3.4 Review of the Project Request

Yap State is situated in western part of the Federated States of Micronesia, holding approximately 10,000 population and 134 islands around the Yap proper islands group. Marine transport system through Yap are consisted of two kind of functions, international trade routes connecting Yap to pacific countries (Japan, U.S.A., Australia, Taiwan, Korea, The Philippines etc.) and inter-island domestic navigation routes.

Yap state is highly depending its daily life necessity and economic activities on import and export through sea transport and international trading. All domestic traffic and transport of passenger and cargo are also dependent on sea lane. Therefore traffic and transport lane on sea are real lifeline of Yap States.

Port of Yap is the only one international trade port and is also functioning as base port for domestic sea traffic. However, present condition and facilities in Yap Port are not in adequate states.

Main facilities of Yap Port at present are consisted of a narrow and meandering approach channel and a rather small water basin and a -10 m deep main quaywall of 138 m length only and a transit shed.

The main quaywall is not long enough for mooring of the currently calling maximum sized cargo boat. The turning basin is also narrow for turning of large size vessel without assistance of tugboat.

State operated ferry Microspirit, which is engaging in inter-island domestic navigation services, is stationed at Yap Port as her mother port. Since length of berth is not sufficient, Microspirit is often forced to shift to mooring buoy, suspending cargo handling work or maintenance work, every time when main vessel arrives at the main wharf to give seat for the main boat.

The approach channel of Yap Port is about 3 km long, connecting outer sea and inner port through coral reefs, and is narrow and meandering with

danger of stranding accident.

To solve the problems in Yap Port as mentioned above, upon request of the state government of Yap, the government of FSM sent request for grant assistance from the government of Japan, to execute expansion work of the approach channel by dredging, expansion work of the main wharf and to provide equipments for maintenance.

The Japanese government dispatched preliminary study mission to FSM from October 3 to October 16 in 1989, to confirm appropriateness of the project and to decide necessity of the grant assistance. As the result of the study, appropriateness of the project has been confirmed by the mission and the scope of basic design of the project were discussed by both sides.

The subjects confirmed by the preliminary study mission are as listed below.

(1) The executing body of the project ; Yap State Government

(2) Contents of the project ;

1) Equipments for maintenance is not necessary

2) Extension of the main wharf is necessary to moor two boats at one time.

3) Expansion of the approach channel and the turning basin are necessary for safety of navigation of the maximum sized vessel.

4) Construction of transit shed will be included in the project when the basic design mission found it necessary.

5) Study for environmental assessment of the project is requested to be made by the basic design mission.

6) Re-arrangement of the navigation aid makers are necessary after realignment of the approach channel.

CHAPTER 4

CONTENTS OF THE PROJECT

CHAPTER 4 CONTENTS OF THE PROJECT

4.1 Objectives of the Project

4.1.1 Problems to be solved

As stated in the preceding chapter, Yap is located at a cross point of international navigation passages, connected to Pacific countries in Asia and America and Oceania by sea transportation. The role of Yap Port is a fundamental infrastructural installation for international and domestic flow of cargo and passenger, supporting daily life and economic activities of Yap itself and the whole FSM. However, Port of Yap involves several problems as pointed out below, and removal or remedy of those problems are the task of primary importance for stabilization and upgrading of life and economy of Yap State.

Safety condition of navigation in Yap Port for entering vessel is the number one problem to be settled. Safety of navigation in this port is, to a considerable extent, disturbed by shallows around the approach channel and the turning basin and by inadequacy of navigation aid markers.

The approach channel to enter the inner mooring basin of Yap Port is a crooked one due to protruding shallows at both sides. Especially at a section near the port mouth, effective width is only 90 m at the narrowest point besides a sharp bend of navigation course by nearly 40 degree angle. This section is the most risky area of the approach channel, having records of many stranding accidents of entering boats, still having old wrecks of stranded ships at outer south of the port mouth. This section is also a restricting cause on the maximum size of entering boats into this port by the current size.

The turning basin, its effective size in diameter being only two ship length of the current maximum vessel entering this port, involve high risk of accidents colliding to quaywall in berthing operation in windy days. Repair of damaged quaywall structure is another problem in addition to

vessels' damages.

Insufficient length of the main berth for the current maximum sized vessel, (requirement is 160 m), is also the cause of accidents damaging both ship hull and quaywall structure, since mooring ropes do not work effectively as they are allotted in improper position in berthing operation.

The navigation aid marker system of this port is consisted of two lighted marks at port mouth and 17 non-lighted markers. Those non-lighted markers can not be clearly observed in squall time and in darkness of evening, restricting navigable time in this port.

Because of those defects in Yap port, Yap Port is threaten by fear of complete shut-down in a case of worst vessel accident. In such case, all cargo flow to and from Yap Port might be closed for a long period paralyzing daily life and economy of Yap state.

Therefore, upgrading of safety by improvement or removal of the above mentioned defects in this port can be recognized as the most urgent and effective matter. As consequence of safety improvement project, even calls of cruising passenger boats to Yap may be realized, encouraging tourism business promotion in Yap.

Since present condition of the approach channel, the turning basin and the main berth are the restricting factors for growth of size of the current calling boat to Yap, improvement of such conditions can remove the restriction for ship size, which in turn results in cost down of marine transportation contributing to stabilization of economy of not only Yap but also of the whole FSM.

Extension of quaywall length will facilitate operation of Microspirit engaging in domestic navigation services. At present, Microspirit is forced to evacuate to the mooring buoy when main boat comes in to the main berth, wasting time and cost by disturbance on her schedule of works. Extension of the main wharf will help improvement of inter-island

navigation service which is one of the targets stressed in the Second Five Year Development Plan.

As stated in the preceding chapter, import cargo to Yap Port have been containerized by more than 80 % already. Condition of existing cargo handling equipment is poor and decrepit with insufficient capacity to hold and shift charged container. Very often, unloaded containers are discharged at the apron as a countermeasure to the above inconveniences causing congestion in the wharf. New 40 feet containers are unable to be shifted even at partially charged condition. Installation of a new cargo handling equipment of proper capacity like a forklift is considered indispensable for improvement of cargo handling efficiency and also for resolution of cargo yard congestion in this port.

Thus, all improvement and expansion works included in this project plan of the Yap Port Extension Project are consisted of items required for the immediate relieves to the present difficulties in the Yap Port, and the implementation of this project are fully justifiable as the most beneficial assistance for Yap State and the FSM.

4.1.2 Objective of the Project Plan

Since present conditions of Yap Port require urgent remedy, and only countermeasures are included in this project plan, objectives of this project can be summarized as followings :

(1) To secure safety of navigation of vessel, by expansion of the approach channel and the turning basin.

(2) To secure safety of vessel in maneuvering operation including night time, by improvement of the navigation aid markers.

(3) To improve safety and efficiency of operation at the main wharf by extension of the main quaywall and the cargo yard.

(4) To improve cargo handling efficiency, by installation of a new cargo handling equipment.

Details of basic plan for this project such as scale, capacity and technical specification are described in the following section and in chapter 6, with cargo throughput forecast and technical requirements by code and standard.

4.2 Projection of Cargo Throughput in Future

4.2.1 Projection of Sea Traffic in Future

(1) Background by the Second Five Year Development Plan

The Primary objective of the Second Five Year Development Plan to be enforced from 1990 is stipulated to diversify industry of Yap to yield more employment opportunity for increasing working age population, and to improve international trade imbalance in excess of import.

To achieve these objectives, emphasis are placed on cut down of import of daily necessities which are available from domestic sources by expansion of Yap's owns local production, together with promotion of export industries. Yet, import of daily necessities are expected to continue increase in proportion to increase of population.

Increase of export by expansion of export industry might encounter many difficulties. Land area is limited in Yap, and mineral resources and man power resource are also not very abundant in Yap. Geographical characteristics as island nation may hinder development of large scale industry in Yap.

Yet, in Yap, already in certain areas, new industries have been successfully growing in recent years in such fields as textile fabrication, soap production from indigenous copra-oil. Fishing

industry is also growing steadily in Yap, with support of Japanese grant and technical assistance with provision of new fishery wharf and modern fishing boats. Fresh fish export to Guam and Hawaii is earning largest share of foreign money in export business in Yap.

On the other hand, traditional export business of copra is rapidly decreasing in Yap, because of stagnation of international copra market. In this way, some replacements are taking place in export industry, offering new business opportunity for Yap.

Tourism business is an area of bright expectation in Yap, and some projects are making progress in Yap for new hotel installation, though basic problems of land ownership system and infra-structures like water system are the problems may require further settlements.

In the Secondary Five Year Development Plan of Yap (1990 -1995), infrastructural development projects such as road, water supply, sewage, reservoir are included. As stated in 3.3 already, those infrastructure projects will give impacts on cargo throughput of Yap Port by requirement of import of construction materials.

(2) Estimate of Cargo Throughput

Referring to the above stated background and basing on the records of the past 10 years, cargo throughput of Yap Port in coming five to ten years are estimated as followings, the maximum approximate annual throughput being 80,000 ton per year:

1) Cargo Import

a. Items for daily life and ordinary economic activity :

Assuming proportional increase to population growth,

12,000 t/y x 13,500 person (in 2000th) /10,000 (in 1990th)

= 16,000 t/year

b. Petroleum Products

7,000 t/y x 13,500/10,000 = 9,500 t/year

c. Items Associated to Infrastructure-Project

Assuming maximum fluctuation in past records,

43,000 t - 12,000 t = 31,000 t/year

2) Cargo Export

Adopting the maximum export quantity in the past 10 years, taking into account some growth of export industry and re-export of construction equipments used in projects,

17,500 t/year

3) Domestic Cargo

Assuming recovery of domestic cargo up to the maximum of the past 10 year records,

2,000 t/year

Gross total at maximum 76,000 t/year

4.2.2 Expected Maximum Ship Size

(1) Container Vessel

With increase of cargo throughputs in Yap, frequency of call of

container vessels is expected to rise in Yap.

Present container boat calls to Yap are approximately 50 times a year, and average cargo handling is ;

12,000 t/50 = 240 t/call

requiring about 4 hours for loading and unloading of containers.

Maximum calls of container boats to Yap per year in future is estimated in the following way. The maximum cargo throughput is assumed at,

16,000 t + 31,000 t = 47,000 t/year

and cargo handling per boat in future is assumed to be double of the above present rate, in proportion to increase of cargo throughput.

Therefore, calls of boat are calculated as ;

47,000 t / (240 x 2) = 98 calls/year

and the frequency of calls of boat are predicted at approximately 2 times a week.

In the above forecast, still, each boat is assumed to be able to depart from the port within 12 hours after berthing, including cargo handling and all other necessary time.

Size of vessel is also expected to become larger in proportion to increase of cargo throughput, when the current maximum sized boat Micronesian commers would have to be replaced in these year due to aging. However, future maximum size of new container boat will still subject to a restriction depending on expansion of the main berth of the other port in FSM.

Referring to the size of NYK line container boat named Cereza (DWT 10,000, width 20.9 m, length 132.9 m, draft 9.42 m), which was in service in Micronesia area though not making call to Yap, the maximum size of cargo boat in future can be assumed to be 10,000 DWT.

Accordingly, in this plan, the maximum size of container boat is set at 10,000 DWT with some other summary data as below.

Maximum boat size	10,000 DWT	
Length	137	m
Width	19.9	m
Draft(full load)	8.5	m
Frequency of call	2	times/week
Berth time	12	hours

(2) Petroleum Tanker

Tanker to supply petroleum products to Yap is the one, making round trip from Guam around tropical Pacific countries, and petroleum supply quantity per each call can be assumed remain same as at present. Therefore, number of call will be expected to increase as per the increase of demands.

Tanker Size	4,409	GT (as at present)
Length	107.8	m
Width	18	m
Draft	6.9	m

Present Interval of Call 45 days

Future Interval: 45 day x 7,000 t / 9,500 t = 33 days

(3) Inter-island Service Boat (Microspirit)

Inter-island service boat, Microspirit, is engaging in domestic transport service of cargo and passenger basing at Yap Port as mother port. Average service trip takes 10 to 15 days, and while staying in Yap, she gets supply and repair.

Though present tramper service is expected to be regularized to intensify domestic service in the period of the Second Five Year Plan, berth occupancy time in Yap Port is considered remain unchanged.

Size of Ship (Microspirit)

DWT	880 DWT
Length	56.0 m
Width	10.0 m
Draft	4.5 m

(4) Cruising Passenger Boat

No call of cruising passenger boat has been recorded in Yap, yet, a new trend of international tourism is pointing at a realization of visit to Yap by international cruising passenger boats in coming few years. Actually, even during the survey period of the basic design team, European cruiser boat Danae tried to enter Yap Port, though not succeeded being hindered by difficulty of port entry maneuvering into this port.

Nowadays already many cruising boats are navigating in these Pacific ocean area from America, Europe and Japan, and Yap is intending to invite them to Yap for tourism development.

When this project is fully developed, call of cruiser boats to Yap are expected at interval of every two months, being expected to stay at Yap for 2 or 3 days each time.

(5) Maritime Service Boats

For maritime service purposes one boat named Paluwlap is in service in Yap, and another one is also expected to come into service in near future to engaging in services like patrol or rescue in surrounding sea of Yap. Those boats will be stationed in Yap Port usually, requiring mooring berth in standby for immediate action.

Ship Size	Length	30	m
	Width	5	m
	Draft	3	m

(6) Summary List of Vessels in Yap Port

The number of boats to be accommodated in Yap Port each month is estimated to be 11 to 12 in near future, almost being doubled from the current number of 6, as shown in Table 4-1.

Table 4-1 Number and Frequency of Calls in Yap Port

		(1983 - 1987)	(1995 - 2000)	berth occupancy
Visitor Boat	Container Boat	4/month	8/month	
	Tanker	0.7/month	1/month	
	Cruiser	0	0.5/month	
Yap Stationed	Microspirit	1	1	15 days/month
	Maritime Service	0	2	full time

4.3 The Basic Plan

In this section, the basic plan of the Yap Harbour Extension Project is proposed as followings, on the basis of objectives of the project and requirements for service function as defined in the preceding sections.

4.3.1 Ship Size for the Basic Plan

The maximum ship size adopted in this project as the design base are summarized as below :

(1) Container Boat ; 10,000 DWT class

Dimensions ; length 137 m, width 19.9 m, draft 8.5 m

(2) Boats to be stationed in Yap

1) Microspirit ; 880 DWT

Dimensions: length 56 m, width 10 m, draft 4.5 m

2) Maritime Service Boats

Dimensions: length 30 m, width 5 m, draft 3.0 m

4.3.2 Scale of Facilities

The scale of facilities adopted in this plan as the design base are as followings:

(1) Approach channel

1) Width

Width requirements for approach channel by PIANC (Permanent International Association of Navigation Channel) Standard is 5B - 10B (B : width of ship) for one way traffic, and the Japanese Codes for Port and Harbour Engineering requires more than 1L (L: length of ship).

In this port, since no traffic congestion is expected, referring to the minimum PIANC requirement, 5B is adopted in this plan as the minimum design base width of the approach channel in this port. Then, the minimum width of the approach channel in a narrowest section is calculated as followings:

W = 19.9 x 5 = approx. 100 m

Therefore, in this project plan, 100 m is adopted for the minimum width of approach channel as the design base.

2) Depth

Depth of channel is determined on the basis of draft of entering vessel, by adding extra depth as allowance for provision to trim due to load unbalance, for provision to pitching and rolling, and for provision of sag at stern due to speed of vessel. Sea bottom soil condition is also taken into consideration in determination of allowance depth.

In ordinary condition, allowance of 0.5 to 1.5 m is required. However, further additional allowance of 0.5 to 2.5 m is added in cases when effect of wave is taken into consideration or when sea bottom is consisted of hard rock.

On the other hand, due to navigation schedule of container boats calling Yap, the boats are in part-cargo condition loaded mostly with empty containers, since they are on return trip way to origin Asiatic ports.

Therefore,taking into consideration effects of wave, coral bed soil at sea bottom and loading condition of calling vessels, in this project plan, dredge depth of -8.5 m is selected for the approach channel as the design base.

Actual dredged depth will be deeper than the above figure by adding some allowances associated with practical field dredge work operation.

Therefore, the above planning dredge depth can be considered practically a satisfactory figure even for the maximum sized part cargo container vessel in this project plan. Even when she is fully loaded, she can enter this port by taking advantage of high tide after improvement work is completed.

(2) Turning Basin

1) Size

Size of turning basin required by the PIANC standard is to be more than 2L (L: length of ship) in diameter in calm condition, and the Japanese Code for Port and Harbour Engineering requires more than 3L in diameter.

As the results of survey conducted by the basic design team it is revealed that here in Yap Port, 2L diameter size has been already secured in front of the main wharf. Yet, taking into consideration the effects of south-eastern wind in trade wind season, expansion of the turning basin by dredging is included in this project plan.

This dredging is also for the purpose of obtaining filling soil required for land reclamation works for expansion of the container yard area. Dredging of shallows protruding at south-east of Donich Island is also included in this plan for the purpose of safety improvement and filling soil obtaining.

2) Water Depth

Referring to the design base dredge depth of the approach channel, the same depth of - 8.5 m is adopted for design depth of the turning basin.

(3) Navigation Aid Markers

Present navigation aid system is consisted of two lighted markers at both sides of the port mouth and 17 non-lighted markers to indicate hazardous points along the approach channel and the turning basin.

The most risky part of the approach channel is the section of about 0.5 km long from the port mouth markers. Along this section, channel width is narrowest while the passage requires a very sharp turn at an angle of more than 40 degree.

Present two navigation markers of lighted ones at the port mouth and the other markers are not adequately well arranged to distinguish safe navigation passage clearly, resulting in stranding accidents of entering boats in windy or high wave days.

In this project plan, improvement of the navigation aid markers by re-arrangement and by illuminating are proposed together with installation of new range markers to show port entry direction.

On markers at shallow points protruding closely to the approach channel, installation of lighting apparatus is proposed as the most effective and satisfactory measure for improvement of safety of navigation, besides re-installation of the markers at most appropriate positions all through the way to reach the inner basin.

Because of shallows at outer south-west of the port mouth, port entering vessels have to take north-western course. New range marks to show this direction for entering boat can be a great help to

facilitate safe entering maneuver especially for large size boats.

(4) Main Wharf Extension

1) Length of berth

Present length of the main wharf quaywall is 138 m only, being rather insufficient in length to accept the current maximum size ship safely.

Required length of the main berth to accept the selected ships by 4.2.2 are as below ;

* Cargo Boat (10,000 DWT) berth length 170 m

* Microspirit (880 DWT) berth length 80 m

Yap is the mother port for Microspirit, with berth occupancy rate of some fifty per cent. International container boat may arrive Yap very often while Microspirit is on the berth.

Considering berth occupancy of the main berth by both boats at a same time together, to eliminate evacuation of Microspirit to somewhere else when main boat comes in, necessary length of the main wharf is ;

$$L = 80 + 170 = 250 \text{ m}$$

including the existing main wharf length.

Since the existing length of the main wharf L1 is 138 m, length of extension L2 is ;

$$L2 = 250 - 138 = 112 \text{ m}.$$

At the return part of the extended main quaywall, a small boat

quaywall of 35 m long is also proposed, arranged perpendicularly to the main wharf at the new south-eastern corner of the extended main wharf, to moor new maritime service boat Paluwlap.

2) Water Depth

Planning base requirement for water depth for the maximum size boat is -8.5 m. However, the main berth extension area has already been excavated down to -10.5 m deep in general, at the occasion of construction of the existing main quaywall. Water depth of the existing main wharf is also -10.0 m.

Therefore, the water depth of the extension part of the main wharf is also selected to be -10 m deep, the same as that of the existing part of the main wharf, though it have to be designed to withstand -10.5 m deep earth pressure loads.

Water depth of small boat quaywall at the return part is to be more then -3 m to accept the maritime service boat. Also at inner end of the return part quaywall, ramp way is proposed to facilitate cargo handling of landing craft type vessel.

3) Apron and Container Yard

In behind the extension quaywall, apron and container yard are proposed, by reclaiming water area in between the extended quaywall and the causeway. Dredged soil and coral from the approach channel and the turning basin will be transported and filled in this area for land reclamation.

In apron area, heavy duty pavement of same width as that in the existing apron area is proposed. Container yard area is to be covered by improved surface layer of compacted well graded materials.

(5) Container Handling Equipment

In Yap Port, main part of cargo are handled in 20 feet containers at present, being loaded and unloaded between wharf and vessel by crane on board the ship. Yard shifting are carried out mainly by a 15 ton forklift now in use. Chassis and ARBI lift are provided here but they are seldom used in this port, due to short shift distance and yard area restriction.

40 feet containers are gradually increasing in Yap Port also, along with international tendency. At present, 40 feet containers are shifted in a hurry by a forklift landed from the container boat, carried around on board the vessel together with cargo containers. In this way, after departure of the cargo boats, the placed 40 feet containers are left at the yard being unable to be re-shifted anymore causing congestion in the yard, until they are completely discharged.

Capacity of the present 15 ton forklift is not sufficient to handle a fully charged 20 feet containers. Still more, due to degradation of aging and wear, this equipment can handle only an empty container at present. For this reason, most containers are forced to be discharged at the apron, causing congestion and unnecessary cargo damages.

To improve above situation, provision of forklift with capacity of handling 20 to 40 feet container is included in this plan.

4.4 The Layout Plan

4.4.1 The Approach Channel

The most risky part in Yap Port is the port mouth section of the approach channel for about 500 m from the port mouth markers. Therefore, in this project plan, primary importance is placed on improvement work of port entrance section of the approach channel.

Improvement of alignment of the approach channel into a perfect

straight line shape will be an ideal solution. However, dredging quantity required for this solution is too huge to be justified from view point of investment cost in this port.

Therefore, as an alternative, and for the best performance of project investment cost, the line shape of the approach channel at entering section is left remain almost as it is now, and expansion of the channel width by dredging excavation at side and corner of the channel as shown Fig 4-2 is proposed as layout plan for the improved approach channel.

At points of sharp turning exceeding 30 degree in angle along the approach channel, corner cut dredging are introduced at inner side of turning line of the channel, to facilitate smoother and safer navigation.

As the result of improvement works of the approach channel, after passing the improved turning point near port mouth, entering boat on the approach channel can proceed on a straight line course until to reach the turning point at east of the Donich island, as shown in Fig. 4.2.

After the improvement by this project, the approach channel will have the minimum width of 100 m and the minimum depth of -8.5 m at low tide time all the way through.

4.4.2 The Turning Basin

Since no tug-boat service is available in Yap Port at present, all boats have to make turning by themselves in berthing operation, and in such case the turning basin for the main wharf have to be provided in water area just in front of the berth.

The improvement of the turning basin is proposed as shown in Fig. 4-1 in this project plan, size of the turning basin being more than 2.3 L in diameter, and the water depth being deeper than - 8.5 m.

4.4.3 The Navigation Aid Markers

To indicate entering course into the approach channel for a vessel coming from south-eastern outer sea, a set of leading(range) markers with lighting is proposed in this plan.

Further, installation of lighting apparatus on markers at hazardous shallow points protruding close to the approach channel are proposed for easier identification of shallows. Existing markers are to be rearranged in accordance to the improved layout of the approach channel and the basin.

4.4.4 The Main Wharf Facilities

The quaywall of the main berth is proposed to be extended towards southeast along extension of the existing main quaywall pierhead line. This is a provision for further extension of the main wharf along this line in future, also providing areas for future expansion of cargo handling purpose.

The length of the main quaywall extension is 112 m, with the berth water depth of -10.0 m. At the south-eastern return part, quaywall of -3 m deep and 35 m long for the maritime service boat is proposed with tail ramp wall for landing craft.

In behind the extended quaywall, apron with heavy duty pavement is proposed, and expansion of container yard with improved surface course are also proposed.

Layout plan of proposed facilities are shown in Figs. 4-1 and 4-2.

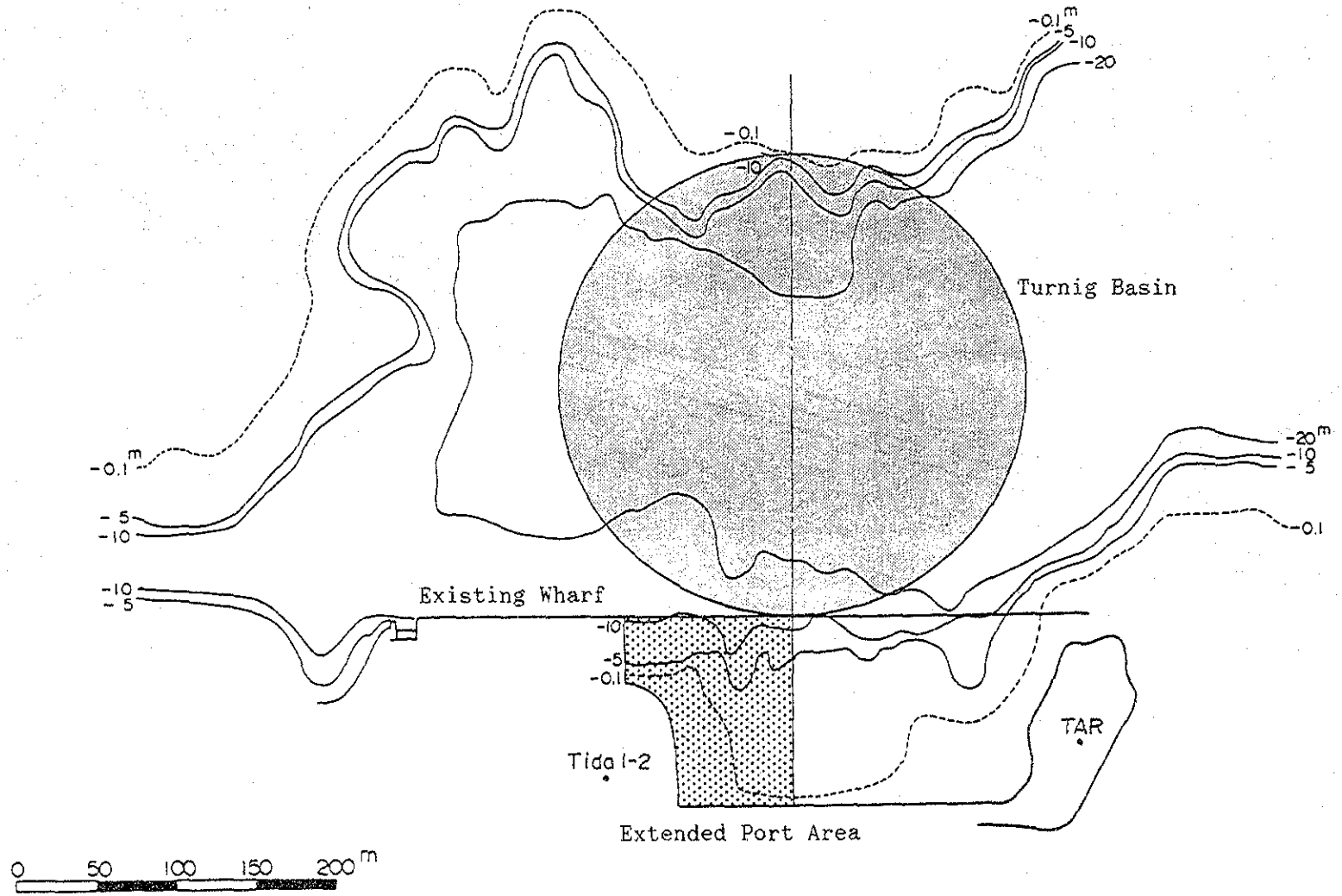


Fig. 4-1 Projected Plan of Extension of the Wharf

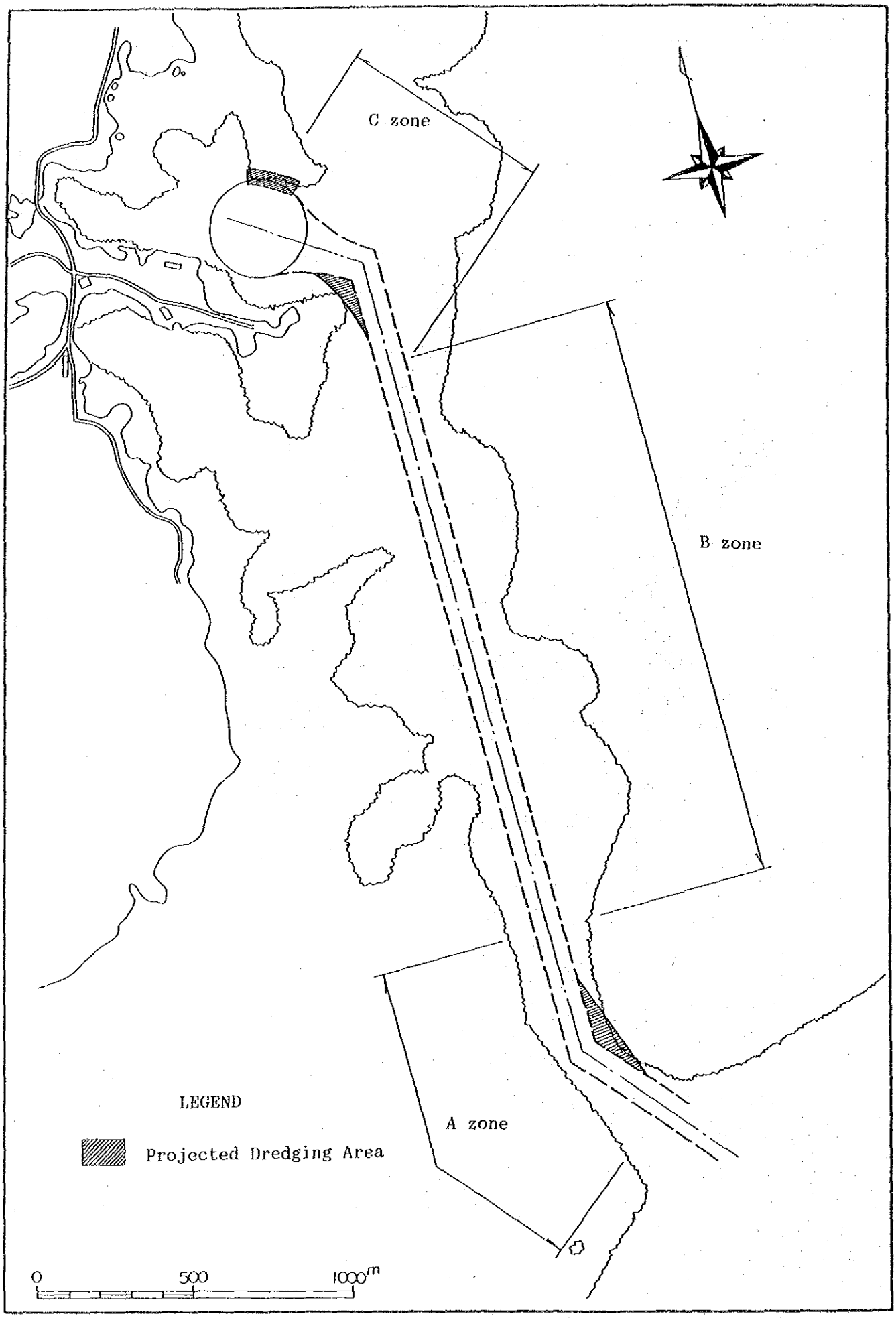


Fig. 4-2 Layout Plan of Channel

4.5 Plan for Administration and Operation

4.5.1 Organization for administration and operation

Port of Yap is under the administration of Yap State Government. Operation of port is controlled by the Office of Sea Port, Division of Transportation, Public Utilities and Contracts Department. Stevedoring service in this port is operated by a private company, Waab Transportation Co., under lease contract of port facilities from the state government.

The State Government of Yap is in charge of administration of the following matters:

(1) Administration of Port Facilities

Administration and maintenance of wharf and navigation aids

Permission for use of port facilities

(2) Control and Procedures

Port entry and departure

Allocation of basin and berth

Safety of navigation and order in the port

Number of staff in the Office of Sea Port are 7 at present, including Port Captain, Port Manager and clerks.

Waab Transportation Co., which is operating port services under lease contract of facilities from the State Government of Yap, is entrusted collection of port entry fee, wharfage fee, dockage fee, on behalf of Yap State Government, besides business operation of stevedoring, cargo handling and delivery, and storing service.

While fixed fee for lease of the facility to Waab Transportation co. is US$ 1,200 per year, Waab is also paying to the state 1 % of total income from port, excluding such fees as above mentioned. Waab is also responsible for submission of

(1) List of entry vessels,
(2) Gross tonnage of entry vessels,
(3) Stay time record of vessels,
(4) Manifest of cargo

to the state.

Number of staff of Waab engaging in port business are 26 including 16 field operators for cargo handling.

With implementation of the Yap Harbour Extension Project, facilities of port will be expanded and improved in the following points :

(1) Main wharf
(2) Navigation aid markers
(3) Forklift

Increase of the staff for administration and operation will not be required for the first two items. For operation of new forklift, the operator in Waab for present forklift will become available either under management of state or either under Waab, without any increase of cost for new personal.

As the conclusion, any change in administrative organization and in operational organization of port will not be required until new port authority system is introduced in Yap Port.

4.5.2 Organization Plan

Administrative organization for Yap Port in Yap State Government will

remain same as it is now, even after expansion of port activity by implementation of this project, and the staff will be consisted as the followings.

Port Captain	1 person
Port Manager	1
Officer	2
Clerks	2
Mechanical Engineer	1
Total	7 persons

4.5.3 Balance of income and operating costs

After completion of this project, increase of operating costs are estimated as below.

(1) Expenditure

1) Operation and maintenance cost of navigation aid markers

Operation cost (electricity)	0.2 kwh rate	US$ 800
Maintenance cost (painting of markers)	1 time/year	US$ 1,000
	subtotal	US$ 1,800

2) Operation and maintenance of forklift

To be covered and balanced by handling charge income

3) Maintenance of the expanded portion of the main wharf

Maintenance of fender etc.
(approximately 0.1 % of construction cost is assumed per year)

subtotal US$ 3,000

total US$ 4,800

Increase of cost is estimated at US$ 4,800 per year. This amount can be considered to be borne by state government budget, since the above amount is only 0.5 % of annual state budget of US$ 1,000,000. For reference, annual budget for Public Utilities and Contracts amounts US$ 2,682,000 in 1990.

4) Income

Increase of income due to this project are consisted of two items as below.

a. Increase of wharfage for extended portion of the main wharf

b. Lease fee income of new forklift

Actual amount for the above two items will be determined by negotiation with Waab, to cover increase of cost as shown above.

As an information for reference, lease fee of Waab owned 15 ton forklift is US$ 35 per hour. If the same fee is assumed for the new forklift, annual fee income of the state will be

US$ 35 x 8(hrs) x 100(boats) = US$ 28,000/y

and this assumption amount is more than enough to cover increase of expenditure for maintenance and operation including personnel cost .

As a conclusion, no problem is expected in administration and operation after the project is completed.

4.6 Technical assistance

As stated in the preceding section, administration of Yap Port is conducted by Yap state government and cargo operation is carried out by private company at present.

Yap state government is now contemplating to introduce and establish port authority system to simplify and unify management and operation of Yap Port, aiming at promotion of port activity in this port through strengthening of port management and expansion of scope of port services.

As increase of cargo throughput and increase of vessel call are expected in Yap Port after expansion of port facilities by implementation of this project, also enhancement of port management to higher efficiency will be an essential requisites for this port in short time.

Therefore, to attain the maximum benefits of this Yap Harbour Extension Project, technical assistance to train and upbring local specialist in port management field is also considered to be the most effective and indispensable procedure to promote and develop port activity of this port.

CHAPTER 5

ENVIRONMENTAL CONSIDERATION

CHAPTER 5 ENVIRONMENTAL CONSIDERATION

5.1 Background of Environmental Survey

A regulation concerning the environmental aspect in FSM is the Environmental Impact Assessment Regulation (EIA). An evaluation based on EIA is required before implementation of project which may affect environment. According to EIA, there are two types of environment assessments. One is the Comprehensive Assessment and it must be carried out in case when some strong impact is expected. In case when no significant impact is expected, only the Initial Assessment is required. In regard to this Project, EIA will be undertaken by Yap State Government as stated in the Minutes of Discussion signed in the Preliminary Study stage. Therefore, Yap State Government had requested the basic design study team assistance to carry out an environmental survey for submitting the application and obtaining the permission of the implementation of the Project.

On a series of discussions between the FSM authorities concerned and the basic study team during the site survey, it has been understood that the EIA for this project would only require the Initial Assessment because the impact on the environment by the implementation of the project is considered to be not significant.

And also it has been understood that FSM Government would require a Japanese Contractor to submit a work plan, when Yap State Government will submit an application to FSM Government to obtain permission on execution of the construction work, as stipulated in the Earth Moving Regulation in FSM.

In this chapter, the results of environmental survey and the check results in accordance to the Initial Assessment made by the Basic Study Team are described.

5.2 Results of the Environment Survey

The environmental survey were carried out with some members of EPA of Yap State at the approach channel area and the main wharf area for eighteen days from January 29th to February 15th 1990. The observation items obtaining the basic data for EIA are as followings ;

(1) Current
(2) Water quality
(3) Bottom material
(4) Marine life

Results of surveys are described in following sections.

5.2.1 Current

Current measurement were carried out by using a current meter (CM-2) and floats.

(1) Current observed by using current meter (CM-2)

Current observation was conducted in thirty minutes intervals for twenty five hours from 9:30 AM on February 2nd at the station shown in Fig. 5-1. The results of tidal current harmonic analysis are shown in Appendix IV. According to the results, the maximum tidal current speed was that of M2 component which was semidiurnal tide and was 6 - 12 cm/sec at each observation depth (-1 m, -5 m, -10 m).

The tidal speed by adding the main four component tides was 12 - 23 cm/sec. The maximum tidal speed were observed at -5 m depth and at -1 m. As the speed of permanent current was 1.4 - 2.5 cm/sec, which was only 8 - 11 % of total tidal speed, it was comparatively small.

In the time of mean spring tide, the direction of current was

observed from north to south during the period from high tide time to one hour before low tide time, and also it was from south to north during the period from low tide time to one hour before high tide time.

The maximum tidal speed during ebb current was recorded at 7 - 14 cm/sec after two hours from high tide time, and during flood current it was also 9 - 19 cm/sec after two hours from low tide time. Each maximum tidal speed of ebb or flood current during the observation are shown in Appendix IV. In every observed depth, flood current were stronger than ebb current and the speed of flood current were 1.5 - 2.0 times stronger than that of ebb tide.

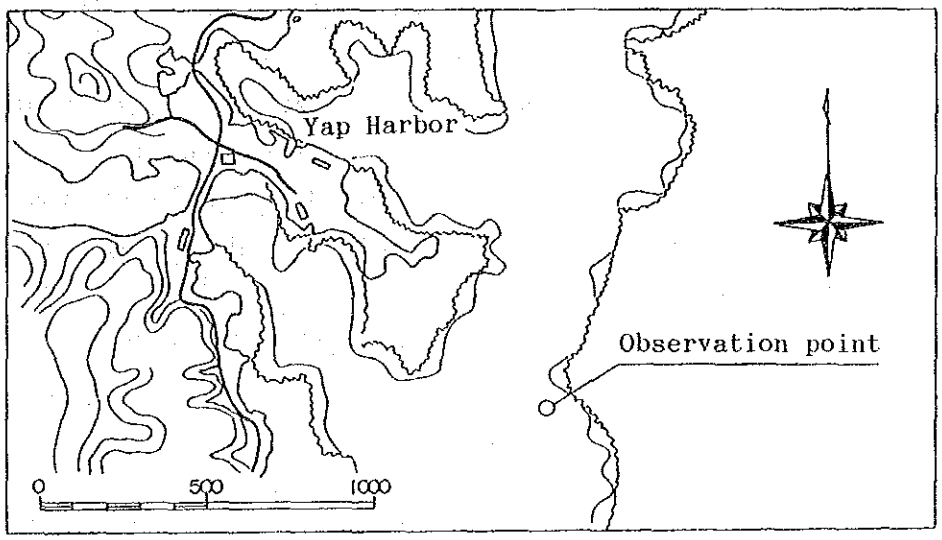


Fig. 5-1 Location of current pattern observation

Table 5-1 Maximum measured velocities

surveyed layer (m)	principal current direction (°)	maximum velocity in the principal current direction			maximum velocity in the anti-principal current direction		
		occurred time	velocity (cm/sec)	current direction (°)	occurred time	velocity (cm/sec)	current direction (°)
- 1.0	340	2.10 4:10	33.0	340	2. 9 17:00	20.0	150
- 5.0	350	2.10 5:30	0.0	0	2. 9 17:30	21.0	170
-10.0	0	2.10 5:30	25.0	10	2.10 0:30	13.0	150

From the results of current measurement conducted at the channel, on the reefs and around the wharf, the characteristics of current in these area is found that the semidiurnal tide is dominant and the current component of south-north direction is stronger than that of east-west direction, and that the tendency of reversing current in the direction of south-north is due to the topographic condition of the channel. Regarding to the current speed, the frequency distribution of the rank of 0 - 5 cm/sec was dominant (30 - 55 %), and the average current speed was 7 - 14 cm/sec.

(2) Float tracking

The float tracking were carried out in flood current (February 2nd and 7th) and ebb current (February 6th and 12th). Every float tracking showed same current direction from north to south, and current speed were 5 - 20 cm/sec. As to the results above, it is considered that the tide of those period was just in the middle between high tide and low tide i.e. the tide deference was about 10 cm, and therefore it would be affected by wind rather than by current. In fact, wind blew from north-east direction on February 7th and 12th.

(3) Summary of the current observation results

The results of the current observation are summarized as followings.

Current condition around the approach channel was a reversing current such as northward direction in the flood tide and southward direction in the ebb tide with the current speed being 10 - 20 cm/sec. Maximum current velocity observed was 42 cm/sec at -5 m depth.

According to the results of float tracking, they showed the direction of wind rather than current.

The current condition of this sea area is easily affected by wind

and waves. Generally it can be presumed that appearance frequency of current pattern as shown in Fig. 5-2 (1)-(2) is high. That is, water level in the lagoon rises by water mass transportation of waves into the lagoon and the water flow through the approach channel toward outer sea is predominant. Sometimes, current velocity will be faster than the records of this observation.

On the other hand, the northward current velocity at flood tide through the channel into bay will not be fast because of mass transportation effect mentioned above.

5.2.2 Water Quality

The locations of water quality observation are shown in Fig.5-3. Variation due to time and their distribution of water quality are shown in Appendix IV. According to the data in those Figures, water quality indexes in this area were 27 - 28 degree in water temperature, 34 - 35 in salinity, 1 - 6 in turbidity, 7 - 21 mg/l in DO and 8.0 - 8.4 in pH. These characteristics are almost same as that of clean sea water in tropical open sea. The fluctuation of value due to the tidal level is small and stable. The reason for this results is considered that there are no large scale land water or source of turbidity and that water circulation ratio in and out of the reef is very high. Though the observed values of 7 to 9 in turbidity at the proposed reclamation area and near the outlet of sewage, according to the results of SS analysis conducted at the same time, the contents was under 0.5 ppm, being not high as a component of turbidity.

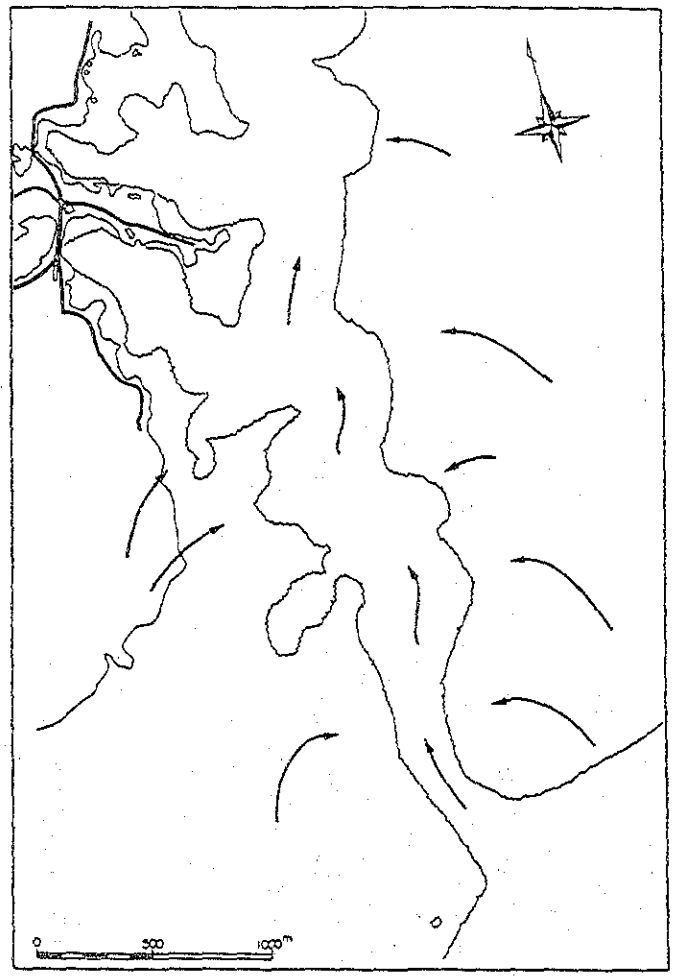


Fig. 5-2 (1) Current Pattern (in flood tide)

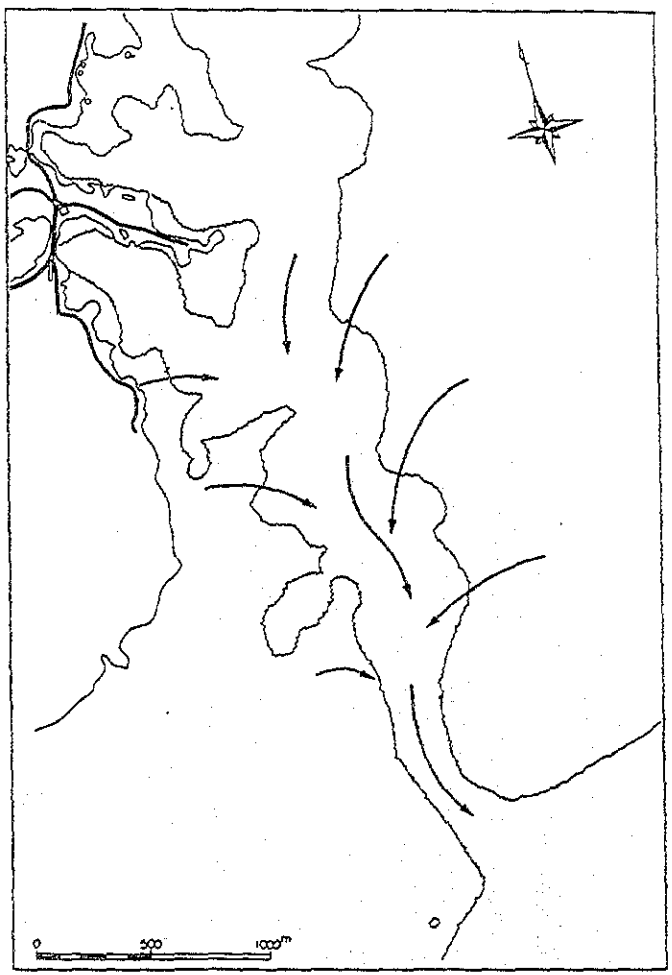


Fig. 5-2 (2) Current Pattern (in ebb tide)

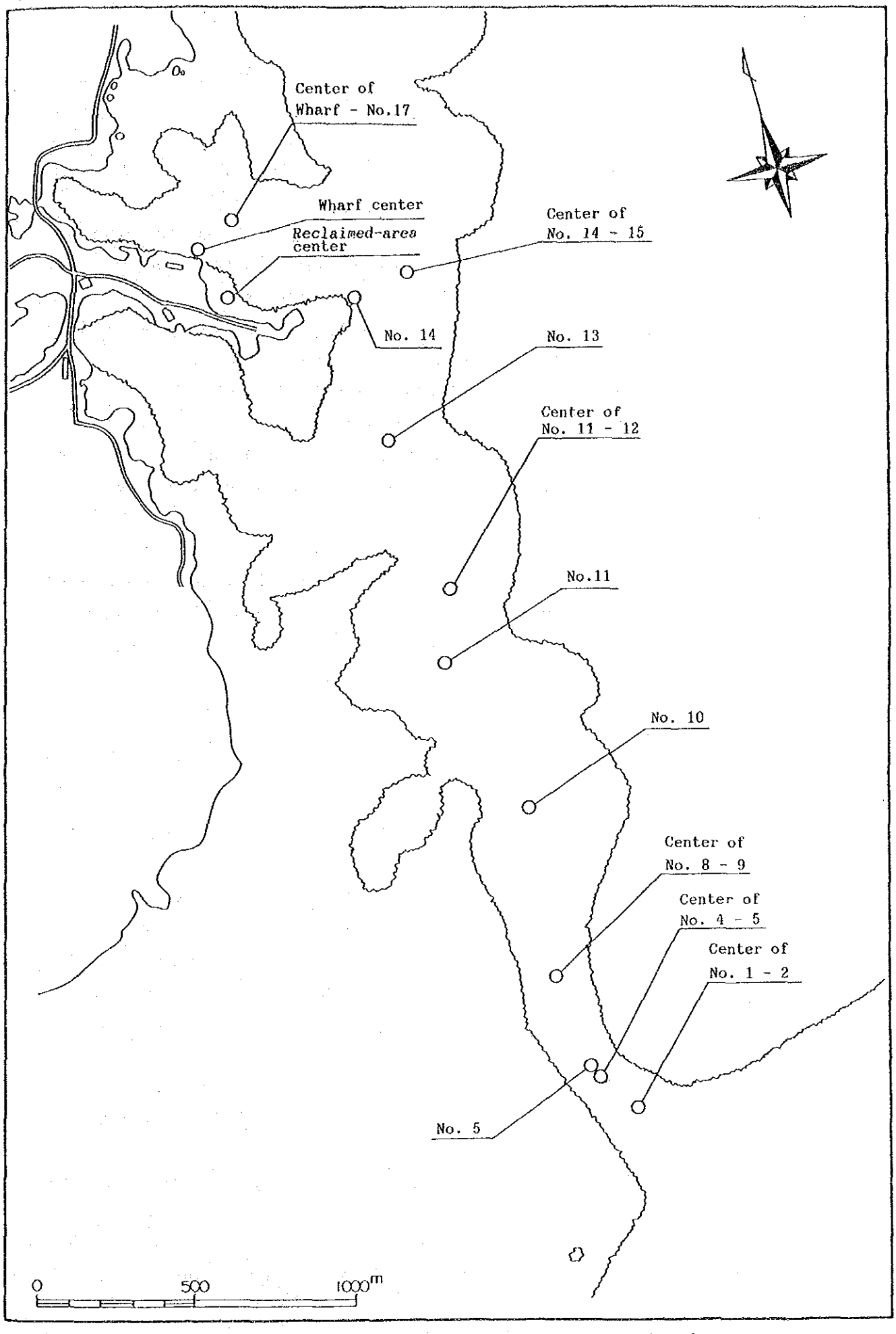


Fig. 5-3 Location of Water Quality Investigation

5.2.3 Bottom materials

Sea bottom in this area are generally covered by coral, covering ratio being about 90 %. Voids are filled with sand in between corals.

The results of sieve analysis for sand are shown in Appendix IV. According to the analysis, high percentage is occupied by coarse sand (2 - 0.42 mm). Silt component (under 0.074 mm) occupies less than 0.5 %.

Particle size at the reclamation area and Bn No.14 are larger than other area. This is due to the sorting mechanism by wave action in these shallow area.

According to the results of heavy metal analysis on samples collected at the reclamation area and near Bn no 1, any kind of harmful heavy metal were not detected as shown in Appendix IV.

5.2.4 Marine life

The results of visual observation on coral are shown in Table 5-2 and Fig.5-4. Covering ratio by coral were over 60 % except the reclamation area where the cover ratio is around 10 %. Main dominant species belong to Family Poritidae. In shallow area of the reef less than -2 m and reclamation area, sea grasses as Enhalus Acoroides and Thalassia hamprichii are distributed. The characteristic of the inhabitant such as corals and sea grasses are described below.

(1) Outside of reef (St.A)

Though water depth at St.A, which is located outside of the approach channel is deeper than -10 m, cover ratio of living corals is as high as 90 %. In this area, main dominant species were Porites Lutea, P. Rus, Diplastrea Heliopora and Turbinaria sp.

Particularly, large size Porites Lutea and Diploastrea Heliopora with more than 2 m diameter were observed at this point as shown in the photos attached in the Appendix IV.

(2) Approach channel area (St. 1,5,8,11,13,14)

Cover ratio of living corals in the approach channel at St.1, 11 and 13 are as high as 90 %, but at St. 5, 8 and 14 as low as 60 - 70 %. The dominant species are Porites Lutea, P. Rus at around the mouth of approach channel, with a tendency of increase of Porites Cylindrica toward inside of the channel.

Sea grass community of Enhalus Acoroides were found in shallow area less than -2 m depth at St.14.

(3) Reef area (St. R,L)

Cover ratio of living corals at two stations on the reef were around 70 %. Small community of Porites Lutea and P. Cylindrica are

seen scattered on coral sand.

On coral sand less than -2 m depth, sea grass community of Enhalus Acorides at St. R and Thalassia Hemprichii at St.L. were found.

(4) Reclamation area (St. B)

Cover ratio of living corals at the reclamation area was 10 %, and it was the lowest compared with other stations. Only Fungia sp. and Favia sp. were found. It is considered that the living conditions here for corals are not suitable due to the situation of sand rolling up by wave actions.

Small community of sea grass such as Thalassia Hamprichii were found in shallow area less than -2 m depth.

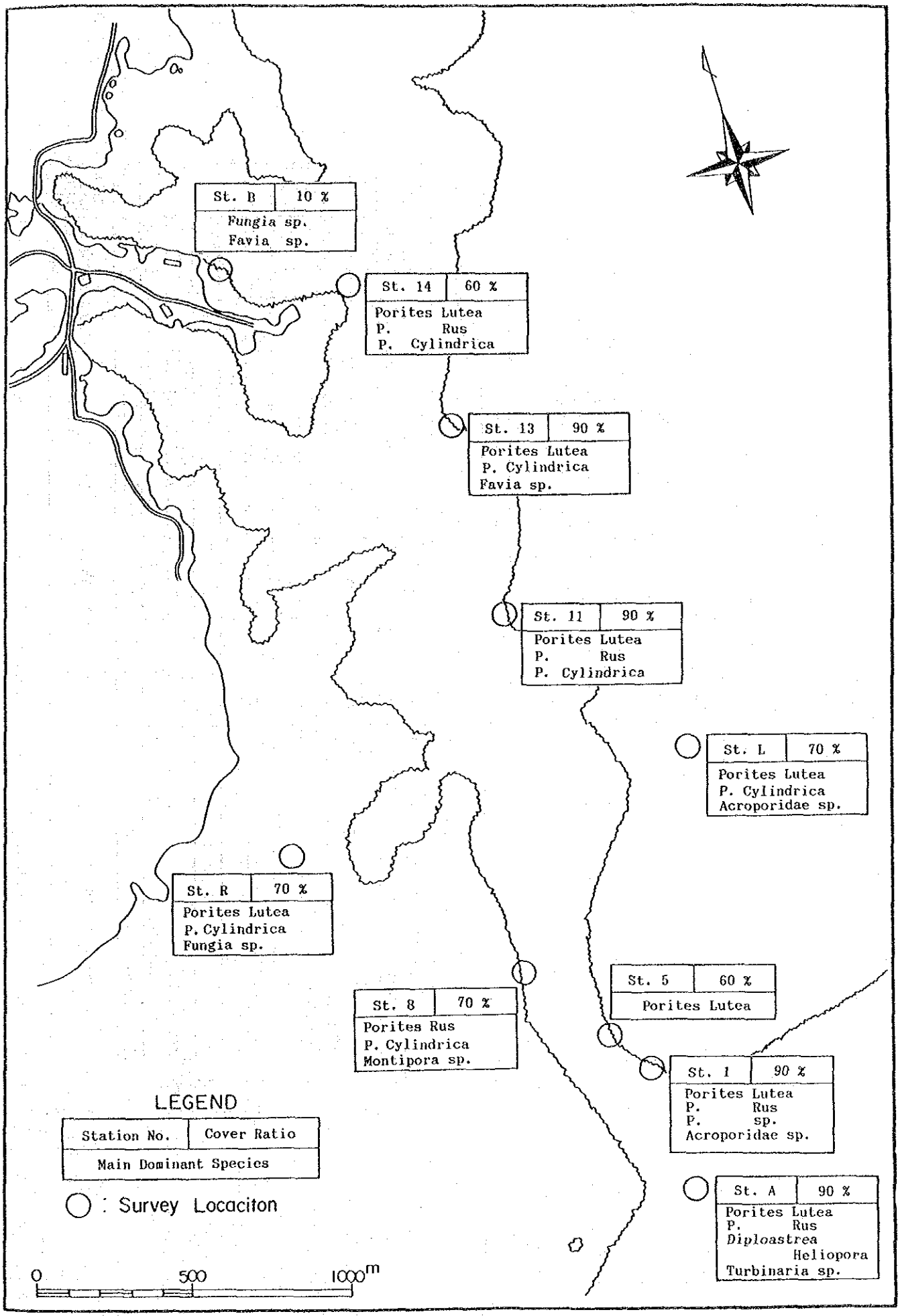


Fig. 5-4 Covered Ratio and Main Dominant Species of Living Corals

Main dominant species	Survey locatin	1.			5.					8.					11.				
	Cover degree%	90			60					70					90				
[Family] [species]	Depth (m)	2	4	10	2	4	6	8	10	2	4	6	8	10	2	4	6	8	10
Acroporidae	Acroporidae sp.		○																
	Montipora sp.													○					
Poritidae	Porites lutea	○	○		○	○	○	○	○						○				
	P. rus	○	○							○	○								○
	P. cylindrica									○		○	○		○	○	○	○	
	P. sp.			○															
Fungiidae	Fungia sp.																		
Faviidae	Favia sp.																		
	Diploastrea heliopora																		
Dendrophyliidae	Turbinaria sp.																		
Dominant Seagrasses		–			–					–					–				

Main dominant species	Survey location	13					14					A	B					R					L
	Cover degree %	90					60					90	10					70					70
[Species]	Depth (m)	2	4	6	8	10	2	4	6	8	10	10	2	4	6	8	10	2	4	6	8	10	2
Acroporidae sp.																							○
Montipora sp.																							
Porites lutea		○	○		○		○			○		○							○		○		○
P. rus											○	○											
P. cylindrica		○	○	○	○		○	○	○									○		○		○	○
P. sp.																							
Fungia sp.															○				○				
Favia sp.						○								○		○							
Diploastrea heliopora												○											
Turbinaria sp.												○											
Dominant seagrasses		–					Enhalus acoroides					–	Thalassia Hemprichii					Enhalus acoroides					Thalassia Hemprichii

Table 5-2 Covered Ratio and Main Dominant Species of Living Corals

5.3 Effects of the Project on Environment

5.3.1 Preliminary Impact Assessment

(1) Environmental Impact

Extension of existing wharf and the improvement of channel are included in this Project. However, the scales are not so large that the current social activities around the project area will not be suffered to change significantly by the implementation of the project.

Therefore, no item is evaluated as significant impact items according to Appendix A of EIA Regulation.

(2) Initial Assessment

As the result of above evaluation, only Initial Assessment is required for this project.

The results of preliminary examination by Initial Assessment program are shown in Appendix IV.

According to this table, considerable environmental factors by this project are the following three items.

1) Influence on current due to the modification of landscape by the channel dredging and the extended wharf.

2) Influence on water quality due to the increase of turbidity and the dissolution of harmful metals by dredging and reclamation works.

3) Influence on marine lives such as living corals and sea grasses by dredging and reclamation works.

5.3.2 Prediction of the influences

(1) Influences during construction works

1) Water quality

Occurrence of turbidity and dispersion of harmful metals are considered to be main influences on water qualities during the construction works.

According to the results of migration test analysis, harmful heavy metal are not extracted.

In regard to occurrence of turbidity, bed material at dredging area are coral rock and coral sand. The coral sand is consists of coarse sand in which sand component occupies more than 70 % and silt component is almost not contained. Therefore, it is expected that only slight turbidity will occur.

Even in case when turbidity would occur by dredging work and spread with the fastest current of 30 cm/sec, the materials of turbidity will not spread over the lagoon due to the current pattern as shown in Fig.5-3(1),(2) and will flow only along the channel, and will deposit into deep bottom of the channel.

Turbidity occurred by the reclamation works will not spread over large area because of slow current velocity of 5 cm/sec. at that area, and the sedimentation velocity will be fast because of large particle size.

As the conclusion of above consideration, it is expected that influence of turbidity will not be significant. However, it is advisable to prepare silt protector and use them when prevention of significant turbidity spreading found necessary in dredging and reclamation works.

2) Marine life

Influence on marine lives are removal and burying of them by dredging and reclamation works. Also, the turbidity occurred by those works will affect living corals and sea grass in the surrounding area.

However, as the construction area is small and the abundant same ecosystem are existing, influence damages on the marine lives will not be significant.

(2) Influence after completion of the Project

1) Current

Influence caused by the reclamation work will not become significant since reclamation area is small, and also the current velocity is small less than 5 cm/sec being adjacent to the existing wharf.

As the dredging area is limited, the current near the dredging area will be only slightly changed, and this change will not force to change the present current patterns in this area. Inflowing volume of sea water from off-shore through the channel will increase due to expansion of the channel cross section. However, as its increasing ratio is relatively small, significant change of the current is not be expected.

As the consequence of above, influence on current will not be significant.

2) Water quality

As there is no source of water polluting material from this project, any influence on the water quality around the reclamation area will not occur.

3) Marine lives

As mentioned above, influences for current and water quality caused by the dredging and reclamation work are small, influence on marine lives in this area will not be significant.

CHAPTER 6

BASIC DESIGN

CHAPTER 6 BASIC DESIGN

6.1 Design Policies

Basic design for this project facilities has been worked out, in this chapter, basing on the results of detailed analysis of all data and information collected by the site survey. The following are policies observed in the basic design of the Yap Harbour Extension Project, for the purpose of improving Yap Port's safe maneuvering and efficient cargo handling.

(1) To design the port facilities required for safe maneuvering and mooring, with the minimum cost.

(2) Moreover, to take into consideration the future extension of wharf in case of increase of calling vessels and cargoes.

(3) Basing on the natural conditions at the site, to plan the facilities to match other development plans, and also to plan the facilities easier to maintain .

(4) Taking local construction conditions into consideration to try to employ local workers and materials in order to activate the local economy in implementation of this project.

(5) To follow agreements with FSM officials on applicable law, regulations and standards on construction work as below.

* Basically Japanese codes and standards are applicable for this project.

* In regard to the influence on environment by such as dredging and reclamation, the local law and regulations should be observed under instruction of the officials concerned.

6.2 Basic Design of Port Facilities

6.2.1 Items included in this Project

The following items are the facilities included in this project, as prescribed in Chapter 4.

(1) The approach channel

For safe maneuvering of vessels, the approach channel is planned to be improved by dredging work as shown in Fig.6-1.

(2) The turning basin

For safe turning of vessels, the turning basin is planned to be improved by dredging work as shown in Fig.6-1.

(3) The navigation aid markers

Range marks to indicate safe entering passage are included in the plan. Also, in accordance with the re-alignment of the approach channel and the turning basin, navigation aid markers indicating dangerous points are planned to be improved by re-arrangement and by setting up of lighting apparatus.

(4) Extension of the main wharf

For the safe mooring of vessels, the main wharf is planned to be improved by extending the wharf length. The necessary length has been determined as the enough length to moor the Microspirit and the maximum container cargo vessel in this plan at a same time. The return portion is planned as a quaywall to moor the maritime service boat. On this return wall, ramp is provide to facilitate loading of landing craft.

(5) Accessory facilities of the quaywall

The following facilities are included in the plan.

1) Fender system
2) Mooring post
3) Curbing for traffic safety

(6) *Cargo handling equipments*

A forklift is included in this plan to improve efficiency of container handling.

6.2.2 Basic design of the proposed items

(1) Dredging plan of the approach channel

1) Maximum cargo vessel as the design base

Dead weight tonnage	:	10,000	t
Overall length	:	137	m
Width	:	19.9	m
Draft in full	:	8.5	m

2) Depth of the channel

Taking into consideration the fact that current vessels calling Yap Port are in part-cargo condition, the design depth of the channel is planned at -8.5 m, which is incidentally the same as the full draft of the planned maximum container cargo vessel.

3) Width of the channel

Width of channel is planned at least 100 m as prescribed in Chapter 4.

4) Location of dredging area

The most dangerous parts of the approach channel is the first 0.5 km section from the mouth of port (shown in Fig.6-2 with mark A), being the narrowest part and requiring a sharp turn at 40 degrees angle when vessels come into this port.

As this part of the approach channel is bent by 40 degree, according to the "Japanese Codes for Port and Harbour Engineering", dredging at inside corner of the channel is included for safe and smooth navigation.

The part of the channel marked with B in Fig.6-2 has sufficient width to maneuver avoiding shallows, and dredging are not included in this plan.

At the part C located at south-east of the main wharf, dredging is required for the same reason as for part A.

All dredged materials are planned to be used for reclamation fill work in behind the extending main wharf. The dredging plan of the channel is shown in Fig.6-1.

5) Side slope for dredging

Basing on the results of soil investigation, side slope of dredging cut sections are planned as followings.

Part A ; 1 : 1
Part C ; 1 : 2

6) Depth and width for excess dredging

Excess dredging have to be added in the work plan, on the above planning base depth and the width as field work allowances.

Part A ;	Excess dredging	depth	0.5 m
	"	width	4.0 m

Part C ; Excess dredging depth 0.5 m
" width 4.0 m

(2) Dredging plan of the turning basin

Planning basis for the turning basin is the same as for the channel,as prescribed in Chapter 4.

1) Lay out plan

Location : in front of the existing main wharf.

Area : area for a turning basin without assistance of tug boat is required at least 2 L in diameter (L : Overall length of vessels)

At present, the turning basin is large enough for the 2 L requirement. Considering offsets of strong wind affecting safety on turning, the turning basin is planned to be dredged with 315 m or 2.3 L in diameter, also to meet required volume of filling material for reclamation purpose.

2) Side slope for dredging 1 : 2

3) Depth and width for excess dredging

Excess dredging depth : 0.5 m
Excess dredging width : 4.0 m

Dredging plan of the turning basin is shown in Fig.6-2.

(3) Basic design of channel markers

Along port entering passage line, a set of range marks with lights to lead ship on safe course is planned to be installed at land side end of extended line of the course.

After improvement of the approach channel and the turning basin by dredging, channel makers will be re-arranged for indication of dangerous spots. These channel markers located close to the channel and the basin are planned to be installed with lighting apparatus with solar battery power.

Structure of channel markers are basically the same as the existing type. H shaped steel piles are to be driven into the sea bottom and channel marker are to be installed at the top of the pile. Layout plan of the channel markers are shown in Fig 6-4.

(4) Basic Design of the Main Wharf Extension

1) Design base requirements

a. Maximum cargo vessels in Design : 10,000 DWT Cargo vessels

b. Design requirements

Quaywall

Design depth : Main Wharf -10.5 m

: Return Wharf -3.0 m

Note 1 : Sea bottom of extending quaywall has been already dredged to -10.5 m during construction of the existing quaywall.
Therefore, the design depth is determined to be -10.5 m.

Note 2 : Return portion is planned to be used for mooring of maritime service boat.

Note 3 : At end of return quaywall, ramp is planned to be used landing craft.

Length of new quaywall

Main Quaywall : 112 m

Return Quaywall : 35 m

Ramp way : 10 m

Ground height of quaywall +3.2 m
(same as the existing wharf)

Width of apron : 19.2 m (same as the existing wharf)

Access parts of new quaywall ;

At west end of the extending main quaywall, jointing to the existing quaywall, steel sheet piling access is planned to be installed in 4 m long section for stability of the structure.

Steel sheet piling revetment is planned for 10 m section from the end of ramp quaywall as a transition part to revetment.

Revetment ;

At east end of transition part above, to reach the causeway, 90 m long rubble mound type revetment using coral blocks are planned.

c. Design Loading

Surcharge load ; Normal time : 2.0 t/sq. m
Seismic time : 1.0 t/sq. m

Berthing speed of ship hull

Maximum berthing speed of ship's hull perpendicular to quaywall : 0.3 m/sec

2) Natural conditions

a. Tide

H.W.L. +1.6 m
L.W.L.(D.L.) +0.00 m
Residual Water Level is +1.0 m for the design purpose

b. Earthquake intensity

KH = 0.15

c. Soil condition

Present water depth on the extending pierhead line is at maximum -10.5 m. Behind the pierhead line the sea bottom is sloping up at gradient of 1:3 to 1:4.

Angle of internal friction (ϕ) of sea bottom soil layer is assumed at 30^{o}, according to the result of boring survey.

Back filling material behind the quaywall is planned to use crushed coral rock dredged from the channel. Angle of internal friction (ϕ) is assumed at 35 degree.

Land side beyond 5 m from the quaywall is to be reclaimed by dredged soil disposition.

3) Materials

a. Unit weight

Steel	: 7.85 t/m3 (in air)
Reinforced concrete	: 2.45 t/m3 (in air)
Concrete	: 2.30 t/m3 (in air)
Sea water	: 1.03 t/m3 (in air)
Soil	: 1.80 t/m3 (in air)
	: 1.00 t/m3 (in water)

b. Allowable stress for concrete

Design compressive strength : 240 Kgf/cm2

Allowable compressive strength : 90 Kgf/cm2

c. Allowable stress for steel

Steel type	SY24	SY30	SY40	
Bending tensile stress (per gross sectional area)	1,400	1,800	2,400	Kgf/cm2
Bending compressive stress (per gross sectional area)	1,400	1,800	2,400	
Shearing stress (per gross sectional area)	800	1,000	1,800	

4) Basic design of quaywall

a. Type of the quaywall structure.

In this project, steel sheetpiling type can be considered the best suitable for foundation soil condition and for saving locally expensive concrete materials.

b. Basic design of the quaywall section.

Following four sections are planned in basic design.

* Main quaywall section d= -10.5 m, l= 112 m
* West access section d= -10.0 m, l= 4 m
* Return section d= -10.5m to -3.0 m, l= 35 m
* Ramp section d= -3.0 m l = 10 m
* East transition section d= -3.0 m to -1.0 m, l= 10 m

c. Anchor pile : H shaped steel pile, interval 2.0 and 1.6 m

d. Wale : H shaped sections, 2 units.

e. Tie-Rod : Tie-bull type

f. Capping concrete : Reinforced concrete in -0.5 to +3.2 m range

g. Apron concrete : Width 19.2 m, thickness 0.3 m

5) Ancillary facilities

a. Fender system

Rubber fenders of V-Type are adopted with average interval of 3 m, as the same one as for the existing quaywall.

b. Mooring posts

30 ton bollards are planned to be installed at 30 m interval. 100 ton bitt is to be installed at southeast corner of the expanded quay wall

c. Curbing

Total 147 m length of concrete curbing is to be installed at the top of cap concrete.

6) Container yard

Container yard is planned at reclamation land area behind the apron up to the causeway.

Surface course is proposed to be of compacted improved material for stabilization. Average land elevation is designed at +3.3 m.

7) Others

Drainage : for drain of rain water in the container yard

Lighting : for illumination of the apron and the yard at night

Power Outlet : for power supply to refrigerating containers

Fence : for boundary between yard area and outer areas

6.5 Basic design of Forklift

Present forklift of 15 ton capacity is degraded by aging and wear in lifting capacity, and is unable to lift charged 20 feet container. In basic design, replacement of the above forklift with new one is included.

Capacity and specification shall be the one to satisfy the following requirement.

(1) Size of container to be handled	: 20 and 40 feet	
	gross weight	30.5ton
(2) Stacking of container	: 3 stacks	
(3) Lifting method	: fork lifting	

6.3 Drawings

(1) Layout plan of the approach channel (Fig. 6-1)

(2) Layout plan of the turning basin (Fig. 6-2)

(3) Location plan of the new and improved navigation aid markers (Fig. 6-3)

(4) Plan of extension of the main wharf (Fig. 6-4)

(5) Structure plan of the quaywall (Fig. 6-5)

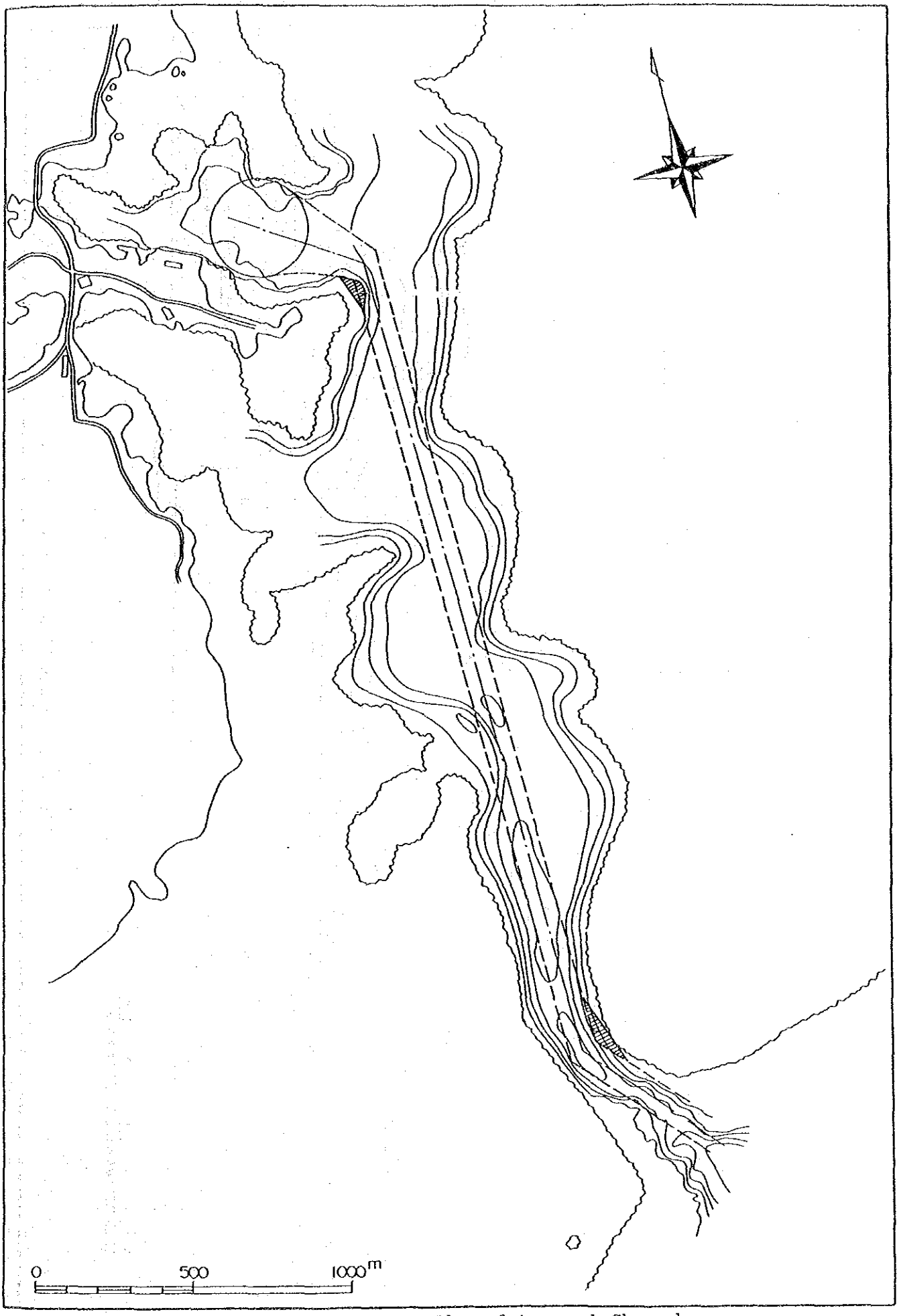


Fig. 6-1 Layout Plan of Approach Channel

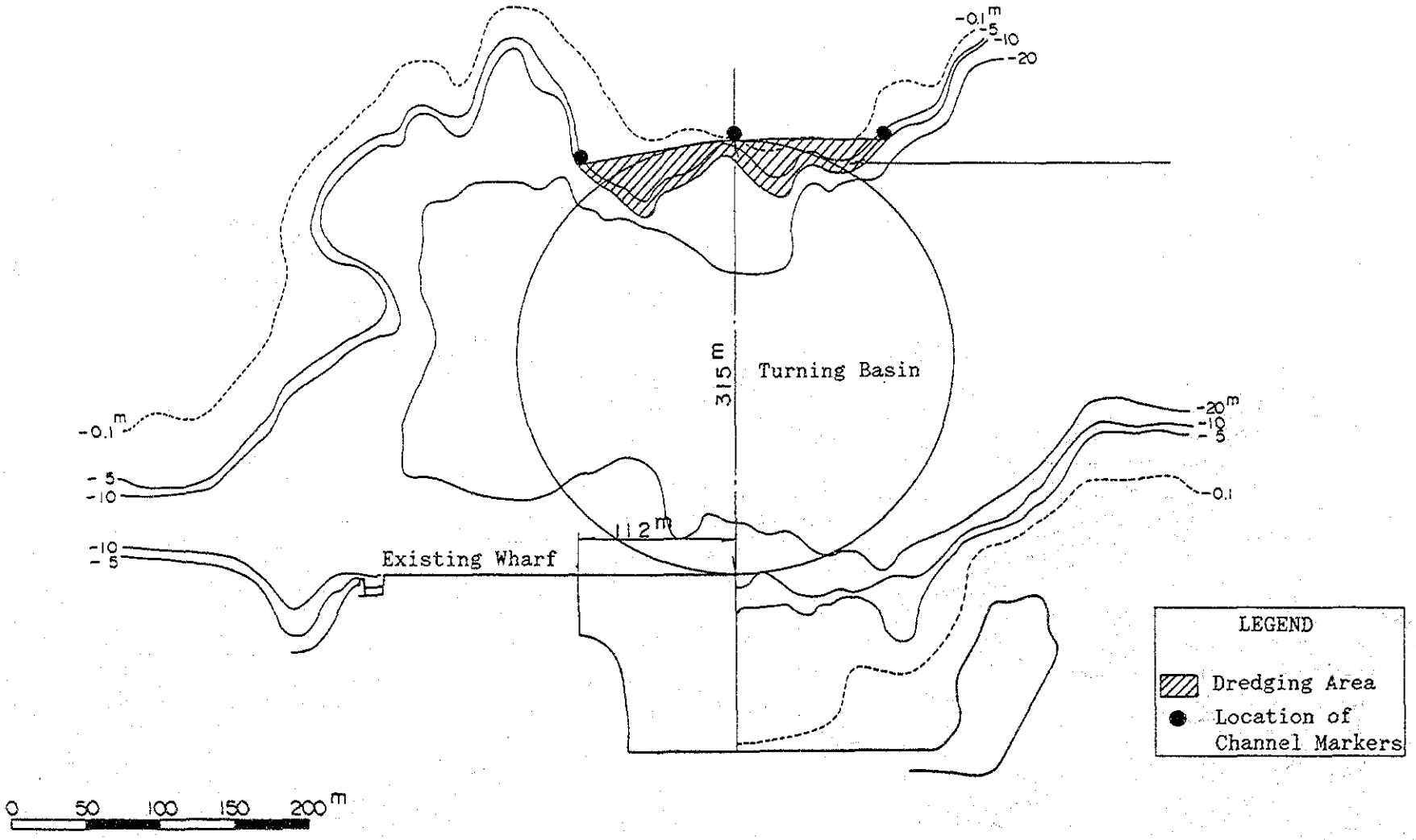


Fig. 6-2 Layout Plan of Turning Basin

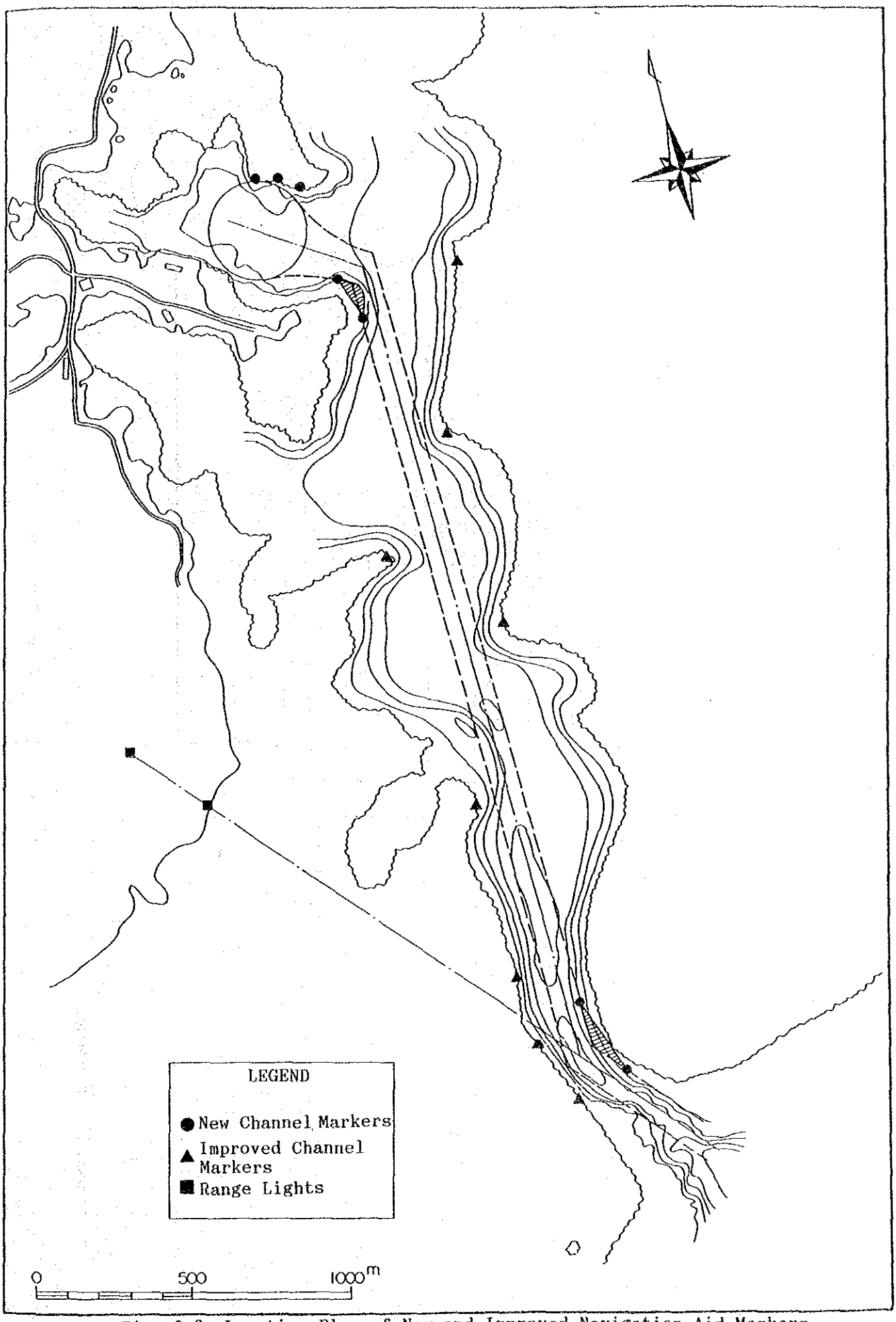


Fig. 6-3 Location Plan of New and Improved Navigation Aid Markers

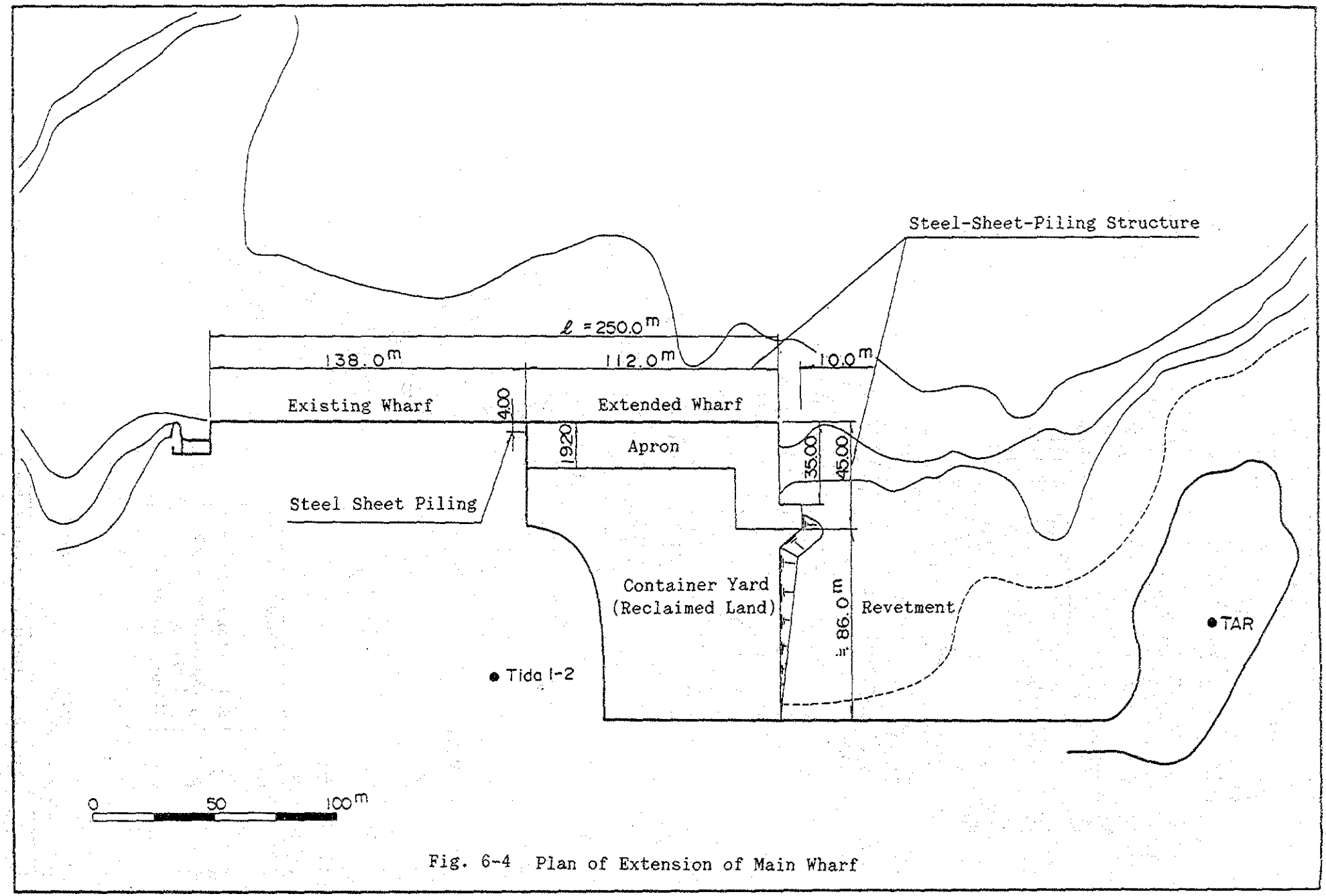


Fig. 6-4 Plan of Extension of Main Wharf

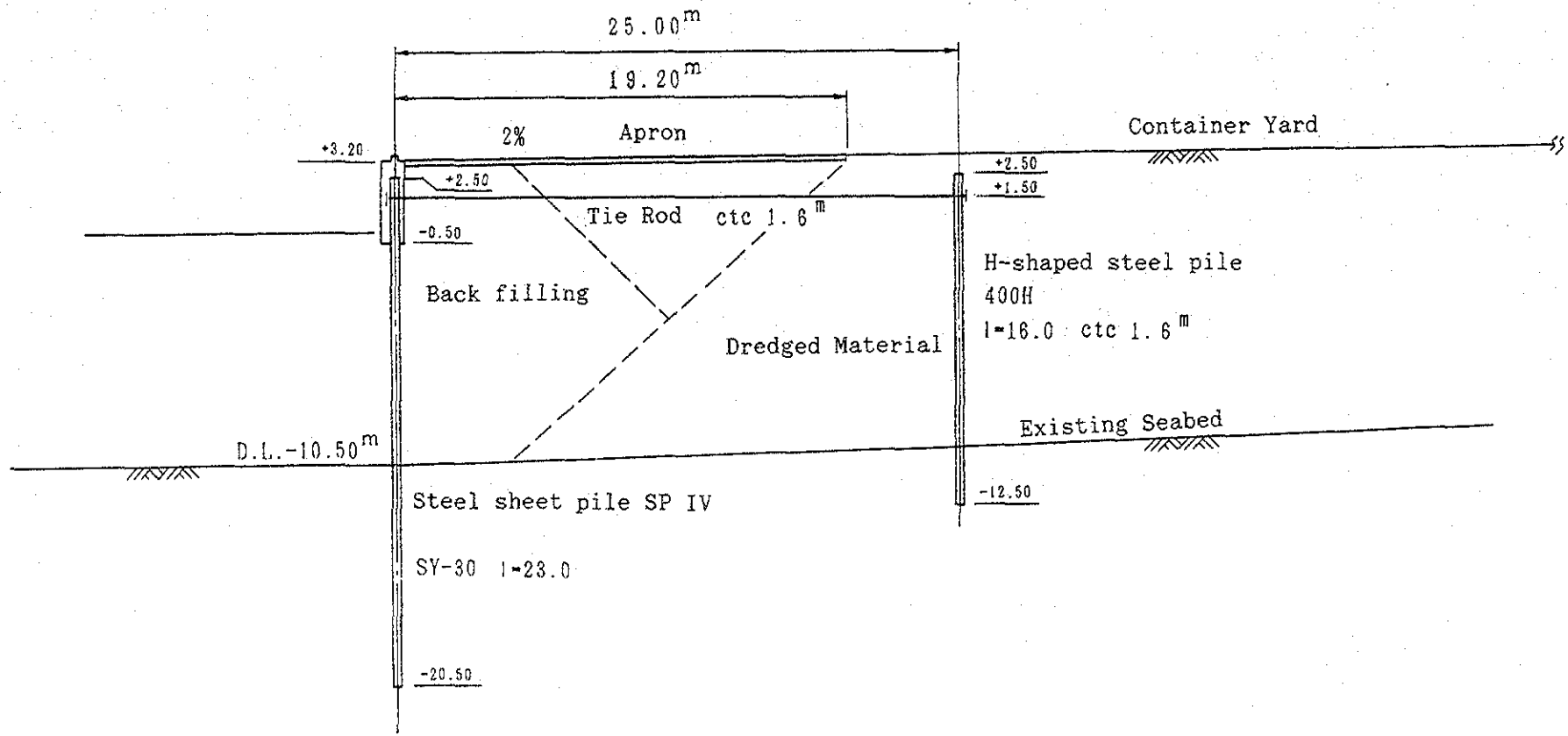


Fig. 6-5 Typical Cross Section of Extension of Main Wharf

CHAPTER 7

PROJECT IMPLEMENTATION PLAN

CHAPTER 7 PROJECT IMPLEMENTATION PLAN

7.1 Construction condition in Yap.

(1) Working hour

Normal working hour	:	7:30-12:00, 13:00-16:30
		Total 8 hrs/day
Working day	:	Monday to Friday
Public Holiday	:	5 days/year

(2) Minimum wage : 0.8 $/hr.

(3) Construction Standard

Both civil and building work are based on the US code and standard. In this project, in civil works, Japanese Standards are also basically applicable.

(4) Annual working days

Annual working days except holidays and bad weather days can be assumed 260 days. Dredging work at the mouth of the approach channel should be avoided during windy season from December to March.

(5) Local construction firm

Several construction firms which have experience in public construction project and private construction work are available in vicinity.

Local	:	Josman Company
	:	United Builders of Yap
International	:	Black Micro Construction
	:	You One Construction Co.

: International Bridge Company.

(6) Construction equipment

Special work vessels such as dredger, barge, tug boat etc. required for this project are not available locally.

Department of Public Utilities and Contracts, Yap State and private construction firms in Yap own construction equipments. It will be difficult to hire them from PU&C because of policy of priority for their own construction project.

(7) Construction Materials and Construction cost

Most of construction materials, such as cement, aggregate, steel, etc. have to be imported. Only coral sand is obtainable locally. Since interval of call of cargo vessels to Yap is about once a month, logistic plan for the project should be made carefully.

7.2 Policy for Construction Planning

7.2.1 Basic policy

Construction work of this project shall be implemented under the following basic policies.

(1) Construction work should be proceeded in full compliance with laws and regulations of FSM. Especially, consideration for environmental protection in execution of works are required in this project.

(2) Work schedule plan should be under observance of local labor custom.

(3) Procurement plan and employment plan should be the one paying

full attention for utilization of locally available sources, following Japan's grant policies.

(4) Required material and skill and method for the construction should be the ones to meet the local condition.

(5) Construction method should be to minimize construction cost.

7.2.2 Undertaking of both countries

Scopes of undertakings for the Government of FSM and the Government of Japan are as followings respectively.

(1) The Works to be borne by the Japanese grant assistance are design, construction, and supervision of the followings.

1) Improvement of the approach channel and the turning basin by dredging.

2) Improvement of the navigation aid markers by installation and re-arrangement and application of lighting instrument.

3) Extension of the quaywall and reclamation of the land for container yard and installation of related facilities.

4) Provision of a forklift and environment monitoring equipments.

(2) Works to be borne by the FSM are the followings

1) Initial environmental assessment for the the project, with assistance of Japanese consultant.

2) Approval of implementation of construction works basing on contractor's plan as required by the Earth Moving Regulation.

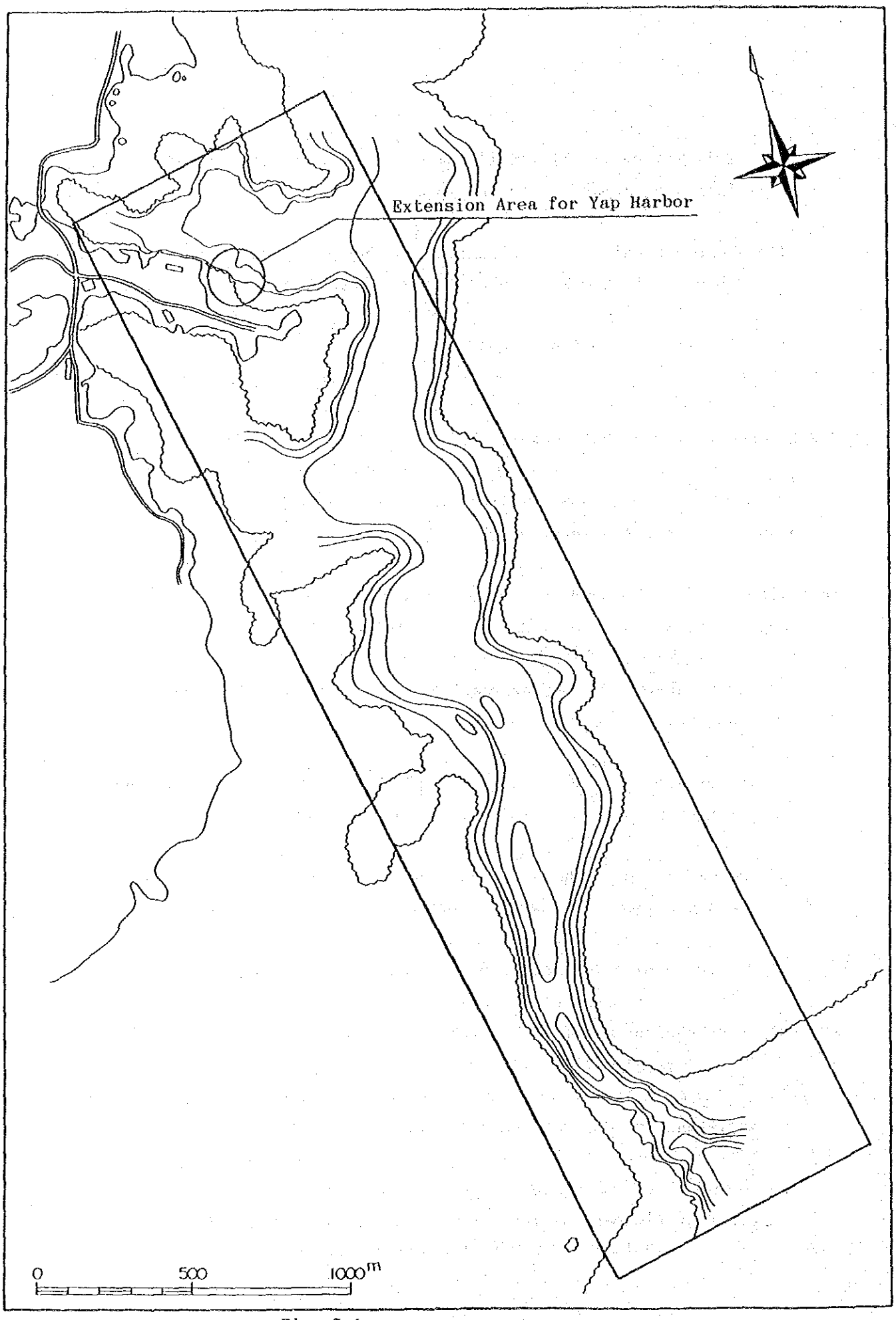


Fig. 7-1 Construction Site

3) Acquirement of land and reef area required for the project. (Fig-7.1)

4) Provision of utilities such as electricity, water supply, drainage, telephone, at the boundary of project site.

5) Supply of data and information required for design and construction works.

6) Custom clearance and transportation of construction materials and equipments to be used up to the project site.

7) Tax exemption on construction materials and equipments.

8) Tax exemption on income of Japanese firms and staffs for the project.

9) Entry and work permits for Japanese staffs for the project.

10) Appropriate use and good maintenance of the granted project facilities.

7.2.3 Organizations of project implementation

The FSM organizations responsible for implementation of the project are as followings.

(1) Tender and contract

Department of External Affairs, Federated States of Micronesia

(2) Coordination of the project implementation

Department of Transportation, Federated States of Micronesia

(3) Control of Construction Work

Department of Public Utilities and Contracts, Yap State..

(4) Administration and maintenance of the Facilities

Department of Public Utilities and Contracts, Yap State

Tender and contract procedures for this project are to be conducted by the government of FSM with assistance of a Japanese consultant, and construction works are to be controlled by the State Government of Yap with assistance of the consultants.

Administration and maintenance after the completion of the project facilities are to be undertaken by the State Government of Yap.

After exchange of diplomatic notes between both governments, a contract shall be concluded between the government of FSM and a Japanese firm for consultation service on this project.

The consultants shall prepare all tender documents such as drawings, technical specifications, cost estimation, conditions of contract etc. necessary for construction contract.

Contractor for this project shall be a Japanese construction company selected by pre-qualification and price bidding.

Construction works shall be performed by the selected contractor in accordance with the contract.

7.3 Construction Method

In implementation of the project, careful consideration must be given to marine work condition and procurement condition of material and equipment for construction including work vessels.

Main construction equipments such as work vessels have to be brought in from Japan for effective and economical performance of the construction works.

Necessary means should be taken to prevent the dispersion of siltation during dredging and reclamation works.

7.3.1 Construction Methods

(1) Improvement of the approach channel and the turning basin

Dredging work in the channel and the turning basin shall be carried out by grab bucket dredger with rock breaker.

Dredged material shall be transported and dumped into the reclamation area for container yard and the quaywall extension by barge and tugboat.

Silt protection curtain shall provided to be used when instructed, to prevent spreading of turbidity, during the dredging and dumping.

Barges shall have provision not to spill silty water and soil during transportation.

For protection of environment and prevention of accident, searching of explosives such as remained bombs and shells in dredging area by use of magnetic metal detector shall be conducted on each layer of dredging work.

(2) Improvement of navigation aid markers

Posts of range markers are to be installed on concrete foundation buried in ground on land area.

Steel pile for markers in sea area should be driven into ground by pile driving equipment on barge.

Concrete shall be placed around driven pile to prevent scouring.

(3) Wharf construction

First, dredged soils shall be damped in the area for election of anchor piles by forming a berm mound. Then anchor pile are driven into this mound.

Then sheet pile are driven into seabed along the pierhead line. After installation of tie rods, back filling shall be taken place with care not to develop deformation of sheet pile wall. Then concrete capping is to be applied.

Then installation of fender and bollard etc. are taken place.

After compaction of base course, on ground surface, concrete pavement for apron is to be placed.

7.3.2 Logistic problem of material and equipment

The major construction materials for this project are steel, cement and sand for reclamation. Construction materials except sand are to be imported and the logistic plan of these materials and mobilization of construction equipments shall be carefully established for successful project implementation.

7.3.3 Work scheduling

Civil works, especially marine works, are frequently affected by natural conditions such as wind and wave, current and rainfall etc. For

dredging works, a critical condition is wave at the mouth of the approach channel, and in north east trade wind season, dredging at this part should be avoided.

Also, high temperature rise should be taken into consideration in concrete work.

7.3.4 Operators for equipments.

Unskilled labors and some kind of skilled labors can be locally available, while skilled operators for dredging work, pile driving work, etc., needed to be mobilized from overseas.

7.4 Construction Supervising Program

For this project, by the policy set forth by the Japanese Government on grant aid project, consultant services are required in regards to detail designing, tendering procedures and construction supervising works all through the works term, to be performed by a team organization. During the supervising stage, the consultant is requested to dispatch resident supervisor with appropriate technical competence to the construction site, to provide guidance on the project works and to maintain liaison between the owner and the contractor.

7.4.1 Basic policies of construction supervision

(1) To aim at completion of all the facilities keeping construction schedule without delay, maintaining close contacts and reporting with the concerned authorities and personnel in charge in both countries.

(2) To offer timely and adequate guidances and advice to the contractor in execution of the works so as to construct all the facilities in conformity with design documents.

(3) To encourage use of a local construction method applying local materials as much as possible.

(4) To realize technology transfer with respect to construction methods and techniques and thus maximize benefits of a grant aid project.

(5) To provide appropriate advice and guidance on administration and maintenance of facilities, after completion and delivery, for their smooth operation.

7.4.2 Details of supervision services by the consultant

(1) Assistance in construction contract procedures

For selection of construction contractor, the consultant is requested to prepare construction contract forms, to examine proposed schedule and construction price, and to witness in awarding of construction contract.

(2) Inspection and approval of working drawings, etc.

The consultant is requested to check working drawings, construction materials and samples proposed by contractor.

(3) Instruction and reporting on construction works.

The consultant is requested to examine work plans and work schedule, and to instruct the contractor, and to report the progress of work to the executing authority.

(4) Assistance in preparing payment approval procedure.

The consultant is requested to assist the owner in examination and in processing of contractor's bills for construction cost payable and after a completion.

(5) Witnessing inspections.

The consultant is requested to inspect the works in progress during construction as necessary and to offer guidances to the contractor. Upon confirmation of completion of the construction and fulfillment of the terms and conditions of the contract, the consultant is also requested to witness delivery of the facilities of the contract. With the government's confirmation of acceptance thereof, the consultant terminate their duties.

The consultant also shall report to the concerned authorities of the Government of Japan, on necessary matters concerning progress of construction works, payment procedures, and delivery of completed facilities.

The organization chart for construction supervision is shown in Fig. 7-2.

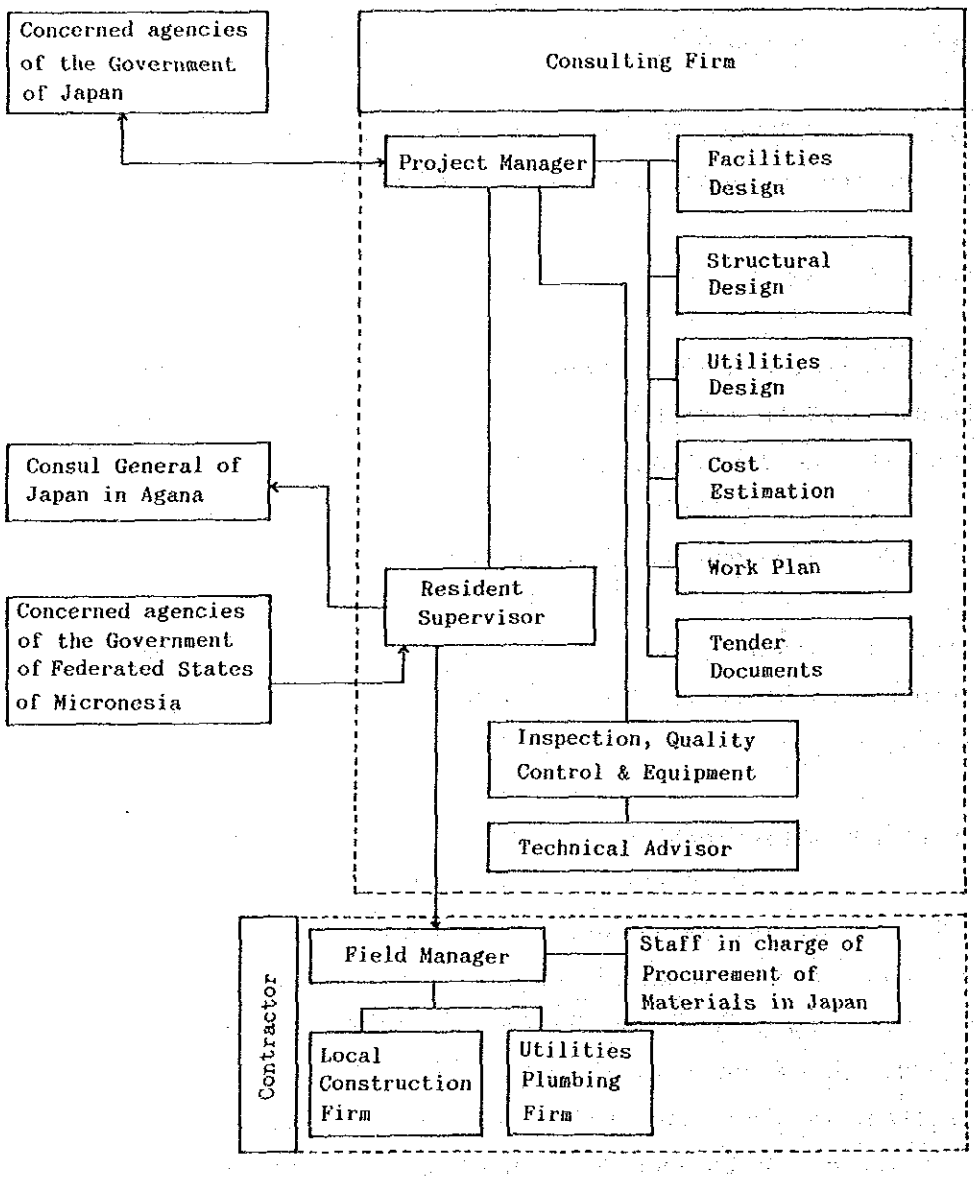


Fig. 7-2 Organization Chart for Construction Supervision

7.5 Environment monitoring program

During dredging and dumping works, monitoring check observation on environments are requested to be taken place at several basic points as shown in Fig 7-3, in order to evaluate the effect of turbidity dispersion from dredging and reclamation work area.

Supplemental observation points on turbidity in surrounding area will be added to the basic points following progress of construction work. Observation items are turbidity, water temperature and salinity by use of monitoring equipments.

In case when the monitoring observation records being much over the base line value, and effect of construction work becoming significant, necessity step such as modification of work method, installation of silt curtain can be requested.

Regular observation is recommended to be taken place once a week at the basic monitoring points. Supplemental observation will be done around work site following progress of the work.

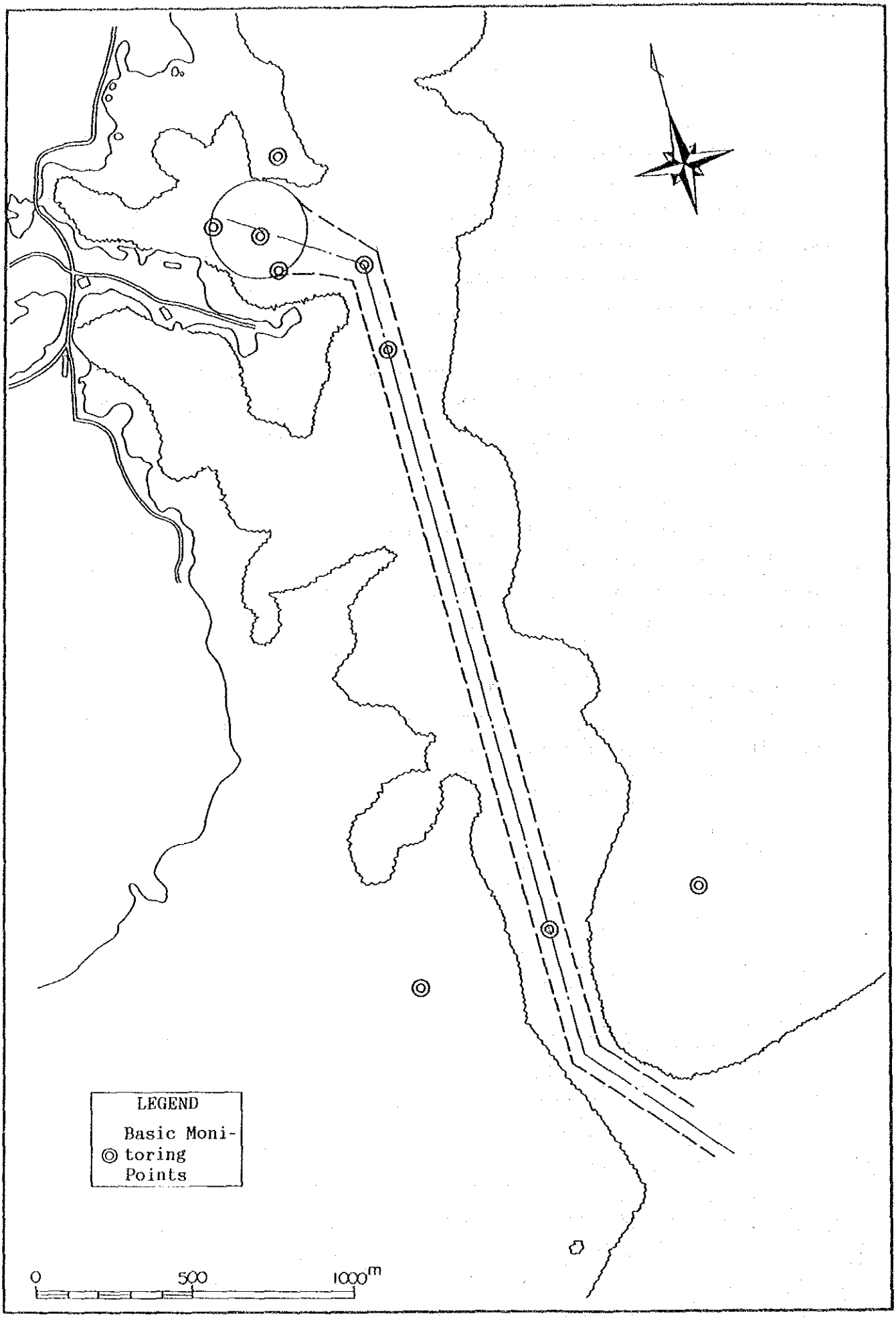


Fig. 7-3 Environment Monitoring Points

7.6 Construction Schedule

Construction terms are consisted of two terms. In each term, after exchange of diplomatic notes between both governments, overall 12 months will be required for each term, totally being 24 months (Table-7.5).

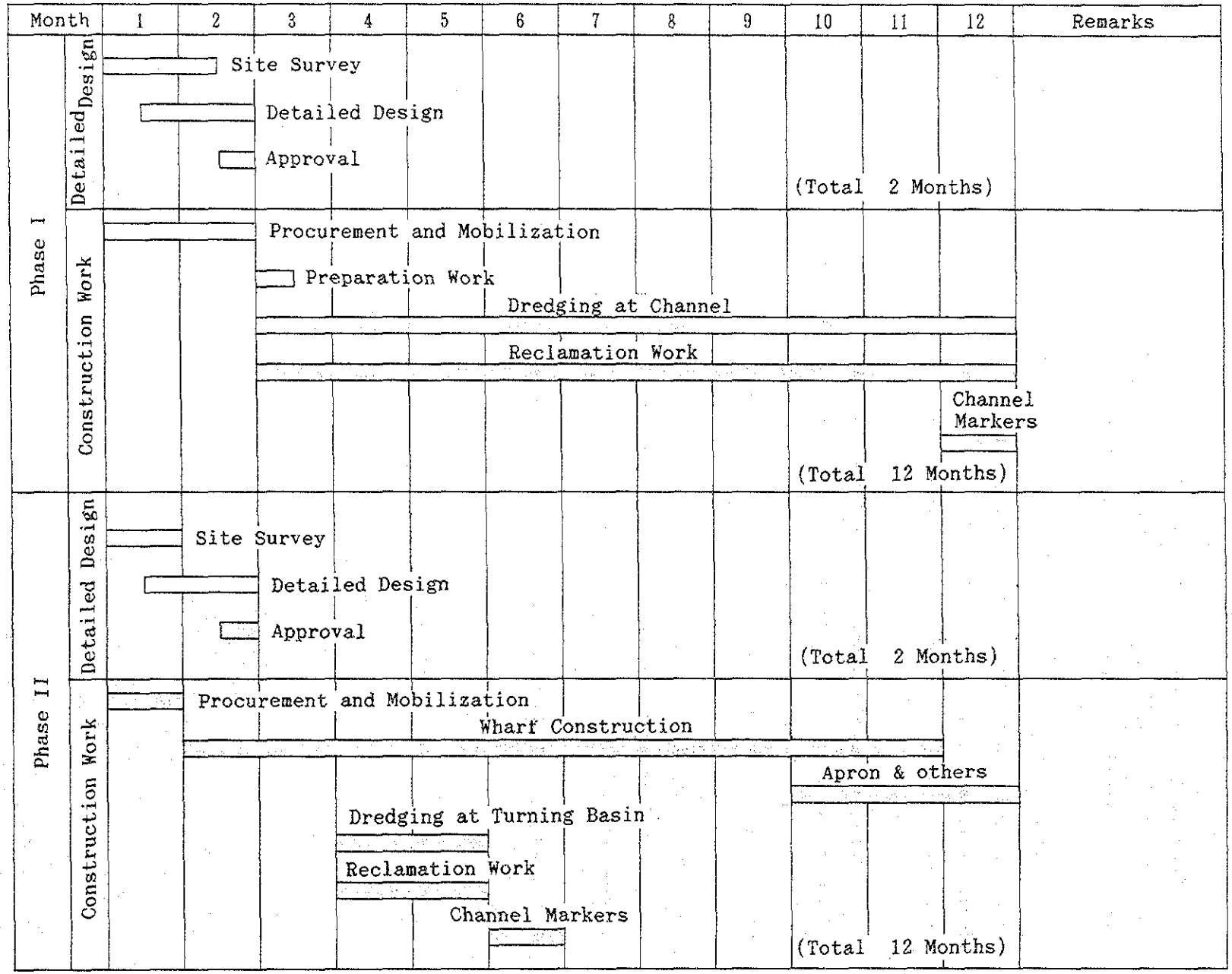
Following the exchange of notes, a Japanese consultant firm will be selected and awarded consultation work contracts for each term. Detail design work and contract procedure will take five months before selection of construction contractor for the first term.

During 19 months after the first construction contract, construction of the first term, all procedures for the second term, namely the exchange of notes, detail design, construction work of the second term will be taken place and completed.

The contents for the phase one are improvement of the approach channel and improvement of navigation aid markers. For the phase two, improvement of the turning basin and the extension of wharf are included.

Outline schedule of the project implementation are shown in Table 7-1.

Table 7-1 Construction Schedule



CHAPTER 8

BENEFITS OF THE PROJECT AND CONCLUSION

CHAPTER 8 BENEFITS OF THE PROJECT AND CONCLUSION

8.1 Effects by the Project

Yap port is situated at the base position of cargo traffic center, playing very important role to maintain and to develop life and economy of Yap State. Almost all goods and materials are imported and exported through Yap port in the State, and grade up or down of port function affect directly the life of Yap people. In such an important infra-structure, from the result of analysis in the basic design study, the following problems are pointed out.

1) Safety navigation problem for entering boats due to the narrow approach channel and the turning basin and also inadequate navigation aid markers.

2) Safety mooring problem at the existing wharf due to insufficient length to accept the maximum size cargo vessels.

3) Inconvenience for Microspirit which is obliged to evacuate to mooring basin at each time when main cargo vessel comes to the wharf, suspending her own works.

4) Degradation of cargo handling efficiency and capability due to superannuated cargo handling equipments .

As mentioned in the New Development Plan of Yap State, to solve above-mentioned problems and to upgrade facilities of the Yap Port as a base port of cargo traffic are considered to be the most important infra-structure development, for strengthening economic base of Yap State.

The benefits of the project are evaluated qualitatively as mentioned in the following section. As the consequence, the Yap Harbour Extension Project is assessed to be feasible for the grant aid assistance from Japan.

8.1.1 Expected Benefits

Expected benefits of the improvement of navigation condition in the approach channel and the turning basin and the extension of the main wharf are as followings.

1) Maritime accident, in this port will be prevented by improvement of the port facilities.

In an occasion of serious maritime accident, since Yap State is not provided with alternative ports, stopping of Yap Port activity involve a risk of shutdown of flow of necessary goods and materials on daily life and economic activities in Yap. Therefore, improvement of physical condition of Yap Port will contribute to a large extent for stabilization of life and economy in Yap.

2) Through grade up of safety and port facilities, increase of call of cargo vessels and realization of call of cruising passenger vessels to Yap become expectable. Also, development of east bound traffic route and trans-shipment service may be taken into accounts.

As the consequence, domestic processing industry and tourism business will be promoted, accompanied by increase of employment opportunity, resulting in rise of life standard of Yap people.

3) Larger size cargo vessels become able to enter Yap Port than at present. Reduction of transportation cost, and resulting price down or stabilization of price of daily goods and materials can be expected.

4) By securing mooring berth for Microspirit, problem of loss of working time and wasting of running cost due to shifting to mooring basin will be solved. Consequently, the operation schedule of Microspirit will be secured and the domestic

transportation service will be improved.

Expected benefit by introduction of new cargo handling equipment are as followings.

1) Improvement of cargo handling efficiency will reduce staying time of boat in the port, and the transportation cost will be cut down.

2) Handling of 40 feet will be facilitated and cargo handling efficiency will be improved in the yard.

In addition to the above, further effects with implementation of the project are also expected as below.

1) Increased employment opportunity by the construction work and income.

2) Increased land area due to the land reclamation works and improved land productivity.

All the above benefits are in complete conformity with the aims of the New Development Plan of Yap State, such as accomplishment of self-reliance of economy by strengthening and promotion of industrial bases.

8.2 Effects of natural condition on works

In the project site, only dredging work at the channel mouth will be affected by waves during north-east trade wind season, and there will be no other problem for work except this season.

There is no significant fear of siltation in the dredged channel by drifting sand and river wash out.

Existing deposition of silty sand of N-value 5 above the bedrock,

will not cause any problem in construction of the steel sheetpile quaywall.

As above, the project is planned appropriately in view of natural condition and working technology.

8.3 Administrative Evaluation and Maintenance

Department of Public Utilities and Contracts is responsible for port administration and management, and Waab Transportation is for operation of cargo handling work under lease contract of port facilities.

After the extension of the wharf and improvement of the navigation aid markers by the project, no staff increasing of PU&C will be involved in the administration and maintenance of the port. Therefore, present organization of PU&C will be able to deal with the task after completion of the project.

Maintenance cost of the facilities is estimated at a small amount only for electricity and painting of the metal facilities, and it will be covered by increasing port fee income.

From the viewpoint of the administration and maintenance, the project is considered to be feasible.

8.4 Conclusion

Considerable benefits as described in previous sections can be expected with the implementation of the project, and the benefits completely fit to the objective of the New Development Plan of Yap to strengthen its economical foundation and to establish the self-reliant economy.

Thus, Yap Harbour Extension Project is assessed necessary as an infrastructure improvement project for promotion of improvement of living condition and expansion of employment opportunities in Yap.

Therefore, it is recommended that the Project of Yap Harbour Extension as grant cooperation to be put into effect at an early date. There will be no problem expected in administration and management aspects.

At the same time, for further improvement of efficiency of management and operation of the port, technical cooperation is also advisable to bring up the specialist in port-management and technology.

And to secure further safety of navigation in this port, introduction of compulsory pilotage together with improvement of equipments for that purpose are worth for consideration.

APPENDIX

APPENDIX - I

ORGANIZATION OF THE STUDY TEAM

The following staffs are assigned to the study ;

Name	Assignment	Position
Mr. Terumi Iijima	Team Leader	Executive Director, Overseas Coastal Area Development
Mr. Toshiro Tsutsumi	Port Planning	Senior Inspector, Port Construction, 3rd District Port Construction Bureau, Ministry of Transport, Government of Japan
Mr. Kenichi Imai	Project Coordinator	Planning Division, Grant Aid Project Management Department, Japan International Cooperation Agency
Dr. Ken Ishiguro	Port Facilities Designing	Nippon Tetrapod Co., Ltd.
Mr. Kozo Matsumura	Port civil Engineering	ditto
Mr. Hiroaki Gahara	Natural Condition Survey	ditto
Mr. Michihiko Kodama	Environmental Survey	ditto

Mn	D		Itinerary	Description	Natural Condition /Environmental Survey
JAN.	25	THU	NARITA(10:00) →GUAM(14:25) NH 911	Visit to Consulate : Explanation of Inception Report to Consul Koshio. Meeting with Mr. POL(Geo Engi) For Boring Survey.	• Mr. Gahara 1/20 Dep:Narita
	26	FRI	GUAM(07:50) → YAP(09:15) CO 950	Site Reconnaissance (AM11:00,PM16:00). Courtesy Call To Governor. ICR Presentation(PM:14:00),Meeting with Mr. Yinug.	Natural 1/21 Arr:Yap
	27	SAT		AM:Sea site Reconnaissance by boat, PM:Field Survey to the North	condition) 1/21～1/25 Preperation of
	28	SUN		Arrival of Mr. Kodama	Site Survey
	29	MON		AM:Visit to EPA,Meeting with Mr. Sohlith, PM:Discussion on Project Plan with Messrs. Yinug, Sohlith	1/26～2/24 Sounding Survey.
	30	TUE		AM:Questionnair discussion Messrs. Yinug, Sohlith PM:14 ～16 Passenger Vessele Danae tried to call Yap but failed.	Topographic Survey.
	31	WEN		AM: 〃 Messrs. Yinug, Sohlith	2/20～3/15 Soil Investigation.
FEB.	1	THU		AM:Discussion on EIA with Mr. Sohlith	
	2	FRI		AM:Site Survey PM:Meeting for Reception Party Mr. Sohlith, 18:00 Reception Dinner Messrs. Yinug and 31 Persons.	
	3	SAT		Team Meeting	• Mr. Kodama 1/27 Dep:Narita
	4	SUN		Arrival Mr. Tsutsumi (MOT), Field Survey to the South, Team meeting.	(Environment) 1/28 Arr:Yap
	5	MON		AM:Meeting with Messrs. Yinug Sohlith PM:Planning Base discussion.	1/29～2/13 Environmental Survey
	6	TUE		PM:EIA Discussion (Ms. Donna, Messrs. Sohlith, Ben. Sean. Tsutsumi, Ishigro. Kodama, Gahara)	2/14 Dep:Yap – Arr:Guam
	7	WEN		PM:WAAB General Manager : hearing for Port Operation,	2/15 Dep:Guam– Arr:Narita
	8	THU		AM:PU&C. Acting Director and Officers concerned, Answer of Questionaire and Discussion. PM:Sohlith, Data Collection.	
	9	FRI		AM:Resources of Development Director. Hearing for Weather, Tide. Visit to Weather Service Office for data collection.	
				Visit to PU&C for Data Collection of Construction Work.	
	10	SAT		Team Meeting	
	11	SUN		Arrival : Mr. Iijima, Mr. Imai, Team Meeting. PM : Field Survey to the west.	
	12	MON		AM : Courtesy Call to Govenor (Mr. Iijima, Mr. Imai, Dr. Ishiguro). Visit to Construction, Black Construction for Data collection on Construction Conditions.	
	13	TUE		8:30 Micro Commerce berthing observation, Cargo handring, hearing from Ct Inaba. Visit to PU&C for data collection of Construction Condition.	
	14	WEN		10:00 Governor, PB Dir, PUC Dir, R.D Rir.Meeting for Project Plan	
	15	THU		15:00 RD Dir. Meeting for office Memo With Yinug.	
	16	FRI		9:00 Office of Planning and Budget, Meeting for Memorandum 15:00 Meeting for boring survey schedule with Gco-Eng	
				18:00 Sign on Memorandum	
	17	SAT		AM:PM Field Survey to the east and north.	
	18	SUN	YAP (12:40) →GUAM (14:00) CO 953	Move to Ponpei with Mr. Yinug	
			GUAM(20:10) →POHNPEI(01:30) CO 991		
	19	MON		AM: POHNPEI PM13:00 Meeting for Minutes Mr. MVS EPEL, Yinug and B.D. Team.	
	20	TUE		AM: Team Meeting 14:00 MOT 15:30 Meeting for Minutes with Mr. Epel.	
	21	WEN	POHNPEI(22:50)	AM: Field Survey PM: Sign on Minutes	
	22	THU	GUAM (01:05) CO 990	GEO Eng Confrimation of Boring Schedule, Visit to Public Works for data collection on earthquakes.	
	23	FRI		Visit to Weather Service Office for data collection on weather. Visit to Construction Ass for data collection.	
	24	SAT	GUAM(15:35) →NARITA(18:05) NH 912		

ORGANIZATION OF THE STUDY TEAM

The following staffs are assigned to the study ;

Name	Assignment	Position
Mr. Terumi Iijima	Team Leader	Executive Director, Overseas Coastal Area Development
Mr. Takeshi Takano	Project Coordinator	Planning Division, Grant Aid Project Management Department, Japan International Cooperation Agency
Dr. Ken Ishiguro	Port Facilities Designing	Nippon Tetrapod Co., Ltd.
Mr. Kozo Matsumura	Port civil Engineering	ditto

Schedule (Draft Final Report Presentation)

The schedule of the presentation of the Draft Final Report was as follows ;

DESCRIPTION

Day	Mr.T.Iijima, Mr.T.Takano, Dr.K.Ishiguro, Mr.Matsumura
1 May 29 (Tue)	Tokyo - Guam, Courtesy Call to Japanese Consulate
2 30 (Wed)	Guam - Yap, Courtesy Call to Yap State Explanation on Draft Final Report
3 31 (Thu)	Explanation and Discussion on Draft Final Report
4 Jun. 1 (Fri)	Discussion on Draft Final Report, Discussion on Minutes
5 2 (Sat)	Discussion on Minutes, Courtesy Call to Yap State
6 3 (Sun)	Yap - Guam - Ponpei
7 4 (Mon)	Courtesy Call to Government of the FSM Explanation on Draft Final Report
8 5 (Tue)	Team Meeting
9 6 (Wed)	Discussion on Draft Final Report Discussion on the Minute Signing the Minutes
10 7 (Thu)	Ponpei - Guam Courtesy Call and Reporting on Meeting with Officials in FSM to Japanesae Consulate
11 8 (Fri)	Guam - Tokyo

FSM Government

Name	Organization	Position
Mr. Robert J. Weilbacher	Department of Transportation	Secretary
Mr. Andon L. Amaraich	Department of External Affairs	Secretary
Mr. A.R. Takesy	Department of External Affairs	Deputy Secretary
Mr. Epel K. Ilon	Department of External Affairs	Acting Secretary
Mr. Samson Pretrick	Department of External Affairs	Foreign Service Officer
Mr. J. Raglmar Subolmar	Division of International Affairs Department of External Affairs	Chief
Mr. John Mangefel	Office of Planning & Statistics	National Planner
Mr. John Crooks	Engineering & Construction Office of Planning & Statistics	Chief
Mr. Hiroshi Suzuki	Office of Planning & Statistics	Technical Advisor
Mr. Weiner H. Hedley	Department of Transportation	Operation Officer
Mr. John S. Ernest	Environmental Protection Agency Department of Human Resources	Health Services Coordinator Specialist
Ms. Donna Scheuring	Department of Human Resources	Environmental Health Coordinator

YAP STATE GOVERNMENT

Name	Organization	Position
Mr. Petrus Tun		Governor
Mr. Constantine Yinug	Office of Planning & Budget(OPB)	Director
Mr. John Sohlith	Planning Division, OPB	Chief
Mr. K. Ikoshia	OPB	Chief
Mr. Sebastian L. Anefal	Department of Resources & Development	Director
Mr. Charles L. Chieng	Department of Public Utilities & Contract (PU & C)	Director
Mr. Faustion Yongmog	PU & C	Deputy Director
Mr. James Sarmog	Contract Division (PU & C)	Chief
Mr. M. K. D. Abeyapala	PU & C	Special Project Engineer
Mr. Feusbio Taleng	PU & C	Special Assistant
Mr. Frederic Figir	PU & C	Port Manager
Mr. Servin Single	PU & C	Port Captain
Mr. Greg Hartkopf	Water Division (PU & C)	Engineer
Mr. Pite Bonus	Power Division (PU & C)	Engineer
Mr. Ben Nifsag	Environment Protection Agency (EPA)	Executive Director
Mr. Joe Xavier	EPA	Chief
Mr. Gabriel Flaley	EPA	Officer
Mr. John Filefuey	EPA	Officer
Mr. John B. Ion	Marine Resources Management Division (MRMD)	Division Chief
Mr. Sean Baker	MRMD	Officer
Mr. Galen Joel	Weather Service Office	Chief

Private Sector

Name	Company Name	Position
Mr. Bill M. Acker	Waab Transportation Company Inc.	General Manager
Mr. Pagar	Waab Construction Company	Manager
Mr. Sonny Baluyut	Black Micro Corp.	Project Manager
Ct Susumu Satake	Kyowa Shipping Co.. Ltd.	Captain
Ct Inada	PMO Line	Captain
Ct Yoshio Tokui	Nippon Yusen	Captain

MEMORANDUM OF UNDERSTANDING
ON
THE YAP HARBOUR EXTENSION PROJECT
IN
THE FEDERATED STATES OF MICRONESIA

In a meeting held in Yap on February 16, 1990 between the Government of Japan Basic Design Study Team and the concerned representatives from the Government of the State of Yap on the Yap Harbour Extension Project, both parties reached a common understanding as hereunder follows :

1. That in order to sufficiently meet the purposes and goals of the Yap Harbour Extension Project, both parties agreed that the scope of the Harbour Extension Project shall be such that would include the followings in order of priority :

A. Dredging :

A-1 Widening and deepening the entrance of the channel to allow for 10,000 DWT type vessel entrance/departure at any tidal height. Considering the loading condition of vessel the required channel depth shall be 8.5 m.

A-2 Dredging coral points protruding in the channel.

A-3 Developing the turning basin. (The minimum diameter shall be two times of the overall length of the 10,000 DWT vessel.)

B. Channel Markers :

B-1 Installation of light channel markers in accordance with international standards.

C. Extension of Wharf :

C-1 Extension of wharf that allows the mooring of two vessels simultaneously with a " return " that could accommodate a small vessel.

C-2 Pavement behind the wharf face to the minimum distance required for the operation.

C-3 Eliminate the existing ".return " but extend the stone/masonry wall toward the island filling by dredged materials.

D. Dredged materials to be filled between the wharf and the causeway to form an unpaved container yard.

E. Equipments for Operation and Maintenance :

E-1 Forklift for 40-foot Containers

E-2 Monitoring Equipments for Environmental protection.

2. That the use of explosive for the channel widening and deeping shall not be done unless absolutely necessary and should also be addressed in the EP chapter in the Basic Design Study Team final report.

Colonia, Yap, February 16, 1990

Mr. Terumi Iijima
Leader,
Basic Design Study Team
Japan International
Cooperation Agency (JICA)

Hon. Petrus Tun
Governor,
State of Yap

MINUTES OF DISCUSSIONS
ON
THE YAP HARBOUR EXTENSION PROJECT
IN
THE FEDERATED STATES OF MICRONESIA

In response to the request of the Government of the Federated States of Micronesia (hereinafter referred to as "FSM"), the Government of Japan decided to conduct a basic design study on the Project for Yap harbour extension (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA"). JICA sent to FSM the study 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 conducted the field surveys on the Project site and had a series of discussions on the Project with the officials concerned of the Governments of FSM and Yap State.

As a result of these discussions, both parties have agreed to recommend to their respective Governments that major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Palikir, Pohnpei, February 21, 1990

Mr. Terumi Iijima
Leader
Basic Design Study Team,
Japan International
Cooperation Agency (JICA)

Mr. Epel K. Ilon
Acting Secretary
Department of External Affairs
Government of the Federated States
of Micronesia

ATTACHMENT

1. Objective of the Project

The objective of the Project is to make the shipping lane safe for international shipping through dredging and realigning of the channel, construction and extension of the commercial dock.

2. Executing Agency

The Department of Transportation of the Government of FSM is responsible for coordination of the Project. The State Government of Yap is responsible for the administration and implementation as well as management of the Project.

3. Request of the Government of FSM

The contents of the Project required by the Government of FSM are listed in Annex I.

4. Project Site

The site of the Project is located at Yap Island as shown in Annex II.

5. Undertaking of the Government of FSM

The Government of FSM will take the necessary measures listed in Annex III on the condition that the Grant Aid of the Government of Japan shall be extended to the Project.

6. Understanding of Japan's Grant Aid Program

The Government of FSM understands the system of Japan's Grant Aid Program explained by the team, which includes a principle of use of a Japanese consulting firm and a Japanese firm for implementation of the Project.

7. Environmental Protection Consideration

Regarding environmental protection consideration, both parties reached the understanding set forth in Annex IV.

EKF

Annex I Request of the Government of FSM

The contents of the Project required by the Government of FSM are as listed below in priority order;

A. Dredging
   A-1 Widening and deepening the entrance of the channel
   A-2 Dredging coral points protruding in the channel
   A-3 Developing the turning basin

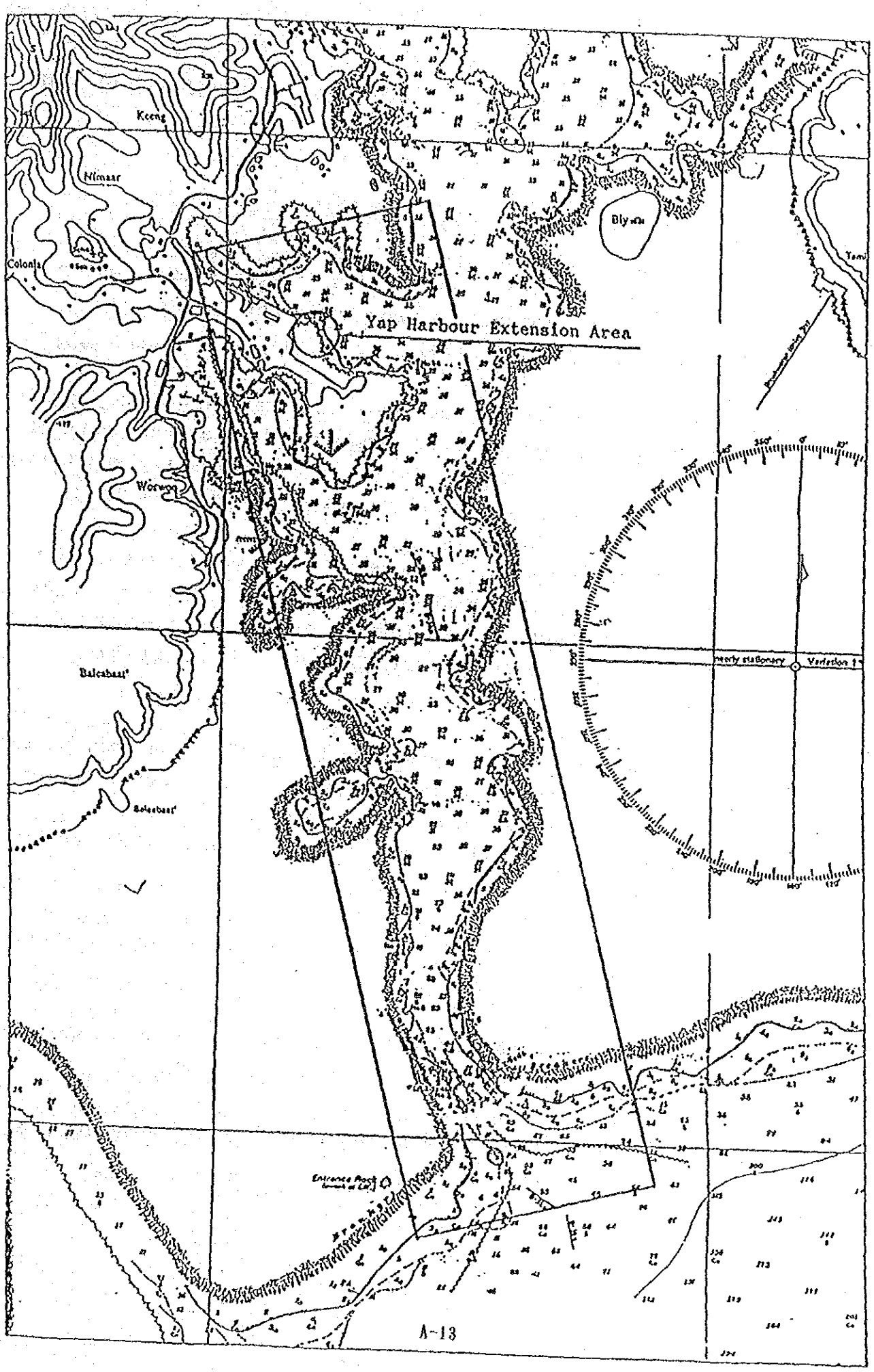
B. Light Channel Markers

C. Extension of Wharf

D. Dredged Materials Utilization

E. Equipments for Operation and Maintenance
   E-1 Forklift for 40-foot containers
   E-2 Monitoring equipments for environmental protection

EC I


Keeng
Nimaar
Colonia
Yap Harbour Extension Area
Balebaar
Balebaar

Annex III Necessary measures to be taken by the Government of FSM

1. To secure the land and reef area for the Project.

2. To provide facilities for distribution of electricity, water supply, telephone, drainage, sewage and other incidental facilities to the project site.

3. To ensure prompt unloading and custom clearance, and to provide for the exemption from taxes and wharfage fees at the ports of disembarkation in the FSM and for prompt internal transportation of the products purchased under the Grant Aid for the Project.

4. To accord Japanese nationals whose services may be required in connection with the supply of products and the services under the verified contract such assistance as may be necessary for their entry and residence in the FSM during the period of performance of their work.

5. To exempt the Japanese nationals concerned with the Project from customs duties, internal taxes and other fiscal levies imposed in FSM with respect to the supply of products and other authorizations for carrying out the Project, as authorized by the law of the FSM.

6. To provide necessary permits, licenses and other authorizations for carrying out the Project.

7. To arrange for transportation such as motor cars or vessels and for office space for the performance of the work.

8. To bear all the expenses other than those to be borne by the Grant.

E/CF

Annex IV Environmental Protection Consideration

1. On the basis of the Minutes of Discussions agreed upon between the Preliminary Study Team and the Government of FSM on October 6, 1989, the State Government of Yap, as the project proponent, is responsible for filing application concerning the Environmental Impact Assessment (EIA).

2. During the course of discussions between the Japanese Basic Design Study Team and FSM agents responsible for environmental impact assessment review, it was determined that the environmental impact on coral due to dredging activities may not be significant and that a comprehensive EIA study may not be required for the project. This decision is subject to revision upon final determination of the scope of the Project.

3. The Basic Design Report which includes one chapter on Environment Protection Precaution will be used by the State Government of Yap as attachment material to the Initial Assessment for application of the project permit.

4. The Earth Moving Permit Regulation of FSM requires the contractor of the project to make application through the appropriate agency of Yap State to the FSM Department of Human Resources for permission to proceed with work. The application shall be accompanied with a work plan to be in compliance with the requirements for environmental protection precaution of the Basic Design Report.

5. In the Basic Design Report, the Basic Design Team is requested to provide a Monitoring Program which will be conducted in the implementation stage of the Project. In this regard, necessary equipment is requested by FSM to be included in the project items.

MINUTES OF DISCUSSIONS

ON

THE PROJECT FOR YAP HARBOUR EXTENSION

IN

THE FEDERATED STATES OF MICRONESIA

In response to the request of the Government of Federated States of Micronesia (hereinafter referred to as "FSM"), the Government of Japan decided to conduct a basic design study on the Project for Yap harbour extension (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA"). JICA sent to FSM the study team headed by Mr. Terumi Iijima, Executive Director, the Overseas Coastal Area Development Institute, from January 20 to March 15, 1990.

As the result of the Study, JICA prepared a Draft Final Report and dispatched a team headed by Mr. Terumi Iijima to explain and discuss it from May 29 to June 8, 1990.

Both parties had a series of discussions on the report and agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Palikir, Pohnpei, June 06, 1990

飯島照美

Mr. Terumi Iijima
Leader
Basic Design Study Team,
JICA

J. Raglmar Subølmar
Chief
Division of International Affairs
Department of External Affairs
Federated States of Micronesia

ATTACHMENT

1. The FSM side has in principle agreed to the basic design proposed in the Draft Final Report.

2. The Final Report (10 copies in English) on the Project will be submitted to the FSM side by the end of August, 1990.

3. The FSM side understood the Japan's Grant Aid System and confirmed that the necessary measures will be taken by the Government of FSM for the realization of the Project as shown in the ANNEX III of "the Minutes of Discussions" signed on February 21, 1990, on the condition that the Grant Aid by the Government of Japan would be extended to the Project.

4. The Government of FSM agreed that the necessary budget will be provided for the Project at the proper time according to the construction schedule.

MEMORANDUM OF DISCUSSIONS
ON THE PROJECT FOR YAP HARBOUR EXTENSION
IN THE FEDERATED STATES OF MICRONESIA

In a series of meetings held in Colonia, Yap State on May 30-31, 1990, between the Basic Design Study Team dispatched by Japan International Cooperation Agency (JICA) and the officials concerned of the Government of the State of Yap on the Yap Harbour Extension Project, the Study Team explained to the Yap side the contents of the draft final report and other related matters.

After discussions between both parties on technical aspects of the project, the Yap State Government expressed satisfaction with the draft final report.

COLONIA, YAP, JUNE 1st, 1990

Mr. Terumi Iijima
Leader,
Basic Design Study Team
Japan International
Cooperation Agency (JICA)

Petrus Tun
Governor, State of Yap
Colonia, Yap State
Federated States of Micronesia

Temperature

(° F)

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
1959	81.3	80.9	81.3	82.1	82.0	82.8	81.0	80.4	80.9	81.6	82.3	81.7	81.5
1960	81.3	81.3	81.4	82.0	82.0	81.8	81.8	80.9	81.6	80.3	81.9	80.6	81.4
1961	80.6	81.4	81.1	82.1	81.2	80.7	80.1	80.3	80.6	79.8	80.1	80.8	80.7
1962	80.7	80.7	80.9	80.6	81.4	81.4	80.8	80.3	81.1	82.0	81.6	79.9	81.0
1963	80.2	80.0	80.9	81.7	81.7	81.8	81.0	80.7	81.3	80.8	81.5	81.1	81.1
1964	80.5	80.0	80.7	81.4	81.1	81.0	81.4	80.7	81.7	81.5	81.6	80.7	81.0
1965	81.1	80.5	79.9	81.2	82.0	81.0	79.0	80.7	80.8	81.3	81.0	81.2	80.8
1966	79.6	80.3	80.5	82.1	82.2	81.6	81.1	81.2	81.5	82.2	81.6	80.4	81.2
1967	79.8	80.3	80.1	80.7	81.5	80.9	80.7	80.6	81.7	81.3	80.9	80.5	80.8
1968	79.9	80.0	81.1	81.0	81.8	81.2	80.6	80.5	80.8	80.4	81.2	80.4	80.7
1969	80.1	79.8	80.5	81.6	81.4	81.9	80.5	80.4	80.1	80.9	80.7	80.8	80.7
1970	80.8	81.0	81.5	82.1	81.7	81.8	81.7	80.6	80.9	81.1	81.4	81.2	81.4
1971	80.3	80.7	81.5	81.1	81.0	80.5	79.9	80.2	80.8	80.0	80.6	80.9	80.6
1972	80.2	80.3	80.4	81.1	81.0	81.4	82.9	81.0	81.0	81.3	81.0	80.8	81.0
1973	79.7	81.1	81.7	82.6	82.2	81.7	80.9	81.0	80.6	80.0	81.2	80.5	81.1
1974	79.3	81.0	80.7	81.2	80.8	80.3	80.7	81.2	80.6	80.5	80.7	80.6	80.6
1975	80.1	80.8	80.8	80.8	80.7	79.9	80.2	79.6	79.7	80.6	80.7	79.9	80.3
1976	79.2	79.9	79.9	79.8	81.0	80.0	79.5	79.5	79.5	81.2	80.6	80.1	80.0
1977	80.0	80.5	81.4	82.3	81.2	81.1	80.1	80.7	80.3	81.3	81.2	80.8	80.9
1978	80.2	79.7	81.2	81.6	82.2	81.3	81.4	80.4	80.2	79.8	81.0	81.1	80.8
1979	80.5	80.2	80.8	81.7	81.5	81.4	80.1	80.2	81.4	81.0	81.3	80.4	80.9
1980	80.7	80.2	81.0	81.7	81.7	80.9	80.6	81.4	80.3	80.9	80.8	80.5	80.9
1981	79.7	80.0	80.6	81.9	82.5	80.6	80.0	80.6	81.5	81.2	81.5	81.7	81.0
1982	80.9	80.6	80.9	82.1	81.3	80.5	80.5	80.3	80.1	80.4	81.1	80.3	80.8
1983	79.3	80.0	80.4	81.0	82.2	81.8	80.8	81.0	81.1	81.8	81.3	81.5	81.0
1984	80.7	80.5	81.3	82.6	83.8	81.8	81.3	80.6	81.4	80.6	81.1	81.8	81.5
1985	80.6	81.4	81.5	81.7	82.1	81.2	80.6	80.5	81.0	81.1	81.7	81.0	81.2
1986	81.3	80.8	80.9	81.2	81.7	81.4	81.3	82.9	81.2	81.7	81.2	81.1	81.4
1987	80.4	80.3	81.0	82.2	82.4	81.9	81.5	80.5	82.4	82.0	81.9	81.8	81.5
1988	81.3	81.0	82.3	82.5	82.4	81.4	81.3	81.2	81.7	81.1	81.1	80.6	81.5
Record													
Mean	80.4	80.6	81.0	81.8	81.8	81.4	81.1	80.9	81.1	81.2	81.4	80.9	81.1
Max	85.8	86.0	86.7	87.7	87.8	87.5	87.2	87.0	87.3	87.4	87.4	86.4	87.0
Min	75.0	75.1	75.3	75.8	75.8	75.3	74.9	74.8	74.9	74.9	75.3	75.4	75.2

Relative humidity

(%)

YEAR	時間	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
	09	79	80	79	78	76	79	81	79	81	77	81	76	79
1986	15	76	78	78	74	76	79	78	77	79	75	78	75	77
	21	86	93	87	88	93	92	90	86	91	90	90	84	89
	09	76	77	73	72	71	81	80	83	80	80	79	77	77
1987	15	72	74	68	68	70	79	79	81	76	78	80	76	75
	21	84	86	81	83	83	88	89	89	89	89	93	86	87
	09	75	75	76	74	77	78	77	76	76	80	78	79	77
1988	15	73	73	72	—	75	77	78	74	75	81	78	78	76
	21	83	83	83	84	86	88	89	89	89	91	88	88	87
	09	77	77	76	75	75	79	79	79	79	79	79	77	78
Ave	15	74	75	73	71	74	78	78	77	77	78	79	76	76
	21	84	87	84	85	87	89	89	88	89	90	90	86	88

Fine days

(day)

YEAR	Condition	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
	Clear	0	1	0	1	1	0	0	0	0	0	0	0	3
1986	Partly Cloudy	9	5	3	9	13	6	5	2	4	10	5	9	80
	Cloudy	22	22	28	20	17	24	26	29	26	21	25	22	282
	Clear	1	0	2	2	2	0	0	0	0	0	0	0	7
1987	Partly Cloudy	11	8	21	19	20	3	4	3	5	6	9	13	122
	Cloudy	19	20	8	9	9	27	27	28	25	25	21	18	236
	Clear	2	0	0	0	1	0	0	1	0	0	0	0	4
1988	Partly Cloudy	13	12	14	17	8	4	4	6	6	6	15	6	111
	Cloudy	16	17	17	13	22	26	27	24	24	25	15	25	251
	Clear	1	0	1	1	1	0	0	0	0	0	0	0	5
Ave.	Partly Cloudy	11	8	12	15	14	4	4	4	5	7	10	9	104
	Cloudy	19	20	18	14	16	26	27	27	25	24	20	22	256

Precipitation

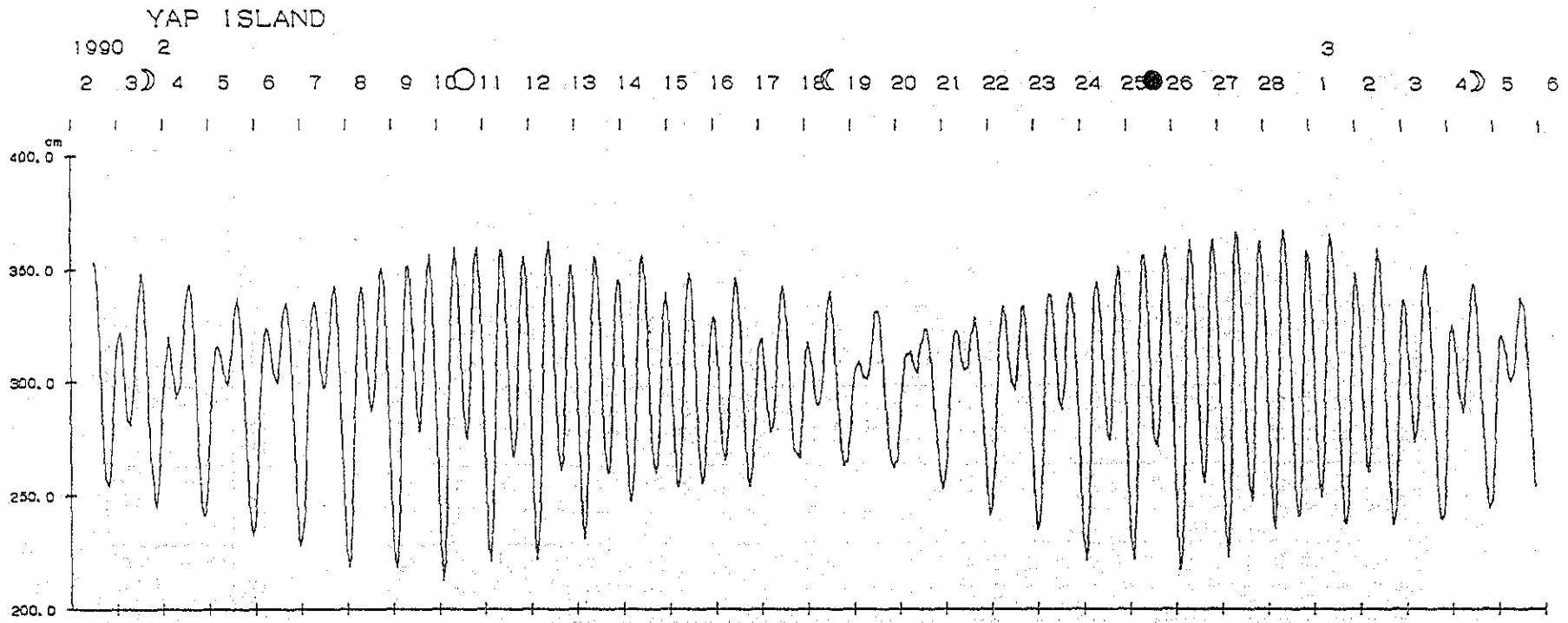
(inches)

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
1959	7.75	7.99	9.07	4.38	11.54	4.69	18.95	11.61	11.18	11.61	10.34	11.16	120.27
1960	7.78	6.23	4.22	6.30	12.70	9.46	11.45	11.96	10.63	18.07	20.66	8.13	127.59
1961	11.65	5.66	11.15	4.75	18.08	12.33	12.70	17.25	15.10	21.16	4.42	11.27	145.52
1962	8.53	13.36	7.82	15.95	14.43	7.96	19.44	17.32	12.23	9.65	7.41	15.01	149.11
1963	11.26	12.20	11.13	4.20	7.14	8.77	13.49	28.20	10.25	16.67	7.47	10.17	140.95
1964	2.37	6.47	4.01	7.61	18.23	6.74	9.44	16.72	12.55	11.69	6.19	10.98	113.00
1965	3.32	6.00	7.63	4.25	8.12	10.88	26.47	12.39	17.73	8.42	12.02	3.69	120.92
1966	4.98	1.29	2.31	1.86	6.71	12.52	17.98	9.02	9.59	7.11	8.84	9.97	92.18
1967	12.02	6.25	5.37	11.76	16.00	16.71	14.14	16.45	11.72	12.80	10.44	7.48	141.14
1968	10.77	8.04	3.72	1.82	3.94	5.76	14.24	10.90	10.66	11.21	3.59	8.34	92.99
1969	4.10	1.24	2.08	3.03	7.69	8.78	34.71	11.58	17.03	11.48	9.76	8.32	119.80
1970	4.64	6.17	4.67	3.04	9.76	8.76	8.80	25.45	11.04	12.31	9.56	8.15	112.35
1971	10.42	10.11	13.48	12.25	12.84	13.94	14.12	12.15	13.87	15.15	10.26	9.71	148.30
1972	6.03	10.42	14.21	8.97	5.33	10.18	9.20	11.09	17.60	5.64	9.35	5.14	113.16
1973	2.14	1.00	1.54	5.62	5.98	12.35	10.11	5.13	17.64	14.92	10.57	7.03	94.03
1974	11.84	4.27	9.99	10.07	9.77	14.30	14.40	12.33	9.48	19.11	18.85	13.30	147.71
1975	19.48	1.20	3.12	10.73	9.09	10.67	8.38	11.90	11.25	12.67	6.79	10.93	116.21
1976	7.36	3.19	8.76	6.77	12.52	13.30	11.43	16.29	13.44	2.59	8.88	9.97	114.50
1977	3.94	2.18	2.42	0.91	10.36	7.49	17.21	13.99	18.73	5.76	9.47	11.64	104.10
1978	4.22	5.25	2.04	5.38	4.87	12.89	8.67	18.52	19.17	18.10	11.09	8.98	119.18
1979	3.88	3.16	7.06	3.98	8.82	21.07	14.44	19.57	9.59	12.18	7.34	13.40	124.49
1980	2.32	4.60	6.42	7.72	10.57	13.52	17.84	9.52	12.71	13.41	7.20	14.52	120.35
1981	12.90	8.00	2.89	1.10	5.05	10.77	18.54	13.61	19.03	14.22	10.12	11.01	127.24
1982	7.30	12.58	7.50	2.62	10.49	32.01	13.04	14.26	13.93	9.34	4.95	7.01	135.03
1983	1.25	0.27	2.76	1.36	3.59	6.98	16.14	16.59	12.59	8.37	13.56	5.38	88.84
1984	5.33	9.59	3.90	2.21	1.77	12.38	9.59	15.33	6.41	17.29	12.03	5.44	101.27
1985	14.46	3.27	6.70	8.83	6.81	18.65	11.52	15.49	17.34	10.31	5.79	14.32	133.49
1986	7.53	10.61	10.90	6.94	9.59	13.08	15.36	11.25	12.31	7.62	14.07	5.88	125.14
1987	5.96	4.91	1.96	4.80	3.96	11.04	15.10	27.87	5.32	6.70	6.47	2.74	96.83
1988	3.68	3.63	2.80	3.93	7.25	10.49	13.79	5.35	14.60	22.12	9.02	8.94	105.60
Record Mean	7.78	5.61	5.96	5.95	8.99	12.02	13.86	14.43	13.28	12.50	9.82	9.54	119.73

Thunderstorms

(day)

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
1986	0	0	0	2	2	1	6	2	4	1	4	0	22
1987	0	0	0	1	0	2	2	3	4	2	5	2	21
1988	0	0	0	0	0	4	1	1	3	4	0	1	14
Ave.	0	0	0	1	1	2	3	2	6	2	3	1	19


YAP ISLAND
1990 2
3
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 1 2 3 4 5 6
cm
400.0
350.0
300.0
250.0
200.0

Tide curve

Harmonic analysis of tide for one month

YAP ISLAND

9° 30' 6" N

138° 8' 18" E

1990 2 2 ～ 1990 3 5

Calculation method:T.I Method.

Component	Amplitude (cm)	Lag angle(°)
Mm	0.6	221.5
MS f	1.7	45.1
Q 1	2.7	178.9
O 1	11.5	185.8
M 1	0.9	197.1
K 1	19.1	213.1
J 1	0.9	223.7
OO 1	0.8	252.6
P 1	6.3	213.1
μ 2	1.6	216.8
N 2	8.2	200.5
ν 2	1.6	200.5
M 2	40.5	212.2
L 2	1.6	187.2
S 2	16.5	248.3

Component	Amplitude (cm)	Lag angle (°)
K 2	4.5	248.3
2SM2	0.1	336.5
MO 3	0.3	70.9
M 3	0.5	247.1
MK 3	0.6	265.0
MN 4	0.0	182.7
M 4	0.3	342.1
SN 4	0.2	229.6
MS 4	0.3	169.0
2MN 6	0.1	173.7
M 6	0.3	82.3
MSN 6	0.0	229.5
2MS 6	0.4	153.3
2SM 6	0.2	166.3
A O	229.6	