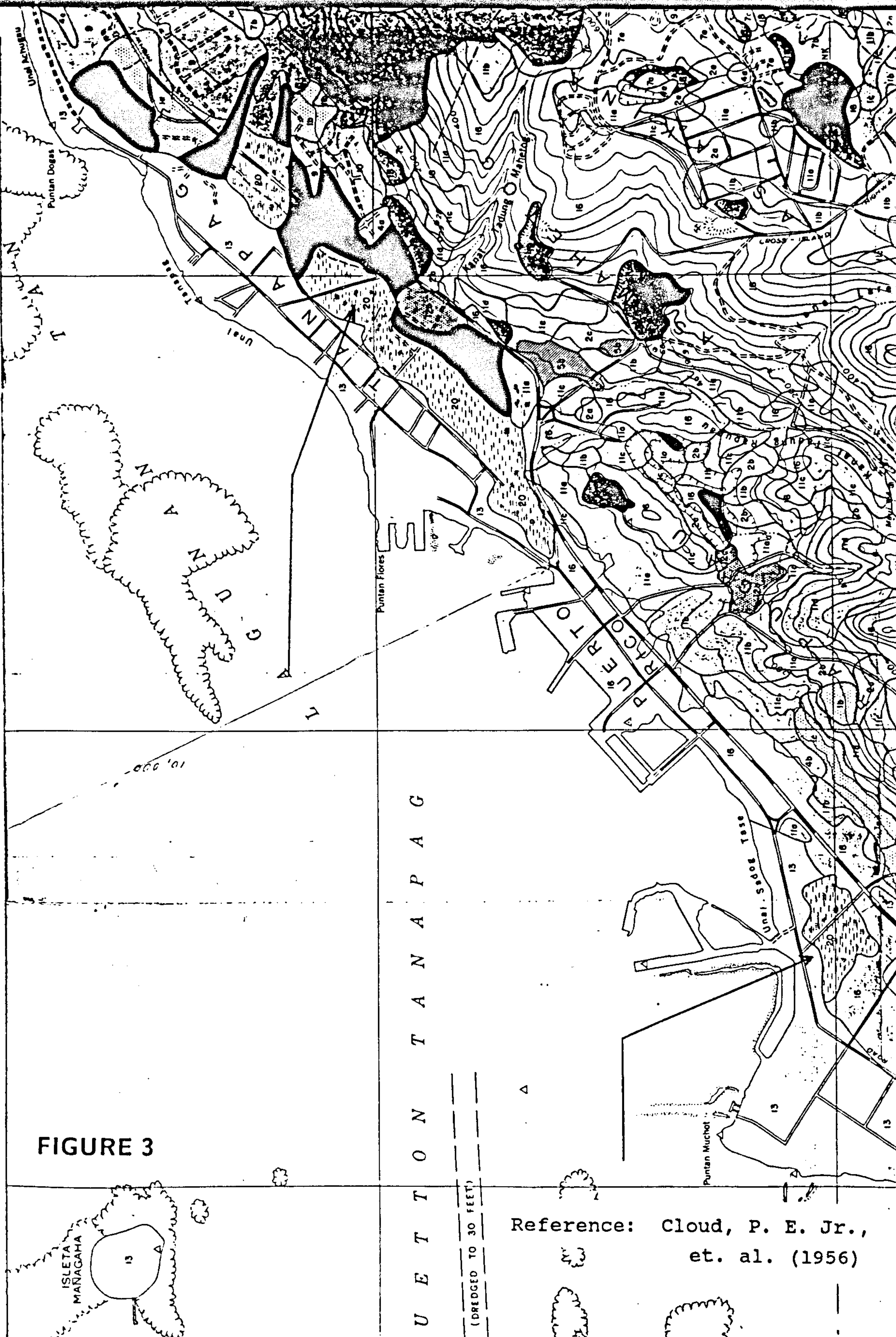



FIGURE 3

Reference: Cloud, P. E. Jr., et. al. (1956)

confirmed in Figure 1, which also labels the known pond/marsh in northern Rota as a "Lagune."

13. At the beginning of World War I in 1914, Japan was able to seize Saipan, as well as other parts of Micronesia. The village of Garapan appears to have changed little during the period of Japanese military occupation. Following the establishment of civilian control of Saipan in 1922, the island landscape was soon radically transformed to provide large-scale sugar cane production and diversified agricultural products such as coffee, cassava and pineapple. In the 1930's, the Japanese imported skilled workers from Korea and Okinawa, so that by the late 1936, almost 41,000 Japanese nationals were residing in the Northern Marianas, compared to only about 4,400 Chamorros and Carolinians.

14. To service this growing economy and population, the Japanese initiated a long-range harbor improvement project in 1926, completing it in 1932. Due to its proximity to the harbor, Garapan became the focal point for island development. In the 1930's it was a large, modern Japanese town, with considerably more complex commercial and architectural structure than its present situation. The village then was divided into eight districts including North Garapan, South Garapan, Punton Muchot, Fana Ganan, Puerto Rico, Sadog Tase, Chalan Laulau, and Gualorai (Russell, 1984). Based on an analysis of placenames on current maps, the proposed flood control project passes through the old districts of Fana Ganan and between Punton Muchot and Sadog Tase. These areas were apparently only sparsely populated and were mostly cultivated (along the present West Coast Highway) or undeveloped (in the Punton Muchot pond/marsh).

15. Military construction programs began in the mid 1930's with the completion of a major seaplane base at Punton Flores in 1935. The significant modification of southern Tanapag Bay, offshore present-day American Memorial Park, appears to have been constructed between 1941 and 1943. A U.S. Navy target map (c. 1944) of the Muchot Point area depicts substantial development in comparison with the 1920's (Figure 4). The project area itself is crossed by a new railroad, a now abandoned road between Beach Road and West Coast Highway, and various buildings and other facilities on both sides of Beach Road. Some of these buildings are identified in the 1979 archaeological survey prepared for the National Park Service by Pacific Studies Institute (see below). It is at this period (late 1930's) that the Puntan Muchot pond/marsh is cut off from any <u>possible</u> surface connection with the lagoon.

16. During the invasion of Saipan in 1944, Garapan and the Japanese military facilities at Punton Muchot were heavily bombarded and much of the town was destroyed. After the war, the island's population and municipal center were moved to Chalan Kanoa and the ruins of Garapan were eventually reclaimed by dense stands of tangantangan. A 1946 aerial photograph (Figure 5) of Garapan/Puntan Muchot shows the maximum extent of landscape modification attained during the World War II period (and since). Comparing Figures 2 and 5, it appears that the

**FIGURE 4**

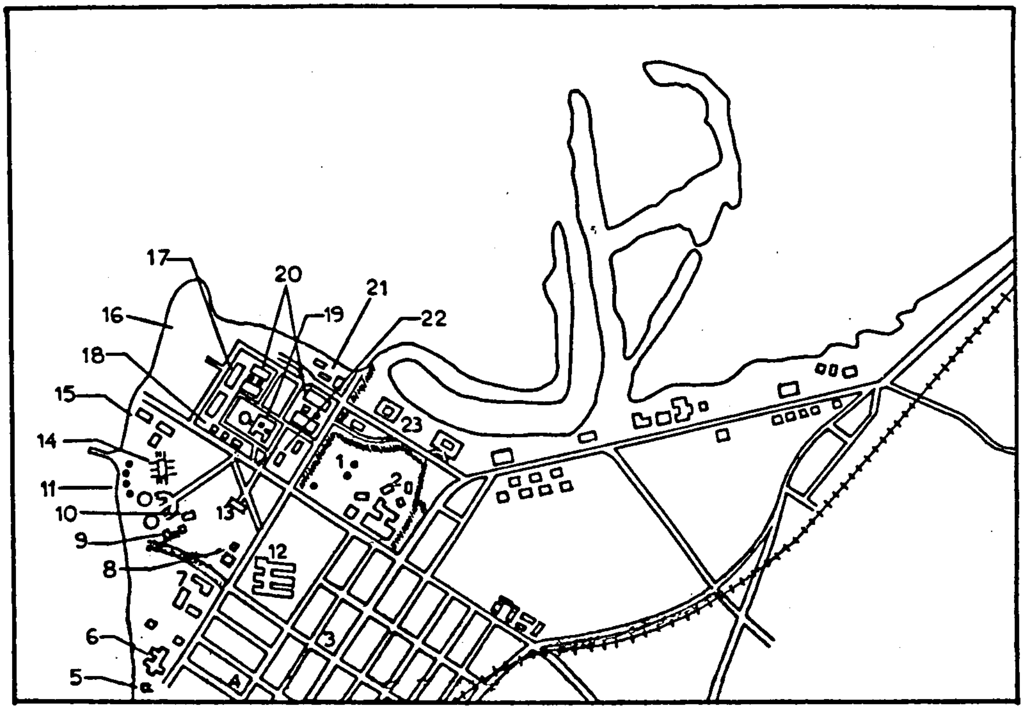



FIGURE 6. TARGET MAP OF MUCHOT POINT AREA
(From U. S. Navy, 1960)

KEY TO MAP NUMBERS:

1. Two heavy anti-aircraft or defensive positions (under construction)
2. Barracks type with sheds/ maybe administration
3. Residences and command posts
4. Homes
5. Low tower
6. Residence or school
7. Formerly a girls school; now possibly a hospital
8. Naval club
9. Generator for gun battery or search light
10. Barracks for gun and search light crews
11. Two coastal defense guns and four medium anti-aircraft with possible search lights
12. Hospital group
13. Officers quarters
14. Underground shelter or storage
15. Storehouse and boathouse
16. Obscured by clouds
17. Kitchen and mess
18. Three garages
19. Military headquarters and administration
20. Barracks
21. Airraid shelter
22. Revetted airraid shelters
23. Revetted magazines

////// Earthen levee

Reference: Pacific Studies Institute, Inc. (1979)

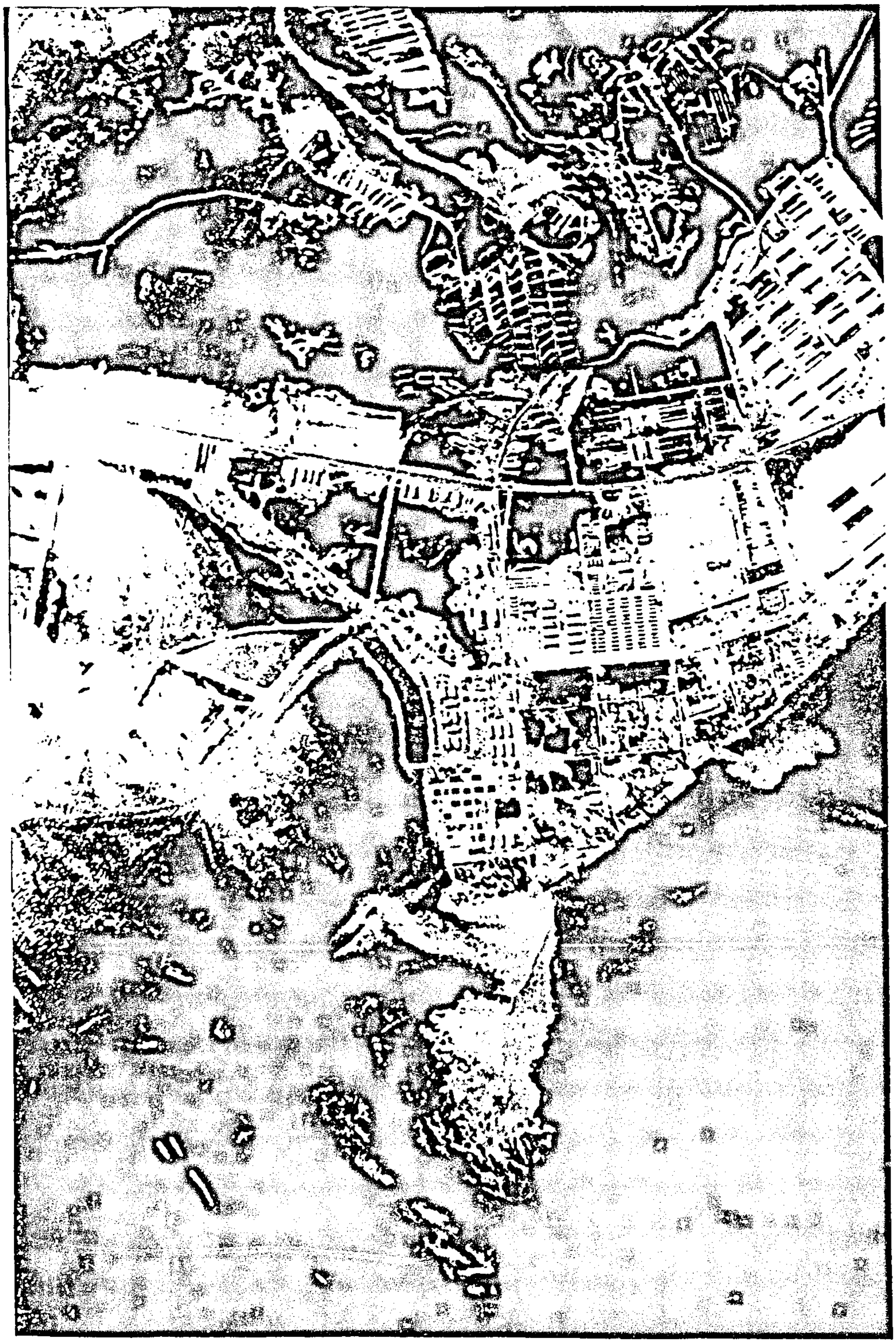


FIGURE 8. 1946 AERIAL PHOTOGRAPH
(From the Saipan Museum)

FIGURE 5

Reference: Pacific Studies Institute, Inc.
(1979)

maximum fill of the Puntan Muchot pond/swamp occurs along the fringes of its northeastern half. Nevertheless, compared with Figure 2, the pond itself probably became ensilted between about 1940 and 1946 and perhaps most significantly as a result of the American invasion process and post-invasion occupation. The photograph also clearly shows the extent of surface modification to the remain portion of the proposed flood channel alignment along West Coast Highway, particularly in the south.

## IV. HISTORIC SITE STUDIES

17. A 1980 Pacific Studies Institute study located several World War II-related historic features in American Memorial Park near the channel alignment of Plan A including a medium-sized Japanese pillbox (Feature 7) and a large Japanese bunker (Feature 8). The CNMI Historic Preservation Officer (HPO) (July 30, 1980 letter) and the National Park service (September 1983 General Management Plan) indicated that these features should be preserved and were probably eligible for inclusion on the National Register of Historic Places. The alignment of Plan B alongside Hillside View Road was not surveyed in 1980, but the HPO indicated in 1980 that there was little likelihood of finding intact subsurface cultural materials there due to modification of the terrain during and after World War II.

18. The Pacific Studies Institute archaeologists also found surface remains (pottery sherds and shell midden) of a possible prehistoric Latte Phase (A.D. 900-1500) site (Site #1) at the southern corner of Navy Hill Road and West Coast Highway. Subsequent coordination with the CNMI HPO in 1980 initially indicated that the site had been destroyed by construction of sewer and water lines. In reviewing the 1984 Draft Environmental Impact Statement, the US Department of the Interior questioned this conclusion based on a review of Corps borings along West Coast Highway.

19. None of the alternative plans would affect any historic sites that are currently listed or formally determined eligible for inclusion on the National Register of Historic Places. Had alternative Plan A been recommended, the Corps would have sought a determination of eligibility for the Japanese World War II-related features 7 and 8 in American Memorial Park, as recommended by the US Department of the Interior letter of September 24, 1984. Determinations of no effect were obtained from the CNMI HPO in January 1980 for alternatives affecting the prehistoric Site #1 and on July 20, 1985 for the previously preferred Plan A. However, this coordination is no longer valid.

20. In response to the Interior letter, the Corps' Honolulu District staff archaeologist conducted a field check of the area of potential environmental impact in March 1984 and substantiated the Department of the Interior hypotheses. Archaeological reconnaissance site survey was performed at the proposed site of the Garapan Flood Control Project,

Saipan, Commonwealth of the Northern Mariana Islands, by Mr. Charles F. Streck, Jr. (Archaeologist, US Army Corps of Engineers, Honolulu District) on 7-9 March 1985.

21. Consultations were held with the CNMI Historic Preservation Office on 7 March about the possible impacts on cultural resources from the proposed Garapan Flood Control Project. Mr. Scott Russell, Acting TTPI HPO and staff historian/archaeologist for the CNMI Historic Preservation Office, expressed his office's desire that all appropriate and sufficient archaeological investigations be preformed before the start of the project. He also passed on similar desires from Mr. Mike Fleming, CNMI Historic Preservation Office's staff archaeologist, who was unexpectedly called to Tinian Island during the survey period. Mr. Fleming was somewhat concerned about the lack, as yet, of controlled subsurface testing for in situ cultural remains within the proposed project area.

22. On-foot archaeological reconnaissance survey was performed in all sections of the American Memorial Park as well as along a section of the W-2 road (southwest Coast highway) of the park (Incl. 1). Particular attention was paid to the area around Site #1, Thomas, Michael R. and Samuel T. Price, Cultural Resource Reconnaissance Report for the Garapan Flood Control Study Area, Saipan, Commonwealth of the Northern Mariana Islands, March 1980) and within the small wetland area bounded by Beach Road, Micro Beach Road, and W-2 Road.

23. The survey was primarily performed by following extant paved and unpaved roadways. Periodic transects were walked from Beach, Micro Beach, and W-2 Roads into the bordering hinterlands. Vegetation in all areas except the peninsular portion of American Memorial Park was extremely dense and dominated by mature stands of tangantangan. The transects off of the road averaged about 30-40 meters in length. Those on the north side of Beach Road were to the shoreline. Several meandering roadways are present within the wetland area. These were followed and survey was conducted as previously described so as to sample the interior portions. Photographic (color slides) and video tape (Betamatic) records were compiled during the survey. Field notes were recorded as well. The total survey area encompassed about 28 hectares (about 69 acres).

24. An archaeological survey had been performed for the U.S. National Park Service within American Memorial Park in 1979 (Thomas, Michael R. and Samuel T. Price, Archaeological Reconnaissance of the American Memorial Park, Saipan, Commonwealth of the Northern Mariana Islands, November 1979) which identified and located a number of archaeological sites and cultural remains, mostly of 20th Century Japanese and American origin. The site location map compiled during that survey was used for reference and checked during the present reconnaissance survey. All of these sites were found to have been only grossly located and in several cases to have been mislocated. Further intensive site survey will have to be performed before the start of the proposed Garapan Flood Control Project so that adequate plans may be compiled minimizing adverse impact.

25. No further surface architectural sites were identified from those located during previous investigations at American Memorial Park. Several areas were identified containing very sparse scatters of possible marine mollusc shell midden and prehistoric Latte Phase (A.D. 900-1500) potsherds. The main concentrations of such cultural remains tended to be near areas located in both the 1979 and 1980 surveys. These were around Site #1 (Incl 2; Thomas and Price 1980) and around sample areas 4.1, B.6, B.10, and B.4 (Incl 4; Thomas and Price 1979). In addition, widely dispersed, sparse pottery sherds were present along the margins of W-2 Road south of the intersection with Micro Beach/Navy Hill Road. These may be the remains and results of excavations performed for sewer and water main lines in this area. The Corps now believes that zone immediately above West Coast Highway, common to all structural alternative plans, may represent an earlier prehistoric-era shoreline and may contain subsurface cultural materials of unknown significance. The triangular area within American Memorial Park bordered by West Coast Highway, Micro Beach Road and Beach Road is not likely to contain subsurface cultural materials within the areas of potential environmental impact, but previously identified historic surface features may not be accurately located.

26. A preliminary plan for further archaeological investigations at the proposed site for the Garapan Flood Control Project has been formulated as a result of this archaeological reconnaissance survey; the results of previous surveys in the area; consultation with the CNMI Historic Preservation Office; and in response to the US Department of the Interior letter to the US Army Corps of Engineers, Pacific Ocean Division dated 24 September 1984. This will include a five(5)-part investigation of the proposed project area:

A. INTENSIVE ARCHAEOLOGICAL SITE SURVEY. This should be performed primarily within those portions of the wetland and adjacent shoreline areas planned for landform modification. A resurvey with accurate site location is preferred for the entire area bounded by Beach, Micro Beach, and W-2 Roads. This will allow for the accurate location and identification of previously unidentified sites as well as accurately locating identified properties. Engineering planning procedures can then be implemented lessening any potential adverse impacts to cultural resources located in the area. The presently available site location maps are insufficient for these purposes.

B. ARCHAEOLOGICAL TEST CORINGS AND/OR AUGER SAMPLES. As per reconnaissance survey results, test corings and/or auger samples of subsurface deposits is highly recommended for the favored alignment of flood control modifications in the survey area. This will allow for the determination of the presence of absence of valuable subsurface cultural deposits within the proposed project area. A maximum spacing of 30 meters is recommended for sampling along this alignment which would require between 25-30 samples. In addition to the determination of the presence or absence of in situ cultural deposits, these samples may be analyzed in order to ascertain the age and possible cultural use of the wetland area. This would be invaluable towards determining the importance of this particular area to prehistoric inhabitants (wet agricultural techniques).

C. ARCHAEOLOGICAL TEST EXCAVATIONS. Archaeological test excavations are recommended for the area around Site #1 at the intersection of Micro Beach and W-2 Road and within areas where the test corings have indicated the presence of a subsurface cultural deposit. The controlled (including specified screening, recording, and descriptive procedures) excavations will allow for a determination of the probable significance of in situ remains within the project area.

D. LABORATORY ANALYSIS. Laboratory analysis of the remains and records recovered during the fieldwork is essential towards ascertaining the significance of the cultural remains. Included within these analyses would be midden identification (shell, bone, etc.); artifact description, source material analysis, and temporal assignation; and soil analysis for depositional sequence, disturbance, agents, and function. Included within laboratory analysis would be the submitting of suitable samples for age determination (charcoal, shell, bone, and/or volcanic glass samples).

E. ARCHAEOLOGICAL MONITORING OF CONSTRUCTION ACTIVITIES. Contingent upon the results of the previously described archaeological investigations, archaeological monitoring of construction activities (any landform modifying activities) may be required along all or portions of the proposed Garapan Flood Control Project. Preliminary discussions with the CNMI, HPO, have indicated that they may be willing to assume such monitoring activities at minimal cost to the Government.

27. The Corps will maintain close coordination with the CNMI Historic Preservation Officer and as required, the National Park Service and Advisory Council on Historic Preservation.

## IV. SOCIAL WELL BEING

28. 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 eliminating 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. These 17 "effects" have been combined in an OSE evaluation account under the Water Resources Council's "Economic and Environmental Principles and Guidelines for Water and Related Land Resources". The components of this OSE account are described here in relation to the six flood damage reduction measures (Plans A-F) developed under this study.

29. Urban and Community Impacts. There would be short-term income and employment benefits during construction of any of the six alternatives, no long-term changes in income or employment are anticipated as a result of having or not having a flood control project at Garapan. The distribution and composition of population in Garapan would likely change only if the non-structural alternative plan was implemented. The fiscal condition of the CNMI government never appears too healthy. Similar to the other United States Pacific Island territories and possessions, the CNMI government's annual budget is heavily dependent on Federal funds. Under the traditional Federal policy on cost sharing for flood damage reduction projects, the local sponsor is responsible only for securing lands, easements, and relocations. For the recommended plan, this includes culverts. Of the total project investment costs, the non-Federal share is about $2,550,000, much of which will probably derive indirectly from other Federal funds as well as lands controlled by the CNMI government (such as American Memorial Park).

30. Life, Health, and Safety. Each of the structural plans would probably reduce the incidence of gastro-intestinal diseases which tend to occur after floods due to overflowing cesspools, privies, and non-functioning sewage pump stations. These conditions would continue to prevail under the non-structural plan, all other factors remaining equal. The presence of standing water in the outlet channel is not expected to lead to a rise of mosquito problems due to its high salinity. To prevent unnecessary loss of lives due to children falling into the reaches of the channel which are permanently filled with standing water, approximately 3,354 feet of six-foot high chain link fence will be erected along the upper side of the collection channel.

31. Displacement of People, Businesses, and Farms. The recommended Plan E will not displace any people, businesses or farms. Plans B and C would have displaced five and two residences, respectively and Plan C would have required relocation of the Garapan Village Center basketball court. None of the alternatives would have resulted in displacement of businesses or farms except the non-structural plan. With no alternative, flooding would have continued to threaten businesses and residences with major damage to structures and monetary losses of goods.

32. Long-term Productivity of Renewable Resources. Plan A would have resulted in the loss of about 4.7 acres of wetland in American Memorial Park. The recommended Plan E will not directly affect any wetlands, but could indirectly permit intrusion of saline water into marsh habitat that is located near the outlet channel. This, in turn, could

affect habitat for the endangered Mariana Gallinule, although the U.S. Fish and Wildlife Service has indicated that construction of the recommended plan would not jeopardize the continued survival of that species of bird.

33. Energy Requirements and Conservation. Energy in the form of petroleum products will be consumed by construction equipment in the course of project construction.

## VI. LIST OF REFERENCES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# GARAPAN FLOOD CONTROL
# SAIPAN, CNMI

## PUBLIC INVOLVEMENT
## APPENDIX F

APPENDIX F

PUBLIC INVOLVEMENT PROGRAM APPENDIX

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# I. PUBLIC INVOLVEMENT PROGRAM

## OBJECTIVES

To insure that the needs of the public are indentified and considered, a public involvement program was developed. The public, as broadly interpreted by the U.S. Army Corps of Engineers, is any affected or interested non-Corps entity; other Federal, state and local government entities and officials; public and private organization and individuals. The public participation program is directed to maintaining information flow, achieving a mutual understanding and acceptance of the problems and opportunities, and attaining a level of interest for proper decision making.

The objectives of the public participation program are to:

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

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

c. Help formulate and review potential plans and improvement.

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

e. 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 forums in this study will be small informal meetings, workshops, and formal public meetings:

a. Informal Meetings. These meetings are with usually less than 10 persons with specific invited agency personnel, group representatives, or citizens. These meetings are undertaken at convenient intervals or at the request of special groups throughout the study to help obtain or exchange information and address certain issues.

b. Workshops. These meetings are Corps sponsored 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 presentation of formal statements by others and tentative conclusions. A public notice of the meeting is issued to the media and the general public is invited. All information and statement are documented as part of the planning record.

## ACTIVITIES CONDUCTED

Government officials and agencies were notified by public notice in May 1983 of the initiation of flood damage reduction studies. The public was invited to present the District Engineer with any information regarding the flooding problem as well as any other information pertinent to the development of possible measures.

A formal public meeting, presided by the District Engineer, was held on 26 July 1984 at the Garapan Elementary School to give the public an opportunity to express their views and comments on the alternative plans of improvement under consideration. Public Notices were mailed to the general public, governmental agencies, the media, and interested parties. The general feeling amongst the attendees (all government officials or representatives) was one of support for having flood control improvements in the area. However, concerns were raised on the tentatively recommended plan of aligning the channel through the American Memorial Park. This would have possibly affected the Mariana Gallinule, which had recently been registered on the Endangered Species list. It was agreed upon that another channel alignment on the outskirts of the American Memorial Park would be investigated for its feasibility and acceptability.

A public workshop was held on 17 April 1985 in Garapan with the various local and Federal Government agencies. This workshop was held in order to present the full range of alternative plans and to give the representatives an opportunity to comment on these plans prior to the Corps of Engineers' completion of the Final Detailed Project Study. The newest alternative plan which consists of a channel alignment which borders on the American Memorial Park but does not go through the wetland was presented. This plan was highly accepted by all parties which attended the workshop because it would not affect the wetland nor the Mariana Gallinule. It has been designated the tentatively recommended plan.

## II. PERTINENT CORRESPONDENCE

### LIST OF LETTERS

Letters received regarding this study are grouped by Federal, Commonwealth and Private interests/individuals generally in chronological sequence. However, emphasis is placed on providing a logical sequence of events, comments or responses.

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Commonwealth of the Northern Mariana Islands
Office of the Governor
Saipan, Mariana Islands 96950

FOR OFFICIAL USE
CABLE ADDRESS
GOV. NMI SAIPAN
REPLY TO:

DEPT. or ACTIVITY

DEC 0 3 1982

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

Dear Colonel Thiede:

I appreciated the opportunity you provided to Lt. Governor Tenorio to discuss the status of our public works program with you on November 12, 1982. As brought up in the meeting, we have had recent flooding in the Garapan area of Saipan following the tropical storm in late October 1982. We are aware of the previous investigations performed for us during the period 1979-1980. However, we feel that there has been significant growth in the area, physical changes and, of course, new flood damages. On behalf of the Commonwealth of the Northern Marianas Government, I am requesting that your staff initiate a new study for the Garapan area to remedy the flood problems. To provide your staff with a basis for the study, we are submitting the following:

1. Map of Garapan showing major features and flood areas due to the recent storm (Tropical Storm Owen).

2. Photographs of 1980 flooding (Typhoon Hazen) and flooding associated with Tropical Storm Owen. The locations of the photographs are marked on the map and the colored ones are of Typhoon Hazen and the black and white ones are of Tropical Storm Hazen.

3. Statistics citing the increase in the number of structures and the economic growth of the area since July 1979.

4. Listing of the total estimated cost of damages resulting from the last storm, categorized by private damages, public damages (roadway, utilities, etc.) and emergency costs (evacuation, temporary busing, public safety costs, etc.). Also provided is a listing of the number of structures affected by the flooding.

We appreciate your technical assistance for the investigation of the flooding problem. We have designated the Department of Public Works as the lead agency for your study and have instructed other government staff to assist you. We look forward to working with you in this needed investigation.

Sincerely,

PEDRO P. TENORIO
Governor

Enclosures

CC: Director of Public Works

INCL 2

**Commonwealth of the Northern Mariana Islands**
**Office of the Governor**
Saipan, Mariana Islands 96950

FOR OFFICIAL USE
CABLE ADDRESS
GOV. NMI SAIPAN
REPLY TO
HISTORIC PRESERVATION
OFFICE
DEPT. OF C&CA

July 20, 1984
Serial:942
File:HP13.4.39

Mr. Kisuk Cheung
Chief, Engineering Division
Department of the Army
Pacific Ocean Division
Corpos of Engineers
Ft. Shafter, Hawaii 96858

Dear Mr. Cheung:

This will acknowledge receipt of your letter of 13 July 1984 which requests that we review and comment on the "Draft Detailed Project Report and Environmental Statement" for the Garapan flood control project on Saipan, Commonwealth of the Northern Mariana Islands.

Based on the assurances given on page 11, part 5.9 - ie. that the two World War II Japanese sites will be avoided during construction and that a qualified archaeologist will be on call to inspect and record subsurface archaeological deposits which may be encountered during excavations - it is the opinion of the CNMI Historic Preservation Officer that the project will have no effect on properties listed on or eligible to be listed on the U.S. National Register of Historic Places.

Thank you for providing us with the opportunity to comment on this draft report.

Sincerely,

Scott Russell
Acting Historic Preservation Officer

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**U.S. DEPARTMENT OF TRANSPORTATION**
FEDERAL HIGHWAY ADMINISTRATION
REGION NINE
Hawaii Division
Box 50206
Honolulu, Hawaii 96850

ARIZONA
CALIFORNIA
NEVADA
HAWAII
GUAM
AMERICAN SAMOA

August 8, 1984
IN REPLY REFER TO
HDA-HI

Mr. Kisuk Cheung, Chief
Engineering Division
U. S. Army Corps of Engineers
Pacific Ocean Division, Bldg. 230
Fort Shafter, Hawaii 96858

Dear Mr. Cheung:

Subject: Garapan Area Flood Control - Draft EIS

We have reviewed the subject draft report and have no comments to offer at this time.

Sincerely yours,

for H. Kusumoto
Division Administrator

**Commonwealth of the Northern Mariana Islands**
**Office of the Governor**
Saipan Mariana Islands 96950

Cable Address
Gov N M I Saipan

Mr. Kisung Cheung
Chief, Engineer Division
Department of the Army
Pacific Ocean Division
Corps of Engineers
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

Enclosed are review comments of the Coordinating Committee for the Garapan Flood Control Projects. The memorandum of appointment of the Coordinating Committee is also enclosed for your reference. I trust that the concerns of the Coordinating Committee will be satisfied by follow-up studies for the Final Detailed Project Report and Environmental Statement for the Garapan Flood Control Project. As more definitive plans are prepared, in conjunction with the follow-up studies, the concern of Coastal Resources, Historic Preservation, the Park Ranger for the American Memorial Park and, most definitely, the questions raised by Public Works, will be answered.

We appreciate the assistance and cooperation of the U.S. Army Corps of Engineers in this project. We look forward for a close working relationship in resolving our flood problems while maintaining a minimum disruption of the natural environment.

Sincerely,

PEDRO P. TENORIO
Governor

Enclosures

cc: Chairman, Garapan Flood
Control Coordinating Committee

Received 8/31/84

AUG 31 1984

COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

*OFFICE OF THE GOVERNOR*
*Saipan, Northern Mariana Islands 96950*

# MEMORANDUM

TO : Mr. Pedro Sasamoto, CIP Advisor    DATE: AUG 30 1984

FROM : Governor

SUBJECT: Garapan Flood Control Project Coordinating Committee

Your are hereby designated to chair a new coordinating committee for the Garapan Flood Control Project being planned by the U.S. Corps of Engineers and the CNMI. The role of this committee will be to:

1. Coordinate all discussions, reviews and responses involving the Corps' inquiries, submission of all information relevant to the project, and any other data needs.

2. Regularly advise my office of the status of the project and make recommendations for executive actions.

3. Draft, as necessary, appropriation and other legislation which may be required for the project.

This committee shall be composed of representatives from the following offices:

1. Planning and Budgeting
2. Coastal Resources Management
3. Natural Resources
4. Commerce and Labor
5. Historic Preservation
6. Division of Environmental Quality
7. U.S. National Park Service (Mr. Gordon Joyce)

By copy of this memorandum, the heads of the above entities are hereby notified of their membership on this committee and are requested to submit the names of staff in their office who will be representing them.

This committee is expected to be extremely alive and active and individuals designated are expected to be full participating members.

My office looks forward to a close working group which will be responsible for achieving the objectives of this very vital public project.

PEDRO P. TENORIO

CC: Acting Special Assistant for Planning and Budgeting
Administrator, Coastal Resources Management
Director, Natural Resources
Director of Commerce and Labor
Chief, Division of Environmental Quality (with copy to Dir. PH&ES)
Historic Preservation Officer (with copy to Dir. C&CA)
[illegible], U.S. National Park Service

F-8

Received 9/6/84

UNITED STATES GOVERNMENT

# memorandum

DATE: 9/4/84

REPLY TO ATTN OF: Gordon Joyce

SUBJECT: Garapan Flood Control Project

TO: Pete Sasamoto

Given the short deadline on consolidating comments for the Corps of Engineers, my own comments will be brief and general in nature. From the standpoint of impact upon American Memorial Park, I would naturally have prefered alternatives B or C. However, given the vital need to control flooding in Garapan, and the apparent lack of any other alternative with a positive B/C ratio, I can understand why alternative A is being favored.

I urge that the following measures be taken:

1. Align the outlet channel to avoid damage to any historic sites, particularly the Japanese pillbox and bunker.

2. As much as possible, preserve the overall integrity of the wetlands area.

3. Take measures to mitigate destruction of gallinule (pulattat) nesting areas. This bird will soon be added to the Dept. of Interior's Endangered Species List and is dependent upon wetlands habitat.

4. Take measures to mitigate the destruction of mangrove areas. This is a rare resource in the Northern Marianas.

5. Provide adequate pedestrian access where the outlet channel crosses West Coast Highway and Beach Road.

Our Pacific Area Director in Honolulu will also be sending comments directly to the Corps of Engineers on this issue.

Gordon Joyce
Park Ranger
American Memorial Park

phone 9479

OPTIONAL FORM NO. 10
(REV. 1-80)
GSA FPMR (41 CFR) 101-11.6
5010-114

COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

*Historic Preservation Office*
*Saipan, Northern Mariana Islands 96950*

# MEMORANDUM

DATE: 9/5/84
SERIAL: 1028
FILE: HP13.4.39

TO : Mr. Pete Sasamoto, Garapan Flood Control Project Coordinator

FROM : Historic Preservation Officer

SUBJECT: Garapan Flood Control Project

Attached for your reference are copies of letters from the Corps of Engineers (letter dated July 13, 1984) and our letter to the Corps (letter dated July 20, 1984) with respect to the Garapan Flood Control Project and its possible impacts on historic properties.

In our letter to the Corps of Engineers (paragraph 2), we stated that based on the assurances given by the "Draft Detailed Project Report and Environmental Statement" for the Garapan Flood Control Project, (page 11, part 5-9) that the Japanese Pillbox and the Japanese Bunker will not be impacted, we made a determination that the project will have no adverse effect on properties listed on or eligible for listing on the National Register of Historic Places. It is also our understanding that no matter which plan the Corps is implementing the two significant historic properties will not be impacted.

My staff and I fully understand the importance of this project to the people of Saipan, especially those living in the village of Garapan. In the event that adverse impacts can not be avoided, the two properties will be properly photographed and recorded prior to their alterations or destruction. However, we strongly suggest that prudent ways and means be seriously considered to prevent the two historic properties from being destroyed so that our people and our visitors may continue to enjoy and appreciate these significant properties.

Jesus B. Pangelinan
Jesus B. Pangelinan

Attachments

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COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

*OFFICE OF THE DIRECTOR OF PUBLIC WORKS*
*Northern Mariana Islands, Saipan, M.I. 96950*

# MEMORANDUM

DATE: September 06, 1984
Ser. No. PW33632

TO : Acting Planning/Budget Affairs Officer

FROM : Director of Public Works

SUBJECT: Comments about Garapan Flood Control Study

Our review of the Project Report and Environmental Impact Statement for the Garapan Flood Control Study, Saipan, CNMI has produced the following comments:

1. We agree with Alternate Plan A, but we have remarks:

   a. How will the open channel portion be protected in order to prevent accidents?

   b. Should a water speed breaker be provided in view of the rapid flow of water (12 feet/sec.)?

   c. How will the relation between the open channel and the existing sewer line that runs parallel to West Coast Highway be resolved?

   d. We recommend a shorter route thru the American Memorial Park. (see attached copy of Plan A).

We thank you for providing us the opportunity to submit our comments concerning this project.

JOHN C. PANGELINAN

Attachment

Received 9/12/84

COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

*Division of Environmental Quality*
*Dr. Torres Hospital*
*Saipan, Northern Mariana Islands 96950*

# MEMORANDUM

TO : CIP Adviser

DATE: SEP 1 2 1984

FROM : Chief, DEQ

SUBJECT: Garapan Flood Control Project

DEQ has reviewed the Detailed Project Report With Environmental Impact Statement (EIS) for the Garapan Flood Control Study, Saipan, CNMI. DEQ finds no objection with respect to proceeding with recomendation of Alternative "A" for design and construction. When the construction phase is in process, the Corps of Engineers will have to apply either through CRM for a CRM permit or through DEQ for an earthmoving permit. Because of the magnitude of the project and its proximity to the lagoon, I rather suspect that a CRM permit will be most appropriate. At that point, DEQ will review specific design and construction plans and offer permit conditions with respect to erosion control and other earthmoving concerns.

William B. Lopp
Willam B. Lopp

cc CRM

F-10



August 23, 1984

Mr. Harvey Young
Project Manager
Garapan Flood Control Plan
U.S. Army Corps of Engineers
District, Honolulu
Building 230
Ft. Shafter, Hawaii 96858

ATTN: POED-PJ

Dear Mr. Young:

This letter is in reference to the Draft Detailed Project Report and Environmental Statement for the Garapan Flood Control Plan. The Coastal Resources Management Office agrees that at times there is a flooding problem in Garapan, however we have several questions relating to the Corps of Engineers analysis and choice of Plan A as having the best cost/benefit ratio. Because the major design criteria for Plan A routes the channel through the wetlands, this office is particularly concerned about the potential impacts. CRM Rules and Regulations place the preservation and enhancement of mangrove and wetland areas as being of the highest priority. In addition, the General Management Plan for American Memorial Park recommends that there be no disturbances of wetland areas.

There appears to be three major information gaps which are consistently acknowledged throughout the report. These gaps must be researched before thorough review can be continued. These gaps include the following:

1. Inconsistent Wetland Boundaries

COE discusses the inconsistent boundaries and conflicting reports in the Environmental Impact Statement (p.6, Sections 4-7, Wetlands).

Due to the undetermined boundaries, comments such as "the outlet channel of Plan A may or may not avoid substantial portions of wetlands within American Memorial Park", (Section 5.4, Wetlands (EIS) p.10) appear throughout the report.

Mr Harvey Young
August 23, 1984
Page Two

2. Additional Wetland Studies.

Several times during the report, COE states that additional wetland studies will be accomplished prior to the final EIS in order to define impacts and identify measures to minimize those impacts. This seems to be particularly important in light of the statements from Sections 3a and 3d of the CZM Consistency Determination (pp.22 and 23), ". . . The outlet channel may alter the essential hydrologic or ecological functions of the wetlands within and adjacent to the channel.", and (3d) ". . . The project (Plan A) impacts on wetlands and endangered species are still being investigated and will lead to the consideration of measures to minimize impacts to wetlands and listed species".

3. Diversion Channel

Section 2 (Physical Effects) of Section 404 of the Evaluation Report (p.2, Appendix H), states that "the diversion channel, a feature common to the three plans may involve work in a wetland area, which has not been clearly identified or located." There is no further discussion in the report with respect to size or location of the diversion channel. Surely, this warrants additional research and information before a decision can be made.

Some other questionable points include COE's determination that the "long term aesthetic enjoyment of the overall beach area will not be adversely affected". This is debatable due to the proposed outlet channel base width of 50 feet (p.17, Main Report) and an eight foot water depth along the shoreline which will interrupt pedestrian movement along the beach (Section 5.8, EIS, p.11).

The comments prepared by the U.S. Fish and Wildlife Service (p.10, Appendix H) state that Plan A "would potentially affect both wetlands and sea grasses and would thus have the worst potential impact on important biological resources."

CRM requests information on the above three points before we can make a decision.

If our office can answer any questions, please do not hesitate to contact us.

Sincerely,

MANUEL T. SABLAN
Administrator
Coastal Resources Management Office



MARIANA ISLANDS HOUSING AUTHORITY
P O BOX 514, SAIPAN, CM 96950

TEL 9447
6666

August 27, 1984

Department of the Army
Honolulu District, Corps of Engineers
Building 230 Ft. Shafter, HI 96858

Subject: Garapan Flood Control, PODED-PJ

Gentlemen:

Please excuse the delay in submitting our comments on the Garapan Flood Control Project.

My technical staff advised that it would be most difficult to make technical comments on the three alternate plans, which the Corps presented during the public hearing on June 20, 1984. However, we feel that the draft report contained adequate information to make an informed recommendation as to which of the alternate plans will provide the best control and mitigate the lost and damages, which residents of Garapan experience during heavy rains as maybe brought about by tropical storms and typhoons.

As we know that the Corps is aware, the Mariana Islands Housing Authority was responsible for the development of the larger portion of the Puntan Muchot area, including the Garapan II Subdivision and, of course, and the Sugar King Estate Part II Subdivision. For this reason, we have been very much concerned about the constant flooding situation in the Garapan area. Our monitoring of flooding situations during heavy rains has let us to believe that Alternate Plan B or Plan C would not work as effectively as Plan A.

The shoreline where the outlet for both Plan B & C is situated is not too far away from the reef. Whenever we have inclement weather, winds direction usually shift to the southwest direction, churning up the sea and creating surf condition of up to 5 feet on the shoreline. This creates two problems; first, prevent the flow of excess water into the ocean; and, secondly, pile up sand on the shoreline, thus closing every outlet that exists on the western shoreline of Saipan. We know that we won't have this kind of problem with Alternate Plan A. The outlet of Alternate Plan A is situated in a protected cove. In addition, the reef is over 1 mile away from the shoreline. This will mean that the wave action, originating from the open seas will significantly be reduced before it reaches the shoreline.

Again, we apologize for the delay in submitting our comments on the Garapan Flood Control Project. If we can be of any assistance in your effort to finalize plans for implementation, don't hesitate to call on us.

Sincerely yours,

Lorenzo LG. Cabrera
Executive Director



September 4, 1984

Mr. Lorenzo Cabrera
Mariana Islands Housing Authority
P.O. Box 514
Saipan, CNMI 96950

Dear Mr. Cabrera:

Thank you for your letter of August 27, 1984 expressing your comments and views on the draft Garapan Flood Control Detailed Project Report and Environmental Impact Statement. We share your concern for the constant flooding in the Garapan Area and that flood control improvements are needed to alleviate the damage potential.

For your information, we have arranged with the CNMI Fish and Game staff to map the wetland area(s) in the American Memorial Park more precisely in order to refine the Plan A channel alignment to avoid or minimize the wetland impact due to project implementation. The mapping work is scheduled to be completed in late September 1984.

Thank you for your continued interest and support on the Garapan study.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

US Department of Transportation
United States Coast Guard

Commander (dpl)
Fourteenth Coast Guard District

Prince Kalanianaole Federal Building
300 Ala Moana Blvd
Honolulu, Hawaii 96850
Phone (808)546-2861

11000
Serial No. 4/133
4 SEP 1984

Mr. Kisuk Cheung
Department of the Army
Chief, Engineering Division
Fort Shafter, Hawaii 96858-5440

Dear Mr. Kisuk Cheung:

The Fourteenth Coast Guard District has reviewed the (Draft EIS) Garapan Area Flood Control Study, Saipan, and has no objection at the present time. A possible beneficial impact is that a flood control program will indirectly reduce the potential for discharges of oil and hazardous substances that could result from flood impact on nonregulated sources such as houses and small business.

Sincerely,

J. F. MILBRAND
Commander, U. S. Coast Guard
District Planning Officer
By direction of Commander,
Fourteenth Coast Guard District

Commonwealth of the Northern Mariana Islands
Office of the Governor
Saipan, Mariana Islands 96950

CABLE ADDRESS
GOV. NMI SAIPAN

September 4, 1984

Mr. Harvey Young
Project Manager
Garapan Flood Control Plan
U.S. Army Corps of Engineers
District Honolulu
Building 230
Ft. Shafter, Hawaii 96858

Dear Mr. Young:

Since my previous letter to you on August 23, 1984, I have learned that the Corps of Engineers has contacted the Department of Natural Resources to assist in the determination of the wetland boundaries as well as conducting additional studies in the wetlands. Those were two of our major concerns. We are pleased that you have already made progress in rectifying the information gaps.

My third point dealt with the diversion channel, which at the time was thought to have meant a separate over-flow type of channel rather than the main outlet. That, too, has since been clarified.

We look forward to working with you on this project. If CRM can be of any assistance, please do not hesitate to contact us.

Sincerely,

MANUEL T. SABLAN
Director
Coastal Resources Management Office

**COMMONWEALTH PORTS AUTHORITY**
Main Office: SAIPAN INTERNATIONAL AIRPORT
P. O. BOX 1055 • SAIPAN • CM 96950

September 5, 1984

Mr. Kisuk Cheung
Chief, Engineering Division
Department of the Army
Pacific Ocean Division
Corps of Engineers
Fort Shafter, Hawaii 96858

Dear Mr. Cheung:

The Commonwealth Ports Authority reviewed the draft Detailed Project Report with Environmental Impact Statement for the Garapan Flood Control Study, Saipan. While we do not have any major comment to submit, we would like to express for the record, our endorsement of this project. Past flooding problem indicates that this is a badly need project and we hope that the Corps of Engineers, together with our government, will eventually get this project to its successful completion.

Thank you for the opportunity provided to us for our comments.

Sincerely yours,

COMMONWEALTH PORTS AUTHORITY

CARLOS A. SHODA
Executive Director



-5440

September 11, 1984

Mr. Carlos A. Shoda
Executive Director
Commonwealth Ports Authority
P.O. Box 1055
Saipan, CM 96950

Dear Mr. Shoda:

Thank you for your letter of September 5, 1984 regarding the Port Authority's review of the draft Garapan Flood Control Detailed Project Report and Environmental Impact Statement.

We share your concern for the constant flooding in the Garapan Area and that flood control improvements are needed to alleviate the damage potential. As you may know, we have arranged with the CNMI Division of Fish and Game to do the detailed wetland mapping in the American Memorial Park so that project implementation impact may be minimized or avoided.

We appreciate your continued interest and support on the Garapan Study.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

Atlanta GA 30333
September 10, 1984

Dr. James E. Maragos
Chief, Environmental Resources Section
U.S. Army Engineer District, Honolulu
Fort Shafter, Hawaii 96858

Dear Dr. Maragos:

We have completed our review of the Draft Environmental Statement (ES) for the Garapan Area Flood Control Project, Saipan, Commonwealth of the Northern Mariana Islands. We are responding on behalf of the U.S. Public Health Service.

Although the proposed project will have a noticeable environmental impact on Tanapag Harbor, the apparent benefits to human health and safety are clear. We believe additional consideration should be given the following aspects.

Potential health and safety hazards may arise during channel construction. Recreational facilities in the vicinity may lead to increased spectator traffic near the construction sites. Appropriate precautionary measures (e.g., signs, temporary fencing, etc.) should be taken to insure spectator safety. Blasting/fabrication operations may temporarily increase airborne particulate levels in contiguous housing areas. What efforts will be made to control fugitive dusts?

Dredged material disposal sites can create highly productive breeding grounds for mosquitoes. The Final ES should provide a description of present and anticipated mosquito problems in the project area, as well as anticipated mitigation. Furthermore, dredging operations will increase turbidity in the harbor which may pose a temporary safety hazard for recreational divers. Consideration should be given to educating and warning divers of hazards created from dredging operations.

Once completed, the control channel may present several safety hazards. Pedestrian beach traffic may be tempted to ford the channel instead of walking to the Beach Road culvert crossing. What measures (e.g., fences, signs, pedestrian bridges) will insure their safety? Anticipated flow velocities in the channel may present additional safety concerns. Even minor storm events may cause "flash-flood-discharges" endangering individuals playing in or crossing through the channel. Mitigative safety measures for these concerns should be addressed in the Final ES.

We appreciate the opportunity to review the Draft Environmental Statement and would like to receive a copy of the Final ES when it becomes available. If you have any questions regarding our comments, please contact Mr. Bob Williams of our staff at (404) 452-4161 or FTS 236-4161.

Sincerely Yours,

Stephen Margolis

Stephen Margolis, Ph.D.
Chief, Environmental Affairs Group
Center for Environmental Health
Centers for Disease Control

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE F/SWC2
P. O. BOX 3830
HONOLULU, HAWAII 96812

September 12, 1984 F/SWR1:JJN

Colonel Michael M. Jenks
District Engineer
U.S. Army Corps of Engineers
Building 230
Fort Shafter, Hawaii 96858

Dear Colonel Jenks:

The National Marine Fisheries Service (NMFS) has reviewed the revised draft environmental impact statement for the Garapan Flood Control, Saipan, Northern Mariana Islands, dated June 1984. The following comments are offered for your consideration.

General Comments

Resources for which NMFS bears a responsibility and alternatives to reduce adverse impacts on these resources have been addressed to our satisfaction in the DEIS. These resources consists of the marine biota located in Saipan Lagoon which, as detailed in the DEIS, could be adversely impacted by implementation of Plans A through C (diversion channels with lagoon outlets).

Of the three structural channel plans NMFS feels Plan A should have the least impact on lagoon resources since the outlet channel would empty into the previously altered environment of Tanapag Harbor. However, the proposed route of the outlet channel for Plan A apparently would remove wetland habitat of importance to two species of endangered waterbirds. This problem should be resolved with the U.S. Fish and Wildlife Service prior to final selection of a plan.

We hope these comments will be of assistance to you in selecting the flood control plan. Please send us a copy of the final EIS as soon as it becomes available.

Sincerely yours,

Doyle E. Gates
Administrator

cc: F/SWR, Terminal Is., CA
F/PS, Washington, D.C.

bc: Corps of Engineers, Honolulu District

May 2, 1985

Mr. Doyle E. Gates, Administrator
Western Pacific Program Office
Southwest Region
National Marine Fisheries Service
P. O. Box 3830
Honolulu, Hawaii 96812

Dear Mr. Gates:

Thank you for your letter of September 12, 1984, providing comments on our Draft Detailed Project Report and Environmental Impact Statement for the Garapan Flood Control Study.

Further study of the flood control problem, wetland resources and listed endangered species within the study area has been conducted subsequent to distribution of the Draft DPR and EIS. The studies resulted in formulation of a new Recommended Plan which will be described in detail in the Final Report and EIS.

The new plan (Encl 1) differs most significantly from the Tentative Recommended Plan in the Draft Report (Encl 2) in that the outlet channel would extend along West Coast Highway past the American Memorial Park Wetland before turning north into Tanapag Harbor. Major impacts to the wetlands and endangered water birds residing there would thus be avoided. No change in project impacts on the near shore marine resources is anticipated.

Sincerely,

Clarence S. Fujii
Acting Chief, Engineering
Division

Enclosures

OFFICE OF THE MINORITY
HOUSE OF REPRESENTATIVES
FOURTH NORTHERN MARIANAS COMMONWEALTH LEGISLATURE
P.O. Box 1937, Saipan, CM 96950

MINORITY LEADER:
Rep. Benigno R. Fitial

MEMBERS
Rep. Francisco T. Cabrera
Rep. Jose C. Cabrera
Rep. Ignacio DLG. Demapan
Rep. Juan DLG. Demapan
Rep. Benigno R. Fitial
Rep. Jose R. Lifoifoi
Rep. Juan S. Torres

STAFF

Legal Counsel
Joel J. Bergsma

Special Assistant
Ray S. Salas

Secretary
Margarita C. Torres

September 18, 1984

Mr. Kisuk Cheung VIC
Chief, Engineering Division
Department of the Army
Corps of Engineers
Ft. Shafter, Ha. 96858-5440

Dear Mr. Cheung:

This is in response to your letter dated August 27, 1984 regarding comments on the Draft Detailed Project Report with Environmental Impact Statement (EIS) for the Garapan Flood Control Study, Saipan, Commonwealth of the Northern Mariana Islands (CNMI).

After reviewing the Draft Detail Report received from your office, I feel we are not in the position to comment on the technical aspects of the project however, based on the Summary Comparison Table, Plan A would yield the maximum net benefit and the least expensive of all proposed plans.

Another major concern that was not discussed in detail in the report is the possible pollution and discoloration damages to the heavily use beaches by tourist and local picnickers on the project area. A further study of the discharge points of all proposed plans and the ocean current trend is necessary to determine the ultimate plan to minimize the above concern.

I hope the above concern is valid and appropriate consideration could be given. Should you have any question or require additional information please feel free to contact the undersigned. Thank you.

Sincerely yours,

Rep. Benigno R. Fitial
House Minority Leader

xc: File

-5440

September 26, 1984

Honorable Benigno R. Fitial
Office of the Minority
House of Representatives
Fourth Northern Marianas Commonwealth
Legislature
P. O. Box 1937
Saipan, CM 96950

Dear Mr. Fitial:

Thank you for your letter of September 18, 1984 providing comments on the Draft Detailed Project Report and Environmental Impact Statement for the Garapan Flood Control Study, Saipan.

In response to your concern on possible pollution and discoloration of the beach areas, we would like to note that of the three channel plans, the outlet channel of Plan A is farther away from the prime beaches located near the resort hotels than either Plan B or Plan C. Plan A would also have the least impact on lagoon resources since the channel outlet would discharge storm flows into the previously altered environment of Tanapag Harbor.

Regarding discharge points and ocean current, we have studied aerial photographs and information concerning dredged areas at Garapan and concluded that a predominant littoral drift is not present along the shoreline. The tide currents set northward on the rising tide and southward on the falling tide, neither exceeding a rate of 0.75 knot in Tanapag Harbor areas. Because of this weak tide in the north-south direction, we believe the littoral effort of Plan A is more favorable than the other alternative plans.

Your views and comments are appreciated. We will incorporate additional information on coastal effects in our final report.

Sincerely,

Clarence Fujii
Acting Chief, Engineering Division

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
215 Fremont Street
San Francisco, Ca. 94105

SEP 24 1984

Kisuk Cheung
Chief, Engineering Division
Department of the Army
Pacific Ocean Division, Corps of Engineers
Fort Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

The Environmental Protection Agency (EPA) has reviewed the Draft Environmental Impact Statement (DEIS) titled: GARAPAN FLOOD CONTROL PROJECT, GARAPAN, SAIPAN, COMMONWEALTH OF THE NORTHERN MARIANAS ISLANDS.

We have classified this DEIS as Category ER-2 (environmental reservations - insufficient information). The classification and date of EPA's comments will be published in the Federal Register in accordance with our public disclosure responsibilities under Section 309 of the Clean Air Act.

EPA has rated this DEIS ER-2 because there is a great potential for a wetland area to be impacted by the project. The DEIS does indicate, however, that future delineation work is planned for the wetlands in the project vicinity. In addition, we recommend a reconsideration of Alternatives B and C. We have the enclosed comments to offer on the DEIS at this time.

We appreciate the opportunity to review this DEIS. Please send four copies of the Final Environmental Impact Statement (FEIS) to this office at the same time it is officially filed with our Washington, D.C. office. If you have any questions please contact Patrick J. Cotter, Federal Activities Branch, at (415) 974-0948 or FTS 454-0984.

Sincerely yours,

Charles W. Murray, Jr.
Charles W. Murray, Jr.
Assistant Regional Administrator
for Policy and Management

Enclosure (2 pages)





## General Comments

It is unclear what factors were considered in the cost-benefit analysis and in the final selection of the Preferred Alternative. For example, the FEIS should clarify to what degree environmental impacts, and other values or amenities, were considered in the final selection of an alternative (40 CFR 1502.23). This is particularly puzzling since Alternative A appears to pass through potential wetlands, disrupts plans for a proposed park and impacts residents. Alternative B also appears to impact a substantial portion of the town. By contrast, Alternative C makes use of an existing drainage ditch and it appears to be less disruptive.

## Wetlands Comments

EPA Region 9 has determined that the Preferred Alternative does not comply with the guidelines for Section 404(b)(1) of the Clean Water Act. Impacts to the, as yet, poorly studied wetlands are unacceptable when two practicable alternatives, B and C, exist. These alternatives are feasible and they will have less adverse impacts on the aquatic ecosystem (40 CFR 230.10 (a)). Although the DEIS states that the wetlands affected by Alternative A will be better defined and evaluated, the preliminary information indicates that the channel will result in greater adverse impacts to the wetlands and nearby aquatic sites than the channels proposed for Alternatives B or C. Accordingly, the EPA recommends that the other alternative plans should be given further consideration as the Preferred Alternative.

Impacts on endangered species' critical habitat for Commonwealth or Federally listed species, including the Nightingale Reed Warbler and those listed in Table G-4 (p. G-9), must also be evaluated when all factors are taken into account.

## Water Quality Comments

1. Support for selecting Alternative A appears to be partially based on an inadequate and speculative hydrologic model that can not be verified ("Thus the results of this investigation are without verification due to the absence of data." Appendix A,P,A-10). Since this is a particularly important criteria for the delineation of wetlands, EPA suggests that an assessment should be conducted on a more local basis.

2. The FEIS should examine the impact of the shallow water table, +5.0 feet MSL (p. B-2), on the construction of drainage channels.

Considerations should include the following:

a. Presence of standing water collecting in the drains and the possible infestation and eradication of pest insects, especially mosquitoes, which will impact residents and nearby property.

b. Eutrophication impacts and contamination due to cesspool and septic tank overflows during floods.

c. Potential impacts related to residential disposal of noxious or hazardous substances into the drainage system.

d. Mitigation proprosals for any or all of the above concerns.

3. Impacts of sediment transport in the vicinity of the drain outfall should be examined in greater detail. Maintenance dredging may be necessary if the entrance to the channel becomes blocked by sand that has accumulated when seas become rough. This discussion should include currents, long shore drift and the impact of the freshwater plume for all of the alternatives.

Air Quality Comments

All measures should be taken to ensure that suspended particulates do not impact residents in the vicinity of the construction. If wetting of the affected areas is employed as mitigation, a sediment retention screen should be used to reduce siltation when the final section of the system is opened to the ocean.



**Commonwealth of the Northern Mariana Islands**
Office of the Governor
Commonwealth Energy Office
Civic Center
Saipan, Mariana Islands 96950

Cable Address:
Gov. NMI Saipan

September 12, 1984

Mr. Kisuk Cheung
Chief, Engineering Division
Department of the Army
Pacific Ocean Division
Corps of Engineers
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

We have reviewed the Draft Detailed Project Report with Environmental Impact Statement (EIS) for the Garapan Flood Control Study per your August 27, 1984, letter.

We agree that flood control is necessary in the Garapan area and that it should be accomplished in the most economical way with the least impact on the socio-cultural life of the people.

Most possibly Plan A would be the most appropriate to these needs.

We have the following questions.

1. Channel outlet extension

The engineering design only extends the channel outlet into the Tanapag harbor over a short distance. Would it be necessary to extend the outflow channel out into the lagoon? What would be the cost?

2. Silt pile up

If the channel is not extended, would silt pile up and require dredging from time to time? If so, what would be the cost and frequency of dredging?

3. Movement of currents

Has any study been made of the movement of currents in this particular area? At the present time, debris from the dump is moving directly to the Smiling Beach and Micro Beach areas. Would Plan A have an adverse effect on these beaches and thus our major industry--tourism?

MR. KISUK CHEUNG
September 12, 1984
Page Two

4. Other flood control methods

Are there any other methods of flood control in use in island countries? If so, have these been addressed with a view toward possible application in the Northern Marianas?

We appreciate your providing us with answers to our questions at your convenience.

Sincerely,

George L. Chan
Energy Administrator

cc: SAA

-5440

September 25, 1984

Mr. George L. Chan
Energy Administrator
Office of the Governor
Commonwealth Energy Office
Civic Center
Saipan, MI 96950

Dear Mr. Chan:

Thank you for your letter of September 12, 1984 providing your comments on the Draft Detailed Project Report and Environmental Impact Statement for the Garapan Flood Control Study. Responses to your questions are as follows:

a. Channel Outlet Extension. The channel invert extends approximately 120 feet into Tanapag harbor from the shoreline. From the hydraulic point of view, farther channel extension is not needed.

b. Silt Pile Up. Estimated design velocity at the channel mouth is approximately six feet per second which provides for self-cleaning and silt pile up is not anticipated. Similar design and conditions in the State of Hawaii indicate silt buildup is not a major problem. However, in our average annual maintenance cost estimate, we have included $6,000.00 for project maintenance including possible silt removal should such work be required periodically.

c. Movement of Currents. We have studied the movement of currents in conjunction with our earlier study for a small boat harbor in this area. The tide currents set northward on the rising tide and southward on the falling tide, neither exceeding a rate of 0.75 knot. Longshore sand movement is not evident at the Garapan shoreline. Because of the weak tide on Saipan, we do not believe Plan A would have an adverse effect on the resort beaches.

d. Other Flood Control Methods. We have considered both structural and nonstructural measures applicable to the Garapan area. We believe the structural method as proposed with further refinement on the level of protection will alleviate much of the flood problem in Garapan.

Sincerely,

Clarence S. Fujii
Acting Chief, Engineering Division

UNITED STATES
DEPARTMENT OF THE INTERIOR

OFFICE OF THE SECRETARY

PACIFIC SOUTHWEST REGION
BOX 36098 • 450 GOLDEN GATE AVENUE
SAN FRANCISCO, CALIFORNIA 94102
(415) 556-8200

ER 84/1049

SEP 24 1984

Commander
Department of the Army
Pacific Ocean Division, Corps of Engineers
Building 230
Ft. Shafter, Hawaii 96858-5440

Dear Colonel Thiede:

The Department of The Interior (DOI) has reviewed the Draft Environmental Statement and Draft Detailed Project Report, Garapan Flood Control Project, Saipan, Northern Marianas. An evaluation of probable fish and wildlife impacts resulting from project alternatives was presented in a September 12, 1983, draft Fish & Wildlife Coordination Act (FWCA) Report (Appendix H, Item II of DEIS). The final FWCA report will be developed after review of the Corps of Engineers' (COE) final plans.

The following comments are related to the environmental acceptability of the proposed project and with the adequacy of the DEIS.

F-21.

Fish and Wildlife Resources

The Fish and Wildlife Service (Service) is particularly concerned about the loss of scarce wetland habitat for the Common Moorhen (Marianas gallinule), a recently listed endangered species, on Saipan. The tentatively selected Plan A would displace roughly 15,000 sq. ft. of wetland within the American Memorial Park and an additional one acre wetland which lies between drainage channel stations 20 + 85 and 31 + 20. The Common Moorhen is known to occur within each of these wetlands. The channel through the park may also cause dewaterment of the remaining wetland. The Service, therefore, recommends selection of alternatives which do not affect these important wetland habitats frequented by waterbirds, including the Common Moorhen.

In accordance with Section 7 of the Endangered Species Act of 1973 (16 USC 1531, et seq.), the COE is required to assure that their actions have taken into consideration impacts to Federally listed or proposed threatened or endangered species for all Federally funded, constructed, permitted, or licensed project.

Through coordination with Service's Endangered Species staff, we have determined that the listed Common Moorhen may be present within the project area. If your actions "may affect", then you should prepare a biological assessment as required in Section 7 of the Endangered Species Act and this should accompany your request for formal Section 7 Consultation with the Service.

Should loss of wetland habitat be unavoidable, the Service will be recommending specific measures to compensate for this loss. These measures may include creation of new wetlands, improvements to existing marginal habitats and increased management of wetlands. Ongoing wetland field studies will provide data upon which we will base our final determination of effect and our recommendations for enhancement.

Cultural Resources

1. In the course of a cultural resources survey conducted for this project by the Pacific Studies Institute (Thomas and Price 1980 "Cultural Resources Reconnaissance Report for the Garapan Flood Control Study Area, Saipan, Commonwealth of the Northern Mariana Islands") one Latte Phase archeological site was discovered. This site ("Site 1") is at least 30 meters long, of undetermined depth, and within a proposed project corridor common to all three construction alternatives (cf. Thomas and Price 1980 Figure 3, and Environmental Statement Plates C-1, C-2, and C-3).

The COE should comply with the Section 106 of the National Historic Preservation Act, as amended, and 36 CFR 800 (or COE counterpart regulations) by evaluating Site 1 for eligibility to the National Register of Historic Places. In order to obtain the necessary information for National Register eligibility (e.g. site boundaries, integrity and significance) it is anticipated that limited test excavations would be required. This course of action is also recommended by the archeologists who discovered and initially recorded Site 1 (Thomas and Price 1980:12 and 13).

References (Environmental Statement pages 3, 13, and 20) to a letter from the Commonwealth Historic Preservation Officer (July 30, 1980) stating that Site 1 has been destroyed by a water or sewer line do not provide adequate documentation of site or impact evaluation. Thomas and Price (1980:10) note that Site 1 has been impacted by water or sewer line construction, which resulted in exposure and discovery of the archeological site. Substantial and significant archeological deposits may still remain within the proposed project corridor. If a formal evaluation of site integrity and significance has been made by a qualified archeologist, and the Commonwealth Historic Preservation Officer (CHPO) has made a formal determination regarding the site's National Register eligibility, then supporting documents to that effect should be presented with the Environmental Statement. If such an evaluation has not been made, as appears to be the case, then the COE should undertake such an evaluation.

In contradiction to statements that Site 1 has been destroyed, we note that within Appendix E of the Environmental Statement (page E-10) it is stated that:

> "This site (Site 1) may be eligible for listing on the National Register of Historic Places as it may contain scientific data that could be used in developing an understanding of prehistoric settlement and use of coastal resources on the west coast of Saipan."

2. In examining Plate B-2 "Geologic Profiles" of the Environmental Statement, we note that beneath the fill layer, bore holes BH-2-84 and BH-3-84 reveal soil characteristics similar to BH-1-84, especially with regard to shell content. BH-1-84 appears to be located within the archeological site (cf. Thomas and Price 1980, Figure 2, and Plate B-1 of the Environmental Statement). Thomas and Price (1980:10) list Anadara and Strombus shell as a major midden constituent of Site 1, along with Marianas Plainware pottery sherds. The elevation and geographic location of BH-2-84 and BH-3-84 are also similar to that of BH-1-84 and the archeological site. The similarity of soil and geographical characteristics may indicate the presence of other buried archeological deposits in the immediate vicinity of BH-2-84 and BH-3-84. Furthermore, Thomas and Price (1980:7) argue that this area, between the Sugar King Subdivision and American Memorial Park, may have been near a previous shoreline, and therefore, preferred for prehistoric settlement. We therefore, recommend that the COE conduct a limited archeological augering program along the proposed project alignment between Navy Hill Road and the Coral Paved Road (opposite Island Power Road). This area would include the known archeological site, the location of the above bore holes, and the potentially sensitive area described by Thomas and Price. The augering program would enable archeologist to ascertain the presence or absence of obscurred archeological deposits and could be easily coordinated with the evaluation of Site 1 (see Comment 1).

Such an augering program should minimally consist of placing a line of auger holes at 50 foot intervals within the project corridor between Navy Hill Road and the Coral Paved Road. The auger holes would be drilled to a depth of 6 feet using 4 inch hand operated augers fitted with sampling heads.

3. It is stated on page 13 of the Environmental Statement that the CHPO, in a letter dated July 30, 1980, recommended archeological monitoring of channel excavation. We believe that implementation of the augering program described in Comment 2 would obviate the need for on-site monitoring, and provide protection against the surprise discovery of archeological deposits during construction of the project. There is no need for on-site monitoring by an archeologist if the augering program described above is implemented.

4. If Plan 3 is given further consideration as a project alternative, the outlet channel associated with the plan should be subjected to an intensive surface reconnaissance for cultural resources. Although as a result of surface disturbance there is little likelihood of finding significant historic structures, archeological deposits may still be present.



5. It is not clear as to what, if any, impacts would result to the historic features of the American Memorial Park as a result of implementing Plan A. The EIS should include a documented presentation regarding such impacts. Maps showing the areal relationship of the historic features to Plan A would be extremely helpful. If Plan A is adopted, the COE should undertake formal determinations of eligibility and effect (36 CFR 800.4) for any features of the American Memorial Park within the impact area of the proposed project that have been identified as potentially eligible to the National Register of Historic Places.

6. If any archeological deposits or other obscured cultural resources are discovered in the course of project construction the COE should comply with 36 CFR 800.7.

7. In order to better understand what cultural resource coordination has taken place, we request that the COE include with the EIS all cultural resources correspondence with the CHPO and any other agencies or individuals.

8. We request copies of all future cultural resource reports concerning this project. Please send the copies to:

Garland J. Gordon, Chief
Interagency Archeological Services Branch
National Park Service, Western Region
Box 36063
450 Golden Gate Avenue
San Francisco, California 94102

American Memorial Park

The proposed project would impact the American Memorial Park which is administered by the National Park Service (NPS). We recommend that the statement address potential impacts on the visitor use and administration of the Memorial Park. The environmental statement does allude to NPS opposition to Plan A because of its potential disruption of visual, recreational and ecological values of the wetland and associated mangrove and lagoon areas. However, there is no documentation of coordination with the NPS to resolve this issue. Therefore, we recommend that this coordination be effected and that the statement be expanded to identify any other potential impacts to visitor use and administration and to provide recommended mitigation measures.

In an attempt to resolve the concerns of the NPS and the FWS regarding the identification of potential impacts and acceptable methods to mitigate such impacts, I encourage the COE to work closely with appropriate DOI staff.

Thank you for the opportunity to comment on this statement.

Sincerely,

Patricia Sanderson Port
Regional Environmental Officer

cc: Director, OEPR (w/copy incoming)
Reg. Dir., FWS
Reg. Dir., NPS

May 2, 1985

Ms. Patricia Sanderson Port
Regional Environmental Officer
U.S. Department of the Interior
Office of the Secretary
Pacific Southwest Region
450 Golden Gate Avenue
San Francisco, California 94102

Dear Ms. Port:

Thank you for your letter of September 24, 1984, providing comments on our Draft Detailed Project Report (DPR) and Environmental Impact Statement (EIS) for the Garapan Flood Control Project.

Subsequent to the distribution of the Draft DPR and EIS, further investigation of the flood control problem, wetland resources and listed endangered species within the Garapan study area was undertaken. Based on the results of these investigations, an additional structural alternative was developed as the Tentative Recommended Plan (see Encls 1 and 2). This plan would avoid loss of wetland habitat and have minimal effect on endangered species. The plan will be described in detail in the Final DPR and EIS scheduled for completion later this Fiscal Year.

Formal Section 7 consultation was initiated with the Fish and Wildlife Service Endangered Species Office in December 1984. Several alternatives, including the current Recommended Plan, were submitted for evaluation. A Biological Opinion is in progress.



We agree with all the concerns and comments regarding cultural resources expressed in the DOI letter. In the event that the project is constructed, we will accomplish all of the necessary archaeological investigations which would include extensive sub-surface testing of the project alignment and appropriate mitigative measures in accordance with Federal Statutes.

Sincerely,

Clarence S. Fujii
Acting Chief, Engineering
Division

Enclosures

F-24

**OFFICE OF THE MINORITY**
**HOUSE OF REPRESENTATIVES**
**FOURTH NORTHERN MARIANAS COMMONWEALTH LEGISLATURE**
P.O. Box 1937, Saipan, CM 96950

MINORITY LEADER:
Rep. Benigno R. Fitial
MEMBERS:
Rep. Francisco T. Cabrera
Rep. Jose C. Cabrera
Rep. Ignacio DLG. Demapan
Rep. Juan DLG. Demapan
Rep. Benigno R. Fitial
Rep. Jose R. Lifoifoi
Rep. Juan S. Torres
STAFF
Legal Counsel
Joel J. Bergsma
Special Assistant
Ray S. Salas
Secretary
Margarita C. Torres

*October 1, 1984*

*Colonel Micheal M. Jenks*
*U.S. Army Engineer District*
*Building 230, Ft. Shafter*
*Honolulu, Hawaii 96858*

*Dear Colonel Jenks:*

*This is to request your office for information as to the latest development of Garapan Flood Control Study, Saipan Commonwealth of the Northern Mariana Islands (CNMI).*

*The Garapan flood issue has been an alarming problem for decades now and as Representative from that district, I would appreciate information as to the latest status of the study or as to what further step the CNMI Government should take to expedite the final approval of the said project.*

*I look forward to hearing from you soon and should you require any assistance from our side, please, feel free to contact the undersigned.*

*Thank you.*

*Sincerely yours,*

Juan Torres

*Juan S. Torres*
*Representative*

*xc: File*

---

October 15, 1984

Honorable Juan S. Torres
Office of the Minority
House of Representatives
Fourth Northern Marianas Commonwealth
Legislature
P.O. Box 1937
Saipan, CM 96950

Dear Mr. Torres:

This is in response to your letter of October 1, 1984 requesting the latest development on the Garapan Flood Control Study, Saipan.

As you may know, our tentative recommended plan as noted in the draft Detailed Project Report is a channel plan through the undeveloped American Memorial Park site. A public meeting was held in late-July 1984 at the Garapan Elementary School to discuss the various alternative plans. Prime concerns raised at the public meeting were the potential wetland impact; and, the Mariana Gallinule which had been nominated for the endangered species listing, could be found in the Park wetland area.

Because of these concerns, we decided to map the wetland areas more precisely in order to refine the channel alignment to avoid or minimize the wetland and endangered species impacts. With the help of the CNMI Fish and Game staff, the mapping work was completed in early October. We are currently modifying the plan of improvement to reflect the detailed mapping work. We are hopeful that the modifications will not affect the economic feasibility of the project. The modified plan is scheduled for early 1985. At that time, we will inform Governor Tenorio and the Garapan Flood Control Study Coordinating Committee (Chairman Mr. Pedro Camacho) of the study findings.

Thank you for your interest and support on the Garapan study.

Sincerely,

Michael M. Jenks
Colonel, Corps of Engineers
District Engineer

Copy Furnished:

Mr. Pedro Sasamoto
Office of the Governor
Saipan, CM 96950

Mr. Francis N. Dayton
Guam Operations Office
Pacific Daily News Bldg, Rm 905
238 O'Hara Street
Agana, Guam 96910

U.S. Department of Housing and Urban Development
Honolulu Area Office, Region IX
300 Ala Moana Blvd., Room 3318
Honolulu, Hawaii 96850

October 9, 1984

Kisuk Cheung
Chief, Engineering Division
Department of the Army
U.S. Army Engineer District, Honolulu
Fort Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

SUBJECT: Draft Detailed Project Report
with Draft Environmental Statement
Garapan Area Flood Control Study
Commonwealth of the Northern Mariana Islands

The subject report for the proposed flood control project in Garapan, CNMI, was reviewed for any conflict with HUD programs and projects.

We find that the action will not adversely impact any HUD assisted project in the area and will mitigate flooding in the Garapan area.

We appreciate the opportunity to review this report and EIS and look forward to receiving the final report.

Sincerely,

Susan Lee for
Robert K. Fududa
Manager

cc: Dale James, 9C

Commonwealth of the Northern Mariana Islands
Office of the Governor
Saipan, Mariana Islands 96950

Phone: 6407/6408/6581
Telex: 783 622 Gov. NMI

JUL 24 1985

29 JUL 1985

Colonel Michael M. Jenks
District Engineer
Department of the Army
U.S. Army Engineer District,
Honolulu
Ft. Shafter, HI 96858-5440

Dear Colonel Jenks:

Subject: Garapan Flood Control Project

The Commonwealth of the Northern Mariana Islands, by virtue of the authority vested in the Governor's Office, is hereby notifying the Department of Army Corps of Engineers of our intent to perform the requisite obligations for the subject project. Pursuant to the local cooperation requirements of Section 205 of the Flood Control Act of 1948, as amended, the Commonwealth intends to:

a. Provide without cost to the United States all lands, easements (including flowage easements), and rights-of-way necessary for implementation and subsequent maintenance of the project, including spoil disposal and borrow, and access thereto required for project implementation and maintenance;

b. Hold and save the United States free from damages due to implementation and maintenance of the project, not including damages due to the fault or negligence of the United States or its contractors;

c. Maintain and operate the project in accordance with regulations prescribed by the Secretary of the Army;

d. Provide without cost to the United States all relocations and alterations of buildings, utilities, streets, bridges, storm drains and other improvements made necessary by the project; and

e. Assume all costs in excess of the $4 million statutory federal limitation for the flood control improvements and related works.

The Commonwealth is also aware that current Administration policy is to require a minimum of 35 percent non-federal contribution. This policy on cost sharing is subject to change by legislation.

We understand that this letter expresses the intent of the Commonwealth and does not legally bind us to the above agreement. We also understand that this agreement must be formally executed in accordance with Section 221 of the River and Harbor Act of 1970, prior to commencement of project construction.

Sincerely,

PEDRO P. TENORIO
Governor

CC: Director of Public Works

April 30, 1986

Ms. Tami Grove, Acting Director
Coastal Resources Management Office
Commonwealth of the Northern
Mariana Islands
Saipan, CM 96950

Dear Ms. Grove:

We are submitting for you review and comment the Garapan Flood Control Study Detailed Project Report and Environmental Impact Statement. Included in the report document is a Federal Coastal Zone Management Consistency Determination for the project. The determination specifically addresses the impacts of the recommended plan of improvement at Garapan, Saipan on the Coastal Resources Management (CRM) Program of the CNMI. Compliance with the Federal Coastal Zone Management Act requires that we receive CNMI concurrence with our findings that the project is consistent with the CRM Program.

We have previously coordinated with your office on this subject during the June 1984 Draft Detailed Project Report phase of the study. Since that report, the recommended plan of improvement has been modified. One modification includes routing of the channel's lower reaches around the American Memorial Park wetland, avoiding the wetland altogether. The other modification includes keeping the channel above West Coast Highway up to the Micro Beach Road intersection, then crossing over to the other side of West Coast Highway.

We are now in the process of finalizing the Detailed Project Report and would appreciate your response regarding the Consistency Determination by May 30, 1986. If you have any questions, please contact Mr. Robert Moncrief at (808) 438-2264.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

Enclosure



DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FT. SHAFTER, HAWAII 96858

May 15, 1986

Mr. William Lopp, Chief
Division of Environmental Quality
Department of Health and Environmental Services
Commonwealth of the Northern Mariana Islands
PO Box 1304, Saipan 96950

Dear Mr. Lopp:

As part of the procedure for implementing the Garapan Flood Control project, Garapan, Saipan, it is necessary to obtain a CNMI water quality certification for the discharge of dredged or fill material as prescribed by Section 401 of the Clean Water Act of 1977.

If a formal certification process is not in effect in the Commonwealth of the Northern Mariana Islands (CNMI), a letter from the Division of Environmental Quality (DEQ) is required which evaluates the effects of the discharge of dredged or fill material on water quality, and provides recommendations, if any, to minimize the impacts of the discharge on water quality. If appropriate, the letter should indicate that the DEQ concurs that the discharge impacts on water quality are acceptable and have been mitigated to the extent practicable and that the discharge will conform to CNMI water quality standards.

We have enclosed for your review a copy of the evaluation of the effects of the discharge of dredged or fill material into waters of the U.S. under the Section 404 (b)(1) Guidelines promulgated by the U.S. Environmental Protection Agency. The evaluation will be published in the Final Detailed Project Report and Environmental Statement, later this year.

Sincerely,

KISUK CHEUNG
Chief, Engineering Division

Enclosure

Copies Furnished:

Meiling Odum
CNMI Project Officer
Mail Code, W-2
Environmental Protection Agency
Region IX, San Francisco 94105

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 ALA MOANA BOULEVARD
P O BOX 50167
HONOLULU HAWAII 96850

IN REPLY REFER TO:
ES
Room 6307

AUG 8 1986

Colonel Michael M. Jenks
U.S. Army Engineer District, Honolulu
Building 230
Fort Shafter, Hawaii 96858-5440

Re: Garapan Flood Control Project, Saipan, Commonwealth of the Northern Mariana Islands

Dear Colonel Jenks:

Our office has been working with your Planning Branch staff to determine the potential impacts of the proposed flood control project on the wetland at the American Memorial Park, Saipan.

On August 23, 1985, Corps representatives met with Service biologists and hydrologists Dan Davis and Chuck Huxel of the U.S. Geological Survey to discuss the Garapan Flood Control Project. At this meeting, the hydrologists expressed concern that insufficient information had been gathered to determine the effects of an outlet channel on the American Memorial Park wetland.

Subsequently, on January 7, 1986, Robert McVein (Regional Hydrologist, U.S. Fish and Wildlife Service) conducted a field inspection of the site with Dr. Clifford Smith (Cooperative National Park Resources Study Unit), and Gordon Joyce (Ranger-in-Charge, American Memorial Park, National Park Service). Their survey confirmed the following:

a. The wetland at the American Memorial Park is groundwater fed and does not depend on surface runoff to maintain its wetland characteristics.

b. Movement of fresh groundwater is through the wetland and into Tanapag Harbor.

c. The proposed flood control channel that skirts along the edge of the marsh would negatively affect the wetland by intercepting groundwater moving into the wetland and lowering the water table within the wetland and by allowing the seepage of salt water into the wetland through the unlined drainage channel.



Based upon McVein's work, it is our belief that the proposed unlined outlet channel will have adverse impacts to the wetland habitat at American Memorial Park. It is likely that modifications in the water quality or water levels would affect the suitability of the wetland as habitat for the endangered Mariana Gallinule (*Gallinula chloropus guami*).

In addition, the Draft General Management Plan and Comprehensive Design for the American Memorial Park, Saipan (National Park Service, 1982) designates this wetland as a natural area for the protection and maintenance of wildlife. The Cooperative National Park Resources Study Unit will be conducting baseline vegetation analyses of this wetland this upcoming fiscal year.

We strongly urge the Corps to conduct the necessary hydrologic studies to evaluate these reasonably foreseeable significant adverse impacts on the Garapan wetland, and to consider alternatives that would avoid these detrimental effects. We believe that this information should appear in the final Environmental Impact Statement in accordance with the recent amendments to 40 C.F.R. 1502.22. We ask that these studies be coordinated with our office, the National Park Service, and the U.S. Geological Survey.

Enclosed for your review is a copy of our hydrologist's trip report. We look forward to working with your staff to resolve this issue.

Sincerely,

Ernest Kosaka
Project Leader
Office of Environmental Services

Enclosure

cc: OCE
NPS, Pacific Area Office
CPSU/UH
RD, FWS, Portland, OR (ARD-HR)
EPA, San Francisco
ARD-AFR/EN (Attn: Robert McVein)

UNITED STATES GOVERNMENT

# Memorandum

FISH AND WILDLIFE SERVICE
PORTLAND, OREGON

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TO : Pacific Island Administrator DATE: March 11, 1986

FROM : Regional Hydrologist
Region 1

SUBJECT: Proposed Garapan Flood Control Project (CE) Saipan, CNMI

At the request of Dr. Clifford Smith of the National Park Service and Mr. Andy Yuen, ES, Honolulu, I conducted a field inspection of the wetland area of the American Memorial Park, Saipan, CNMI, on January 7, 1986. I was accompanied during this inspection by Dr. Smith and Park Superintendent, Gordon Joyce. The purpose of the inspection was to determine the effect the proposed Garapan Flood Control Project will have on the wetland area. Following are my findings and opinions based on a visual inspection of the area.

A walking survey starting at the intersection of Beach Road and Micro Beach Road clockwise around the wetland area indicated there are no surface drains entering the marsh. No road culverts, no swales or any other low areas where surface waters could enter the marsh (photographs 1 through 5). A drain culvert was located on the ocean side of the marsh under Beach Road (photographs 6 and 7).

Salinity measurements were taken in the marsh, at the ocean side of the marsh drain culvert on Beach Road and at the confluence where the drain enters Tanapag Harbor, using a hand refractometer. A reading of zero was found in the marsh indicating fresh water, confirmed by a taste test, at the culvert (approx. 50' makai of Beach Road) a salinity level of 5 ppt (parts per thousand) was measured, and at the harbor site, a salinity level of 16 ppt was measured. These readings indicate an outflow of fresh water from the marsh to the sea. In addition a noticeable discharge of water was noted at the drain culvert site. The water level in the marsh was approximately 2-3 feet above the level in the harbor at the time of observation. The readings and observations indicate a movement of fresh ground water through the wetland area to the harbor.

This information leads me to the conclusion that a flood control drain constructed along the mauka side of the wetland area, paralleling the West Coast Highway, as proposed by the U.S. Army District, Honolulu, would intercept most of the flow of fresh water to the marsh and short circuit the water directly to the harbor. This could result in the destruction of the wetland area by either lowering the fresh ground water table or allowing the intrusion of salt water into the area.

Pacific Island Administrator - Proposed Garapan Flood Control Project (CE)
Saipan, CNMI

Observation of the residential area of Garapan village leads me to believe that most of the flooding from sheet flow runoff due to heavy storms could be accommodated by the construction and maintenance of a roadside ditch and culvert system throughout the village rather than the extensive large interceptor drain as proposed by the U.S. Army Engineers.

I am willing to discuss my findings with the Honolulu district engineers, if necessary.

Robert F. McVein
Robert F. McVein

Attachments (8)

RMcVein:kbr

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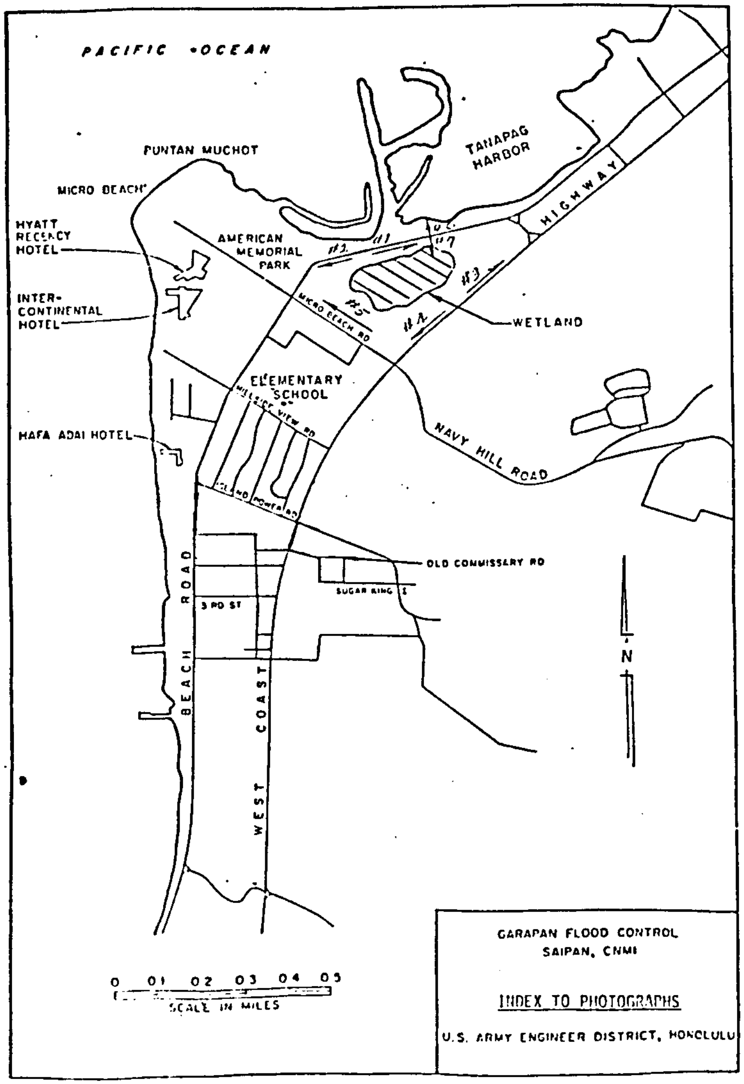
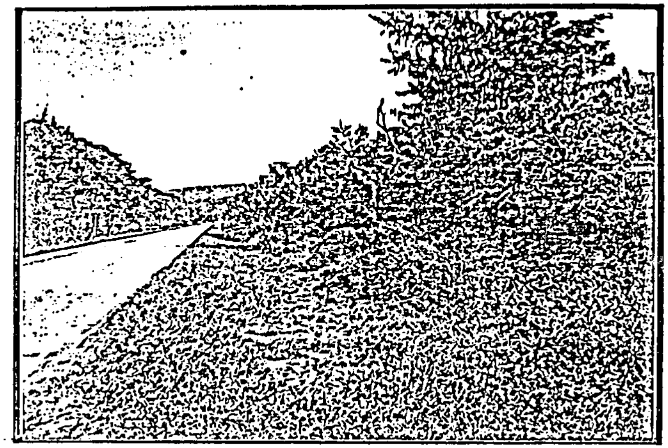
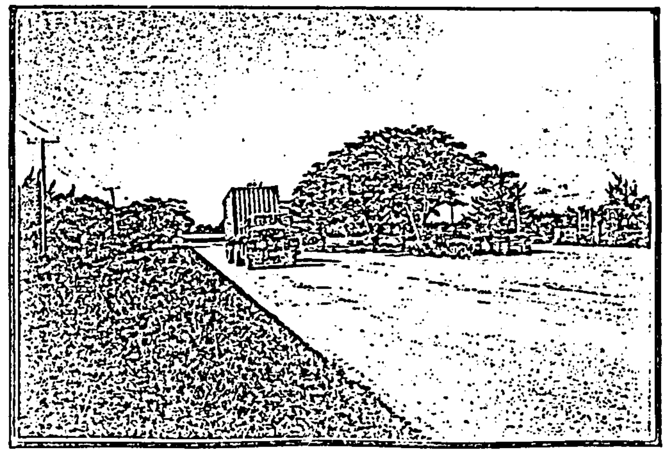
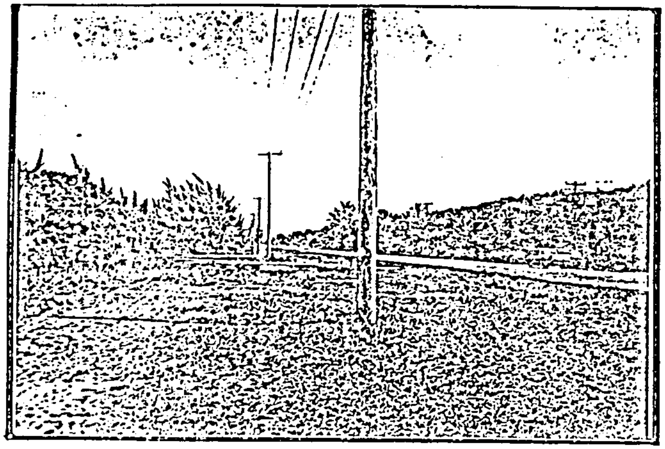


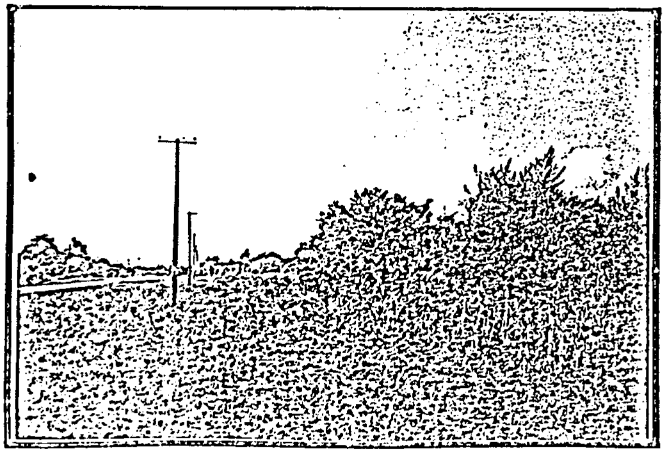
#1 - Looking northeasterly along Beach Road. Yellow guard rail at left of road is location of marsh drain. Marsh located to right.



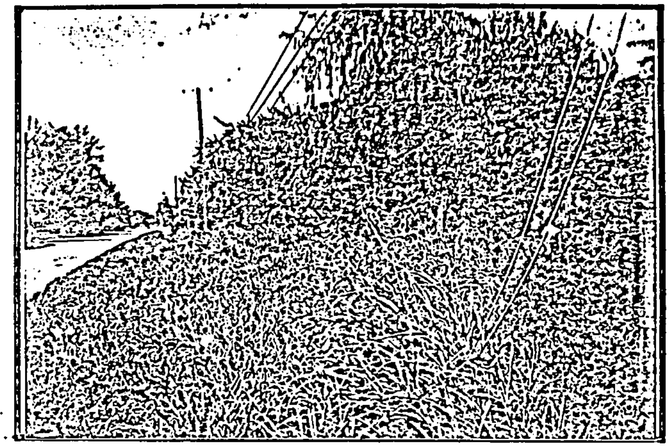
#2 - Looking southwesterly along Beach Road towards Garapan. Marsh located to left.



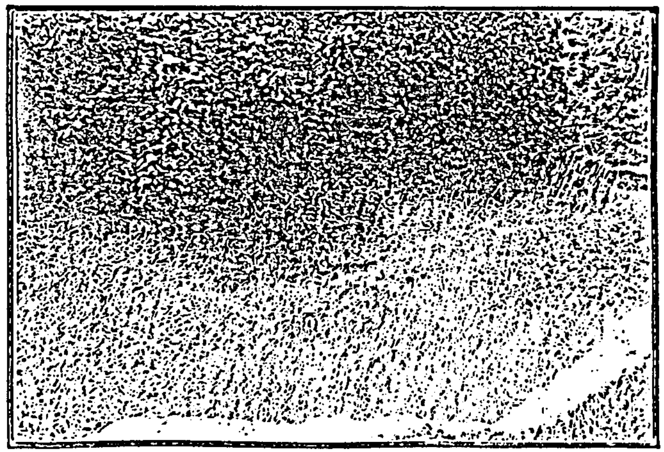
#3 - Looking northeasterly along West Coast Highway. Marsh located to left.



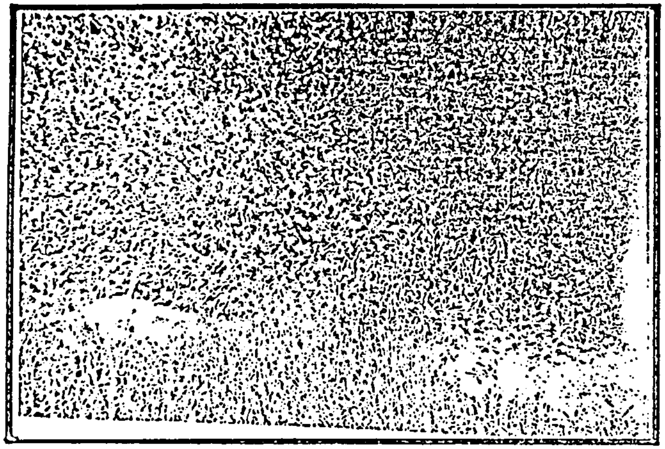
#4 - Looking southwesterly along West Coast Highway. Marsh located to right.



#5 - Looking northwesterly along Micro Beach Road. Marsh located to right.



#6 - Marsh drain structure located on makai side of Beach Road. Site for measuring salinity and observation of water movement is beyond hau tree at top of picture.



#7 - Marsh drain outlet on mauka side of Beach Road. Standing water observed in vegetation at center of picture.

Commonwealth of the Northern Mariana Islands
Coastal Resources Management
Office of the Governor
Saipan, Mariana Islands 96950

CABLE ADDRESS
GOV. NMI SAIPAN
TELS. 6623/7320

August 15, 1986

Mr. Kisuk Cheug
Chief, Engineering Division
U.S. Army Corps of Engineers, (ACOE)
Honolulu District
Ft. Shafter, Hawaii 96858

Ref: Garapan Flood Control Project; Federal Coastal Zone Management Consistency Determination

Dear Mr. Cheug:

I am writing today in response to your request for concurrance from the Commonwealth of the Northern Mariana Islands (CNMI) Coastal Resources Management (CRM) Program in regard to the ACOE consistency determination prepared for the Garapan Flood Control Project.

Enclosed you will find a summary of our review findings and conclusions on the proposed project and your office's consistency detemination which was included in "Appendix H" of the the Final Detailed Project Report & Environmental Impact Statement (EIS) of the Garapan Flood Control Project, May 1986. The enclosure explains that CRM has completed its review of the above mentioned report and determined that, as currently recommended, the proposed project (Plan E) is not consistent to the maximum extent practicable with the CRM Program.

I would like to take this opportunity to note that the July, 1985 Draft Detailed Report and EIS was submitted to our office with your letter of April 30, 1986 requesting our review. CRM subsequently wrote you on June 11, 1986 and June 20, 1986 requesting additional time to review the project report and consistency determination.

On Friday, July 18, 1986 we had the opportunity to meet with Mr. Harvey Young and Mr. Rudy Mina from your office to discuss both the Garapan and Susupe/Chalan Kanoa Flood Control Projects. We appreciated the opportunity to have some of our questions answered. Unfortunately, it was not until that date that CRM was able to obtain a copy of your final report dated May, 1986. At that time we mutually agreed that CRM would prepare its response within the next couple of weeks and forward it to your office.

Pursuant to CFR 15 Section 930.64(c) and CRM Rules and Regulations (Vol. 7, No.10 of the Commonwealth Register) at Section 21 (v), our



office desires to resolve our areas of disagreement with the ACOE consistency determination contained in the May 1986 final report. We suggest that you review the enclosed information which describes our points of disagreement and ask that you contact us at your earliest convenience so that we may search for solutions to the areas of conflict. In addition, we have found that there is insufficient information in certain areas which we trust that you will be able to provide.

In the event that our two offices are unable to come to an agreement on the manner in which the Garapan Flood Control project may be conducted in a manner consistent, to the maximum extent practicable, with the CRM Program, it is my duty to inform you that mediation of the disagreement may be requested pursuant to the procedures set forth in Section 307 of the Federal Coastal Zone Management Act of 1972 (as amended) and 15 CFR 930, Subpart H. However, I am confident that such a request will not be necessary following coordination between our two offices and resolution of our disagreements.

Please do not hesitate to contact me or Mr. Bob Rudolph at (670) 234-6623 or 234-7320 should you have any questions or need further clarification on this matter. Allow me to thank you for you and your staff's continuing understanding and cooperation on this project. A copy of this review is being sent to the Assistant Administrator of the Office of Ocean and Coastal Resources Management, (NOAA/U.S. Department of Commerce) as provided in CFR 15 930.42(C). We look forward to discussing this matter further with you.

Sincerely,

Tami Grove

TAMI GROVE
CRMO Administrator

Commonwealth of the Northern Mariana Islands
Coastal Resources Management
Office of the Governor
Saipan, Mariana Islands 96950

CABLE ADDRESS
GOV. NMI SAIPAN
TELS. 6433/7320

Summary of Review
Findings & Conclusions by the
Coastal Resource Management Program

Federal Agency: U.S. Army Corps of Engineers (ACOE)

Activity Description: Consistency Determination for construction of 5,960 foot flood-control channel to convey flood waters of the Garapan watershed around the American Memorial Park (AMP) wetland into the Tanapag Harbor, Saipan, CNMI.

Substantive File Documents:

1) Garapan Flood Control Study Final Detailed Project Report Environmental Impact Statement (EIS) & Appendices, Saipan, CNMI

2) Army Corps' Consistency Determination (contained in the above document)

I. Project Description

The proposed flood control project consists of channel improvements which would convey flows transversely through the floodplain upland of the West Coast Highway and which would then cross the West Coast Highway and Micro Beach Road intersection. The grasslined channel would proceed around the AMP wetland and end with a Tanapag Harbor outlet. (See Attachment I, "Figure 7.")

The channel improvements will be trapezoidal in shape with riprap lining as needed. The length of flood control improvments is about 5,960 feet. This plan would provide for ditches and spillway inlets to convey upland flows to the interceptor channel. This plan would also require construction of culverts along the channel alignment at six road crossings. The six road crossings include Beach Road, Micro Beach Road and West Coast Highway intersection, Hospital Roads 1 and 2, Paganville Road, and Island Power Road. The existing Old Commisary Road would be closed to through traffic at the West Coast Highway. Water and sewer utilities would require relocations at these crossings. In lieu of channel transitions and culverts, bridges were considered and were found to be more costly. No relocation of homes or businesses would be required.





II. Army Corps Consistency Determination and Findings

The ACOE prepared a consistency statement with its final project report and ELS. While it is not explicity stated, we assume, based upon the determination's statements, that the ACOE finds the project to be consistent to the maximum extent practicable with the CRM Program.

III. CRM's Objection to the Consistency Determination

CRM hereby objects to the consistency determination made by the ACOE, finding that: a) the proposed project is inconsistent with the policies and objectives of the CRM Program, particularly as set forth in the Coastal Resource Management Act of 1983 (CNMI Public Law 3-47) and CRM Rules and Regulations promulgated thereunder in Vol.7, No.10 of the Commonwealth Register, because the proposed project has the potential to have a direct and significant adverse impact on coastal resources; b) the ACOE has failed, subsequent to previous written CRM requests, to provide all information needed to fully determine the consistency of the project with the CRM Program, and; c) it appears there are alternatives available that could eliminate or reduce adverse impacts created by the project.

IV. CRM's Review Findings and Conclusions

1) General

ACOE's statement that the current "CRM Policies, Goals, and Objectives were promulgated by CNMI Executive Order 15" is incorrect. While very similar to E.O.15, the CNMI Coastal Resource Management Act of 1983 (Public Law 3-47) superceded the Order and has been incorporated into the CRM Program as a routine program implementation. The CRM Rules and Regulations now in effect were published in Volume 7 Number 10 of the Commonwealth Register. Included in these regulations are general standards and criteria for evaluating proposed projects located wholly, partially or intermittently within an Area of Particular Concern (APC), or which have a direct and significant impact on an APC or which are designated as a major siting. Specific standards and priorities of Major Sitings and APC's under the CRM Program are also provided. The regulations require project proponents to demonstrate by a fair preponderance of evidence that the project will not have a significant adverse impact on the coastal environment or its resources.

At the outset, CRM notes that there appear to be several inconsistencies and unresolved issues that make it difficult to fully understand and evaluate the recommended project. For example:

a) inconsistencies:

1) Page 17 of the EIS states that "(t)he outlet channel will contain standing seawater as far as the West Coast Highway culvert." CRM measurements of ACOE Plate C-1 describing the recommended plan find this distance to be about 2,400 feet.

On the other hand, Page 1 of the evaluation of the project in relation to Environmental Protection Agency (EPA) Section 404(b)(1) Guidelines (Appendix H [I]) states that "if the channel mouth is dredged first, then the portion of the outset channel subject to standing saline water [will be] about 4,500 feet."

2) Page 8 of the ACOE CRM Consistency Determination states at 5(e) that "(t)he project will commit a total of approximately 13.2 acres to structural flood control improvements." However, Table 2 of the EIS states at Item (2)(a) that 10.4 acres of the "terrestrial environment" will be modified by the project (Plan E).

3) The December 17, 1984 letter from the ACOE to the U.S. Fish & Wildlife Service (FWS) described a recommended plan that "will not encroach on the existing Garapan wetland boundary."

"Attachment 1" with the letter is the ACOE Figure 7 map for Alternative A which depicts the outlet channel running directly through the AMP wetland.

4) Page 24 of the project report describes Alternative Plan E. The outlet channel in the plan is to "detour around and not encroach upon the wetland areas."

Page 5 of the consistency determination states in 3(a) that the project "requires location within wetlands and a lagoon."

5) In reviewing the hydrology section of the Final Project Report (Appendix A), CRM notes that the ACOE has used hydrologic information from two Guam river watersheds (Ugum & Umatac) in order to





extrapolate hydrograph data for the Garapan watershed. The applicability and similarity of the Guam information to Saipan is questionable since the former relates to rivers draining volcanic watersheds. The Garapan project, on the other hand, addresses a floodplain of limestone whose watershed is also primarily limestone and whose overland flow of water is irregular. In addition, the floodplain area has groundwater present at 5 feet or less which fluctuates with the tides, conditions quite dissimilar to the Guam areas.

6) On page 11, the EIS states that "preliminary current studies suggest that there is little significant continuous littoral movement of coastal materials along the lagoonal shoreline at Garapan." Later in the same paragraph, it is further stated that:

> The Unai Sadog Tasi intertidal reef is now a sluggish backwater area within Tanapag Harbor due to the creation of artificial peninsulas in the harbor and blocking of a stream during World War II. The reef flat is now a mud flat probably influenced most by <u>slow</u> tidal currents. (Emphasis added).

However, it appears that the ACOE contradicts itself later in the Consistency Determination (page 7 Section 4 [d]) by stating that "(t)he <u>rapid</u> residence time of lagoon waters is expected to minimize adverse effects of sedimentation caused by silt-laden flood water discharg from the project." (Emphasis added.)

b) unresolved issues:

In its August 23, 1984 letter to the ACOE, CRM noted that the draft EIS made several references to additional wetland studies that were to be accomplished prior to the final EIS in order to define impacts and potential mitigation measures. CRM also stated that such information would be needed in order to evaluate the consistency of the recommended project. However, page 6 of the ACOE evaluation of the project in relation to the EPA Section 404 (b) guidelines states at (d) that "the significance of [the sheet flow of rain] water to the overall hydrology of the marsh and swamp is not known." And that the:

> "(c)haracteristics of the soils along this channel alignment have not been determined. It is quite possible that relatively porous soils occur in the project area, in which case without an impermeable lining seawater infiltration of the wetland could result.

Significant alteration of the salinity of the wetland could result in adverse midification of the marsh as gallinule habitat. The Army Corps of Engineers has determined that providing an impermeable lining the length of the outlet channel is not cost effective. Additional soils studies will be conducted to determine the porosity of soils."

The ACOE evaluation of the project in relation to the EPA Section 404 (b) guidelines also admits on page 6 that the significance of sheetflow runoff rain water "to the overall hydrology of the marsh and swamp is not known."

Obviously the Corps itself realizes that additional studies need to be done in order to understand the effects of the project. Without such data the ACOE lacks support for its claim that the project will not harm coastal resources (the AMP wetland in particular). Furthermore without such data it is impossible for CRM Program to make a consistency determination. * Moreover, the ACOE claim that mitigation by an impervious lining is prohibitively expensive is not supported by cost comparisons.

CRM also notes that the "Final Coordination Act Report" prepared by the U.S. Fish & Wildlife Service (FWS), July 1985, states on Page 10 that "(w)ithout the impervious channel, the Service finds Alternative E unacceptable." The FWS Finding further supports the conclusion that the channel lining is a significant unresolved issue for parites concerned with the evaluation of the project. The ACOE admits that "seawater intrusion into groundwaters adjacent to the wetlands still adversely affect the marsh and the Marian Gallinule habitat" (EIS page 19). Within the consistency determination (pg. 6, Section 3[A], the Corps also states that the "outlet channel may alter essential hydrological or ecological functions of the wetlands nearby the channel."

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*CRM Regulations at Section 9(C)(iii) set forth management standards for wetland and mangrove APC's. These standards for project evaluation include:

(1) Significant adverse impact on natural drainage patterns, the destruction of important habitat and the discharge of toxic substances shall be prohited; adequate water flow, nutrients and oxygen levels shall be ensured.
(2) The natural ecological and hydrological processes and mangrove areas shall be preserved.
(3) Critical wetland habitat shall be maintained and, where possible, enhanced so as to increase the potential for survival of rare and endangered flora and fauna.





In fact, the ACOE has helped to articulate the incompatability of the recommended project with the CRM Program by stating in the determination (page 10 Section 5[g]) that the "project may induce changes in hydrologic (sic) and reduce habitat value for wetland-dependent organisms including endangered species."

CRM therefore finds that additional hydraulic, hydrologic and geologic information is needed in order to fully evaluate the potential impacts of the project on coastal resources. The program also finds that it is likely that practicable mitigation measures or design alternatives exist for the project.

Accordingly, CRM objects to the consistency determination at page 6, Section 3(f), that "to the maximum extent possible, principal features of the project have been sited... to preserve the Garapan wetlands" (Emphasis added).

2) Comparison of ACOE Consistency Determination to CRM Program Goals, Policies and Regulations.

a) Public Law 3-47, The Coastal Resources Management Act of 1983.

The above referenced law requires that CRM shall plan for and manage any use of activity with the potential for causing a direct and significant impact on coastal resources. Significant adverse impacts are to be mitigated to the maximum extent practicable.

Policies relating to impacts on water quality, including discharges, are further clarified as:
Section (9) Require any development to strictly comply with erosion, sedimentation and related land and water use districting guidelines...
Section (10) Maintain or improve coastal water quality through control of erosion, sedimentation, runoff, siltation, sewage and other discharges;
Section (13) Require compliance with all local air and water quality laws and regulations and any applicable federal air and water quality standards;
Section (14) Not permit, to the extent practicable, development with the potential for causing significant adverse impact in fragile areas such as designated and potential historic and archaeological sites, critical wildlife habitats, beaches, designated and potential pristine marine and terrestrial communities, limestone and volcanic forests, designated and potential mangrove stands and other wetlands;

Section (15) Manage ecologically significant resource areas for their contribution to marine productivity and value as wildlife habitats, and preserve the functions and integrity of reefs, marine meadows, salt ponds, mangroves and other significant natural areas.

The first inadequacy that CRM notes in reviewing the flood water discharge impacts is that the recommended plan fails to incorporate sedimentation controls to mitigate the impacts of silt laden flood waters discharging into the lagoon. In fact, the ACOE claims that the estimated design velocity at the channel mouth is six feet per second in order to make the project "self cleaning" and prevent silt pile up. In addition, the ACOE plans to line approximately 3,530 feet of the upland channel with fill material consisting predominantly of "natural occuring materials with particle sizes larger than silt" (Appendix H[I], page 2). Given the expected volume and rate of flow of flood waters, concern is raised as to how such particles will be prevented from becoming suspended and discharged. As several reviewers have noted, the outlet is in the vicinity of several popular public beaches. "Whether or not silt and debris-laden flood waters are discharged during rising or falling tidal movements would likely determine the degree to which 'dirty' water might be carried to recreational beaches" (EIS page 16 Section 6.3).

CRM finds the lack of any sedimentation controls to be contrary to the CRM program. We note in the preceding section and in IV(a)(6) above that the ACOE has made incomplete and inconsistent statements about the receiving waters and the effects of flood waters at Unai Sadog Tasi.

Public Law 3-47 at Section (14) & (15) and CRM Regulations at Section 9(c)(iii), which are referenced above, specifically address the management and protection of wetlands and other important habitats. As already noted, additional data is necessary in order to evaluate the potential impacts of the project on the AMP wetland. The importance of such data is underscored by the fact that the Marianas Gallinule (Gallinula chloropus), listed on the Federal Register of August 27, 1984 as an endangered species, is found in the AMP wetland. Historically, the Gallinule had wide distribution in the freshwater wetlands of the Northern Marianas; however, increasing urban development and the drainage of suitable wetland habitat have been cited as major contributing factors in the species' population decline. On Saipan, much of the Gallinule habitat has been filled or drained over the past several decades, making wetlands suitable as habitat quite scarce. Garapan marshes (including the AMP wetland) and Lake Susupe are considered to be the only two Gallinule habitat areas in Saipan. Both are therefore considered by the U.S. Fish & Wildlife Service to be of critical importance for the continued survival of the bird. The Service further considers the area of Garapan marsh which is to be





affected (AMP wetland) as falling under Resource Catagory 2 since it is a habitat of high value for the species "and is relatively scarce or becoming scarce on a national basis or in the ecoregional setting." (See "Final Coordination Act Report" July, 1985, Appendix H [II].) Based on this, CRM objects to the ACOE consistency statements at 2(c)(2) that the AMP wetland is "not considered significant to the survival" of the Gallinule and at 5(c) that the "(w)etland habitat in the proposed project area is considered to be as secondary value as habitat for endangered waterbirds."

The paucity and importance of wetlands in Saipan underscore the need for adequate data to describe the potential impacts of the proposed project. Included in this information should be models of the expected alterations caused or contemplated by the project such as water quantity and salinity fluctuations and as well as supporting data for mitigation measures. For example, the EIS on page 6 states that the recommended plan includes a spillway and swale which will discharge a portion of the stormwater conveyed by the flood control channel into the AMP wetland. The ACOE explains that this "environmental feature" (EIS, page 8) is "(t)o minimize impacts on the hydrology of the marsh due to loss of runoff from elevated areas east of the AMP wetland that would normally flow into the wetland during high rainfall condition" (EIS page 17). However, as was previously pointed out, hydrologic studies have not been made of the area. Moreover, CRM is unable to identify any discussion of the expected quantities, occurances, durations or impacts of such a discharge into the wetland; although, we note that the ACOE consistency detemination at 5(d) does state that "(s)ignificant effects on the salinity of the wetland could occur." Contrary to being consistent with the program, projects which significantly alter the ecological integrity of wetlands and reduce habitat suitability for endangered species are incompatible with CRM goals and policies.

Although CRM is unsure of the intent of the statement, we note that the consistency determination at Section 6 (g)(2) states that "(t)he principal project purpose is flood control; and net project effects to shoreline resources are negative." One such negative affect may be coastal access restriction. CRM understands that there is to be a six foot high chain link fence along each side of the channel. If this fencing is to continue to the edge of the outlet channel, access along the shoreline will be inhibited by both the fence and the channel. It is CRM policy to "(e)ncourage the preservation of traditional rights of public access to and along the shorelines consistent with the rights of private property owners" (P.L.3-47 Section 3[22]). Other possible negative effects to "shoreline resources" are discussed below.

b) Further comparison to CRM Rules and Regulations as published in Vol. 7 No.10 of the Commonwealth Register

The recommended plan includes a channel which will be located in both the Shoreline and Lagoon and Reef APC's. The consistency determination at Section (2)(b)(2) incorrectly describes the "shoreline area" to be removed as "approximately 400 square feet and 80 foot length." The Shoreline APC is by definition "the area between the mean high water mark... and one hundred fifty (150) feet inland" (CRM Regulations Section 5[EE]). The 400 square feet (80 feet in length) to be excavated at the end of the outlet channel will affect the marine environment and will fall within the Lagoon and Reef APC.

Management standards for the Shoreline APC are found within the CRM Regulations at Section 9(C)(v). Standards against which projects are to be evaluated include:

- (a)(1) The impact of onshore activities upon wildlife, marine or aesthetic resources shall be minimized;
- (a)(2) The effects of shoreline development on natural beach processes shall be minimized;
- (b)(2) Whether the proposed project is to facilitate or enhance coastal recreational, subsistence, or cultural opportunities. (i.e., docking, uut, fishing, swimming, picnicking, nagivation devices).

Management standards for the Lagoon and Reef APC are found at Section 9(C)(i)(a) and include:

(1) Subsistence usage of coastal areas and resources shall be insured;
(2) Living marine resources, particularly fishery resources, shall be managed so as to maintain optimum sustainable yields;
(3) Significant adverse impacts to reefs and corals shall be prevented;
(4) Lagoon and reef areas shall be managed so as to maintain or enhance subsistence, commercial and sportfisheries;
(5) Lagoon and reef areas shall be managed so as to assure the maintenance of natural water flows, natural circulation patterns, natural nutrient and oxygen levels and to avoid the discharge of toxic wastes, sewage, petroleum products, siltation and destruction of productive habitat;
(6) Areas and objects of historic and cultural significance shall be preserved and maintained;

Particularly given the lack of any sedimentation controls, which is discussed above, there is concern that the proposed project does not meet these standards. The outlet channel and storm water runoff will





have temporary, intermittant and long term impacts upon coastal water quality and marine resources. As the FWS "Final Coordination" July 1985 report notes on page 10:

> Portions of the channel below 0 MSL would have mixohaline water and may retain sediments. This may provide habitat for brackish-water flora and fauna, including mudskippers (Periophthalmus koeleutii), juvenile mullet (Chelon engeli), and flagfish (Kuhlia sp.). Such areas may provide some additional feeding resources and habitat for shore and waterbirds.
>
> Suspended sediments carried with storm water runoff would create localized turbidity plumes. Benthic communities near the mouth of the outlet channels may be negatively impacted by sedimentation, freshwater dilution, and a gradual increase in the concentrations of some urban pollutants.
>
> Sediments discharged from the channel may also have negative long-term impact on sea grass beds located approximately 20-30 meters seaward from the high tide line. The sea grass, E. acoroides, is not expected to be affected by freshwater dilution, although increased sedimentation may bury some stands. A decrease in the quality or quantity of E. acoroides may indirectly affect rabbitfishes (Siganus spp.) and other subsistence fishery species in Tanapag Harbor.

In terms of the impact of this project on recreational opportunities, CRM notes that the proposed project does require alterations to several features of the National Park Service's Management Plan (1982). While most of the facilities should be able to be resited within the park, the advantage of siting them along the West Coast Highway for public accessibility and cohesiveness will be lost. An additional impact may be the need to reclaim undisturbed portions of the natural area for such purposes. Moreover, the Plan calls for the protection of the AMP wetland for wildlife and education purposes. In fact, the ACOE consistency determination bolsters the argument against creating obstructions within the area by stating (at Section 5[f]) that "(t)he wetland within AMP would be maintained in its present state or even enhanced if a National Park Service management plan is implemented."

V. Closing comments

As a final comment to the proposed plan and CRM's objection to the consistency determination, we again emphasize that additional information is needed and that mitigation or design alternatives exist to develop a flood control project which is consistent to the maximum extent practicable with the CRM Program. We also note

Summary of Review
August 15, 1986
Page eleven

that only expensive, large scale projects are discussed as structural design alternatives within the final project report. Alternatives involving less costly and smaller scale drainage systems are conspicuously absent. During the Japanese administration, most of the flooding in Garapan from sheet flow runoff due to heavy storms was accomodated by the construction and maintenance of a roadside ditch and culvert system throughout the village. Such a system would quite likely have fewer impacts and be less expensive to build and easier to maintain than the extensive "interceptor channel" being proposed. Particularly in light of the high cost of the project and the 1.1 Benefit/Cost ratio of the proposed plan, which is the lowest positive B/C ratio possible and which does not include environmental or amenity costs, the investigation of a smaller system is highly desirable.

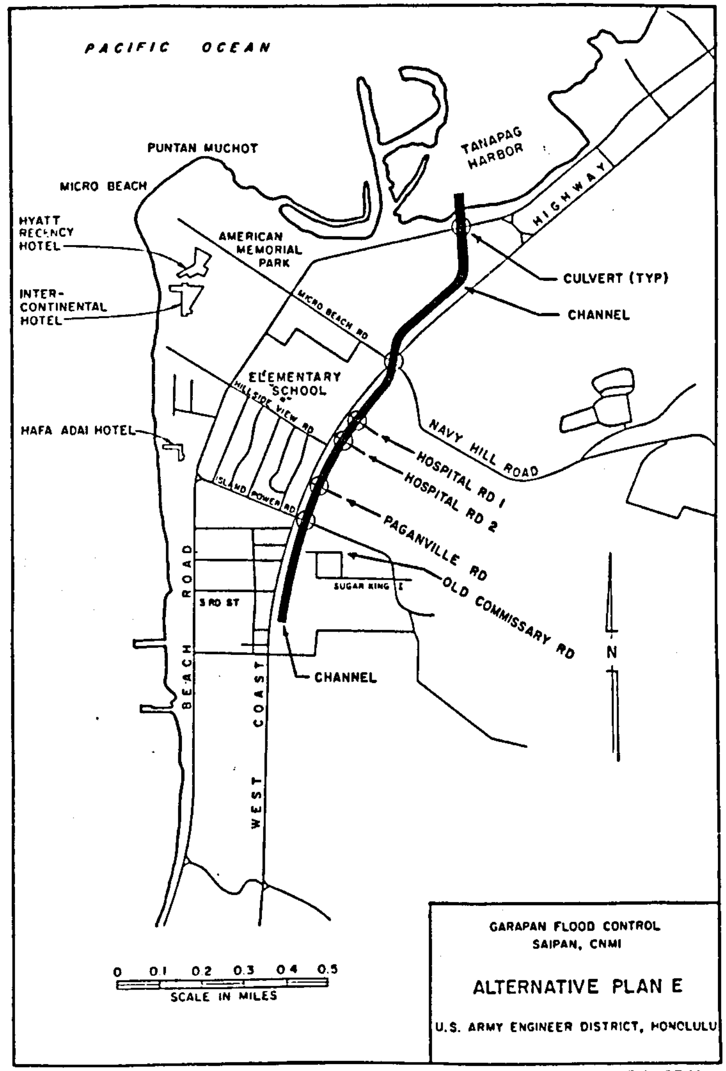

FIGURE 11

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

REPLY TO
ATTENTION OF:

October 6, 1986

Mr. Ernest Kosaka
Project Leader
Office of Environmental Services
U.S. Fish and Wildlife Service
P. O. Box 50167
Honolulu, Hawaii 96850

Dear Mr. Kosaka:

This is in response to your August 8, 1986 letter regarding the Garapan Area Flood Control Study. As you are aware, the August 23, 1985 meeting (mentioned in your letter) was requested by our office to further coordinate the recommendations presented in the Final Coordination Act Report, Section 2(b). At that meeting, we presented the effects of the recommended plan on the wetland based on investigations by our hydrologist and biologist.

We have examined the observations your staff has made during their January 1986 visit to the American Memorial Park wetland and the statements you have made concerning the impact of the channel alignment of the proposed recommended plan on the American Memorial Park (AMP) wetland. We feel that further investigations of the effect of the channel alignment on the wetland are not warranted for the following reasons.

First, the marsh fern (Acrostichum aureum), which is the primary nesting habitat of the Mariana Gallinule, has been found to thrive in brackish waters. According to three sources, the Acrostichum aureum flourishes on the shores of brackish waters in coastal hammocks of Florida, West Indies, Mexico and South America ("Flora of Tropical Florida" (1971)); in coastal swamps and marshes ("Guide to the Vascular Plants of the Florida Pan Handle" (1985)); and in margins of mangrove swamps and in open brackish or salt marshes ("Flora of the Lesser Antilles" (1977)). In addition, 15 plant species found in the AMP wetland have been found in the Lake Susupe wetland, where widely varying chloride levels have been measured (251 to 1,800 ppm) in Lake Susupe.



The fact that higher salinity levels may already exist in the wetland is emphasized by the proximity of the wetland to the ocean and the quality of well water in the surrounding areas. The chloride concentrations in the Garapan area wells are upward of 300 to 800 ppm and USGS well data showed a chloride concentration over 800 ppm one mile inland of the AMP wetland. Although well water quality can be a function of pumping rates, well depths and seasonal fluctuations in water levels, these high chloride concentrations indicate that seawater intrusion is widespread and not confined to the immediate shoreline areas. Hence, high salinity is expected in the groundwater which sustains the AMP wetland because the wetland is located just a few hundred feet inland from the shore.

Second, the fact that the wetland also depends on surface flow is supported by Mr. McVein's measurement of the wetland water showing a salinity of zero parts per thousand. If he had measured groundwater in the wetland, we suspect that the salinity would have been higher given the chloride measurements in wells further inland. Because his visit occurred in early January, near the end of the wet season, he most probably measured surface water which had ponded in the wetland. The general consensus, based on our field investigations and interviews with Garapan residents and CNMI biologist, is that the wetland perimeter rapidly increases during the wet season and shrinks during long droughts.

Evidence points to the AMP wetland being quite tolerant to changes in water levels and salinity. Consequently, the assumption that negative impacts on the Mariana Gallinule may result because of adverse impact on nesting and other vegetation due to possible seawater intrusion or changes in water levels is not supported.

However, we do feel, based on existing data, that the effects of the channel alignment of the recommended plan should not significantly affect the viability of the Mariana Gallinule. Our data, consisting of borings, archaeological excavations and USGS data, show the water table in the region where the channel runs along the AMP wetland to have a height between one and two feet above mean sea level (MSL). The water table in the AMP wetland also ranges between one and two feet above MSL. Large differences in gradient (approximately 2 to 3 feet) between the water level in the channel and water table of areas adjacent to the channel will be short-lived due to natural tidal cycles. For the most part, the difference in gradient will be very small and although water will transfer through the surface of the unlined channel whenever a gradient exists, rise in salinity or decrease in the wetland water levels will be minimized by: 1) dilution effects caused by the flow of water into the channel from upstream reaches where the channel intersects the water table; and 2) the likelihood of a layer of low permeability silts and clays near the bottom of the wetland resulting from the accumulation of humus and other decaying organic matter that will tend to stabilize the water levels in the wetland.

We have seen and are aware of the Draft General Management Plan and Comprehensive Design for the American Memorial Park. Our environmental staff has coordinated and consulted with Mr. Gordon Joyce (NPS), and Mr. Tom Lemke (Division of Fish and Wildlife, CNMI) during previous field investigations of potential impacts of various alternatives on the Garapan wetland. The recommended channel alignment is the result of these consultations and is believed by Mr. Joyce and Mr. Lemke to be the least environmentally damaging of the economically feasible plans. Hence, the recommended plan is the result of in-depth study and coordination with local and other Federal agencies.

The recent amendments to 40 C.F.R. 1502.22 require the disclosure of the fact of incomplete or unavailable information when evaluating reasonably foreseeable significant adverse impacts on the human environment. As part of our compliance with environmental statutes, we have completed coordination under Section 7 of the Endangered Species Act with respect to impacts on two species found in the wetland, the Mariana Gallinule and Nightingale Reed Warbler. On February 12, 1985, we received a "no jeopardy" Biological Opinion from the U.S. Fish and Wildlife Service. On this basis and in view of our overall environmental impact analysis, we





concluded that the proposed project would not pose any reasonable foreseeable significant adverse impact on the human environment.

In addition (referring to Mr. McVain's observation noted in his trip report), we do not agree that a roadside ditch and culvert system throughout the village would serve the flood control needs. Our economic sensitivity analysis of the structural alternative plans indicates that optimization occurs at approximately the 50-year level of protection. The 50-year design flow is about 2,000 cubic feet per second (cfs). In comparison, the existing lined ditch along Island Power Road has an estimated capacity of 220 cfs, which means that numerous ditches similar to the existing ditch would be required to convey 2,000 cfs to the ocean. In addition to high land costs (purchasing prime hotel resort and residential lands), a ditch and culvert system throughout the village would cause major community disruption in the urban area. We believe that the socio-economic impacts, and the aesthetic and water quality effects of having multiple outlets at the beachfront would be economically infeasible and unacceptable to the general public.

Our findings indicate that the technical, economic, social and environmental study objectives are optimized by the recommended plan. Based on the extended effort that has been put forth in the study of the American Memorial Park wetland, and our ongoing evaluation and findings, we feel that further hydrologic studies are not warranted.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

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

REPLY TO
ATTENTION OF:

October 14, 1986

Mr. Bob Rudolph
Administrator
Coastal Resources Management
Office of the Governor
Saipan, CM 96950

Dear Mr. Rudolph:

We are responding to your letter of August 15, 1986, regarding the Federal Consistency Determination for the Garapan Flood Control Project, Saipan, Commonwealth of the Northern Mariana Islands. Enclosure 1 contains our point-by-point responses to your comments listed in your Summary of Review. On review of your numerous comments, we believe the issues or points of disagreement may be summarized as follows:

(a) Adequacy of the evaluation and documentation of hydrologic data to demonstrate the probable impacts on the American Memorial Park (AMP) wetland due to implementation of the recommended project; and,

(b) Compatibility of the recommended project with CRM program goals, policies and regulations -- particularly with respect to potential adverse impacts on coastal resources, water quality, and recreation.

On item (a), we will incorporate additional information in the report regarding our analysis and conclusion on the probable changes in salinity of the AMP wetland water due to the project. Based on our research and evaluation of existing information, we concluded that the impacts of increased salinity on th wetland waters would be only marginal periodically. Under normal dry weather conditions, the groundwater table adjacent to the channel is estimated generally higher (approximately 2.0 ± MSL) than the expected tid controlled water level in the proposed channel, creati a differential in head (or gradient) which provides groundwater seepage into the channel. This gradient





would tend to confine the saline waters within the channel. The resultant inflow of groundwater would also tend to mix and dilute the saline waters. Conversely, during extreme high tide conditions, the channel water surface elevation may exceed the adjacent groundwater table to cause seawater intrusion. The magnitude of this gradient in either direction would be limited to a narrow range of about 3 feet due to the estimated groundwater table and tide range. Also, because of the high and low tide cycle, reversal of flow between the channel and the groundwater waters would occur practically on a daily basis. Thus, significant increases in the salinity of the wetland waters are not expected. Because of the proximity of the AMP wetland to the ocean, we further believe that saltwater intrusion into the wetland is already occurring. This is supported in the U.S. Fish and Wildlife Service (FWS) Final Coordination Act Report [Section 2(b) Report] where the marsh waters are considered to be saline.

Our perception of the main concern raised by the U.S. Fish and Wildlife Service (FWS) in their Final Coordination Act Report [Section 2(b) Report] is that increased salinity in the wetland has the potential to adversely impact the marsh fern (_Acrostichum aureum_), which the Mariana Gallinule (_Gallinula chloropus guami_) is known to use for nesting, thereby indirectly affecting the suitability of the wetland as a Gallinule habitat. Our research findings concur with the statements made by FWS in Section 2(b) for Alternative Plan D, which states that the marsh fern is tolerant of brackish waters and can be found in habitats ranging from freshwater to saltwater marshes. "Another coastal saline marsh is the _Acrostichum_ marsh dominated by this robust fern averaging 1 m tall. The _Acrostichum_ marsh is found in the Caroline and Mariana Islands, and Samoa, and can occur where mangrove has been cleared by man, or naturally damaged by storms." (Page 9, _A Guide to Pacific Wetland Plants_). A copy of "A Guide to Pacific Wetland Plants" by Loni Stemmermann has also been enclosed for your information (enclosure 2). Hence, due to the proximity of the AMP wetland to the ocean, the short-term reversal of flow through the channel surface, and the established tolerance of the _Acrostichum aureum_ to wide salinity ranges, we do not agree with the FWS assessment that any increase in wetland salinity will adversely impact the marsh fern and by doing so, adversely impact the Mariana Gallinule.

Based on available data and our current knowledge of the groundwater conditions and the wetland flora, we believe that the impacts of the project on the AMP wetland will not be significant. In the past and in reference to the potential increases in salinity of the AMP wetland, the word significant, as used by the U.S. Geological Survey and FWS, meant any measurable change. We do not believe that a measurable change in the existing salinity levels would necessarily cause significant adverse impacts to the AMP wetland. In our assessment, the AMP wetland is not a true freshwater marsh but one that also exhibits characteristics of a saltwater marsh. Both fresh- and saltwater marsh types are characterized by herbaceous species (mostly sedges and grasses), which can be found in the AMP wetland. Therefore, we conclude that further studies of the AMP wetland are not needed.

As for item (b), we believe we have considered the provision of the CRM Program satisfactorily based on guidance we have on hand, and that the documentation was prepared in like manner. Our responses to your concerns are prepared to further clarify our study findings on project related impacts, which for the most part, are considered unavoidable or insignificant in light of the beneficial effects of the flood control project. However, as stated in our September 1986 letter to your office on the Lake Susupe Consistency Determination, we are waiting anxiously for a copy of your revised CRM regulations so that we can review the compliance aspects of the consistency document. To reflect your recent changes in the CRM regulations, we will resubmit the consistency determination for your review.

In summary, we will be incorporating additional information in the report to illustrate more clearly the groundwater/seawater effect and its relationship to the AMP wetland; and more importantly, our determination and rationale that the project will not significantly affect the marsh and the Mariana Gallinule habitat. In reviewing our enclosed responses, please keep in mind





that certain resources development and management requirement contained in some of your CRM policies are local actions or responsibilities and beyond the scope of our flood control study. Nevertheless, we welcome any specific suggestions or practical mitigation measures you may have.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

Enclosures

Copy Furnished: (With Enclosures)

Honorable Pedro P. Tenorio
Governor, Commonwealth of the
Northern Mariana Islands
Office of the Governor
Saipan, CM 96950

Mr. Pete Sasamoto
CIP Advisor
Office of the Governor
Saipan, CM 96950

Ms. Laurie J. McGilvray
Pacific Region, U.S. Department
of Commerce
National Oceanic and Atmospheric
Administration
Office of Ocean and Coastal
Resource Management
1825 Connecticut Avenue, N.W.
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RESPONSES TO
COASTAL RESOURCES MANAGEMENT (CRM) COMMENTS
ON THE
FEDERAL COASTAL ZONE MANAGEMENT (CZM)
CONSISTENCY DETERMINATION,
FINAL DETAILED PROJECT REPORT
AND
FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR GARAPAN FLOOD CONTROL STUDY
SAIPAN, COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

## I. PROJECT DESCRIPTION

1. CRM COMMENT:

The proposed flood control project consists of channel improvements which would convey flows transversely through the floodplain upland of the West Coast Highway and which would then cross the West Coast Highway and Micro Beach Road intersection. The grasslined channel would proceed around the AMP wetland and end with a Tanapag Harbor outlet. (See Attachment I, "Figure 7.")

The channel improvements will be trapezoidal in shape with riprap lining as needed. The length of flood control improvements is about 5,960 feet. This plan would provide for ditches and spillway inlets to convey upland flows to the interceptor channel. This plan would also require construction of culverts along the channel alignment at six road crossings. The six road crossings include Beach Road, Micro Beach Road and West Coast Highway intersection, Hospital Roads 1 and 2, Paganville Road, and Island Power Road. The existing Old Commisary Road would be closed to through traffic at the West Coast Highway. Water and sewer utilities would require relocations at these crossings. In lieu of channel transitions and culverts, bridges were considered and were found to be more costly. No relocation of homes or businesses would be required.

POD RESPONSE:

No response required.





## II. ARMY CORPS CONSISTENCY DETERMINATION AND FINDINGS

2. CRM COMMENT:

The ACOE prepared a consistency statement with its final project report and EIS. While it is not explicitly stated, we assume, based upon the determination's statements, that the ACOE finds the project to be consistent to the maximum extent practicable with the CRM Program.

POD RESPONSE:

No response required.

## III. CRM'S OBJECTION TO THE CONSISTENCY DETERMINATION

3. CRM COMMENT:

CRM hereby objects to the consistency determination made by the ACOE, finding that: a) the proposed project is inconsistent with the policies and objectives of the CRM Program, particularly as set forth in the Coastal Resource Management Act of 1983 (CNMI Public Law 3-47) and CRM Rules and Regulations promulgated thereunder in Vol. 7, No. 10 of the Commonwealth Register, because the proposed project has the potential to have a direct and significant adverse impact on coastal resources; b) the ACOE has failed, subsequent to previous written CRM requests, to provide all information needed to fully determine the consistency of the project with the CRM Program, and; c) it appears there are alternatives available that could eliminate or reduce adverse impacts created by the project.

POD RESPONSE:

a) The US Army Corps of Engineers, Pacific Ocean Division (POD) had not been aware, nor been informed by CRM personnel, of changes to the rules and regulations governing the CRM Program. Although there have been several opportunities for the CRM office to transmit copies of the Coastal Resources Management Act of 1983 (CNMI Public Law 3-47) and CRM's Rules and Regulations (Vol. 7, No. 10 of the Commonwealth Register) to the Corps, CRM has elected not to do so. A revised Federal Consistency Determination will be submitted for review once the appropriate reference materials have been obtained and incorporated. As stated in the report and consistency determination, no "significant" adverse impacts to the coastal resources are anticipated due to the project.

b) A letter dated August 23, 1984, outlining three (3) concerns with a request for information, and a subsequent letter dated September 4, 1984, acknowledging the Corps' initiative to address these concerns, are the only written comments received from CRM prior to the August 15, 1986 letter in which these comments are in response to. Since two (2) of the issues (inconsistent wetland boundaries, and diversion channel) have been resolved, the only issue unresolved by this comment appears to be in reference to further wetland studies, which we no longer feel is necessary. The environmental resources of the wetlands have already been adequately identified. We also do not feel that the impacts of the project on the wetland hydrology, and subsequently the environmental resources, is significant enough to warrant special studies.

c) It is unclear as to which available alternative(s) this comment refers to.

## IV. CRM'S REVIEW FINDINGS AND CONCLUSIONS

1) General

4. CRM COMMENT:

ACOE's statement that the current "CRM Policies, Goals, and Objectives were promulgated by CNMI Executive Order 15" is incorrect. While very similar to E.O. 15, the CNMI Coastal Resource Management Act of 1983 (Public Law 3-47) superceded the Order and has been incorporated into the CRM Program as a routine program implementation. The CRM Rules and Regulations now in effect were published in Volume 7 Number 10 of the Commonwealth Register. Included in these regulations are general standards and criteria for evaluating proposed projects located wholly, partially or intermittently within an Area of Particular Concern (APC), or which have a direct and significant impact on an APC or which are designated as a major siting. Specific standards and priorities of Major Sitings and APC's under the CRM Program are also provided. The regulations require project proponents to demonstrate by a fair proponderance of evidence that the project will not have a significant adverse impact on the coastal environment or its resources.

POD RESPONSE:

See POD Response #3(a).





a) Inconsistencies:

5. CRM COMMENT:

Page 17 of the EIS states that "(t)he outlet channel will contain standing seawater as far as the West Coast Highway culvert." CRM measurement of ACOE Plate C-1 describing the recommended plan find this distance to be about 2,400 feet.

On the other hand, Page 1 of the evaluation of the project in relation to Environmental Protection Agency (EPA) Section 404(b)(1) Guidelines (Appendix H [I]) states that "if the channel mouth is dredged first, then the portion of the outlet channel subject to standing saline water [will be] about 4,500 feet."

POD RESPONSE:

The statement in the EIS, regarding standing seawater in the outlet channel, describes the predominant conditions expected. Groundwater seepage into the channel will occur due to the higher static head of the groundwater table in relation to the standing water elevation in the channel. Thus, a zone of mixing (groundwater and seawater) is expected within the channel. Generally, the mixing zone would extend as far as the West Coast Highway culvert. The upper extent of the zone of mixing would be variable, dependent on the such factors as rainfall, tidal fluctuations, groundwater level, sedimentation within the channel and so forth.

The statement in the Section 404(b)(1) Guidelines describes the expected maximum extent of brackish water in the channel. During construction, the amount of groundwater seeping into the channel is minimized, thus saline water could extend up to about 4,500 feet up the channel where the invert is at 0 feet MSL during low tide. The mixing of groundwater and seawater is expected to reach an equilibrium state soon after.

Necessary clarifications will be made in the report.

6. CRM COMMENT:

Page 8 [should be Page 10] of the ACOE CRM Consistency Determination states at 5(e) that "(t)he project will commit a total of approximately 13.2 acres to structural flood control improvements". However, Table 2 of the EIS states at Item (2)(a) that 10.4 acres of the "terrestrial environment" will be modified by the project (Plan E).

POD RESPONSE:

The channel improvements will require about 20.7 acres of land, as described in the design appendix, to construct the project. Corrections in the Consistency Determintion and EIS will be made to show 20.7 acres. Of the 20.7 acres, the estimated "terrestrial environment" acreage is 10.4.

7. CRM COMMENT:

The December 17, 1984 letter from the ACOE to the U.S. Fish & Wildlife Service (FWS) described a recommended plan that "will not encroach on the existing Garapan wetland boundary."

"Attachment 1" with the letter is the ACOE Figure 7 map for Alternative A which depicts the outlet channel running directly through the AMP wetland.

POD RESPONSE:

Attachment 1 (Figure 7) is a copy of Alternative Plan A which we superimposed Plan E alignment onto in red and changed the "A" to E". Unfortunately, subsequent printing and reduction did not pick up the changes made. Nevertheless, Alternative Plan E was the subject of the letter. Although barely perceptable in the report copy, the channel alignment referred to in the letter was clearly distinguishable in the original sent to the Fish and Wildlife Service. This channel extends around the wetland area (the figure for Alternative Plan E had not been drafted during the time of the letter).





8. CRM COMMENT:

Page 24 of the project report describes Alternative Plan E. The outlet channel in the plan is to "detour around and not encroach upon the wetland areas."

Page 5 [should be Page 6] of the consistency determination states in 3(a) that the project "requires location within wetlands and a lagoon."

POD RESPONSE:

These two statements refer to separate wetland areas and are not necessarily inconsistent. The statement on page 24 should read, "detour around and not encroach upon the American Memorial Park (AMP) wetland areas". The statement on page 5 of the consistency determination should read, "requires location within the intertidal wetland and a lagoon". The latter statement refers to the mangrove swamp and shoreline wetland area located at Unai Sadog Tase near the channel mouth. Necessary clarifications will be made in the report to make this clear.

9. CRM COMMENT:

In reviewing the hydrology section of the Final Project Report (Appendix A), CRM notes that the ACOE has used hydrologic information from two Guam river watersheds (Ugum & Umatac) in order to extrapolate hydrograph data for the Garapan watershed. The applicability and similarity of the Guam information to Saipan is questionable since the former relates to rivers draining volcanic watersheds. The Garapan project, on the other hand, addresses a floodplain of limestone whose watershed is also primarily limestone and whose overland flow of water is irregular. In addition, the floodplain area has groundwater present at 5 feet or less which fluctuates with the tides, condition quite dissimilar to the Guam areas.

POD RESPONSE:

Due to a lack of hydrologic information as related to surface runoff, the best available data was used. This is an accepted method for the evaluation of the hydrology in areas where such insufficiencies exist. Typically, the differences in rainfall between Ugum (Guam) and Garapan (Saipan) are not anticipated to differ significantly due to regional proximity. Fluctuations in the groundwater level are not relevent to surface water hydrology. However, it is interesting to note that CRM agrees with our assertion that groundwater in the area of the AMP wetlands are influenced by tidal fluctuations.

F-47

10. CRM COMMENT:

On page 11, the EIS states that "preliminary current studies suggest that there is little significant continuous littoral movement of coastal materials along the lagoonal shoreline at Garapan." Later the same paragraph, it is further stated that:

> The Unai Sadog Tasi intertidal reef is now a sluggish backwater area within Tanapag Harbor due to the creation of artificial peninsulas in the harbor and blocking of a stream during World War II. The reef flat is now a mud flat probably influenced most by slow tidal currents. (Emphasis added).

However, it appears that the ACOE contradicts itself later in the Consistency Determination (page 7 [should be page 9] section 4 [d]) by stating that "(t)he rapid residence time of lagoon waters is expected to minimize adverse effects of sedimentation caused by silt-laden flood water discharge from the project." (Emphasis added.)

POD RESPONSE:

The statements in the EIS describe conditions at Unai Sadog Tasi under normal circumstances. The second refers to conditions under the influence of flood waters from the channel. These are two different conditions and the statements are not contradicting or inconsistent.

b) unresolved issues:

11. CRM COMMENT:

In its August 23, 1984 letter to the ACOE, CRM noted that the draft EIS made several references to additional wetlands studies that were to be accomplished prior to the final EIS in order to define impacts and potential mitigation measures. CRM also stated that such information would be needed in order to evaluate the consistency of the recommended project. However, page 6 of the ACOE evaluation of the project in relation to the EPA Section 404 (b) guidelines states at (d) that "the significance of [the sheet flow of rain] water to the overall hydrology of the marsh and swamp is not known." And that the:

> "(c)haracteristics of the soils along this channel alignment have not been determined. It is quite possible that relatively porous soils occur in the project area, in which case without an impermeable lining seawater infiltration of the wetland could result.



> Significant alteration of the salinity of the wetland could result in adverse modification of the marsh as gallinule habitat. The Army Corps of Engineer has determined that providing an impermeable lining the length of the outlet channel is not cost effective. Additional soils studies will be conducted to determine the porosity of soils."

POD RESPONSE:

Since August 1984, we conducted the wetland boundary study with CNMI Fish and Game staff. Because of the potential adverse impacts on the AMP wetland, the previously recommended plan (Plan A) was dropped and a new recommended plan (Plan E) was developed.

Additional wetland studies have since been determined to be unnecessary for the following reasons:

a) We do not consider the infiltration of high salinity seawater from the channel into the AMP wetland to be a likely event. The groundwater table near the proposed channel is at about +2 feet MSL from STA 10+00 to about STA 25+00, where it gradually increases to about +4.5 feet MSL at around STA 49+00. The highest tide expected (highest water level in the channel) is +1.9 feet MSL. Thus, the general tendency is for the groundwater to flow into the channel beyond STA 10+00, not vice versa.

b) We do not expect the channel to significantly alter the groundwater flow in the vicinity of the AMP wetland. To significantly alter the location of the zone of mixing, the channel would have to divert virtually all the present flow toward the sea. As we have found that there is also a groundwater gradient from across Micro Beach Road toward the AMP wetland, we do not see this as a likely event. The maximum difference in static head expected between the groundwater table and the water level within the channel is about 2 feet, limiting the amount of water flowing into the channel from the groundwater body. Only under circumstances of extreme droughts would we expect the zone of mixing to move significantly inland, causing the intrusion of seawater into the wetland from the seaward direction. We believe that this condition already occurs due to the high permeability of the underlying material in the area.

c) Based on a plot of the groundwater elevations in the area, groundwater tends to flow into the wetland area from across Micro Beach Road as well as from the uplands and across the West Coast Highway. Thus, groundwater recharge of the wetland does not occur from the direction of the proposed channel alone. In fact, this plot indicates the change in hydraulic gradient to be greater in this direction.

d) Since the brackish, mixohaline water in the channel would be denser than fresh water, it would tend to seep downward through the channel bottom as well as seaward. However, before reaching the AMP wetland, this water would be further diluted by groundwater flows from across Micro Beach Road. Thus, with the project in place, high concentrations of saline waters in the AMP wetland are not anticipated to occur due to these mechanisms.

This whole process would vary with the same set of factors which affect the mixing of groundwater and seawater within the proposed channel. Mixohaline waters which seep into the soil near the AMP wetland are anticipated to be "flushed out" during periods of heavy rain.

e) We believe that the AMP wetland is fed by surface water as well as groundwater. There is also likely to be a layer of low permeability silts and clays created by the accumulation of humus and other decayed organic material at the bottom of the wetland. The significance of this layer is that it would act as a buffer against saltwater intrusion from the direction of the proposed channel as well as the ocean.

f) We question claims stating the waters within the AMP wetland are perpetually or even predominantly fresh (salinity levels below 1,000 mg/L or 1 part per thousand [ppt]). These assertions are not substantiated by the following information:

1) Plant life within the AMP wetland is quite similar to that found in the wetlands of Lake Susupe. The waters of Lake Susupe are quite brackish with chloride concentrations as high as 5 ppt recorded in 1983 1/. The corresponding salinity level is about 7 ppt based on a ratio of chloride content to total dissolved solids (TDS) concentration (salinity) of 1:1.4. Of the nineteen (19) species of vegetation identified within the AMP wetland, fifteen (15) are also found around Lake Susupe. Several of these species are known to inhabit saltwater marshes. (The non-occurrence of the remaining species can probably be explained by factors other than salinity differences between the two wetlands.)

1/ - "Compilation of Water Resources Development and Hydrologic Data of Saipan, Mariana Islands, 1984", Water Resources Investigations Report 84-4121, van der Brug, Otto, U.S. Geological Survey, 1985.





Two conclusions can be drawn from the similarity of plant life in Lake Susupe and the AMP wetland. One, if the AMP wetland is not a true freshwater marsh and experiences salinity increases from time to time, then existing plants in the AMP wetland thrive because they are able to adapt to these fluctuations, which we believe to be the case. Secondly, if the AMP wetland were to be a true freshwater marsh, which we think unlikely, then increases in salinity levels of the wetland waters would not necessarily be detrimental to these plants because these plants are able to survive in the brackish water environment of Lake Susupe.

The marsh fern (Acrostichum aureum), is especially hardy and tolerant of salts in water. This species is often found in saltwater marshes and saltwater swamps dominated by mangroves. Along with the bulrush (Scirpus litoralis), which are found in abundance around Lake Susupe and in other saltwater marshes, the marsh fern is known to be used as cover by the Marianas Gallinule.

2) Chloride measurements from water system wells (Calhoun wells Nos. 1X & 2X) located approximately one mile inland from the AMP wetland (in the vicinity of drainage area 3, Plate A-1) have read as high as 1,200 mg/L, translating into salinity levels of nearly 2 ppt. Although this figure is undoubtedly influenced by the pumping rate, depth of well intake, and seasonal fluctuations of the rainfall (and groundwater levels) and other factors, as the USGS states regarding salinity patterns and groundwater bodies, "Probably the most nearly consistent feature is a generally increasing freshness of water with distance inland from the shore..."2/.

3) Seasonal variations in rainfall would likely influence any salinity level readings taken within the AMP wetland. Salinity measurements recorded in say early January, which is toward the end of the wet season when the groundwater levels are at a maximum, would be expected to be lower than if these measurements were made later during the dry season (April through June). Other factors which would influence salinity levels in the wetland are tidal fluctuations, depth at which these measurements were taken, and proximity in time of these measurements to recent rainfall.

4) The high permeability of the underlying material in the vicinity of the AMP wetland makes it is highly probable that migration or infiltration of seawater into the wetland already occurs during periods of moderate precipitation or droughts.

2/ - "Compilation of Water Resources Development and Hydrologic Data of Saipan, Mariana Islands, 1984", Water Resources Investigations Report 84-4121, van der Brug, Otto, U.S. Geological Survey, 1985.

g) The claim that salinity increases within the AMP wetland would have an adverse impact on its suitability as a habitat for the Mariana Gallinule is not supported. The primary habitat of the waterfowl is Lake Susupe, which as previously stated is quite brackish. The bulrush (Scirpus litoralis) and marsh fern (Acrostichum aureum), which are common in the wetlands of Lake Susupe, are used as cover by the Gallinule and are very tolerant of increased salinity. Although the two species of plants probably would not be able to survive direct exposure to seawater, this condition would not occur with the project. Only slight increases in salinity are expected.

12. CRM COMMENT:

The ACOE evaluation of the project in relation to the EPA Section 404(b) guideline also admits on page 6 that the significance of sheetflow runoff rain water "to the overall hydrology of the marsh and swamp is not known".

POD RESPONSE:

It is likely that the AMP wetland is predominantly groundwater fed. Although we stated the significance of surface runoff is not known, we also stated after the quoted statement that "even during drought conditions, standing water remains within the marsh, indicating a subsurface water source". However, to state that the wetland is not dependent on surface runoff or heavy rainfall would be erroneous. We believe that the surface runoff to the wetland becomes prominent only during high flood flow events. Accordingly, we do not consider the overall surface water hydrology of the wetland to be significant.

13. CRM COMMENT:

Obviously the Corps itself realizes that additional studies need to be done in order to understand the effects of the project. Without such data the ACOE lacks support for its claim that the project will not harm coastal resources (the AMP wetland in particular). Furthermore without such data it is impossible for CRM Program to make a consistency determination. *Moreover, the ACOE claim that mitigation by an impervious lining is prohibitively expensive is not supported by cost comparisons.

POD RESPONSE:

As previously stated, we no longer feel that additional studies are needed to understand the effects of the project, especially in regards to the issue of seawater intrusion into the AMP wetland. Our





information indicates that there will be a net flow of groundwater into the channel even during high tides and that these quantities will not be sufficient to significantly alter the location of the zone of mixing on the seaward side of the wetland from that naturally occurring.

The conjecture that salinity increases would have adverse impacts on the wetland as a suitable habitat for the Mariana Gallinule is not supported by evidence. Two species of plants known to be used as nesting material by the Gallinule are found in the wetland waters of Lake Susupe which, as previously stated, is quite brackish.

The use of an impervious channel lining, whether it be of concrete or elastomeric material, is not a viable option from an engineering and cost standpoint. Weepholes would be required to relieve and dissipate the build-up of hydrostatic pressure behind the lining. These weepholes are essentially holes in the lining. Thus, with weepholes, nothing would be gained by the use of an impervious lining. The use of sheet piles to confine the mixohaline waters in the channel were found to be costly. This later proposal would increase the project costs by an additional $750,000. If concrete were to be used to line the channel, the project costs would probably increase on the order of $1 to $2 million.

14. CRM COMMENT:

CRM also notes that the "Final Coordination Act Report" prepared by the U.S. Fish & Wildlife Service (FWS), July 1985, states on Page 10 that "(w)ithout the impervious channel, the Service finds Alternative E unacceptable." The FWS Finding further supports the conclusion that the channel lining is a significant unresolved issue for parties concerned with the evaluation of the project. The ACOE admits that "seawater intrusion into groundwaters adjacent to the wetlands still adversely affect the marsh and the Mariana Gallinule habitat" (EIS page 19). Within the consistency determination (pg. 6, Section 3[A], the Corps also states that the "outlet channel may alter essential hydrological or ecological function of the wetlands nearby the channel."

In fact, the ACOE has helped to articulate the incompatibility of the recommended project with the CRM Program by stating in the determination (page 10 Section 5[g]) that the "project may induce changes in hydrologic (sic) and reduce habitat value for wetland-dependent organisms including endangered species."

CRM therefore finds that additional hydraulic, hydrologic and geologic information is needed in order to fully evaluate the potential impacts of the project on coastal resources. The program also finds that it is likely that practicable mitigation measures or design alternatives exist for the project.

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POD RESPONSE:

Again, we do not feel that further studies or information are required to assess the impacts of the project on the AMP wetland. The statement that "...the Service finds Alternative E unacceptable" is followed by the qualifier, "...the Service believes that the increase in salinity will reduce the suitability of the Garapan wetland as habitat for the endangered Mariana Gallinule". Again, this condition is not supported by evidence from Lake Susupe, where the waters have been shown to be quite brackish. If the salinity of the AMP wetland waters were shown to be extremely low, indicating freshwater, and it were also shown that the Gallinule had a preference for freshwater wetlands, then greater numbers of Gallinules within the AMP wetland would be expected than presently exist.

Perhaps more significant than the 2(b) Final Coordination Report is the consultation under Section 7 of the Endangered Species Act of 1973 between the Corps and the FWS. The bottom line of these consultations indicates that "the wetland area on Saipan is small, and any further decreases in wetland area or quality would inhibit the recovery of gallinule on the island. However, such inhibition of recovery, although detrimental, would not be likely to jeopardize the continued existence of the Mariana gallinule in consideration of the total population extant." Although we believe that such extreme degradations of the water quality within the AMP wetland will not occur solely due to the project, the question of the continued survival of the Gallinule is not at issue. Even the concern over the suitability of the AMP wetland as a habitat for the Gallinule with increased salinity is unsubstantiated on Saipan and is therefore suspect.

Changes to incorporate our present views will be made to the sections quoted in the report under this comment.

If CRM would like to submit suggestions on "practicable mitigation measures or design alternatives", please feel free to do so. However, without being specific, modifications to our present plan are not likely to result from these comments.

15. CRM COMMENT:

Accordingly, CRM objects to the consistency determination at page 6, Section 3(f), that "<u>to the maximum extent possible</u>, principal features of the project have been sited ... to preserve the Garapan wetlands" (emphasis added).



POD RESPONSE:

Granted other alternatives are available which have lower potential impacts on the Garapan wetland by placing the channel outlet near the hotels. However, these alternatives are not economically feasible, and would be socially unacceptable because of their potential adverse impacts on the tourist industry. These plans would also raise concerns over their negative impacts to the recreational beaches and water quality fronting the hotels. Of the remaining alternatives, the recommended plan decreases the amount of adverse environmental impacts associated with actual construction in the wetland. All things considered (economics, social impacts, environmental concerns, project costs), we believe that the recommended plan is the best available.

From an engineering standpoint, the use of shallow open drainage channels or ditches, similar to the old Japanese drainage system in Garapan, is not practicable. These systems are undersized and unlikely to convey the flood flows expected from storms greater than the 2-year frequency. For comparison, the existing ditch along Island Power Road is capable of conveying flood flows of about 200 cubic feet per second (cfs), the recommended channel, on the other hand, is able to convey flood flows over ten times greater. (The ratio of flood flow to channel size is not directly proportional.)

<u>2) Comparison of ACOE Consistency Determination to CRM Program Goals, Policies and Regulations</u>.

<u>a) Public Law 3-47, The Coastal Resources Management Act of 1983.</u>

The above referenced law requires that CRM shall plan for and manage any use of activity with the potential for causing a direct and significant impact on coastal resources. Significant adverse impacts are to be mitigated to the maximum extent practicable.

Policies relating to impacts on water quality, including discharges, are further clarified as:

Section (9) Require any development to strictly comply with erosion, sedimentation and related land and water use districting guidelines...

Section (10) Maintain or improve coastal water quality through control of erosion, sedimentation, runoff, siltation, sewage and other discharges;

Section (13) Require compliance with all local air and water quality laws and regulations and any applicable federal air and water quality standards;

Section (14) Not permit, to the extent practicable, development with the potential for causing significant adverse impact in fragile areas such as designated and potential historic and archaeolcgical sites, critical wildlife habitats, beaches, designated and potential pristine marine and terrestrial communities, limestone and volcanic forests, designated and potential mangrove stands and other wetlands;

Section (15) manage ecologically significant resource areas for their contribution to marine productivity and value as wildlife habitats, and preserve the functions and integrity of reefs, marine meadows, salt ponds, mangroves and other significant natural areas.

16. CRM COMMENT:

The first inadequacy that CRM notes in reviewing the flood water discharge impacts is that the recommended plan fails to incorporate sedimentation controls to mitigate the impacts of silt laden flood waters discharging into the lagoon. In fact, the ACOE claims that the estimated design velocity at the channel mouth is six feet per second in order to make the project "self cleaning" and prevent silt pile up. In addition, the ACOE plans to line approximately 3,530 feet of the upland channel with fill material consisting predominantly of "natural occuring materials with particle sizes larger than silt" (Appendix H[I], page 2). Given the expected volume and rate of flow of flood waters, concern is raised as to how such particles will be prevented from becoming suspended and discharged. As several reviewers have noted, the outlet is in the vicinity of several popular public beaches. "Whether or not silt and debris-laden flood waters are discharged during rising or falling tidal movements would likely determine the degree to which 'dirty' water might be carried to recreational beaches" (EIS page 16 Section 6.3).

CRM finds the lack of any sedimentation controls to be contrary to the CRM program. We note in the preceding section and in IV(a)(6) above that the ACOE has made incomplete and inconsistent statements about the receiving waters and the effects of flood waters at Unai Sadog Tasi.





POD RESPONSE:

The outlet area of the proposed channel at Unai Sadog Tasi is characterized by mud flats and sea grasses. The receiveing water there is already degraded with silts. The negative impacts associated with the discharge of additional sediment from the channel during flood flows are insignificant under such conditions. In fact, we expect beneficial impacts to occur as a result of the increased nutrients to be discharged into the mud flats in this area of the lagoon. The affected lagoon area is also insignificant at about 0.10 acres. Apparently the CRM reviewers have failed to notice that the a man-made peninsula exists directly in the path between the channel outlet and the "recreational beaches" fronting the major hotels.

17. CRM COMMENT:

Public Law 3-47 at Section (14) & (15) and CRM Regulations at Section 9(c)(iii), which are referenced above, specifically address the management and protection wetlands and other important habitats. As already noted, additional data is necessary in order to evaluate the potential impacts of the project on the AMP wetland. The importance of such data is underscored by the fact that the Marianas Gallinule (Gallinula chloropus), listed on the <u>Federal Register</u> of August 27, 1984 as an endangered species, is found in the AMP wetland. Historically, the Gallinule had wide distribution in the freshwater wetlands of the Northern Marianas; however, increasing urban development and the drainage of suitable wetland habitat have been cited as major contributing factors in the species' population decline. On Saipan, much of the Gallinule habitat has been filled or drained over the past several decades, making wetlands suitable as habitat quite scarce. Garapan marshes (including the AMP wetland) and Lake Susupe are considered to be the only two Gallinule habitat areas in Saipan. Both are therefore of critical importance for the continued survival of the bird. The Service further considers the area of Garapan marsh which is to be affected (AMP wetland) as falling under Resource Category 2 since it is a habitat of high value for the species" and is relative scarce or becoming scarce on a national basis or in the ecoregional setting." (See "Final Coordinaiton Act Report" July, 1985, Appendix H [II].) Based on this, CRM objects to the ACOE consistency statements at 2(c)(2) that the AMP wetland is "not considered significant to the survival" of the Gallinule and at 5(c) that the "(w)etland habitat in the proposed project area is considered to be as secondary value as habitat for endangered waterbirds."

POD RESPONSE:

The determination that "further decreases in wetland area or quality..., although detrimental, would not be likely to jeopardize the continued existence of the Mariana gallinule" was made by the FWS. In the report, we simply reiterated this statement. Any objections to this statement should be directed to the Endangered Species Coordinator for the FWS. Based on later discussions with the Endangered Species Coordinator, he stated that he stood by FWS's prior biological opinion of "no jeopardy" on the Mariana Gallinule and the Nightingale Reed Warbler under more extreme circumstances than simply having a measureable increase in the salinity of the wetland waters. Statements made about the possible effects of salinity increases on the Gallinule habitat in the Final Coordination Act Report [Section 2(b) report] were not made by endangered species experts at FWS. Their findings and conclusions are presented in the Section 7 report. The statements in the Section 2(b) report regarding increased salinity in the AMP wetland waters having adverse effects on the survival of the Gallinule were made under the assumption that the marsh fern (Acrostichum aureum) would not be able to tolerate salinity increases. Our investigations indicate that the marsh fern is highly tolerant of brackish waters and that it occurs in a wide range of habitats from freshwater to saltwater marshes.

18. CRM COMMENT:

The paucity and importance of wetlands in Saipan underscore the need for adequate data to describe the potential impacts of the proposed project. Included in this information should be models of the expected alterations caused or contemplated by the project such as water quantity and salinity fluctuations and as well as supporting data for mitigation measures. For example, the EIS on page 6 [should be page 8] states that the recommended plan includes a spillway and swale which will discharge a portion of the stormwater conveyed by the flood control channel into the AMP wetland. The ACOE explains that this "environmental feature" (EIS, page 8) is "(t)o minimize impacts on the hydrology of the marsh due to loss of runoff from elevated areas east of the AMP wetland that would normally flow into the wetland during high rainfall condition" (EIS page 17). However, as was previously pointed out, hydrologic studies have not been made of the area. Moreover, CRM is unable to identify any discussion of the expected quantities, occurrences, durations or impacts of such a discharge into the wetland; although, we note that the ACOE consistency determination at 5(d) does state that "(s)ignificant effects on the salinity of the wetland could occur." Contrary to being consistent with the program, projects which significantly alter the ecological integrity of wetlands and reduce habitat suitability for endangered species are incompatible with CRM goals and policies.





POD RESPONSE:

None of the adverse impacts stated above are expected. Any discussions remaining in the report regarding significant effects of the project on the salinity of the wetland, especially with regards to its potential detrimental effects on the Gallinule habitat, will be deleted. Although significant impacts are not expected with increased salinity of the AMP wetland waters, one possible measure to increase the wetland's suitability as a Gallinule habitat, might be to introduce the bulrush (Scirpus litoralis) and other plants for forage into the wetland. The bulrush is known to be tolerant of slightly brackish waters as evidenced in Lake Susupe and is also used by the Gallinule for nesting. Presently, the bulrush is not known to occur in the AMP wetland.

19. CRM COMMENT:

Although CRM is unsure of the intent of the statement, we note that the consistency determination at Section 6 (g)(2) states that "(t)he principal project purpose is flood control; and net project effects to shoreline resources are negative." One such negative affect may be coastal access restriction. CRM understands that there is to be a six foot high chain link fence along each side of the channel. It is CRM policy to "(e)ncourage the preservation of traditional rights of public access to and along the shorelines consistent with the rights of private property owners" (P.L. 3-47 Section 3[22]).

POD RESPONSE:

Public access to the shoreline will not be impeded by the chain link fence. It is an easy matter of crossing the Beach Road culvert to get from one side of the channel to the other. At most, a detour of about 700 feet is required. This slight inconvenience pales in comparison to public safety.

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20. CRM COMMENT:

Other possible negative effects to "shoreline resources" are discussed below.

b) Further comparison to CRM Rules and Regulations as published in Vol. 7 No. 10 of the Commonwealth Register

- The recommended plan includes a channel which will be located in both the Shoreline and Lagoon and Reef APCs. The consistency determination at Section (2)(b)(2) incorrectly describes the "shoreline area" to be removed as "approximately 400 square feet and 80 foot length." The Shoreline APC is by definition "the area between the mean high water mark... and one hundred fifty (150) feet inland" (CRM Regulations Section 5[EE]). The 400 square feet (80 feet in length) to be excavated at the end of the outlet channel will affect the marine environment and will fall within the Lagoon and Reef APC.

  Management standards for the Shoreline APC are found within the CRM Regulations at Section 9(C)(v). Standards against which projects are to be evaluated include:

  (a)(1) Subsistence usage of coastal areas and resources shall be insured;
  (a)(2) The effects of shoreline development on natural beach processes shall be minimized;
  (b)(2) Whether the proposed project is to facilitate or enhance coastal recreational, subsistence, or cultural opportunities. (i.e., docking, out, fishing, swimming, picnicking, navigation devices).

Management standards for the Lagoon and Reef APC are found at Section 9(C)(i)(a) and include:

(1) Subsistence usage of coastal areas and resources shall be insured;
(2) Living marine resources, particularly fishery resources, shall be managed so as to maintain optimum sustainable yields;
(3) Significant adverse impacts to reefs and corals shall be prevented;
(4) Lagoon and reef areas shall be managed so as to maintain or enhance subsistence, commercial and sportfisheries;
(5) Lagoon and reef areas shall be managed so as to assure the maintenance of natural water flows, natural circulation patterns, natural nutrient and oxygen levels and to avoid the discharge of toxic wastes, sewage, petroleum products, siltation and destruction of productive habitat;
(6) Areas and objects of historic and cultural significance shall be preserved and maintained;



Particularly given the lack of any sedimentation controls, which is discussed above, there is concern that the proposed project does not meet these standards.

POD RESPONSE:

We believe that the proposed project meets these standards. Subsistence usage of coastal areas and resources would not be adversely affected. Public access would not be impeded nor do we expect any significant alteration in the natural conditions of the receiving waters. Changes which do occur are generally expected to be beneficial to the existing coastal resources.

Except in times of heavy rainfall, the effects of the flood control channel on the natural beach processes would be minimal because of the near stagnant conditions of the Unai Sadog Tase. Impacts from infrequent flood flow events are anticipated to be temporary and non-significant. Currently, storm wave actions which often accompany heavy rainfall already cause temporary turbidity to occur in the Unai Sadog Tase. Thus, although the amount of sediment being released into the receiving waters may increase, the frequency and occurrence of these turbidity events are not.

No change in the existing coastal recreational, subsistence, or cultural opportunities are anticipated.

Marine resources are anticipated to be enhanced by the project. Channel waters would eventually provide increased habitat for juvenile fishes and other marine fauna. In addition, "such areas may provide some additional feeding resources and habitat for shore and waterbirds".

Detrimental impacts on the existing subsistence, commercial and sportfisheries are not anticipated. Beneficial impacts to the fishery resources, from increased habitat area for juvenile fishes, should exceed any temporary impacts from intermittent increases in the turbidity.

The Unai Sadog Tase is not known to be a habitat for living corals.

See also POD response to comment #16.

21. CRM COMMENT:

The outlet channel and storm water runoff will have temporary, intermittent and long term impacts upon coastal water quality and marine resources. As the "FWS Coordination" July 1985 report notes on page 10:

> Portions of the channel below 0 MSL would have mixohaline water and may retain sediments. This may provide habitat for brackish-water flora and fauna, including mudskippers (Periophthalmus koeleutii), juvenile mullet (Chelon engeli), and flagfish (Kuhlia sp.). Such areas may provide some additional feeding resources and habitat for shore and waterbirds.
>
> Suspended sediments carried with storm water runoff would create localized turbidity plumes. Benthic communities near the mouth of the outlet channels may be negatively impacted by sedimentation, freshwater dilution, and a gradual increase in the concentration of some urban pollutants.
>
> Sediments discharged from the channel may also have negative long-term impact on sea grass beds located approximately 20-30 meters seaward from the high tide line. The sea grass, E. acoroides, is not expected to be affected by freshwater dilution, although increased sedimentation may bury some stands. A decrease in the quality or quantity of E. acoroides may indirectly affect rabbitfishes (Siganus spp.) and other subsistence fishery species in Tanapag Harbor.

POD RESPONSE:

Storm water discharge into the Unai Sadog Tase is not expected to greatly increase the frequency of turbidity events occurring now. The sea grass and other benthic organisms living in the Unai Sadog Tase essentially thrive because the existing terrigenous sediments provide nutrients required to sustain the ecosystem. Without these sediments and occassional freshwater dilution, it is doubtful that the plant and other bottom species could survive in the area. Although increased sedimentation may bury some sea grass plants after flooding events, other plants are expected to grow in their place. Thus, the overall intregrity of the habitat is not expected to be degraded. The claims made by the F&WS on the effects of the sedimentation on the rabbitfishes and other subsistence fishery species in Tanapag Harbor are probably exaggerated.

See also POD response to comment #16.





22. CRM COMMENT:

In terms of the impact of this project on recreational opportunities, CRM notes that the proposed project does require alterations to several features of the National Park Service's Management Plan (1982). While most of the facilities should be able to be resited within the park, the advantage of siting them along the West Coast Highway for public accessibility and cohesiveness will be lost. An additional impact may be the need to reclaim undisturbed portions of the natural area for such purposes. Moreover, the Plan calls for the protection of the AMP wetland for wildlife and education purposes. In fact, the ACOE consistency determination bolsters the argument against creating obstructions within the area by stating (at Section 5[f]) that "(t)he wetland within AMP would be maintained in its present state or even enhanced if a National Park Service management plan is implemented."

POD RESPONSE:

We believe that compromises between the National Park Service, CNMI government, and Corps of Engineers can be reached on this matter without difficulty. However, one must realize that this comment does not concern an existing recreational opportunity. Generally, we are limited to addressing the existing conditions and the projects potential impacts on such. We feel that alterations to the Plan can be accommodated without decreasing these recreational opportunities.

## V. CLOSING COMMENTS

23. CRM COMMENT:

As a final comment to the proposed plan and CRM's objection to the consistency determination, we again emphasize that additional information is needed and that mitigation or design alternatives exist to develop a flood control project which is consistent to the maximum extent practicable with the CRM Program. We also note that only expensive, large scale projects are discussed as structural design alternatives within the final project report. Alternatives involving less costly and smaller scale drainage systems are conspicuously absent. During the Japanese administration, most of the flooding in Garapan from sheet flow runoff due to heavy storms was accomodated by the construction and maintenance of a roadside ditch and culvert system throughout the village. Such a system would quite likely have fewer impacts and be less expensive to build and easier to maintain than the extensive "interceptor channel" being proposed. Particularly in light of the high cost of the project and the 1.1 Benefit/Cost ratio of the proposed plan, which is the lowest positive B/C ratio possible and which does not include environmental or amenity costs, the investigation of a smaller system is highly desirable.

POD RESPONSE:

Please refer to the project scaling and economic summary for various levels of protection (page 30 of the main report). As shown on the table, the cost for a "small" scale project such as the 10-year level of protection is only $240,000 lower than the recommended project at a 50-year level of protection (only a 3.6% "savings" in the project first cost). Based on the cost study, a smaller flood control project (in terms of a lower degree of protection) does not mean the costs would be proportionately or significantly lower. Also, please be advised that provision of a basic drainage system to collect and convey local runoff is a non-Federal responsibility.

As previously discussed, one possible measure to increase the wetland's suitability as a habitat for the Mariana Gallinule would be to introduce the bulrush (Scirpus litoralis) into the AMP wetland area, even though no "significant" adverse impacts to the wetland are anticipated due to the project. Design alternatives which concern the use of shallow drainage ditches similar to the Japanese system are not practicable because these systems are undersized. Only flood flows occurring from storms with less than a 2-year frequency would be accommodated. To construct a similar system capable of handling flows similar to the recommended project would not have fewer impacts, be less expensive, or be easier to maintain.

**Commonwealth of the Northern Mariana Islands**
**Department of Public Health & Environmental Services**
**Division of Environmental Quality**
**Saipan, Mariana Islands 96950**

Cable Address:
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October 20, 1986

Mr. Kisuk Cheung
Chief, Engineering Division
Department of the Army
Army Engineer District, Honolulu
Ft. Shafter, Hawaii 96858

RE: Garapan Flood Control Project §401 Certification

Dear Mr. Cheung:

We have reviewed a copy of the Corps 404(b)(1) evaluation of the effects of the discharge of dredged or fill materials into waters of the United States. We have also reviewed the Detailed Project Report and Environmental Statements for the project. Based on these reviews and pursuant to Section 401 of the Clean Water Act of 1977, as amended, we provide the following comments concerning the expected effects of the Garapan Flood Control Project on the water quality of Commonwealth waters.

For purposes of this certification response, the project can be viewed in two parts: The construction and dredging phase and the long term operation of the flood control system.

<u>Effects of Construction and Dredging</u>

The 404(b)(1) evaluation and the Project Report confirm that during construction and dredging appropriate measures will be taken to mitigate the effects of construction and dredging related run-off of silt laden waters into the lagoon. If these measures are taken the project construction should meet or only temporarily exceed the CNMI water quality standards.

<u>Long Term Effects of Project</u>

The primary purpose of the project is to capture and drain storm water run-off which would otherwise flood and pond in the Garapan flood plain. Almost by definition, the project as designed will dramatically increase the flow of silt laden storm water run-off which enters the lagoon. It appears likely that during storm run-off the turbidity of the waters discharged from the project would greatly exceed the applicable turbidity standard of 5 NTU.





The effect of this project on the siltation of the lagoon is a serious concern of this office. Seasonal heavy rainfall coupled with an unprecedented amount of construction activity and the increasing land area dedicated to buildings and streets has resulted in excessive turbidity and siltation in the Saipan Lagoon. As designed, this project would be a significant contributor to this problem. Specific adverse effects include possible formation of a terrigenous silt delta, the smothering of benthic habitat, changes in local fishing success and the potential long term siltation of barrier reef habitat.

<u>Salt Water Intrusion into Wetlands</u>

The 404(b)(1) evaluation indicates that salt water intrusion from the channel into the adjacent wetland could significantly alter the salinity of the wetland. This potential degradation of the wetland water quality would be inconsistent with the CNMI water quality standards.

<u>Conclusion</u>

The discharge related to project construction and dredging will be mitigated to the extent practicable and the discharge during construction will conform to CNMI water quality standards.

The discharges into the lagoon resulting from the capture and diversion of run-off waters has not been adequately mitigated and will not conform to CNMI Water Quality Standards. The effect of salt water intrusion from the channel into the adjacent wetlands will not conform to CNMI Water Quality Standards.

We invite comments from your office as to how the project may be altered to include mitigation measures to promote conformance with CNMI Water Quality Standards. Such mitigation measures might include: (1) sediment retention structures near the outlet channel to reduce the siltation impacts of the flood control project and (2) a mechanism to prevent salt water intrusion into the wetlands.

Sincerely,

William B. Lopp

WILLIAM B. LOPP
Chief, DEQ

cc: Robert Rudolph - CRM
Francis Dayton - ACOE
Meiling Odom - USEPA

United States Department of the Interior

FISH AND WILDLIFE SERVICE
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IN REPLY REFER TO:

OCT 29 1986

Mr. Kisuk Cheung
Chief, Engineering Division
U.S. Army Engineer District, Honolulu
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Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

Thank you for your response of October 6, 1986, to our request for additional hydrological studies of the American Memorial Park (AMP) wetland as part of the Garapan Area Flood Control Study, Saipan. On August 14, 1986, Dr. James Maragos of your staff verbally indicated to us that the Honolulu District concurred with our request for additional studies; hence, we were surprised to discover that your staff is now recommending that these investigations not be conducted.

The Service is particularly concerned with the suitability of the AMP wetland as habitat for the Mariana Common Moorhen (*Gallinula chloropus guami*), a listed endangered species. We believe that the primary adverse effect of the project will be a long-term, significant increase in the salinity of the wetland. The current Technical Review Draft of the Mariana Common Moorhen Recovery Plan prepared by the Service identifies both Lake Susupe and the Puntan Muchot/Garapan wetlands as primary habitat for this species. Population estimates of the moorhen at Lake Susupe range from 60 to 120 birds. Despite historical disturbances to the AMP wetland, moorhen consistently have been seen in the area but the population level is not known. The fate of the moorhen population on Saipan is directly linked to the future conditions of these remaining wetland habitats.

We are concerned that your conclusion of no significant project-related impact upon the AMP wetland habitat was based on incorrect biological information. We know of no scientific literature or data which supports the statement in your letter that "the marsh fern (*Acrostichum aureum*)...is the primary nesting habitat of the Mariana Gallinule...". Certainly the marsh fern flourishes in both brackish and fresh waters on Saipan; however, the moorhen does not. Although moorhen are observed in brackish waters, there are no known records or sitings of this species *nesting* in waters of greater than 4 parts per thousand (ppt) salinity. Similarly, neither the Hawaiian race of the Common Moorhen (*Gallinula chloropus sandvicensis*) nor the North American Common Moorhen (*Gallinula chloropus*) is known to nest in brackish waters.

CONSERVE AMERICA'S ENERGY



In your biological assessment prepared for our Section 7 consultation you stated "the significance of [sheet flow runoff from elevated areas east of the AMP wetland] to the overall hydrology of the marsh and swamp is not known. However, even during extended drought conditions, standing water remains within the marsh, indicating a subsurface water source." According to information provided by Mr. Rudy Mina of your staff on July 19, 1985, the Honolulu District believed that the AMP wetland was supplied entirely by groundwaters, and was not dependent upon freshwater overland runoff.

Your recent letter now suggests that this subsurface water source for the AMP wetland may already have high salinity levels under natural conditions. You cite "varying chloride levels" of between 261 and 4,800 parts per million (ppm) in Lake Susupe, and between 300 and 800 ppm in Garapan area wells as evidence that "...high salinity is expected in the groundwater which sustains the AMP wetland because the wetland is located just a few hundred feet inland from the shore."

These data do not reflect high salinities. These chloride concentrations roughly equate to *salinities* of between 0.5 and 9.0 parts per thousand (ppt); or limnetic to mildly brackish waters. The salinity of water samples taken from a depth of 1.4 meters *below sea level* in Lake Susupe by Corps biologists ranged between 0.5 ppt during the rainy season (December 1978) to 4.2 ppt in the dry season (May 1981). Salinities in nine distinct groundwater wells surrounding Lake Susupe ranged between 0.5 ppt and 6.0 ppt in May 1981. Hence, the range of measured salinities was between freshwater and mildly brackish conditions, and in almost all cases, well within the expected tolerance of nesting moorhen.

Despite the fact that the hydrology of the wetland is poorly known, the Honolulu District has speculated that there will be a sufficient volume and frequency of freshwater discharge through the proposed channel, and a sufficient barrier of impermeable sediments lining the floor of the wetland, to prevent a significant long-term increase in wetland salinity after construction of the proposed improvements. The Service does not believe that sufficient hydrologic information exists to support this conclusion. According to Mr. Mina or your staff, under post-project conditions, saline waters from Tanapag Harbor will extend 4,498 feet into the outlet channel which will have no impermeable lining. Thus, the Service anticipates a significant increase in the salinity of groundwaters within the AMP wetland, particularly during extended periods of low rainfall.

The AMP wetland may indeed be quite tolerant of changes in water levels and salinity. The fact remains, however, that the moorhen is not tolerant of such changes. It clearly prefers freshwaters and avoids waters of elevated salinities. Although the wetland itself may persist after project construction, the habitat would no longer be suitable for the endangered moorhen because of elevated salinities. In our Biological Opinion of February 12, 1985, we clearly stated that if the wetland "...becomes increasingly saline...the gallinules [= moorhens] would be expected to suffer."

At present, the Service's position remains unchanged: we believe that construction of the preferred alternative, as proposed, will significantly decrease the habitat suitability of the American Memorial Park (AMP) wetland for the moorhen. Therefore, based upon the recent information gathered by our regional hydrologist, the professional opinions of United States Geological Survey hydrologists and our staff biologists, we conclude that the assumptions used in the preparation of our "no jeopardy" Biological Opinion of February 12, 1985 will not be met under the proposed plan of improvement. Accordingly, we recommend that the Honolulu District re-initiate formal consultation with the Service as directed by Section 7 of the Endangered Species Act. We continue to recommend that additional studies be conducted to clarify the hydrology of the AMP wetland, and urge you to consider additional mitigation or alternatives which will insure against the loss of suitable wetland habitat.

Sincerely,

Ernest Kosaka
Project Leader
Office of Environmental Services

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DEPARTMENT OF THE ARMY
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REPLY TO ATTENTION OF:

November 10, 1986

Dr. Allen Marmelstein
Pacific Island Administrator
U.S. Fish and Wildlife Service
P.O. Box 50167
Honolulu, Hawaii 96850

Dear Dr. Marmelstein:

In accordance with the recommendation in your letter dated October 29, 1986, we are re-initiating formal consultation as directed by Section 7 of the Endangered Species Act for the Garapan Flood Control Project, Garapan, Saipan. This consultation was earlier designated by the Service as case number 1-2-85-F-018. On February 12, 1985, we received a "no jeopardy" Biological Opinion. Since that time, there have been no changes in the project and, to our knowledge, no new information on the use of the American Memorial Park wetland by the endangered Mariana Gallinule. We understand that the Service has obtained recent hydrologic information that may modify the assumptions used in the preparation of its Biological Opinion, and that a revised Opinion will be prepared based on new assumptions.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

DEPARTMENT OF THE ARMY
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November 17, 1986

REPLY TO
ATTENTION OF:
PODED-PJ

Mr. William B. Lopp
Chief, Division of Environmental Quality
Department of Public Health
& Environmental Services
Saipan, CM 96950

Dear Mr. Lopp:

Thank you for your letter of October 20, 1986, regarding the Section 401 certification for the Garapan Flood Control Project. We agree that discharges into the lagoon during stormy runoff conditions will exceed the CNMI water quality standards. Unfortunately, there are no mitigation measures that we can develop economically to address the discharge water quality aspects during periods of inclement weather. As stated in your letter, the primary purpose of the project is to capture and drain storm water runoff which would otherwise flood and pond in the Garapan flood plain. The recommended plan addresses this basic need while also considering the other planning criteria such as effectiveness in alleviating the specific problems; and efficiency of alleviating problems in a cost effective way. All things considered, we feel that the recommended plan is the best alternative plan available.

Potential environmental effects resulting from the discharge of storm water into the lagoon have been given full consideration and minimized to what we believe to be an acceptable level by locating the channel outlet at Tanapag Harbor, rather than the nearby resort area in Garapan. The harbor is a shallow, partially man-made embayment approximately 50 acres in area. Much of the bay is intertidal, hence dry at low tide. Along its periphery and extending some distance into the bay are elevated shoals. The area has been noted for its use by migratory shore birds as feeding and loafing habitat. The substrate of the bay is composed of fine silt and sand and the biota here are adapted to the soft bottom. Extensive beds of sea grass occur throughout the bay.





This environment does not favor the establishment of coral colonies which are absent in the bay. Fishes using this area are essentially transient, entering and leaving with the tidal cycle. Water quality in the bay and surrounding coastal area is poorer than the rest of the lagoon. As noted in the CNMI Coastal Resources Management Office document, Saipan Lagoon Management Plan, coastal waters in the region receive runoff from the commercial port, sewage effluent from the outfall south of Charlie Dock and leachate and debris from the Puerto Rico dump. It further states that a combination of fine silt/mud bottom in the harbor and the silt-laden water entering the lagoon from the port area severely reduces water clarity. Winds and currents from the northeast tend to stir up and suspend these fine bottom sediments creating a silt plume which normally extends as far as 1000-1500 meters from shore.

The shoreline is muddy and fringed with mangroves. There is no beach. Several barges in an advanced state of deterioration are partially submerged in the mud along the shoreline. From the standpoint of aesthetics, the area is not conducive to human use, and to our knowledge it is not used by residents or others for recreational purposes. In summary, the nearshore waters are polluted and generally murky (with ambient turbidity levels probably in excess of the 5 NTU CNMI water quality standard). The bottom is silty, the shoreline is muddy, the biota adapted to a soft-bottom environment, and the fish population transient. Against this background, long term project impacts resulting from the intermittent discharge of storm water would be essentially negated.

Although the area is not known to be widely used by fishermen, any changes in fishing success resulting from the project would most likely be positive. The creation of a limited estuarine environment would increase the use of the area by mullet, milkfish, tarpon, flagtails and other sport and food fish.

The long term siltation of the barrier reef as a consequence of the proposed flood control project is entirely unlikely. The barrier reef is more than two miles distant. Silt from this source, were it to reach the barrier reef, would be dispersed to the extent that it would have no significant effect. Siltation is not a new phenomenon in this region of the coastline. Recent borings at the Saipan Dock site indicate a layer of silt more than 100 feet deep. Evidently some kind of equilibrium between historic sedimentation of nearshore coastal areas and the continued growth and sustenance of the barrier reef prevails.

We have addressed specific criticism of the proposed flood control project by the CNMI Coastal Resources Management Office and the U.S. Fish and Wildlife Service concerning possible impacts on the American Memorial Park (AMP) wetland and its value as habitat for the endangered Mariana Gallinule (*Gallinula chloropus guami*). In doing so we have attempted to illucidate the hydrologic processes relevant to the potential impacts of the project on the water quality and hydrology of the wetland. We have also addressed the probable ecological effects of the increase of salinity within the wetland. Copies of our responses to these Agencies have been enclosed for your information (Enclosure 1).

Your suggestion for sediment retention structures was included in one of our alternative plans. This alternative involves routing the channel directly into the American Memorial Park (AMP) wetland and using it as a retention basin (Refer to Alternative Plan D in the Detailed Project Report). However, we feel that this alternative would not serve the purpose in high runoff conditions due to the short retention time because of the limited storage capacity of the basin. Furthermore, the economic feasibility of Plan D (Benefit to cost ratio of 1.0) is less favorable than the recommended plan.

From a technical standpoint, provisions for an impermeable lining or other mechanism to prevent salt water intrusion into the wetland would not work. Build-up of pore water pressure behind such a lining would have to be alleviated by the use of weepholes, which would invalidate the intended benefits from its use.

Shortly, we will be revising the report and EIS for the Garapan Flood Control Project. These revisions will include additional information relative to the potential impacts of the project on the AMP wetland and effects of the channel discharge on the lagoon environment.





Based on the above, we again request your certification under Section 401 of the Clean Water Act of 1977.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

copy furnished: (without enclosure)

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DEPARTMENT OF THE ARMY
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REPLY TO
ATTENTION OF:

November 20, 1986

Dr. Allen Marmelstein
Pacific Island Administrator
Fish and Wildlife Service
P.O. Box 50167
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Dear Dr. Marmelstein:

Thank you for your follow-up letter of October 29, 1986, regarding the Garapan Area Flood Control Study, Saipan. We put much thought and consideration into your earlier request of August 8, 1986, to conduct further hydrological studies of the American Memorial Park (AMP) wetland. Our decision to forego further studies was based on several premises. The first involves the inherent uncertainty of the study results. To accurately predict the impacts of the proposed flood control channel on the adjacent groundwater hydrology would be extremely difficult. At the very least, it appears that a model study may be required. However, of real concern is the paucity of available hydrologic information about Saipan. The lack of such substantive, long-term data would preclude the reliability of the model study findings. Hence, the efficiency of additional studies is at best questionable.

Second, we do not believe that a long-term, significant increase in the salinity of the AMP wetland waters would result because of the project. As discussed in our previous letter of October 6, 1986, we expect only slight increases above natural salinity levels because a hydraulic gradient would exist between the channel waters and the surrounding groundwater table. The tendency would be for the water to flow into the flood control channel from the surrounding soil and not vice versa. Revisions to the Detailed Project Report and EIS are in progress and will include additional information on our analysis of project-related effects on the hydrology of the AMP wetland.

Third, although we share your concern regarding the suitability of the AMP wetland as habitat for the Mariana Gallinule, we do not agree on its relative importance.

Based on available information, we do not believe that a case can be made supporting its recent designation as primary habitat for this species in the Service's Draft Mariana Common Moorhen Recovery Plan. The following is a list compiling observations and information available to the Corps:

a. The Corps of Engineers Ornithological Survey of Wetlands in Guam, Saipan, Tinian and Pagan, 1979, observed no gallinule in the AMP wetland during the 6 month survey period (several gallinule were observed in the Garapan Area in a small ponding basin created from an adjacent subdivision).

b. In May 1979, FWS biologists conducted field surveys in the Garapan Flood Control project area. One moorhen was seen in the AMP wetland.

c. During March through June 1982, the FWS Micronesian Forest Bird Survey was conducted on Saipan, Tinian, Agiguan and Rota. In the Garapan area, one dead moorhen was seen on a road adjacent to the AMP wetland. None were observed within the wetland.

d. In October of 1984, Corps and CNMI biologists conducted field surveys in the AMP wetland. Two moorhen were heard in different locations during a three-day period.

e. Again in October 1984 FWS and CNMI biologists conducted field surveys in the AMP wetland. Two moorhen were observed on this occasion.

f. In January 1986, a survey of the AMP wetland was conducted by FWS, NPS and CNMI personnel. No gallinule observations were reported.

To our knowledge, this represents the sum total of information on gallinule population densities in the AMP wetland. The existing information is admittedly inadequate. However, it does indicate that the frequency and magnitude of use of this wetland by the gallinule has been minimal.

The greatest population of gallinule on Saipan inhabits Lake Susupe and its surrounding wetlands. In





1981, the Corps of Engineers field survey estimated a population of between 90-120 gallinule in the Susupe wetland. The FWS Micronesian Forest Bird Survey, 1982, stated that this was a reasonable estimate for the numbers around Susupe.

Incidental observations of gallinule outside of the Susupe area were also noted in the FWS Forest Bird Survey. Two birds were found dead on roads near small wetlands, one in Garapan (the AMP wetland) and one in Tanapag. A single gallinule was observed twice in a small tidal channel at Tanapag. Two birds were observed far from known water sources. One of these was seen in the Kagman area, probably in the vicinity of the wetland located there, and the other near the airport crossing the road and entering a dry tangan tangan thicket. Although definitive information on gallinule movement patterns is lacking, it appears that the gallinule are concentrating in the Susupe wetland during the dry season, from December to July, which coincides with their observed nesting season. During the wet season, some of the gallinule disperse to forage at other small or seasonal wetlands located throughout Saipan, including the AMP wetland. In any case, the Susupe wetlands are clearly of primary significance to the gallinule population of Saipan. The role of the other wetlands is uncertain, but available information suggest that they are largely marginal.

In the case of the AMP wetland there seems to be a question of the presence of suitable nesting vegetation. This together with the paucity of edge vegetation, considered to be another important component of gallinule habitat, may explain the apparent lack of use of this wetland by the gallinule.

We agree that there is no known scientific literature or data suggesting that the marsh fern (Acrostichum aureum) is a primary nesting habitat for the gallinule. This was misstated in our previous letter. What we tried to convey was that the fern is the dominant emergent plant in the marsh. Unlike Susupe, Hagoi and other wetlands in the Northern Mariana Islands, the bulrush (Scirpus littoralis) is a minor component of the emergent plant community in the AMP wetland. Where it does exist, it is sparce and would not afford cover or protection for the gallinule. For this reason, it is unlikely that gallinule nesting would occur here. No nesting activity of any kind has been observed in the ANP wetland. However, were it to occur, the marsh fern, because of its abundance, would be the most likely vegetation to be used for that purpose. If the marsh fern is unacceptable to the gallinule as nesting habitat, it is improbable that any nesting would occur in the wetland.

From what we have been able to ascertain, there is no scientific data documenting a decline in the population of Mariana gallinule. In fact, the basis for the designation of the species as Federally endangered seems to derive entirely from anecdotal information and supposition. Certainly, if a valid scientific analysis addressing population decline and the factors contributing to it has been attempted it would be cited or referenced somewhere in the literature. Instead, from the limited information that is available, it appears that gallinule in Saipan, Tinian and Guam have remained relatively stable for the last 40 years with no indication of a decline.

Based on the above discussion, we reiterate our position that potential project-related adverse impacts on the suitability of the ANP wetland as a nesting habitat for the Mariana gallinule will be minimal. A small increase in the salinity of the wetland waters may occur. We would expect there to be peaks and troughs in the salinity, coinciding with the seasonal cycle of rainfall similar to the situation at Lake Susupe. However, we certainly do not anticipate the long-term increase in salinity to average 4 parts per thousand (ppt) or greater. Thus, were the gallinule to nest in the ANP wetland, which appears unlikely based on what is presently known about the Saipan population of the subspecies, the salinity would be within the speculative tolerances for this activity. Ultimately, the habitat value of the wetland would not be compromised by the flood control project.

Sincerely,

Kisuk Cheung
Chief, Engineering Division



Copy Furnished:

Mr. Pete Sasamoto
CIP Advisor
Office of the Governor
Saipan, CM 96950

United States Department of the Interior

FISH AND WILDLIFE SERVICE
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IN REPLY REFER TO:

NOV 24 1986

Mr. Kisuk Cheung
Chief, Engineering Division
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Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

This replies to your November 10, 1986 letter which addressed previous consultations with us regarding possible impacts of your proposed Garapan Flood Control Project on Saipan on the endangered Maraiana common moorhen. Although the conclusions reached in our biological opinions of February, March, and May of 1985 remain (that none of the project designs would be likely to jeopardize the continued existence of the bird), recent changes in the regulations governing Section 7 of the Endangered Species Act and possible disagreements concerning the impact of the project on the wetland should be addressed.

In June of this year, new final Section 7 regulations were published in the Federal Register. In part, these regulations change the unit of a species under consideration from a universal to a population membership. Previously, a jeopardy finding could be issued only if jeopardy to the species as a whole could be demonstrated; now, only jeopardy to a distinct population within that species need be shown to justify a jeopardy finding. The Saipan population of moorhens is considered distinct from the population as a whole, which includes Guam. In our previous biological opinions, we stated that the project would not be likely to jeopardize the continued existence of the moorhen as a species. Although any negative impact of the project on the birds at Garapan would be expected to affect the Saipan population to a greater degree than to the species as a whole, we believe that any of the three alternatives discussed in our above referenced opinions would not jeopardize the continued existence of the Saipan population of moorhen.

We make this determination with the understanding that the project, as most recently proposed, may result in an increase in the salinity of the Garapan wetland over time due to the possibility of the interception of freshwater inflow by the flood control structures or due to other project modifications affecting the "natural" salinity balance there. Such increases in salinity may decrease its desirability as moorhen habitat.





Our concern for the maintenance of habitat at Lake Susupe would be expected to increase should the desirability of Garapan as bird habitat be diminished.

Thank you for your continued interest and cooperation in discussing this project and its possible impacts on this endangered species.

Sincerely yours,

William R. Kramer
William R. Kramer
Acting Project Leader
Office of Environmental Services

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GARAPAN FLOOD CONTROL
SAIPAN, CNMI

COMPLIANCE DOCUMENTS

APPENDIX G

# APPENDIX G

## COMPLIANCE DOCUMENTS

| Section | Title |
|---|---|
| I | Evaluation of the Effect of the Discharge of Dredged Materials into Waters of the United States, Using US Environmental Protection Agency (EPA) Section 404(b) Guidelines |
| II | U. S. Fish and Wildlife Service Section 2(b) Report |
| III | U. S. Fish and Wildlife Service Section 7 Coordination |
| IV | Federal Coastal Zone Management (CZM) Consistency Determination |
| V | Presidential Executive Order 11990 on Protection of Wetlands |
| VI | Presidential Executive Order 11988 on Floodplain Management Evaluation Report |

## SECTION I

(Revised February 1987)

Evaluation of the Effect of the Discharge of Dredged Materials
into Waters of the United States,
Using US Environmental Protection Agency (EPA)
Section 404(b) Guidelines

I

## GARAPAN FLOOD CONTROL STUDY

## EVALUATION OF THE EFFECTS OF THE DISCHARGE OF DREDGED OR FILL MATERIAL INTO WATERS OF THE UNITED STATES USING U.S. ENVIRONMENTAL PROTECTION SECTION 404(b)(1) GUIDELINES

1. Project Description

a. Description of the proposed discharge of dredged or fill material:

(1) General Characteristics of the Material. The material used to line the flood control channel will consist of 11-76 pound limestone rocks (riprap) and 6- inch to 9-inch limestone aggregates (bedding layer). Concrete will be used to construct concrete riprap channel lining and the culverts under the coastal highway and existing roads.

(2) Quantity of material proposed for discharge *.

| | Recommended Plan E |
|---|---|
| Riprap | 11,460 cy |
| Bedding Material | 5,810 cy |
| Concrete | 3,630 cy |
| Fill | 2,100 cy |

(3) Source of Material. The material will be quarried from Black Micro Quarry on Saipan.

b. Description of the proposed discharge site for the dredged or fill material:

(1) Location of the Discharge Site. Garapan, Saipan (see attached figure). The discharge site will be the 400 S.F. mouth of the outlet channel in Tanapag Harbor at Unai Sadoa Tase. If the channel mouth is dredged first, then the portion of the outlet channel subject to the influence of seawater (about the first 2,400 ft) will also be subject to 404(b) guidelines.

* See paragraph 1b(2)

(2) Type of Discharge Site Involved. Except for the four-celled concrete culvert at Beach Road and concrete culvert approaches, the first 2,430 feet of the channel (designated the outlet channel) will be grasslined. The remaining 3,530 feet possible subject to 404(b) guidelines will be lined with fill material to protect it from erosion.

(3) Method of Discharge. The material will be placed in the channel banks by crane. The temporary fill will be placed by bulldozer and removed by crane and bucket.

(4) Date and Length of Time When Discharge Will Occur. The discharge should occur within 5 years of project approval, and it will take about 7 months to complete the outlet channel construction.

(5) Project Life of the Discharge Site. The flood control channel will have an estimated economic life of 50 years.

(6) Provide Bathymery (if open water site): Not applicable.

2. Physical Effects. The discharge of fill material will have no effect on current patterns, salinity characteristics or water residence time.

3. Chemical-Biological Interactive Effects.

a. The material proposed for discharge meets the criteria for exclusion from elutriate and bioassay testing. The fill material will consist predominantly of gravel or other naturally occurring material with particle sizes larger than silt.

b. Impacts on the Water Column:

(1) Reduction in Light Transmission. The placement of the bedding material and the temporary causeway will temporarily increase water turbidity since the material will contain some fine, limestone dust. Concrete and riprap placement will not increase water turbidity.

(2) Degradation of Water Aesthetics. The increase in water turbidity will temporarily degrade water aesthetics.

(3) Direct Destructive Effects on Nektonic and Planktonic Populations. No effect is anticipated because the fill is not expected to contain toxic substances.

(4) Presence of Contaminants in the Fill Material. The fill is not expected to contain any contaminants since it will be obtained from a quarry source.

(5) Concentration of Contaminants. Not applicable. The material meets criteria for exclusion from elutriate testing.

(6) Comparison of Constituent Concentration with Applicable Water Quality Standards. Not applicable.

(7) Size of the Mixing Zone. Not applicable. Except for the temporary dredge causeway, all fill material will be confined to the discharge site.

c. Site Comparisons: See FEIS for a comparative evaluation of sites (Plans A, B, C, and D).

4. Impacts of the Discharge at the Discharge Site.

a. Need for the proposed activity: The discharge is related to the construction of a flood control channel which is needed to reduce flood damages and losses in the Garapan area.

b. Availability of alternate discharge sites and methods of discharge: The alternative outlet channel alignments through the Garapan area were considered in the project EIS.

c. Description of the impacts on the following items:

(1) Chemical, Physical, and Biological Integrity of the Aquatic Ecosystem. No effect. The aquatic ecosystem will be man-made with the discharge created by excavating a channel on land. The fill material is inert and will not introduce any new pollutant discharges into the new aquatic ecosystem.

(2) Food Chain and Trophic Level. No effect.

(3) Diversity of Plant and Animal Species. The rocky habitat formed by the placement of the riprap will be colonized by organisms preferring solid substrates.

(4) Movement into and out of Feeding, Spawning, Breeding, and Nursery Areas. No effect.

(5) Wetlands that have Significant Functions on Water Quality Maintenance. No effect.

(6) Areas that Serve to Retain Natural High Waters or Flood Waters. The fill will not effect water storage capacity of the floodplain.

(7) Degradation of Water Quality. No long-term degradation anticipated as a result of the placement of the fill material.

d. Description of methods to minimize water turbidity:

(1) The channel can be constructed without connection to the ocean for the majority of its length. All the fill will be placed in a man-made channel and no turbid waters will be probably discharged into the lagoon during the majority of the construction period. This action will also allow any fine material, suspended in the water column, to settle out in the channel.

(2) The majority of the material to be placed in the water will consist of material larger than silt size and will not be easily eroded. In particular, any temporary dredge causeway that might be constructed will be constructed using bedding material and not fine sand.

(3) Any dewatering effluent will be discharged into a stilling basin to remove sediments prior to discharge into the lagoon.

(4) No fill materials will be placed in adjacent wetlands.

(5) Silt curtains may be used during dredging in Tanapag Harbor. In any case construction there will comply with CNMI water quality standards for turbidity of marine waters.

e. Description of methods to minimize degradation of aesthetics, recreation, and economic values:

The outlet channel is expected to increase recreational diversity and reduce flood damages and losses resulting in economic benefits to the floodplain residents. Aesthetic intrusion in American Memorial Park will be reduced by use of grassed channel banks rather than riprap.

f. Other methods investigated to minimize possible harmful effects:

(1) Appropriate scientific literature developed by EPA.

(2) Consideration of alternatives to open water discharge, such as confined discharges.

(3) Use of disposal sites where physical environmental characteristics were amenable to the type of dispersion desired.

(4) Discharge beyond the baseline of the territorial seas.

(5) Covering any contaminated material with cleaner material.

(6) Conditions to minimize runoff from confined areas.

g. Impacts on the following items of water use:

(1) Municipal Water Supply Intakes. No effect.

(2) Shellfish. No adverse effect. The discharge increases habitat for potential use by shellfish.

(3) Fisheries. No effect. The channel may increase fish nursery and spawning habitat.

(4) Wildlife. No effect.

(5) Recreational Activities. Plan E will affect the National Park Service's American Memorial Park and require resiting of five proposed sports facilities, a proposed parking lot, proposed maintenance yard, and proposed park ranger's residence.

(6) Benthic Life. The fill creates new aquatic habitat for benthic life.

(7) Wetlands. Plan E may affect wetlands and associated endangered species habitat. See paragraph 4f(4) above.

(8) Submersed Vegetation. No effect.

(9) Size of the Disposal Site. No effect.

(10) Coastal Zone Management Programs. No effect. A federal consistency determination has been prepared and is included with the final EIS and project report.

5. Determinations.

a. An ecological evaluation was made following the guidance in 40 CFR 230.4, in conjunction with the evaluation consideration of 40 CFR 230.5.

b. Appropriate measures were identified and incorporated in the proposed plan to minimize adverse effects on the aquatic environment as a result of the discharge.

c. Consideration was given to the need for the proposed activity, the availability of alternative sites and methods of discharge that are less damaging to the environment, and such water quality standards as appropriate and applicable by law.

d. Wetlands: The recommended Plan E flood control channel would intercept and divert sheet flow runoff from elevated areas east of the American Memorial Park wetland that would normally flow into the wetland during high rainfall conditions.

Plan E includes a channel invert elevation of -6 MSL to -4 feet from the outlet at Tanapag Harbor through the channel reach adjacent to the wetland. Thus, the possibility of seawater intrusion affecting the salinity of the peripheral segments of the wetland does exist. The general area of concern for seawater intrusion is the portion of the channel where the water table elevation is less than the height of the highest tide (STA 0+00 to approximately STA 10+00). Water from the channel would tend to penetrate the ground only during times when the water surface level of the channel exceeds the water table elevation. Whenever the tide reverses, water will tend to flow out of the channel walls. Since the water table elevation is always above sea level, the general period of concern would be during the high tide phase. A zone within the immediate vicinity of the channel walls and invert in the very lower reaches may experience a semi-diurnal flushing phenomenon caused by the interaction between the groundwater pressure (or head) and the fluctuating tide. However, because the proposed channel skirts around rather than cuts across the wetland, the effects should be minimal.

Finding of Compliance
for the
Garapan Flood Control Study

1. No significant adaptations of the guidelines were made relative to this evaluation.

2. The discharge is necessary for protecting the lower reach of the flood control channel from erosion and constructing culverts under the coastal highway and existing roads. The discharge site is project specific; there are no practicable alternatives to the proposed discharge site that would achieve the desired project purpose. The discharge will not result in significant adverse impacts on the aquatic ecosystem.

3. The discharge of rock and fill material at the site would not violate any applicable CNMI Water Quality Standards. Nor would it violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

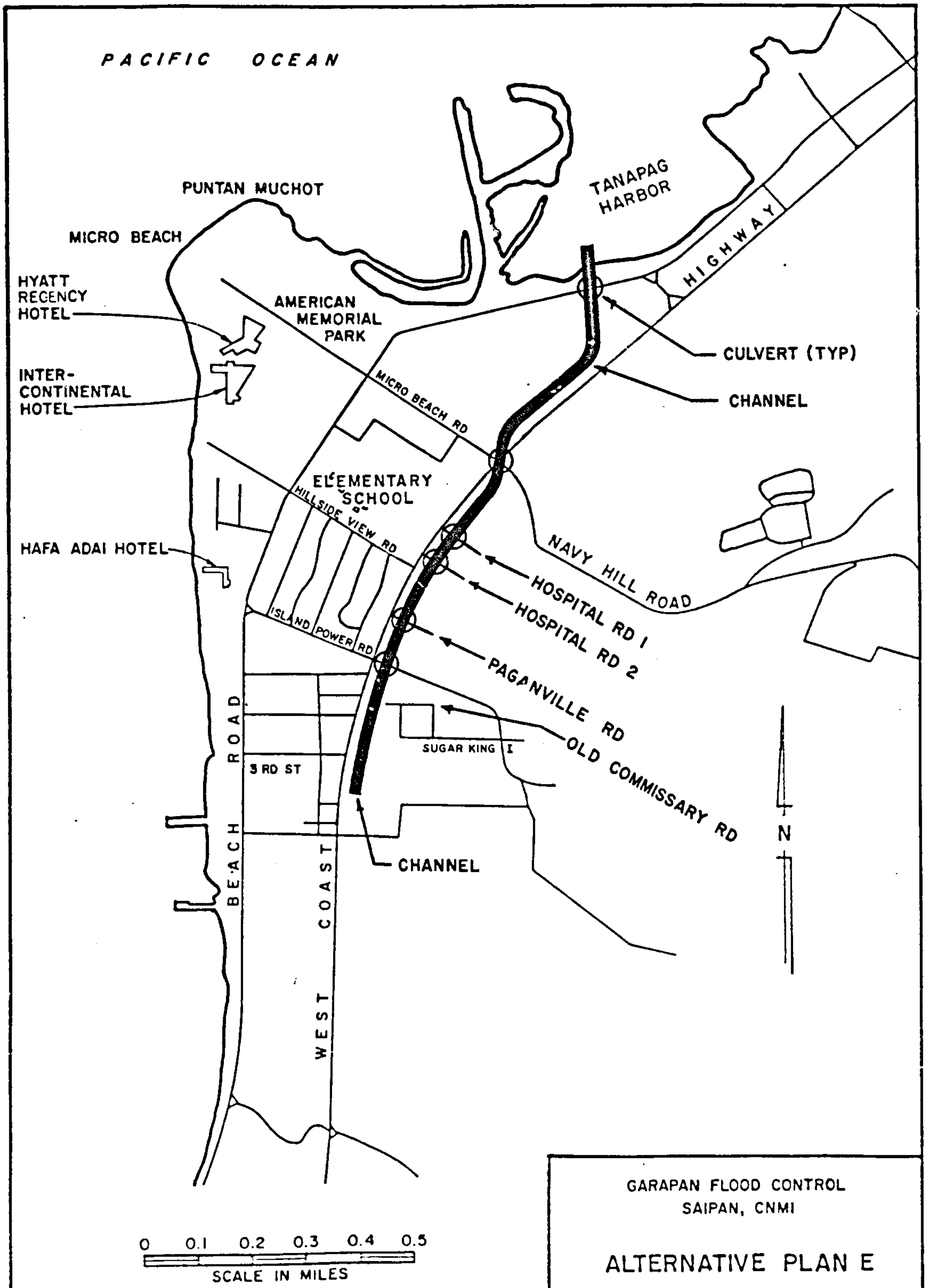
4. The discharge of fill material at the proposed site will not harm any endangered species or their critical habitat.

5. The proposed discharge will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic and economic values will not result from the discharge of fill material for this project.

6. On the basis of the guidelines, the proposed site for the discharge of fill material complies with the requirements of these guidelines.

13 May 86
Date

John D. French
Major, Corps of Engineers
Deputy District Engineer




GARAPAN FLOOD CONTROL
SAIPAN, CNMI

ALTERNATIVE PLAN E

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE

# SECTION II

## U. S. Fish and Wildlife Service
## Section 2(b) Report

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 ALA MOANA BOULEVARD
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IN REPLY REFER TO:

ES
Room 6307

JUL 30 1985

Colonel Michael M. Jenks
District Engineer
U.S. Army Engineer District, Honolulu
Bldg. 230
Ft. Shafter, Hawaii 96858-5440

Dear Colonel Jenks:

This is the U.S. Fish and Wildlife Service's Final Coordination Act Report for the Honolulu District's Garapan Flood Control Study, Saipan, Commonwealth of the Northern Mariana Islands. This is the report of the Secretary of the Interior in accordance with Section 2(b) of the Fish and Wildlife Coordination Act. It is also consistent with the National Environmental Policy Act.

Sincerely,

Allan Marmelstein
Pacific Islands Administrator

cc: Director, FWS, Washington, D.C. (AHR-ES/FP)
RD, FWS, Portland, OR (AHR)
NMFS-WPPO
EPA, San Francisco
Planning Br., Engrg Div, COE
GEPA
GDAWR

# FINAL COORDINATION ACT REPORT
# GARAPAN FLOOD CONTROL STUDY
# SAIPAN, COMMONWEALTH OF
# THE NORTHERN MARIANA ISLANDS

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
HONOLULU FIELD OFFICE

July 1985

Prepared for the U.S. Army Engineer District, Honolulu

## TABLE OF CONTENTS

## PREFACE

This report was prepared by John Ford, Andy Yuen, and Yvonne Ching, and is based on data gathered from existing literature and from Service field investigations conducted by Thomas Hablett, Gerald Ludwig, and Peggy Kohl from April 30 to May 11, 1979; and by John Ford and Commonwealth of the Northern Mariana Islands (CNMI) biologists on November 20, 1984. Data from Service forest bird surveys were provided by John Engbring, Supervisory Wildlife Biologist. Project alternatives were provided by Rudy Mina, Planning Branch, Engineering Division, Honolulu District. We wish to acknowledge Drs. Tom Lemke and Thane Pratt of CNMI Division of Fish and Wildlife for their excellent logistical and field support, and for their assistance in impact identification and analysis. We also gratefully thank Mr. Nicholas Guerrero, Director of the CNMI Department of Natural Resources.

## DESCRIPTION OF PROJECT AREA

Garapan village is located on Saipan's west-central coast (Fig. 1). Prior to its nearly complete destruction during World War II, it was the principal population center on Saipan. Extensive rebuilding was completed after invasion by U. S. forces to facilitate administrative services and storage of war-related materials. Since the late 1940's, most of the U. S. military buildings have deteriorated or have been replaced by residential or light commercial buildings. Garapan is also the site of three major hotels. These are located along the white sand Micro Beach that borders Saipan Lagoon.

Inland from this coastal plain area, the land rapidly rises in a series of terraces that form Saipan's central limestone hill range. Mt. Tagpachau, Saipan's highest elevation (1,555 feet), is about 2.5 miles southeast of the village. The slopes of the geologically complex Tagpachau limestone ridge are dissected by steep ravines and occasional nearly vertical fault cliffs (Ref. 2). The narrow ravines and areas along the cliffs appear to have been shrub or forest vegetation in 1944. Many of the remaining terraces were cleared and cultivated in what appears to be sugar cane. Aerial photographs from 1978 show little evidence of farming along the slopes above Garapan.

There are no perennial streams within the project area. Deep valleys on the hillsides contain intermittent stream channels. The watershed within the project area covers 1.9 square miles (Ref. 15 and 16). Three wetland areas totalling about 32.1 acres in area are present within the Garapan watershed (Fig. 3). The largest is located in the American Memorial Park, just southwest of Tanapag Harbor (Fig. 3). This wetland covers an area of approximately 8.4 acres (Ref. 9). This area was an open water *Phragmites-Scirpus* dominated marsh before the U. S. military invasion. Since the invasion, the marsh has been partially filled and is now overgrown with pago (*Hibiscus tiliaceus*), kafu (*Pandanus fragrans*), and tangantangan (*Leucaena leucocephala*). There is standing, but not open water in the Garapan Marsh. Two smaller wetlands are located in the Garapan village area.

Post-World War II construction obliterated Japanese drainage ditches in Garapan and no replacements were provided. Storm runoff as sheet flow now moves overland toward the low lying urban areas and causes serious flood damage. Garapan and neighboring areas were declared a major disaster area following a major flood that occurred in August of 1978 (Ref. 8 and 19). Flood problems in parts of Garapan are compounded by roads being elevated above the house lot levels and inadequate urban drainage systems.

Service field investigations in May 1979 included a visual survey of the northern end of the drainage system. Lack of defined trails and large numbers of wasps precluded extensive exploration of the upper watershed. An additional ground survey was performed along the beach from Puntan Muchot to the Garapan Sugar dock area. The Service's November 1984 surveyed the principal wetland area at the American Memorial Park.

## PROJECT DESCRIPTION

Six flood control alternatives are considered for the Garapan area.

Alternative A consists of approximately 5,720 feet of channel improvements (Fig. 3). The channel would run upland of the West Coast Highway, across the West Coast Highway and Micro Beach Road intersection, and through the body of the primary Garapan wetland. The channel would discharge into Tanapag Harbor. The channel would be trapezoidal in shape and would be riprap lined in areas of high water velocities.

This alternative would displace approximately 4.2 acres of wetlands. Mitigation includes excavating an additional 4.2 acres of wetland habitat in the northeast portion of the American Memorial Park and the removal of existing fill areas to create two larger open water areas.

Alternative B has the the same upland channel location as Alternative A (Fig. 4). The 2,450-foot long outlet channel would run along Hillside View Road. The outlet channel would discharge into Saipan Lagoon south of the Inter-Continental Hotel. The channel would be trapezoidal in shape and would be riprap lined in areas of high water velocities. This alternative would require the relocation of 4 homes between Latte Street and West Coast Highway.

Alternative C is similar to Alternative B except that the 1,800-foot long outlet channel would run along the Island Power Road (Fig. 5). The outlet channel would discharge into Saipan Lagoon south of the Hafa Adai Hotel. The channel would be trapezoidal in shape and would be riprap lined in areas of high water velocities. This alternative would affect 27 private lots and would require the relocation of 5 residences.

Alternative D has the same upland channel location as Alternative A (Fig. 6). This alternative would use the main Garapan wetland as a ponding basin for flood flows. The maximum storage capacity within the area is about 112 acre-feet over an area of 43 acres. The wetland would be graded to connect the ponds and create one large pond. The outflow channel would have an invert elevation set at +2.00 feet above mean sea level. The flood waters would discharge into Tanapag Harbor through four box culverts at Beach Road.

Alternative E has the same upland channel location as Alternative A (Fig. 7). However, the outlet channel is about 500 feet longer and detours around the main Garapan wetland. Flood waters would discharge into Tanapag Harbor.

Alternative F is a non-structural alternative that would require the permanent relocation of people and contents from flood prone areas or flood proofing buildings in the flood zone.

## TERRESTRIAL AND AQUATIC RESOURCES WITHOUT THE PROJECT

Previously cleared areas in the Garapan watershed have been revegetated with nearly pure stands of tangantangan (*Leucaena leucocephala*). The closed tangantangan canopy is 15-20 feet high and dense enough to inhibit extensive undergrowth in the more xeric hillside habitats. Ravines, however, have deeper soils that retain water better than the slopes. In these areas, undergrowth is more diversified with dense areas of grasses and tigre (*Sansevieria trifasciata*). Pago (*Hibiscus tiliaceus*), papao-apaka (*Alocasia macrorrhiza*) and kafu (*Pandanus fragans*) are also important constituents of the damper tangantangan areas. Dominant vegetation observed in the Garapan watershed is listed in Appendix 1.

The remaining forest vegetation is generally dominated by a mixture of introduced food or ornamental trees along with kafu, bamboo (*Bambusa vulgaris*), pago and ironwood (*Casuarina litorea*). Typical strand vegetation observed along the beach includes the beach morning glory (*Ipomoea pes-caprae*), pago, coconut (*Cocos nucifera*), ironwood and various grasses and shrubs. Urban vegetation includes many of the previously mentioned species as well as the flame tree (*Delonix regia*), a variety of garden vegetables and ornamental shrubs.

The 27-acre wetland at the American Memorial Park is dominated by ironwood, pago, and the fern *Acrostichum aureum*. *Scirpus* bullrushes are scattered throughout the inundated portions of the wetland. The higher grounds surrounding the swamp are covered with tangantangan.

Few terrestrial animals other than birds, introduced marine toads (*Bufo marinus*), African land snails (*Achatina fulica*) and domesticated farm animals were observed within the Garapan village drainage system (Appendices 2 and 3).

The upper watershed provides habitat for a relatively dense population of birds (Ref. 19). Except for the Eurasian Tree Sparrow (*Passer montanus*) and the Philippine Turtle-Dove (*Streptopelia bitorquata*), the avifauna is dominated by species indigenous or endemic to the Mariana Islands. These include the abundant (2,000 per square km) Bridled White-eye (*Zosterops conspicillata*); the abundant (200-600 per square km) Golden Honeyeater (*Cleptornis marchei*), Rufous-fronted Fantail (*Rhipidura rufifrons*) and Cardinal Honeyeater (*Myzomela cardinalis*); the common (10-200 per square km) Collared Kingfisher (*Halcyon chloris*), Mariana Fruit Dove (*Ptilinopus roseicapilla*), Micronesian Starling (*Aplonis opacus*), Vanikoro Swiftlet (*Collocalia vanikorensis*); and uncommon (less than 10 per square km) White-throated Ground Dove (*Gallicolumba xonthonura*) and Yellow Bittern (*Ixobrychus sinensis*) (densities taken from Ref. 6, Garapan region). One seabird, the White Tern (*Gygis alba*), is also found in the upper watershed. Densities have not been calculated for this species, but relatively high numbers were recorded in the upper watershed during the 1982 cooperative surveys. The Mariana fruit bat (*Pteropus mariannus*) may also be present in this area, but was not observed during the 1979 or 1984 surveys.

A number of species which inhabit the upper watershed are known to occur within wetlands or urban areas of the lower watershed; however, the urban areas tend to have a higher exotic avifaunal component and generally lower densities of native forest birds.

Philippine Turtle-Doves and Eurasian Tree Sparrows appear to be more common here than in the upper watershed. Greater vegetation stratification, higher topographical relief, decreased human disturbance, and greater abundance of mature fruit trees may account for the greater numbers of native bird species in the upper watershed.

Water dependent and water associated birds that are found in the wetlands of the lower watershed include the resident Yellow Bittern, Nightingale Reed Warbler, and Common Moorhen (*Gallinula chloropus*), and migratory shorebirds such as the Wood Sandpiper (*Tringa glareola*) and Common Sandpiper (*Actitis hypoleucos*) (Ref. 9) (J. Engbring, pers. comm.). The resident water associated species are found mostly in the dense marsh vegetation and, to a lesser extent, in adjacent brushy stands. Migratory shorebirds prefer open shallow water, open muddy banks, and the expansive tidal flats along the shoreline of the lagoon. Lemke (1983, unpublished) listed six species of wading birds and 14 species of migratory shorebirds known from Saipan. Most of these species utilize the tidal flats adjacent to the American Memorial Park as resting and foraging habitat (Figure 16).

The Common Moorhen, Mariana Mallard (Anas oustaleti), Nightingale Reed Warbler, La Perouse's Megapode (Megapodius laperouse), and Vanikoro Swiftlet are listed endangered species. Although no endangered Micronesian Megapodes have been recorded from the Garapan watershed, a small population exists on Northern Saipan (Ref. 6). The upper Garapan watershed may be suitable habitat for this bird.

Marianas fruit bat (Pteropus mariannus mariannus) may be present in this area, but was not observed during the 1979 survey (Ref. 19). At one time, the endangered Mariana Mallard may have been found in the wetlands of the lower watershed; however, it is not known to reside there now.

Two Common Moorhens, a Black-Crowned Night Heron (Nycticorax nycticorax), two Mariana Fruit-Doves, two Nightingale Reed Warblers, and four Rufous Fronted Fantails were observed within the American Memorial Park wetland by Service and CNMI biologists during their survey on November 20, 1984.

A standing water body within the American Memorial Park provides a curious habitat for an estuarine fish. The small pond is linked with Tanapag Harbor by a drainage culvert during freshets. Apparently during these events, juveniles Megalops cyprinoides migrate into the pond and become trapped there by receding flows. At least 3 large adults (1.5 to 2 ft. in length) were observed in the shallow stagnant pond by Service and CNMI biologists in November 1984.

The nearshore marine environment within the study area can be generally described as sandy algae-sea grass (Enhalus acoroides and Halophila minor) habitat (Appendix 4) that is inhabited by at least 31 species of fish (Appendix 5) and an unknown variety of invertebrates (Ref. 1 and 19). The dock and shoreline substrate at the southern boundary of the site is rubble that appears to have resulted from previous dredging and deterioration of the dock and shoreline seawall. The rubble along the outer edge of the basin is often exposed at low tide. This habitat (Fig. 8) (Table 1) is frequented by schools of cardinal fish, juvenile squirrel fish, damselfish, surgeonfish, rabbitfish, snappers, goatfish, an occasional eel and a variety of gobies and blennies (Appendix 5). Approximately 5% of the bottom is covered with living coral (Pocillopora damicornis). The bottom of the dredged area is sandy and is about 90% covered by a variety of algae and sea grasses.

Fewer fish species were observed in the dredged area. Those present principally included a few snappers and schools of goatfish. The most conspicuous invertebrate was a jellyfish, *Cassiopea* sp. These animals nearly covered the bottom in some places as they rested oral-side up. Sea cucumbers, principally *Holothuria atra*, and conical sand mounds of an unidentified invertebrate were scattered across the bottom.

Numerous wrecks were observed in the area. A wrecked World War II barge lies just south of the end of the main dock. Several other wrecks were present off a second deteriorated rubble-fill dock that parallels Garapan Dock about 450 feet to the south. These wrecks and rubble were focal points for a diverse array of fishes, invertebrates, and plants. Three unidentified crab species and an octopus were seen in crevices, while encrusting sponges, algae, and bryozoans, covered many other surfaces. Schools of goatfish, snappers, gerrids, and many other reef species were common around the deteriorated dock. Squirrelfish and a host of other nocturnally active species (e.g. sweepers) were hidden within the wrecks and rubble interstices. The tip of the eroded dock is apparently a center of fishing activity judging from the presence of a number of broken fish lines and an abandoned net.

The inshore reef area between the two docks was dominated by *Halimeda* sp. and the sea grasses, *Enhalus acoroides* and *Halodule uninervis*. This community changes to a bare sand bottom scattered with dense patches of *Enhalus acoroides*. These patches appear as dark dots on Fig. 9. Further seaward, the bottom is mostly rubble and sand, with occasional colonies of coral (*Pocillopora damicornis*) and scattered algal growths.

A dredged channel that extends to the sea from Garapan Dock cuts through luxuriant coral reef (Habitat 15) (Fig. 4) (Table 1). South of the channel, patch reefs are completely covered with *Acropora formosa*, a branching finger-like coral (Fig. 10) that has recolonized much of the channel itself, and along with *P. damicornis*, also covers almost 50% of the reef platform north of the channel.

The very high reef diversity at these sites are reflected in the 84 fish species recorded there (Appendix 5). Although the brilliant Blue Chromis (*Chromis caerulea*) (Fig. 10) was the most common species, Service biologists were always able to observe four or five species simultaneously. Surveys indicated that the diversity of nocturnal species was not as great.

Besides _A. formosa_, the most obvious invertebrates present were sea cucumbers (0.5 per m2) (Fig. 11) found on sandy substrate between coral growths. Species observed included _Holothuria atra_ (most common), _H. axiologa_, _H. edulis_, _Synapta maculata_, and _Bohadchia argus_. Also present were unidentified invertebrates including crabs, a variety of sponges (Fig. 12), hydrozoan corals, bryozoans, and various worms.

These patch reefs apparently represent a unique environment within Saipan Lagoon (Fig. 4). Amesbury _et al_ (Ref. 1) highly recommended preservation of this area because of the great diversity of fish species present. Interviews with boat operators that cater to tourist skin divers indicated that this spot is highly valuable to them because of its beauty, easy accessibility, and safety. Threatened Green Sea Turtles (_Chelonia mydas_) and Endangered Hawksbill Turtles (_Eretmochelys imbricata_) are occasionally observed on the reef off Garapan Dock (Ref. 21).

The northern site for the outlet channel near the American Memorial Park, is presently being used as a small boat harbor (Fig. 13). Its protected nature and proximity to hotels and to Managasan Island make it a prime site for tour boats, three of which were present during the 1979 survey. The site also serves as a mooring area for pleasure crafts.

Erosion of coral fill, in areas where sheet piling and wood retaining walls have deteriorated, has resulted in excessive turbidity. Poor visibility made the site difficult to survey during 1979.

Most of the substrate is sand, silt or rubble with occasional small corals. The bottom has an abundance of scrap metal and other debris, possibly artifacts from World War II. A wrecked World War II barge was present at the harbor entrance. A small boat harbor under construction at the time of the American invasion lies just north of the entrance. The remains of many landing crafts, reminders of World War II, are strewn across the nearby reef (Fig. 14) and around Garapan Dock.

Benthic marine vegetation is primarily _Halimeda_ spp., _Padina_ spp. with scattered _Sargassum_ spp., _Halodule uninervis_, and _Enhalus acoroides_ (Table 4). Deeper into the anchorage, murky water prevented an accurate estimation of vegetation cover, but _Halimeda_ spp. and _Padina_ spp. appeared to be dominant. Sea cucumbers, most likely _Holothuria atra_, were scattered across the bottom. The most common invertebrates along the shore were neritid and littorine mollusks.

The most obvious fishes observed were snappers (*Lutjanus monostigmus*) and surgeonfish (*Acanthurus mata*) (Appendix 5). An occasional "cloud" of small sweepers (*Pempheridae*) was also observed. At the north entrance to this site, a 2.5-foot Bluejack (*Caranx melampygus*) was feeding on large schools, of what appeared to be, silversides (*Atherinidae*).

## TERRESTRIAL AND AQUATIC RESOURCES WITH THE PROJECT

The continued protection and maintenance of wetlands essential to endangered waterbirds is one of this office's highest priorities. Increasing human populations and urban development threaten the few remaining wetland habitats in Micronesia. Garapan Marsh and Lake Susupe are two such wetlands on Saipan and are of critical importance for the continued existence of the Federally listed endangered Mariana Gallinule (*Gallinula chloropus*) and the possibly still extant Mariana Mallard (*Anas oustaleti*).

### Alternative Plan A

This alternative will displace approximately 4.2 acres of wetlands within Garapan Marsh. The Corps has proposed that mitigation for the loss of this wetland habitat would consist of excavating 4.2 acres in the northeast portion of the American Memorial Park to create wetlands and removing existing fill areas in the wetland. Since other environmentally preferable alternatives exist, the Service considers this an unacceptable loss of important existing wetland habitat. We strongly recommend that this alternative be dropped from further discussion.

### Alternative Plans B and C

These alternatives would have no impact on the Garapan wetland. The impacts of the outlet channel on the marine environment for Alternatives B and C are similar to those discussed for the other alternatives and are discussed below. Alternatives B and C are environmentally preferable; however, the Corps believes that these Alternatives are economically unfeasible.

### Alternative Plan D

Alternative D uses the Garapan Marsh as a flood water collection basin; this is an important natural function of a wetland and is generally compatible with the maintenance of fish and wildlife resources. The use of Garapan Marsh as an integral part of the flood protection program for the Garapan area will insure that the area remains a wetland in the future.

A concern discussed in our draft 2(b) Coordination Act Report (February 25, 1985) was that the periodic introduction of flood waters into the marsh would reduce the salinity of the marsh waters and would negatively affect the wetland fern *Acrostichum aureum* and other components of the endangered Mariana Gallinule habitat.

Our report stated that the fern *A. aureum* flourishes in brackish water wetlands. The fern is not an obligate brackish water plant and flourishes in both freshwater and brackish water wetlands (D. Herbst, pers. comm.). This fern is tolerant of brackish water and has been found on the landward edge of mangroves swamps and in other mixohaline coastal wetlands.

The decrease in salinity of marsh waters would be temporary since the outflow time for 112 acre-feet would range from 3.7 to 5.0 hours. The reduction in salinity in the wetland resulting from the periodic flood water input would not have an adverse effect on *A. aureum* or the other vegetation components of the Garapan Marsh.

The use of the Garapan Marsh as a flooding basin does have the potential for introducing and bioaccumulating toxic substances in wetland fauna. Urban growth within the watershed may introduce petrochemicals, biocides, and other hazardous materials to the wetland.

Relative to the other alternatives, this alternative would result in a lower suspended sediment load being introduced into Tanapag Harbor because of the ponding and settling effects within the Garapan Marsh. This would result in a reduced impact to nearshore water quality and seagrass beds.

The removal of the asphalt fill areas in the Garapan wetland would require the construction of temporary causeways into the marsh. This construction would have temporary negative impacts on wetland vegetation and waterbird habitats. However, the removal of the asphalt fill would result in a net gain of wetland and waterbird habitat by removing fast lands within the wetland. From a wildlife standpoint, however, the removal of the fill is not necessary.

Alternative Plan E

In our draft 2(b) Coordination Act Report, the Service stated that the drainage channel alternative that skirted the marsh would have the least adverse impact on the Garapan wetland. An important qualifier to this recommendation was that the drainage channel be impervious to prevent sea water intrusion into the drainage channel and thereby increasing the salinity of the Garapan wetland. An impervious channel is necessary to maintain the existing water conditions within this wetland (Chuck Huxler, U.S. Geological Survey, pers. comm.).

Alternative E does skirt the wetland; however, the proposed drainage channel is not impervious and will not prevent sea water intrusion. Without the impervious channel, the Service finds Alternative E unacceptable. Based on discussions with the U.S. Geological Survey, the Service believes that the increase in salinity will reduce the suitability of the Garapan wetland as habitat for the endangered Mariana Gallinule.

The Service continues to recommend that the drainage channel from the mouth of the channel to approximately Station 44 + 98 (point where 0 MSL is reached) be impervious to seawater intrusion.

This alternative also intercepts surface runoff from entering the Garapan wetland. This reduction of surface runoff may reduce the amount of wetland habitat and encourage the conversion of marginal wetland areas into dry land habitats.

This alternative would result in the direct discharge of sediment-laden waters into Tanapag Harbor. There is no settling pond effect to capture suspended sediments in the flood waters.

The impacts of the outlet channel and storm water runoff for all alternatives on marine resources would have both temporary and long-term impacts upon the marine environment.

Portions of channel below 0 MSL would have mixohaline water and may retain sediments. This may provide habitat for brackish-water flora and fauna, including mudskippers (*Periophthalmus koeleutii*), juvenile mullet (*Chelon engeli*), and flagfish (*Kuhlia* sp.). Such areas may provide some additional feeding resources and habitat for shore and waterbirds.

Suspended sediments carried with storm water runoff would create localized turbidity plumes. Benthic communities near the mouth of the outlet channels may be negatively impacted by sedimentation, freshwater dilution, and a gradual increase in the concentrations of some urban pollutants.

Sediments discharged from the channel may also have negative long-term impact on sea grass beds located approximately 20-30 m seaward from the high tide line (Ref. 17). The sea grass, *E. acoroides*, is not expected to be affected by freshwater dilution, although increased sedimentation may bury some stands. A decrease in the quality or quantity of *E. acoroides* may indirectly affect rabbitfishes (*Siganus* spp.) and other subsistence fishery species in Tanapag Harbor.

The outlet channel would affect less than 0.10 acres of mud and intertidal habitat.

## U.S. FISH AND WILDLIFE MITIGATION POLICY

The Service's Mitigation Policy (Federal Register, Vol. 46, No. 15, January 23, 1981) was formulated with the intent to ". . . protect and conserve the most important and valuable fish and wildlife resources while facilitating balanced development of the Nation's natural resources." The policy outlines internal guidance for Service staff and complements our participation under the Fish and Wildlife Coordination Act and National Environmental Policy Act. The Mitigation Policy does not apply to threatened or endangered species; specific requirements for these resources are covered in the Endangered Species Act of 1973 (50 CFR 17).

The policy focuses on the mitigation of habitat value, and on impacts to fish and wildlife populations. Our recommendations for mitigation/compensation will be based upon the habitat values adversely affected by the project, and not by loss of acreage alone. Our habitat valuations and recommendations will be based upon thorough consideration of all relevant biological data.

The Service considers the Garapan Marsh to be Resource Category 2. Under this category, the habitat to be impacted is of high value for the evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion setting. The mitigation goal for this category is no net loss of in-kind habitat value. Specific planning goals include (1) physical modification of the replacement habitat to convert it to the same type lost; (2) restoration or rehabilitation of previously altered habitat; (3) increased management of similar replacement habitat so that the in-kind habitat value of the lost habitat is replaced; or (4) a combination of the above.

The evaluation species were various migratory waterfowl including the Green-winged Teal (Anas creca), Northern Pintail (A. acuta), Garganey (A. querquedula), Northern Shoveler (A. clypeata), and Tufted Duck (Aythya fuligula) and migratory shorebirds including the Lesser Golden Plover (Pluvialis dominica), Common Greenshank (Tringa nebularia), Marsh sandpiper (T. stagnatilis), Wood Sandpiper (T. glareola), Gray-tailed Tattler (Heteroscelus brevipes), Bar-tailed Godwit (Limosa lapponica), and others (J. Engbring, pers. comm.).

### RECOMMENDATIONS

a. From the mouth of the channel to Station 44 + 98, the drainage channel will be impervious to seawater intrusion. This impervious channel is necessary to maintain the existing water quality conditions within the Garapan Marsh.

b. If the Corps determines that an impervious channel for Alternative E is economically unfeasible, the Service recommends the selection of Alternative D.

c. Dredged material from the drainage channel and the wetland fill will not be discharged or stockpiled below 0 MSL and in wetland areas. Excess material will not be used to fill wetland areas and will be disposed of at approved upland landfill sites.

d. The outlet of the entrance channel will be constructed after the dredging and stabilization of the drainage channel.

e. Silt curtains shall be used during construction of the outlet channel to minimize turbidity and suspended sediments.

f. Cleared areas be revegetated as soon as possible following construction.

g. The invert for the outlet channel for Alternative D will be set at 2.0 to 2.5 MSL to maintain water levels in the wetland.

h. During construction of the outlet channel, care will be taken to minimize impacts to mangroves and sea grass beds.

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Appendix 1. Dominant plants observed in the Garapan Drainage during 1979 Service surveys (Ref. 19).

| COMMON NAME | SCIENTIFIC NAME |
|---|---|
| **MONOCOTYLEDONS** | |
| Bamboo | Bambusa vulgaris |
| Banana | Musa xparadisiaca |
| Betel nut | Areca cathecu |
| Coconut | Cocos nucifera |
| Crowfoot grass | Dactyloctenium aegyptium |
| Guinea grass | Panicum maximum |
| Kafu | Pandanas fragans |
| Lovegrass | Eragrostis tenella |
| Rat-tail dropseed | Sporobolus elongatus |
| Sedge | Cyperus odoratus |
| Sword grass | Miscanthus floridulus |
| Tigre | Sansevieria trifasciata |
| Upland taro (papao-apaka) | Alocasia macrorrhiza |
| **DICOTYLEDONS** | |
| Acacia | Acacia confusa |
| African tulip tree | Spathodea campanulata |
| Beach morning glory | Ipomoea pes-caprae |
| Breadfruit | Artocarpus incisus or mariannensis |
| Candlebrush | Cassia alata |
| Coffee-senna | Cassia occidentalis |
| False verbena | Stachytarpheta indica |
| Flame tree | Delonix regia |
| Indian pluchea | Pluchea indica |
| Ironwood | Casuarina litorea |
| Kapok tree | Ceiba pentandra |
| Lagundi | Vitex trifolia |
| Mango | Mangifera indica |
| Milo | Thespesia populnea |
| Nigas | Pemphis acidula |
| Pago | Hibiscus tiliaceus |
| Papaya | Carica papaya |
| Passion fruit | Passiflora foetida var. hispida |
| Tangan tangan | Leucaena leucocophala |

Appendix 2. Mammals, Reptiles and Amphibians observed or believed to be present in Garapan watershed and nearshore area (Ref. 19).

| COMMON NAME | SCIENTIFIC NAME |
|---|---|
| **MAMMALS** | |
| Cow | *Bos* sp. |
| Pig | *Sus scrofa* |
| Dog | *Canis familiaris* |
| Cat | *Felis domesticus* |
| Marianas Fruit Bat | *Pteropus mariannus mariannus* |
| Norway Rat | *Rattus norvegicus* |
| Roof Rat | *R. rattus* |
| Polynesian Rat | *R. exulans* |
| Mouse | *Mus musculus* |
| **REPTILES** | |
| Bluetail Skink | *Emoia cyanura* |
| Brown Skink | *Emoia* sp. |
| Green Skink | *Lamprolepis smaragdina* |
| Green Anole | *Anolis* sp. |
| Indian Monitor | *Varanus indicus* |
| Geckos | Gekkonidae |
| Green Sea Turtle | *Chelonia mydas* |
| Pacific Hawksbill Turtle | *Eretmochelys imbricata* |
| **AMPHIBIANS** | |
| Marine Toad | *Bufo marinus* |

Appendix 3. Birds observed in the Garapan Drainage during Service surveys by Gerald Ludwig in May of 1979 (Ref. 19) and by Engbring & Ramsey in 1982 (Ref. 6). A number of other migratory shorebirds would be expected to occur on reef flats along the coast. Nomenclature is based on Owens, 1977 (Ref. 12).

| COMMON NAME | SCIENTIFIC NAME |
|---|---|
| Yellow Bittern | *Ixobrychus sinensis* |
| Marianas Crow[1] | *Corvus kubaryi* |
| Marianas Fruit-Dove | *Ptilinopus roseicapilla* |
| Philippine Turtle-Dove | *Streptopelia bitorquata* |
| White-throated Ground-Dove | *Gallicolumba xanthonura* |
| Rufous-fronted Fantail | *Rhipidura rufifrons* |
| Red Junglefowl | *Gallus gallus* |
| Cardinal Honeyeater | *Myzomela cardinalis* |
| Golden Honeyeater | *Cleptornis marchei* |
| Collared Kingfisher | *Halcyon chloris* |
| Common Moorhen | *Gallinula chloropus* |
| Rock Pigeon | *Columba livia* |
| Lesser Golden Plover | *Pluvialis dominica* |
| Nightingale Reed-Warbler | *Acrocephalus luscinia* |
| Common Sandpiper | *Actitis hypoleucos* |
| Wood Sandpiper | *Tringa glareola* |
| Eurasian Tree Sparrow | *Passer montanus* |
| Micronesian Starling | *Aplonis opaca* |
| Vanikoro Swiftlet | *Collocalia vanikorensis* |
| Gray-tailed Tattler | *Heteroscelus brevipes* |
| Wandering Tattler | *Heteroscelus incanus* |
| White Tern | *Gygis alba* |
| Ruddy Turnstone | *Arenaria interpres* |
| Bridled White-eye | *Zosterops conspicillata* |

[1] Unconfirmed record

Appendix 4. Marine Sea Grasses and Algae observed nearshore of Garapan Flood Control Study Area by Service biologists (May 1979) or recorded by FitzGerald and Tobias, 1974 (Ref. 7).

| | Garapan | Memorial Park |
|---|---|---|
| SEA GRASSES | | |
| *Enhalus acoroides* | X | X |
| *Halodule uninervis* | X | X |
| *Halophila minor* | X | X |
| ALGAE | | |
| *Boodlea composita* | X | |
| *Caulerpa spp.* | X | |
| *Dictyosphaeria versluysii* | X | |
| *D. triabilis* | X | |
| *Enteromorpha compressa* | X | |
| *Feldmannia indica* | X | |
| *Gelidium pusillum* | X | |
| *Halimeda macroloba* | X | |
| *H. opuntia* | X | |
| *Hormothamnion enteromorphoides* | X | |
| *Hypnea pannosa* | X | |
| *Padina spp.* | X | |
| *Polysiphonia scopulorum* | X | |
| *Spryidea filamentosa* | X | |
| *Tolpiocladia glomerulata* | X | |
| *Valonia fastgiata* | X | |

Source: USFWS Planning Aid Letter for Saipan small boat harbor.

Appendix 5. Fishes recorded from offshore habitats near alternative sites for Garapan Flood Control Study by USFWS biologists, 1979 and Amesbury *et al*., 1979 (Ref. 1).

[1]Habitats sampled by Amesbury *et al*. Habitat description in Table 1 and Fig. 4.

[2]Collection sites of FWS biologists:
- GR - Garapan Reef, includes Amesbury's habitat types 7, 11, 15
- GD - Garapan Dock, includes Amesbury's habitat types 2, 7, 11, 15
- MP - Memorial Park, includes Amesbury's habitat types 2, 9, 10.

| FAMILY<br>Species | HABITAT[1]<br>2 | 7 | 9 | 10 | 11 | 15 | COLLECTING SITE[2]<br>GR | GD | MP |
|---|---|---|---|---|---|---|---|---|---|
| DASYATIDAE - Sting Rays | | | | | | | | | |
| *Taeniura melanospila* | | | | | + | | | | |
| CHANIDAE - Milkfish | | | | | | | | | |
| *Chanos chanos* | | | | | + | | | | |
| MURAENIDAE - Moray Eels | | | | | | | | | |
| *Gymnothorax undulatus* | + | | | | | | | | |
| SYNODONTIDAE - Lizardfish | | | | | | | | | |
| *Saurida gracilis* | | | | | + | + | + | + | |
| HOLOCENTRIDAE - Squirrelfish | | | | | | | | | |
| *Adioryx diadema* | | | | | | + | | | |
| *Flammeo opercularis* | | | | | | + | | | |
| *F. sammara* | + | | | | | + | + | + | |
| *M. murdjan* | + | | + | | | + | | | |
| APOGONIDAE - Cardinalfish | | | | | | | | | |
| *Apogon coccineus* | | | | | | | | | |
| *A. novemfasciatus* | + | + | | | | | | | + |
| *A. nubilis* | + | | | | | | | | |
| *Apogon* sp. A | | + | | + | | | | | |
| *Apogon* spp. | + | | | | + | | | | |
| *Cheilodipterus macrodon* | | | | | | + | | | |
| *Paramia quinqurlineata* | + | + | | | | + | | | |
| SERRANIDAE - Groupers | | | | | | | | | |
| *Epinephelus merra* | | | | + | | | | | |

| FAMILY<br>Species | HABITAT[1]<br>2 | <br>7 | <br>9 | <br>10 | <br>11 | <br>15 | COLLECTING SITE[2]<br>GR | <br>GD | <br>MP |
|---|---|---|---|---|---|---|---|---|---|
| LUTJANIDAE - Snappers | | | | | | | | | |
| *Aprion virescens* | | | | + | | | | | |
| *Lutjanas fulvus* | + | | + | | | + | | | |
| *L. kasmira* | + | | | + | | + | | | |
| *L. monostigmus* | | | | | | | + | + | + |
| *Lutjanus* sp. | + | | | + | + | + | | | |
| LEIOGNATHIDAE - Majorras | | | | | | | | | |
| *Gerres argyreus* | + | | | | | | | + | |
| AULOSTOMIDAE - Trumpetfish | | | | | | | | | |
| *Aulostomus chinensis* | | | | | | + | | | |
| FISTULARIDAE - Cornetfish | | | | | | | | | |
| *Fistularia commersoni* | | | | | | + | | | |
| SYNCNATHIDAE - Pipefish | | | | | | | | | |
| *Corythoichthys intestinalis* | | | | | | | + | + | |
| ATHERINIDAE - Silversides | | | | | | | | | |
| unidentified silversides | | | | | | | | | + |
| MUGILIDAE - Mullet | | | | | | | | | |
| unidentified mullet | | | | | | | | + | + |
| PEMPHERIDAE - Sweepers | | | | | | | | | |
| unidentified sweeper | | | | | | | | + | + |
| SPHYRAENIDAE - Brracudas | | | | | | | | | |
| *Sphyraena chinensis* | | + | | | | | | | + |
| SCORPAENIDAE - Scorpionfish | | | | | | | | | |
| *Dendrochirus brachipterus* | | | | | + | | | | |
| *Scorpaenopsis diabolus* | | | | | | | + | | + |
| CHAETODONTIDAE - Butterflyfish | | | | | | | | | |
| *Chaetodon auriga* | + | + | + | + | | + | + | + | + |
| *C. bennetti* | | | + | | | + | | | |
| *C. citrinellus* | | | | | | + | | | |
| *C. ephippium* | + | + | | | | + | + | | + |
| *C. lunula* | | + | | + | | + | + | + | |
| *C. melannotus* | | | | | | + | | | |
| *C. mertensii* | | | | + | | | | | |
| *C. trifasciatus* | | | + | + | | + | + | | |
| *C. ulietensis* | | + | + | | | + | | | |
| *Heniochus chrysostomus* | | + | + | + | | + | | | |
| *Megaprotodon trifascialis* | | | | | | + | + | | |

| FAMILY<br>Species | HABITAT[1]<br>2 | <br>7 | <br>9 | <br>10 | <br>11 | <br>15 | COLLECTING SITE[2]<br>GR | <br>GD | <br>MP |
|---|---|---|---|---|---|---|---|---|---|
| POMACANTHIDAE - Angelfish | | | | | | | | | |
| *Pomacanthus imperator* | | | | | + | | | | |
| POMACENTRIDAE - Damselfish | | | | | | | | | |
| *Abudefduf septemfasciatus* | | | | | | + | | | |
| *A. sexfasciatus* | | + | + | | | + | | + | |
| *Amphiprion clarkii* | | | | + | | | | | |
| *A. melanopus* | | | | | | + | | | |
| *Chromis atripectoralis* | | | | | | + | | | |
| *C. caerulea* | | + | + | + | | + | + | + | |
| *Xanthura* sp. | | | | + | | | | | |
| *Dascyllus aruanus* | | + | + | + | + | + | + | + | + |
| *D. reticulatus* | | | | + | | | | | |
| *D. trimaculatus* | + | | | + | + | | | | |
| *Eupomacentrus albifasciatus* | + | + | | | | + | | | |
| *E. fasciolatus* | | | | | | + | | | |
| *E. lividus* | | | | | | + | | | |
| *E. nigricans* | | + | + | | | + | | | |
| *Glyphidodontops leucopomus* | + | + | | | | | | | |
| *Plectrogyphidodon leucozona* | + | | | + | | | | | |
| *Pomacentrus pavo* | + | + | | + | + | | | | |
| *P. vaiuli* | | + | | + | + | + | | | |
| LABRIDAE - Wrasses | | | | | | | | | |
| *Cheilinus chlorurus* | | + | | + | | | | | |
| *C. trilobatus* | + | + | | + | | + | | | |
| *Cheilinus* sp. | + | | | | | | | | |
| *Cheilio inermis* | + | + | | | + | + | | | |
| *Cirrhilabrus* sp. | | | | + | | | | | |
| *Cymolutes praetextatus* | | | | | + | | | | |
| *Epibulus insidiator* | | | | | | + | + | | |
| *Comphosus varius* | | | | | | + | | | |
| *Halichoeres centriquadrus* | | | | | | + | | | |
| *H. hartzfeldi* | | | | + | | | | | |
| *H. margaritaceous* | | + | | | | | | | |
| *H. trimaculatus* | + | + | | + | + | + | | | |
| *H. melapterus* | | + | | | | + | | | |
| *Labrichthys unilineatus* | | | | | | + | | | |
| *Labroides dimidiatus* | | + | + | + | | + | + | | |
| *Pseudocheilinus evanidus* | | | | + | | | | | |
| *Stethojulis bandanensis* | | + | | + | | + | + | + | |
| *S. strigiventer* | + | | | | | | | | |
| *Stethojulis juveniles* | + | | | | | | | | |
| *Thalassoma hardwicke* | | | | | | + | | | |
| *T. lutescens* | | | | + | | + | + | | |
| *Xyrichtys macrolepidotus* | | | | | + | | | | |
| *X. taeniourus* | | | | | + | + | | | |

| FAMILY<br>Species | HABITAT[1]<br>2 | 7 | 9 | 10 | 11 | 15 | COLLECTING SITE[2]<br>GR | GD | MP |
|---|---|---|---|---|---|---|---|---|---|
| SCARIDAE - Parrotfish | | | | | | | | | |
| *Scarus chlorodon* | | | + | + | | + | | | |
| *S. forsteri* | | | | + | | + | | | |
| *S. ghobban* | + | | + | + | | + | | | |
| *S. harid* | | | | | | + | | | |
| *S. sordidus* | + | + | + | + | | + | | | |
| *S. venosus* | | | | + | | | | | |
| *Scarus* sp. | | | | | | + | | | |
| *juvenile scarids* | + | + | + | + | | + | + | + | + |
| ACANTHURIDAE - Surgeonfish | | | | | | | | | |
| *Acanthurus glaucopareius* | | | | | | + | + | | |
| *A. lineatus* | | | | | | + | | | |
| *A. mata* | | + | | + | | + | + | + | + |
| *A. nigricaudus* | | | | + | | + | | | |
| *A. olivaceous* | | | | + | + | | | | |
| *A. leucopareius* | | | | | | | | + | |
| *A. triostegus* | | + | + | | | | | + | |
| *A. xanthopterus* | + | + | + | + | | + | | | |
| *Ctenochaetus striatus* | | + | + | | | + | + | + | |
| *Naso brevirostris* | | | | + | + | + | | | |
| *N. literatus* | | + | | + | | + | | | |
| *Zebrasoma flavescens* | | + | + | + | | + | + | | |
| *Z. veliferum* | | + | + | | | + | + | + | |
| ZANCLIDAE - Moorish Idol | | | | | | | | | |
| *Zanclus cornutus* | | + | + | + | | + | + | | |
| SIGANIDAE - Rabbitfish | | | | | | | | | |
| *Siganus argenteus* | + | + | + | | | + | | | |
| *S. spinus* | + | + | + | + | + | + | + | | |
| MICRODESMIDAE | | | | | | | | | |
| *Gunnelichthys monostigma* | | | | | + | | | | |
| BLENNIIDAE - Blennies | | | | | | | | | |
| *Exallias brevis* | | | | | | | | + | |
| *Meiacanthus atrodorsalis* | | | | + | | + | + | | |
| *Plagiotremus tapeinosoma* | | + | | + | | | + | | |
| *Salarias fasciatus* | | + | | | | + | | | |
| CALLIONYMIDAE - Dragonet | | | | | | | | | |
| *Deplogrammus goramensis* | | | | | + | | | | |
| GOBIIDAE - Gobies | | | | | | | | | |
| *Acentrogobius ornatus* | | + | | | | + | | | |
| *Amblygobius albimaculatus* | + | + | | + | | + | | | |

| FAMILY<br>Species | HABITAT[1]<br>2 | <br>7 | <br>9 | <br>10 | <br>11 | <br>15 | COLLECTING SITE[2]<br>GR | <br>GD | <br>MP |
|---|---|---|---|---|---|---|---|---|---|
| <u>Eusigobius neophytus</u> | | | | + | + | + | | | |
| <u>Gnatholepis</u> sp. | | | | | + | | | | |
| unidentified gobiids | | | | | | | + | + | + |
| ELEOTRIDAE - Gobies | | | | | | | | | |
| <u>Asterropteryx semipunctatus</u> | | + | | | | | | + | |
| <u>Plereleotris microlepis</u> | | + | | + | | | | | |
| <u>Valenciennes strigatus</u> | | | | | + | | | | |
| BOTHIDAE - Left-eyed Flounders | | | | | | | | | |
| <u>Bothus mancus</u> | | | | | | | + | + | |
| SOLEIDAE - Soles | | | | | | | | | |
| <u>Aseraggodes melanostictus</u> | | | | | + | | | | |
| BALISTIDAE - Triggerfish | | | | | | | | | |
| <u>Balistoides viridesces</u> | | | | | + | | | | |
| <u>Rhinecanthus aculeatus</u> | | + | | + | + | + | + | + | + |
| MONACANTHIDAE - Filefish | | | | | | | | | |
| <u>Oxymonacanthus longirostris</u> | | | | | | + | + | | |
| CANTHIGASTERIDAE - Sharp Nosed Puffers | | | | | | | | | |
| <u>Canthigaster cornatus</u> | | | | | | | + | + | |
| TETRADONTIDAE - Puffers | | | | | | | | | |
| <u>Arothrn nigropunctatus</u> | | | | | | | + | | |
| TOTAL SPECIES | 31 | 46 | 24 | 49 | 27 | 73 | 29 | 21 | 15 |

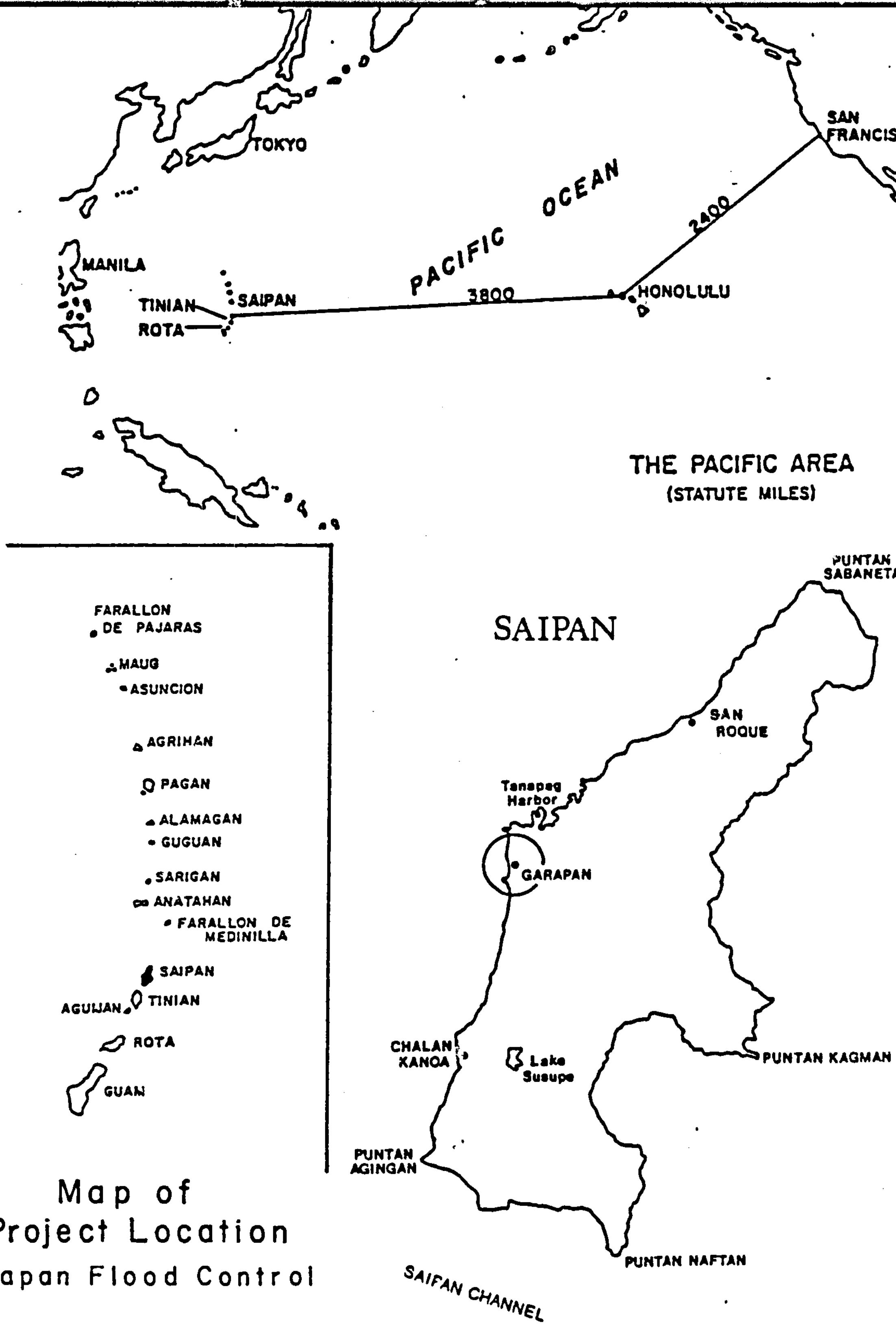



Fig. 1 Map of Project Location
Garapan Flood Control

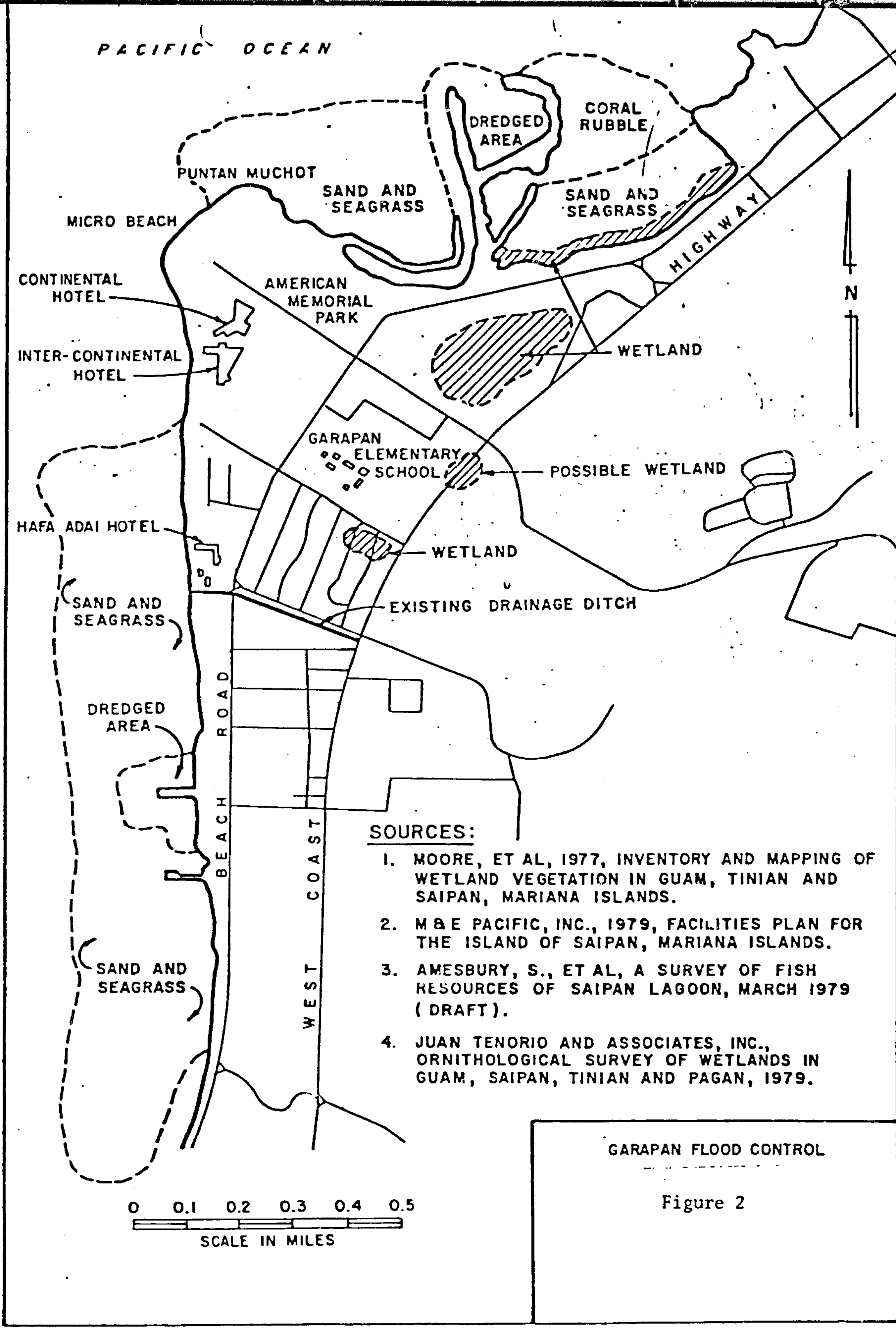

PACIFIC OCEAN
DREDGED AREA
CORAL RUBBLE
PUNTAN MUCHOT
SAND AND SEAGRASS
SAND AND SEAGRASS
MICRO BEACH
HIGHWAY
N
CONTINENTAL HOTEL
AMERICAN MEMORIAL PARK
INTER-CONTINENTAL HOTEL
WETLAND
GARAPAN ELEMENTARY SCHOOL
POSSIBLE WETLAND
HAFA ADAI HOTEL
WETLAND
EXISTING DRAINAGE DITCH
SAND AND SEAGRASS
DREDGED AREA
BEACH ROAD
WEST COAST
SAND AND SEAGRASS
SOURCES:
1. MOORE, ET AL, 1977, INVENTORY AND MAPPING OF WETLAND VEGETATION IN GUAM, TINIAN AND SAIPAN, MARIANA ISLANDS.
2. M & E PACIFIC, INC., 1979, FACILITIES PLAN FOR THE ISLAND OF SAIPAN, MARIANA ISLANDS.
3. AMESBURY, S., ET AL, A SURVEY OF FISH RESOURCES OF SAIPAN LAGOON, MARCH 1979 (DRAFT).
4. JUAN TENORIO AND ASSOCIATES, INC., ORNITHOLOGICAL SURVEY OF WETLANDS IN GUAM, SAIPAN, TINIAN AND PAGAN, 1979.
0 0.1 0.2 0.3 0.4 0.5
SCALE IN MILES
GARAPAN FLOOD CONTROL

Figure 2

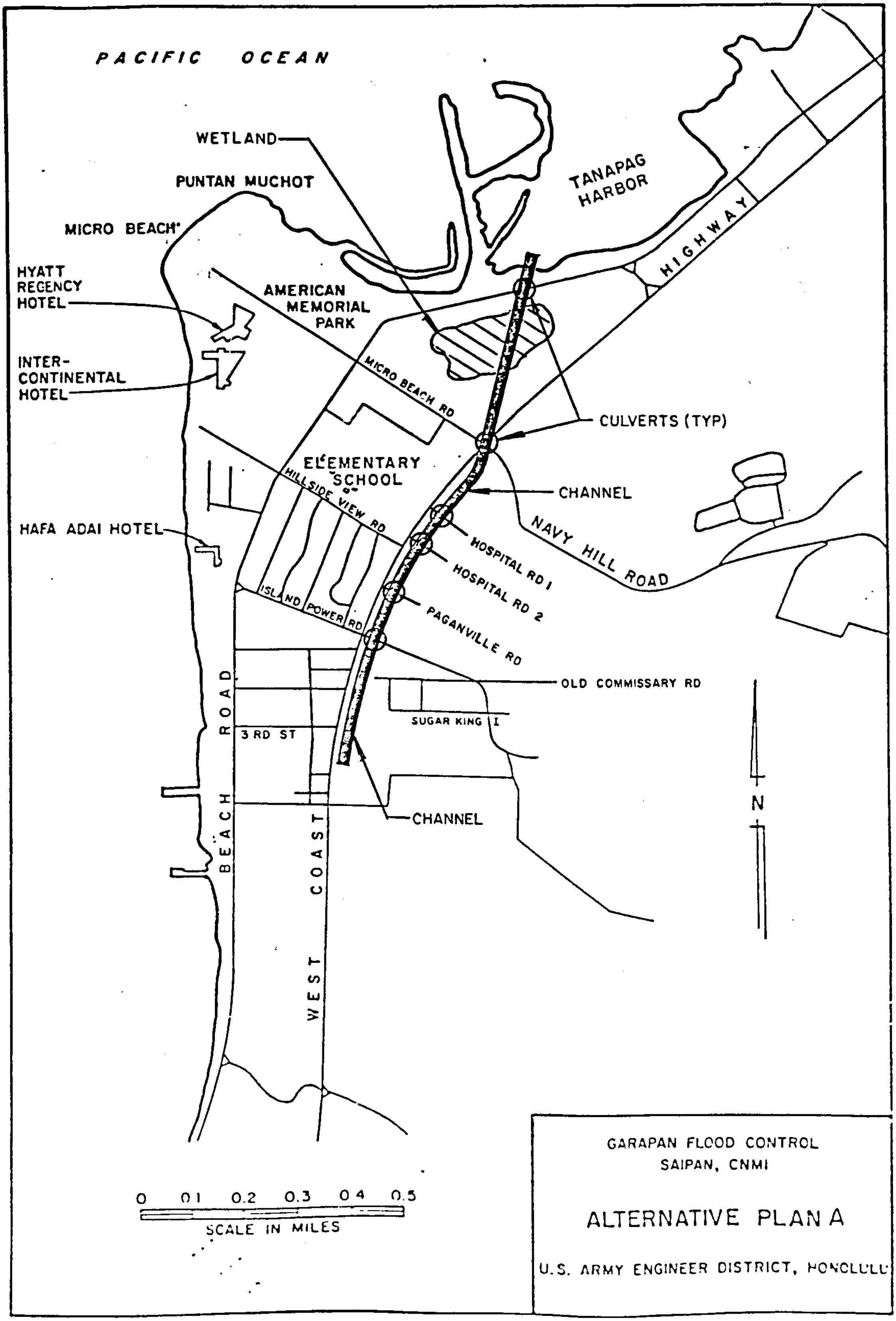

PACIFIC OCEAN
WETLAND
PUNTAN MUCHOT
MICRO BEACH
TANAPAG HARBOR
HIGHWAY
HYATT REGENCY HOTEL
AMERICAN MEMORIAL PARK
INTER-CONTINENTAL HOTEL
MICRO BEACH RD
CULVERTS (TYP)
ELEMENTARY SCHOOL
HILLSIDE VIEW RD
CHANNEL
NAVY HILL ROAD
HAFA ADAI HOTEL
HOSPITAL RD 1
HOSPITAL RD 2
ISLAND POWER RD
PAGANVILLE RD
OLD COMMISSARY RD
SUGAR KING I
3 RD ST
BEACH ROAD
CHANNEL
N
WEST COAST
0 0.1 0.2 0.3 0.4 0.5
SCALE IN MILES
GARAPAN FLOOD CONTROL
SAIPAN, CNMI
ALTERNATIVE PLAN A
U.S. ARMY ENGINEER DISTRICT, HONOLULU

Figure 3

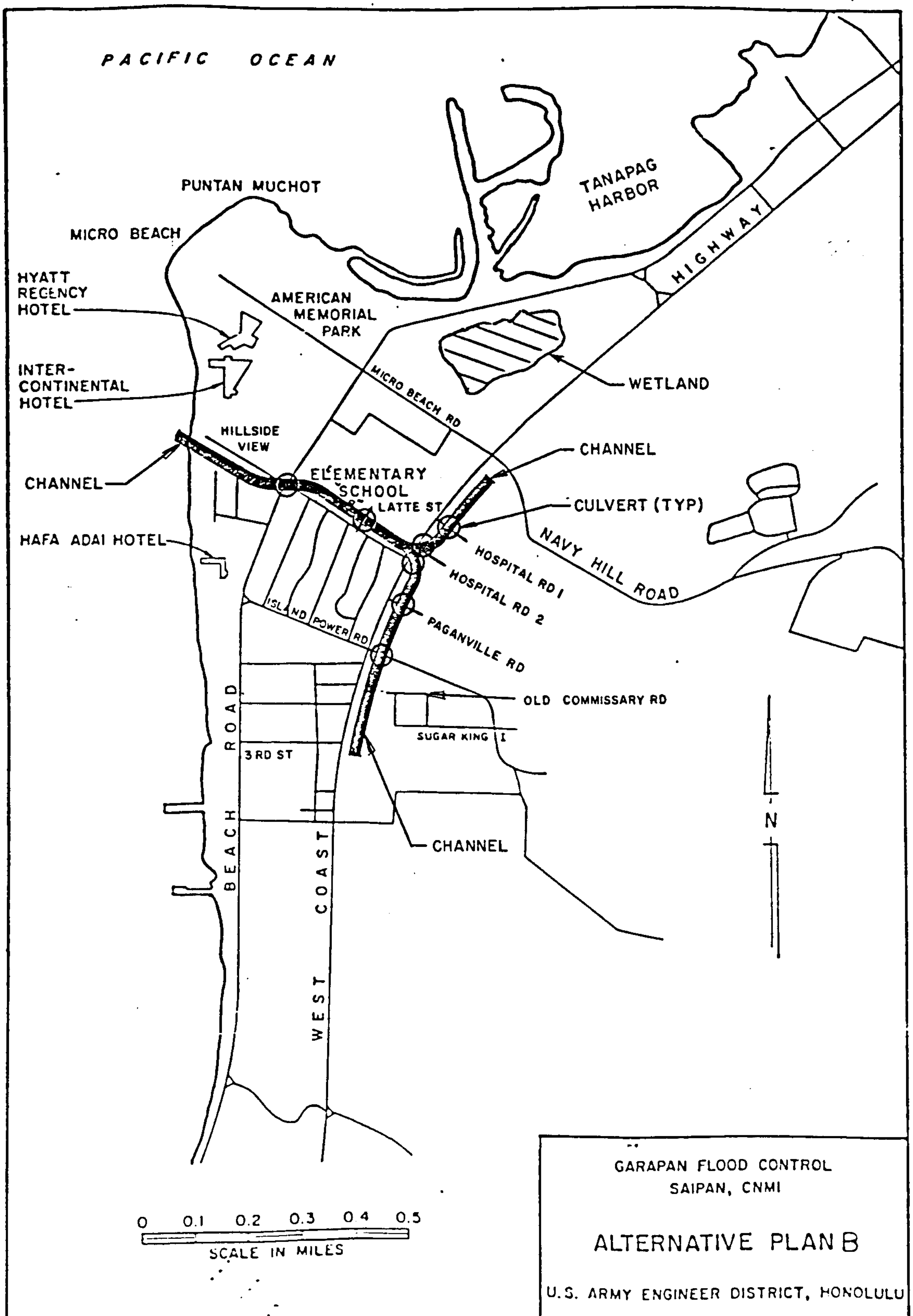

PACIFIC OCEAN
PUNTAN MUCHOT
MICRO BEACH
HYATT REGENCY HOTEL
INTER-CONTINENTAL HOTEL
AMERICAN MEMORIAL PARK
TANAPAG HARBOR
HIGHWAY
WETLAND
MICRO BEACH RD
HILLSIDE VIEW
CHANNEL
ELEMENTARY SCHOOL
LATTE ST
CHANNEL
CULVERT (TYP)
NAVY HILL ROAD
HAFA ADAI HOTEL
HOSPITAL RD 1
HOSPITAL RD 2
ISLAND POWER RD
PAGANVILLE RD
OLD COMMISSARY RD
SUGAR KING
3RD ST
BEACH ROAD
WEST COAST
CHANNEL
N
0 0.1 0.2 0.3 0.4 0.5
SCALE IN MILES
GARAPAN FLOOD CONTROL
SAIPAN, CNMI
ALTERNATIVE PLAN B
U.S. ARMY ENGINEER DISTRICT, HONOLULU

Figure 4

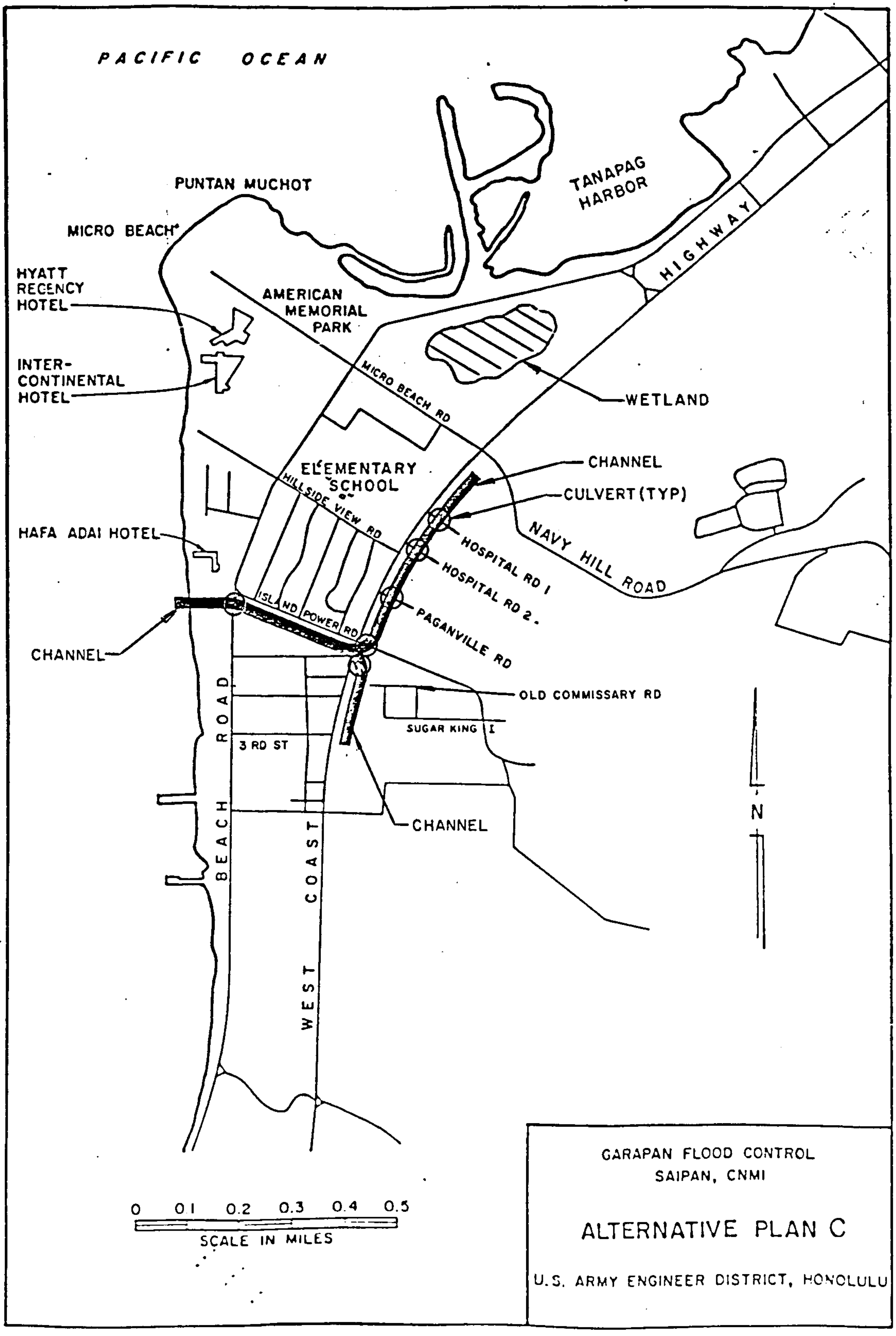

PACIFIC OCEAN
PUNTAN MUCHOT
MICRO BEACH
TANAPAG HARBOR
HIGHWAY
HYATT RECENCY HOTEL
AMERICAN MEMORIAL PARK
INTER-CONTINENTAL HOTEL
MICRO BEACH RD
WETLAND
ELEMENTARY SCHOOL
CHANNEL
CULVERT (TYP)
HILLSIDE VIEW RD
NAVY HILL ROAD
HAFA ADAI HOTEL
HOSPITAL RD 1
HOSPITAL RD 2
ISLAND POWER RD
PAGANVILLE RD
CHANNEL
OLD COMMISSARY RD
SUGAR KING
BEACH ROAD
3 RD ST
CHANNEL
N
WEST COAST
0 0.1 0.2 0.3 0.4 0.5
SCALE IN MILES
GARAPAN FLOOD CONTROL
SAIPAN, CNMI
ALTERNATIVE PLAN C
U.S. ARMY ENGINEER DISTRICT, HONOLULU

Figure 5

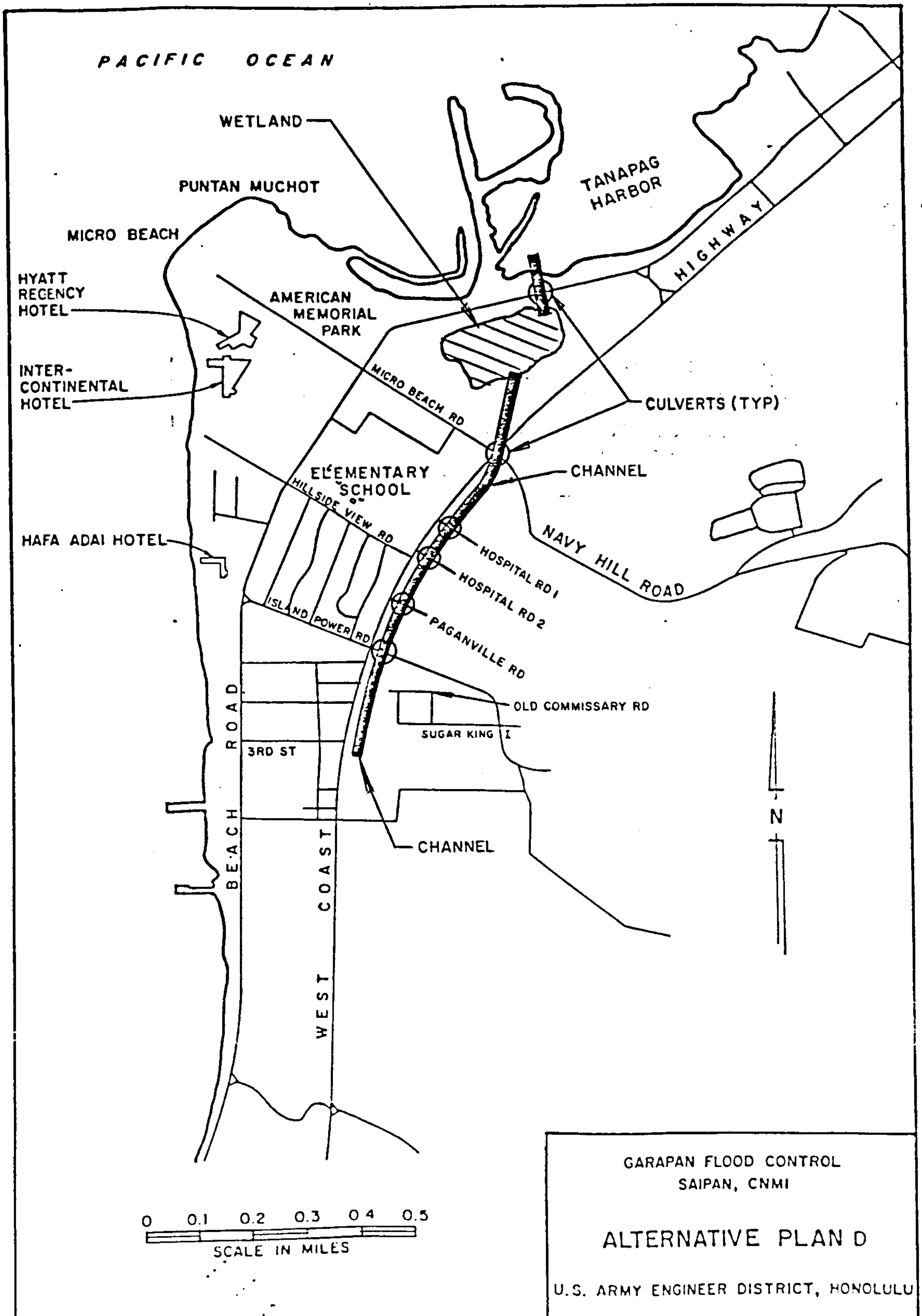

PACIFIC OCEAN
WETLAND
PUNTAN MUCHOT
TANAPAG HARBOR
MICRO BEACH
HIGHWAY
HYATT RECENCY HOTEL
AMERICAN MEMORIAL PARK
INTER-CONTINENTAL HOTEL
MICRO BEACH RD
CULVERTS (TYP)
ELEMENTARY SCHOOL
CHANNEL
HILLSIDE VIEW RD
HAFA ADAI HOTEL
NAVY HILL ROAD
HOSPITAL RD 1
HOSPITAL RD 2
ISLAND POWER RD
PAGANVILLE RD
OLD COMMISSARY RD
SUGAR KING
3RD ST
BEACH ROAD
N
CHANNEL
WEST COAST
0 0.1 0.2 0.3 0.4 0.5
SCALE IN MILES
GARAPAN FLOOD CONTROL
SAIPAN, CNMI
ALTERNATIVE PLAN D
U.S. ARMY ENGINEER DISTRICT, HONOLULU

Figure 6

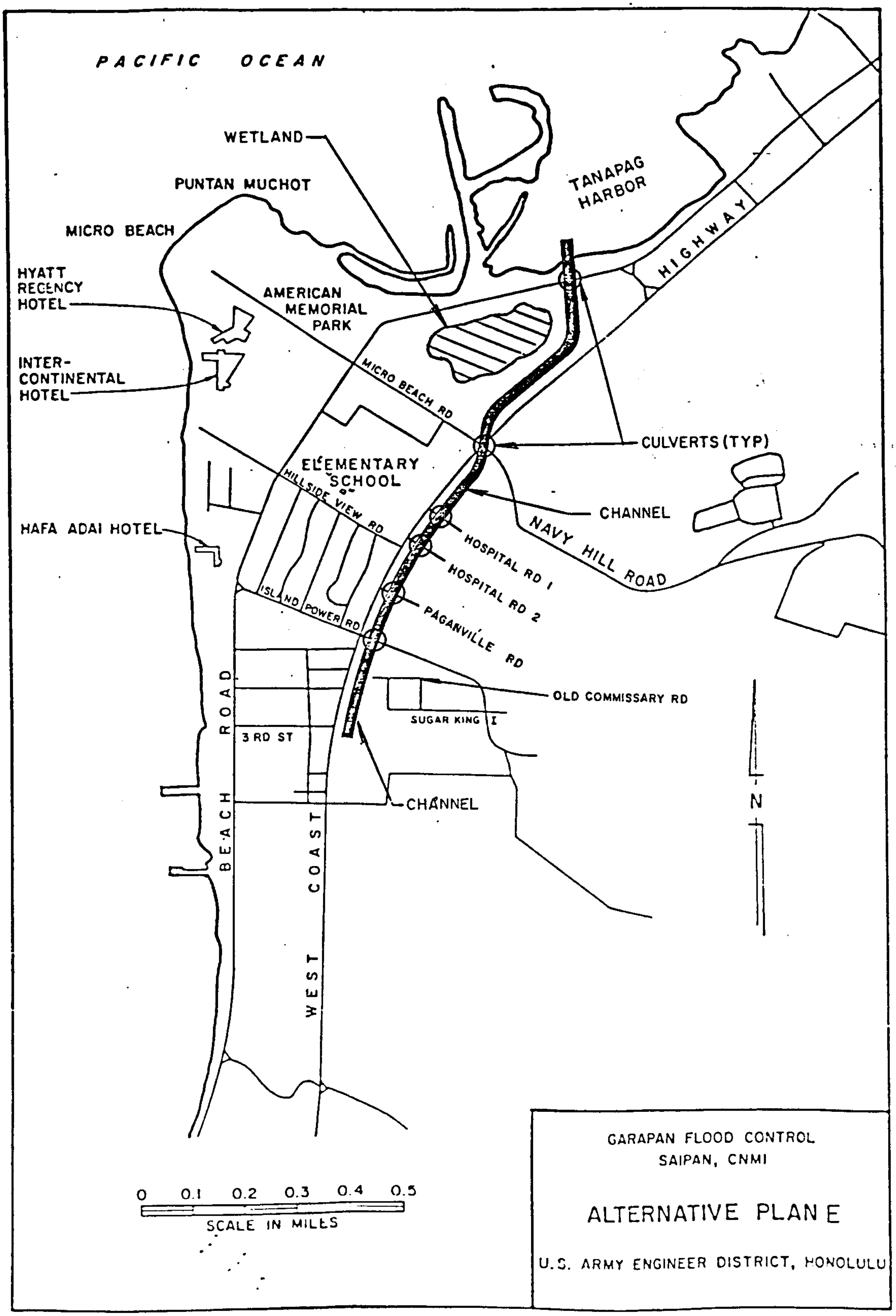

PACIFIC OCEAN
WETLAND
PUNTAN MUCHOT
TANAPAG HARBOR
MICRO BEACH
HYATT RECENCY HOTEL
AMERICAN MEMORIAL PARK
INTER-CONTINENTAL HOTEL
MICRO BEACH RD
HIGHWAY
CULVERTS (TYP)
ELEMENTARY SCHOOL
HILLSIDE VIEW RD
CHANNEL
NAVY HILL ROAD
HAFA ADAI HOTEL
HOSPITAL RD 1
HOSPITAL RD 2
ISLAND POWER RD
PAGANVILLE RD
OLD COMMISSARY RD
SUGAR KING
3 RD ST
BEACH ROAD
CHANNEL
N
WEST COAST
0 0.1 0.2 0.3 0.4 0.5
SCALE IN MILES
GARAPAN FLOOD CONTROL
SAIPAN, CNMI
ALTERNATIVE PLAN E
U.S. ARMY ENGINEER DISTRICT, HONOLULU

Figure 7

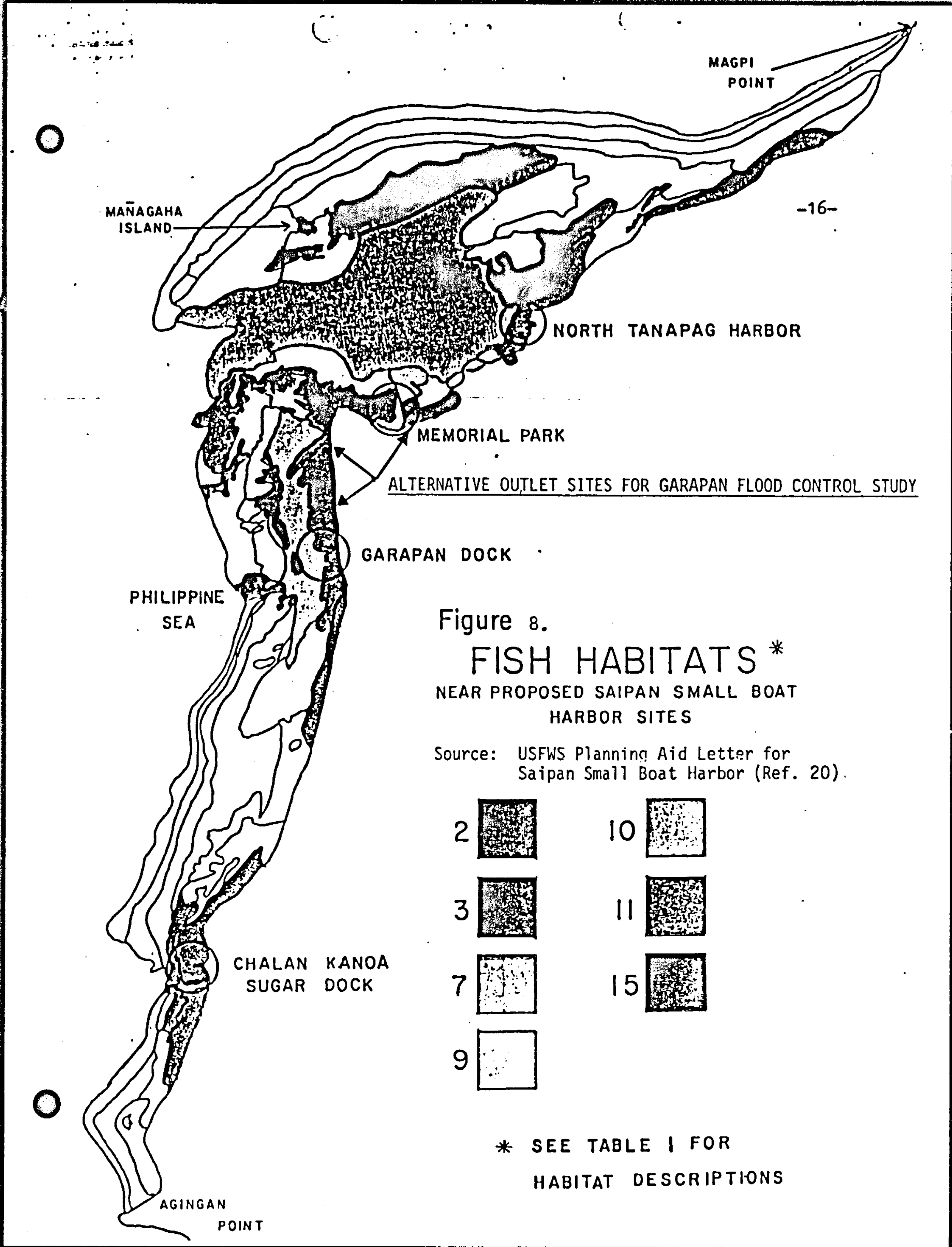



Figure 8.

FISH HABITATS *

NEAR PROPOSED SAIPAN SMALL BOAT HARBOR SITES

Source: USFWS Planning Aid Letter for Saipan Small Boat Harbor (Ref. 20).

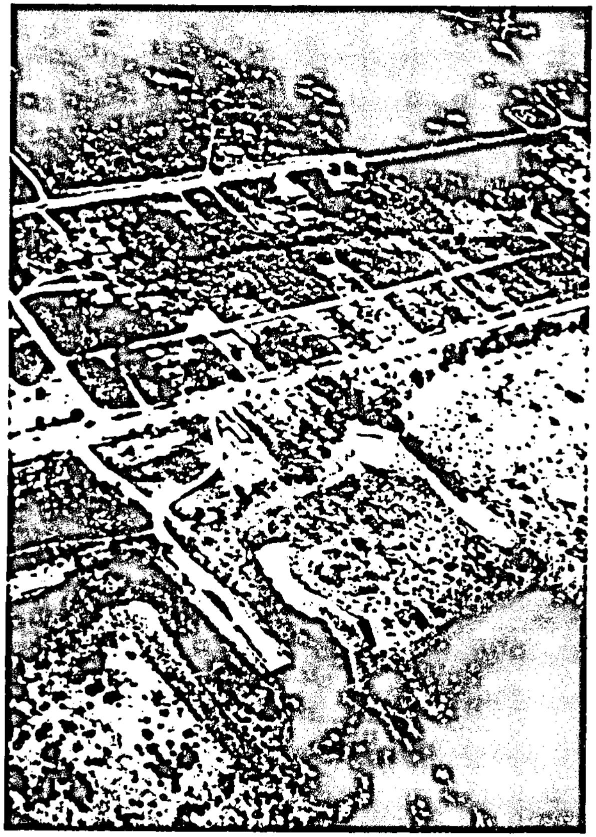


Fig. 9. Garapan Dock. Colonies of Sea Grass, Enhalus acoroides, appear as dark dots.

Fig. 10. Garapan Reef. Blue Chromis, Chromis caerulea, among branches of the coral, Acropora formosa.

Fig. 11. Garapan Channel. Sea cucumbers and feather duster worms.

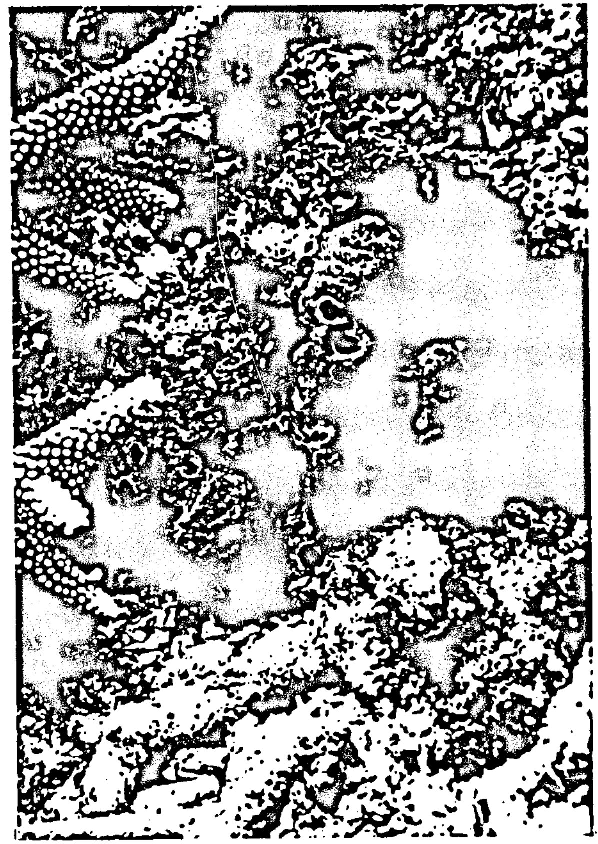


Fig. 12. Garapan Channel. Sponge in rubble-gravel adjacent to the reef.

Fig. 13. American Memorial Park site. Tanapag Harbor is in the left, foreground. Japanese WWII boat harbor is in the center, foreground.

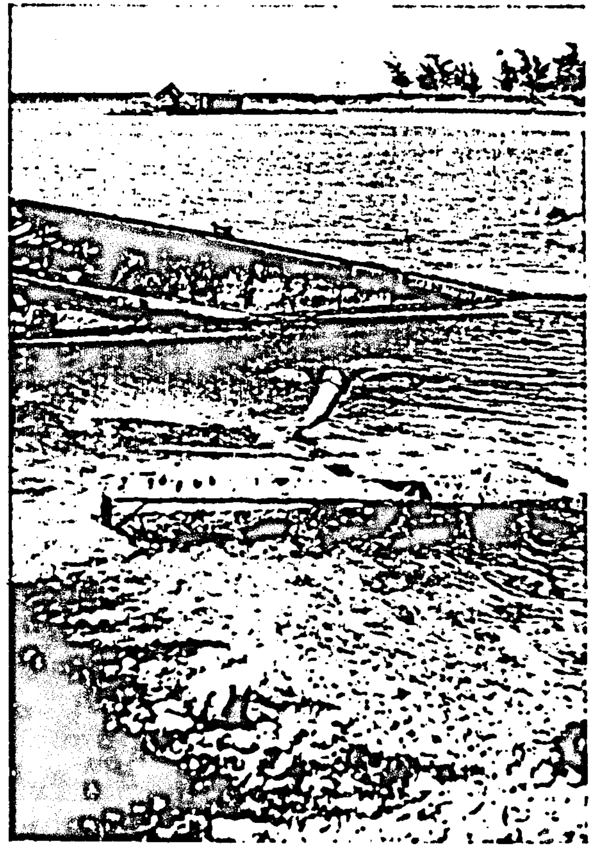


Fig. 14. Japanese WWII boat harbor. Artifacts of Japanese wrecks.

Figure 15. The American Memorial Park wetland. The blue lines illustrate the NEP Plan (solid line) and Alternative 5 (dotted line). The cleared area where a new hospital is being constructed would drain into the proposed channel.

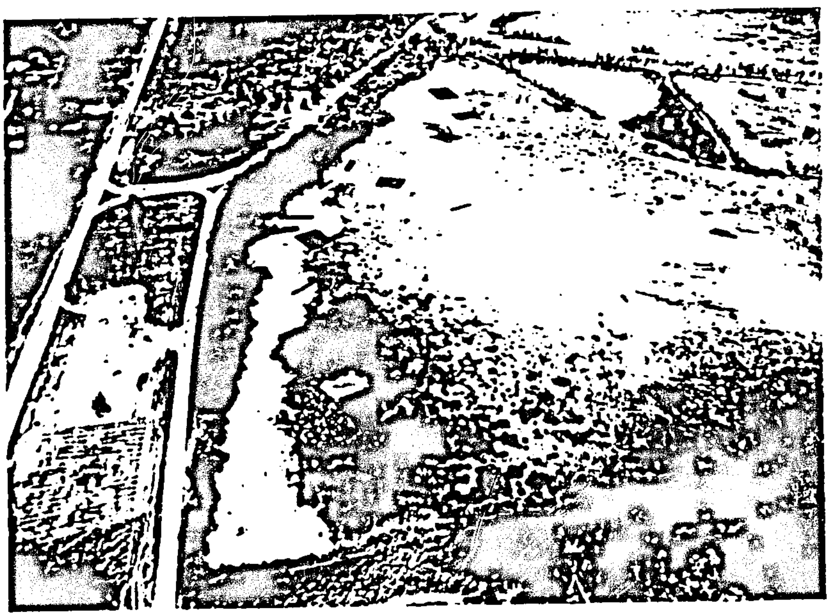


Figure 16. The mudlfats and seagrass beds of Tanapag Harbor adjacent to the American Memorial Park provide the premier feeding and loafing site for migratory shorebirds on Saipan.

# SECTION III

## U. S. Fish and Wildlife Service
## Section 7 Coordination

DEPARTMENT OF THE ARMY
PACIFIC OCEAN DIVISION, CORPS OF ENGINEERS
FT SHAFTER, HAWAII 96858

November 17, 1983

Mr. Doyle Gates
National Marine Fisheries Service
Southwest Region
Western Pacific Program Office
P. O. Box 3830
Honolulu, Hawaii 96812

Dear Mr. Gates:

Pursuant to the 1978 Amendments of the Endangered Species Act, we are requesting information on any listed proposed or candidate endangered or threatened species that may be present in the Garapan Flood Control Study Area, Saipan, CNMI (Enclosure 1). We would appreciate receiving your reply by December 15, 1983 in order to plan our project in a timely manner. If you have any questions, please contact Mr. Robert Moncrief, Environmental Resources Section, at 438-2263.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

Enclosure

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
Western Pacific Program Office
P. O. Box 3830
Honolulu, Hawaii 96812

November 23, 1983 F/SWR1:ETN

Mr. Kisuk Cheung
Chief, Engineering Division
U.S. Army Engineer Division
Pacific Ocean
Fort Shafter, HI 96858

Dear Mr. Cheung:

This responds to your November 17, 1983 request for information regarding any listed, proposed or candidate endangered or threatened species pursuant to the Endangered Species Act of 1973, as amended, that may be present in the Garapan Flood Control Study Area, Saipan, Commonwealth of the Northern Mariana Islands.

The threatened green turtle (*Chelonia mydas*) and the endangered hawksbill turtle (*Eretmochelys imbricata*) have both been reported from the waters around Saipan. Although green turtles are more often seen than hawksbill turtles the relative numbers and distributions around the Study Area are unknown.

The endangered humpback whale (*Megaptera novaeangliae*) has also been reported from the waters around the Marianas during the winter months. However, we are unaware of any confirmed observations of humpback whales within the Study Area and are unsure of their habitat use or behavior while in Marianas waters.

Please contact Mr. Eugene Nitta at 955-8831 if you have any further questions.

Sincerely yours,

Doyle E. Gates
Doyle E. Gates
Administrator

**DEPARTMENT OF THE ARMY**
PACIFIC OCEAN DIVISION, CORPS OF ENGINEERS
FT. SHAFTER, HAWAII 96858

November 17, 1983

Mr. William Kramer
Office of Environmental Services
Fish and Wildlife Service
U. S. Department of the Interior
300 Ala Moana Blvd., P. O. Box 50167
Honolulu, Hawaii 96850

Dear Mr. Kramer:

Pursuant to the 1978 Amendments of the Endangered Species Act, we are requesting information on any listed or proposed endangered or threatened species that may be present in the Garapan Flood Control Study Area, Saipan, CNMI (Enclosure 1). We would appreciate receiving your reply by December 15, 1983 in order to plan our project in a timely manner. If you have any questions, please contact Mr. Robert Moncrief, Environmental Resources Section, at 438-2263.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

Enclosure

Copy Furnished: w/o enclosure

Mr. Richard Myshak, Regional Director
Fish and Wildlife Service
U. S. Department of the Interior
Lloyd 500 Bldg., Suite 1692
500 NE Multnomah Street
Portland, Oregon 96232

United States Department of the Interior

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

IN REPLY REFER TO:
ES 6307
1-2-84-SP-033

NOV 29 1983

Mr. Kisuk Cheung
Chief, Engineering Division
Pacific Ocean Division
U.S. Army Corps of Engineers
Fort Shafter, Hawaii 96858

Dear Mr. Cheung:

This replies to your request of November 17, 1983 for information on species listed, proposed, or candidate, which may be present at the site of the proposed Garapan Flood Control Study Area, Saipan, CNMI.

After reviewing information on the area, we believe the three species listed below may occur at the site:

ENDANGERED SPECIES

(Nightingale) Reed Warbler - *Acrocephalus luscinia*

CANDIDATE ENDANGERED SPECIES

Marianas Gallinule (Common Moorhen) - *Gallinula chloropus guami*

Vanikoro Swiftlet - (*Aerodramus vanikorensis*)

If we can be of any additional service, please contact us again.

Sincerely yours,

William R. Kramer
William R. Kramer
Acting Project Leader
Office of Environmental Services

cc: Regional Director, FWS, Portland, OR (AFA-SE)

DEPARTMENT OF THE ARMY
PACIFIC OCEAN DIVISION, CORPS OF ENGINEERS
FT. SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF

December 17, 1984

Dr. Allen Marmelstein
Pacific Island Administrator
US Fish and Wildlife Service
P.O. Box 50167
Honolulu, Hawaii 96850

Dear Dr. Marmelstein:

This letter forwards the U.S. Army Corps of Engineers biological assessment on the effects of the proposed Garapan Area Flood Control project on the endangered Nightingale Reed Warbler and Mariana Gallinule. The assessment fulfills the requirements of Section 7 of the Endangered Species Act of 1973, as amended. Based on the biological assessment (Encl 1), we conclude that the proposed flood control project at Garapan, Saipan, CNMI, will not adversely effect the two endangered species nor result in the destruction or adverse modification of their respective habitats. We request that your office provide us a response to the biological assessment by January 31, 1985 so that we may meet our schedule for the completion of the study.

If you have any questions, please contact Mr. Robert Moncrief, Environmental Resources Section at (808) 438-2264.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

Enclosure

Endangered Species Biological Assessment
for Garapan Flood Control Project

1. Project Description:

The structural flood control channel plan, presently under consideration by the Corps as the recommended plan, includes a diversion channel above West Coast Highway which would convey floodwaters to an outlet channel. The outlet channel continues on the west side of West Coast Highway along the eastern boundary of American Memorial Park beyond the wetland. It then turns north crossing the park and ultimately discharging into Tanapag Harbor (see Attachments 1 and 2). This alignment will not encroach on the existing Garapan wetland boundary. Channel width will depend on the level of protection provided by the project, which has not yet been determined.

2. Endangered Species Within the Project Area:

The U.S. Fish and Wildlife Endangered Species Office has informed the Corps that the endangered Nightingale Reed Warbler (*Aerocephalus luscinia*) and the formally proposed Mariana Gallinule (*Gallinula chloropus guami*) had been reported from the American Memorial Park wetland area. In October 1984 a survey of the Garapan wetland was conducted by Corps and CNMI Department of Natural Resources biologists to delineate the wetland boundary and obtain additional information on the biological characteristics of the wetland area (Attachment 3). During the survey the Nightingale Reed Warbler was frequently heard and sighted. The Mariana Gallinule was heard throughout the wetland but, because of its preference for seclusion, was never sighted. An estimate of the number of gallinule inhabiting the wetland was not attempted. In the open water areas, large clumps of the Marsh fern (*Acrostichum aureum*) were abundant. This fern, emerging several feet above the water surface, is known to be used by the gallinule as nesting habitat in other wetland areas. Because the American Memorial Park wetland is one of two wetlands in Saipan inhabited by the gallinule, it is assumed, but not yet confirmed, that nesting occurs here. The paucity of wetlands in Saipan, and the CNMI in general, underlines the importance of the American Memorial Park Wetland as Mariana Gallinule habitat.

3. Impact Assessment:

Construction of the outlet channel reach, across the American Memorial Park, will remove trees and shrubs along this alignment. Many of these trees and shrubs are non-native species and most of them are common throughout the western coastal plain of Saipan. Although the affected forest area in the American Memorial Park does comprise habitat for the Nightingale Reed Warbler, it is not unique habitat critical to the survival of the species. The Reed Warbler is found throughout large areas of the island in a variety of habitats.

The flood control channel will intercept and divert sheet flow runoff from elevated areas east of the American Memorial Park wetland that would normally flow into the wetland during high rainfall condition. The significance of this source of water to the overall hydrology of the marsh and swamp is not known. However, even during extended drought conditions, standing water remains within the marsh, indicating a subsurface water source.

The channel will be lined with concrete or other impervious material to insure that no direct impacts on the subsurface hydrologic regime result from the project. The channel alignment of the alternative under consideration will be located so that it does not encroach on the existing wetland boundary, precluding removal or modification of the endangered gallinule habitat.

4. <u>Conclusion</u>:

A limited amount of mixed forest and scrub vegetation will be remove by the project. This habitat, although used by the endangered Nightingale Reed Warbler, is abundant elsewhere on the island and is not critical to survival of this species.

The flood control channel will not encroach on the American Memorial Park wetland which may be considered significant habitat for the endangered Mariana Gallinule. The channel will significantly reduce the amount of water entering the wetland via overland sheet flow runoff. The importance of this source of water has not been documented. Standing water within the wetland appears to be permanent, with the water level and wetted-perimeter fluctuating during the wet and dry seasons. Reduction of runoff into the wetland may have a positive effect on the gallinule population, by dampening the water level fluctuations during periods of heavy rainfall. If the gallinule does nest in the marsh, the possibility of nest inundation would be greatly reduced. The flood control channel will not effect the subsurface hydrologic regime.

It is, therefore, our conclusion that the flood control project will not have a significant effect on either the endangered Nightingale Reed Warbler or Mariana Gallinule.



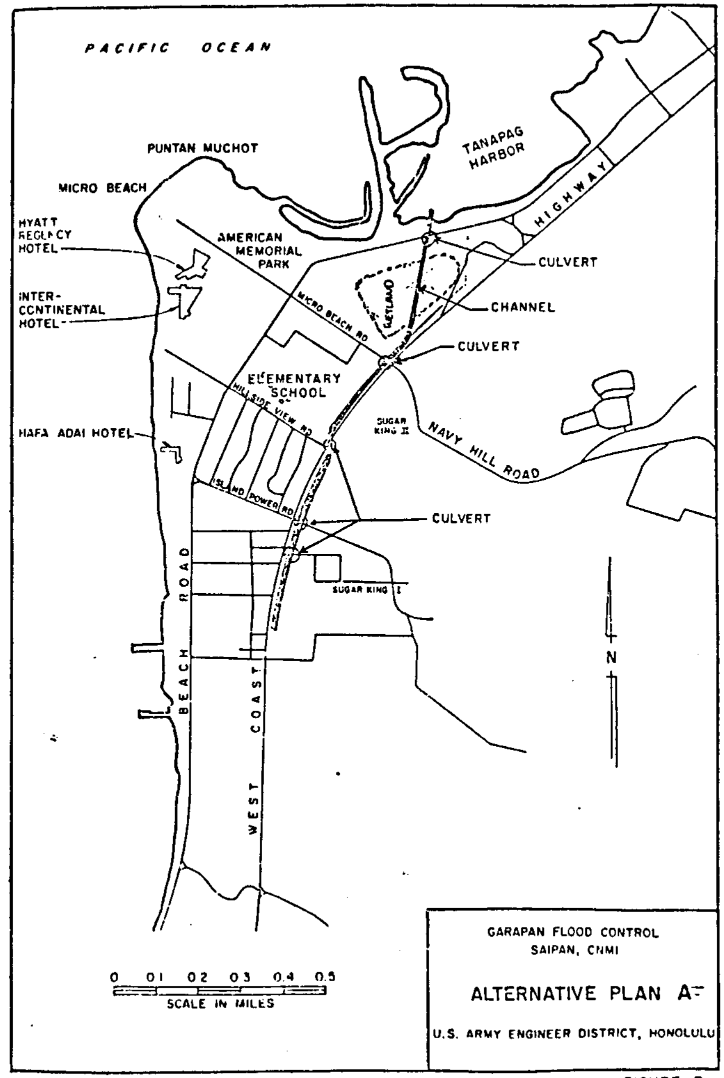
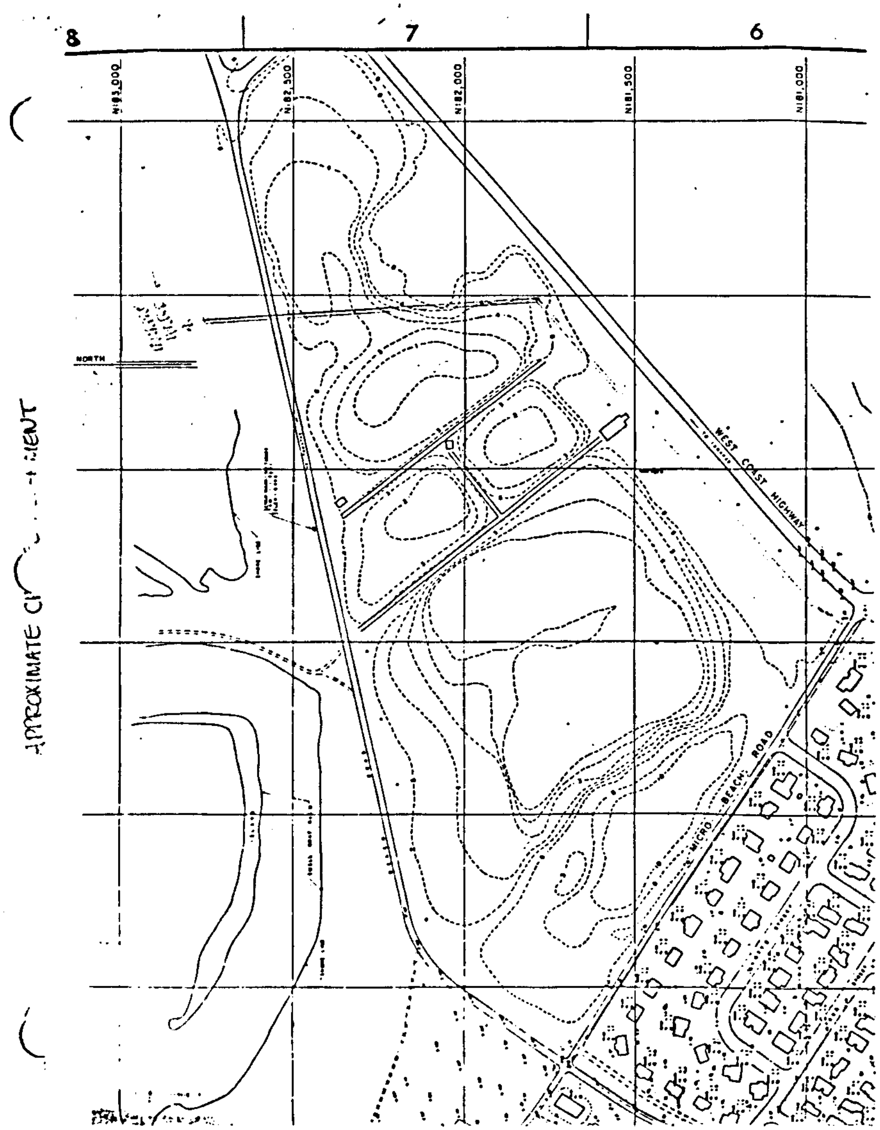


FIGURE 7




United States Department of the Interior

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

IN REPLY REFER TO:

1-2-85-F-018

JAN 18 1985

Mr. Kisuk Cheung
Chief, Engineering Division
U. S. Army Engineer District, Honolulu
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

This acknowledges your request dated December 17, 1984 for consultation as directed by Section 7 of the Endangered Species Act on your proposed authorization of the Garapan Flood Control project.

Your request was received here on December 19, 1984 and has been designated as case number 1-2-85-F-018. Please refer to this case number in any further correspondence.

This consultation has been assigned to this office for completion. Please refer any questions regarding this consultation to William Kramer, Deputy Project Leader, at the letterhead address or by telephone on 546-7530.

Sincerely yours,

Allan Marmelstein
Pacific Islands Administrator

cc: Regional Director, FWS, Portland, OR (AFA-SE)

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

United States Department of the Interior

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

IN REPLY REFER TO:

JAN 14 1985 ES 6307

JAN 10 1985

Mr. Kisuk Cheung
Chief, Engineering Division
U. S. Army Engineer District, Honolulu
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

This provides comment on your letter of December 17, 1984 concerning the proposed Garapan Area Flood Control Project in Saipan. Specifically, possible impacts to two endangered bird species, the reed warbler (a.k.a. nightingale reed warbler) and the Mariana gallinule, were discussed.

The biological assessment (BA) enclosed with your letter identified both of these species as occurring in the wetland and/or adjacent areas which will be affected by the flood control project. Your conclusion that the project will not adversely affect the two nor result in the destruction or adverse modification of their respective habitats and, therefore, that the project does not require formal consultation as per Section 7 of the Endangered Species Act (ESA) is, however, misleading. Perhaps the uncertain status of current proposed Section 7 regulations is causing some misunderstanding. As stipulated by the ESA, formal Section 7 consultation is required whenever a federal project may affect a listed species. Whether the effect may be positive, negative, or neutral is not to be considered at that point. There have been proposals to modify the regulations so that consultation will be required only when a negative effect is produced, but that has not yet been implemented by the Fish and Wildlife Service. That the Garapan project may affect the two birds fulfills the requirement for your initiation of formal consultation.

If you have any questions concerning Section 7 requirements or procedures pertinent to the Garapan Flood Control or other projects, please contact William Kramer of my staff at 546-7530.

Sincerely yours,

Allan Marmelstein
Pacific Islands Administrator

cc: Regional Director, FWS, Portland, OR (AFA-SE)



---

United States
Department of the Interior

Fish and Wildlife Service
Lloyd 500 Building, Suite 1692
500 N.E. Multnomah Street
Portland, Oregon 97232

In Reply Refer To: AFA-SE
1-2-85-F-018

Your Reference:

1985

February 12, 1985

Mr. Kisuk Cheung
Chief, Engineering Division
U. S. Army Engineer District, Honolulu
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

This responds to your November 30, 1984 request for consultation under Section 7 of the Endangered Species Act of 1973, 16 U.S.C. 1531, *et seq.* (ESA). At issue are the possible effects of your authorization of the alternative routing for the Garapan Flood Control Project proposed in your December 17, 1984 letter on the following species:

Mariana gallinule (*Gallinula chloropus guami*)
Reed (willow) warbler (*Acrocephalus luscinia*)

The flood control project is to be constructed in Garapan, Saipan, Commonwealth of the Northern Mariana Islands (Figure 1), with a channel exit into Tanapag Lagoon.

This letter represents the biological opinion of the U.S. Fish and Wildlife Service (FWS) as directed by Section 7 of the ESA, "Interagency Cooperation Regulations" (50 CFR 402, 43 FR 870) on your proposed action.

On January 24, 1985 we completed our review of the information provided by you along with other related information in our files. We also contacted some of those familiar with the biology, management, and recovery of the species involved. Copies of pertinent materials and documentation are contained in an administrative record maintained in this Service's office in Honolulu, Hawaii. Our reference number for this consultation is 1-2-85-F-018.

## BIOLOGICAL OPINION

It is our biological opinion that the action of authorizing, and thereby allowing for, the construction and operation of the Garapan Flood Control Project (as described in your December 17, 1984 letter to us) is not likely to jeopardize the continued existence of the Mariana gallinule or the reed warbler.

Background information on the project and biological information pertinent to this determination follow.

PROJECT DESCRIPTION AND BACKGROUND INFORMATION

A history of flooding of commercial and residential property in the lower Garapan area on Saipan has been recognized. To alleviate this recurring problem, a draft Garapan Flood Control Project Report and Environmental Statement was published by the Corps of Engineers in June, 1984. This study addressed three alternative plans in detail, each of which required the construction of a diversion channel which would be located above West Coast Highway. These alternatives differed, in part, in their channel alignments. This biological opinion addresses only the channel alignment presented with your December 17, 1984 letter (Figure 2). It is a modification of the Alternative Plan "A" presented in your June report.

The channel would border a portion of the Garapan wetland. The wetland presently is bordered on three sides by roads. The area is described in the 1977 report Inventory and Mapping of Wetland Vegetation in Guam, Tinian and Saipan, Mariana Islands:

> "The marsh is poorly defined, and occupies lower areas of a rather "lumpy" terrain which has several seldom-used and ill-defined roads going through it. The dominant species are grasses, including *Panicum maximum*. *Phragmites karka* is absent, but the presence of a duckweed (*Lemna* cf. *minor*) indicates that the wetland is permanent."

As stated in the biological assessment (BA) attached to your letter initiating this consultation:

> "The structural flood control channel plan, presently under consideration by the Corps as the recommended plan, includes a diversion channel above West Coast Highway which would convey floodwaters to an outlet channel. The outlet channel continues on the west side of West Coast Highway along the eastern boundary of American Memorial Park beyond the wetland. It then turns north crossing the park and ultimately discharges into Tanapag Harbor. This alignment will not encroach on the existing Garapan wetland boundary. Channel width will depend on the level of protection provided by the project, which has not yet been determined."



This most recent plan modifies some of the earlier proposals in that it does not require the alignment of the drainage channel through the wetlands found in the American Memorial Park.

The channel will be lined with impervious materials. Its width has not yet been determined.

SPECIES ACCOUNTS

**Willow (Reed) Warbler:**

This species, also known as the nightingale reed warbler, was listed as endangered in the Federal Register of June 2, 1970. Three subspecies of this genus are found in the Marianas: one on Guam, Saipan, and Alamagan; one on Pagan; and the third on Agiguan. None of the subspecies are found on Rota or Tinian. Other subspecies are found on Truk, Ponape, Kosrae and Nauru.

Although the Guam population disappeared in the late 1960's and the Agiguan population is very small, the bird can be found on Saipan in a variety of forest types. It prefers dense vegetation around wetlands or other semi-open areas, but can be found in second growth forest as well. It feeds on insects, lizards, snails, and spiders. A 1982 survey of Saipan estimated the warbler population to be in excess of 4,800 individuals.

**Mariana Gallinule:**

This subspecies, endemic to Guam and several of the Northern Mariana Islands, was added to the federal endangered species list in the Federal Register of August 27, 1984. Although historically the bird had a wide distribution in the freshwater wetlands of those islands, the drainage of suitable wetland habitat has been cited as a major contributing factor in their population decline.

By 1983, their number on Guam had decreased to only 100 to 200 individuals restricted to Fena Lake, Agana Swamp, and a few small freshwater ponds. Small, restricted populations can be found on some of the other islands in the Mariana chain. On Saipan, it has been reported at Lake Susupe, the Garapan wetlands (including the wetland at the American Memorial Park), and scattered sites in other parts of the island. On Tinian, it has been recorded at Lake Hagoi and Marpo Swamp, but not in large numbers. A 1981 survey of Lake Susupe estimated the population of gallinules there to be between 90 and 120. Recent investigations of the wetlands at the American Memorial Park identified gallinules as being present by their call, but it was not possible to estimate the number present. Gallinules possibly move between Susupe and the Garapan wetlands, making a comparison of the value of the two wetlands for gallinules difficult. A 1979 Corps of Engineers survey identified 5.8 gallinules per 100 minute field count at the Garapan wetland as opposed to 5.4 at the Susupe site.

The bird is a year-round breeder with peak breeding from March through August. Broods range from two to eight chicks with an average of three birds successfully fledged. Up to three broods per year have been observed.

ANALYSIS OF IMPACTS

The wetlands adjacent to the proposed flood control channel are known to be habitat for both the reed warbler and the Mariana gallinule. Two impacts from the project may be the actual structural changes to the environment (digging the channel, removal of trees, and other physical disturbances) and changes in the water quality or quantity resulting from the flood control structure.

The reed warbler does not depend on the wetland for any part of its life cycle. It can be found around the wetland, and is relatively abundant throughout the central and southern portions of Saipan. It also can be found distant from both the Garapan and Susupe wetlands. As stated in the BA, construction of the channel will require the removal of trees along the channel alignment. The BA further states that the vegetation to be removed is predominantly exotic, and is not unique or critical to the survival of the reed warbler given the small percentage of vegetation that will be destroyed. We concur with your analysis and conclude, therefore, that the construction of the flood control structure will have little, if any, impact on the reed warbler.

The Mariana gallinule, however, is dependent on the wetlands of Saipan for its existence there. Any decrease in wetland area on the island would be considered detrimental to the species. As the proposed alignment of the flood control channel does not penetrate the Garapan wetlands or directly decrease the wetland area, the channel, in and of itself, does not constitute a



detrimental factor. The construction and function of the channel, however, may affect the wetland. These effects can be summarized as;

a. Construction operations: It is our assumption that materials excavated during the construction of the channel will be removed from the site, and that spoil will neither be placed in the wetland nor stored in locations where it could erode or wash into the wetland area. It is also our assumption that equipment and personnel employed during the construction will not be intruding into the wetlands themselves and that no temporary or permanent fills will be allowed in the wetland. Such prohibitions on intrusions would include the leaching or disposal of such items as fuel, oil, washings from cement trucks and other equipment, etc. This Biological Opinion is based, in part, on these assumptions.

b. Wetland water quality and quantity: The BA states:

> "The flood control channel will intercept and divert sheet flow runoff from elevated areas east of the American Memorial Park wetland that would normally flow into the wetland during high rainfall condition. The significance of this source of water to theoverall hydrology of the Marsh and swamp is not known. However, even during extended drought conditions, standing water remains within the marsh, indicating a subsurface water source."

If it is assumed that the interception of surface sheet flow runoff by the proposed channel will not appreciably affect the quantity or quality of the water in the wetlands nor block the presumed present feeding of the wetlands by subsurface water sources, the project would have little adverse impact on the gallinules using that area. As stated in the BA, if a tempering of sudden innundation by sheet flow did occur as a result of water interception by the channel, the gallinules may be aided in that low-lying nests may not be rapidly flooded (water level in the wetland has increased in the past as much as three feet due to temporary flooding). We concur with these conclusions if the assumptions are correct. If, however, sheet flow (or subsurface water) is prevented from entering the wetland, and, as a result, if the wetland area decreases, becomes choked with vegetation as a result of water level decreases, or becomes increasingly saline due to a decrease in the diluting influence of fresh water inflow, the gallinules would be expected to suffer.

As stated previously, the wetland area on Saipan is small, and any further decreases in wetland area or quality would inhibit the recovery of gallinule on the island. However, such inhibition of recovery, although detrimental, would not be likely to jeopardize the continued existence of the Mariana gallinule in consideration of the total population extant.

CUMULATIVE EFFECTS

Cumulative effects are those impacts of future Commonwealth, and private actions which are reasonably certain to occur prior to completion of the subject action. A non-Federal action is "reasonably certain" to occur if the action requires the approval of a local resource or land use control agency, and such agencies have essentially approved the action. Actions that may be exempt from local land use controls must be essentially ready to proceed. We have identified no commonwealth or private actions that would have effects cumulative to the proposed action.

BIOLOGICAL OPINION

It is our biological opinion that the action of authorizing the construction of the Garapan Flood Control Project alternative, presented in the referenced December 17, 1984 letter to us, is not likely to jeopardize the continued existence of either the reed warbler or the Mariana gallinule.

INCIDENTAL TAKE

Section 9 of the ESA prohibits any taking (harm, harassment, mortality, etc.) of listed species without specific exemption. Under the terms of Section 7(b)(4)iii and 7(o)(2), taking that is incidental to and not intended as a part of the agency action (in this case, the construction and operation of the Garapan flood control channel as described in your December 17, 1984 letter) is



not considered taking within the bounds of the Act provided that such taking is in compliance with the terms and conditions of this Biological Opinion.

Since the project will not result in the direct taking of either of the listed species in the Garapan wetland for completion of the project, no take is authorized as a result of the actual construction. However, the chance does exist that the project may result in such taking if those assumptions expressed in subparagraphs a. and b. of our Analysis of Impacts prove to be false.

To address the issue of taking either of the listed species, we specify that the following reasonable and prudent measures be included in your overall flood control plan:

a. The project contractor shall incorporate, as part of the overall construction plan and construction contract, the stipulation that if any individual of any of the listed species discussed in this Opinion is killed during construction, the constructing agency and COE shall require that the causative action of such taking cease immediately, and that the Corps of Engineers shall then re-initiate formal consultation prior to proceeding with the action.

b. All listed species which are injured or killed as a result of the subject action shall be retrieved and turned over to the Fish and Wildlife Division, Department of Natural Resources, Commonwealth of the Northern Mariana Islands, Saipan, immediately.

c. The project supervisor shall immediately prepare a written report which shall include the date, location, and circumstances surrounding the taking and the disposition of the individual(s) taken. Written and telephone reports shall be directed to William R. Kramer at:

U.S. Fish and Wildlife Service
P. O. Box 50167
Honolulu, Hawaii 96850

Phone: (808) 546-7530

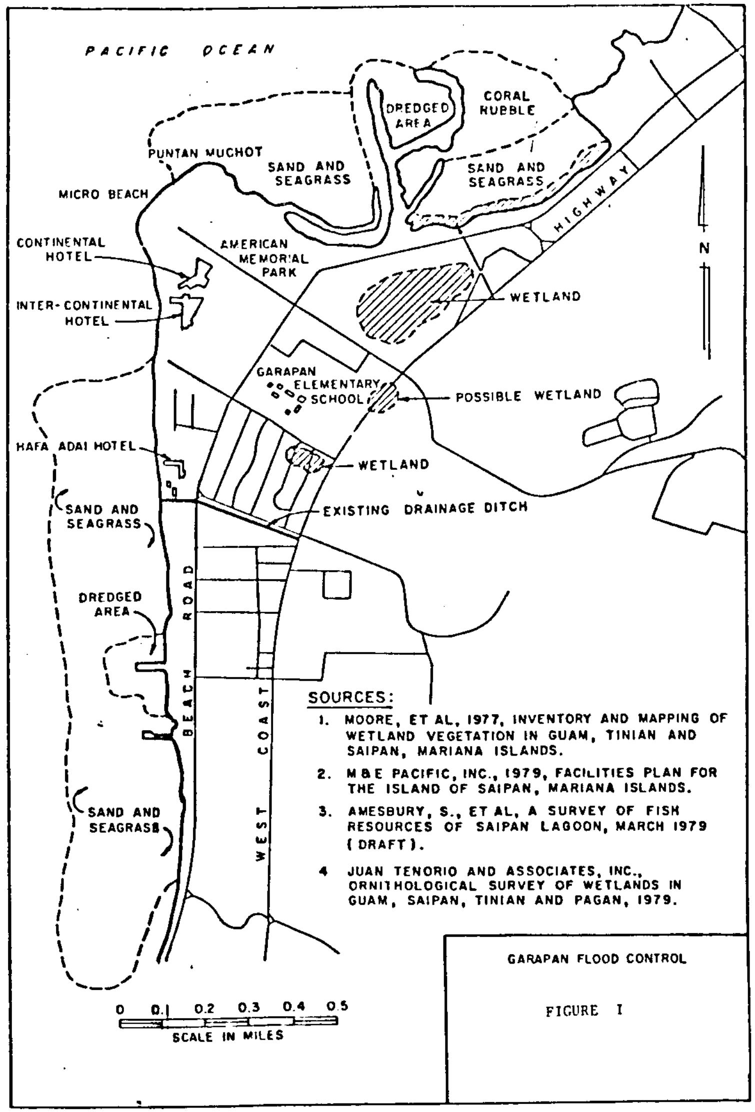
d. Excavated materials shall not be used as intentional or unintentional fill in any wetland on Saipan. Such materials shall not be stockpiled or otherwise placed where they could erode into or otherwise pollute the wetland area. Oil, fuel, cement, cement truck washings, and other such materials associated with the construction of the project shall not be allowed to enter the wetland.

In futherance of the purposes of the Endangered Species Act, Section 7(a)(1) authorized Federal agencies, in consultation with our Service, to carry out programs for the conservation of listed species. In this regard we wish to emphasize that increased flood protection of the area in and adjacent to the wetland should not be allowed to encourage new construction in areas heretofore protected by wetland use restrictions. We encourage strict enforcement of the Corps of Engineers regulatory program (33 CFR 320-325). We would expect that all applications received for work in the Garapan wetlands will be scrutinized for effects on endangered species. We will take a very critical view, during formal interagency consultations, of any permit application that adversely affects endangered species.

This concludes formal consultation on this action. Should any significant changes be made in the proposed action, or should new species be listed which are not addressed in this letter which may be affected by the action, you must re-initiate consultation with this office.

Sincerely yours,

William F. Shake
Assistant Regional Director
Federal Assistance




GARAPAN FLOOD CONTROL

FIGURE I

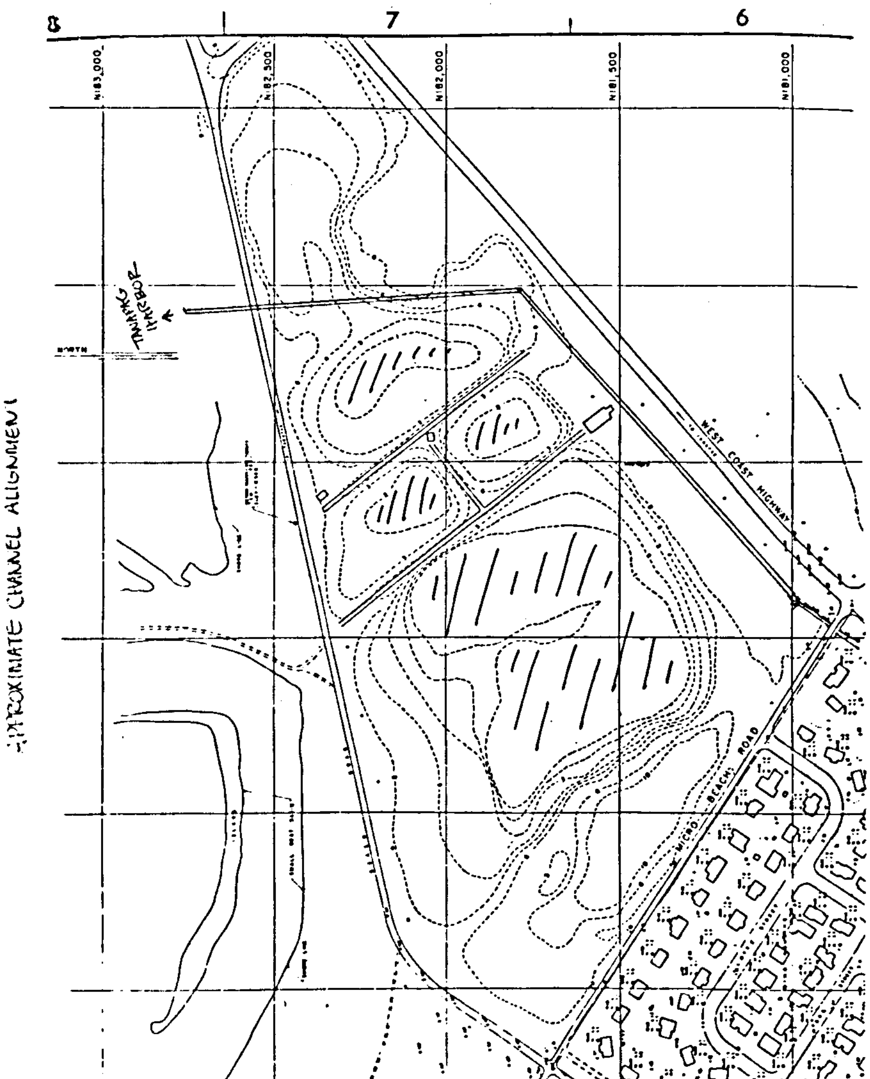


FIGURE II

February [illegible]

Mr. [illegible]
[illegible]
U.S. Fish and Wildlife Service
P. O. Box 50167
Honolulu, Hawaii 96850

Dear Mr. [illegible]:

In December 1984 we initiated formal consultation as directed by Section 7 of the Endangered Species Act for the Garapan Flood Control Study. The consultation was assigned to your office for completion and designated as case number [illegible].

We are presently considering an additional flood control alternative which may affect the endangered Mariana Gallinule (*Gallinula chloropus guami*) and request that this plan be included under the current Section 7 Consultation for Garapan. A description of the alternative plan and possible effects on endangered species is provided in the Corps' biological assessment (Encl 1).

If you have any questions, please contact Mr. Robert [illegible], Environmental Resources Section at (808)438-2264.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

Enclosure

Endangered Species Biological Assessment
for Alternative Plan E of the
Garapan Flood Control Project

1. Project Description:

The structural flood control channel plan designated alternative plan E includes a diversion channel above West Coast Highway which would convey floodwaters to an outlet channel. The outlet channel continues on the west side of West Coast Highway across Micro Beach Road and discharges into the southern end of the American Memorial Park wetland. The discharge channel into the wetland would be approximately 750 feet long, 50 feet wide with side slopes of 3 horizontal to 1 vertical. The invert would be at elevation - 4.5 ft MSL. The channel invert and side slopes would be grossed.

Excavation of a 440 ft corridor through the wetland area, removing the existing Port WWII road and sewerline fills to an elevation of +1 (MSL), is planned. This would unify the wetland which is presently divided into four discrete units and enhance the circulation of water throughout the wetland. The corridor would allow storm water to flow unobstructed across the wetland and out the outlet channel to the northwest. The outlet is designed with a control structure that would allow water above the -2 ft (MSL) elevation to drain. Water below the -2 ft (MSL) elevation would remain within the wetland. (The ambient surface water elevation within the wetland has been estimated by Corps' hydraulic engineers at approximately +1.0 ft MSL elevation). Four 10 ft x 4 ft box culverts would be added to the existing culverts that presently drain the wetland. A channel would continue from the road into Tanapag Harbor.

2. Endangered Species Within the Project Area:

The U.S. Fish and Wildlife Endangered Species Office has informed the Corps that the endangered Nightingale Reed Warbler (Aerocephalus luscinia) and the formally proposed Mariana Gallinule (Gallinula chloropus guami) had been reported from the American Memorial Park wetland area. In October 1984 a survey of the Garapan wetland was conducted by Corps and CNMI Department of Natural Resources biologists to delineate the wetland boundary and obtain additional information on the biological characteristics of the wetland area (Attachment 3). During the survey the Nightingale Reed Warbler was frequently heard and sighted. The Mariana Gallinule was heard throughout the wetland but, because of the preference for seclusion, was never sighted. An estimate of the number of gallinule inhabiting the wetland was not attempted. In the open water areas, large clumps of the Marsh fern (Acrostichum aureum) were abundant. This fern emerging several feet above the water surface is known to be used by the gallinule as nesting habit in other wetland areas. Because the American Memorial Park wetland is one of two wetlands in Saipan inhabited by the gallinule, it is assumed but not yet confirmed that nesting occurs here. The paucity of wetlands in Saipan, and the CNMI in general, underlines the importance of the American Memorial Park Wetland as Mariana Gallinule habitat.

3. Impact Assessment:

Construction of the 700 feet channel reach from Micro Beach Road into the wetland will remove some trees and shrubs along this alignment. Many of these trees and shrubs are non-nature species and most of them are common throughout the western coastal plain of Saipan. Although the affected forest area in the American Memorial Park does comprise habitat for the Nightingale Reed Warbler, it is very limited in area and not unique habitat critical to the survival of the species. The Reed Warbler is found throughout large areas of the island in a variety of habitats.

The flood control project will intercept and divert sheet flow runoff from elevated areas southeast of American Memorial Park into the wetland located there. Silt, petrochemical and pesticide residues and other debris carried in the storm water will be discharged into the wetland where much of it will settle out. Petrochemical, pesticide and other toxic material levels in the drainage area are probably low. Most of the area is presently undeveloped and thickly vegetated with the shrub "Tangen tangen." Water levels in the wetland during storm conditions would rise approximately 1 foot. This could result in inundation of nests and loss of developing eggs. It is not known at present whether gallinule do nest in the American Memorial Park wetland. No nests or young have been observed there. Thus, it is not possible to predict the degree of adverse impact to the gallinule population attributable to the intermittent increases in water level resulting from the project.

Excavation of the existing road and sewerline fill, connecting all four wetland units, should have beneficial effects: increased open water areas, better water circulation, greater available gallinule habitat, etc. Enhancement features - the creation of small nesting islands, areas or channels deeper than +1 ft (MSL) - could be incorporated in the "corridor" design if these or similar features are considered to have sufficient merit.

United States
Department of the Interior

Fish and Wildlife Service
Lloyd 500 Building, Suite 1692
500 N.E. Multnomah Street
Portland, Oregon 97232

In Reply Refer To: AFA-SE    Your Reference:

1-2-85-F-018-R

March 21, 1985

Mr. Kisuk Cheung
Chief, Engineering Division
U. S. Army Engineer District, Honolulu
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

This responds to your February 6, 1985 request for a reinitiation of formal consultation under Section 7 of the Endangered Species Act of 1973, 16 U.S.C. 1531, *et seq.* (ESA). At issue are the possible effects of your authorization of a new alternative routing (as described in your February 6 letter) for the Garapan Flood Control Project on the following species:

Mariana gallinule (*Gallinula chloropus guami*)

The flood control project is to be constructed in Garapan, Saipan, Commonwealth of the Northern Mariana Islands (Figure 1).

This letter represents the biological opinion of the U.S. Fish and Wildlife Service (FWS) as directed by Section 7 of the ESA, "Interagency Cooperation Regulations" (50 CFR 402, 43 FR 870) on your proposed action.

On February 25, 1985 we completed our review of the information provided by you along with other related information in our files. We also contacted some of those familiar with the biology, management, and recovery of the species involved. Copies of pertinent materials and documentation are contained in an administrative record maintained in this Service's office in Honolulu, Hawaii. Our reference number for this consultation is 1-2-85-F-018-R.

BIOLOGICAL OPINION

It is our biological Opinion that the action of authorizing, and thereby allowing for, the construction and operation of the Garapan Flood Control Project (as described in your February 6, 1985 letter to us) is not likely to jeopardize the continued existence of the Mariana gallinule.



PROJECT DESCRIPTION AND BACKGROUND INFORMATION

A history of flooding of commercial and residential property in the lower Garapan area on Saipan has been recognized. To alleviate this recurring problem, a draft Garapan Flood Control Project Report and Environmental Statement was published by the Corps of Engineers in June, 1984. This study addressed three alternative plans in detail, each of which required the construction of a diversion channel which would be located above the west Coast Highway. These alternatives differed, in part, in their channel alignments.

On November 30, 1984 you initiated formal consultation with this Service on one of those alternative alignments; that plan featured the construction of a drainage channel inland of the Garapan wetlands with a channel exit into Tanapag Lagoon; no construction in or use of the wetlands was indicated. We determined that implementation of the plan would not be likely to jeopardize the continued existence of the Mariana gallinule or the reed warbler. ( Note: Although the Mariana gallinule would be expected to be effected by this proposal, the reed warbler would not.) The newest proposal, titled Alternative Plan E in your February 6, 1985 letter and the subject of this Biological Opinion, would require both construction in and use of the wetland as both a flood water channel and temporary flood water reservoir. As stated in your letter:

> "The structural flood control channel plan designated alternative Plan E includes a diversion channel above West Coast Highway which would convey floodwaters into a discharge channel continuing along the west side of West Coast Highway across Micro Beach Road and into the southern end of the American Memorial Park wetland (Figure 2). The discharge channel into the wetland would be approximately 750 feet long, 30 feet wide with side slopes of 3 horizontal to 1 vertical. The invert would be at elevation -4.5 ft MSL. The channel invert and side slopes would be grassed.
>
> "Excavation of a 440 foot corridor through the wetland area, removing the existing Post will road and sewerline fills to an elevation of +1 (MSL), is planned. This would unify the wetland which is presently divided into four discrete units and enhance

the circulation of water throughout the wetland. The corridor would allow storm water to flow unobstructed across the wetland and out the outlet channel to the northwest. The outlet is designed with a control structure that would allow water above the +2 foot (MSL) elevation to drain. Water below the +2 foot (MSL) elevation would remain within the wetland. (The ambient surface water elevation within the wetland has been estimated by Corps' hydraulic engineers at approximately +1.0 feet (MSL). Four 10-foot x 4-foot box culverts would be added to the existing culverts that presently drain the wetland. A channel would continue from the road into Tanapag Harbor."

In addition, this alternative includes the construction of islands within the wetland. The islands will provide increased nesting area, protected from predators, for the gallinule.

The actual area of the wetland is described in the 1977 report Inventory and Mapping of Wetland Vegetation in Guam, Tinian and Saipan, Mariana Islands:

"The marsh is poorly defined, and occupies lower areas of a rather "lumpy" terrain which has several seldom-used and ill-defined roads going through it. The dominant species are grasses, including *Panicum maximum*. *Phragmites karka* is absent, but the presence of a duckweed (*Lemna minor*) indicates that the wetland is permanent."

SPECIES ACCOUNT

The Mariana gallinule is endemic to Guam and several of the Northern Mariana Islands, and added to the federal endangered species list in the Federal Register of August 27, 1984. Although historically the bird had a wide distribution in the freshwater wetlands of those islands, the drainage of suitable wetland habitat has been cited as a major contributing factor in their population decline.

By 1983, their population on Guam had decreased to only 100 to 200 individuals restricted to Fena Lake, Agana Swamp, and a few small freshwater ponds. Small, restricted populations can be found on some of the other islands in the Mariana chain. On



Saipan, it has been reported at Lake Susupe, the Garapan wetlands (including the wetland at the American Memorial Park), and scattered sites in other parts of the island; on Tinian, it has been recorded at Lake Hagoi and Marpo Swamp, but not in large numbers. A 1981 survey of Lake Susupe estimated the population of gallinules there to be between 90 and 120. Recent investigations of the wetlands at the American Memorial Park identified gallinule as being present by their call, but it was not possible to estimate the number present. Gallinule possibly move between Susupe and the Garapan wetlands, making a comparison of the value of the two wetlands for gallinule difficult. A 1979 Corps of Engineers survey identified 5.8 gallinules per 100 minute field count at the Garapan wetland as opposed to 5.4 at the Susupe site.

The bird is a year-round breeder with peak breeding from March through August. Broods range from two to eight chicks with an average of three birds successfully fledged. Up to three broods per year have been observed.

ANALYSIS OF IMPACTS

The wetland area of Saipan is limited; much of the habitat of the gallinule has been drained over the past several decades. Your proposal appears to be a method for both controlling floods for the benefit of the human community while actually creating a more favorable environment for the gallinule. We would expect your proposal to dredge portions of the existing Garapan wetland (thus increasing both its depth and area) coupled with the construction of islands which will offer both an increase in nesting area and the added benefit of protection from such predators as dogs, cats, and rats, to have little long-term detrimental effect on the birds if the integrity of the wetland is maintained.

Our concern for long-term integrity exists in two related areas. First, if the wetland will function as a flood "buffer", temporarily holding flood waters until they drain into the Tanapag Harbor, we would expect silt to settle out in the wetland. Over a period of years, such a silt buildup would both decrease the flood control potential of the wetland and encourage the growth of plants intolerant of deeper water conditions. Such woody plant growth would accelerate the siltation process, and would decrease the value of the wetland to the gallinule.

Second, the temporary flooding of the wetland may cause the flooding of gallinule nests. Such inundation may cause mortality to eggs or newly hatched young. It is our belief, however, that the construction of the islands as proposed in your plan would offset the losses due to nest flooding. It is also recognized that flooding of nests may occur presently, without the proposed flood control construction, and that the season for the most heavy rains on Saipan (late summer through early winter) is also the period of least gallinule nesting activity.

In consideration of all of these factors, we believe the proposed flood control project balances both positive and negative impacts on the gallinule. If periodic dredging (if and when siltation allows the invasion of woody, non-wetland, vegetation) of the wetland around the newly constructed islands was incorporated as part of the overall wetland/flood control management plan, the net result may be very positive for the birds.

CUMULATIVE EFFECTS

Cumulative effects are those impacts of future Commonwealth and private actions which are reasonably certain to occur prior to completion of the subject action. A non-Federal action is "reasonably certain" to occur if the action requires the approval of a local resource or land use control agency, and such agencies have approved the action. Actions that may be exempt from local land use controls must be essentially ready to proceed. We have identified no Commonwealth or private actions that would have effects cumulative to the proposed action.

BIOLOGICAL OPINION

It is our Biological Opinion that the action of authorizing the construction of the Garapan Flood Control Project alternative presented in the referenced February 6, 1985 letter to us (titled Alternative Plan E) is not likely to jeopardize the continued existence of the Mariana gallinule.

INCIDENTAL TAKE

Section 9 of the ESA prohibits any taking (harm, harassment, mortality, etc.) of listed species without specific exemption. Under the terms of section 7(b)(4)iii and 7(o)(2), taking that is incidental to and not intended as a part of the agency action (in



this case, the construction and operation of the Garapan flood control project Alternative Plan E as described in your February 6, 1985 letter) is not considered taking within the bounds of the Act, provided that such taking is in compliance with the terms and conditions of this Biological Opinion.

Since the project does not require the direct taking of the listed species in the Garapan wetland for completion of the project, no take should occur as a result of actual construction. However, the chance does exist that the project may result in such taking if those assumptions expressed in this letter's section titled Analysis of Impacts prove to be false.

To address the issue of taking Mariana gallinule, we specify that the following reasonable and prudent measures be included in your overall flood control plan:

a. The project contractor shall incorporate as part of the overall construction plan and construction contract the stipulation that if any individual listed species discussed in this Opinion is killed as a result of the subject project during construction, the constructing agency and the COE shall require that the causative action of such taking cease immediately, and that the Corps of Engineers shall then re-initiate formal consultation prior to proceeding with the action.

b. All listed species which are injured or killed as a result of the subject action shall be retrieved and turned over to the Fish and Wildlife Division, Department of Natural Resources, Commonwealth of the Northern Mariana Islands, Saipan, immediately.

c. The project supervisor shall immediately prepare a written report which shall include the date, location, and circumstances surrounding the taking and the disposition of the individual(s) taken. Written and telephone reports shall be directed to William R. Kramer at:

U.S. Fish and Wildlife Service
P. O. Box 50167
Honolulu, Hawaii 96850

Phone: (808) 546-7530

d. Excavated materials shall not be allowed to be used as intentional or unintentional fill in any wetland on Saipan except for the construction of Alternative Plan E addressed by this Opinion (e.g. in the construction of nesting islands, berms, etc.). Oil, fuel, cement, cement truck washings, and other such materials associated with the construction of the project shall not be allowed to enter the wetland.

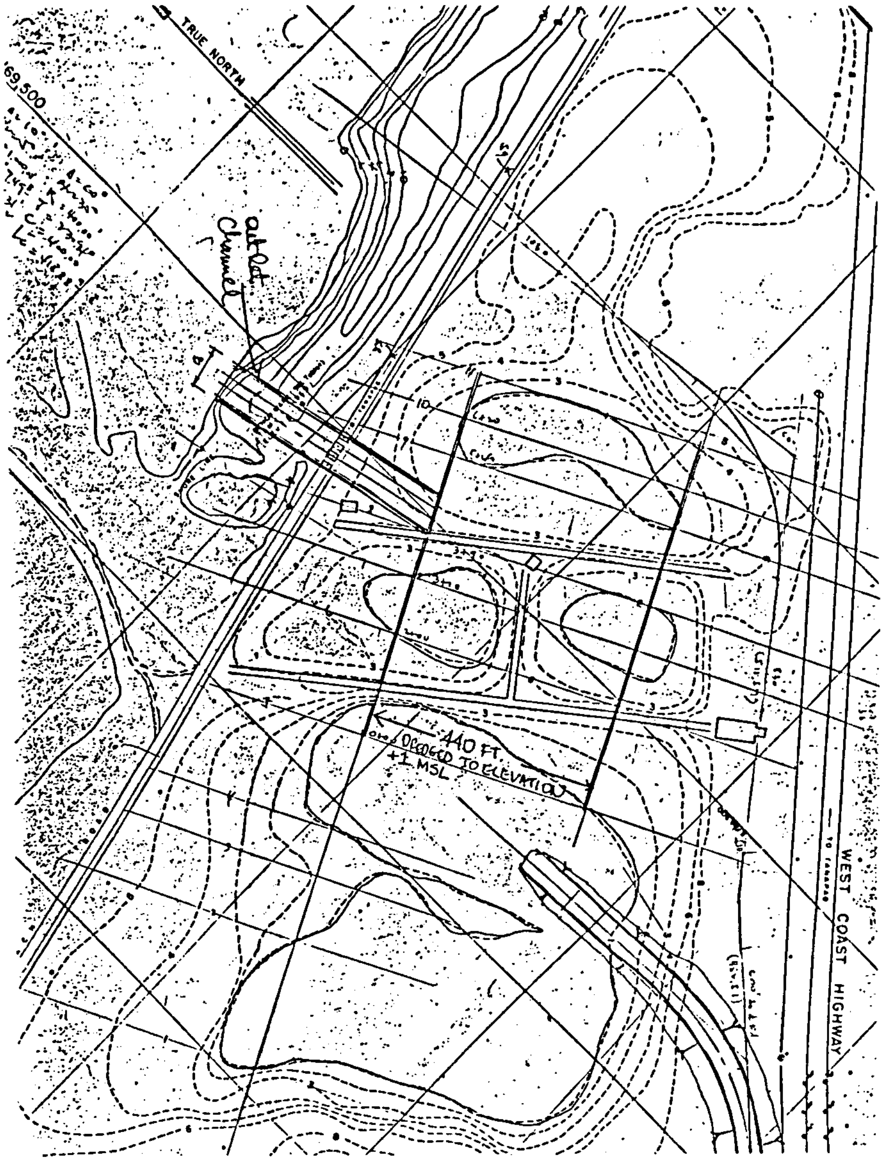
This concludes formal consultation on this action. Should any significant changes be made in the proposed action, or should new species be listed which are not addressed in this letter which may be affected by the action, you must re-initiate consultation with this office.

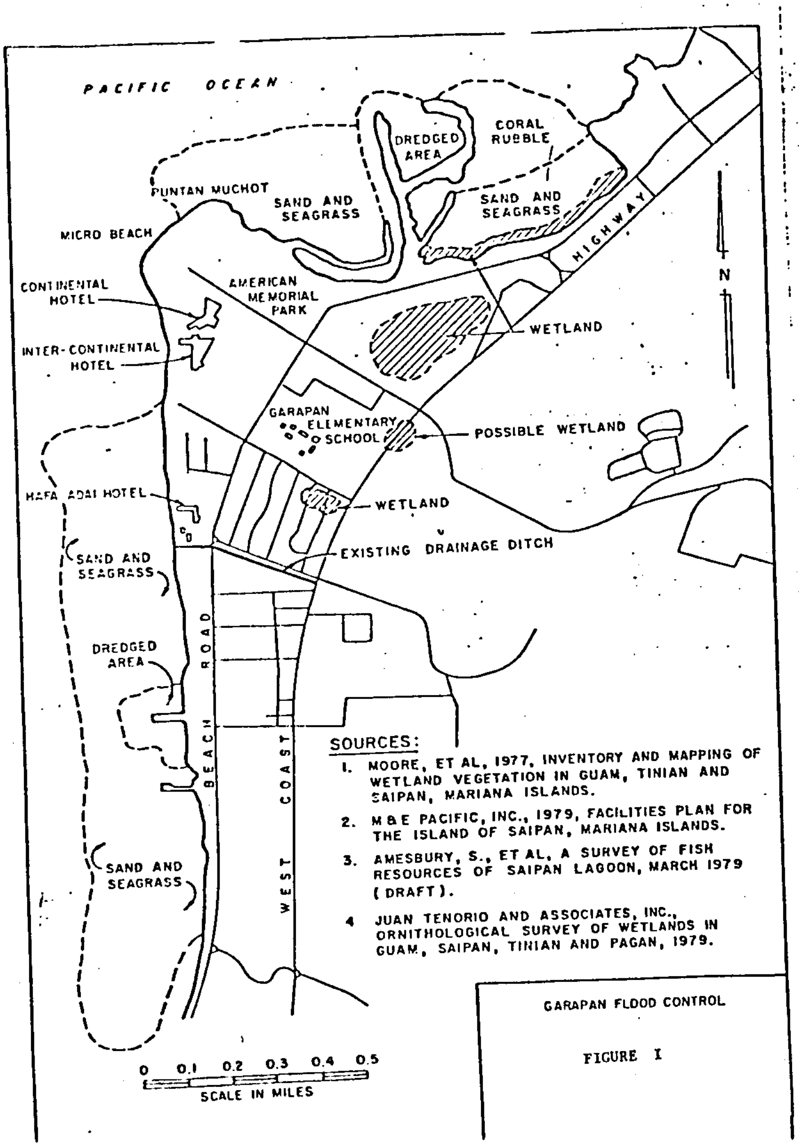
Sincerely yours,

William F. Shake

William F. Shake
Assistant Regional Director
Federal Assistance

Attachments






SOURCES:

1. MOORE, ET AL, 1977, INVENTORY AND MAPPING OF WETLAND VEGETATION IN GUAM, TINIAN AND SAIPAN, MARIANA ISLANDS.
2. M&E PACIFIC, INC., 1979, FACILITIES PLAN FOR THE ISLAND OF SAIPAN, MARIANA ISLANDS.
3. AMESBURY, S., ET AL, A SURVEY OF FISH RESOURCES OF SAIPAN LAGOON, MARCH 1979 (DRAFT).
4. JUAN TENORIO AND ASSOCIATES, INC., ORNITHOLOGICAL SURVEY OF WETLANDS IN GUAM, SAIPAN, TINIAN AND PAGAN, 1979.

GARAPAN FLOOD CONTROL

FIGURE I

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FT SHAFTER, HAWAII 96858

March 27, 1985

Dr. Allen Marmelstein
Pacific Island Administrator
U.S. Fish and Wildlife Service
P. O. Box 50167
Honolulu, Hawaii 96850

Dear Dr. Marmelstein:

In December 1984 we initiated formal consultation as directed by Section 7 of the Endangered Species Act for the Garapan Flood Control Study. the consultation was assigned to your office for completion and designated as case number 1-2-85-F-018.

We are presently considering a third flood control alternative which may affect the endangered Mariana Gallinule (Gallinula chloropus guami), and request that this plan be included under the current Section 7 Consultation for Garapan. A description of the alternative plan and possible effects on endangered species is provided in the Corps' biological assessment (Encl 1). Additional information regarding potential impacts on the wetland resulting from Plan E is also provided (Encl 2).

If you have any questions, please contact Mr. Robert Moncrief, Environmental Resources Section at (808) 438-2264.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

Enclosures

Endangered Species Biological Assessment
for Alternative Plan A of the
Garapan Flood Control Project

1. Project Description:

The structural flood control channel plan designated Alternative Plan A includes a diversion channel above West Coast Highway which would convey floodwaters into a discharge channel. The channel continues along the west side of West Coast Highway across Micro Beach Road and the American Memorial Park wetland into Tanapag Harbor (see attachment 1). The discharge channel through the wetland would be approximately 20-feet wide at the base (up to a 50 year level of protection) with side slopes of 3 horizontal to 1 vertical. The invert would be at approximately elevation - 6.0 ft MSL. The channel invert and side slopes may or may not be lined with riprap depending on optimum design level of protection.

Mitigative measures included in this alternative would consist of excavating an additional 4.2 acres of wetland (habitat replacement of wetland area lost as a result of channel construction). The proposed location of the replacement acreage is in the north-easterly portion of the American Memorial Park (see attachment 2). Mitigative measures would also include removal of portions of the existing fill areas thus creating two (larger) open water areas.

2. Endangered Species Within the Project Area:

The U.S. Fish and Wildlife Endangered Species Office has informed the Corps that the endangered Nightingale Reed Warbler (*Aerocephalus Luscinia*) and Mariana Gallinule (*Gallinula chloropus guami*) had been reported from the American Memorial Park Wetland area. In October 1984 a survey of the Garapan wetland was conducted by Corps and CNMI Department of Natural Resources biologists to delineate the wetland boundary and obtain additional information on the biological characteristics of the wetland area. During the survey the Nightingale Reed Warbler was frequently heard and sighted. The Mariana Gallinule was heard throughout the wetland but, because of the preference for seclusion, was never sighted. An estimate of the number of gallinule inhabiting the wetland was not attempted. In the open water areas, large clumps of the Marsh fern (*Acrostichum aurem*) were abundant. This fern emerging several feet above the water surface is known to be used by the gallinule as nesting habit in other wetland areas. Because the American Memoral Park wetland is one of two wetlands in Saipan inhabited by the gallinule, it is assumed but not yet confirmed that nesting occurs here. The paucity of wetlands in Saipan, and the CNMI in general, underlines the importance of the American Memorial Park wetland as Mariana Gallinule habitat.

Encl 1

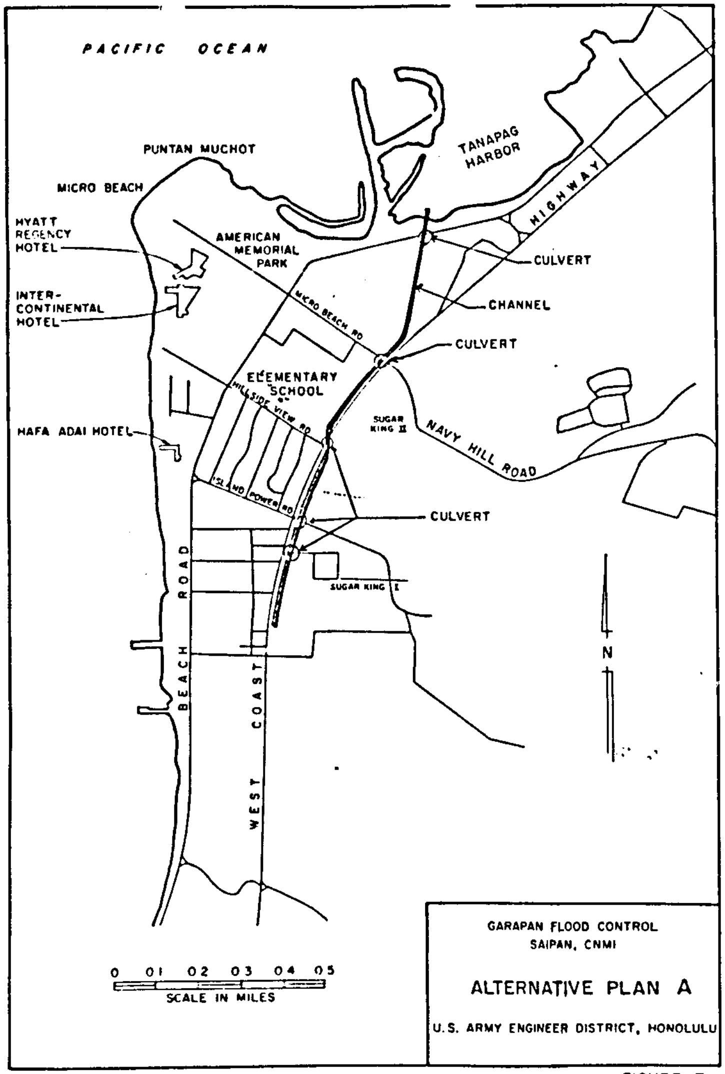
Impact Assessment:

a. Nightingale Reed Warbler.

Loss of a very limited amount of habitat (removal of some trees) will result from this alternative. Habitat affected is not unique. Impact on the Reed Warbler would be minimal.

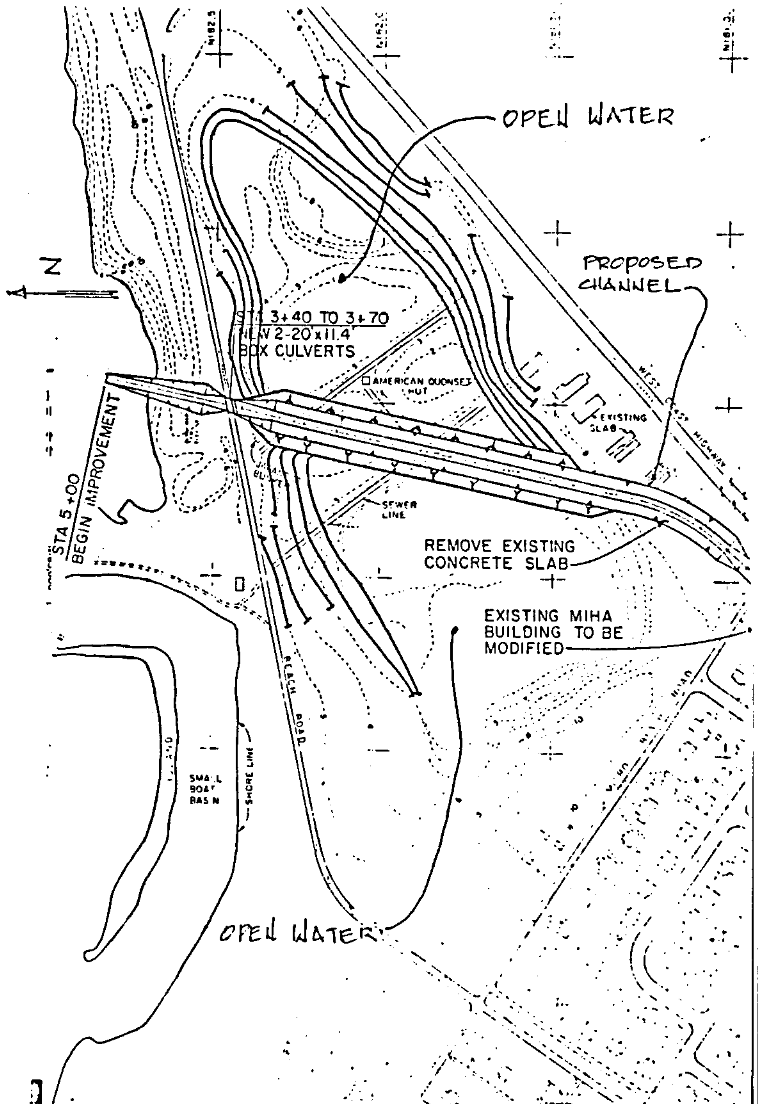
b. Mariana Gallinule.

The outlet channel will remove approximately 4.2 acres of wetland area which would be replaced elsewhere in the wetland to mitigate the loss. The area affected is open water with abundant acrostichum fern islets, providing the best gallinule nesting habitat within the wetland. During non-flood flow conditions, the channel invert (elevation about - 6 feet MSL) will contain standing sea water from the outlet, well into the terminal wetland areas. Depending upon the permeability of existing soils, the introduction of saline water may modify the water quality characteristics of the wetland (lining the channel with impermeable material is not planned at this time). If the salinity becomes too high, the marsh fern and other existing wetland vegetation may be adversely affected. This in turn could affect the suitability of the marsh as gallinule habitat.




ATTACHMENT 1

FIGURE 7




ATTACHMENT 2

Garapan Flood Control Project
Supplemental Information for Alternative
Plan E, Section 7 Consultation

1. An additional impact of Plan E on the American Memorial Park wetland from the channel invert elevation of -6 MSL to -4 feet from the outlet at Tanapag Harbor to the channel reach adjacent to the wetland. During non-flood conditions, the channel portions adjacent to the terminal wetland areas will contain standing seawater. If these channel portions are not made impermeable, it is possible that seawater infiltration into the wetland could result. The amount of infiltration (if any) would depend on soil permeability in the subject area, and would most probably affect only the wetland areas directly adjacent to the proposed channel alignment. The soil permeability has not been determined at this time.

Possible significant change in the salinity of the wetland could result in adverse modification of the marsh as gallinule habitat.

2. Lining the channel with an impermeable material is not planned at this time. Investigations up to this point have indicated that, if necessary, an impermeable lining would increase considerably the cost of this alternative.

Encl 7-

United States
Department of the Interior

Fish and Wildlife Service
Lloyd 500 Building, Suite 1692
500 N.E. Multnomah Street
Portland, Oregon 97232

May 7, 1985

In Reply Refer To: Your Reference:
AFA-SE
1-1-85-F-18R
Second Reinitiation

Mr. Kisuk Cheung
Chief, Engineering Division
U.S. Army Engineer Division, Pacific Ocean
FT. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

This responds to your March 27, 1985 request for a reinitiation of formal consultation under Section 7 of the Endangered Species Act of 1973, 16 U.S.C. 1531, *et seq.* (ESA). At issue are the possible effects of your authorization of a third alternative routing (as described in your March 27 letter) for the Garapan Flood Control Project on the following species:

Mariana gallinule (*Gallinula chloropus guami*)

The flood control project is to be constructed in Garapan, Saipan, Commonwealth of the Northern Mariana Islands (Figure 1). This letter represents the Biological Opinion of the U.S. Fish and Wildlife Service (FWS) as directed by Section 7 of the ESA, "Interagency Cooperation Regulations" (50 CFR 402, 43 FR 870) on your proposed action.

On April 24, 1985, we completed our review of the information provided by you along with other related information in our files. We also contacted some of those familiar with the biology, management, and recovery of the species involved. Copies of pertinent materials and documentation are contained in an administrative record maintained in this Service's office in Honolulu, Hawaii. Our reference number for this consultation is 1-2-85-F-C18-R (Reinitiation).

## BIOLOGICAL OPINION

It is our Biological Opinion that the action of authorizing, and thereby allowing for, the construction and operation of the Garapan Flood Control Project (as described in your March 27, 1985 letter to us) is not likely to jeopardize the continued existence of the Mariana gallinule

## PROJECT DESCRIPTION AND BACKGROUND INFORMATION

A history of flooding of commercial and residential property in the lower Garapan area on Saipan has been recognized. To alleviate this recurring problem, a draft *Garapan Flood Control Project Report and Environmental Statement* was published by the Corps of Engineers in June, 1984. This study addressed three alternative plans in detail, each of which would be located above the West Coast Highway. These alternatives differed, in part, in their channel alignments.

On November 30, 1984, you initiated formal consultation with this Service on one of those alternative alignments. That plan featured the construction of a drainage channel inland of the Garapan wetlands with a channel exit into Tanapag Lagoon. No construction in or use of the wetlands was indicated. Our Biological Opinion of February 12, 1985, determined that implementation of the plan would not likely jeopardize the continued existence of the Mariana gallinule or the reed warbler. (Note: Although the Mariana gallinule would be expected to be affected by the present proposal, the reed warbler would not.) On February 6, 1985, you presented a second alternative (Alternative Plan E) which would require both construction in and use of the wetland as both a flood water channel and temporary flood water reservoir. In addition, this alternative included the construction of islands within the wetland, increasing the gallinule nesting area and offering protection from predators. Our Biological Opinion of March 21, 1985, concluded that this second flood control plan also would not likely jeopardize the Mariana gallinule.

This Opinion addresses the possible impacts of a third flood control alternative (Alternative Plan A). As stated in your March 27, 1985 letter initiating this consultation, the plan would consist of:

> . . . a diversion channel above West Coast Highway which would convey floodwaters into a discharge channel. The channel continues along the west side of West Coast Highway across Micro Beach Road and the American Memorial Park wetland into Tanapag Harbor (see Enclosure 1). The discharge channel through the wetland would be approximately 20-feet wide at the base (up to 50-year level of protection) with side slopes of 3 horizontal to 1 vertical. The invert would be at approximately elevation -6.0 ft MSL. The channel invert and side slopes may or may not be lined with riprap depending on optimum design level of protection.
>
> Mitigative measures included in this alternative would consist of excavating an additional 4.2 acres of wetland (habitat replacement of wetland area lost as a result of channel construction). The proposed location of the replacement acreage is in the north-easterly portion of the American Memorial



> Park (see Enclosure 2). Mitigative measures would also include removal of portions of the existing fill areas thus creating two larger open water areas.

The actual area of the now existing wetland is described in the 1977 report Inventory and Mapping of Wetland Vegetation in Guam, Tinian and Saipan, Mariana Islands:

> The marsh is poorly defined, and occupies lower areas of a rather 'lumpy' terrain which has several seldom-used and ill-defined roads going through it. The dominant species are grasses, including *Panicum maximum*. *Phragmites karka* is absent, but the presence of a duckweed (*Lemna minor*) indicates that the wetland is permanent.

SPECIES ACCOUNT

The Mariana gallinule is endemic to Guam and several of the Northern Mariana Islands, and was added to the federal endangered species list in the Federal Register of August 27, 1984. Although historically the bird had a wide distribution in the freshwater wetlands of those islands, the drainage of suitable wetland habitat has been cited as a major contributing factor in their population decline.

By 1983, their population on Guam had decreased to only 100 to 200 individuals restricted to Fena Lake, Agana Swamp, and a few small freshwater ponds. Small, restricted populations can be found on some of the other islands in the Mariana chain. On Saipan, it has been reported at Lake Susupe, the Garapan wetlands (including the wetland at the American Memorial Park), and scattered sites in other parts of the island. On Tinian, it has been recorded at Lake Hagoi and Marpo Swamp, but not in large numbers. A 1981 survey of Lake Susupe estimated the population of gallinules there to be between 90 and 120. Recent investigations of the wetlands at the American Memorial Park identified gallinules as being present by their call, but it was not possible to estimate the number present. Gallinules possibly move between Susupe and the Garapan wetlands, making a comparison of the habitat value of the two wetlands for gallinules difficult. A 1979 Corps of Engineers survey identified 5.8 gallinules per 100 minute field count at the Garapan wetland as opposed to 5.4 at the Susupe site. These data were derived from a one day survey and may not be representative of the habitat utilization by gallinules. We consider Susupe to be superior habitat to Garapan due to its larger size.

The bird is a year-round breeder with peak breeding from March through August. Broods range from 2 to 8 chicks with an average of 3 birds successfully fledged per brood. Up to three broods per year have been observed. No nesting has been reported at Garapan for 7 to 8 years now. In contrast, active nesting occurs at Susupe.

## ANALYSIS OF IMPACTS

Of the three alternatives presented for the Garapan Flood Control Project, the alternative addressed by this Biological Opinion, Alternative A, would have the greatest potential to be detremental to the gallinule.

1. Loss of 4.2 acres of existing gallinule wetland habitat. This area would be altered by the channel which is to be dug through the wetland. The channel would be flooded during periods of heavy or extended rains, but its construction would result in an overall loss of wetland. Especially important is that the area which would be lost contains islets which provide nesting habitat protected from predators. As the channel lining is to be permeable, the extent of the wetland which potentially could be drained is not known. The unique geology of Saipan makes it difficult to predict the extent of wetland drainage. Surface water and ground water roles in wetland recharge are not clear. Thus we are unable to conclude that the entire Garapan wetland would be lost with this project. Should Garapan be largely drained by the project, peripheral wetlands would undoubtedly remain and support at least some gallinule use. Although you have suggested the creation of an equal area of wetland nearby as mitigation for the 4.2 acre loss, it is yet unknown if that new wetland will provide the same quality of habitat which is to be lost. It is also unknown if water levels in the new wetland could be maintained in consideration of the possible horizontal movement of subsurface water toward the channel.

2. Possible increases in water salinity.
Due to its low elevation, fresh water entering the channel would be expected to increase in salinity as it approaches sea level, decreasing its value to the gallinules (gallinules prefer fresh water). Likewise, a permeable channel lining may increase the salinity of the adjoining wetlands. Increases in salinity would not only directly discourage the use of the area by gallinules, but may result in changes in the plants associated with that wetland. A more brackish condition may encourage mangrove growth, for example, which could eventually choke out other vegetation used by gallinules for nesting or cover.

In summary, Alternative A has the potential to decrease both the amount and quality of the Garapan wetland significantly. In so doing, there would be a decrease in the habitat suitable for gallinules on Saipan. For the purposes of this Biological Opinion, however, we must consider that the Garapan wetland does



not constitute the entire gallinule habitat throughout its range. Other gallinule populations would continue to exist on Guam and other isolated islands of the Northern Marianas. On Saipan, the Susupe area would continue to be the most important habitat for the species. Although the project may be detrimental to gallinules, in consideration of the small number of birds using the wetland to be affected, and the fact that they are capable of movement to the newly created wetland offered as mitigation or to other suitable habitats on Saipan, such as Lake Susupe, it is doubtful that implementation of Alternative A would be likely to jeopardize the continued existence of that species.

## CUMULATIVE EFFECTS

Cumulative effects are those impacts of future Commonwealth and private actions which are reasonably certain to occur prior to completion of the subject action. A non-Federal action is "reasonably certain" to occur if the action requires the approval of a local resource or land use control agency, and such agencies have essentially approved the action. Actions that may be exempt from local land use controls must be essentially ready to proceed. We have identified no Commonwealth or private actions that would have effects cumulative to the proposed action.

## BIOLOGICAL OPINION

It is our Biological Opinion that the action of authorizing the construction of the Garapan Flood Control Project alternative presented in the referenced March 27, 1985, letter to us (titled Alternative Plan A) is not likely to jeopardize the continued existence of the Mariana gallinule.

## INCIDENTAL TAKE

Section 9 of the ESA prohibits any taking (harm, harassment, mortality, etc.) of listed species without specific exemption. Under the terms of Section 7(b)(4)iii and 7(o)(2), taking that is incidental to and not intended as a part of the agency action (in this case, the construction and operation of the Garapan Flood Control Project Alternative Plan A as described in your March 27, 1985 letter) is not considered taking within the bounds of the Act, provided that such taking is in compliance with the terms and conditions of this Biological Opinion.

Since the project does not require the direct taking of the species in the Garapan wetland for completion of the project, no take should occur as a result of actual construction. However, the chance does exist that the project may result in such taking if those assumptions expressed in our Analysis of Impacts prove to be false.

To address the issue of taking Mariana gallinule, we specify that the following reasonable and prudent measures be included in your overall flood control plan:

a. The project contractor shall incorporate, as part of the overall construction plan and construction contract, the stipulation that if any individual listed species discussed in this Opinion is killed as a result of the subject project during construction, the constructing agency and the COE shall require that the causative action of such taking cease immediately, and that the Corps of Engineers shall then re-initiate formal consultation prior to proceeding with the action.

b. All listed species which are injured or killed as a result of the subject action shall be retrieved and turned over to the Chief, Fish and Wildlife Division, Department of Natural Resources, Commonwealth of the Northern Mariana Islands, Saipan, immediately.

c. The project supervisor shall immediately prepare a written report which shall include the date, location, and circumstances surrounding the taking and the disposition of the individual(s) taken. Written and telephone reports shall be directed to William R. Kramer at:

U.S. Fish and Wildlife Service
P.O. Box 50167
Honolulu, Hawaii 96850

Phone: (808) 546-7530

d. Excavated materials shall not be allowed to be used as intentional or unintentional fill in any wetland on Saipan except for the construction of Alternative Plan A addressed by this Opinion. Oil, fuel, cement, cement truck washings, and other such materials associated with the construction of the project shall not be allowed to enter the wetland.

In furtherance of the purposes of the Endangered Species Act (Sections 2(c) and 7(a)(1) which mandates Federal agencies to utilize their authorities to carry out programs for conservation of listed species, we strongly recommend that your agency give paramount consideration to adopting Alternative Plan E (as evaluated on our Biological Opinion dated March 21, 1985) for flood control at Garapan, Saipan. Plan E has the fewest negative impacts to endangered species. It also offers the opportunity to construct isolated nesting habitat for gallinules which will offset two major limiting factors in the Garapan habitat--lack of nesting areas, and predation by feral dogs and cats. Thus Plan E could contribute to the recovery of the gallinule.



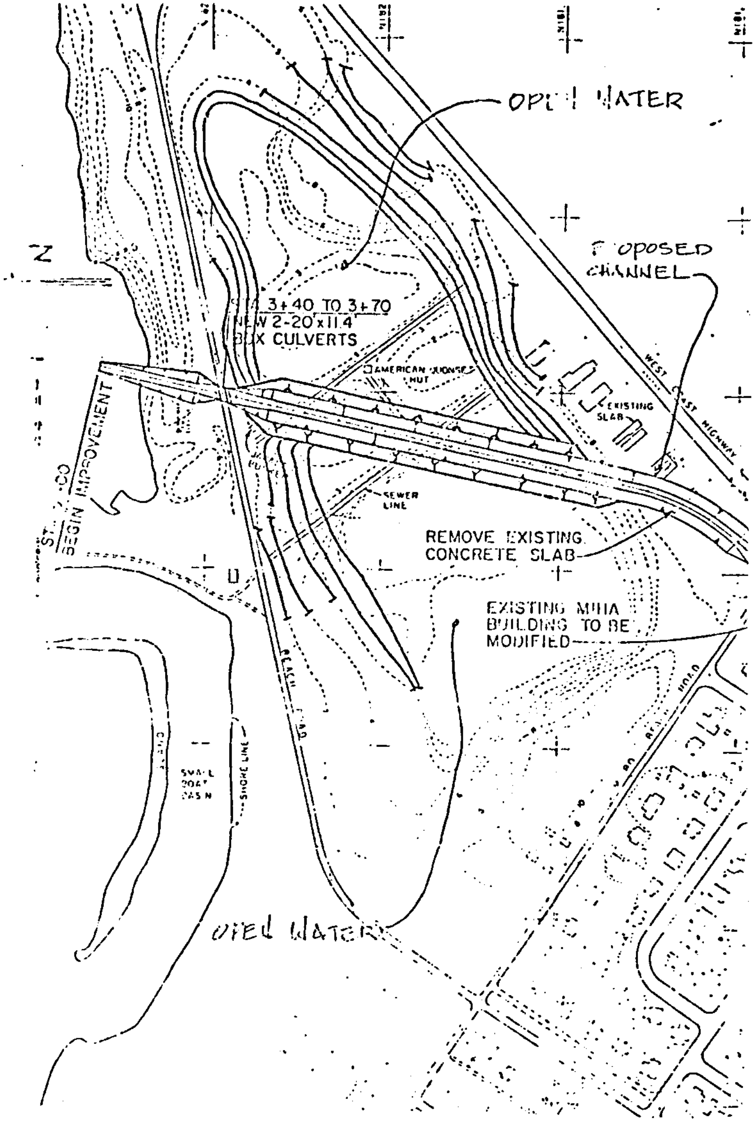
If you select Alternative A for the Garapan Flood Control Project, we would like to continue to work with you to ensure that adverse impacts are kept to a minimum. Please keep us advised of your decision in this regard. Also, should any significant changes be made in the proposed action, or should new species be listed which are not addressed in this letter which may be affected by the action, you must re-initiate consultation with this office.

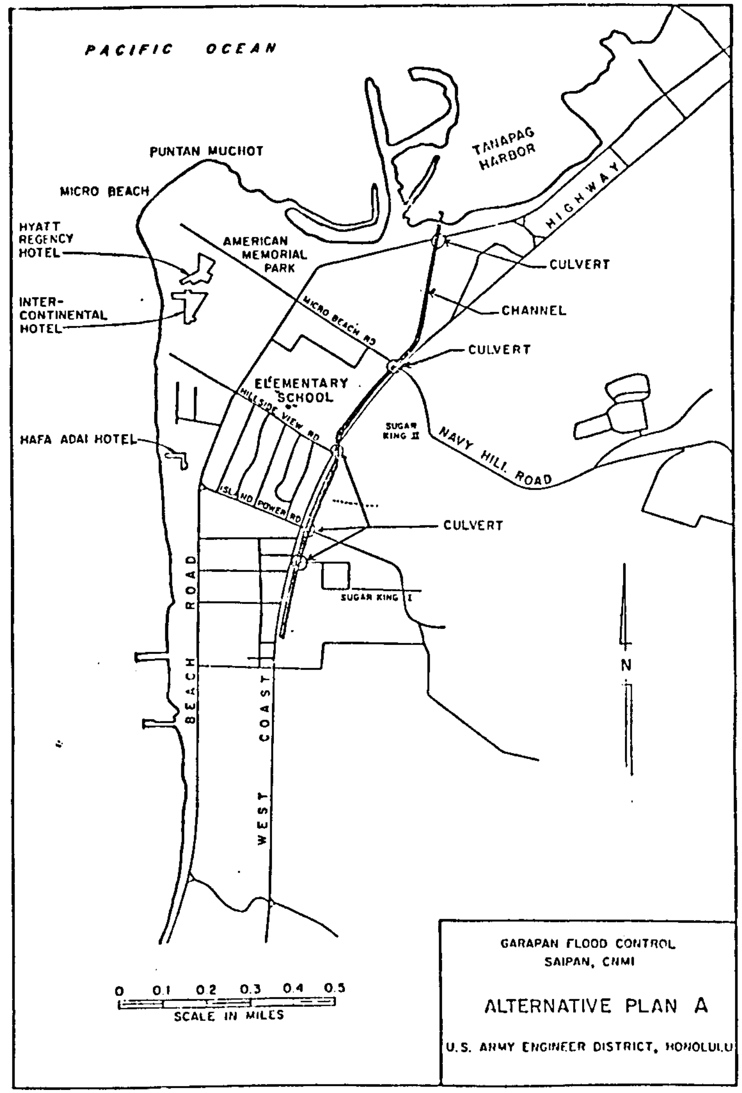
Sincerely yours,

William F. Shake

William F. Shake
Assistant Regional Director
Federal Assistance

Enclosures


STA 3+40 TO 3+70
NEW 2-20'x11.4'
BOX CULVERTS
AMERICAN QUONSET HUT
EXISTING SLAB
WEST COAST HIGHWAY
SEWER LINE
REMOVE EXISTING CONCRETE SLAB
EXISTING MIHA BUILDING TO BE MODIFIED
BEGIN IMPROVEMENT
SMALL BOAT BASIN
SHORE LINE
BEACH RD


PACIFIC OCEAN
PUNTAN MUCHOT
MICRO BEACH
TANAPAG HARBOR
HIGHWAY
HYATT REGENCY HOTEL
AMERICAN MEMORIAL PARK
CULVERT
INTER-CONTINENTAL HOTEL
MICRO BEACH RD
CHANNEL
CULVERT
ELEMENTARY SCHOOL
HILLSIDE VIEW RD
SUGAR KING II
NAVY HILL ROAD
HAFA ADAI HOTEL
ISLAND POWER RD
CULVERT
SUGAR KING I
N
BEACH ROAD
WEST COAST
0 0.1 0.2 0.3 0.4 0.5
SCALE IN MILES
GARAPAN FLOOD CONTROL
SAIPAN, CNMI
ALTERNATIVE PLAN A
U.S. ARMY ENGINEER DISTRICT, HONOLULU

ENCLOSURE I

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

REPLY TO
ATTENTION OF:

November 10, 1986

Dr. Allen Marmelstein
Pacific Island Administrator
U.S. Fish and Wildlife Service
P.O. Box 50167
Honolulu, Hawaii 96850

Dear Dr. Marmelstein:

In accordance with the recommendation in your letter dated October 29, 1986, we are re-initiating formal consultation as directed by Section 7 of the Endangered Species Act for the Garapan Flood Control Project, Garapan, Saipan. This consultation was earlier designated by the Service as case number 1-2-85-F-018. On February 12, 1985, we received a "no jeopardy" Biological Opinion. Since that time, there have been no changes in the project and, to our knowledge, no new information on the use of the American Memorial Park wetland by the endangered Mariana Gallinule. We understand that the Service has obtained recent hydrologic information that may modify the assumptions used in the preparation of its Biological Opinion, and that a revised Opinion will be prepared based on new assumptions.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

United States Department of the Interior

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

IN REPLY REFER TO:

NOV 24 1986

Mr. Kisuk Cheung
Chief, Engineering Division
U. S. Army Engineer District, Honolulu
Building 230
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

This replies to your November 10, 1986 letter which addressed previous consultations with us regarding possible impacts of your proposed Garapan Flood Control Project on Saipan on the endangered Maraiana common moorhen. Although the conclusions reached in our biological opinions of February, March, and May of 1985 remain (that none of the project designs would be likely to jeopardize the continued existence of the bird), recent changes in the regulations governing Section 7 of the Endangered Species Act and possible disagreements concerning the impact of the project on the wetland should be addressed.

In June of this year, new final Section 7 regulations were published in the Federal Register. In part, these regulations change the unit of a species under consideration from a universal to a population membership. Previously, a jeopardy finding could be issued only if jeopardy to the species as a whole could be demonstrated; now, only jeopardy to a distinct population within that species need be shown to justify a jeopardy finding. The Saipan population of moorhens is considered distinct from the population as a whole, which includes Guam. In our previous biological opinions, we stated that the project would not be likely to jeopardize the continued existence of the moorhen as a species. Although any negative impact of the project on the birds at Garapan would be expected to affect the Saipan population to a greater degree than to the species as a whole, we believe that any of the three alternatives discussed in our above referenced opinions would not jeopardize the continued existence of the Saipan population of moorhen.

We make this determination with the understanding that the project, as most recently proposed, may result in an increase in the salinity of the Garapan wetland over time due to the possibility of the interception of freshwater inflow by the flood control structures or due to other project modifications affecting the "natural" salinity balance there. Such increases in salinity may decrease its desirability as moorhen habitat.



Our concern for the maintenance of habitat at Lake Susupe would be expected to increase should the desirability of Garapan as bird habitat be diminished.

Thank you for your continued interest and cooperation in discussing this project and its possible impacts on this endangered species.

Sincerely yours,

William R. Kramer

William R. Kramer
Acting Project Leader
Office of Environmental Services

# SECTION IV

## Federal Coastal Zone Management (CZM) Consistency Determination

**FEDERAL COASTAL ZONE MANAGEMENT
CONSISTENCY DETERMINATION
for the
Garapan Flood Control Project
Saipan, Commonwealth of the Northern Mariana Islands
January 1987**

The following consistency determination for the Garapan Flood Control project addresses the specific standards applicable to major sitings within established areas of particular concern (APC). The standards are set forth in the Coastal Resources Management Office's (CRMO) Rules and Regulations, Vol. 7, No. 10 of the Commonwealth Register, October 17, 1985.

**1. LAGOON AND REEF APC; MANAGEMENT STANDARDS.**

a. <u>Subsistence usage of coastal areas and resources shall be insured</u>.

The project would have no significant effect on subsistence usage of marine resources in the coastal areas.

b. <u>Living marine resources, particularly fishery resources, shall be managed so as to maintain optimum sustainable yields</u>.

No significant changes to the composition, diversity and abundance of lagoon resources are anticipated in the vicinity of the outlet channel in Tanapag Harbor. In general, a gradual shift toward species tolerant of salinity fluctuations is anticipated. Detailed evaluatin of effects on the lagoon environment appears in the EIS.

c. <u>Significant adverse impacts to reefs and corals shall be prevented</u>.

The project would not have significant adverse effects on corals or reefs. The long term siltation of the barrier reef (where most corals are located) is entirely unlikely. The barrier reef is more than 2 miles offshore from the discharge site, silt from the source, would not reach the barrier reef in concentrations that would adversely affect the reef.

d. <u>Lagoon and reef areas shall be managed so as to maintain or enhance subsistence, commercial and sportfisheries</u>.

The project will not have a significant effect on subsistence, commercial or sportfisheries. A small increase in sport/subsistence fish species may occur in the limited estuarine environment created by the project.

e. Lagoon and reef areas shall be managed so as to assure the maintenance of natural water flows, natural circulation patterns, natural nutrient and oxygen levels and to avoid the discharge of toxic wastes, sewage, petroleum products, siltation and destruction of productive habitat.

The project will result in the intermittent dischage of storm water into the Unai Sadog Tasi embayment. During these periods natural water flows, circulation patterns, nutrient and oxygen levels will be disrupted.

f. Areas and objects of historic and cultural significance shall be preserved and maintained.

No historically significant resources are known to exist in the portion of the lagoon directly affected by the project.

g. Underwater preservation areas shall be designated.

No underwater preservation areas have been designated in the project area, and to our knowledge none have been nor are anticipated to be designated.

**2. WETLAND AND MANGROVE APC; MANAGEMENT STANDARDS.**

a. Significant adverse impact on natural drainage patterns, the destruction of important habitat and the discharge of toxic substances shall be prohibited; adequate water flow, nutrients and oxygen levels shall be ensured.

The flood control channel will intercept and divert sheet flow runoff from elevated areas east of the AMP wetland that would normally flow into the wetland during high rainfall conditions. The project will not destroy wetland habitat. A small increase in salinity within the wetland may occur. Such an increase in salinity would not result in significant adverse impacts on the wetland habitat and may eventually result in the expansion of mangroves in the vicinity of the outlet channel. The project would not result in the discharge of toxic substances into the wetland.

b. The natural ecologicaland hydrological processes and mangrove areas shll be preserved.

Effects of the project on the natural ecological and hydrological processes are discussed in the EIS and Appendix I. Slight increases in salinity are anticipated but would result in minimal effects on the ecology of the wetland. The outlet channel would cut through the narrow band of mangrove trees fringing the shoreline at Unai Sadog Tasi. Removal of several mangrove trees would be required. It is likely that mangroves would establish along the border of the discharge channel as they have done along the drainage ditch north of Charlie Dock. The net effect would probably be beneficial tothe mangrove commuinity at Unai Sadog Tasi.

c. Criticl wetland habitat shall be maintained and, where possible, enhanced so as to increase the potential for survival of rare and endangered flora and fauna.

Our conclusion based on available information on the use of AMP wetland by the Marianas Gallinule, indicate that the habitat is of marginal value. Observed population densities have not exceeded 3 individuals and no nesting activity is known to occur here. It appears that suitable vegetation for nesting is lacking. The projected slightincrease in wetland salinity resulting from the project would not adversely affect the habitat value of the wetlandwith respect to rare and endangered flora and fauna. The U.S. Fish and Wildlife Service has stated that the endangered Mariana Gallinule would not be jeopardized by the proposed project plan E in their letter dated 24 November 1986.

d. Public landholdings in and adjacent to the wetland and mangrove APC shall be maintained and, to the extent possible, increased, for the purpose of access and/or hazard mitigation, through land trades with Marianas Public Land Corporation, land purchasers, creation of easement or through taking by eminent domain.

The project will commit a total of approximately 20.7 acres to structural flood control improvements. Approximately one third of the area is located in or adjacent to the wetland and mangrove APC.

e. Wetland resources shall be utilized for appropriate agriculture, recreation, education, public open space and other compatible uses which would not degrade productivity.

The AMP wetland would be maintained in its present state and may eventually be enhanced through the implementation of the National Park Service Management plan.

3. **SHORELINE APC; MANAGEMENT STANDARDS.**

a. The impact of onshore activities upon wildlife, marine or aesthetic resources shall be minimized.

Onshore activities associated with the project will consist of construction of the flood control channel and periodic maintenance. Environmentl controls covering noise, duct, hydrocarbon emissions and turbidity in coastal waters will be included in the plans and specifications and implemented during project construction. Once completed, onshore activities associated with the project will be minimal and would not affect marine or wildlife resources. The majfority of the channel alignment runs parallel to the East Coast highway in areas that have already been largely cleared of vegetation so the channel will not drastically change the existing visual setting. About two thirds of the length of the channel will be lined with riprap and one third with grass, moderating the visual obtrusiveness of the flood control structure.

b. The effect of shoreline development on naturl beach processes shall be minimized.

The channel outlet is located in the small embayment called Unai Sadog Tasi. The shoreline is composed of a muddy silt/sand mixture and not the typical calcareous white sand beach which dominates the leeward shoreline south of this area. Water circulation in the embayment is dominated by tidal fluctuation. A longshore movement of littoral material here is minimal if it occurs at all. Hence the project will have little or no effect on natural beach processes.

c. The taking of sand, gravel or other aggregates and minerals from the beach and near shore areas shall not be allowed.

A limited amount of sand and silt material would be removed from the shoreline area just offshore during excavation of the mouth of the channel.

d. Removal of hazardous debris from beaches and coastal areas shall be strongly encouraged.

The project does not require and therefore does not include the removal of hazardous debris from the beach or coastal area within or adjacent to the project area.

e. Where possible public landholdings along the shore shall be maintained and increased, for the purpose of access and hazard mitigation, through land trades with Marianas Public Land Corporation (MPLC), land purchases, creation of easements, and where no practicable alternative exists, through the costitutional authority of eminent domain.

Less than one acre of land within the shoreline APC must be committed to a construction easement for the outlet channel.

## SECTION V

Presidential Executive Order 11990
on Protection of Wetlands

V

# GARAPAN FLOOD CONTROL STUDY
# PRESIDENTIAL EXECUTIVE ORDER 11990 ON PROTECTION OF WETLANDS
# EVALUATION REPORT

1. Executive Order 11990 directs the Corps to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out its Civil Works activities.

2. To insure compliance with Executive Order 11990, the following evaluations were incorporated into the plan formulation for flood damage reduction of the Garapan area, Saipan.

a. Procedure: Determine if wetlands are present within the study area.

Evaluation: Site inspections of soils, water and vegetation of the study area indicated the presence of wetlands within the American Memorial Park. Since the degree of soil saturation in the wetland varies with seasonal variations in rainfall, the outside limits of the wetland are difficult to pinpoint. Based on field observations of vegetation, soils, and hydrology; and on interpretation of aerial photographs of the area taken at different years and seasons, the area defined as wetland was determined to be approximately 8.4 acres.

b. Procedure: If wetlands are present, make protection and/or enhancement of the beneficial values of wetlands a planning objective.

Evaluation: Wetland protection and enhancement were considered throughout the planning process and are incorporated into the planning objectives in the Main Report.

c. Procedure: During the plan formulation process, include appropriate wetlands protection and/or enhancement measures in alternative plans.

Evaluation: Wetlands protection and enhancement were considered during the development of each of the alternative plans. The structural elements of Alternative Plans B, C, and E the recommended plan, avoid wetland areas entirely. Plans A and D impinge upon the wetland area. Plans A and D incorporate removal of fill areas as mitigation. Alternative Plan F (floodproofing and floodplain management) would not affect the American Memorial Park wetland.

d. Procedure: If the proposed Corps action would be located in wetlands, identify and evaluate practicable alternatives to wetlands location.

Evaluation: Alternative Plans B, C, E, and F are not located in the wetlands. Alternative Plan E is the only economically feasible plan.

e. Procedure: Identify and evaluate adverse impacts related to the loss and degradation of beneficial values of wetlands.

valuation: Limited areas of wetland will be affected by Plans A and D. Beneficial values associated with the wetland include nutrient filtering; buffering against erosion; food chain production; and storage of storm and floodwaters.

f. Procedure: Include appropriate measures in alternative plans to minimize unavoidable adverse impacts to beneficial wetlands and their function.

Evaluation: Attempts were made to preserve of enhance wetlands during development of the alternative plans. Plans B, C, E, and F will have no effects on wetlands. Plans A, and D will affect wetlands to the minimum extent possible given the structural requirements of the project components.

g. Procedure: Based on the above, and in close coordination with appropriate agencies and the public throughout the planning process, recommend the plan most responsive to the planning objectives and evaluation criteria.

Evaluation: This report has been coordinated with the US Fish and Wildlife Service for review and comment and preparation of a FWCA Report (Appendix H). Plan E appears to be the least environmentally damaging plan in terms of wetland resources, while meeting planning objectives and other evaluation criteria.

# SECTION VI

## Presidential Executive Order 11988
## on Floodplain Management
## Evaluation Report

VI

# GARAPAN FLOOD CONTROL STUDY
# PRESIDENTIAL EXECUTIVE ORDER 11988 ON FLOODPLAIN MANAGEMENT
# EVALUATION REPORT

## 1. PURPOSE

The purpose of this supplemental report is to present the results of additional studies in accordance with 33 CFR 239 which implements Executive Order (EO) 11988, Floodplain 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 development in 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. COMPLIANCE

a. It has been determined that the project is located within the base flood. The base flood is defined as the one percent (1%) exceedance frequency floodplain (100-year floodplain).

b. Practicable alternatives to locating the "action" in the base floodplain have been considered. The term "action" is defined as 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.

No practicable alternatives are available that could locate the action outside the 100-year floodplain. The only measure, which locates the action outside the floodplain, is relocating each individual structure outside the floodplain.

c. Impact Assessment (Natural and Beneficial Values). Assessment of the impacts of the proposed action on the natural/beneficial values of the floodplain indicates there are no Federally listed endangered or threatened species of fauna or flora that will be affected. Structural alternatives A and D will encroach upon the wetlands. Indirect development in this area as a result of the proposed actions should be closely regulated by existing building restrictions within the designated 100-year floodplain. Cultural or archeological resources may be affected depending on the alignment of the structural actions; however, close coordination with the Government Historic Preservation Officer should handle that possibility.

d. Induced Development as a Result of the Proposed Action. A practicable alternative to the proposed actions must consider water resources; conservation; economics; aesthetics; impact of future floods on human safety; locational values with respect to housing, education and work force; functional need for locating within the floodplain, historic, fish and wildlife habitat values; endangered and threatened species; support of local, municipal infra-structure; energy conservation; cost effectiveness; and the general needs and welfare of the local community.

Structural alternatives A, B, C, D, and E may alter the 100-year floodplain limits. The degree of alteration will depend on the level of protection recommended. Alternative F, which is a nonstructural proposal will not reduce or alter the 100-year floodplain.

e. Viable Methods to Minimize Adverse Impacts and to Restore and Preserve the Natural and Beneficial Values of the Floodplain.

Floodplain management measures are all an integral part of the proposed alternative plans. These measures restrict future development in the floodplain and minimize potential flood damages. Measures to minimize adverse impacts include:

(1) Floodplain management services are available from the U.S. Army Corps of Engineers under the authority of Section 206 of the River and Harbor and Flood Control Act of 1960 (Public Law 89-789). These services include providing flood hazard data, maps and technical assistance and studies.

(2) A flood insurance program is administered 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. Presently the Government of the Commonwealth of the Northern Mariana Islands is participating in the emergency phase of the Flood Insurance Program.

(3) The U.S. Department of Housing and Urban Development (HUD) has minimum building standard requirements for Federally subsidized housing projects administered by the agency. The Mariana Housing Authority (MIHA) funded by HUD requires compliance to these standards which incorporates floodplain planning requirements.

(4) 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 displace persons.

(5) 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 provided during Typhoon Carmen in August 1978.

f. Advise the general public.

The general public was notified of this action by public notice and was given the opportunity of voicing their concerns on this action during a formal public meeting. The Public comments are documented in the Final Report and Environmental Impact Statement.

g. Recommendation of the most desirable plan.

After consideration of all information pertaining to the various alternatives with respect to EO 11988, the selection of Plan E is recommended.

GARAPAN FLOOD CONTROL

SAIPAN, CNMI

ANALYSIS OF
GROUNDWATER AND ENVIRONMENTAL CONCERNS

APPENDIX H

APPENDIX H

ANALYSIS OF GROUNDWATER AND ENVIRONMENTAL CONCERNS

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APPENDIX H

## I. GARAPAN AREA

The coastal area of Garapan is a triangular coastal plain with elevations generally less than fifty feet above mean sea level (MSL). Most of the area seaward of the West Coast Highway is less than ten feet above MSL and characterized by urban development. Hotels are located along the shoreline areas, and residential and commercial developments cover the area between the hotels and the West Coast Highway. Additional public and residential developments, which include the new Commonwealth Medical Center (CMC) and Paganville housing units, can be found on the lower slopes of the foothills of Garapan. The northern extent of the Garapan area is bordered by the American Memorial Park wetland which has an area of approximately 27 acres.

### A. PHYSICAL DESCRIPTION

Saipan is an island comprised of volcanic and sedimentary rock formations. The underlying volcanic formations tend to be of low permeability; however, localized variations in permeability are commonplace. The limestone sediments, predominantly unconsolidated calcareous sands, silts and gravels, are the most widespread rocks on the surface. These sediments generally have high permeability, but permeability can vary greatly over short distances. Tuffaceous units and consolidated sandstone and limestone layers may occur within the unconsolidated layer. These layers are relatively low in permeability and can act as confining layers.

The rock formations in the Garapan area are principally Pleistocene with recent deposits of calcareous and noncalcareous sands and gravels. The area is underlain throughout by basal water of varying quality with a water table slightly above sea level. Noncalcareous alluvium, which is characteristic of this part of the island, are not good well producers as compared to the calcareous sands and gravels in southern Saipan.

### B. GROUNDWATER HYDROLOGY

In light of the fact that there is limited baseline data on groundwater properties in Saipan and especially in the Garapan area, further collection of data within a reasonable time frame and level of effort will be insufficient to produce conclusive evidence on the effects of the proposed channel on the American Memorial Park wetland. However, using information that is available and sound assumptions and theoretical methods, a reasonable estimate can be made on probable effects of the proposed channel on the wetland. The following discussions are based on these premises.

There are two basic sources of groundwater in Saipan: basal and high level waters. The groundwater source of the coastal Garapan area is basal water, which is recharged by rainfall and flows toward the ocean.

The depth to seawater for oceanic islands is a function of rainfall recharge, permeability and size of the island. Freshwater tends to float on seawater due to the difference in densities, and the depth to seawater through a groundwater body can be approximated using Dupuit assumptions and the Ghyben-Herzberg relationship (Todd, 1959). Ideally, basal water forms a double-convex lens that is characterized by a ratio of water table height above MSL to groundwater depth below MSL of 1 to 40 with the outer edge of the lens at sea level. Groundwater flow caused by rainfall recharge and differences in permeability tend to alter the 1 to 40 relationship that occurs under static conditions. In addition, there is no distinct meeting of the two lenses at MSL due to groundwater flow toward the ocean. Instead, the depth to the seawater and freshwater interface is expected to be more than 1 to 40 near the shoreline. Flow would be expected to exit the ground below sea level extending the interface for some distance beyond the shoreline (See Figure 1).

There is a transition zone between the fresh and salt water interface and its thickness is influenced by the permeability of rock strata, tidal fluctuations and seasonal changes in the water table elevation. This zone may range up to several feet in thickness. The transition zone may be extensive in the Garapan area because highly permeable media, fluctuation due to tides, and general groundwater movement enhance mixing between freshwater and seawater layers.

The lower reaches of the proposed flood control channel (Plan E) skirts around the American Memorial Park wetland. Its proximity to the shoreline indicates that under typical conditions illustrated in Figure 1, the depth of the groundwater body including the transition zone would be greater than 40 feet if the water table elevation were one foot above MSL. According to water level measurements taken from boring logs and other literature, the height of the water table along the channel on the southeast side of the wetland was found to be approximately two feet above MSL. Due to hydrodynamic effects near the shore area caused by groundwater flowing out to the ocean, the depth of the groundwater body (freshwater layer and brackish transition zone) would be approximately 80 feet or greater. Although the channel invert along much of the lower reaches is close to 5 feet below MSL, flow will continue through the wetland toward the coast due to the extent of the groundwater body below the proposed invert of the channel.

1. Permeability Determination

Field tests to determine the permeability of underlying material near the American Memorial Park wetland have not been performed. However, a reasonable estimate of permeability can be made using an empirical relationship that is derived from measured permeability and effective pore diameters of soil. The effective pore diameters are determined from sieve analyses performed for soils in the Garapan area.

Permeability for the Garapan area was estimated to be between a few millimeters per day to a few feet per day. The lower permeability is representative of fine sands and silts and higher permeability of coarse, sandy material. A permeability of three feet per day was used to analyze effects of the proposed channel on possible seawater intrusion into the wetland area. The selected permeability is conservative because it would assist in identifying the expected impacts under a probable worst case condition.

2. Groundwater Seepage into the Proposed Channel

Groundwater seepage is expected into portions of the proposed channel because the channel invert is below the water table elevation along most of the reach. Seepage will continue as long as the water table surface is higher than the level of water in the channel. The water table elevation is approximately two feet between 1000 feet from the ocean end of the channel and STA 26+40 (See Plate C-1, Appendix C). Hence, even during the maximum tide of 1.9 feet, a gradient will exist above the 1000-foot point in the channel so that groundwater will tend to flow into the channel.

The amount of groundwater flow into the channel, roughly estimated using Darcy's law, was between 10,000 and 40,000 gallons per day. This net inflow of freshwater will tend to mix with denser seawater that enters the channel from the ocean and moves up the channel bottom. The state of the tide and rate of groundwater seepage into the channel will influence the mixing rate. Upstream areas of the channel that intersect the water table will experience greater influx from groundwater due to the higher water table elevation. This will tend to cause salinity to decrease in the upstream direction. Also seawater moving up the channel from the shoreline will be mixed and tend to be diluted (exhibiting lower salinity) by the time it reaches the upper channel.

3. Seawater Intrusion from the Proposed Channel

The general area of concern for seawater intrusion is the portion of the channel where the water table elevation is less than the height of the highest tide (STA 0+00 to approximately 1000 feet upstream). Water from the channel would tend to penetrate the ground only during times when the water surface level of the channel exceeds the water table elevation. Whenever the tide reverses, water will tend to flow out of the channel walls. Since the water table elevation is always above sea level, the general period of concern would be during the high tide phase. A zone within the immediate vicinity of the channel walls and invert in the very lower reaches may experience a flushing in and out phenomena daily. However, because the proposed channel skirts around the wetland, there should be minimal effect on the wetland.

## C. SURFACE WATER FLOW TO THE WETLAND

Surface water flow across West Coast Highway were observed to carry sediment into the wetland following the recent Super Typhoon Kim (date of observation by Dr. Maragos, December 4, 1986). Continued sediment laden storm flow into the wetland from across West Coast Highway has probably caused the gradual filling of the landward side of the AMP wetland, thereby eliminating open water areas and hastening transition of the wetland to a woody, bottomland habitat. Construction of the proposed flood control channel should not interfere with localized surface runoff that flows to the wetland. However, sediment laden waters from across the highway would be prevented from entering the wetland, which in turn would retard the rate of sediment presently filling the wetland, a positive consequence of the channel.

## II. AMERICAN MEMORIAL PARK (AMP) WETLAND

### A. WETLAND SALINITY

In the past, salinity measurements taken within the AMP wetland have ranged between 0.5 parts per thousand (ppt) and 6.5 ppt. The variations in the salinity readings are the result of the sample locations (See Figure 2 for salinity measurement locations of the AMP wetland) and hydrologic conditions. The salinity readings from three separate field visits are presented below.

The latest measurements were taken by Dr. James Maragos (USACE) and Mr. Andy Yuen (USFWS) on December 2 and 4, 1986 using a Yellow Springs model conductance salinometer. They determined that salinities at the site were too low to obtain accurate measurements using a hand held refractometer and values obtained by refractometer deviated by up to 5 ppt from those obtained using the salinometer. On December 2, eight measurements in the wetland near Beach Road yielded values between 2.0 and 6.5 ppt, distinctly displaying brackish conditions (above a maximum tap water measurement of 0.2 ppt taken for reference purposes) and showing wide variations in a small area. The precision and accuracy of measurements obtained using the salinometer is 0.1 to 0.2 ppt.

The measurements taken on December 4 followed Super Typhoon Kim and were taken along the culvert crossing Beach Road (See Figure 2). These measurements were 0.5 in the wetland just upstream of the culvert entrance, 1.5 ppt at the culvert entrance, and 2.5 ppt at the exit or ocean side of the culvert. The lower salinity measurement in the wetland (0.5 ppt) on December 4 could be attributed to dilution from runoff and precipitation from Super Typhoon Kim. The 1.5 and 2.5 ppt values in the culvert is probably due to mixing of seawater with surface runoff on the down stream side of the culvert that is backing up to the culvert. A possibility exists that winds from Super Typhoon Kim carried sea spray into the wetland. However, if sea spray caused the higher salinity readings in the culvert, the wetland reading should also have been higher.

Mr. Robert McVein (USFWS), regional hydrologist, took a single salinity measurement in the wetland on January 7, 1985 using a hand held refractometer. He measured zero salinity, but due to the salinity variations found in the wetland over short distances and greater inaccuracy of the refractometer, the validity of the measurement is questioned. A zero reading on an instrument with a precision and accuracy of $\pm$ 1 to 5 ppt does not document a lack of salinity at the site of measurement.

The first set of measurements were taken on September 28, 1984 by Mr. Robert Moncrief (USACE) and Mr. Pat Bryan (CNMI - Division of Environmental Quality (DEQ)). Three samples, taken by Mr. Moncrief and analyzed by CNMI's DEQ, yielded salinities of 1.5, 0.6, and 1.3 ppt. These values are indicative of low salinity levels present during the rainy season and are within the range taken by Dr. Maragos following the super typhoon.

These earlier measurements were taken at locations in the swamp that are considered to be areas of perennial standing water, probably more dependent upon basal groundwater than precipitation. A gradient in salinities from the lower to higher would be expected in the wetland when moving closer to the coast and could explain the higher salinities recorded by Maragos and Yuen.

Wetlands having salinity levels greater than 0.5 ppt are defined as brackish by Fish and Wildlife Service in "Classification of Wetlands and Deepwater Habitats of the United States," (FWS/OB-79/31). These salinity measurements show that, at least, the seaward half of the wetland is not a freshwater swamp and that brackish conditions do exist even under or following periods of relatively high rainfall. Brackish conditions are probably caused by the mixing of high salinity ocean water with the groundwater in proximity to the coast. Although these factors have not been documented through long-term measurements, the overriding evidence, which indicates naturally occurring brackish conditions, are the types and zonation of vegetation found in the wetland. Of the 15 identified species, 13 are known to be salt tolerant and can survive in a relatively saline environment where salinity exceeds 2 ppt. Figure 2 further shows that mangroves along with higher salinity readings are found near the culvert where the proposed channel outlet is located. Hence, any increase in salinity near the outlet should not have any significant impact on that portion of the wetland. Furthermore, a wetlands vegetation map prepared by Corps and CNMI biologists in 1984 (Figure 2) show that mangroves are widely distributed throughout the seaward half of the AMP wetland. Mangroves are a known indicator of estuarine to marine conditions. Their distinctive distribution may represent regions in the wetland predominantly characterized by brackish water.

## B. FLORA AND FAUNA

The dominant vegetation in the open areas of the wetland is the marsh fern (*Acrostichum aureum*) with scattered patches of emergent grasses, mainly sedges. Our research findings indicate that the marsh fern is tolerant of brackish waters and can be found in habitats ranging from freshwater to saltwater marshes. Other dominant flora within the wetland are the ironwood trees (*Casuarina*) and pago trees (*Hibiscus*). Tangan tangan (*Leucaena leucocephala*) covers the higher ground fringing the wetland. The mangrove (*Brugiera gymnorrhiza*) is tolerant and adapted to salinities ranging from brackish to fully marine. The widespread occurrence of *Brugiera gymnorrhiza* in AMP wetland may suggest an even wider distribution of the mangrove in the wetland prior to Beach Road construction which now blocks the movement of mangrove propagules from the ocean to the wetland.

The Mariana Gallinule (Gallinula chloropus guami), a subspecies of the Common Gallinule or Moorhen (Gallinula chloropus), has been recently listed on the Federal Endangered Species list. The largest population of gallinule on Saipan is found at Lake Susupe and its surrounding wetlands. In 1981, a field survey by the Corps of Engineers estimated a population of about 90 to 120 gallinule in the Susupe wetland. The Fish and Wildlife Service Micronesian Forest Bird Survey (1982) stated this was a reasonable estimate. Gallinule have also been observed on a few occasions in the AMP wetland. The maximum number of birds observed on any occasion has not exceeded two individuals. However, no nesting activities by the gallinule have been observed in the wetland. This may be due to a lack of suitable nesting vegetation and sparse edge vegetation (considered to be another important component of the gallinule habitat) at the AMP wetland.

The bulrush (Scirpus littoralis), a known nesting habitat of the gallinule, is found to flourish at Susupe, Hagoi, and other wetlands. However, the bulrush is a minor component of the emergent plant community at the AMP wetland, and because it is sparse would not provide adequate cover or protection for the gallinule.

Although there is no known scientific literature or data suggesting that the marsh fern (Acrostichum aureum) is a primary nesting habitat for the gallinule, the fern is the dominant emergent plant in the marsh and would be the most likely vegetation to be used if nesting were to occur.

Reevaluation of potential impacts of the recommended flood control alternative on the hydrology of the AMP wetland indicates that increases in salinity, if they result, will be negligible and would not result in degradation of the wetland habitat value for the gallinule. Section 7 coordination was reinitiated on November 10, 1986 at the recommendation of the FWS in their letter dated October 29, 1986. The reevaluation concluded that the project would not jeopardize the continued existence of the Saipan population of the moorhen (gallinule). A portion of the reevaluation stated in the November 24, 1986 letter is presented below.

> In June of this year, new final Section 7 regulations were published in the Federal Register. In part, these regulations change the unit of a species under consideration from a universal to a population membership. Previously, a jeopardy finding could be issued only if jeopardy to the species as a whole could be demonstrated; now, only jeopardy to distinct population within that species need be shown to justify a jeopardy finding. The Saipan population of moorhens is considered distinct from the population as a whole, which includes Guam. In our previous biological opinions, we stated that the project would not be likely to jeopardize the continued existence of the moorhen as a species. Although any negative impact of the project on the birds at Garapan would be expected to affect the Saipan population to a greater degree than to the species as a whole, we believe that any of the three alternatives discussed in our above referenced opinions would not jeopardize the continued existence of the Saipan population of moorhen.

## C. RECENT MODIFICATIONS TO THE WETLAND

Historical documents (reviewed in the cultural resources appendix) and the presence of remains of World War II-era structures and construction in the AMP wetland document a period of major modification to the wetland after the German and early Japanese occupation of Saipan. Early German accounts refer to the presence of waterfowl, mangroves and brackish water in what was then a lake between Garapan and Tanapag. Maps from the later Japanese era show the wetland still removed from the nearest roads, and an open water area in the wetland that was much larger than exists now (See Figure 2). A 1946 aerial photograph reveals that major construction and filling in the wetland had been accomplished by that time. Beach Road was constructed along the coast separating what is now the AMP wetland from the nearby mangrove lagoon shoreline. Other roadways were constructed through the wetland, connecting Beach Road to West Coast Highway and subdividing the wetland. The remnants of the roadways, concrete slabs, a Quonset hut, a Japanese bunker and a sewer line are still visible near or within the wetland (Figure 2).

These disturbances changed the wetland in several ways: increased sedimentation, decreased salinity regimes and encouraged invasion of exotic vegetation. Construction of the wetland roadways and Beach Road blocked the movement of sediments through the wetland to the coast and accelerated sediment disposition and conversion of wetland habitat to bottomland habitat during the past half century. In a similar manner the movement of surface water runoff through the wetland to the lagoon was impeded. The location of Beach Road also reduced the landward movement of marine waters into the wetland. These factors probably led to a <u>reduction</u> in salinity levels within wetland waters and have reduced the depth and area of open water habitat. In turn, these changes probably encouraged the invasion of exotic vegetation including ironwood and tangan tangan trees. The wetland is now rapidly approaching senescence, and its value for waterbirds and wetland vegetation has been substantially diminished. Despite decades of degradation, the wetland still supports some residual mangroves and brackish water conditions.

On a "worst" case basis, the proposed flood control project would probably reverse the above trends by reducing sediment deposition and possibly increasing salinity levels slightly (if at all) along the northern fringe of the wetland closest to the channel outlet. Groundwater discharges into the channel may prevent the movement of higher salinity water towards the wetland from the channel. In any case, salinity levels will probably not increase to the levels that characterized the wetland prior to its World War II-era disturbance. Since water fowl were apparently well adapted to brackish water conditions then, they should still be adapted to such conditions now. Thus, the flood control project should not result in any significant impact to water birds or vegetation, and may result in some beneficial effect by reducing further loss of open water habitat and increasing the colonization of rare mangroves along the coast near the channel outlet.

## III. UNAI SADOG TASE

### A. GENERAL DESCRIPTION

The harbor is a shallow, partially man-made embayment approximately 50 acres in area. Much of the bay is intertidal, and hence, dry at low tide. Along its periphery and extending some distance into the bay are elevated shoals.

The shoreline is muddy and fringed with mangroves. There is no beach. Several barges in an advanced state of deterioration are partially submerged in the mud along the shoreline. From the standpoint of aesthetics, the area is not conducive to human use, and to our knowledge it is not used by residents or others for recreational purposes.

In summary, the nearshore waters are polluted and generally murky (with ambient turbidity levels probably in excess of the 5 NTU CNMI water quality standard). The bottom is silty, the shoreline is muddy, the biota adapted to a soft-bottom environment, and the fish population transient. Against this background, long-term project impacts resulting from the intermittent discharge of storm water would be essentially negated.

### B. WATER QUALITY

Water quality in the bay and surrounding coastal area is poorer than the rest of the lagoon. As noted in the CNMI Coastal Resources Management Office document, Saipan Lagoon Management Plan, coastal waters in the region receive runoff from the commercial port, sewage effluent from the outfall south of Charlie Dock and leachate and debris from the Puerto Rico dump. It further states that a combination of fine silt/mud bottom in the harbor and the silt-laden water entering the lagoon from the port area severely reduces water clarity. Winds and bottom sediments create a silt plume that normally extends as far as 1,000 to 1,500 meters from shore.

### C. FLORA AND FAUNA

The area has been noted for its use by migratory shore birds as a feeding and loafing habitat. The substrate of the bay is composed of fine silt and sand, and the biota here are adapted to the soft bottom. Extensive beds of seagrass occur throughout the bay. This environment does not favor the establishment of coral colonies, which are absent in the bay. Fish using this area are essentially transient, entering and leaving with the tidal cycle.

Although the area is not known to be widely used by fishermen, any changes in fishing success resulting from the project would most likely be positive. The creation of a limited estuarine environment would increase the use of the area by mullet, milkfish, tarpon, flagtails and other sport and food fish.

### 1. Seagrass

The short-term construction related impact is physical removal of seagrass in the 60-foot by 85-foot channel outlet in the shallow intertidal area of Tanapag Harbor. However, seagrass may reestablish in the channel outlet.

Depressed salinity and sedimentation that result from intermittent discharge of stormwater into Tanapag Harbor would not be expected to have adverse long-term effects on seagrass.

Because seagrasses are euryhaline (grow in a wide range of salinities), they can acclimate to a changing salinity regime. Many seagrass species can tolerate short-term salinity changes ranging from fresh to 90 parts per thousand (ppt) and maintain osmotic resistance. Temporary salinity changes from storm water discharge would not be expected to adversely affect seagrass beds in the proximity of the outlet channel.

The primary functions of seagrass communities are to trap and accumulate particulate matter (fine sediments). Sedimentation is a process that seagrasses are adapted to and ultimately depend on for survival. Normal sedimentation would not be expected to adversely affect seagrasses. Addition of nutrients would probably stimulate growth and increase plant density.

### 2. Mangroves

The Unai Sadog Tase shoreline is ringed by a narrow strand of mangrove trees (*Brugiera gymnorrhiza*). The short-term impact of constructing the channel outlet could result in removal of several mangrove trees, possibly as many as six.

In the long run, the flood control channel will create a limited estuarine environment. Such an environment would be favorable to growth and propagation of *B. gymnorrhiza* , which would be expected to colonize the banks of the unlined flood control channel for some distance inland from the shoreline. The overall long-term effects of the channel would be beneficial to the mangrove community. As quoted from the *Atlas of Reefs and Beaches of Saipan, Tinian, and Rota* (Eldredge and Randall, 1980), "Mangroves are found only on Saipan in a narrow band along Unai Sadog Tase and around the small inlet north of Delta Dock." Due to the rarity of mangroves in the Northern Mariana Islands, the Garapan Flood Control Project may constitute an important positive impact on mangroves.

D. PUBLIC ACCESS

Public access along the shoreline would be interrupted by the channel outlet. The shoreline is not a recreational area and to our knowledge is used infrequently, if at all, by the public. Pedestrians travelling along the shoreline could detour at low tide around the channel mouth, approximately 80 feet offshore, or walk inland a short distance to Beach Road and cross over the channel there.

## IV. LIST OF REFERENCES


1. Todd, D. K., Groundwater Hydrology, John Wiley and Sons, Inc., New York, 1959.

2. Hubbert, M. K., "The Theory of Ground-Water Motion," Journal Geology, Vol. 48, pp. 785-944, 1940.

3. Kashef, Abdel-Aziz I., Groundwater Engineering, McGraw Hill, Inc., New York, 1986.