

**BASIC DESIGN STUDY REPORT
ON
THE YAP HARBOUR EXTENSION PROJECT
IN
THE FEDERATED STATES OF MICRONESIA**

JULY, 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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国際協力事業団

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PREFACE


In response to a request from the Government of the Federated States of Micronesia, the Government of Japan has decided to conduct a Basic Design Study on Yap Harbour Extension Project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Micronesia a survey team headed by Mr. Terumi Iijima, Executive Director, the Overseas Coastal Area Development Institute of Japan, from January 20 to March 15, 1990.

The team exchanged views with the officials concerned of the Government of Micronesia and conducted a field survey. After the team returned to Japan, further studies were made. Then, a mission was sent to Micronesia in order to discuss the draft report and the present report was prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Federated States of Micronesia for their close cooperation extended to the teams.

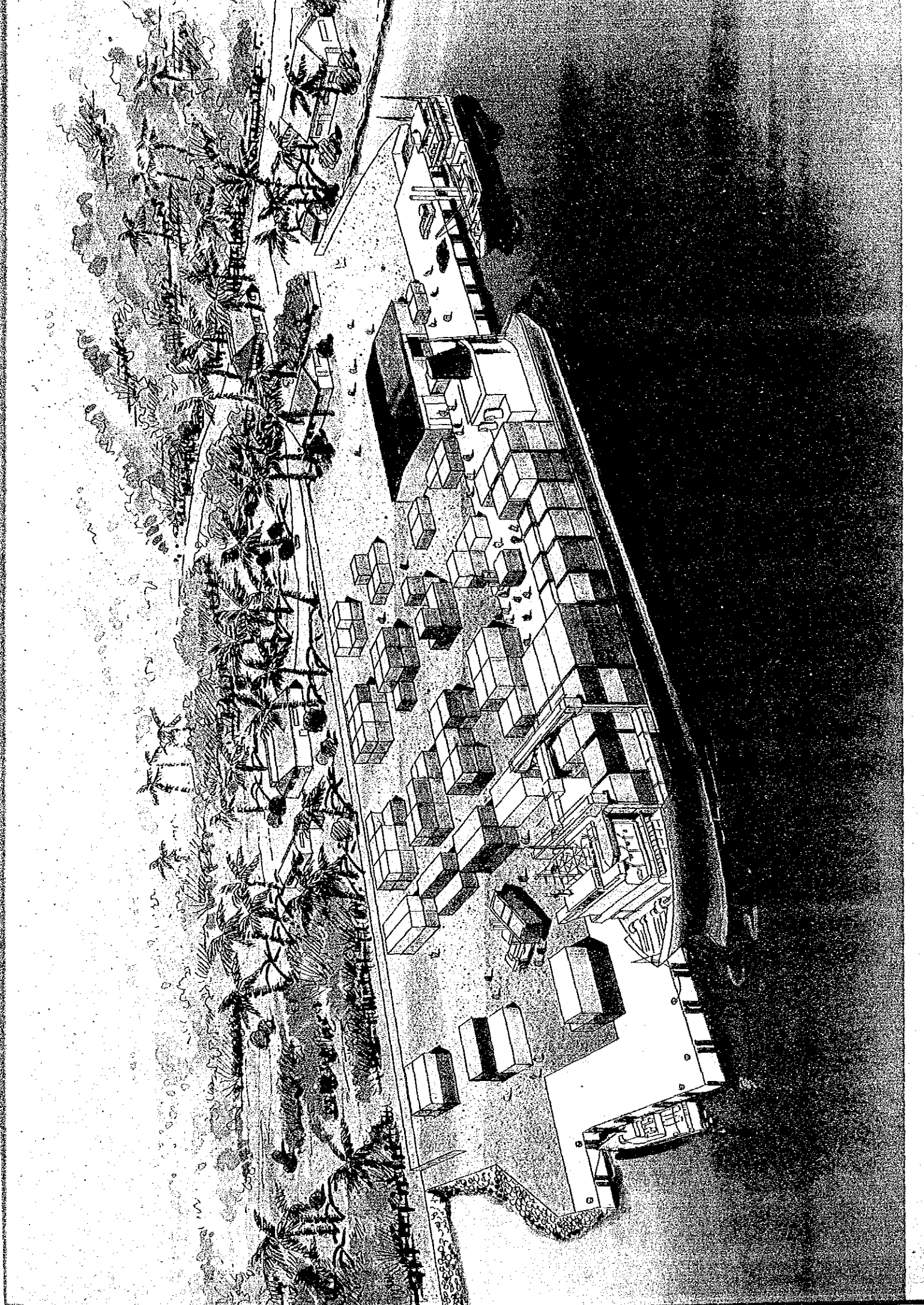
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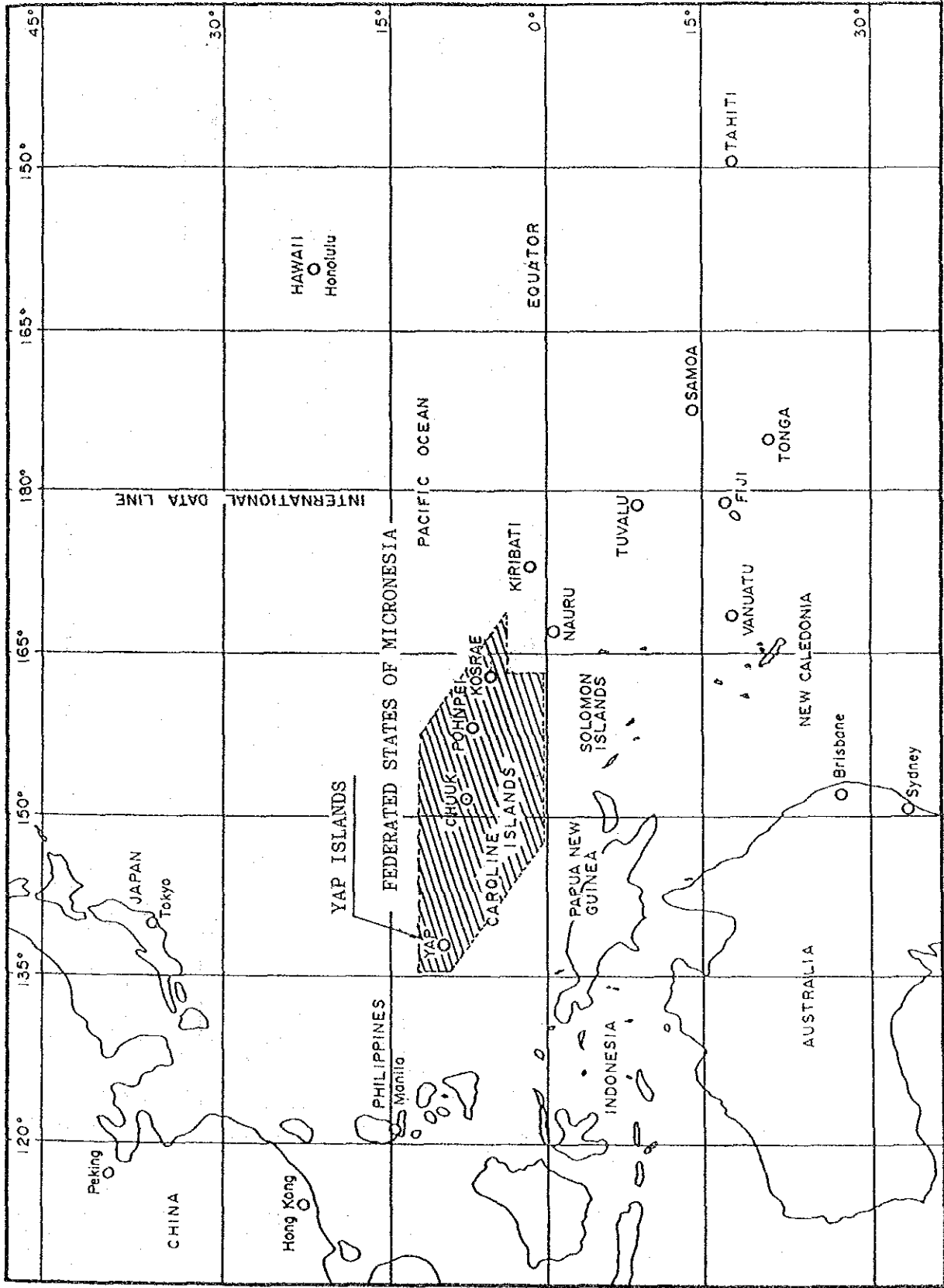


Kensuke Yanagiya

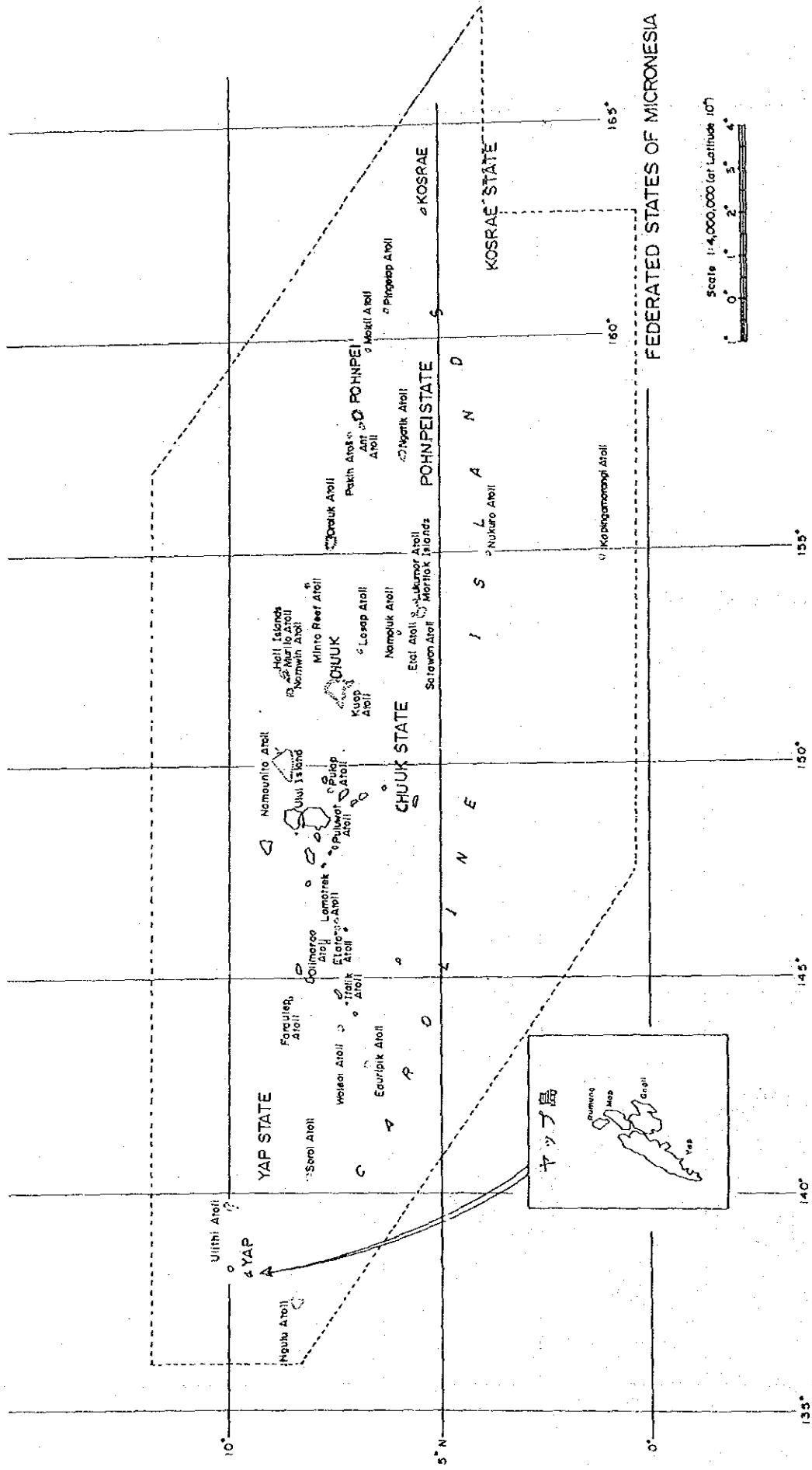
President

Japan International Cooperation Agency

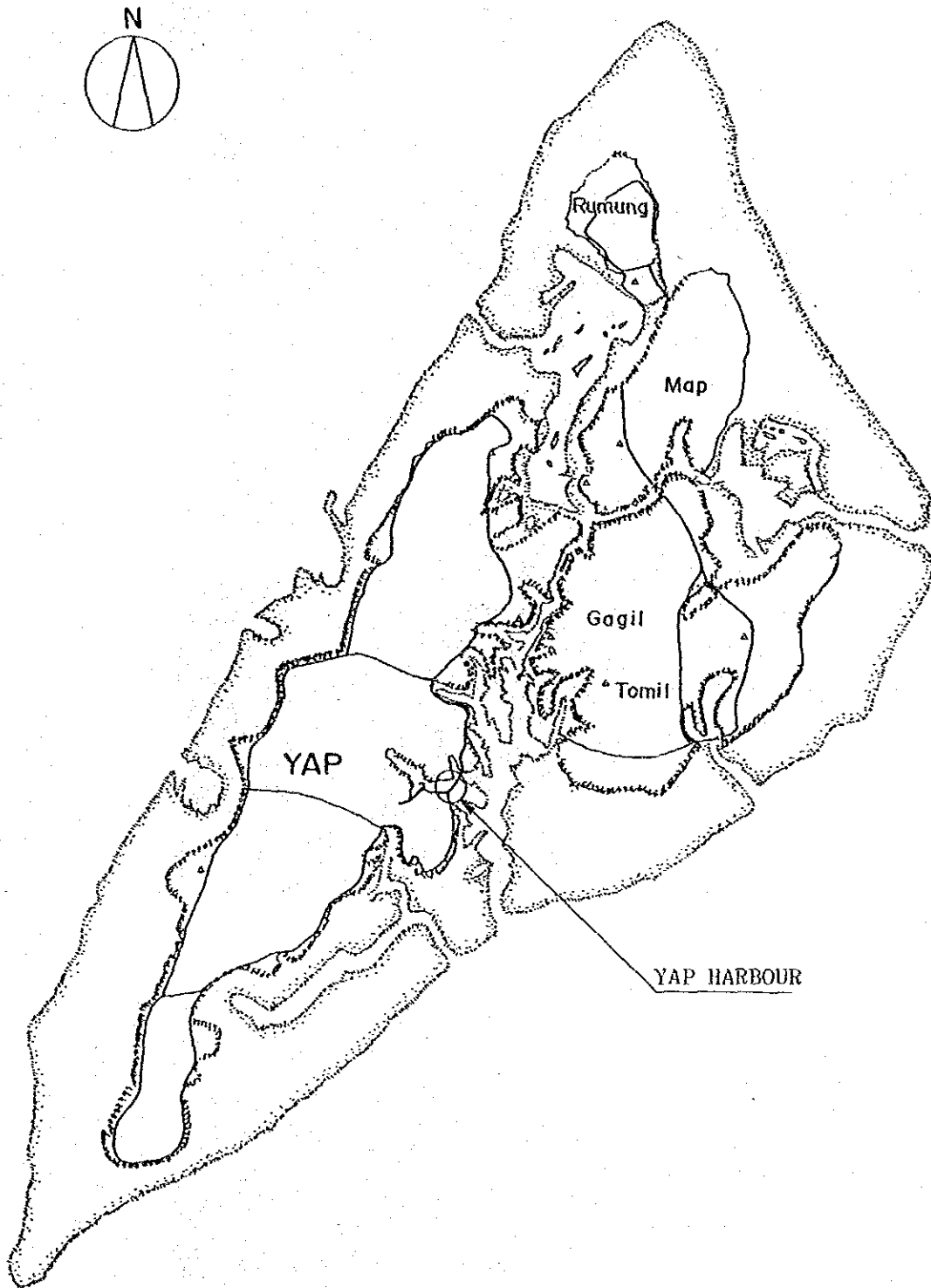




LOCATION OF FEDERATED STATES OF MICRONESIA



LOCATION OF YAP ISLANDS



0 2 4 6 8 10 KM

LOCATION OF YAP HARBOUR



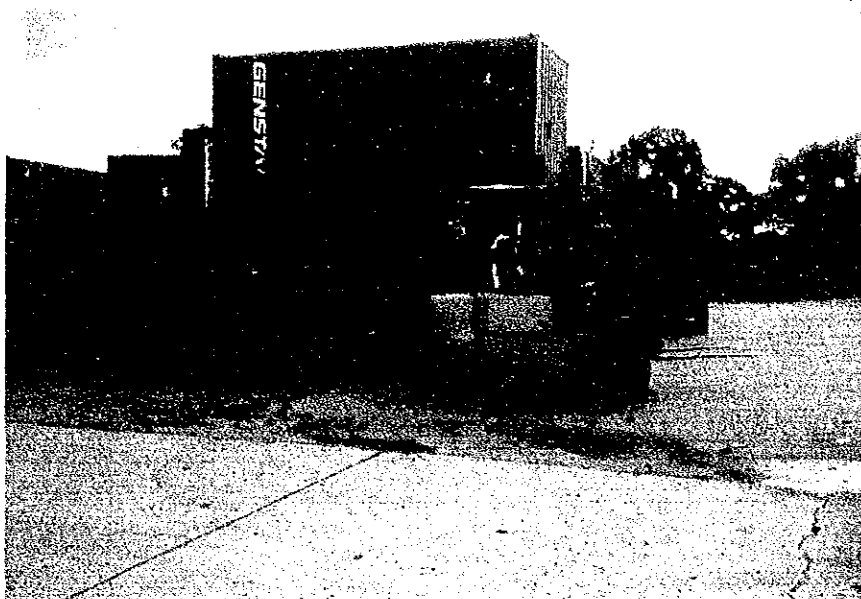
Overall view of Yap Harbour



Existing Wharf



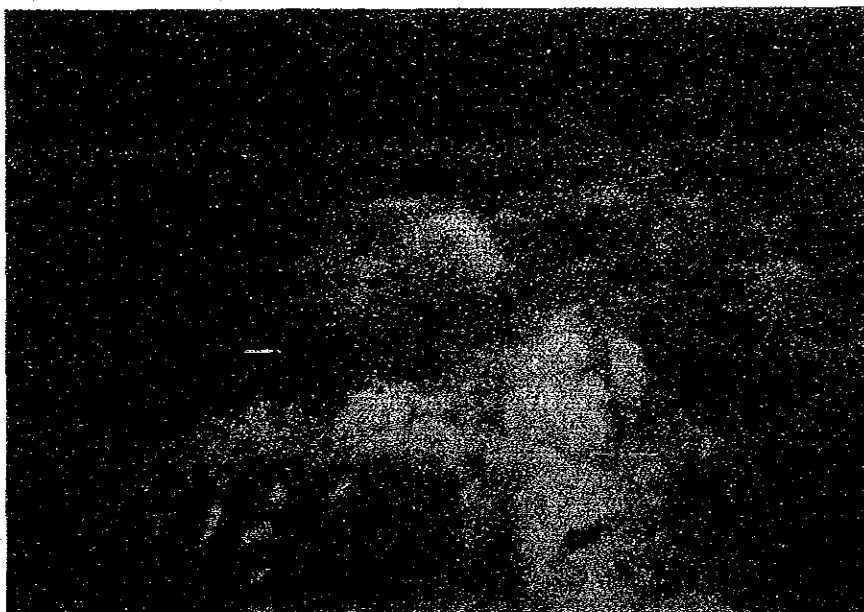
Existing Transit Shed



Cargo Handling Equipment



Navigation Aids



Living Coral around Yap Harbour

SUMMARY

SUMMARY

The Federated States of Micronesia (FSM) is a oceanic country in western Pacific area, and is consisted of 607 scattered islands over vast sea area of 2,600,000 square kilometers, with totally 702 square kilometers of land area and approximately 91,000 population.

FSM is a very young country established in 1987 by federation of four states of Kosrae, Pohnpei, Chuuk and Yap, after termination of the UN trusteeship through administration of the U.S.A. since the end of the World War II, and in this country the right of autonomy of each state are highly respected.

The five year period of 1985 through 1989, during which the UN trusteeship were terminated, were designated by the Government of Micronesia as "the Period of Transition and Rehabilitation", enforcing "the First Five Year National Development Plan". In this plan, investment of US\$ 169 million were placed in infrastructural development purpose of the new country, occupying 67 % of the whole investment of this plan. Investment for transportation sector in this plan was US\$ 91 million, constituting 54 % in the total infrastructural investment.

In this plan, development of the transportation system by construction of roads and ports are regarded as the basic requisites for promotion of rehabilitation and self-reliance of national economy of FSM. Among all, in this country, transportation by sea routes is considered to be the most important measure in supplying all necessities of life including foodstuffs. As this country is consisted of islands over the ocean and depends on marine transport of all materials and goods, facilitation of sea transportation is the essential and fundamental subject in views of stabilization of price of imported goods and of promotion of exporting industry.

Sea lanes in FSM are consisted of two categories. One is international trade line system connecting main ports of FSM to outer countries like USA, Japan, as the major country among Asian countries and Oceanic

countries. Another system is inter-island domestic routes in each state connecting main island of the state and surrounding islands within the state.

Since in FSM almost all transportation of cargoes are through ports and sea routes, the Government of FSM is driving port development plans in each state as followings in the First National Development Plan.

Government of FSM	Construction of ship repair dock
Pohnpei State	Wharf construction in small islands Improvement of approach channel Improvement of navigation aid markers
Chuuk State	Installation of dry dock Expansion of wharf facilities
Yap State	Improvement of inter-island navigation Improvement of approach channel and wharf Improvement of navigation aid markers Improvement of cargo handling equipment
Kosrae State	New vessel for inter-island navigation Improvement of utilities(power water) Installation of transit shed

However, because of difficulties in financing, progress of port development projects are rather behind schedule.

Basing on the above described background, in 1989, the Government of FSM sent the government of Japan a request in regard to grant assistance for expansion of Port of Yap, one of major port in FSM, in state capital Colonia of Yap state.

Yap Port is the only one international trade port in Yap state and is

the base port for inter-island domestic sea navigation. Yap Port is consisted of approach channel, inner water basin, a 138 m long -10 m main wharf and a transit shed. However, the condition of port is not in adequate state.

The approach channel between outer sea and inner basin is 3 km long and meanderingly passing through narrow and winding gap between coral reefs, hence involving high risk of stranding of ship on the way. The turning basin is also not wide enough and turning of a large size vessel in this basin is very risky without provision of tugboat.

The length of the main wharf is not satisfactory for berthing of large size boat currently calling this port. Yap Port is also the mother port for Microspirit, the state operated inter-island service boat stationed in this port. Because of short length of the main wharf, Microspirit has to evacuate from the berth every time when main boat of liner service comes in to the wharf, suspending her own cargo handling or other service works.

The request of FSM government for grant assistance from Japan is to help FSM to execute improvement project of Yap Port including dredging of the approach channel, expansion of the main wharf and so forth, to solve the above problems in Yap Port.

The Japanese government dispatched preliminary survey mission to FSM upon the request, from November 3 to November 16 in 1989, to confirm appropriateness of the project and to decide assistance. As the consequence, the necessity of the project has been recognized and the contents of the project have been clarified as the followings:

- (1) Realignment of the approach channel and the turning basin by dredge works and improvement of the navigation aid markers to make shipping lane safe
- (2) Extension of the main wharf to accept two ships at one time

Basing on the above conclusion of the preliminary survey mission, the Government of Japan decide to carry out basic design of the project and dispatched the basic design team headed by Mr. Terumi Iijima, Executing director of the Overseas Coastal Area Development Institute of Japan (OCDI), to FSM from January 20 through March 15.

The study team made a series of survey and study on present condition of Yap Port, natural condition of the site, and on environmental effects of the project. The study team also held a series of discussion on scope of the project with the concerned officials of the FSM government and the Yap State government.

As the result of the studies, existence of problems in the approach channel, the turning basin and the navigation aid markers as mentioned in the request have been confirmed to affect seriously safety of navigating ship in this port. The study team also recognized that improvement and expansion of this port are urgent for benefits for stabilization of daily life in this area. The project can contribute to lower costs of transportation and to lower price of necessities of life by effect of making ship size calling Yap larger than at present.

Also the study team clarified need of a new cargo handling equipment in this port, to replace the old under-powered one, to improve efficiency of container handling and yard marshaling, since nearly 80 % of imported cargo are already containerized in this port.

As the results of the basic design study, through discussion with concerned officials of FSM and Yap state and through analysis of all data and information, the objectives of the Yap Port Extension Project have been clarified as followings:

- (1) To improve the approach channel and the turning basin to secure safety of navigating vessels in this port
- (2) To improve channel markers for aid to navigation in the port

- (3) To extend the main wharf to secure safety of moored vessels, also preparing for call of larger size container ship and to attract cruising passenger boat to Yap for tourism business promotion
- (4) To provide forklift type container handling equipment to improve cargo handling efficiency

Basic design for this project have been worked out by the study team to accomplish each of the above objectives, being the most reasonable and justifiable plan in views of cost of investment and in view of cost of maintenance for the Yap State government, as described below ;

(1) Improvement of the approach channel

Width of channel	100 m (in minimum)
Depth of channel	- 8.5 m (in minimum)

(2) Improvement of the turning basin

Size in diameter	315 m
Depth of basin	- 8.5 m

(3) Improvement of navigation aid markers

Leading range lights	1 set
New Markers (lighted)	6 points
Light installation	8 points

(4) Extension of the main wharf

Length of the main wharf	112 m
Depth of the main wharf	-10 m
Length of return wharf	35 m
Depth of return wharf	-3 m

(5) Expansion of the container yard:

Area 12,000 sq. m

(6) Forklift

Lifting capacity 30.5 ton

(7) Monitoring instrument for environmental control

Survey instrument 1 set

FSM regulation for the Environmental Impact Assessment requires an environmental impact assessment study on this project, and a joint study in this regard were worked by FSM and Japanese study team during the basic survey. As the conclusion of the study, only Initial Assessment is determined to be necessary for this project.

Permission of this project on the basis of the FSM environmental regulation is to be made for application of the Yap State before exchange of official notes diplomatically.

During construction stage, earth moving permission and monitoring of siltation are also required for this project.

This project of Yap Harbour Extension is divided into two phases as below since it requires long term of twenty four months for total project implementation.

The first phase: 12 months

Improvement of the approach channel
Improvement of the navigation aid markers

The second phase: 12 months

Improvement of the turning basin
Extension of the main wharf

The implementing agency of this project is the Department of Public Utilities and Contracts in Yap State Government. This department is also responsible for administration and management of the finished facilities by the project, being considered to be able to afford to spent additional US\$ 4,800 expenditure on the present annual budget for port, within the Yap state government budget.

Benefits expected to be brought about by implementation of this project are as listed below:

- (1) Reduction of accident of navigating and berthing ship due to improved safety
- (2) Increase of calling vessel for international trade due to improvement of safety and expansion of facilities
- (3) Reduction of transportation cost due to shipment by larger size vessels and the following price stabilization of necessity of life
- (4) Improvement of inter-island navigation service due to improvement of mother berth for Microspirit

Those benefits can be considered as significant contributions for promotion of industrial development and hence for accomplishment of self-reliance of economy of Yap state. Therefore, in conclusion, implementation of this project under the grant assistance system of Japanese Government can be fully justified and highly evaluated.

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CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Outline of the Request

Yap state is located in western part of the Federated States of Micronesia, and Port of Yap is situated in a position of "western gateway" to Micronesia from all Asiatic countries, also being linked to the U.S.A. via Guam by eastern route.

However, condition of Port of Yap is rather inferior to other major ports in FSM, those of Pohnpei State or of Kosrae State, in view of acceptable ship size, due to insufficient length of main quaywall. Also, narrow approach channel and turning basin in Yap Port involve very serious problem for safety of large size vessel in entering maneuvering, together with inadequacy of navigation aids system, causing many accidents of calling vessels. Thus, the Port of Yap is rather isolated from other ports of FSM with less frequency of calling ships.

In consideration of the above mentioned conditions and the primary importance of role and function of Yap Port, the Government of FSM requested a grant assistance for improvement project of Yap port, to the government of Japan officially.

Upon the request, the Government of Japan dispatched officially a preliminary study mission for FSM in October 1989, to confirm background of the request, and appropriateness of the project, and to establish scope of basic design for the project.

The mission has clarified the background of the requests of the FSM Government and has confirmed the objectives of the Yap Harbour Extension Project as followings :

- (1) To make shipping lane safe through dredging and realigning of the channel
- (2) To construct and extend the commercial dock

(3) To provide equipment for operational works

1.2 Dispatch of the Basic Design Mission

On the basis of the foregoing request of the Government of FSM, the Government of Japan decided to undertake a basic design study, and entrusted the study to the Japan International Cooperation Agency (JICA). JICA organized a Basic Design Team headed by Mr. Terumi Iijima, Executive Director of the Overseas Coastal Area Development Institute of Japan (OCDI), and dispatched them to FSM from January 20 through March 15.

The work program of the mission and the member list are contained in Annex I of this report.

The study team made a series of survey and study on natural condition, design base condition and on environmental condition of the project site and held a series of discussions on project requirements and on scope of the project with concerned officials of the Yap State on February 18, and with officials of FSM on February 21, as concluded in the memorandum and the minutes respectively as recorded in Annex II of this report.

1.3 Study Items

The purpose of the basic design study is, basing on the results of study of the Preliminary Mission, to establish basic design for the Yap Port Extension Project, for which the Government of FSM has requested grant assistance from the Government of Japan. The study work were started with confirmation of background and scope of the request, and then proceeded to selection of the most suitable project components of optimum scale, and finally concluded with examination of the effect of the project and the appropriateness of the project.

The Basic Design Team performed the survey and study on the following items during stay in Micronesia and after returning to Japan :

- (1) Clarification of the scope and background of the request
- (2) Confirmation of priority order of the components of the project
- (3) Survey on the project site
- (4) Survey on the environmental conditions
- (5) Study of the natural conditions
- (6) Study on present state of the Port of Yap
- (7) Planning and design of the project components
- (8) Study on administration and organization of the port
- (9) Study on operation and maintenance of the port
- (10) Study on construction work conditions
- (11) Scope of undertakings and executing body in FSM

After returning to Japan, on the basis of results of study at the site, the Basic Design Team worked out the Basic Design Report for the Yap Harbour Extension Project, covering all matters on the project scope, project scale, layout plan, type of construction, investment costs, work scheduling and appropriateness of the project.

CHAPTER 2

BACKGROUND OF THE PROJECT

CHAPTER 2 BACKGROUND OF THE PROJECT

2.1 Outline of FSM

2.1.1 Geography of FSM

Federated States of Micronesia (FSM) is a typical archipelagic country consisted of 607 islands, scattered in a wide expanse of the Pacific Ocean, covering about 2,600,000 square km of sea area, spanning over 135 - 166 degree in East-longitude and over 0 - 14 degree in North-latitude.

For this specific geographical reason, each island in FSM is separated distance wise and time wise in traffic and communication, being restricted in promptness and frequency.

All islands are rather sterile only good enough to raise coconuts and taro potato, because of the geological feature of volcanic origin or coral atoll origin in lack of fertile top soil. However, surrounding sea area are rich of fishery resources with high potential of utilization developments.

2.1.2 Administration

The Federated States of Micronesia is constituted of four states, Yap, Chuuk, Pohnpei and Kosrae State from west to east, the national capital being situated in Palikir, Pohnpei state. In each state, state capital is located in main island, and right of state autonomy is rather strong in this country.

Until establishment of FSM as independent country in 1987, this country was under trusteeship of UN and U.S.A. since the end of the World War II. Before this trusteeship, historically this area was under trustcesships of Germany and Japan succeedingly.

For FSM, it is considered that accomplishment of economical self-reliance will take a rather long time after independence. And at present, economical assistance from U.S.A. is playing the most important role to support national economy of FSM. The U.S.A. is offering financial assistance to FSM on the basis of COMPACT fund agreement. However, this kind of assistance from the U.S.A. is expected to be reduced yearly, according to a certain report, and finally after 10 years to a level of one half of the present amount. Establishment of self-supporting economic structure by promotion of local industries is the fundamental requisite problem in politics and administration in this country.

In 1987, as a provision for termination of trusteeship administration of Micronesia, the U.S.A. have founded a fund to be used for investment to infrastructural construction, offering employment opportunity to the local inhabitants. This special fund has been utilized by governments of Micronesia for construction of such facilities as airports, port and harbours, sewages and water supply system.

2.1.3 Socio-economic Conditions

The total population of FSM is approximately 91,000, major share of 46,000 being inhabited in Chuuk State, and next share of 27,000 being allotted to Pohnpei States. Remaining 10,000 and 6,500 are inhabited in Yap State and Kosrae State respectively.

Population growth rate of FSM became high after 1960 era, and the average rate of population increase was recorded at approximately 3 % per annum for the period of 1970 through 1980.

Number of work forces in FSM are 16,140 (75.9 %) for men and 8,940 (42.3 %) for women in 1987, employment rate being given in brackets. Numbers of unemployment were 2,980 for men and 2,540 for women.

As the specific feature of structure of economy of FSM, it should be noted that economic structure of FSM is a combination type of two systems,

namely, monetary or cash market system and bartering system basing on self-subsistence. The former system is functioning in main islands and in the state capitals among merchants, public servants and urban workers. The latter system of self-subsistence and bartering is prevalent in distant island among rural inhabitants. In FSM, about 50 % of population is counted in self subsistant economy without including school age population.

Number of working forces inhabiting in the monetary economic zone of FSM is slightly below 50 %, and 56 % of which are occupied by public service men. Especially in Yap State and in Kosrae State, public servant occupancy rate are exceeding 60 %. However, further increase of employment in governmental services are not expectable since it is depending on rather declining U.S.A. aid. And the problem of employment of younger generation which is growing at a high rate, have to be solved only by promotion of private industries.

Major portion of GDP of FSM are consisted of US\$ 44.9 million worth of agricultural and fishery production constituting 42.2 % in total GDP. And US\$ 31.5 million worth of governmental services constitutes 29.6 %, and US\$ 12.7 million of wholesale and retail commercial services constitutes 11.9 %. However, above GDP composition rate turns out that 47.8 % being for governmental services and 19.2 % being for commercial services and 6.5 % for agricultural and fishery industry, if production in self-subsistant region were substracted from the above mentioned figures. Very high weight of contribution of the governmental expenditure is seen in the above figure in the monetary economy of FSM.

Thus monetary economy of FSM is dependent to a very high degree on the governmental expenditures, which in turn depending on the financial assistance of the U.S.A. COMPACT Fund, as high as 80 %. In FSM, tax income from domestic sources can cover only 15 to 18 % of the total revenue. On the other hand, as the U.S.A. is ranked at the top of export origin source countries to FSM, assistance money from U.S.A. are returning to U.S.A. again for purchase of U.S.A. products.

Main foreign currency income of FSM are from tourism business (54 %)

and from copra export(38 %), covering only less than one third of necessary amount for import of foodstuff. Out of the total import to FSM, 22.8 % is occupied by import of foodstuff, consisted of import of rice (42 %) and meat (20 %) and canned fish meat (14 %) as major items. It should be noted that import of rice as staple food for this country is playing the most important role in FSM import and that import of canned fish meat is also significant in spite of existence of abundant fishery resources in the surrounding sea of this country.

2.1.4 Trade and Foreign Exchange Balance

Total export of FSM was approximately US\$ 3.6 million according to 1983 records, while total imports amounted to US\$ 54.4 million in the same year. Foreign exchange balance in 1983 was as shown in Table 2-1, the deficits of trade being balanced by the financial assistance from the U.S.A., amounting to US\$ 78.1 million and covering 91 % of total income of FSM in foreign currency accounts.

Table 2-1 Foreign Exchange Balance (1983)

(unit : US\$ million)

Foreign Receipts		Expenditures Abroad	
Exports	\$ 3.6	Imports	\$ 54.4
U.S.Gov't Transfers	78.1	Private sector	\$ 43.4
Current account	\$ 36.3	Public sector	11.0
Other grants	10.5	Net investment income	
Capital account	31.3	from abroad	1.3
Other bilateral		Unrequited transfers	3.2
transfers	0.8	Net remittances	3.2
Capital transfers	0.8	Net decrease in	
Fees and royalties	3.2	foreign liabilities	27.2
Fishing rightal fees	3.2		
Private capital			
transfers from abroad	0.4		
Total	\$ 86.1		\$ 86.1

(source : The National Development Plan)

Main origin sources of FSM import are U.S.A., Singapore, Japan and Guam in the order of amounts as shown in Table 2-2.

Table 2-2 Import source countries for FSM (1983)

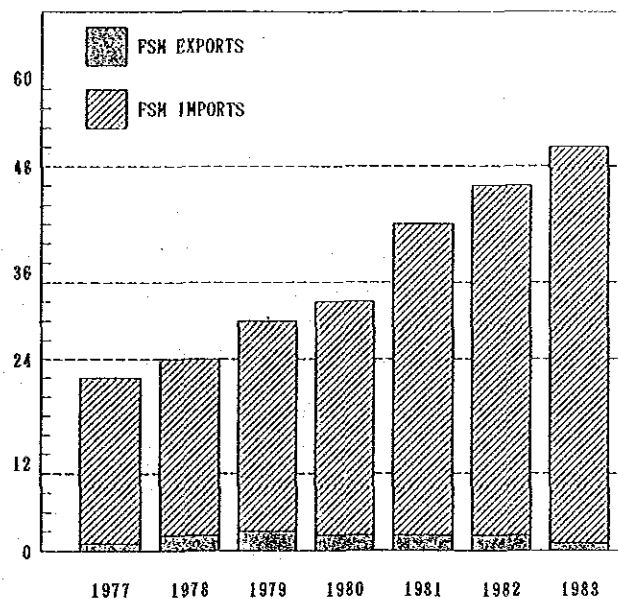
(unit : US\$ million)

Country	Amount	Por Cent
U.S.A.	\$ 18.68	38.2
Singapore	11.39	23.3
Japan	10.57	21.6
Guam	4.20	8.6
Australia	1.87	3.8
Others	2.17	4.5
Total	\$ 48.87	100.0

(source: The National Development Plan)

Import amount to FSM have been increasing rapidly, while export from FSM is decreasing yearly as shown in Fig. 2-1.

Fig.2-1 Export and Import Amounts of FSM (1977-1983)



Import was increasing by 11 - 12 % annually in cargo tonnage base while export stayed at around 2,000 ton. This unbalance of export and import cargo volume results in raise of freight cost of import goods to this country. FSM government is making every effort for improvement of trade imbalance in FSM by introduction of new export products of high value, by development of new markets for FSM.

2.2 Marine Transport and Ports in FSM

2.2.1 Traffic by Sea

Sea traffic is functioning in FSM like artery, playing main roles of transportation to support livelihood of people and economic activities of this country, as FSM is a sea borne country where all material and goods have to be bring in by sea.

Cargo traffic by sea lanes in FSM are consisted of two categories, one is international trade lanes linking main ports of each state to outside countries in Asia(mainly Japan), to U.S.A., and to Oceanic countries. Another sea lane is for domestic routes for connection of scattered islands to the main port of each state.

International liner routes come in to each main port of the four states bringing in import cargo into each state respectively. Domestic routes are operated by each state to distribute imported cargo to small islands of the state.

At present, in FSM, 12 international liner routes are operated by 8 companies as shown in Table 2-3, visiting each main port at an interval of about once a month.

All international sea routes start from Guam to reach each main port of FSM, and in western FSM no route runs east bound. In this way, to reach Guam, the greatest consumption area in Micronesia, no traffic route is open from each FSM main port, thus making it unable for FSM states to export their products to Guam. Especially for Yap State, though it is situated at the closest distance to Guam, absence of east bound sea traffic is a bottle-neck condition for promotion of export industries in this state.

Inter island domestic navigation are operated by each state with 800 DWT class boat owned by the FSM Government for transportation of passenger and cargo within each state. At present, the navigation is not regularly

operated and improvement for regularization are anticipated. Inter-island services are playing essential rolls in administration also, since it also provides means of traffic for public servicemen and for students on education.

At present, no state to state navigation services are provided in FSM.

Table 2-3 International Shipping in Micronesia

Carrier	Routes	Frequency	NO. VES
1. PM&O Line	Route 1. : Los Angeles / San Francisco / Honolulu / Majuro / Ebey / Kosrae / Pohnpei / Chuuk / Yap / Palau Route 2. : Manila / Cebu / Davao / Hong Kong / Kaohsiung / Majuro / Ebey / Kosrae / Pohnpei / Chuuk / Yap / Palau	27 days	3
2. Matson	Seattle / Los Angeles / San Francisco / San Diego Honolulu / Kwajalein / Majuro	30 days	4
3. PHL (NVOCC)	All US ports to / All Micronesian ports	27 days	0
4. Zim Line	Route 1. : Australia / Guam / Chuuk / Pohnpei / Kosrae / Ebey / Majuro (Tranship out of Guam on UMDA / SAISHIP) Route 2. : Australia / Guam / Yap / Palau (Tranship out of Guam on UMDA)	30 days	
5. NYK	Yokohama / Nagoya / Kobe / Guam / Saipan / Chuuk / Pohnpei	30 days	2
6. UMDA	Route 1. : Kobe / Yokohama / Kaohsiung / Busan / Palau / Yap / Saipan / Chuuk / Pohnpei / Kosrae / Majuro Route 2. : Guam / Yap / Palau / Chuuk / Pohnpei / Kosrae / Majuro	30 days 30 days	2 2
7. Satship	Keelung / Pusan / Kobe / Nagoya / Yokohama / Saipan / Guam / Chuuk / Pohnpei / Majuro	30 days	5
8. Palau Shipping	Keelung / Kaohsiung / Pusan / Yokohama / Kobe / Manila / Guam / Yap / Palau	30 days	1
9. TSK Line	Kobe / Yokohama / Nagoya / Yap / Palau	30 days	1
10. Kyoza Line	Route 1. : Singapore / Jakarta / Bangkok / P. Kelang / Guam / Chuuk / Pohnpei / Kosrae / Ebey / Majuro (Tranship out of Guam on UMDA / Satship) Cargo for Yap / Palau Tranship out of Guam on UMDA	30 days	8

2.2.2 Outline of Main Ports in FSM

In FSM, each state capital has each own international open port as import-export trade base for each state, as listed below, functioning as basic infrastructure to support livelihood of state inhabitants.

Pohnpei State : Takatik Port

Chuuk State : Moen Port

Yap State : Yap Port

Kosrae State : Okat Port

Main facilities of each port are outlined below.

(1) Takatik Port in Pohnpei State

Approach Channel:	Length of channel	3.2 km
	Width of channel	91.4 m
	Depth of channel	(at narrowest part) -22 to -44.8 m
Main Wharf:	Length	292.6 m
	Water depth	-9.1 m
	Type of construction	Concrete piling type
Transit Shed:	Area	2,043 m ²
Cargo yard:	Area	17,800 m ²

(2) Moen Port in Chuuk State

Approach Channel:	Length of channel	22.5 km
	Width of channel	240.0 m
	Depth of channel	14.6 m
Main Wharf:	Length	South Wharf 97.5 m
		West Wharf 91.4 m
	Water depth	- 9.1 m
	Type of construction	Concrete piling type
Transit Shed:	Area	1,443 m ²
Cargo yard:	Area	3,715 m ²

(3) Yap Port in Yap State

Approach Channel:	Length of channel	2.4 km
	Width of channel	91.0 m
		(at narrowest part)
	Depth of channel	- 30.5 m
		(at deepest part)
Main Wharf:	Length	138.0 m
	Water depth	10.0 m
	Type of construction	Steel sheetpile type
Transit Shed:	Area	1,486 m ²
Cargo Yard:	Area	14,100 m ²

(4) Okat Port in Kosrae State

Approach Channel:	Length of channel	0.8 km
	Width of channel	91.0 m
		(at narrowest part)
	Depth of channel	- 22.0 m
Main Wharf	Length	167.6 m
	Type of construction	Steel sheetpile type

Common characteristics of the above ports are longer in approach channel with narrow width. Length of the main wharf is shortest in Yap Port not sufficient for current large size vessel mooring.

In the First National Development Plan, the main wharves are considered adequate in view of present cargo throughput, though capacity of transit shed and cargo handling equipments are not sufficient requiring improvements.

Major items requiring improvement in FSM ports are as listed below:

Government of FSM ; Installation of Ship Repair Dock

Pohnpei State ; Wharf construction in small islands,

Improvement of approach channel
Improvement of navigation aids markers

Chuuk State ; Installation of dry dock
Expansion of port facilities

Yap State ; Improvement of inter-island navigation
Improvement of approach channel and wharf
Improvement of navigation aids markers
Improvement of cargo handling equipments

Kosrae State ; New vessel for inter-islands navigation
Improvement of utilities (power, water)
Installation of transit shed

2.2.3 Organization for Port Administration and Operation

Each port is under administration of Port Division of Department of Public Utilities and Contracts in each state government. Operation of cargo handling are operated by private sectors entrusted by the state government, owing their own private equipments.

2.3 The National Development Plan of FSM

2.3.1 The National Development Plan of FSM

The Government of FSM enforced the First National Development Plan for the period of 1985-1989, to establish foundation of national economy to attain self-reliance economy of the new nation after termination of the trusteeship administration in 1987.

The five year period covered by the First National Development Plan was regarded as the period of transition from trusteeship administration to independence and the term of reconstruction.

Even in the three years period of 1981 through 1983 in advance to the First National Development Plan period, Micronesian governmental investments were concentrated in infrastructure sector as shown in Table 2-4.

Table 2-4 Governmental Investments (1981-1983)

(unit : US\$ 1,000)

Sector	1981		1982		1983	
	\$	%	\$	%	\$	%
Economic	544	2	665	2	7,823	24
Social Services	375	2	398	1	2,599	8
Infrastructure	23,131	93	39,513	96	21,399	67
Other Gov. Services	704	3	735	2	428	1
Total	24,754	100	41,311	101	32,249	100

(source: The First National Development Plan)

In the First National Development Plan period, the government of FSM pursued a policy to invest governmental development fund in infra-structural sectors with highest priority, though its weight was declining by year in total governmental investments. In this period, infra-

structural investments were mostly concentrated for transportation area, except for energy area in Pohnpei State.

Necessary fund for infrastructural investments in FSM was estimated at US\$ 169 million, occupying 47 % of the whole investments of the First National Development Plan, as shown in Table 2-5.

Allocation of investment for transportation area in the infrastructural sector is US\$ 91 million, constituting 54 % of share in the infrastructural investment. This figure shows importance of development and improvement of transportation system assessed by the FSM Government for accomplishment of rehabilitation of the national economy and for establishment of self-supporting economy.

Table 2-5 Summary of Total FSM Development Allocations by Sector
(unit : US\$ 1,000)

Sector	1985		1986		1987		1988		1989		Total	
	\$	%	\$	%	\$	%	\$	%	\$	%	\$	%
Economic	27,038	33	31,709	39	28,972	37	23,468	37	28,041	50	139,228	38
Social Services	7,420	9	5,762	7	12,018	15	11,213	18	3,928	7	40,341	11
Infrastructure	43,156	53	40,648	49	34,715	44	27,709	43	22,499	40	168,727	47
Other Gov. Services	3,373	4	4,308	5	2,624	3	1,585	2	1,471	3	13,361	4
Total	80,987	99	82,427	100	78,329	99	63,975	100	55,939	100	361,657	100

(source : The National Development Plan)

Table 2-6 Summary of FSM Development Allocations for Infrastructures
(unit : US\$ 1,000)

Item	1985	1986	1987	1988	1989	Total	%
Capital	4.000	8.400	9.500	3.000	--	24.900	15
Transportation	20.957	16.877	17.821	18.180	17.461	91.296	54
Energy	11.300	7.238	3.053	3.468	2.053	27.112	16
Water and Sanitation	6.741	8.015	4.283	3.061	2.985	25.085	15
Other	158	118	58	na	na	334	--
Total	43.156	40.648	34.715	27.709	22.499	168.727	100

(source : The National Development Plan)

In the above listed investment amounts for transportation area, 67 % is allocated for road and bridge construction, 14 % for runway of airport, 6 % for inter-island aviation, 3 % for port and wharf, and 5 % for port channel improvement.

In the above investment plan for the First National Development Plan, total allocation for Yap State is US\$ 50 million, occupying 14 % of the whole national investments. Infrastructural investment for Yap State is US\$ 28 million for the first five years as given in Table 2-7 for more detailed allocations.

Table 2-7 Planned Development Allocation for Yap State

(unit : US\$ 1,000)

Sector	1985	1986	1987	1988	1989	Total	%
Economic	3.669	3.999	3.884	3.341	3.678	18.571	37
Social Services	802	584	290	293	292	2.261	5
Infrastructure	5.543	5.403	6.633	4.775	5.775	28.129	57
Government	28	443	100	100	--	671	1
Total	10.042	10.429	10.907	8.509	9.745	49.632	100

(source : The National Development Plan)

With termination of the First National Development Plan in 1989, the Second National Development Plan for the following five years (1990 -1994) is now in drafting stage. In regard to development of port and harbour, followings items are listed in the new plan.

- (1) Reorganization of port administration and management toward new port authority system aiming at simple and efficient operation.
- (2) Improvement and expansion of facilities at the main port in each state, for establishment of feasibility for commencement of new transshipment services for cargo in each main port.
- (3) Improvement of management on inter-island navigation services
- (4) Improvement of maintenance services for the vessels for the inter-island navigation.
- (5) Training of staff and crew for improvement of safety and efficiency

In conclusion, as described above, improvement and expansion of port and harbour are considered of primary importance in FSM, since this country is an island country in basic characteristics, whose economic structures are entirely depending on import and export of goods, which in turn requiring smoother operation of transport by sea.

2.3.2 The Secondary Development Plan of Yap State (Draft)

Yap State Government is preparing to enforce the New Development Plan for the period of 1990 through 1994 to establish economical self reliance.

Development Goals of Yap State are following six items.

- (1) Strengthen and diversify economic base and provide gainful employment opportunities for the growing population.
- (2) Provide basic human needs for all the people.
- (3) Decrease dependency on outside sources of supply by increasing local production.
- (4) Create a government in rational size and structure that can be afforded within the economic means of the people reducing the reliance on outside subsidies.
- (5) Promote the culture of the people according to the cherished values of the Yapese society.
- (6) Promote development of Yap's human and natural resources within a healthy natural environment.

Basic policy of the new development plan is to strengthen and diversify the economic base of Yap by establishing local industries to increase indgenouse products and by decreasing dependency on import sources of supply for the purpose of economical self-reliance of Yap.

To reach to above mentioned goals, the State Governments of Yap raise the following government guidance for economic policy.

(1) Balances of Trade

Reduce gap between imports and exports by promoting of export and

by substitution of import.

(2) Private Enterprise

Promote growth in private production sector through provision of financial, institutional and technical assistances, together with provision of development of infrastructure.

(3) Simple Government

Rationalize government functions and minimize participation of government in entrepreneurial activities to keep the government sector at an affordable size.

(4) Employment Expansion

Stimulate productive and meaningful employment opportunities by developing economy of Yap, as much as possible covering village economy.

(5) Investment Attraction

Boost foreign investment which will provide benefits to the people of Yap also. Benefits to Yap shall be measured in terms of local participation, employment, import reduction, export promotion, retained income in Yap and other indirect benefits to the economy.

(6) Manpower Development

Promote and encourage development of local skills and expertise in order to satisfy manpower requirements domestically.

In addition to the above, the concrete policy for development of Yapese economy are listed as below.

- (1) Development of marine resources.
- (2) Promotion of domestic agriculture production for reduction of outside dependency.
- (3) Promotion of processing industry for increase of export goods.
- (4) Promotion of tourism business.

Infrastructural developments are also proposed in the plan on the following main area for promotion of economy and improvement of basic human need (BHN) of Yap.

- (1) Improvement of water supply and sewage system.
- (2) Development of safe drinking water resources.
- (3) Improvement and construction of roads.
- (4) Development of agriculture purpose roads.

Development programs for sea-transportation in the new five year plans are as followings.

- (1) Create east-bound shipping service lanes via Yap to improve position of Yap in international trade.
- (2) Improve frequency and reliability of inter-island shipping services within the state to accommodate domestic passenger and cargo.
- (3) Improve management and efficiency of port operations in the Port of Yap.
- (4) Minimized state subsidies needed for operation of sea transportation facilities.

In Yap state, the priority of the sea transportation plan is given to the improvement of inter-islands services also. For this effort, following three items are proposed in the plan:

- (1) Rationalization of maintenance and operation of Microsprit which is currently in inter-island field services
- (2) Introduction of new maritime service boat Paluwlap, releasing Microsprit from occasional maritime service and to devote entirely for domestic transporting service without interruptions due to emergencies and patrolling operations.
- (3) Also the state government is contemplating privatization of the field trip services in order to simplify government and to improve service efficiency.

Yap State will continue to pursue the objective of commencement of east bound cargo service, as the basic requirement for development of domestic industries and promotion of exports.

In regard to port management, Yap State Government is contemplating to establish a port authority in Yap Port to raise integral efficiency of management and operation in this port.

CHAPTER 3

OUTLINE OF YAP PORT

CHAPTER 3 OUTLINE OF YAP PORT

3.1 Socio-economic Condition of Yap State

3.1.1 Geography

Yap State is situated at western side of FSM, consisting of 134 islands composing 16 island groups, scattered in some 1000,000 square kilometers of ocean area, encompassing eastern longitude 137 to 148 degrees and northern latitude 0 to 10 degrees.

Islands of Yap State can be classified into two types topographically, Waab islands group of hilly high land type in the first, and the other low islands of coral atoll origin in the second. The Waab islands group of the first type occupy about 81 % of totally 100 square kilometer of land area of Yap State. Most of lands suitable for cultivation are concentrated in Waab Islands group, and all other islands are not suitable for vegetation. Survey of 1960 reported that about 12 % of land area in Waab islands are good for cultivation in view of soil type and topography.

Climate at Waab islands is tropical nature and the islands are covered with thick vegetation, though not all area are good for cultivation due to soil nature. All other islands are deposit of coral sands which are not suited for vegetation except for coconut plantation.

All islands in Yap State are surrounded by coral reefs and lagoons in shore area, and fishery resources are abundant in the vast economic sea territory of 1000,000 square kilometers. However, fishing industry in this country is not yet fully activated except some development in lagoon area and in 12 mile territorial water area for tuna fishing.

Mineral resources worth for industrial development are not abundant in this state, except 38,000 ton of phosphate deposits in Faith Island.

3.1.2 Population

Population in Yap State has been increasing steadily in recent years. The peak of population of Yap was recorded with 40,000 in era of 1800 year, however, in 19th century when this area had first contact with external world, population started to decrease continuously until end of the World War II. During trusteeship administration by U.S.A., due to improvements of medical condition and food supply, population started to increase again.

Censuses show that the population of Yap was 8,394 in 1920, 4,227 in 1939, 8480 in 1977 and 10,139 in 1987. In 1987, 6,650 were inhabited in Waab islands and 3,489 in other islands, and population growth rate was 2.0 %, showing slight decline of population growth rate.

Population of Yap is estimated to be 10,782 in 1990 and in further future estimate is 13,000 - 13,500 in 2000th year, with fear of over population in limited land area, also with fear of unemployment.

Composition of population by age group was shown in Table 3-1. Age group of 0 - 14 occupies 42.1 % and age group of 15 - 64 occupies 52.5 %, thus indicating high rate in younger generation. This tendency requires development of more employment opportunity for increasing working force in generation of 15 - 64 age by promotion of industrial development in this country.

Table 3-1 Population of Yap by Age Groups Percentage

	1973	1987	1990	1994	2000
0~14	42.4%	4267 42.1%	4450 41.3%	4648 39.5%	5040 37.4%
15~64	51.1%	5321 52.5%	5806 53.8%	6590 56.0%	7905 58.5%
65~	6.5%	551 5.4%	526 4.9%	525 4.5%	548 4.1%
計	(7613)	10139	10782	11763	13493

(source: 1987 Statistical Yearbook, 1987 Census of Population)

3.1.3 Economics

In Yap State, for a sound development of economy in the state, there seem many problems to be settled in such fields as international trading, employments in governmental and private sectors, consumption demand and local production supply and so forth.

(1) Trade balance

Deficits in international trade balance have been a serious problem in Yap since monetary market system have been introduced into Yap in 1950 era.

In years of 1985 - 1987, import amounts were recorded in a range of US\$ 500 - 600 million yearly, while export was declining from peak amount of US\$ 269 thousand in 1987, due to stagnation of export of indigenous products of Yap copra and bean to international markets. In spite of successful effort for enhancement of export in fishery and textile industries besides export of banana and betel nuts, improvement of trade imbalance of Yap may take a long time.

Import amount in Yap is almost thirty times of export amount and major imbalance is attributed to import of foodstuffs like canned fish, meat products, vegetables, fruits and beverages and other luxury foods, though most of them are considered producible in Yap domestically by improvement of primary industry.

Table 3-2 International Trade in Yap State

(unit : US\$ 1000)

	1954	1961	1971	1978	1985	1986	1987
exports	69	139	71	269	187	183	150
imports	128	323	1,563	7,342	6,092	5,698	5,088
trade gap	59	184	1,492	7,073	5,905	5,515	4,938
rate (E : I)	1.9	2.3	22.0	27.3	32.6	31.1	33.9

(source : Office of Planning, Budget)

(2) Employment problem

Number of employee in Yap fluctuates due to temporary employment for governmental project. According to 1987 census, regular employee were 1,600 - 1,700, with 40 % of employment rate for work force of over 15 ages.

Working force in Yap can be classified into two categories, those who are earning wage from government or private sectors in cash economy area and those who live in self-subsisting economy area.

In Yap, number of private business and private enterprise are rather small, resulting in problem against promotion of employment in private sector.

In the National Development Plan, the State Government of Yap is emphasizing expansion of employment opportunity and activation of economy through promotion of private enterprises. In this connection, gap of wage level between governmental sector and private sector, the former is almost two time higher than the latter, is also a problem to be settled.

In the First National Development Plan, Yap state government tried to restrain increase of public employment, and the number of public employee decreased to 979 in 1986 from 984 of 1982 successfully. However, in 1987, governmental employment again increased by 3.45 % as shown in Table 3-3, increasing personnel cost in the national budge. Since most part of necessary fund for personnel cost are depending on the financial assistance of U.S.A. basing on the Compact of Free Association agreement, tendency of decline of assistance money may cause severe problem in public employment.

(3) Production and Consumption

During 30 years' trusteeship administration by U.S.A. after the World War II, modernization took place in Micronesia and many new

systems have been established in fields of politics, administration and infrastructure. However, progress are not remarkable in the fields of economy and industry.

As the consequence, structure of economy in FSM is still a combined system of old fashioned bartering economy and modernized cash market economy. The first system is prevailing in rural area of self-supporting life depending on primary industry of farming and fishing, and the second is functioning in urban area depending to a large extent on expenditures of government and on expenditures of public employee.

In Yap State, as described above, economic system and economic activity are dependent on expenditure of government and public employee substantially. In Yap, private sectors are mostly concentrated in commercial business, and industrial activities are low.

Despite low industrial production, consumption level in Yap is considerably in high standards. For instance, Yap's import amounts only for tobacco and beer are more than 6 times of total export amounts. Wage rate per hour is US\$ 0.8, staying almost same level since 1980, while prices are rising slightly.

In Yap, since her potential of farming and fishing production are considered high, present over dependence on import can be relieved by raising and promotion of indigenous foodstuffs domestically. At present, due to economic structure of traditional self-subsistence in rural area, products from farming and fishing area are not circulating in urban monetary market, without supporting daily needs of urban habitats. In return, urban life depends on imported goods from out side to a large extent, with out return flow of money to rural area.

Table 3-3 Yap State Government Budget

	FY86 Expenditure	FY88 Budget	86-88 change
Governor's Office	170.813	173.970	+ 2%
Health Services	809.921	932.008	+15%
Education	1,050.806	1,244.261	+18%
Resources & Development	400.491	454.091	+13%
Attorney General's Office	297.554	358.614	+21%
Public Utilities & Contracts	692.276	805.963	+16%
Public Affairs/Youth & Civic Affairs	140.964	152.643	+ 8%
Administrative Services	261.947	290.543	+11%
Planning & Budget	147.907	139.336	- 9%
Executive Branch	3,972.679	4,551.429	+15%
Legislative Branch	188.730	274.831	+46%
Traditional Councils	77.579	75.099	- 4%
Judicial Branch (State Court)	83.964	98.126	+17%
Total State Government			

source: Budget Office

3.2 Yap Port at Present

Yap Port is the sole international trade port in Yap State, playing role of artery in transportation and economy of Yap. This port also serves for domestic transportation of Yap state as the base port of the inter-island navigation.

The main wharf of Yap Port is situated in inner bay area after passing through about 3 km of narrow and winding approach channel. Along the channel, many shallow coral reefs are protruding very close to the channel passage, and this condition is the cause of many stranding accidents of entering vessels in the past history.

Size of the turning basin in front of the main wharf is rather small, and accidents often happened on berthing vessels when making turn without assistance of any tug-boat. Further, present length of the main wharf is only 138 m, being too short to accept the regular calling vessels safely at the berth.

3.2.1 Cargo and passenger at present

Cargo throughputs of Yap Port are shown in Fig.3-1 - 3-3. More than 90 % of the total cargo in Yap Port are international cargo, and of which 95 % are import cargo. Weight of domestic cargo is low here. In major items of imported cargo, included are foodstuffs occupying 20 %, tobacco and beer occupying 16 %, equipments occupying 15 % in imports.

International shipping lines calling Yap are operated by three companies, Tiger Line, Palau Shipping Line, and PM & O Line, besides one tanker line belonging to Mobile Oil.

Import of petroleum products are about 7,000 ton a year, consisted of gasoline, kerosene and diesel oil, transshipped from Guam at 30 - 45 day intervals. The import oils are unloaded from tanker through terminal pipe facility installed at the main wharf, to be stored in tank farm in

backyard area.

Yearly variation of international cargo in Yap are shown in Fig.3-1, fluctuating in association with increase of construction equipments and materials for infrastructural projects. Increase of cargo in 1981, 1983 and 1984 are mainly due to construction of the main wharf and the airport in Yap Island.

Ordinary average import of cargo into Yap for general use purposes such as foodstuffs, equipments and other daily necessities are counted at about 12,000 ton per year, on the basis of analysis of import records in three years of 1982, 1986 and 1987.

Most of import cargo to Yap are containerized already as high as up to 80 %, only excepting some break bulk cargoes.

Inter-island cargo transport in Yap State is operated at almost once a month interval by the government owned ferry boat named Microspirit. Domestic cargo are decreasing in recent years as shown in Fig.3-2, mainly because of decline of copra export due to stagnation of market. The inter-island passenger traffic by Microspirit is also decreasing despite no alternate way of traffic between islands.

International tourist boats calling at Yap are only small cruising crafts like yacht at present. However increasing tendency of international cruising tourism in Pacific area gives Yap hope to attract them for Yap's tourism business promotion. The Secondary Five Year Development Plan of Yap is also proposing to realize calls of tourism passenger boat at Yap. Actually, even during the survey period of the basic design team, an European cruising passenger ship Danae tried to enter in Yap Port, though canceling call because of difficulty of entering maneuver due to adverse weather condition.

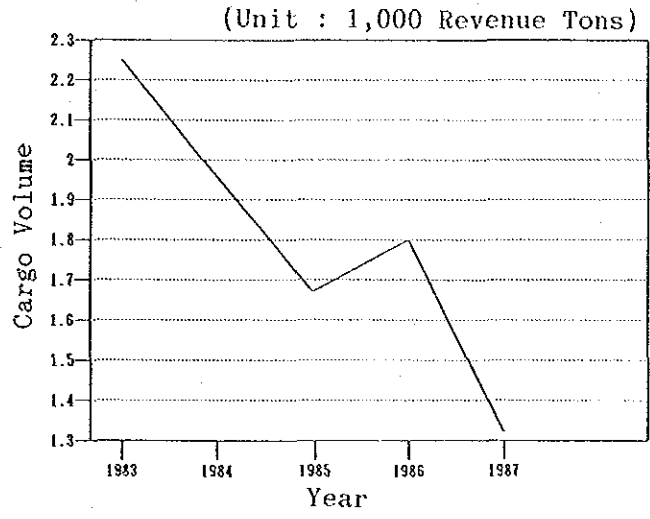
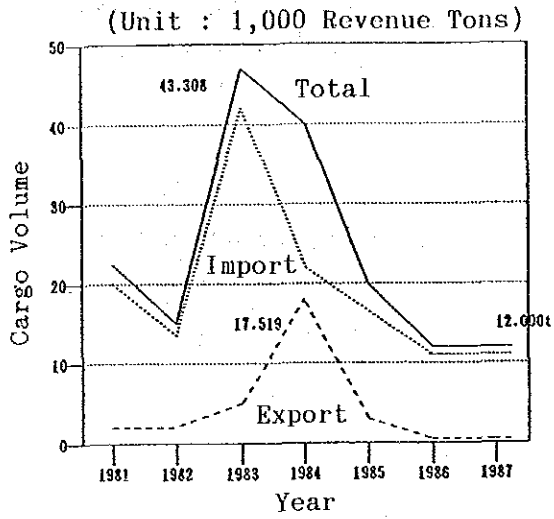


Fig. 3-1 International Cargo at Yap Port

Fig. 3-2 Domestic Cargo at Yap Port

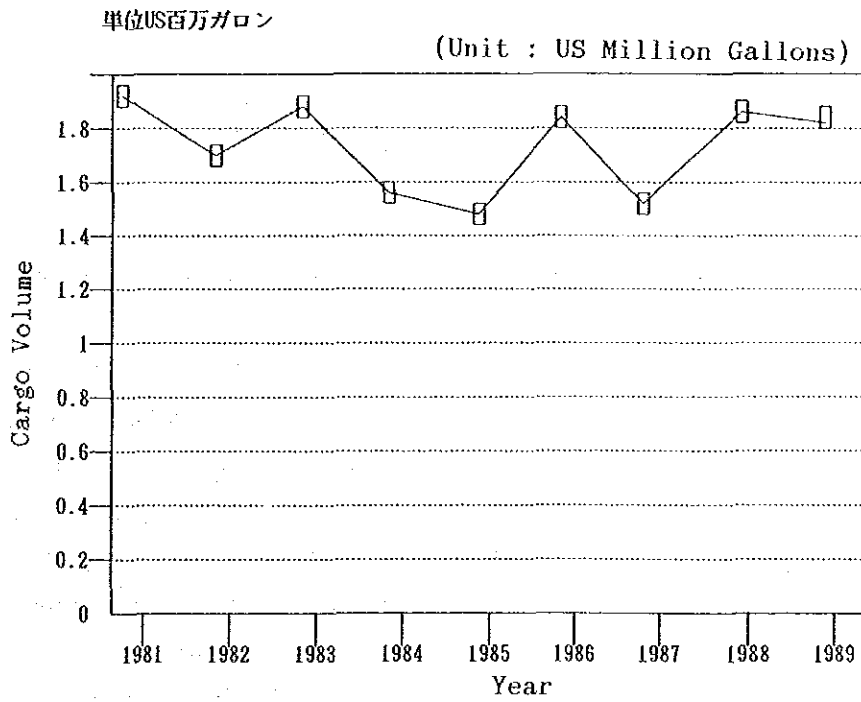


Fig. 3-3 Fuel Bulk Import at Yap Port

3.2.2 Approach Channel and Navigation Aid Markers

The approach channel to the main wharf in Yap Port is meandering one with many shallows protruding at both sides as shown in Fig. 3-4. There are 19 navigation aid makers installed along this approach channel to reach the main wharf at the inner basin.

Width of approach channel are 90 - 120 m at the narrowest sections of the channel, water depth being 20 to 30 m in these sections, according to data supplied by the Yap Transportation Office. The channel is extremely narrow at the section from port mouth to No.8 Marker, including sharp bend of about 40 degree angle.

Port entering vessels have to maneuver through this channel along the bathymetric contour, making 7 turns before to reach the mooring basin as shown in Fig. 3-4. Report of a Japanese captain calling this port pointed out the following three spots along this channel.

- (1) Shallows of -3.6 m depth at outer south-west of No.1 marker
- (2) Shallows of -5 m depth between No.4 and No.5 markers
- (3) Shallows of -1.8 m depth at No.15 marker

Also he noted that visibility of markers on shallows are not good at squall hours or in morning and evening time.

Present navigation aid markers have been installed in October 1986 with assistance of the Coast Guard of U.S.A. in conformity to requirements of IALA (International Association of Lighthouse Authority). Except two markers at the port mouth, which are provided with solar battery lights, all other markers are non-lighted, making navigation impossible at night.

Markers indicating hazards around port mouth seems to be arranged not adequately for safe maneuvering of an entering vessel to avoid dangerous shallows on the way. The reason of aforementioned failure of Danae to call Yap also could be attributed for this defect of the port mouth and entrance channel markers.

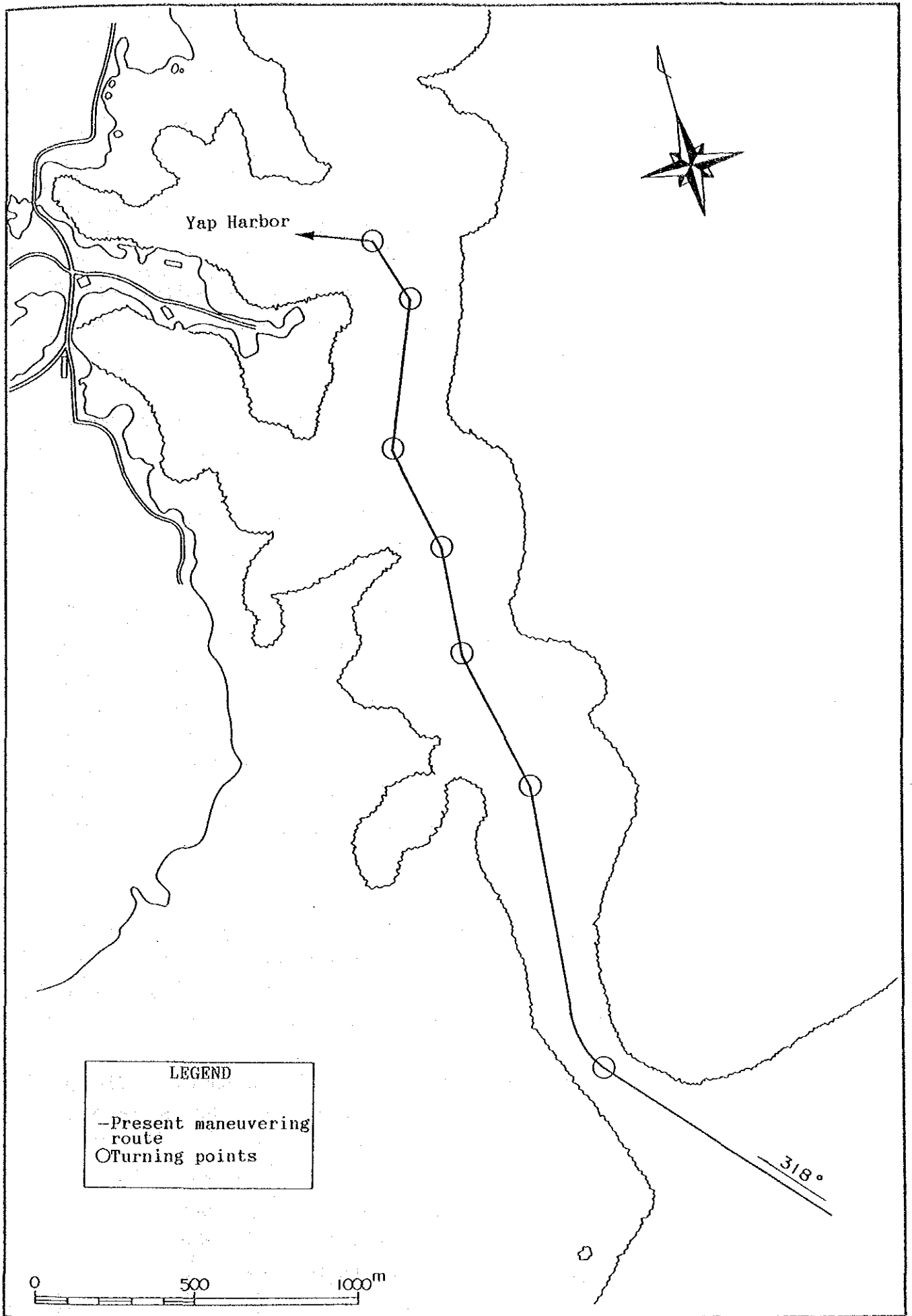


Fig. 3-4 Maneuvering Route at Present

3.2.3 Present facilities at the Main Wharf

Map of the main wharf area is shown in Fig. 3-5.

The main wharf is a -10 m deep steel sheet-piling quay wall of 138 m long. At south-eastern end of the quaywall, at the return part, a 38 m long shallow quay is provided for small boat berthing purpose.

Cargo handling yard is 14,100 square meter wide, and the transit shed is 1,486 square meter wide in behind the main wharf apron.

A small mooring buoy is provided in the mooring basin area in east of about 700 m off the main wharf.

Present main wharf length is 138 m long, but this length is less than necessary length of 160 m to allow safe berthing of actually calling boat to Yap, the container liner boat Microcommerce. The quaywall at the return part is also not sufficient in length to moor the inter-island ferry vessel Microspirit, since tail end of moored Microspirit protrude into the main wharf basin area, involving danger of collision with the berthing main boat. Therefore, moored Microspirit is forced to evacuate to other location, the mooring buoy at eastern offshore of the main wharf, every time when main vessel arrives in the main wharf.

Turning basin in front of the main wharf is rather small in size for main vessel when she makes turn herself without assistance of any tugboat, involving high risk of accident hitting into the main wharf quaywall, especially in predominant south-eastern trade wind season.

At the main wharf, cargo handling is operated by equipments as listed below, owned by Waab Transportation Co., the stevedoring agent in Yap Port.

35 ton crane	(1980 built)	-----	one
15 ton forklift	(1979 built)	-----	one
ARBI lift	(1978 built)	-----	one
small forklifts	(1975,77 built)	-----	two

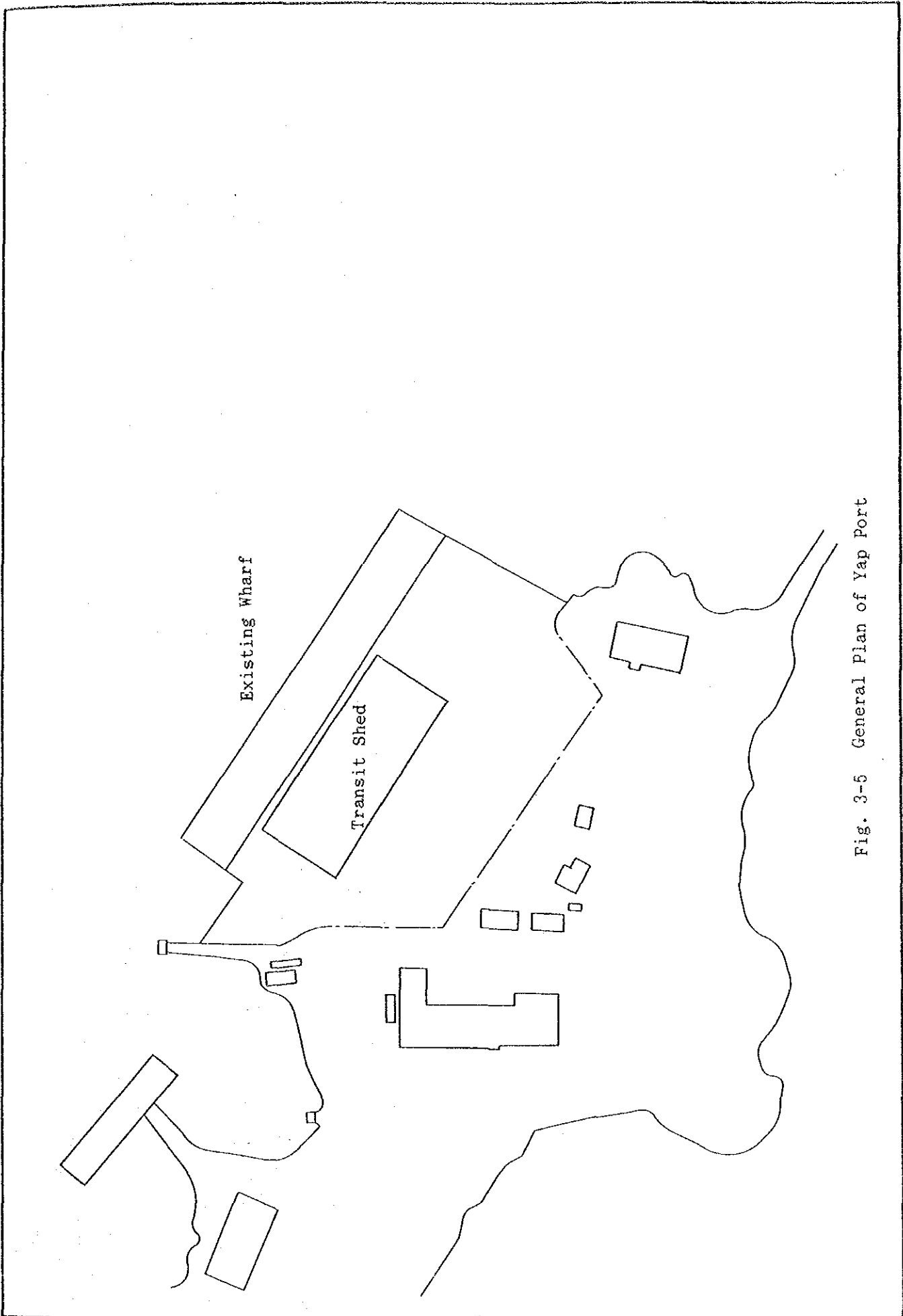


Fig. 3-5 General Plan of Yap Port

40 foot chassis (1987 built) ----- six

The main equipments such as 35 ton crane and 15 ton forklift are in decrepit condition with lessened capacities.

3.2.4 Container Handling

About 80 % of import cargo in Yap are already containerized and all liner boats calling at Yap for international shipping are container boats, annual throughput of containers here being approximately 1000 TEU. Average number of containers handled in one boat call are 20 to 30 pieces.

Size of container is predominantly 20 foot size due to restriction of cargo handling equipment capacity. However, along international tendency, 40 foot containers are also appearing in Yap, already occupying some 10 percent.

Loading and unloading of containers in Yap Port between wharf and vessel are operated by ship cranes only, since no wharf crane is provided in this port. Charge and discharge of contents of containers are carried out basically at the container yard after shifting container from apron to yard. However, because of insufficient capacity of cargo handling equipments, containers are often discharged at the apron as they were unloaded from the boat, causing congestion in apron and damage of cargo.

Existing cargo handling equipments are as listed in the preceding section.

As described already, in this port, one 15 ton forklift is now engaging in container shifting. But this forklift is already decrepit and lowered in capacity, being unable to handle fully charged 20 foot container, is serving only for empty or half discharged containers.

ARBI lift and chassis for 40 foot container are almost not in use now because of short hauling distance and unavailability of tractor. Therefore, 40 foot containers sometimes unloaded at Yap are either discharged at the apron or shifted to the yard area by a forklift carried by vessel on board deck during navigation.

Handling of refrigerating container is another problem in Yap, since power connection to land electricity could not be done in appropriate way

due to difficulty of shifting of unloaded container, causing deterioration of contents.

3.2.5 Size and Number of at Yap Port

Number of ships called at Yap were recorded in between 40 to 50 boats per year in five years of 1983 through 1987, and frequency of call is one boat per week in average. Size of boat calling this port are as listed in Table 3-4, being in a range of 4,000 to 6,000 gross ton or 6,400 to 8,900 DWT.

Call of tanker to Yap are recorded in a range of 8 to 19 boats per year, with call frequency of one boat per 1 to 1.5 month, the tanker size being 4,000 gross ton.

Call of fishery boats of 300 to 400 ton class are also reported here, together with barges for construction materials and equipments, though details are not known.

Call of boat by more than two boats simultaneously happened in Yap Port as shown in Table 3-5, being actually happened 7 times in 9 months. Though, case of two large boats occurred only two times as listed in Table 3-5.

Table 3-4 Records of Vessels Called Yap (1989 1/1 to 1989 10/4)

Name of Ship	Gross Tonnage	Length	Draft	Width
TANJUNG PERAK (Container Ship)	5.954GT (9.100DWT)	-	-	-
MICRONESIAN COMMERCE (Container Ship)	5.730GT (8.800DWT)	127.3 m	6.7 m	20m
KYOWA ROSE (Container Ship)	5.450GT (8.300DWT)	99.4 m	7.4 m	-
GOLDEN CRAIG (Tunker)	4.409GT	107.8 m	6.9 m	18m
MICRO SPIRIT	813GT	56.0 m	4.5 m	10m

Table 3-5 Records of Simultaneous Entering in Yap Port

Date	Name of Ship	GT
89. 1. 11	TITAN 'A' (TUG BOAT)	266.52
	KYOWA ROSE (C.V)	5.650
89. 2. 9	ASIAN LILY (C.V)	3.647
	CAROLINE ISLAND (G.V)	813.4
89. 3. 17	KYOWA ROSE (G.V)	5.650
	MIYABI MARU (F.B)	1.890
	MATSUO 82 (F.B)	399.75
89. 3. 19	MYOJIN 78 (F.B)	299.62
	MYOJIN 78 (F.B)	369.54
	SHOICHI 32 (F.B)	299.58
89. 4. 24	KYOWA ROSE (G.V)	5.650
	TANJUNG PERAK (C.V)	5.945
89. 7. 24	KYOWA ROSE (G.V)	5.650
	GOLDEN CRAIG (TUNKER)	4.409
89.10. 1	SPECO GIANT (G.V)	2.489.22
	MICRONESIAN COMMERCE (C.V)	5.930.74

CV : Cargo Ship CV : Container Ship FB : Fishing Boat

3.2.6 Accidents of Vessels in Yap Port

Many accidents of vessels are recorded in Yap Port, since many dangers are involved in the approach channel and in the turning basin at this port as described in preceding sections.

Port entry section of the approach channel near port mouth is the most risky section for entering boat when affected by coastal current. Actually two old wrecks of stranded boats are seen on each side of the port mouth.

As the records of most recent accidents, following two example can be mentioned for years of 1987 and 1988.

- (1) On January 23 in 1987, moored Microspirit at the return wall had a collision accident with Microcommerce in berthing operation.
- (2) On November 2 in 1988, Microcommerce hit her bottom to shallows near the port mouth during entrance maneuvering.

The cause of these accidents were attributed to insufficient size of the turning basin, effect of wind and inadequate length of the berth for the first accident, and narrow width of approach channel, sharp bent of course at the port mouth section and inadequacy of navigation aid markers.

3.2.7 Management and Administration of Yap Port

Port of Yap is under administration of the Office of Sea Port, Division of Transportation, Public Utilities and Contracts Department in Yap State Government as shown by the organization chart of Fig. 3-6.

Five state officials are in charge of administration and operation of Yap Port with budgets as given below:

Annual State Budget for Yap Port (1989)

Administration	Income	US\$ 141,222
	Expenditure	89,568
Operation & Maintenance	Income	400,895
	Expenditure	228,329

Cargo handling in Yap is operated by Waab Transportation Co., locally founded private company, under rental contract of port facilities from the state government, holding 26 staffs, of which 16 being field operators for cargo handling. Annual fee for rent of the wharf and the transit shed is US\$ 1200, and Waab is earning cargo handling fee from cargo owner.

Cargo handling work is operated by one shift team organization, since average work time for one boat are nearly four hours to handle some 30 pieces of containers. Most of the containers are discharged in wharf area and transported inland way by trucks.

Bulk break cargoes are generally unloaded by deck crane of vessel.

DEPARTMENT OF PUBLIC UTILITIES AND CONTRACTS

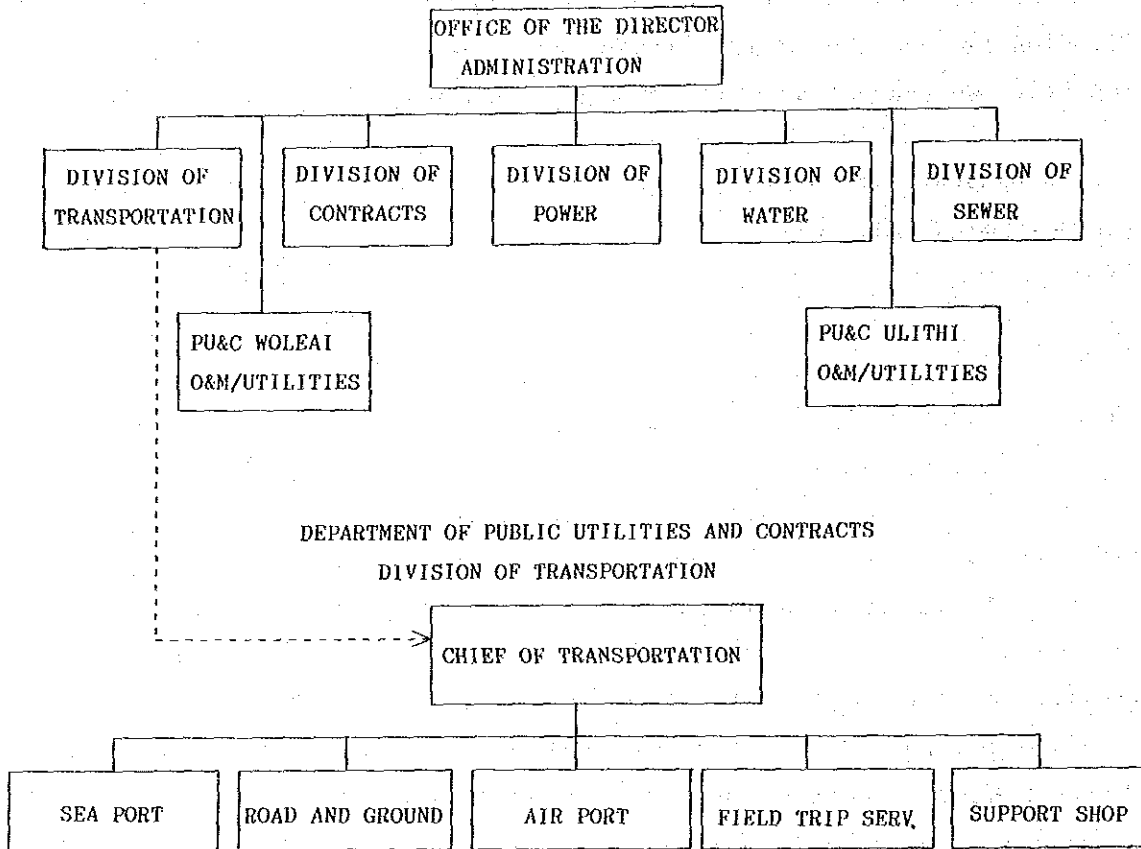


Fig. 3-6 Organization Chart

3.3 Natural Conditions

3.3.1 Climatic Condition

Climate of Yap is a typical tropical one of high temperature and high precipitation, and seasons are split into two. Monsoon season starts in July with predominant south-western wind accompanied by heavy squall until end of October. Then trade wind season starts in November with predominant north-eastern wind accompanied by occasional slight shower.

Weather observation in Yap have been carried out by the Weather Station located nearby the Yap Airport since March 1968, and the following summary are based on information obtained from the records.

(1) Temperature and Humidity

Average temperature in Yap through a year is 27.2 C degrees (81.1 F) for the past thirty years of 1959 through 1988, with less than one degree fluctuation in monthly average. Yet, temperature variation in a day is something like 7 degrees.

In other words, temperature change by season are very little in Yap and rise and fall of temperature in a day from morning to night is rather high.

Relative humidity have been observed in Yap three times a day. Annual average relative humidity are 78 % at 9 o'clock, 76 % at 15 o'clock and 88 % at 21 o'clock, according to records of three years from 1986 to 1988, indicating higher humidity in daytime than at night. Monthly variation of relative humidity is as small as 5 %.

(2) Weather and Precipitation

Average number of complete fine days in daytime are only 5 days per year, and partly cloudy days are 104 a year. And, cloudy/rainy days are 256 days a year in Yap, according to the observed records of

three years from 1986 to 1988. Generally speaking, most of days are cloudy/rainy in daytime and fine at night. In trade wind season of predominant north-eastern wind, cloudy day rate in a month are 19, and in monsoon rainy season monthly cloudy rate goes up to 26 days.

Average annual precipitation is 3,041 mm for the past thirty years of 1959 through 1988. In rainy season of July through October, monthly precipitation exceeds 300 mm.

Thunder storm attacked Yap 19 times a year in average.

Tropical cyclones are often generated in around Yap area. However, the effect are slight due to prematured size of cyclone.

No fog is ever recorded in Yap.

(3) Winds

Average wind velocity round a year is 3.6 m/sec. In the trade wind season, average wind velocity goes up to a range of 3.5 - 4.5 m/sec due to predominant north-eastern wind, while it goes down to an average of 3.0 m/sec in monsoon season with predominant south-western winds. The maximum wind velocity in records was 32.2 m/sec in 1960.

3.3.2 Oceanographic Condition

(1) Tide

During field survey of the basic design team, tide observation were made at site for 32 days using pressure type tide-meter by 10 minutes interval at a station near No.12 navigation aid marker along the approach channel.

The tide curve plotted on the basis of hourly tide record shows a specific nature of tide in this area, that differences between morning

high tide and afternoon high tide are rather small compared with that of low tides in a day.

As the results of harmonic analysis of tide records of one month, tide amplitude due to main four tide components of M₂, S₂, K₁, O₁ is calculated to be 0.876 m. In tides of this area, it is found that effect of semi-diurnal components are predominant, as M₂ + S₂ = 0.570 m, against K₁ + O₁ = 0.306 m. Tidal type index (K₁ + O₁)/(M₂ + S₂) = 0.54, indicating mixed tide type characteristic having diurnal tide amplitude of only one half of semi-diurnal tide amplitude.

In Table 3-6, harmonic constants for main tide components are shown on the basis of the observed records of the basic design team. Also, harmonic constants published in the Admiralty Tide Table by the British Navy are shown in the same table for comparison purposes. It can be seen from this table that the both values are quite closely fit to each other in amplitude (H). Differences in angle K are within 2 degree for M₂ and K₁, and in regards to S₂ and O₁ differences are less than 10 degree, showing good accord of values from both sources.

Table 3-6 Comparison of Tide Harmonic Constant

		M ₂	S ₂	K ₁	O ₁	M ₂ + S ₂ + K ₁ + O ₁	Z ₀
Tide Table	H _m	0.41	0.14	0.19	0.12	0.86	1.0
	k°	210	238	211	194	--	--
Observation	H _m	0.405	0.165	0.191	0.115	0.876	--
	K°	212	248	213.1	185.8	--	--

Comparison of observed high tide and low tide with those forecasted in Yap Almanac Calendar in spring tide and neap tide also showed good accords in time and elevation. Differences in time were within thirty minutes and in elevation were within 0.1 m in either

way.

In Fig. 3-7, tide chart drawn by use of the harmonic constants and the amplitudes are shown with the mean sea level, basing on analysis of the observed tide records. The mean sea level of this chart may subject to deviation by season and by weather, since the period of observation was quite limited in this survey. According to the Admiralty Tide Table, level of mean sea show drop by 0.1 m in February-March, and rise by 0.1 m in October-November season. The observed mean sea level during the survey period of February 2 through March 5 may be a lower one by 0.1 m than annual mean sea level.

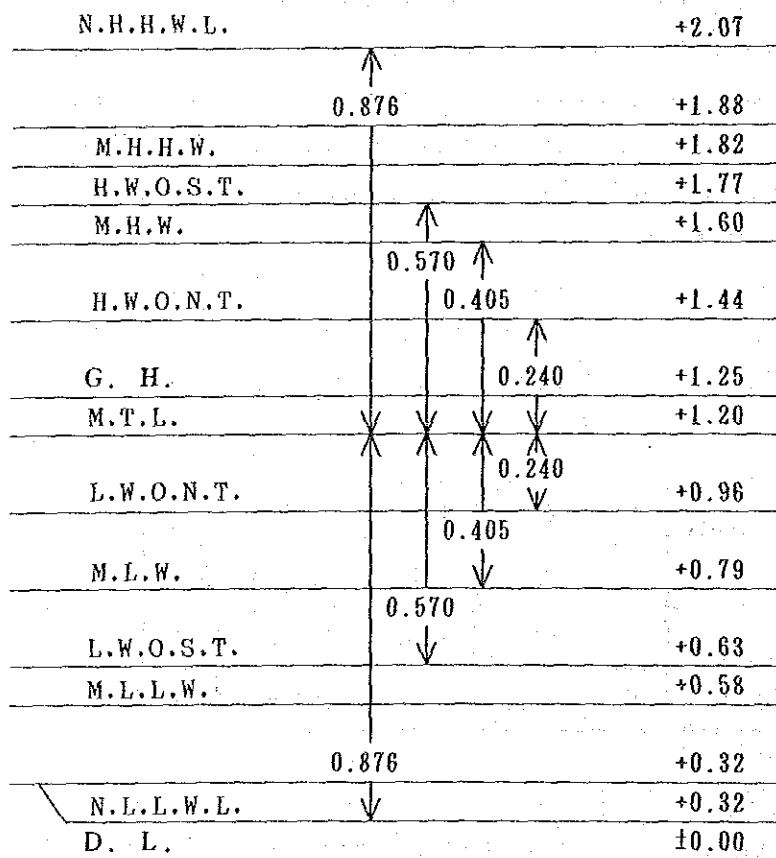


Fig. 3-7 Heights of Tides

(2) Wave

No wave observation were ever made in Yap island area.

When cyclone proceeds far north of Yap island from south-east to north-west, usually no very high waves are generated in outer sea area of Yap because of prematured size of cyclone.

The approach channel of Yap Port is sheltered by offshore coral reefs on both sides, and high waves cannot reach inner basin area due to diminishing effects by topography.

The turning basin area in front of the main wharf is not affected badly by wind wave also even in trade wind season because of limited blowing distance of 2 km only due to topographic condition.

Only effects of minor waves have to be taken into consideration in planning of mooring facility and stone revetments.

(3) Currents

Current observation were made by the basic design team at the site by means of direct reading current meter and drifting buoys. Observed data are compiled in Appendix IV and summarized below.

Current around the approach channel reverses direction to north and south depending on weather and tide conditions due to the effects of topography. Velocity of current vary in depth. When affected by wind, current near surface run from east to west while current in deep water run south-north direction at -5 m and -10 m depth.

Basic current pattern in channel area is predominant out-bound (south bound) at ebb tide and predominant in-bound(north bound) at flood tide time.

Observation of current for 25 hours at 30 minutes interval by

means of current meter proved that average current velocity is in a range of 7 - 14 m/sec, while rate of appearance of slow current below 5 cm/sec is as high as 30 - 50 %.

3.3.3 Topography in land area

Land area topographic survey were carried out by the basic design team in an area in vicinity of the main wharf. Outline sketch of the area is shown in Fig. 3-8.

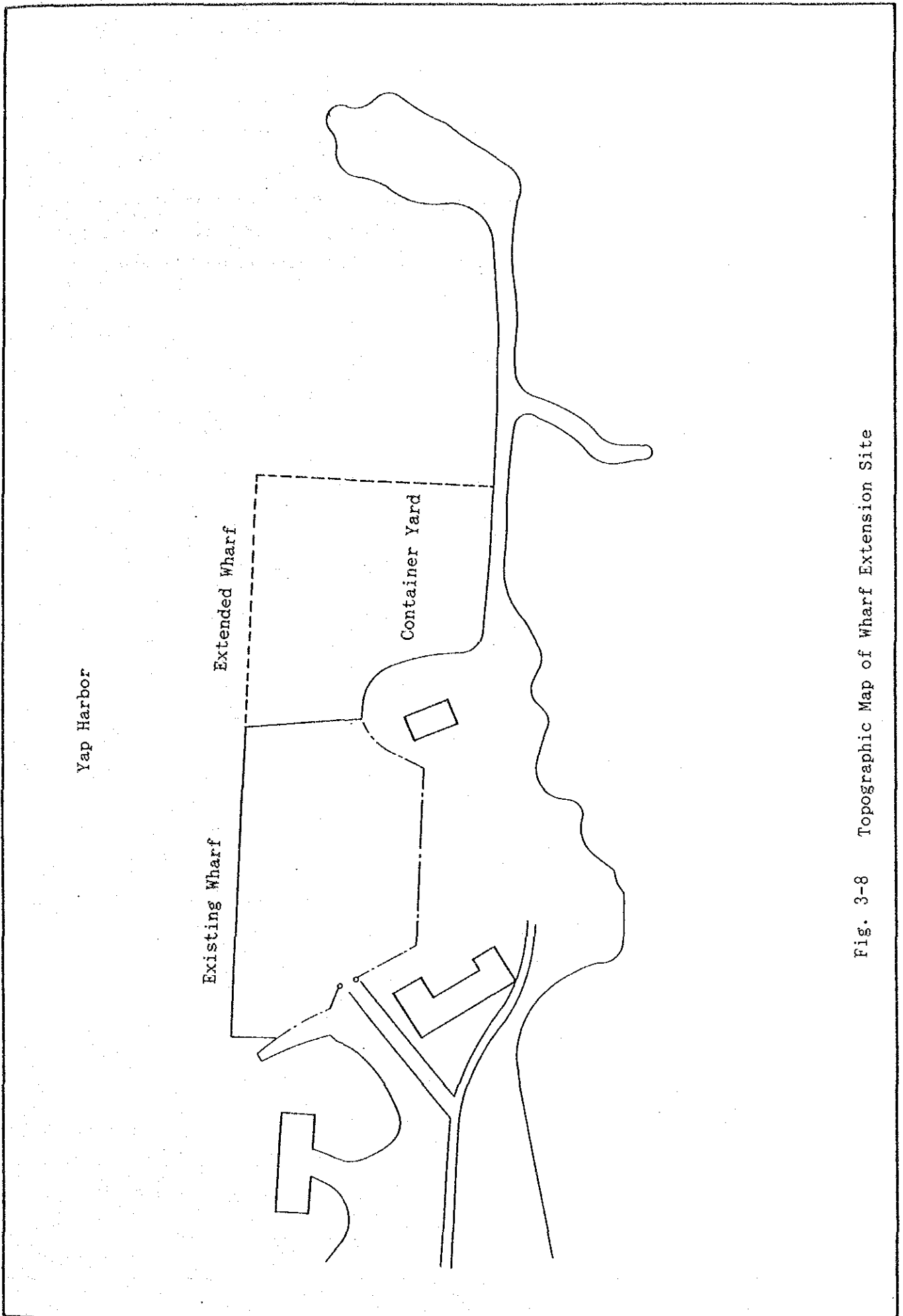


Fig. 3-8 Topographic Map of Wharf Extension Site

3.3.4 Bathymetry

Bathymetric survey were conducted by basic design team in areas such as the channel dredging area, the turning basin dredging area and in the wharf extension area. Resulted sea bottom contour line chart are shown in Fig. 3-9.

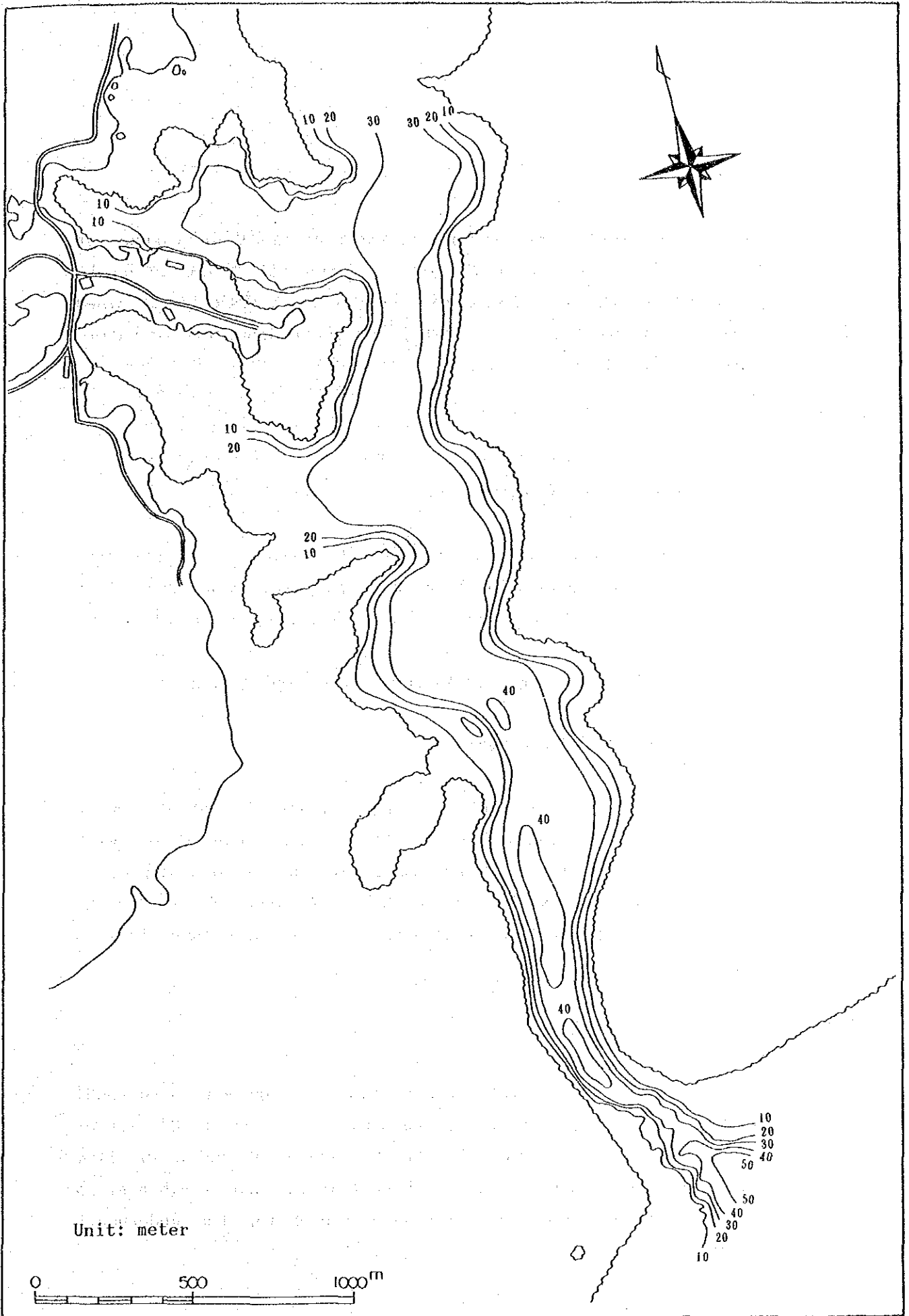


Fig. 3-9 Bathymetric Chart

3.3.5 Soil condition

Soil surveying were carried out by the basic design team by means of soil boring method, at the channel dredging area, the turning basin dredging area and the wharf extension area. Boring log data are obtained at 10 points as shown in Fig. 3-10 (1)-(3) and the characteristic nature of the ground soil are found as below.

(1) Dredging areas

1) Port mouth channel dredging area

Sea bottom layer at the port mouth entrance dredging area (BH9) is consisted of hard layer of coral reef with dense silty sand mixture, and underneath layer is silty sand of dense consistency.

Number of blows per inch in coral layer are around 10.

2) Dredging Area off Donich Island

Soil layer in area off the sewage disposal plant at Donich Island (BH7) are consisted of 1 m thick coral layer at top with underneath silty layer of medium consistency containing coral fragments. N value was 17 for the top coral layer, and 10 for the intermediate layer (-1 to -7 m) and 3 for the third layer in 7 to -11 m depth.

3) Turning Basin Dredging Area

Soil layer in the turning basing expansion dredging area (BH6) in front of the existing wharf are similar to that of BH7. Top of sea bottom is covered by 0.3 m thick coral reef buried in silty sand, and underneath is silty sand containing coral fragments. N value is 15 for the top coral reef and 4 for the underneath layer.

(2) Main Wharf Extension Area

Four boring logs were excavated in 30 m intervals along the pierhead extension line, and another log was drilled at 25 m behind the pierhead line at south end. In each log, existence of bed rock layer were confirmed. The top of the bed rock was at -16 m depth at BH1 and it deepened toward south as deep as -24 m at BH4. The overlaying layer up to sea bed were silty sand containing coral block and fragments at BH1 and BH2 with 15 - 20 N value, while at BH3 and BH4 in eastern side N value varies in between 5 to 20. At BH5 bed rock was exposed at - 4.5m sea bottom.

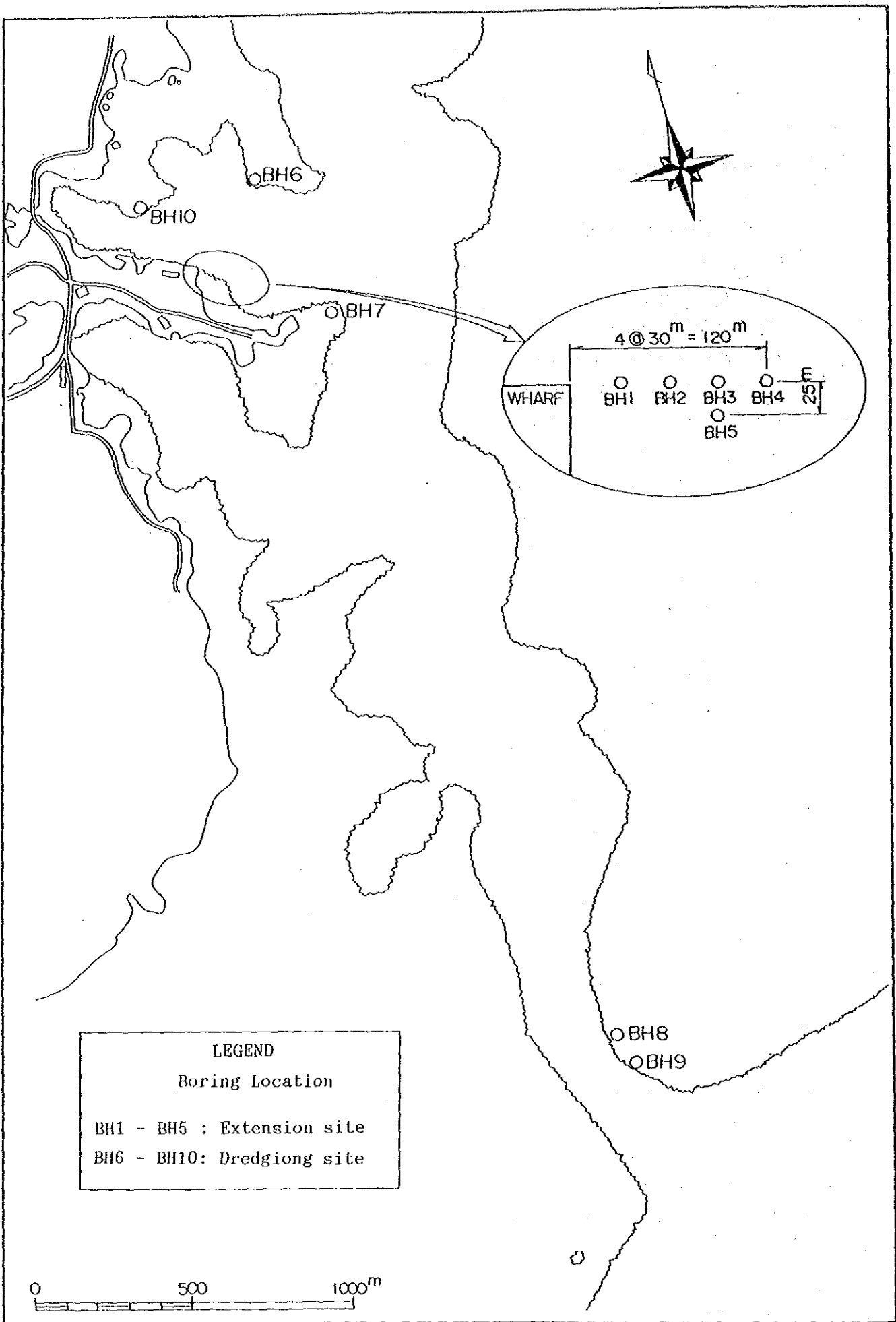


Fig. 3-10 (1) Location of Boring

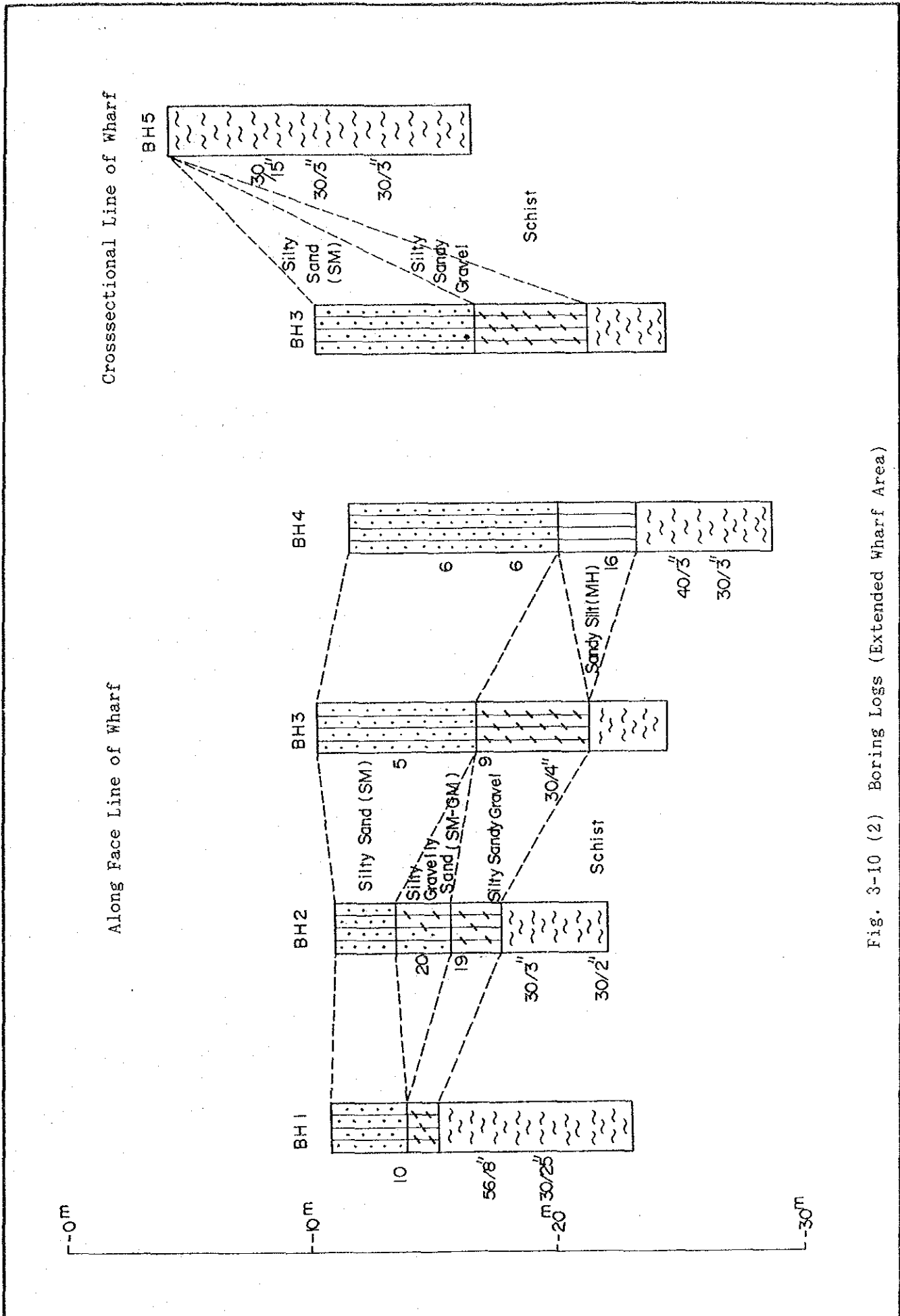


Fig. 3-10 (2) Boring Logs (Extended Wharf Area)

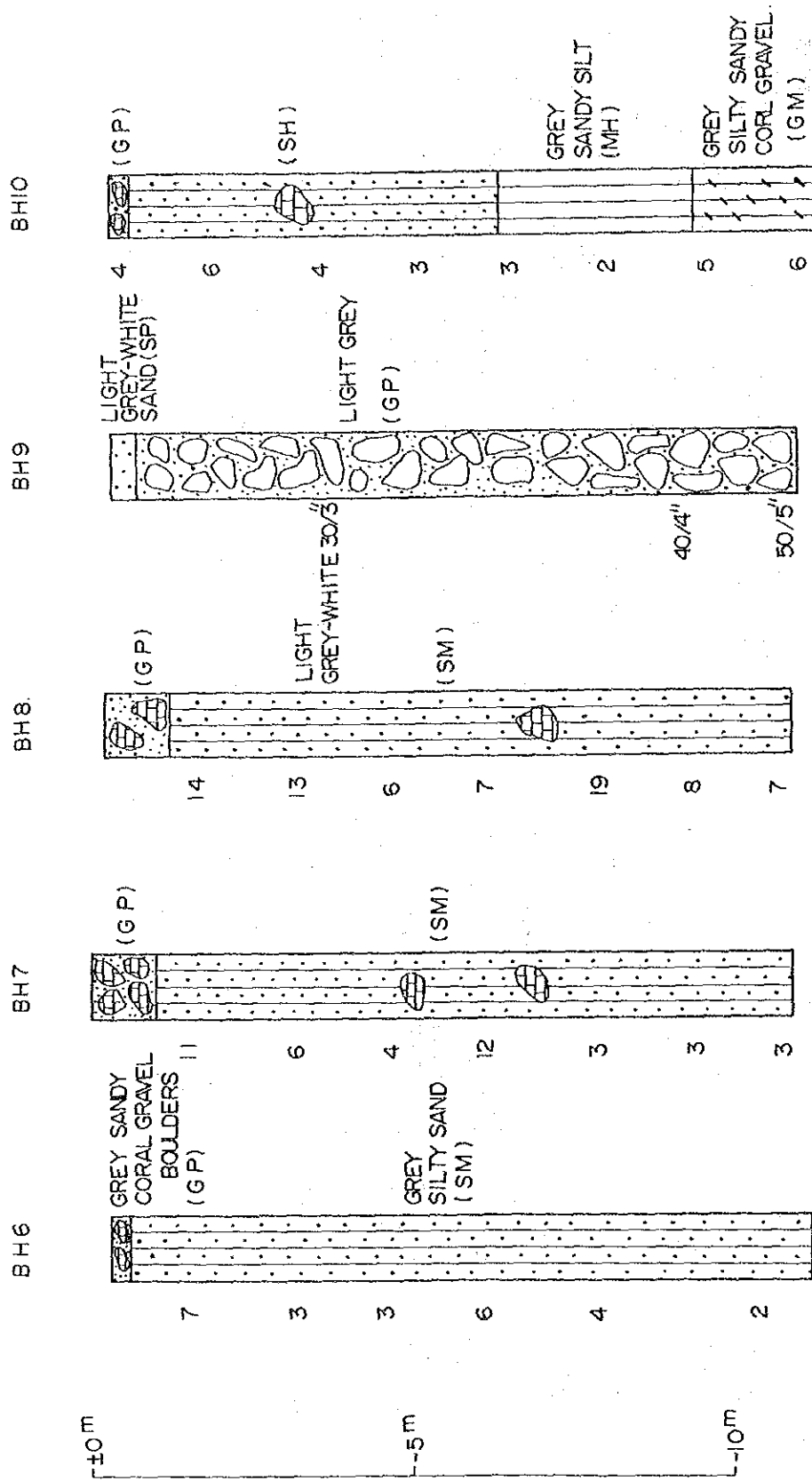


Fig. 3-10 (3) Boring Logs (Channel and Turning Basin)

3.3.6 Geological Condition

Land area in southern part of Yap Island is hilly land with maximum elevation of 70 m, while in north the topography is steeper and the highest elevation reaches up to 180 m. Geologically, rock base is chlorite-schist in south and breccia in north. Beyond shore line, in most area, coral reefs are extending toward sea. Bed rock at the main wharf extension site in east of the existing wharf is consisted of partly decomposed hard greenish schist rock. In general, sea bottom in this area are deposited silty sand layer with coral fragments.

3.3.7 Earthquake

No instrumental record is available in Yap in regards to earthquake to evaluate intensity of earthquake. However, since this project area is in between two earthquake zones of Guam and Palau, attention have to be paid to earthquake in design of susceptible structures.

As the result of discussion between Yap officials and Japanese team in this regard, the Uniform Building Codes of U.S.A., which states earthquake intensity in Guam and Palau, is cited for reference to determine design earthquake intensity in Yap. Though current edition of the Uniform Building Codes has no description on Yap, as an intermediate intensity of Palau and Guam, design earthquake intensity in Yap in this report is assumed at 0.15.

An earthquake was reported in Yap on June 15 1990, and according to data Yap officials obtained from "Tsunami Warning Center, Hawaii", the epicenter of the earthquake was about 100 miles northwest of Yap with magnitude of 5.6 Mb. Also the same information states that two earthquakes hit in 1911 and 1912 with magnitudes of 7.7 and 7.5 respectively.