GOVERNMENT OF THE REPUBLIC OF INDONESIA
DEPARTMENT OF COMMUNICAION
DIRECTORATE GENERAL OF SEA COMMUNICATIONS

THE FEASIBILITY STUDY ON THE EXPANSION PROJECT OF THE BITUNG PORT (FTA-156)

Interim Report

October 1977

77

JAPAN INTERNATIONAL COOPERATION AGENCY

JICA LIBRARY
1055580[3]

国際協力事業団
受入月日 '84. 5.16 | 108
登録No. 04873 | 72.8
SDF

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Preface

This is an Interim Report of "The Feasibility Study for the Expansion Project of the Bitung Port", which is conducted in response to the request made by the Government of the Republic of Indonesia.

This report is submitted for the purpose of promoting the exchange of opinions between the Indonesian authorities and JICA. It is desired that the Indonesian authorities shall send their comments on this report within one month following the arrival of this report, as agreed in the scope of work.

This Interim Report is roughly divided into two parts, namely, the part of current state (1, 2, 3) and the part of planning (4 - 9).

The current state and the site conditions of Port of Bitung are reported in the part of current states (1, 2, 3). The basic ideas on the following subjects are discussed in the part of planning (4 - 9).

Definition of Service Area
Traffic Forecast
Selection of Construction Site
Facility Planning

The present Interim Report does not contain final cost estimates. This is because the survey of soil conditions, which is essential for cost estimates, was completed relatively recently. The data on soil conditions were not fully available when this report was written. The discussion on economic and financial factors is limited to qualitative analysis alone in this report.

The discussion of costs and the assessment of the project will be left to the final report. The final report will also contain the process of discussions, which is not sufficiently reported in the Interim Report.

I. Current State of Port of Bitung

1. Current State of Port of Bitung

1-1. General

Port of Bitung is located at the northeast part of Indonesia, near the northern end of Sulawesi Island. It is situated in Lat. 1°26' N and Long. 125°12' E. The port facilities are faced with the 16 km long Lembeh Strait . It is a good natural port sheltered by Lembeh Island (As shown Fig. 1-1).

The construction of Port of Bitung was begun in 1950s. Concrete pier (432 m in length and -10m in water depth) was completed at that time. The construction is still being continued. Concrete Pier will have been extended to 582 m by the end of 1977. Facilities for vessels for domestic use are being carried out.

The port tonnage traffic (including both foreign trade and domestic trade) in 1976 was 731 thousand tons. The port tonnage traffic has been increasing rapidly during the recent years. This has promoted the current drive to improve port facilities.

1-2. Administration and Operation

1-2-1. Organization

Port of Bitung used to be under Sea Communications whose headquarter is located at Ujung Pandang. After a subsequent reorganization, its jurisdiction was transferred to Marine Transport Bureau VII (Kepala Daerah Pelabuhan) located at City of Menado.

The Chief of ADPEL is under the control of the chief of Marine Transport Bureau VII of Sea Communications and checked by him. He reports to the Chief of Directorate of Port and Dredging. In other words, a so-called cross-check system is adopted. The organization is shown in Fig. 1-2.

It is legally obliged to collect information and send information to the center since it is a contact with beneficiaries. The organization is characterized by port council and Menado Port Division. Port Council assists Port Administrator. Menado Port Division is under Bitung Port Administrator both legally and practically.

1-2-2. Employees and Workers

255 employees (as of 1976) are engaged in the administration and operation of Port of Bitung and 725 workers (as of 1976) are employed for port operation. Workers are managed by the Man Power Administration of Port of Bitung. There is no special problem in the supply of workers.

1-2-3. Port Services

The ADPEL has made efforts to improve operation and service efficiency to meet increasing demands at Port of Bitung. For example, wooden containers etc.have been adopted. Vessels to call at Port of Bitung are expected to increase both in quantity and size. This naturally means that cargo volume will increase. Means for efficiently handling various types of cargo (copra, coconut oil, etc.) must be studied. Means for efficiently assigning berths to various types of vessels must be studied.

1-2-4. Tariff

The tariff of Port Bitung is roughly classified into charges for cargo and charges for vessels.

The former includes stevedoring, cargo handling and delivery charges. Charges are set according to cargo type and quantity.

The latter includes entrance charge and berthing charge. They are set according to vessel type, size and period (hours).

1-3. Facilities

1-3-1. General

The mooring facilities of Port of Bitung are faced with the wide and calm Lembeh Strait (width: about 1 km; water depth: 10 - 40 m) and its anchorage is as large as 857 ha. The land area available for the port is 45 ha, including some swamps. Fig. 1-8 shows the existing facilities of Port of Bitung.

1-3-2. Existing Major Facilities

(1) Mooring Facilities

The mooring facilities at Port of Bitung are functionally classified as below. Each type of the existing facilities is:

1) Open-type concrete pier

The open-type concrete pier (water depth: -9m - -10m; length: 582 m) is the main berth of Port of Bitung and is used by ocean going vessels, R.L.S. vessels and local vessels. The maximum allowable ship size is 15,000 D.W.T.

The 75m in length on the east side of the pier were newly constructed in January, 1977 and will become available from the year of 1978.

The pier of 432m length out of 582 m is wharf structure with piles (width: 10m) and is connected with the revetment through access bridges. Each access bridge is 12 m wide and 12 - 16 m long and they are arranged at approximately 44 m intervals. This area shows neither differential settlement, nor cracking though it has been in service for about 20 years and is sufficiently in good conditions for continued services. However, all the wood fenders have been destroyed and tires are used in stead.

The other 75 m length has been constructed and completed in 1976, and has a piled wharf structure (width: 16 m) connected with the sheet pile bulkhead.

The gap between above 432 m long pier and the revetment lowers cargo-handling capacity and not only limits the operation range of cargo handling machineries, but also raises some safety problems.

2) Wood Pier

The 3.0 m wide and 50 m long wood pier was constructed in 1975 and is used by local vessels and sailing vessels.

3) Quay for Coasting Vessels

A quay for coasting and local vessels is started to be constructed in 1977 behind the east side of the concrete pier. It will be planned 350 m long and the water depth of -5.5 m. Then the basin in front of this quay is to be dredged down to -5.5 m and its dredging volume will be approximately 300,000 m^3.

4) Other Mooring Facilities

One dolphin for oil tankers and concrete piers for loading small tankers are existing on the west side of the concrete pier. They belong to P.N. Pertamina and are handling oil only.

A coconut oil pipe line belonging to P.T. Bimoli is laid toward the coast in the west side of P.N. Pertamina's facilities. However, berthing facility does not exist.

(2) Sheds and Warehouses

Three sheds (36 m x 120 m^2 = 4,320 m^2) are in parallel to the concrete pier. They were constructed in 1953 - 1955 and have a brick wall sturcture, corrugated-galvanized iron sheet walls and corrugated-galvanized iron sheet roof covered on a steel framed structure.

One warehouse with the same structure and area as above are existing. All warehouses including private company's ones are located behind the sheds.

Detailed area of the warehouses and sheds are given below.

Owner	Shed (m^2)	Warehouse (m^2)
Port administration of Bitung	13,398	4,320
Private company	-	18,264
Total	13,398	22,584

The total area of the open storage yard is 26,900 m^2. (Paved area: 10,900 m^2; unpaved area: 16,000 m^2).

(3) Cargo Handling Facilities and Service Vessels

The cargo handling facilities and service vessels currently used at Port of Bitung are given in the following:

List of Cargo Handling and Service Vessels

Name	Capacity	Quantity	Year of construction	Remarks
Tug boat	120 HP	1	1953	Old, but still usable
Tug boat	120 HP	1	1964	"
Barge	100 ton	1	1941	Old and damaged, not used at present
"	200 ton	1	1952	"
Pilot boat		1	1975	good condition
Mobile crane	35 ton	1	1968	Old
"	15 ton	2	1968, 1976	
Forklift	2.5 ton	2	1971	Good condition
"	5 ton	2	1976	"

(4) Water Supplying Facilities

Water has been supplied by two systems, namely, by a pipe from Bitung City and by transportation of barges from Air perang. The former system alone is used at present because the barges became old and not in working condition.

The source of water supply in Bitung City is the natural spring water (200 - 300 l/sec.) at the altitude of 165 m in the upstream of Girian River located at 7 km from the city.

Water from the spring is stored in a reservoir (Capacity: about 4,000 m^3), where sterilized by adding chlorine and then sent to Bitung City or Bitung Port. Water is sent to Bitung Port through a main pipe (Diameter, 150 mm) and to vessels through five branch pipes (Diameter, 80 mm) of the concrete pier of 507 m.

The water supply to the vessels is sufficient at present. Actually in 1976, 65,000 m^3 of water was supplied to vessels.

A water supply pipe (Diameter: 150 mm) was laid in 1976 along the face line of the new quay (-5.5 m) to be planned.

(5) Power Facilities

For illumination of the piers, roads and offices at Bitung Port, the power of 60 KVA from Bitung Sub Station of P.L.N. (National Power Corporation) is used.

(6) Oil Supplying Facilities

Tank lorries (Capacity: 4 kl) are used for supplying oil to vessels. The existing concrete piers have not oil supply pipe, therefore, P. N. Pertamina (national oil corporation) completely supply the fuel oils.

(7) Navigation Aids

The light stations exist at the southeast end of Lembeh Island as aids for vessels entering into Bitung Port.

The principal specifications are given below.

Item \ Lamp tower	No. I	No. I I
Location	Lat. 01°23'05" N. Long. 125°09'05"E.	Lat. 01°26'00" N Long. 125°11'00"E.
Lamp color	Natural color	Natural color
Characteristics	GS(2) 10 sec.	GS(1) sec.
Visibility	11 sea miles	11 sea miles
Height of tower	17 m	12 m
Elevation of lamp	W.L. +16 m	W.L. +59 m

1-4. Operation

1-4-1. Statistics

(1) Port Tonnage Traffic

The port tonnage traffic at Port of Bitung was 731 thousand tons in 1976 (Table 1-1). It has been increasing at the rate of 13 % p.a. year during the past five years. These figures indicate the recently prosperity of Port of Bitung.

A detailed study of port tonnage traffic shows that the growth of import traffic is 1.4% p.a., that of export traffic is 12% p.a., that of domestic inbound traffic is 18% p.a., that of domestic outbound traffic is 18% p.a. Large growth is observed generally in domestic traffic rather than foreign trading. This means that the rapid increase of port tonnage traffic during the recent years is accounted mostly by the increase of domestic trading.

Table 1-1 shows the port tonnage traffic by commodity through Port of Bitung. The details are given in Table 1-2. The commodities are grouped in this table to facilitate understanding.

Table 1-2 shows that the same commodity group appears both in inbound traffic and in outbound traffic. This indicates that Port of Bitung is a transmit port.

The commodity groups which arrive more heavily than depart are foodstuffs, construction materials, vehicles, miscellaneous goods and petroleum. They are consumed in the service area behind Port of Bitung.

On the other hand, agricultural products are shipped more heavily than arrive. They are produced in the service area behind Port of Bitung.

In other words, Port of Bitung is a base of goods distribution, which supplies foodstuffs, construction materials and petroleum to its service area and collects agricultural products.

Table 1-3 shows the figures of Table 1-2 in percentage composition. Petroleum (30%) and agricultural products (25%) account for the largest part of discharged and loaded traffic. They are followed by foodstuffs (17%), construction materials (14%) and miscellaneous goods (12%). Vehicles (2%) began to grow rapidly during the recent years.

As for discharged traffic, petroleum accounts for the largest part. It is followed by foodstuffs, construction materials and miscellaneous goods in this order. Agricultural products account for only 9%. As for loaded traffic, agricultural products account for 55%. They are followed by petroleum (25%).

Table 1-3 shows the details of cargo by destination and origin. Cargo from Surabaya and Ujung Pandang accounts for nearly 60% of the discharged traffic. They are followed by North Sulawesi, East Kalimantan and Jakarta.

Cargo destined to Jakarta accounts for a quarter of the total loaded traffic. It is followed by Surabaya, North Sulawesi, Central Sulawesi, and North Maluku.

(2) Ship Call

Table 1-5 shows the transition of calling vessels at Port of Bitung. The number of calling vessels and their D.W.T. have been gradually increasing, but the growth rate is small.

The trend of sailing vessels is completely opposite to that of general vessels. Sailing vessels have recently decreased rapidly both in the number of calls and in D.W.T., On the other hand, general vessels have been increasing both in the number of calls and in D.W.T., The number of calls has been increasing specially in the calls of general vessels.

Table 1-6 shows the number and D.W.T. of the vessels which called Port of Bitung in 1976 and the ratio. In 1976, 2,648 vessels (2,085 thousand tons in D.W.T.) called at Port of Bitung. In terms of calls, inter-insular vessels account for the largest percentage (63%). They are followed by sailing vessels (22%). The percentage of the other types of ships is far smaller. In terms of D.W.T., ocean going vessels (45%) are followed by interinsular vessels (34%). Sailing vessels account for less than 1%.

Table 1-7 shows the port tonnage traffic through Port of Bitung classified by types of ship. It shows that ocean-going vessels, R.L.S. vessel and special vessels account for 30%, 31% and 34%, respectively. The total of the three exceeds 90%. Local vessels and sailing vessels account for only 3% and 2%, respectively.

(3) Passengers

Table 1-8 shows the transition of the number of disembarkation and embarkation passengers at Port of Bitung. The number of passengers was 13 thousand in 1976. The general trend shows gradual decrease with considerable fluctuations.

1-4-2. Uses of Facilities

(1) Water Area

Most of the vessels entering Port of Bitung approach Lembeh Strait from the south side.

Lembeh Strait is navigable in north-south direction, but most of the large vessels approach from the south side. A pilot boards near the pilot limit and assists berthing.

(2) Mooring Facilities

Port of Bitung has three mooring facilities. However, Concrete Pier alone can accommodate ocean going, R.LS and local vessels. Vessels of these types berth according to ADPEL's assignment. Mooring places for ocean going vessels are not distinguished from those for vessels for domestic use.

The 432 m long pier was rendered for services as of June, 1977. It was used as six berths (max.). The two bends of the water front seem to have restricted the assignment of berthing places.

Table 1-9 shows the traffic through Concrete Pier (per m). It was 950 t/m in 1976. It has been increasing gradually with some fluctuations during the recent several years.

The vessels which entered Port of Bitung in June, 1977, were analyzed to study ship congestion at the port. Forty-four vessels entered Port of Bitung, this month. One of them berthed once and anchored at the anchorage and then, berthed again. Therefore, forty-five vessels berthed. The average berthing time was 36 hours/vessel. The average anchoring period prior to berthing was 19 hours. This was calculated by assuming that 40 minutes are required for shifting from the anchorage to a berth. Sixteen vessels (1/3 of all the vessels) had to queue for berthing.

The considerable high average of t/m means considerable waiting on the part of vessels.

(3) Land Area

Fig. 1-4 shows the patterns of the movements of discharged cargo. It shows that 2/3 of the discharged cargo are loaded on trucks at the pier and carried to the hinterland. Most of the remaining 1/3 is stored once in transit sheds or open storages. They are shipped by trucks after some period.

It is only a small percentage of cargo that is loaded on small vessels. The difference from the cargo statistics discussed in 1-4-1 (1) leads to suspect that most of the cargo discharged at Port of Bitung is stored once somewhere outside the gate and then shipped from Port of Bitung.

Passengers walk to vessels. Vessels are moored at all the places along Concrete Pier. Therefore, passengers must walk to their vessels, avoiding cargo-handling operations.

1-5. Role of Port of Bitung

The role of Port of Bitung can be summarized on the basis of 1-4 and 2 (to appear later). It is the key port for foreign and domestic tradings for North Sulawesi Province, Central Sulawesi Province and North Maluku of Maluku Province. Port of Bitung is the gateway of foreign and domestic tradings for City of Menado, Minahasa Regency and Bolaang Mongondow Regency. It is a transit port for the other areas.

2. Economic and Social Conditions Related to Port of Bitung

2. Economic and Social Conditions Related to Port of Bitung

2-1. General

The present chapter is concerned mainly with the economic and social conditions of the current service area of Port of Bitung to be discussed in Chapter 5. It covers North Sulawesi Province, Central Sulawesi Province, North Maluku Regency of Maluku Province. They will be called hereafter as North Sulawesi, Central Sulawesi and North Maluku, respectively.

Port of Bitung is connected with its service area in various ways. It is connected with Minahasa Regency, City of Menado and Bolaang Mongondow Regency in North Sulawesi by roads. These areas are most strongly connected with Port of Bitung. However, Port of Bitung is connected with the other areas by sea routes. Their connection is not necessarily strong because of the characteristics of sea routes.

In terms of economic activities, the service area is divided into some sub-areas because of geographical conditions. However, such devided situation is expected to change along with the development of traffic routes. For example, road construction will bring about strong influences of Port of Bitung to the hinterland of Port of Gorontolo.

Cities of Bitung and Menado seem to support Port of Bitung. It is relatively recent that Port of Bitung became an active port. City of Bitung has not been developed enough to meet all the requirements of a port city.

Port of Bitung will continue to be supported by City of Menado and City of Bitung.

2-2. Population

The population in the service area of Port of Bitung is 3,395 thousands in 1976. The population of North Sulawesi accounts for 58%, that of Central Sulawasi accounts for 31% and that of North Maluku accounts for 11%. The average annual growth rate during the recent five years is 3.0%. The growth rate of North Maluku is the largest (Table 2-1).

Table 2-2 shows the details (by Regency and City) of the population of North Sulawesi. The population of City of Menado, Minahasa Regency and Bolaang Mongondow Regency connected with Port of Bitung by roads is 1,140 thousand. The population of Gorontalo Regency and City of Gorontalo connected with Port of Bitung by sea routes is 542 thousands. The population of Sangir Talaud Regency is 246 thousands.

2-3. GRP

Table 2-3 shows the GRP converted into the 1973 prices. The GRP in the entire service area is 214 billion Rp in 1975. North Sulawesi accounts for 69% of the total. The annual growth rate is 11%. The growth rate of Central Sulawesi is the largest (14%).

Table 2-4 shows the recent per capita GRP and the ratio to the national total. It shows that the per capita GRP in North Sulawesi, Central Sulawesi and North Maluku is 129%, 68% and 96% of the Indonesian average, respectively. In other words, North Sulawesi is richer than the average standard, but Central Sulawesi is poorer. North Maluku is nearly at the average standard. The data of the subsequent years show that Central Sulawesi is approaching the national average.

2-4. Industries

The industrial structure of North Sulawesi is shown in Table 2-5. The agricultural division accounts for approximately 41% of the regional income. It is followed by trading (about 20%), industries (8%), service (7%), transport and traffics (7%) and others (17%). It is a typically agriculture-oriented industrial structure.

The main agricultural products are rice, vegetables, coconut, clove and nutmeg. The main fishery products are tuna and shrimp for export (mainly to Japan).

Minahasa is the center of rice cultivation. Coconut is cultivated in Minahasa, Kae Island, Sangihe Island and Talaud Island. Clove is produced mainly in Minahasa (85%), but also in Bolaang Mongondow and Gorontalo. Nutmeg is produced mostly in Minahasa.

Processing of agricultural products is the major industry. The industries include copra productions, coconut oil production, automotive knockdown, shipbuilding, nail and needle fabrication.

2-5. Transports

2-5-1. General

The transport conditions related to Port of Bitung is as follows.

2-5-2. Road Conditions

Among the main roads of North Sulawesi, the paved road in the North of

Amurang (Bitung - Menado - Amurang) now exists.

The road, connecting Amurang - Inobonto - Kotamabagu - Duloduo in the south of Amurang is being repaired or constructed with a loan of World Bank. And also Amurang - Kotamobagu is being repaired or constructed with a loan of Japan. Above road construction will be completed by the end of 1978. While a paved road is to be constructed between Inobonto and Kuwandang after 1979.

The North Sulawesi road network will be completed when these construction works are completed. Fig. 2-1 shows the location of these main roads.

(1) Menado - Bitung - Aertembaga

This road is the main road from Bitung Port to the inland and a national road with economic and administrative importance. The road is approximately 49 km long and has two traffic lanes. The alignment of the road is good. It is paved with asphalt and maintained in good condition.

(2) Menado - Amurang

This road passes through Tomohon (altitude 700 m) and many mountains. It is a 84 km long national road with two traffic lanes. It is paved with asphalt and its slope and alignment conditions are relatively good in comparison with the other mountain roads.

(3) Amurang - Inobonto - Kotamobagu - Duloduo

The road of Amurang - Poigar - Inobonto is a newly constructed two traffic lane road, 94 km long and passes both flat area (about 70%) and mountain area (30%). It is still under construction, but will be completed in 1978.

The area between Inobonto and Kotamobagu is a 35 km long one-lane national road passing mostly through mountains. The existing road is under betterment construction at present, and to be completed in 1978.

Kotamobagu - Duloduo

This road passes mainly through flat areas except the mountain area neighboring Kotamobagu. A 54 km long one-lane road is under construction at present and will be completed in 1978.

(4) Amurang - Kotamobagu

The 97 km long road between Worotijnn and Kotamobagu (located 9 km in the south of Amurang) runs mostly through mountains. The pavement repairing (4.5 m wide) and bridge replacement are planned in 1977/1978.

(5) Inobonto - Kuandang - Gorontalo

The road between Inobonto and Gorontalo is 201 km long. The road from Kuandang to Gorontalo (60 km) has been paved. Though the road between Inobonto and Kuandang is not paved at present, the pavement construction will be performed by Indonesian's Public Works after 1979.

2-5-3. Air Transport

Sam Ratulangi Air Port is located near City of Menado. A trip between the air port and Port of Bitung takes about one hour by car.

One daily flight (Garuda's DC9) is available as of August, 1976. Garuda flies from Menado to Ujung Pendang without any stop. Flights to Ambon, Sorong, Surabaya and Jakarta are available from Ujung Pandang.

Many local flight services are available. They connect Menado with the major cities in the service area.

Table 2-6 shows the number of passengers at Sam Ratulangi Air Port. In 1975, 76,000 persons used the air port. This is four times as large as the number of passengers through Port of Bitung. The number of air port users has been increasing at the average rate of 13% per year. This is a good contrast from the number of port using passengers which seems to be steady.

2-5-4. Marine Transport

Port of Bitung is called by ocean going vessels (tramp vessels alone, at present), R.L.S. vessels, special vessels, local vessels and sailing vessels (1-4).

The routes of domestic transport are R. L. S. routes and local routes. Port of Bitung is used also for pioneer routes. Table 2-7 shows the number and codes of domestic routes which call at Port of Bitung.

The R.L.S. routes calling at Port of Bitung are Trunk Routes, Singapore Routes and Special Routes. The Singapore Routes connect Port of Bitung with the area from West Irian and to Singapore by way of Tg. Priok and Surabaya. The Trunk Routes connect Port of Bitung with the four provinces of Sulawesi, North Maluku, Surabaya and Tg. Priok. The Special Routes extend the connection even to East Kalimantan in addition to that of Trunk Routes.

The Local Routes connect Port of Bitung directly with North Sulawesi, Central Sulawesi and North Maluku.

In other words, this route system connects Port of Bitung with Tg. Priok and Surabaya and makes it the center of North Sulawesi, Central Sulawesi and North Maluku. It also connects Port of Bitung with West Irian and Singapore.

Among the ports within the service area of Port of Bitung those with relatively large port tonnage traffic are listed in Table 2-8. It shows that Ports of Ternate and Donggala are active next to Port of Bitung.

3. Natural Conditions of Port of Bitung

3. Natural Conditions of Port of Bitung

3-1. General

Port of Bitung is located on the southeast coast at the north end of the Sulawesi Island, at 1°26' North Latitude and 125°12' East Longitude, facing to the southwest of the Lembeh Strait. (Refer to Fig. 3-1.) This Lembeh Strait is 1 to 2 km width and about 16 km length running from northeast to southwest direction between the Lembeh Island and Sulawesi Main Island.

The Lembeh Island is a narrow island with 1 to 5 km width and approximately 23 km length, and hills with about 200 to 448 m altitudes are running through the middle of the island.

At the portion of the Sulawesi Island along the strait, volcanic mountains of Mt. Duasudars with 1351m altitude and Mt. Batuangus with 1109m altitude are located inland at a distance of 7 to 8 km from the coastline.

Thus, the flat land behind the Bitung Port is located between these mountains and coast and therefore is very narrow.

3-2. Climate

The weather in this area Bitung Port located in is tropical climate with high temperature and high humidity. Also the mountains run in all directions in the Sulawesi creating a complicated topography so that the weather greatly differs depending upon the locality.

The climate in the peninsula in the North of the Sulawesi is generally expressed by much rainfalls and monsoon blowing in the northeast direction from December to March. Also from June to September, the rainfalls are less due to the monsoon in the southeast direction.

The weather station in the Bitung Port was opened in February 1977, and weather observation is being performed.

Other weather station nearest to the Bitung Port is the Mapanget station in the Manado airport.

3-2-1. Temperature and Humidity

The records of air temperature and relative humidity for last 5 years in Mapanget are shown in Table 3-1.

From these records, the monthly mean temperature throughout the year is about 25°C to 27°C and its yearly variation is approximately 2°C. And monthly average of the daily maximum temperature is within the range of 29°C to 31°C, monthly averaged highest mean extreme temperature is 31.7°C, monthly averaged lowest mean extreme temperature is 21.0°C, and daily variation is 6°C to 8°C.

The humidity is generally high and monthly mean relative humidity is 76% to 87% and monthly minimum relative humidity is 32% in September.

3-2-2. Rainfall

The records of rainfall for last 5 years in Mapanget are shown in Table 3-1. From this table, the yearly total rainfall is 3294mm.

Generally the rainfall is less in the dry season between June and October, and the minimum value of the monthly mean rainfall is 115mm. There is much rainfall in the rainy season between December and March. And especially the monthly rainfall from December to February is greater than 325mm. The rainfall in the rainy season is rather a squall and generally concentrated within one or two hours.

3-2-3. Wind

The records of the wind in the Bitung Port are available for 6 months since February, 1977. These records are shown in Figs. 3-2 and 3-3.

Wind records for the last five years measured at the weather station in Mapanget which is nearest station to the Bitung Port are shown in Fig. 3-4 to Fig. 3-8.

The records of these two stations indicate some differences mainly because both stations are separated more than 30 km and are influenced topographically by the mountain with 2,000 m altitude located between these two stations.

From the records in the Bitung Port and also weather maps and records of Mapanget for the period from August to January for which records are not available in Bitung station, wind in the vicinity of the Bitung is as follows.

In the months between November and March, north or northeast wind is more prominent due to the influence of the northeast trade wind with velocity of 5 to 8 m/sec maximum each month but occasionally 9 to 10 m/sec wind also occurs.

In the months between May and October, south or southeast wind is predominant due to the influence of the southeast monsoon and its velocity is about 7 to 12 m/sec especially from June to August but occasionally the velocity of 15 m/sec will also occur. This wind occurs between land and sea so that it blows in the afternoon in many cases.

3-3. Maritime Climate

3-3-1. Tide

According to tidal observation at Port of Bitung, the examples of the tidal level records are shown in Fig. 3-9. The tide in Bitung Port is semidiurnal tide and H.W.L. is 1.9 m above basic level.

3-3-2. Tidal Current

Results of tidal current observation performed in June and July, 1977 are shown in Fig. 3-10 to Fig. 3-16 and are as follows.

(1) At No.1 and No.2 points, current flowed almost to east and northeast direction along the strait during flood tide and its max. velocity was 0.7 to 0.9 m/sec. During ebb tide, the current flowed to west and southwest direction and its max. velocity was 0.55 to 0.57 m/sec.

Flow direction for both surface current and bottom current is almost same at No.1 and No.2 points and velocity at the bottom is about 0.8 to 0.9 times more than that of surface current.

(2) At No.3 point where the strait faces to Open Sea, the current velocity is smaller than that observed at Nos. 1 and 2 points. The velocity is 0.3 m/sec maximum in the direction of northeast during rising tide, and 0.2 m/sec maximum in the direction of west or southwest during falling tide.

Velocity of bottom current during rising tide at No.3 point is about 0.6 times of that for surface current, and during falling tide is the same as or larger than that for surface current.

3-3-3. Waves

Records of wave observation are not available for Bitung Port. Thus, the waves coming to the Bitung area are assumed here from the wind records in Bitung and Mapanget and weather maps.

The deep water waves coming to Bitung Port are caused by seasonal wind (monsoon) blowing from southeast and their wave height is 2 to 3 meters from May to September. Deep water waves in the other months are not so high.

Of the waves coming from the south from May to September, the deep water waves in July and August grow to about 3 m wave height and arrive upon the Bitung. However, these waves coming from the south are shielded by Lembeh Island in front of the Bitung Port so that they do not directly arrive upon the Bitung Port.

Waves through the west side of the Lembeh Island will come directly to the coast of Bitung Port but some waves diffract and scatter toward Bitung Port. These scattered waves synthesized with wind waves occurred in the sea between Lembeh Island and Bitung coast are shown in Fig. 3-17 and as follows.

(1) Waves at west end of existing concrete piers

Wave hight of 0.6 m - 1.0 m occur for 8 to 10 days during July and August in this area and similarly 0.6 m - 1.0 m waves occur for a very short period of time in September and October. This area is generally very calm in other months.

(2) Waves at the coast 0.5 km away to the west from existing concrete piers

Waves higher than 0.5 m will arrive upon this area from June to October. Wave height of 0.6 m - 1.0 m occur slightly in June but for about 16 days in July. In August, waves higher than 0.6 m will arrive upon for approximately 15 days and four days of those will be 1.1 m - 1.5 m high waves. Waves with 0.6 m - 1.0 m heights will slightly occur during September and October.

(3) Waves at the coast 1 km away to the west from existing concrete pier

Waves to this area excel from May to October. In May and June, 0.6 m - 1.0 m waves occur for 4 - 10 days approximately. In July, waves higher than 0.6 m will occur almost every day and waves with 1.1 m - 1.5 m heights will occur for about 8 days.

In August, waves higher than 0.6 m will occur for about 20 days and 12 days of this will be 1.1 m - 1.5 m high waves and 2 to 3 days of this will be 1.6 m - 2.0 m high waves. In September and October, waves of 0.6 m - 1.5 m high will occur for a very short period of time.

3-3-4. Water depth in the vicinity of Port of Bitung

The results of sounding performed during June and July in 1977 are shown in Fig. 3-18 and as follows.

(1) Coast 2 km away to the west from existing concrete pier

The water depth is about -2m and the slope of seabed is 1:10 - 1:15 in the area of 20 - 30 m off from the coast. For about 50 m offshore, the water becomes deeper up to -18 m to - 27 m depth with slopes of 1:2 to 1:3, and front of this portion is -37m to -38m depth with a slope of 1:10 - 1:20.

(2) Existing concrete pier

Water depth at the front of the existing concrete pier is -8m to -9m with slope of about 1:6 to 1:8, and the depth gradually increases to -38 m - -48m at the center of the strait.

(3) Bay in the east of existing concrete pier

Water depth at the north end of the bay is +1.0 m with a gentle slope of 1:80 to 1:110 and gradually is deepened toward center of the bay and depth is about -5 m to -6 m at the baymouth.

Construction of a berth for domestic ships is planned for fiscal years of 1977 and 1978 at the west side of the bay, and this area of 400 m x 200 m is to be dredged up to -5.5 m.

(4) Coast 2 km away to the east from existing concrete pier

Sea bottom becomes deep with a slope of 1:5 in an area of 50 m from shoreline. In front of the area a longshore bar with a depth of -10 m are existing and the sea bottom behind the bar becomes deep to -34 m - -38 m with a slope of 1:4 to 1:30 toward the center of the strait.

3-3-5. Littoral Drift

(1) Bottom materials

Results of bottom materials investigation performed in July, 1977 are shown in Figs. 3-19, 3-20 and 3-21 and described below.

1) Bed materials at east and west sides (point C and point B) are coarse sand with 0.1 to 4 mm grain size mixed small gravel, but medium sand is dominant in the bay (point A). That is, the grading component of the east and west side coast greatly differs from that of the bay where small grain size is outstanding. This probably indicates that small grain sand has been transported by tidal current or waves to the bay and deposited there.

2) The grain size of bed materials at the west coast is more uniform compared to other area. And the grain size is coarse and the slope of the sea bottom in the breaker zone is steep. This indicates that the transport of the littoral drift in the west coast is more outstanding compared to that in the east coast and bay.

(2) Littoral Drift

From the results of site investigations and hearing, it is found that the coastline approximately 2 km away to the west from the existing concrete pier repeats erosion and sedimentation by 1 m to 2 m depending upon the season and the sea bottom at the west end of the existing concrete pier is seasonally changed and shallowed to the depth of -3 m from May to October and deepened to -8 m in other seasons.

From the bed materials and facts stated above, it is assumedly considered that the beach sand at the west side of the existing concrete pier is transported, as littoral drift, toward the existing concrete pier by the waves coming from May to October.

Since there is no large-scale eroded and deposited beach in the shore, it is also considered that some part of the sand transported during May - October to the west end of the existing concrete pier will return to the west coast by the waves during quiet season between November and April and other parts of the sand are transported toward the bay, by the waves and current.

(3) Amounts of Littoral Drift in the area of existing pier and bay

In assuming the amount of littoral drift, a report indicates that the bottom of area in the area of the existing concrete pier was shallowed by 2 m to 2.5 m for 10 years from 1957 to 1966 and total of 30,000 m^3 was deposited. (Note)

Also amount of littoral drift is assumed in comparison with the sounding map surveyed by Hidrografi Tini Al in January and February, 1976 and sounding survey performed in June and July, 1977.

When comparing these sounding survey maps, the front area (150 m long, 20 m to 30 m wide) of east side pier constructed in 1975 and 1976 has been shallowed by 1 m to 2 m for about 1.5 year. This means that about 3,000 - 4,000 m^3 has been deposited per year. The area of 200 m x 100 m in the bay has been shallowed by 1.5 m to 2.0 m. That is, about 20,000 to 30,000 m^3 of sand has been deposited annually. However, these assumed volumes of deposits should be considered as very approximate values since measured spots of 1976 were not so much, both surveys are different in the location of deposit and erosion and test dredging was partially performed in June, 1977.

Amounts of littoral drift is roughly assumed 20,000 ~ 30,000 m^3 from exisiting data.

Note: "Survey Reports on Modernization Plan for Bitung Port and Road Improvement Plan for South and North Sulawesi States" by Overseas Technical Cooperation Agency of Japan.

3-4. Soil Conditions

The results of soil investigation performed during June - August, 1977 are shown in Fig. 3-22 and as follows.

Soil in this area comprises mostly volcanic sand small gravel and soft cohesive soil.

1) Soil in bay at the east side of existing concrete pier

According to the soil investigation in this area, loose sand and gravel stratum with N = 5 to 10 including some silt exists up to the depth of -30 m to -42 m. Occasionally sand stratum with N = 20 to 30 is locally found in the stratum but this is extremely thin. Stratum with N value greater than 50 exists in the sand stratum or mud stone stratum which is located 30 m to 42 m.

At No. 8 point at east end of the existing concrete pier, there is a hard sand stratum with N = 47 at a depth of -15 m.

2) Soil at west coast 1.2 km away from existing concrete pier

Soil in this point is sand with N = 10 to 12 from ground surface to -20 m depth. From this sand stratum to the depth of -52 m, there exists a sand stratum with N = 25 to 50 and cohesive soil with N = 8 is interposed from the depth of -33 m to -38 m.

The stratum below the depth of -52 m is hard tight sand stratum with N = 50 or greater.

(3) Soil at Aertembaga coast

The sand stratum with N = 19 to 28 is found from ground surface to the depth of -11 m. The stratum from the depth of -11 m to -46 m is consisting of cohesive soil with N = 4 to 12 and this stratum is interposed by a loose sand layer from depth of -21 m to -24 m.

3-5. Earthquake

This area is located within the Pacific Volcanic Belt and thus many earthquakes have occurred here. Volcanos of Sangihe Island in the north of Bitung are currently active so that earthquake frequently occurs in Bitung Port.

Scales of earthquake in Indonesia are indicated in Fig. 3-23 and seismic acceleration in Bitung is from 0.07g to 0.15g.

Thus, the port structures should be earthquake-proof with seismic factor of approximately 0.15.

4. Determination of the Service Ared

4. Determination of the Service Area

4-1. General

Service area of Port of Bitung will be discussed in this chapter. Generally term "service area" may include all traffic origins and destinations related to a particular port but the term"service area" will be defined here as areas where influences by Port of Bitung are especially outstanding, in the analyses described hereinafter. In other words, the service area means the area which has Port of Bitung as its distribution center.

The service area for Port of Bitung must be defined in both land and sea directions since Port of Bitung has roles not only as gateway to inland but also as a transit port as described before (1-5 Roles of Port of Bitung).

4-2. Service Area on the Land

Service area on the land of the port is greatly governed by the conditions of the land transportation. Presently, road conditions in the west of City of Bitung are poor with paved roads less than 50% of all roads so that driving by car to City of Gorontalo is very difficult due to the poor road condition. Thus land service area of the Port of Bitung is presently limited to extremely narrow area which include Minahasa and a part of Mongondow, and this port is also separated from the service areas for other neighboring ports.

In considering future land service area, the Feasibility Study conducted under UNDP and carried out by World Bank in 1970 can be used as a convenient reference since it has been proved to be right even though the inflation has actually occurred after the survey (Refer to Fig. 4-1).

According to this study, it is said that a new major port should not be provided within 300 km distance by ship transport from an unimproved port if 4-ton trucks are used for land transportation and within 400 km by ship transport from an improved port if 10-ton trucks are used for land transportation.

The traffic improvements expected for the future in the North Sulawesi Province are the completion of roads (420 km) from City of Bitung to City of Gorontalo through Kwandang, road from Kwandang to Kotamobagu, road from Inobonto to Kotamobagu, road from Kotamobagu to Duludo and so forth in 1980's so that road network in the North Sulawesi Province will be completed thus connecting Gorontalo City service area to the Bitung City service area.

From the analysis made heretofore, it is considered that the service area of Port of Bitung will be enlarged in future to the neighboring area of the Gorontalo.

4-3. Service Area on the Sea

4-3-1. General

Service area appropriate presently in the direction of the sea will be discussed and determined in this section. For this purpose, degree of dependent rate of cargo to the Port of Bitung will be calculated from O.D. tables, and method for determining service area on the sea in future will be described and results will be indicated.

Then, these results will be coordinated with previously made analysis for present condition, and finally alternatives for service area on the sea will be selected and commented.

4-3-2. Present Service Area

In order to understand the range of present service area on the sea, the dependent rate on Port of Bitung by "X" port for commodity "Y" will be defined by

$$D_{XY} = \frac{Q_{BY}}{Q_{XY}} \times 100\ (\%)$$

where D_{XY} : Dependent rate on Port of Bitung for Commodity Y by X area (in %)

Q_{BY} : Amount of cargo (tons) for Commodity Y related to Port of Bitung in X area

Q_{XY} : Total amount of cargo (tons) for Commodity Y in X area

Table 4-1 indicates the dependent rates on Port of Bitung for dry cargo as calculated from "Interisland Seatransport in Indonesia, 1974". From this table, the areas which are considered to have relatively high dependent rates on Port of Bitung are Sulawesi Utara I, Sulawesi Utara II, Sulawesi Tengah II and Maluku Utara.

Table 4-2 indicates the dependent rate on Port of Bitung for mineral oils. The dependent rate for mineral oils seems to be in the range similar to that for the dry cargo but generally dependent rate for mineral oils is higher than that of the dry cargo. This tendency is especially outstanding for Irian Jaya.

Table 4-3 indicates dependent rate on Port of Bitung for commodities which are relatively large in quantity and convenient for observing the distribution functions of Port of Bitung. In the bottom row of the table, the ratios between cargo sent from each of 6 different areas and total cargo handled in Port of Bitung are indicated in percents. These values show that amount of rice loaded, amount of cement loaded and amount of copra discharged are all high exceeding more than 90% so that these 6 areas are considered to be the major service area on the sea. On the other hand, the value for the mineral oils loaded is only 57%.

This indicates that the mineral oils have wide distribution area other than these 6 areas.

4-3-3. Service Area in Future

(1) Future Service Area

In determining service area in the direction of the sea for Port of Bitung in future, the following two prerequisites were taken into consideration:

1) Port of Ujung Pandang and Port of Ambon will continue their important activities as shipping bases in future as they are today.

2) Present shipping system such as R.L.S. and local ship operation in Indonesia will not be drastically changed in future.

If such prerequisites are made and maintained, the only determining factor of the service area will be the marine transport costs. This means that the service area will be determined almost by marine transport distances.

Thus, the service area on the sea of Port of Bitung may be expressed by area surrounded by curve, on which the points having marine transport distance to Port of Bitung being equal to marine transport distance to Port of Ujung Pandang or Port of Ambon have been plotted.

When considering this service area boundary in association with administrative jurisdictional boundary, the service area of Port of Bitung thus determined will contain North Sulawesi Province, Central Sulawesi Province and North Maluku of Maluku Province. This area will coincide with the present service area for dry cargo.

(2) Alternatives

Other alternatives which can be considered may be either wider or smaller in area than that stated in (1).

The range of area established in (1) will coincide with the present service area. However, this service area is a product of present marine transport system and port system. Therefore, for newly defining a service area which differs from present service area, some changes to present two systems stated above must be expected.

For justifying wider service area as an alternative, relative drop of influential forces by Port of Surabaya and Port of Tanjung Priok to the eastern part of Indonesia must exist as a prerequisite but this prerequisite will not be met under present situation especially when considering present mutual dependency between Java Island and other islands.

However, if the marine transport system and port system are modified by the enforcement of new policies by the Indonesian government, much wider service area could be requested since Port of Bitung has geographically better conditions.

In such a case, however, changes in policies, if occur, will be naturally supported by outstanding economic growth in Maluku Province and West Irian Province. However, such growth will not come so so soon in consideration of present conditions in these two provinces but, as forecasted, it will come probably in the years between 1985 and 2000 most likely in the last part in this period.

On the other hand, ability to accept new port construction by Port of Bitung is naturally limited so that the range of service area covered by the port is limited accordingly. Thus, at a time when the service area is increased, enlargement and improvement of other ports such as Ternate and Ambon will also become necessary to respond to the wider demand for the ports.

Thus, this alternative cannot be selected under present conditions but Port of Bitung may probably need to respond to new situation depending upon the changes of various environments after 1985. In such a case, however, Port of Bitung will be required to flexibly respond to new situation, maintaining mutual relations with Port of Ternate and Port of Ambon.

On the other hand, an alternative with a narrower service area may be necessary if one of ports in the neighboring area is further improved and performs port function which is previously done by Port of Bitung. This will likely to occur depending upon the government policies on the port system and marine transport system for North Sulawesi, Central Sulawesi and North Maluku. However, a transport system which allows to hold only narrow service area for Port of Bitung is considered to be disadvantageous since the excellent locational condition of the Port of Bitung cannot be fully utilized if such a system be employed.

5. Prospect for Regional Activities

5. Prospect for Regional Activities

5-1. General

Population, regional income (GRP) and industries in the service area of Port of Bitung in 1985 and 2000 will be projected in this chapter. These projections will be the prerequisities for the traffic forecast through the port described in the following chapter. These items are normally used as basis for the regional development plan and they are furnished as given conditions for all works for determining each project.

Future conditions of service area of Port of Bitung may not be fully utilized as given conditions so that new assumptions have been made. However, the data prepared by Indonesian authorities have been utilized as much as possible in the projection and the adherence to the trend to the present has been carefully maintained.

First, the service area was divided into 6 areas as indicated in Table 5-1 for the convenience of traffic forecast through Port of Bitung. In dividing this area, the areas which can be combined as an unity to Port of Bitung in view of transport conditions at present and in future, were considered as a group.

Characteristics of each sub-area in relation to the degree of dependance on the Port of Bitung are indicated below.

(1) The area presently tied to Port of Bitung by roads is Area 1. A part of Area 3 may be also included to this in future. These areas are the most strongly tied with Port of Bitung.

(2) Areas tied to Port of Bitung by the marine transport are Areas 1, 3, 4, 5 and 6. A part of Area 3 will be tied to Port of Bitung by roads in future. The ties between these areas and Port of Bitung are not strong as that of areas shown in (1).

5-2. Population

In forecasting future population, yearly growth rate of 2.9% employed in planning for the area other than Java Island in Pelita II was applied in assuming future population for each province. Then, the forecasted population for each province was subdivided into populations for several areas considering the trends in the past. The forecasted population is generally indicated in Table 5-2.

According to this table, total population in the service area will be 4,380,000 in 1985 and 6,780,000 in 2000 which are 1.3 times and 2.0 times respectively, compared to that in the year of 1976.

5-3. GRP

In making perspective of GRP of each area in the service area, target of per capita GRP for each province was set first and perspective of GRP was derived by multiplying this value by population assumed for each area in Section 5-2.

When comparing existing per capita GRP to per capita GDP, the difference between these two values will considerably vary depending upon the province (Section 2-4.) Ratio between per capita GRP for each province and per capita GDP in 1973 is 1.29 for North Sulawesi, 0.68 for Central Sulawesi and 0.96 for Maluku. According to the latest data for Central Sulawesi and Maluku, the ratio to per capita GDP is gradually approaching to "1" in these provnirce. The target for ratio between per capita GRP and per capita GDP for North Sulawesi, Central Sulawesi and Maluku is respectively determined as 1.29, 0.75 and 1.0 for the year of 1985 and 1.29, 1.0 and 1.0 for the year of 2000. In this case, the target value of per capita GDP was established assuming 8.5% increasing rate for GDP by 1985 and 7.5% by 2000. The results of the prespective of per capita GRP are indicated in Table 5-3. By multiplying per capita GRP thus obtained by forecasted population for each area, GRP for each area is obtained as indicated in Table 5-4.

5-4. Industries

5-4-1. General

North Sulawesi Province has a typical agriculture oriented industrial structure as stated previously. The industrialization in this district is slower in its progress than South Sulawesi Province, which is also in the same Sulawesi Island. And its government is also very active in promoting industrialization especially the processing of the agricultural products as planned by Pelita II.

In the field of processing of agricultural products, processing of copra is one of the important objects and increase in the production or the copra is considered to be very effective for the growth of the industrial sector. Due to increase in production of coconuts and increase in production capacity for copra and related products, increase in production is expected in the future.

Other industries are manufacturing of metal products such as nails and wires, knockdown factories for automobiles, shipbuilding and repairing factories. Increases in shipbuilding capacities are particularly expected for future due to the increases in domestic demand.

As far as mining industry is concerned, this area is the production center for kaolin and lime stone but copper and nickel are bei ng investigated at present time.

In the fishery, the fishing for bonitos is very active in the vicinity of City of Bitung and its development as export center to Japan is being expected for future.

As far as North Maluku and Central Sulawesi which are related to Port of Bitung, are concerned, increase in processing factories for copra and coconuts related products and increase in processing of consumer related materials are expected for the future as well as North Sulawesi Province. However for other sectors of industries, City of Bitung and City of Manado will function as center of accumulation and supply for industries.

5-4-2. Agriculture

Provinces included in the service area of the Port of Bitung have the identical agricultural configuration. However, North Sulawesi Province is the most important of these three provinces in the service area and agricultural future of this province will be described here.

Typical agricultural projects under way in North Sulawesi Province are the project being performed in Dumoga of Bolaang Mongondow Regency and the other being performed in Marisa of Golontalo Regency. These projects are mainly for rice growing but soybeens, coconuts and corns will be also raised in a manner suited to steep land peculiar to the North Sulawesi Province. Also, a project for raising cattles in the existing coconut farms is being considered. These projects suggest by themselves that kinds of agricultural products in future may be very similar to those which are available now.

Major agricultural activities which may have a possibility to give some influences to the forecast of traffic through the Port are the production of the foods.

Of the food stuffs carried to the service area through Port of Bitung at present time, amounts of rice, wheat flour, sugar and salt are relatively large in each year. And also in future, wheat, sugar and salt may be dependent upon the products made in other area. But efforts for increasing rice production within the service area are being made now and this will continue also in future. Increase in production is achieved by increasing area of agricultural land and improving productivity of land. However, topography of North Sulawesi is mountainous so that production increase only by increasing agricultural land area is not advantageous and, therefore, use of fertilizer and introducing of new species may be employed in parallel with area increase.

Other agricultural product which affects to the port cargo next to the Commodities stated above is coconuts. The coconuts are also shipped to Port of Bitung from other neighboring areas, though increasing rates of coconut-growing land area and its productivity are stagnant in recent years. However, new coconut species which has a land productivity several times higher than conventional species, is being introduced according to the Ministry of Agriculture. Therefore, it was' assumed that this new species would be introduced also to North Sulawesi in early 1980's. However, flow of cargo related to the marketing of this new coconut species was considered to occur after the year of 1986.

When live stock project is progressed, demand for feeds will be increased accordingly. Casava is one of the important feeds and its excess will be processed and shipped.

Cloves and nutmegs are also important products of North Sulawesi but amounts of these cargo shipped through Port of Bitung are relatively small and therefore not stated here.

5-4-3. Manufacturing Industries

Industries are important cores in the development plan for North Sulawesi area. During the execution of lst 5-year plan, the industries grew tremendously with average increase of 16% each year. Nevertheless of such growth, this has not reached to 10% of total productions.

Industries in North Sulawesi area have been developed mainly for processing of agricultural products such as copra and are mostly producing daily necessaries or foods in small-scale factories. According to survey made in 1972 (Table 5-5), number of enterprises is 21 for coconut oil factories and 52 for rice mills and these amount to more than half of all factories. Number of average workers per enterprise is 20 which is small in scale and more like a household industry.

Purpose of industrial development in Indonesia seems to be the creation of employment opportunities and thus development of labor-intensified industries may have been expected. Types of industries that can be started in the North Sulawesi area are stated in Table 5-6.

Due to increase in demand for shipbuilding in future, shipbuilding and related repairing industries may be increased in scales of shipyard. As far as scale is concerned, ship of 10,000-ton class may be built and fabrication of land facilities such as steel frame structure, bridge girders and water gates may become also possible (Refer to Fig. 5-1).

6. Forecast of Traffic through the Port

6. Forecast of Traffic through the Port

6-1. General

Forecast of traffic through the port for the years of 1985 and 2000 will be described in this chapter. The traffic being forecasted here is port tonnage traffic, passegners and calling vessels.

6-2. Port Tonnage Traffic

Forecast of port tonnage traffic is made first by commodity. Then, tonnage by commodity is devided into by traffic type of ship.

As a rule, traffic by commodity is forecasted by forecasting goods demand and supply condition for each area in the service area and then by considering dependent rate on Bitung for the each area.

However other methods of forecast are also employed if traffic is very small or if above method gives forecast with less accuracy.

Results of forecast for traffic by commodity are indicated in Table 6-1 and Table 6-2, where traffic is shown by commodity group. Traffic forecasted is approximately 1,500 thousands tons for 1985 and 4,500 thousands tons for 2000.

Traffic ratios between the year of 1976 and the year of 1985 and 2000 are indicated respectively in Table 6-3. According to this table, total traffic will increase to 2.1 times in 1985 and 6.1 times in 2000 of the traffic of 1976.

However, increase of traffic excluding the petroleum by the year of 1985 and 2000 will be 2.0 times and 4.6 times respectively of the traffic of 1976.

Table 6-4 indicates traffic through Port of Bitung by type of ship. And Table 6-5 indicates ratios of these traffic between the year of 1976 and other years being projected. These results indicate that traffic by special vessels will increase the most and traffic by R.L.S. vessels and local vessels will increase in the next place. A large traffic by the special vessels is reflecting great increase in traffic of petroleum.

6-3. Passengers

There is no apparent sign of increase or decrease in number of passengers passing through Port of Bitung in recent years (Table 1-8). Therefore, number of passengers forecasted for the years of 1985 and 2000 is 25,000 persons which is equal to a maximum actually recorded since 1971.

6-4. Calling Vessels

Forecast for calling vessels in future is made for both sizes of vessels and number of calling vessels.

Considering actual past records of vessels calling at Port of Bitung and size of vessels being built, maximum size of vessels is forecasted 10,000 D. W. T. for ocean going vessels and 2,000 D. W. T. for vessels for domestic use. As far as sailing vessels are concerned, the size being used now is considered for the forecast. For special vessels, the maximum size forecasted is 15,000 D. W. T. for facility planning purposes since maximum berthing capacity of 15,000 D. W. T. is already available in existing facilities of Pertamina.

For the size of calling vessels in the year of 2000, introduction of size that is 1-rank larger than that of the year of 1985 is assumed, considering 15,000 D. W. T. maximum for ocean going vessels and 3,000 D. W. T. maximum for local vessels. However, average size of vessels for domestic use will be approximately 2,000 D. W. T.. For sailing vessels, presently used size is also taken for the future.

For number of calling.vessels, variation in discharging and loading volumes by type of ship is considered, and forecasted number of vessels is, more or less, 5,000 for 1985 and 8,000 for 2000.

7. Selection of Construction Site

7. Selection of Construction Site

7-1. General

Generally two groups of possible sites can be considered as construction site for new port facilities for the Expansion Project for Port of Bitung, as indicated below.

(1) Site in the vicinty of present Port of Bitung.

(2) Nearby ports in the North Sulawesi Province.

The area in the vicinty of Port of Bitung is well sheltered by Lembeh Island from wind waves coming from Maluku Sea and well located for a port with excellent connection with existing Port of Bitung and City of Bitung. Therefore, this area is divided into several sections as possible site and each section is examined in detail.

Nearby ports in the North Sulawesi Province are examined and evaluated as possible sites for the Expansion Project of Port of Bitung since these ports are located directly behind the Port of Bitung and geographically connected to both Menado and Bitung which are the center of urban activities in the North Sulawesi Province.

7-2. Evaluation of Possible Sites in the Vicinity of Port of Bitung

7-2-1. General

Area appropriate for the new port facilities on the coast in the vicinity of existing Port of Bitung must be, more or less, sheltered by Lembeh Island from waves. Some of the possible site may require new breakwater but even such sites will be considered here for examination and evaluation.

There are six preliminary possible sites as indicated in Fig. 7-1. They are Bitung South, Bitung West, BitungEast, Bitung North, Batu-Angus and Lembeh.

Each site is evaluated analytically from socio-economic aspects and by engineering view points then conclusions will be formed by synthesizing these analysis.

7-2-2. Evaluation from Socio-Economic Aspects

In selecting a site appropriate for construction of port facilities, a site will be the most desirable if construction of new port facilities in this site does not compete with any other activities. If there is a competition with other activities, an extra time will be required for adjustment and costs for compensation will be also required. In such a case, this site is disadvantageous for building port facilities.

Adjustment required and costs for compensation will naturally vary depending upon the type of other competitive activities. From this point of view, Bitung West may be the most disadvantageous since Pertamina is existing there. However, in other sites farm-land and houses will also exist in all cases in certain extent if it is in a flat land. Thus, some kind of competition will always exist.

In view of port utilization after the completion of the port facilities, a site will be desirable if efficient port management is possible and connection with service area is well maintained. That is, a site is favorable if port operation can be unified with nearby existing port, functions of existing port cities can be utilized and access to service area is conveniently provided.

In view of such considerations stated above, Bitung West and Bitung East are the most desirable sites which are located next to existing port facilities. Then, Bitung South where road from Menado to Bitung runs directly behind it, is considered to be acceptable. However, Lembeh is not desirable since the strait exists between tw islands.

In addition, industries related to port must be able to find required lands around the port in order to continuously maintain the development of the port, and thus easy availability of lands for the industries is an important prerequisite. Especially, industries are capable to create new port demands by themselves so that sufficient industrial lands should be available around the port site.

Thus, an area where a wide plain is available with less competition or water surface suitable for land reclamation may be considered as excellent site for construction of new port facilities. In view of this requirement, Bitung South and Lembeh are more advantageous than the others.

7-2-3. Site Evaluation by Engineering Viewpoint

1) Bitung East

The sea in front of Bitung Port is shielded by Lembeh Island from waves coming from the ocean so that a natural calm water area is available there. Littoral drift appears in the area but not as much as seashore in the west of existing concrete pier. Water depth available is -9m to -10m at the area of extension the face line from existing concrete pier.

The Soil bearing layer with N-value of about 50 is -17m near the existing concrete pier and generally -30m to -42m. Also, max current velocity is about 1m/sec and there is no special problem in ship maneuvering due to the current. From engineering point of view,

2) Bitung West

From engineering point of view, waves and littoral drift may be the problem in this area.

Monthly operating ratio in this area for 0.5m and 1.0m wave heights is calculated on the basis of waves assumed in Paragraph 3-3-3, and indicated in Fig. 7-2. According to this figure, total of 27 days will have waves higher than 0.5m, and 8 days of this will have waves higher than 1m in July. In August, about 20 days will have waves higher than 0.5m and 14 days of this will have waves higher than 1m. Therfore, the operating ratio of this seashore is 50% to 70% in July and August. Since the waves are rough on this coast, the water depth of -10m is generally obtained at a point which is about 20m to 50m away from the coast line. This distance is considered to be relatively short.

The soil bearing layer is -52m so that long piles will be needed if pile foundation is employed. As far as littoral drift is concerned, much seasonal movement of littoral drift is considered so that detail investigation for the littoral drift will be required prior to execution of the project.

3) Batu-Angus

This site is facing directly to ocean in the north. According to the information obtained from local fishermen, due to the northeast trade wind from December to March the waves higher than 1m will occur for 12 to 20 days per each month and waves higher than 2m occur for about 7 days and occasionally waves higher than 3.5m will occur especially in January and February.

The material of coast is mainly boulder in the area and this also proves the roughness of waves on this coast.

Large amount of investment will be necessary for breakwater facilities if new port is constructed here so that this site is not appropriate for the port construction.

4) Bitung North

This site is well shielded by Lembeh and very calm but steep hills exist behind coastline and sea bottom is also steep so that obtaining of available port area and construction of wharf are costly. Thus, this site is not appropriate for the port construction.

5) Lembeh

Water area is sufficient calm and some area along the coastline is flat so that the construction of new port facilities is possible in this area.

6) Bitung South

This site is open to the Maluku Sea and, therefore, a large amount of investment will be required for breakwater to keep the water calm, so that this site is not appropriate for the new port.

7-2-4. Overall Evaluation

(1) Evaluation Method

Requirements for new port facilities will be established here first in order to totally evaluate the possible sites for the new port construction. Then, factors for comparison for relative evaluation of the possible sites will be abstructed. And each possible site will be then evaluated and graded to three ranks. A, B and C for each of these factors.

Ranks A, B and C mean the following:

A : Proper
B : Usual
C : Improper

Finally, tabulations of three-rank evaluation and importances to the project of the factors for comparison will be totally studied and overall judgement will be made.

(2) Requirements for New Port

The requirements for the new port which are used for site comparison, are the functions of the port to be considered for the year of 2000 as follows:

1) The traffic to be handled shall be about 4 times of the traffic through the existing Port of Bitung.

2) Sufficient calmness shall be secured throughout the year.

As a new port fully meeting with such requirements, new wharf must have berthing facilities and back-up land area and, depending upon the location, the breakwater and access may become necessary. The new facilities required as a new port for each of possible sites are listed in Table 7-1.

(3) Comparison Factors and 3-Rank Evaluation

Suitability of each possible site for the construction of new port should be evaluated first for its easiness in construction and secondly for its easiness in operation for the constructed port facilities. And in planning the port facilities, full consideration for future port development should be taken, viewing the port as basis of regional development and as center of local traffic. Thus as third comparison factor the possibility of future development of each possible site must be examined. These three factors are then subdivided into several elements to make significant differences among possible sites and thus three-rank evaluation will become more easier and definitive. Results of three-rank evaluation by examining each site for its conformity to these comparison factors are indicated in Table 7-2.

(4) Overall Evaluation

By the consideration stated heretofore, the following evaluation can be made for each possible site:

1) Bitung South

Breakwater and probably excavation will be required for this site for securing the calm basin so that high construction costs are expected and this is a critical disadvantage.

2) Bitung West

Pertamina facilities are located in most parts of this construction site. These facilities are fairly new so that building of new port after removing these facilities is not realistic at present time. However, transferring of these facilities to somewhere else can be naturally considered after the facilities become old or after cities behind them would have been developed.

In adjacent to Pertamina, land for factories has been planned behind the coast line so that this site is extremely advantageous for developing industries in the area adjacent to the wharf.

Therefore, this site is very excellent as site for new port construction after Pertamina is removed. But this area is affected by waves and littoral drift and possibly creates some degree of problem as new port site.

3) Bitung East

Bitung East is the most suitable new port site by the year 2000 from the view point of operation as well as that of construction. However, for building a larger-scale port, the existing ship-repairing facilities should have been removed in advance. New land for relocating these facilities after removal may be easily found in land to be reclaimed in the sea surface in the direction of Aer Tembaga.

4) Bitung North

This area is steep everywhere on land in adjacent to coast line and water area is also suddenly deepened so that wharf construction seems to be very difficult.

5) Batu-Angus

Land behind the site in Batu-Angus is designated for bird and beast conservation zone so that this land is not suited to new port that inveitably invites the cities, traffic and industries. Also this area requires breakwater for new port which means higher cost. In addition, this area may be far away from present cities and ports which is considered to be a demerit for the port management.

6) Lembeh

Lembeh has the advantage that clam water surface can be obtained everywhere. And less social or economic frictions can be expected in the port construction since both population and industries are relatively thin in this area.

As far as chart examination and on-site investigation is concerned, this area seems to offer no problem in finding proper land for reclamation. Therefore, this site is considered to have relatively good conditions for port construction up to the year of 2000 or even after this year.

Greatest disadvantage of this site of Lembeh is the presence of Lembeh Strait between Bitung and Lembeh which is at least 600m wide with some current. Due to presence of this strait, ferry boats must be used without choice for transportation of passengers and cargo between Salawesi and Lembeh Island. Bridge is too costly and economically unrealistic.

Lembeh Island has to be said to be better suited to petroleum distributing center or to shipbuilding center rather than to port, since danger to life and properties by petroleum distributing facilities can be eliminated by the strait located between cities and facilities and petroleum transport to Sulawesi Island can be made through pipe line, and since less demerit is expected as shipyard than as port due to smaller amounts of passenger and material transportation required for a shipyard in comparison to a port.

From the analyses and consideration made in Items 1) to 6) above, the most suitable site for port construction by the year of 2000 is Bitung East. But Bitung West is also capable to have the same priority as Bitung East if adjustment for Pertamina is properly made. And Lembeh can be effectively utilized in future as land for relocating of either petroleum distributing base or shipyard.

7-3. Evaluation for Other Ports

7-3-1. Port of Menado

This port is located in Menado, provincial capital, and this port historically functioned as a trigger for the development of City of Menado and North Sulwesi Province. It is advantageously located in relation to cities but it is a small port utilizing a river mouth affected by silitation with small mooring basin and shallow water depth unsuitable for mooring large vessels. This part also faces to Celebes Sea and, therefore, breakwater must be constructed against monsoon if this port is to be selected for the project. Construction of breakwater is extremely costly and therefore this port is not suited to the project.

7-3-2. Port of Gorontalo

This port is located next to City of Gorontalo and hills in this city and in its vicinity are being developed as center of the agricultural development in the North Sulawesi Province. This port is located about 275km west of Bitung almost at a center of North Sulawesi Province so that this is an ideal area geographically as transport center to the west part of the province.

This port is opened to Maluku Sea so that a tremendous amount of investment will be required if breakwater is constructed here for building port facilities for large vessels. In addition, area directly behind this existing port is covered with many hills and therefore sufficient land cannot be obtained. Thus, berthing facilities for small vessels must be improved in this port as supplemental port for Port of Bitung but this port itself is not proper as port for large vessels.

7-3-3. Area around Likupang

Likupang is located at northeast end of the Celebes Island. This area on coast is located about 30km away from City of Menado and also from City of Bitung. Across Bangka Strait in the north, Bangka and Talisei Islands are located. Flat land behind the coast in the area is considerably wide and securing of port land and mooring basin is not difficult. However, this area has no sheltering in both east and west directions so that influence by wind waves cannot be avoided during monsoon season. Sand beach is widely extended on the coast and some area may be adequate as reclamation land. Reef is located 1 to 2km offshore and tremendous amounts of dredging costs will be required for maintaining proper depth but possibility of siltation by waves is considered.

Therefore, for the construction of port facilities for large vessels, breakwater may be built in east side, channel and basin can be dredged and wharf and port facilities can be built because of large space both on water and land, but tremendous amounts of investment are required for these and therefore inadequate as site for this project.

7-3-4. Other Ports

Ports other than those described above and worth considering in the North Sulawesi, are Ports of Kwandang, Labuan-Uki and Amurang. All of these ports are located on north coast in the North Sulawesi.

In Kwandang, fishery port facilities are being added presently and local vessels call this port. This port is located within extremely calm bay but water is shallow and, therefore, it is not suitable as port site for large vessels.

Labuan-Uki is, according to the chart, a bay with 0.5km bay mouth width and 1.5km bay length, and its water depth is 30m maximum. Muddy deposit is located at the innermost end of the bay.

At present time, construction project of large-scale cement plant is being studied near this bay and there is a possibility of using this bay as marine transport base. However, approach from land is difficult and, in view of available space for port construction in bay, access and relation with cities, construction of a commercial port taking the place of Port of Bitung will be difficult in this bay.

Amurang is sufficiently wide bay and a port, navigation aids and houses are already built around the bay. However, this oprt cannot be a commercial port taking the place of Port of Bitung due to its geological conditions with relation to service area and to locational relation with City of Menado which is a center in the area.

7-4. Selection of Construction Site

Excellent construction site for port facilities for Expansion of Port of Bitung is considered to be the area in the vicinity of Port of Bitung among those two groups stated in Section 7-1. And especially, as described in Section 7-2, the coast and water area in Bitung East are excellent which are located between the -10m wharf of Port of Bitung and the shipyard. No.2 site is considreed to be Bitung West and No.3, Lembeh.

Thus Bitung East is proposed in this project as the most excellent site for construction of new port.

Bitung West which is the coast in front of Pertamina at west side of existing wharf, if very precious space as a room to allow the port development in future after the year of 2000 even though it is limited by influence of wind waves and littoral drift for its west side extention and by plan adjustment required for Pertamina.

Of the coast of Bitung East, the front of shipyard is also an adequate area as extra allowance for extension of the commercial port if an adjustment is made with extention plan of the shipyard.

No.3 site Lembeh is a proper site that can be effectively utilized in future as reserved site for extention of oil tank yard, shipyard and so forth and, thus, this site also should be taken into consideration as an important element when considering future expansion for the commercial port facilities of Port of Bitung.

8. Port Facility Planning

8. Port Facility Planning

8-1. General

The port tonnage traffic for the target year of the project is shown in Table 8-1. Excluding petroleum to be handled at Pertamina Piers from this table, the port tonnage traffic to be handled at public wharves is then indicated in Table 8-2. In accordance to section 7-4 of the types and sizes of ship a standard wharf with 185m length and -10m water depth is planned for an ocean going vessel with capacity up to 15,000 D.W.T., and a standard wharf with 90m length and -5.5m water depth is planned for a R.L.S. vessel with average ship size of 2,000 D.W.T.. However, maximum ship size of 3,000 D.W.T. is assumed for R.L.S. vessels so that 3 berths among necessary numbers of 5.5m wharves should be provided with effective water depth of 6m at least. For local vessels and sailing vessels, facilities with -4m and -3m water depth should be constructed, respectively.

The quantities of wharf required in accordance with traffic shown in Table 8-2 are indicated below.

	Year 1985	Year 2000
-10m Wharf	2 berths	4 berths
- 5.5m Wharf	10 berths	18 berths
- 4 m Wharf	2 berths	3 berths
- 3 m Wharf	100 m	100 m

However, existing facilities are:

-10m Wharf;	3 berths	582 m length
- 5.5 m Wharf;	approx. 4 berths	350 m length (under construction)

Thus, required number of berths to be newly constructed is:

		No. of berths		
1.	-10m wharf:	0	up to 1985	Note #1
		1	1986 to 2000	Note #1
2.	-5.5m wharf:	8	up to 1985	Note #1
		10	1986 to 2000	Note #1 & 2
3.	-4m wharf:	150 m	up to 1985	
4.	-3m wharf:	100 m	up to 1985	

5. In addition, wharf for boats for port service and official use and wharf for passenger vessels are required and estimated quay length is 150m.

Note #1: This required number of berths may be subject to slight change since existing -10m wharf may be planned to use for domestic vessels depending upon planning.

Note #2: 3 berths among 10 berths for -5.5m wharf shall be of structure with -6m water depth.

8-2. Layout Plan

In planning the layout, a base of facility planning, the required berths which are stated in previous section are planned to be located in water area and coast line of Bitung East covering from east side of existing Concrete Pier to existing shipyard, Three alternative layout plans are prepared. These three alternatives are shown in Figs. 8-1, 8-2 and 8-3, and they indicate long-term plan for target year 2000 and medium-term plan for target year 1985. In preparing these three plans, the following basic ideas are commonly used:

Basic Ideas Used in Planning

1. Required berths should be provided.

The facilities to be newly constructed under the expansion project are described in previous section, and layout of new berths will be made in conformity with the descriptions. However, numbers of berths for -10m wharf and -5.5m wharf may be subject to change, depending upon the contents of the three plans since existing concrete piers can be utilized also for domestic trade.

For berths for local vessels, port service boats, official-use boats and passenger's vessels, the berths with total length of 300m consisting of 150m of part of -5.5m wharf being constructed now behind existing Concrete Piers and of 150m of -4m wharf planned for new construction, will be considered in each of three plans.

2. Type and size of vessels are determined as shown below.

Ocean going vessels:	15,000 D.W.T.
R.L.S. vessels:	2,000 D.W.T. average
	3,000 D.W.T. maximum
Local vessels:	700 to 1,000 D.W.T.

3. Each berth should be used by specific type of vessels. Especially, group of local vessels, boats for port service, boats for official use and passenger vessels and group of sailing vessels are separated as much as possible from berths for large vessels and R.L.S. vessels. For a certain period of time during construction, large vessels and R.L.S. vessels may use common berths but, after the completion, these berths can be used specifically by specific vessels only if so desired.

4. Easy ship maneuvering is fully taken into consideration. The current of Lembeh Strait will not affect too much for entrance and departure of vessels. However, the face line for large vessel berths is planned in such a manner that the face line will become parallel with or become close to parallel with current of strait as much as possible. In addition, width of harbour entrance and turning basin in the port are properly secured for each specific type of vessel.

5. Back ground area should be secured. In Bitung East, area behind port is not wide enough to that securing of land may be limited in certain degree but securing of largest land required is taken into consideration. And land with minimum width of 120m is determined to be secured for this purpose behind the face line of wharf in south side of road between Bitung and Aer Tembaga. Also for jetty type wharf, securing of 180m wide jetty area is considered but this is inevitably reduced to 130m to 150m in some cases due to interference with existing facilities.

6. Soil conditions and water depth should be considered. Generally speaking of the soil in Bitung East area, the foundation layer is deeply located at the center of the bay toward east or northeast of Concrete Pier and shallowly located gradually as it goes to west and east side from there so that this is advantageous for the construction of structures.

In regard to water depth, -10m contour line runs along the face line in front of Concrete Pier approximately in parallel with current of strait so that it is considered to be advantageous to maintain the construction in the further north side than the contour line.

7. Future space for port expansion after the year 2000 should be taken into consideration.

This may be not directly related to the purposes of this report but, in view of the potentiality of Port of Bitung, space allowed for future expansion is projected in advance within a certain degree of possible limit, and special cautions are taken for not obstructing future expansion and for providing ability to flexibly responding to transport innovation in future.

8-3. Comments and Outline Evaluation for Alternative Plans

Preliminary plans and rough estimates for construction costs for Alternative 1, 2 and 3 are shown in the following Tables 8-3, 8-4 and 8-5.

Merits and demerits of these Alternatives are compared here and outline evaluation is indicated in the table below.

As basis of the evaluation, the items such as economic problems, construction costs, problems in utilization, possibility of unified layout for foreign trade berths, easiness for ship manuevering, and possibility of separation of sailing and other vessels have been considered. In addition, the possibility of future port development is also considered from long-term viewpoint.

These three plans are all made for laying out facilities with similar quality and quantity within limited area so that they will not greatly differ from the other. However, Alternative 3 is highest in cost and has some elements for ship maneuvering and port utilization which are inferior to these of other two plans.

There is no outstanding difference between Alternative-1 and 2 and judgement for superiority or inferiority seems to be very difficult to make. However, as far as easiness for unified utilization and management for foreign trade wharf area are concerned, Alternative-1 is more likely to be advantageous. And also for easiness for ship maneuvering within the inner harbor during entrance and departure, Alternative-1 seems to be slightly better due to its shape of face line of the pier.

Therefore, this report uses Alternative-1 as proposed plan for the expansion project.

8-4. Preliminary Design of Major Facilities

The types of structures for -5.5m wharf and -10m wharf of the port, which have been studied and examined are described below. These schemes are considered to be appropriate as wharf for this port considering the natural conditions especially the soil conditions for earthquake-proof structures. In the studies, surcharge used are 2 t/m^2 for normal condition and 1 t/m^2 during earthquake and seismic factor of 0.15 is employed.

1) Alternative schemes for -5.5m wharf:

Sheet Pile quaywall
Pile wharf

2) Alternative schemes for -10m wharf:

(1) Steel-pipe-pile quaywall
(2) Pile wharf

In addition to the above types for -5.5m wharf, gravity types such as caisson, concrete blocks, cellular blocks, L-shape concrete and so forth can be also considered. However, these gravity types are disadvantageous compared to the above shcemes by the following reasons:

(1) Construction and fabrication of facilities are newly required on land and even launching facilities are needed especially for caisson.

(2) Working ships including large crane boat and tugboat is required for installation in the sea.

(3) Seismic force proportioned to the weight of structure will act as big load so that construction costs are generally high.

Alternative shemes for -5.5m and -10m wharf are shown in Fig. 8-4 and Fig. 8-5.

Construction cost per one linear meter of -5.5m wharf is about $R_p 2.5 \times 10^6$ for sheetpile quaywall and about $R_p 3.2 \times 10^6$ for pile wharf.

Construction cost per one linear meter of -10m wharf is about $R_p 6 \times 10^6$ for steel-pipe-pile quaywall and about $R_p 5 \times 10^6$ for pile wharf.

(Note): Above estimates should be used only as tentative values.

CONCLUSION

The basic idea of the expansion project of Port of Bitung mentioned in the Interim Report is summerized as follows:

(1) Characteristics of Port of Bitung

Port of Bitung to which the vessels for foreign trade and domestic trade call now is one of physical distribution bases for East Indonesia. Port of Bitung has a function as a transit port for the service area in the direction of sea, that is, a part of North Sulawesi Province, Central Sulawesi Province and North Maluku of Maluku Province. It has also the service area in the direction of land in the remaining part of North Sulawesi Province, to which it functions as a gateway of physical distribution. These characteristics of the present Port of Bitung from the functional view point is attributable to the existing systems of ports and marine transports.

The future characteristics of Port of Bitung may be the same to the above-mentioned present one on the assumptions that the functional apportionment of Port of Bitung with Poarts of Ambon and Ujung Pandang may last as well and the system of Indonesian marine transport may not be modified in large extent.

(2) Scale of Port of Bitung

Recent increase of port tonnage traffic through Port of Bitung is outstanding which reflects the development of economic activities in its service area. The future traffic may be forecasted as 1.5 million tons in 1985 and 4.5 million tons in 2000 on the basis of appropriate projections of population and economy in the service area. The traffic through the public wharves which may be reproduced from the traffic by type of ships derived from, the total traffic is a million tons and 2.4 million tons in 1985 and 2000, respectively.

Port of Bitung in future may be planned in its scale to cope with this increase of traffic adequately on operational sense.

Thus, the mooring facilities to be newly constructed by 1985 may be 820m including 540m of -5.5m wharf and those from 1986 to 2000 may be 1,080m including 220m of -10m wharf.

(3) Construction Site of New Port Facilities

The existing Port of Bitung is situated at an excellent site as a physical distribution base for a part of East Indonesia from the view points of natural conditions and social and economical conditions. Then several sites are compared around the existing port to select the construction sites for new port facilities. The comparison brings the conclusion that the area adjacent to the existing port to the eastward is the best from the overall consideration on the aspects of construction, operation and future development.

Table 1-1 Port Tonnage Traffic through Port of Bitung, 1971 – 1976

Unit: 1,000 tons

Year	Foreign Trade		Domestic Trade		Total
	Import	Export	Inbound	Outbound	
1971	131	46	144	78	399
1972	117	86	152	91	446
1973	124	66	200	120	510
1974	122	43	287	136	588
1975	87	79	306	121	593
1976	140	80	330	181	731
1977*	73*	36*	153*	78*	340*
Growth rate % p.a.	1.4	12	18	18	13

Note: * are the figures for January to May in 1977.
Source: ADPEL of Bitung

Table 1-2 Port Tonnage Traffic through Port of Bitung by Commodity Group in 1976

Unit: 1,000 tons

Commodity Group	Foreign Trade		Domestic Trade		Ground Total		
	Dis-charged	Loaded	Dis-charged	Loaded	Dis-charged	Loaded	Total
Food stuffs (Rice, Wheat flour, Sugar)	56.2	–	43.2	22.9	99.4	22.9	122.3
Agricultural Products (Coconut Oil Cake, Coconut Oil,	–	71.5	43.1	72.0	43.1	143.5	186.6
Construction Materials (Cement, Asphalt, Iron)	76.2	8.0	15.2	6.1	91.4	14.1	105.5
Production Materials	–	–	0.1	0.3	0.1	0.3	0.4
Vehicles	3.0	–	8.7	0.6	11.7	0.6	12.3
Miscellaneous	4.1	0.8	70.3	12.3	74.4	13.1	87.5
Sub Total	139.5	80.3	180.6	114.2	320.1	114.5	594.6
Petroleum	0.6	–	149.6	66.5	150.2	66.5	216.7
Total	140.1	80.3	330.2	180.7	470.3	261.6	731.3

Notes: 1) The commodities in parentheses show the main commodities included in the related commodity group in these order.

2) Derived from the annual report of Adpel Bitung.

Table 1-3 Percentage Composition of Port Tonnage Traffics through Port of Bitung by Commodity in 1976

Unit : %

Commodity Group	Discharged	Loaded	Total
Food stuffs	21	9	17
Agricultural Products	9	55	25
Construction Materials	19	6	14
Production Materials	–	–	–
Vehicles	3	–	2
Miscellaneous	16	5	12
Sub Total	68	75	70
Petroleum	32	25	30
Total	100	100	100

Table 1-4 Interregional Flow of Dry Cargo Discharged and Loaded at Bitung, 1974

Statistical Maritime Regions		Discharged (100 tons)	Loaded (100 tons)	Discharged (%)	Loaded (%)
12	Sumatra Selatan	–	–		
16	D.K.I. Jaya I	64	200	6.6	25.9
17	D.K.I. Jaya II	1	–	0.1	–
19	Jawa Tengah I	1	–	0.1	–
21	Surabaya	329	110	34.0	14.2
26	Kalimantan Selatan	7	–	0.7	
27	Kalimantan Timur I	71	–	7.3	
28	Kalimantan Timur II		–		
29	Sulawesi Utara I	110	119	11.4	15.4
30	Bitung	5	5	0.5	0.6
31	Sulawesi Utara II	68	84	7.0	10.9
32	Sulawesi Tengah I	8	20	0.8	2.6
33	Sulawesi Tengah II	33	88	3.4	11.4
34	Ujung Pandang	225	11	23.2	1.4
36	Sulawesi Tenggara	21	–	2.2	–
37	Bali	18	–	1.9	–
38	Nusatenggara Barat	2	–	0.2	–
40	Maluku Utara	6	125	0.6	16.2
41	Maluku Tengah	–	6	–	0.8
43/47	Irian Jaya	–	5	–	0.6
	Total	969	773	100	100

Note: Derived from "Interisland Sea Transport in Indonesia, 1974" by Puslitbang and I.S.T.P.

Table 1-5 Ship Calls to Port of Bitung, 1971–1976

Year	General Vessels		Sailing Vessels		Total	
	Calls	1000 D. W. T.	Calls	1000 D. W. T.	Calls	1000 D. W. T.
1971	1,433	1,783	1,027	9	2,460	1,792
1972	1,500	1,946	854	8	2,354	1,954
1973	1,554	1,756	691	7	2,245	1,763
1974	1,759	1,868	597	7	2,356	1,875
1975	1,806	2,208	763	8	2,569	2,216
1976	2,063	2,100	585	5	2,648	2,105

Source : ADPEL Bitung

Table 1-6 Ship Calls to Port of Bitung by Type of Vessels in 1976

Type of Ships	Vessels	D.W.T.	Composition	
			Vessels	D.W.T.
	Vessels	1000 D.W.T.	%	%
Ocean Going Vessels				
Foreign Flag	120	768	4	37
Indonesian Flag	18	163	1	8
Tanker				
Foreign Flag	2	27	–	1
Indonesian Flag	173	411	7	20
Interinsular Vessels	1,663	711	63	34
Sailing Vessels	585	5	22	–
Others	87	–	3	–
Total	2,648	2,085	100	100

Source: ADPEL Bitung

Table 1-7 Port Tonnage Traffic Discharged and Loaded at Port of Bitung, 1976

Type of Ships	Tonnage	Composition
Ocean Going Vessels	220 1,000 tons	30 %
RLS Vessels	227	31
Special Vessels	248	34
Local Vessels	19	3
Sailing Vessels	17	2
Total	731	100

Source: ADPEL Bitung

Table 1-8 Disembarkation and Embarkation of Passengers at Port of Bitung, 1971 – 1976

Year	Disembarkation	Embarkation	Total
1971	7	13	20
1972	7	10	17
1973	12	10	22
1974	16	9	25
1975	11	6	17
1976	9	4	13

Source: ADPEL Bitung

Table 1-9 Traffic per Meter of the Concrete Pier at Port of Bitung, 1971 – 1976

Year	Length of Concrete Pier	Traffic	Traffic per Meter of the Pier
	m	1,000 tons	t/m
1971	432	385	891
1972	432	330	764
1973	432	347	803
1974	432	403	933
1975	432	387	896
1976	507	482	950

Table 2-1 Population of North Sulawesi, Central Sulawesi and North Maluku, 1971 – 1976

Unit: 1,000 persons

Region	1971	1972	1973	1974	1975	1976	Growth rate per annum
North Sulawesi	1,718	1,768	1,820	1,873	1,928	1,984*	2.8
Central Sulawesi	914	943	971	997	1,024	1,051	2.8
North Maluku	307	314	322	329	340	360	3.2
Total	2,939	3,025	3,113	3,199	3,292	3,395	3.0

Note: * estimate
Source: Statiscis of Provinces

Table 2-2 Population of North Sulawesi Province by City or Regency, 1975

Unit : 1000 persons.

Regency or City	Population	
Sangihe Tolaud Regency	246	
City of Menado	192	1,140
Minahasa Regency	706	
Bolaang Mongondow Regency	242	
City of Gorontalo	87	542
Gorontalo Regency	455	
Total	1,928	

Source : North Sulawesi Province

Table 2-3 GRP of North Sulawesi, Central Sulawesi and North Maluku in 1973 Constant Price, 1971–1975

Unit : billion Rp.

Region	1971	1972	1973	1974	1975	Growth rate 1975/1971 % per annum
North Sulawesi	97	104	124	135 1)	147 1)	11
Central Sulawisi	27	31	35	39	45	14
North Maluku 2)	15	16	18	21	22	10
Total	139	151	177	195	214	11

Note 1) Estimate

2) GRP for North Maluku is estimated by allocating GRP in Maluku by its population composition.

Source : Provinces.

Table 2-4 Percapita GRP of North Sulawesi, Central Sulawesi and North Maluku

Region	1973	1974	1975	Ratio to the value of Indonesia 1973	1974	1975
	(1000 Rp.)	(1000 Rp.)	(1000 Rp.)	(%)	(%)	(%)
North Sulawesi	69.2	–	–	129	–	–
Central Sulawesi	36.5	38.7	44.6	68	69	77
North Maluku	51.5	58.2	58.9	96	103	102
Indonesia	53.6	56.1	57.7	100	100	100

Note : in 1973 prices

Table 2-5 Composition of GRP by Industrial Origin

Unit: Million Rp. (1969 constant price)

	1969		1970		1971		1972		1973	
		%		%		%		%		%
GRP	43,019.22	100	45,914.18	100	50,175.88	100	53,876.40	100	64,287.33	100
Agriculture	16,850.89	39.2	19,166.75	41.7	19,720.87	39.3	18,686.97	34.7	26,596.38	41.4
Mining	79.17	0.2	124.69	0.3	99.06	0.2	95.21	0.2	178.58	0.3
Industry	3,390.37	7.9	2,766.75	6.0	3,881.67	7.7	5,423.10	10.1	5,594.11	8.7
Building	1,248.68	2.9	1,508.41	3.3	1,773.13	3.5	1,821.83	3.4	2,043.46	3.2
Electricity & Drinking Water	143.63	0.3	158.87	0.4	180.19	0.4	176.17	0.3	170.65	0.3
Transportation & Communication	2,276.66	5.3	2,613.36	5.7	3,265.66	6.5	3,674.51	6.8	4,577.41	7.1
Trade	9,430.95	21.9	9,755.75	21.3	10,360.84	20.7	12,568.01	23.3	12,978.55	20.2
Bank & Other financial body	1,039.20	2.4	922.84	2.0	970.86	1.9	724.36	1.3	1,034.78	1.6
House Hiring	1,251.36	2.9	1,291.92	2.8	1,327.44	2.7	1,363.94	2.5	1,401.44	2.2
Gov. & Army	2,927.93	6.8	3,276.95	7.1	3,908.26	7.8	4,517.79	8.4	4,733.00	7.3
Services	4,374.38	10.2	4,327.89	9.4	4,687.90	9.3	4,824.51	9.0	4,978.97	7.7

Source: Pendapatan Regional Daerah Tingkati Sulawesi Utara

Table 2-6 Passengers through Sam Ratulangi Air Port, 1971 – 1975

Traffic	1971	1972	1973	1974	1975	Growth rate 1975/1971
Embarkation	23	24	29	42	33	9
Disembarkation	23	24	29	43	42	16
Transit	–	–	–	1	1	–
Total	46	48	58	86	76	13

Source : Bappeda of Menado

Table 2-7 Sea Routes Related to Port of Bitung

Kinds of Routes	Number of Routes	Codes of Routes
R.L.S. Route		
Trunk Route	6	T5, T6, T22, T23, T24 & T25
Singapore Route	2	(S17) & S18
Special Route	2	C1, C6
Local Route	7	L. VII a1 ~ L. VIIa7
Pioneer Route	3	

Source : Directorate General of Sea Communication and KEDAPEL of Manado.

Table 2-8 Traffic through Main Ports in North Sulawesi, Central Sulawesi and North Maluku, 1975

Unit : 1,000 tons

Ports	Traffic
North Sulawesi	
Bitung	593
Menado	27
Gorontalo	80
Tahuna	27
Siau	14
Central Sulawesi	
Toli-Toli	46
Donggala	198
Parigi	14
Posso	20
Ampana	18
Luwuk	84
Pagimana	11
Banggai	10
North Maluku of Maluku	
Ternate	468
Labuna	14

Note : Data on the ports whose traffic was more than 10 thousand tons.

Source 1) Ports of North Sulawesi: Bappeda of North Salawesi

2) Ports of Central Sulawesi : Central Bureau of Statistics

3) Ports of North Maluku of Maluku: Census and Statistical Office of Maluku

Table 3-1 Climatic Table

Station: Mapanget in North Sulawesi

Item \ Month	JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEP	OCT	NOV	DEC	JAN
Mean Temperature (°C)	25.2	24.6	25.2	25.8	26.0	25.6	25.8	26.2	25.8	26.2	25.8	25.9	25.7
Mean Maximum Temperature (°C)	29.1	28.9	29.5	29.9	30.8	30.2	31.0	31.5	31.4	31.7	30.1	29.7	30.3
Mean Minimum Temperature (°C)	22.0	21.7	22.0	22.0	21.8	21.8	21.3	21.0	21.1	21.3	22.1	21.9	21.7
Extreme Maximum Temp. (°C)	31.4	31.2	32.0	32.6	33.0	33.6	34.0	34.2	34.9	35.0	33.6	32.0	35.0
Extreme Minimum Temp. (°C)	19.9	18.9	19.8	20.0	20.0	19.0	18.6	17.5	17.4	18.2	20.2	20.2	17.4
Mean amount of Precipitation(mm)	325	377	225	294	251	214	186	115	224	260	451	372	3294
Mean Relative Humidity (%)	87	87	84	82	83	77	77	74	76	79	84	85	81
Minimum R. Humidity (%)	53	53	50	50	33	45	37	36	32	33	52	48	32

Remarks: Period of Record: January 1972 – July 1977.

Table 4-1 Dependent Rate on Bitung of Dry Cargo Flow by Region, 1974

Unit: %

Statistical	Maritime Regions	Traffic from Bitung	Traffic to Bitung
12	Sumatra Selatan	–	–
16	D. K. I. Jaya I	2	2
17	D. K. I. Jaya II	–	–
19	Jawa Tengah I	–	–
21	Surabaya	2	3
26	Kalimantan Selatan	–	–
27	Kalimantan Timur I	–	–
28	Kalimantan Timur II	–	–
29	Sulawesi Utara I	17	21
30	Bitung	–	1
31	Sulawesi Utara II	27	18
32	Sulawesi Tengah I	3	–
33	Sulawesi Tengah II	19	5
34	Ujung Pandang	1	7
36	Sulawesi Tenggara	–	4
37	Bali	–	2
38	Nusatenggara Barat	–	–
40	Maluku Utara	26	1
41	Maluku Tengah	1	–
43/47	Irian Jaya	1	–

Note : Derived from "Interisland Seatransport in Indonesia, 1974".

Table 4-2 Dependent Rate on Bitung of Mineral Oils by Region, 1974

Statistical	Maritime Regions	Traffic from Bitung	Traffic to Bitung
12	Sumatra Selatan	–	–
16	D. K. I. Jaya I	–	1
17	D. K. I. Jaya II	–	–
19	Jawa Tengah I	–	–
21	Surabaya	–	–
26	Kalimantan Selatan	–	–
27	Kalimantan Timur I	–	4
28	Kalimantan Timur II	3	–
29	Sulawesi Utara I	35	9
30	Bitung	–	–
31	Sulawesi Utara II	89	40
32	Sulawesi Tengah I	19	–
33	Sulawesi Tengah II	37	5
34	Ujung Pandang	5	3
36	Sulawesi Tenggara	–	–
37	Bali	–	–
38	Nusatenggara Barat	–	2
40	Maluku Utara	27	16
41	Maluku Tengah	2	–
43/47	Irian Jaya	13	–

Note : Derived from "Interisland Seatransport in Indonesia, 1974".

Table 4-3 Dependent Rate on Bitung of Selected Commodity by Region

Unit : %

Area	Traffic from Bitung			Traffic to Bitung
	Rice	Cement	Mineral Oils	Copra
Sulawesi Utara I	58	13	35	36
Bitung	20	20	–	13
Sulawesi Utara II	45	13	89	20
Sulawesi Tengah I	10	5	19	–
Sulawesi Tengah II	75	8	37	–
Maluku Utra	80	10	27	2
(Traffic from/to Above-quoted Regions / Traffic to/from Bitung) (%)	99	94	57	99

Table 5-1 Service Area of Port of Bitung

Sub-area of the Service Area	Sphere of the Sub-area
Area 1	Sangir Talaud Regency in North Sulawesi Province
Area 2	City of Menado, Minahasa Regency and Bolaang Mongondow Regency in North Sulawesi Province
Area 3	City of Gorontalo and Gorontalo Regency in North Sulawesi Province
Area 4	Toli-Toli Regency and West Coast of Donggala Regency in Central Sulawesi Province
Area 5	Poso Regency, Banggai Regency and East Coast of Donggala Regency in Central Sulawesi
Area 6	North Maluku Regency of Maluku Province.

Table 5-2 Projection of Population in the Service Area of Port of Bitung

Sub-area	1975	1976	1985	2000	1985/1976	2000/1976
	(1,000)	(1,000)	(1,000)	(1,000)		
Area 1	246	250*	290	370	1.2	1.5
Area 2	1,140	1,179*	1,580	2,520	1.3	2.2
Area 3	542	556*	700	1,000	1.3	1.8
Sub total	1,928	1,985*	2,570	3,940		
Area 4	512*	526*	670	1,040	1.3	2.0
Area 5	512*	525*	670	1,040	1.3	2.0
Sub total	1,024	1,051	1,340	2,080		
Area 6	340	360	470	760	1.3	2.1
Total	3,292	3,396	4,380	6,780	1.3	2.0

Note : * are estimates

Table 5-3 Projection of Percapita GRP in the Service Area of Port of Bitung

Unit : 1000 Rp.

Province	1985	2000
North Sulawesi (Area 1, 2 and 3)	135	268
Central Sulawesi (Area 4 and 5)	79	208
Maluku (Area 6)	105	208
Indonesia	105	208

Note : in 1973 price

Table 5-4 Projection of GRP in the Service Area of Port of Bitung

Sub-area	1975	1976	1985	2000	1985/1976	2000/1976
Area 1	19	21	40	100	1.9	4.8
Area 2	87	94	210	700	2.2	7.4
Area 3	41	45	90	260	2.0	5.8
Sub total	135	160	350	1,060	2.2	6.6
Area 4	23	25	50	220	2.0	8.8
Area 5	22	24	50	210	2.0	8.8
Sub total	45	49	100	430	2.0	8.8
Area 6	22	24	50	160	2.0	6.7
Total	202	233	500	1,650	2.1	7.1

Note: GRP in 1975 and 1976 are estimates based on the latest data on each province.

Table 5-5 Manufacture Industry in North Sulawesi

Type of Industry	North Sulawesi	Indonesia
1. Slaughtering, Preparing and preserving of meat	1	33
2. Manifacture of dairy products	5	428
3. Process & Preserving of fish & other seaproducts	1	110
4. Manufacture of coconut oil	21	384
5. Rice mills	52.	6,109
6. Manufacture of macaroni, noodle and other kind of noodles	2	373
7. Manufacture of backery products	5	488
8. Manufacture of Ice cube	8	247
9. Manufacture of other food products	4	335
10. Manufacture of soft drinks and car bonated waters	1	170
11. Manufacture of wearing apparels	4	111
12. Saw mills and other woodsmills	-	1,090
13. Manufacture of furniture and furniture primarily of wood	1	373
14. Manufacture of paper	1	33
15. Manufacture of paper boad, fibreboad	-	39
16. Printing, publishing & allied Industries	11	669
17. Manufacture of drugs & Medicine except native medicines	1	89
18. Manufacture of native medicines	1	33
19. Manufacture of soap, detergent and cleaning preparations	3	224
20. Manufacture of smoked sheet rubber	1	214
21. Manufacture of bricks	1	425
22. Manufacture of cutlery, nail, bolts and other similar products	1	147
23. Repair & painting of ship	2	12
Total	128	12,136

Source: Statistic Indonesia 1975

Table 5-6 Possible Types of Manufacturing Industries in North Sulawesi

Area	Characteristics	Types of Manufacturing Industries
Area along coast	Area is relatively narrow but is transit base of marine transport for nearby islands and a part of North Maluku.	Shipbuilding, Feed processing, Manure processing, Food processing, Vegetable oil processing, Burlap-bag manufacturing.
Mountainous area	Climate is relatively warm and rich with water and natural resources (kaolin and lime)	Pottery industry, Textile industry, Earthware industry, Cement industry.

Table 6-1 Forecast of Port Tonnage Traffic through Port of Bitung by Commodity Group, 1985

Unit: 1,000 tons

Commodity Group	Foreign Trade		Domestic Trade		Grand Total		
	Dis-charged	Loaded	Dis-charged	Loaded	Dis-charged	Loaded	Total
Food stuffs (Rice, Wheat Flour, Sugar)	55	–	53	70	108	70	178
Agricultural Products (Coconut-oil Cake, Coconut Oil, Cassava Products)	–	95	37	92	37	187	224
Construction Materials (Cement, Asphalt, Iron)	50	–	220	54	270	54	324
Production Materials (Fertilizer, Steel and Machinery)	6	–	23	4	29	4	33
Vehicles	15	–	15	7	30	7	37
Miscellaneous	100	–	72	38	172	38	210
Sub Total	226	95	420	265	646	360	1,006
Petroleum	–	–	360	160	360	160	520
Total	226	95	780	425	1,006	520	1,526

Note: The commodities in parentheses show the main commodities include in the related commodity group.

Table 6-2. Forecast of Port Tonnage Traffic through Port of Bitung by Commodity Group, 2000

Unit: 1,000 tons

Commodity Group	Foreign Trade		Domestic Trade		Grand Total		
	Dis-charged	Loaded	Dis-charged	Loaded	Dis-charged	Loaded	Total
Food stuffs (Rice, Wheat Flour, Sugar)	120	–	124	104	244	104	348
Agricultural Products (Coconut-oil Cake, Coconut Oil, Cassava Products)	–	267	78	209	78	476	554
Construction Materials (Cement, Asphalt, Iron)	80	–	433	106	513	106	619
Production Materials (Fertilizer, Steel and Machinery)	16	–	100	21	116	21	137
Vehicles	30	–	90	26	120	26	146
Miscellaneous	250	–	197	96	447	96	543
Sub Total	496	267	1,022	562	1,518	829	2,347
Petroleum	–	–	1,470	650	1,470	650	2,120
Total	496	267	2,492	1,212	2,988	1,479	4,467

Note: The commodities in parentheses show the main commodities included in the related commodity group.

Table 6-3 Increase of Port Tonnage Traffic through Port of Bitung by Commodity Group

Commodity Group	1985/1976	2000/1976
Food stuffs	1.5 times	2.9 times
Agricultural Products	1.2	3.0
Construction Materials	3.1	5.8
Production Materials	–	–
Vehicles	3.0	11.9
Miscellaneous	2.4	6.2
Sub Total	2.0	4.6
Petroleum	2.4	9.8
Total	2.1	6.1

Note: Production materials are too little in 1976 and the increase ratios are omitted.

Table 6-4 Forecast of Port Tonnage Traffic to Be Discharged and Loaded at Port of Bitung by Type of Ships, 1985 and 2000

Type of Ships	Tonnage		Percentage composition	
	1985	2000	1985	2000
	(1,000 tons)	(1,000 tons)	(%)	(%)
Ocean Going Vessels	321	763	21	17
RLS Vessels	599	1,450	39	32
Special Vessels	543	2,110	36	47
Local Vessels	44	115	3	3
Sailing Vessels	19	29	1	1
Total	1,526	4,467	100	100

Table 6-5 Increase of Port Tonnage Traffic Discharged and Loaded at Port of Bitung by Type of Ships

Type of Ships	1985/1976	2000/1976
Ocean Going Vessels	1.5 times	3.4 times
RLS Vessels	2.6	6.4
Special Vessels	2.2	8.5
Local Vessels	2.3	6.0
Sailing Vessels	1.1	1.7
Total	2.1	6.1

Table 7-1 Facilities to be Needed for New Ports

New Facilities	Bitung South	Bitung West	Bitung East	Bitung North	Batu-Augus	Lembeh
Wharvies	o	o	o	o	o	o
Break water	o				o	
Access Road				o	o	o*

Note: * Ferries

Table 7-2 Comparison of New Port Construction Site

Comparative Factors	Bitung South	Bitung West	Bitung East	Bitung North	Batu-Angus	Lembeh
Construction	C	B	A	C	C	A
Aquisition of wharf and berth space	(C)	(A)	(A)	(C)	(B)	(A)
Competition of Other Activities	(A)	(B)	(A)	(A)	(C)	(A)
Cost of Construction	(C)	(B)	(A)	(C)	(C)	(A)
Operation	A	A	A	B	C	C
Transport	(A)	(A)	(A)	(B)	(B)	(C)
Relation to the Existing Port	(B)	(A)	(A)	(B)	(C)	(B)
Relation to the Cities	(A)	(A)	(A)	(B)	(C)	(C)
Future Development	A	B	B	B	B	A
Room for More Expansion	(A)	(B)	(B)	(B)	(B)	(A)
Space for Water Front Industrial Area	(A)	(A)	(B)	(B)	(B)	(A)
Total Count	2A+C	A+2B	2A+B	2B+C	B+2C	2A+C

Table 8-1 Forecast of Port Tonnage Traffic to Be Discharged and Loaded at Port of Bitung

(Unit: 1,000 tons)

Type of Ships \ Year	1985	2000	Remarks
Oceangoing Vessels	321	763	
R.L.S. Vessels	599	1,450	
Special Vessels (1)	528	2,090	through Pertamina Piers
Special Vessels (2)	15	20	through Public Wharves
Local Vessels	44	115	
Sailing Vessels	19	29	
Total	1,526	4,467	

Table 8-2 Forecase of Port Tonnage Traffice through the Public Wharves at Port of Bitung

(Unit: 1,000 tons)

Type of Ships \ Year	1985	2000
Ocean going Vessels	321	763
R.L.S. & Special Vessels	614	1,470
Local Vessels	44	115
Sailing Vessels	19	29
Total	998	2,377

Table 8-3 Construction Plan of Main Facilities of Port of Bitung for Alternative – 1

Facilities \ Year	~ 1985	1986 ~ 2 000	Total	2 000 ~ (Future Expension)
– 10 m Wharf	0	1 Berth 220m *1	1 Berth 220m	3 Berths
– 5.5m Wharf	6 Berths 540m (450m + 90m)	10 Berths 860m *2 (150m+260m+180m+180m+90m)	16 Berths 860m	3 Berths
– 4.0m Wharf	150m		150m	
– 3.0m Lighter's Wharf	130m *3 (100m + 30m)		130m	
Temporary Revetment	185m		185m	
Rough Cost Estimate of Construction	2.40 bil. Rp.	4.07 bil. Rp.	6.47 bil. Rp.	

*1 Including 35m extention to existing berth.
*2 Water depth of these 3 berths is 6m
*3 Including side wall length 30m

Table 8-4 Construction Plan of Main Facilities of Port of Bitung for Alternative – 2

Facilities \ Year	~ 1985	1986 ~ 2 000	Total	2 000 ~ (Future Expension)
– 10 m Wharf	0	1.2 Berth 220m *1		3-Berths
– 5.5 m Wharf	6 Berths 520m (70m+270m+90m+90m)	10 Berths *2 850m (360m+360m+130m)		4 Berths
– 4.0 m Wharf	150m	–		
– 3 m Lighter's Wharf	100m	–		
Temperary Revetment	185m	–		
Rough Cost Estimate of Construction	2.19 bil. Rp.	4.34 bil. Rp.	6.53 bil. Rp.	

*1 Including 35m extention to existing berth.
*2 Water depth of these 3 berths among 10 berths is 6 m.

Table 8-5 Construction Plan of Main Facilities of Port of Bitung for Alternative – 3

Facilities \ Year	~ 1985	1986 ~ 2,000	Total	2 000 ~ (Future Expension)
– 10 m Wharf	1 Berth 220m *1	1 Berth 85m	2 Berths 405m	1 Berth
– 5.5m Wharf	3 Berths 260m	11 *2 Berths 965m (150m+185m+630m)		
– 4 m Wharf	150m	–		
– 3 m Lighter's Wharf	100m+150m *3 (100m+40m+50m+60m)	–		
Temperary Revetment	150m	–		
Rough Cost Estimate of Construction	3.10 bil. Rp.	3.54 bil. Rp.	6.64 bil. Rp.	

*1 Including 35m extension to existing berth

*2 Water depth of these 3 berths among 10 berths is 6 m

*3 Including the length of side wall 40m+50m+60m.

Table 8-6 Comparison of the Alternative Layout Plans

Comparative Factors		Alternative 1	Alternative 2	Alternative 3
Construction Cost	1985 Plan	Medium	Low	High
	1985/2 000 Plan	Medium	High	Low
	Total	Low	Medium	High
Concentration of Foreign Trade Area		Possible	Impossible	Possible
Separation of Sailing Vessels		Possible	Possible	Not Perfect
Ship Maneuvering		Excellent	Good	Possible
Room for Further Expansion		Large	Large	Only around the Surface Attached to Ship Yards
Overall Priority		1	2	3

Fig. 1-1. Location Map

S = 1: 500,000

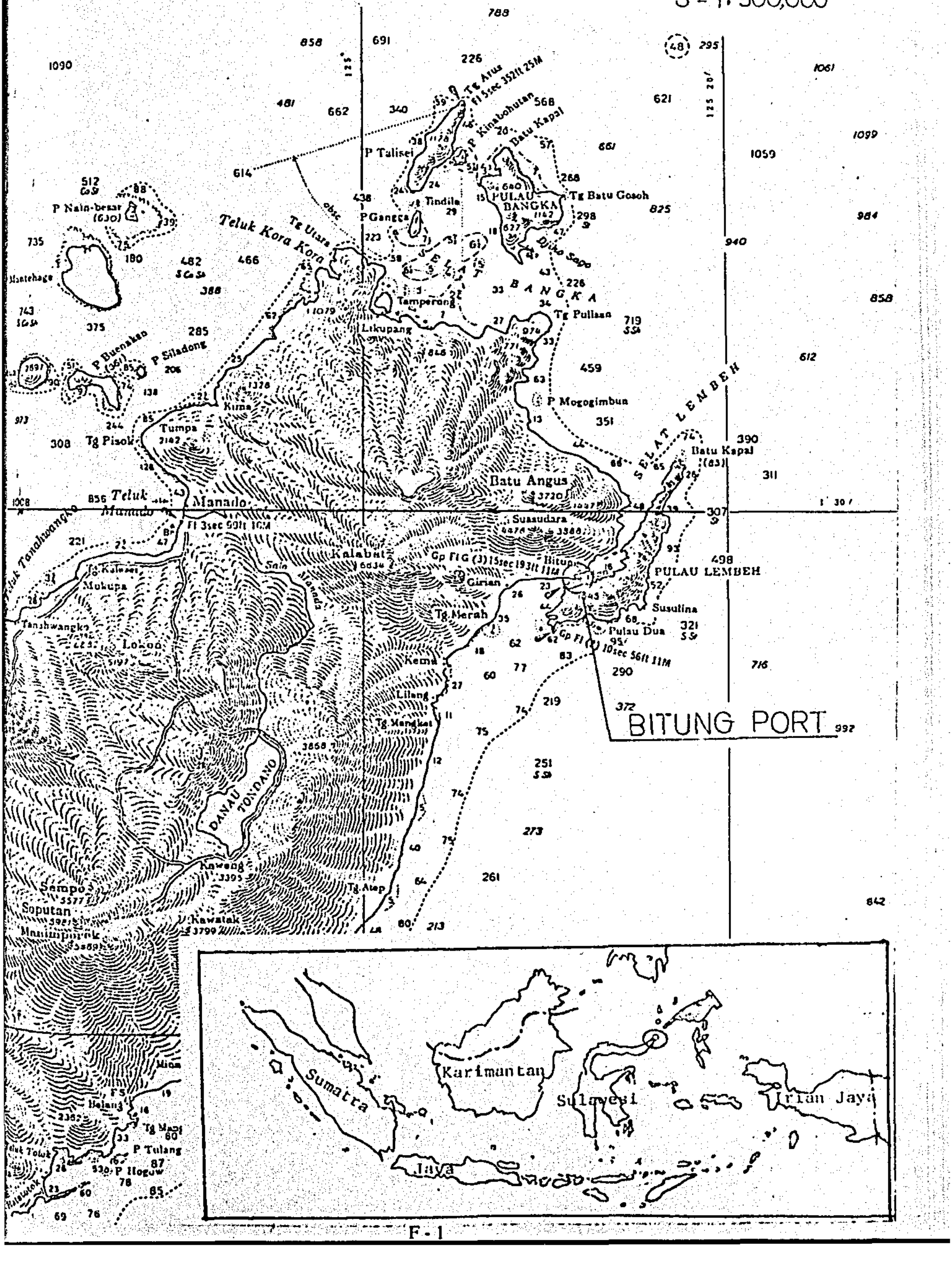


Fig. 1-2. Organization Chart of Port Administration of Port of Bitung

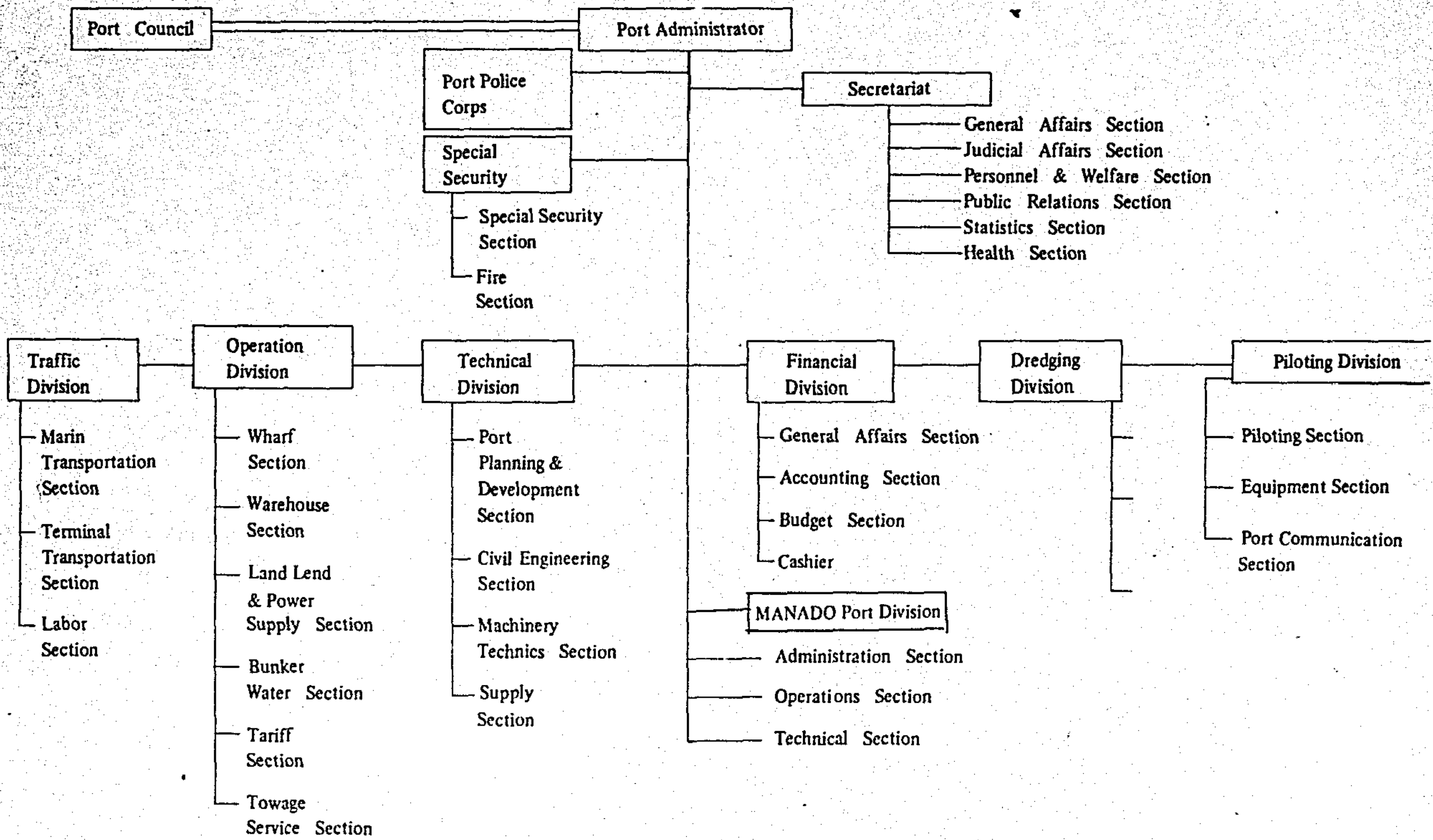


Fig. 1-3. Existing Facilities of Port of Bitung

Scale = 1: 5,000

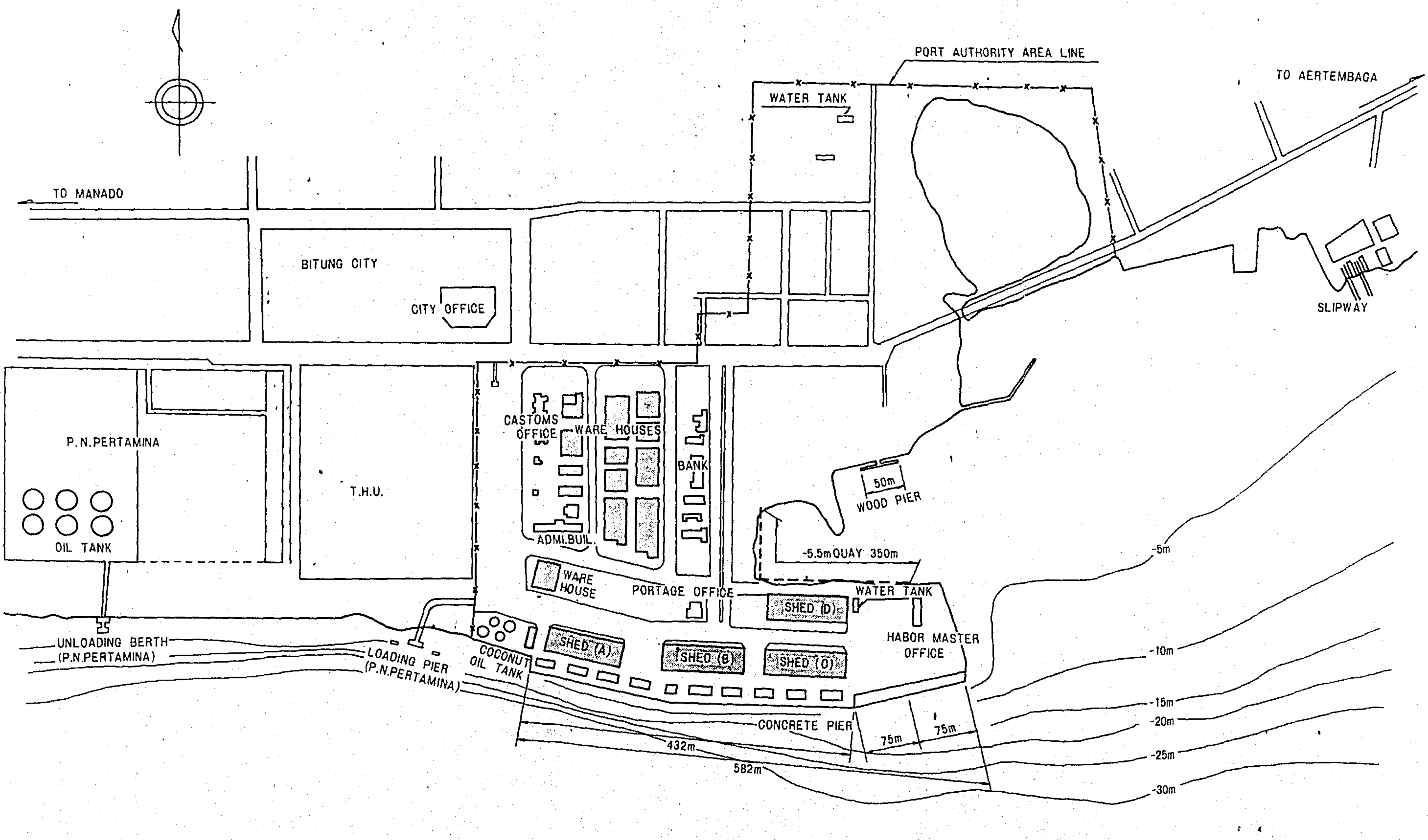


Fig. 1-4 Pattern of Inbound Cargo Movement within the Port Area of Port of Bitung

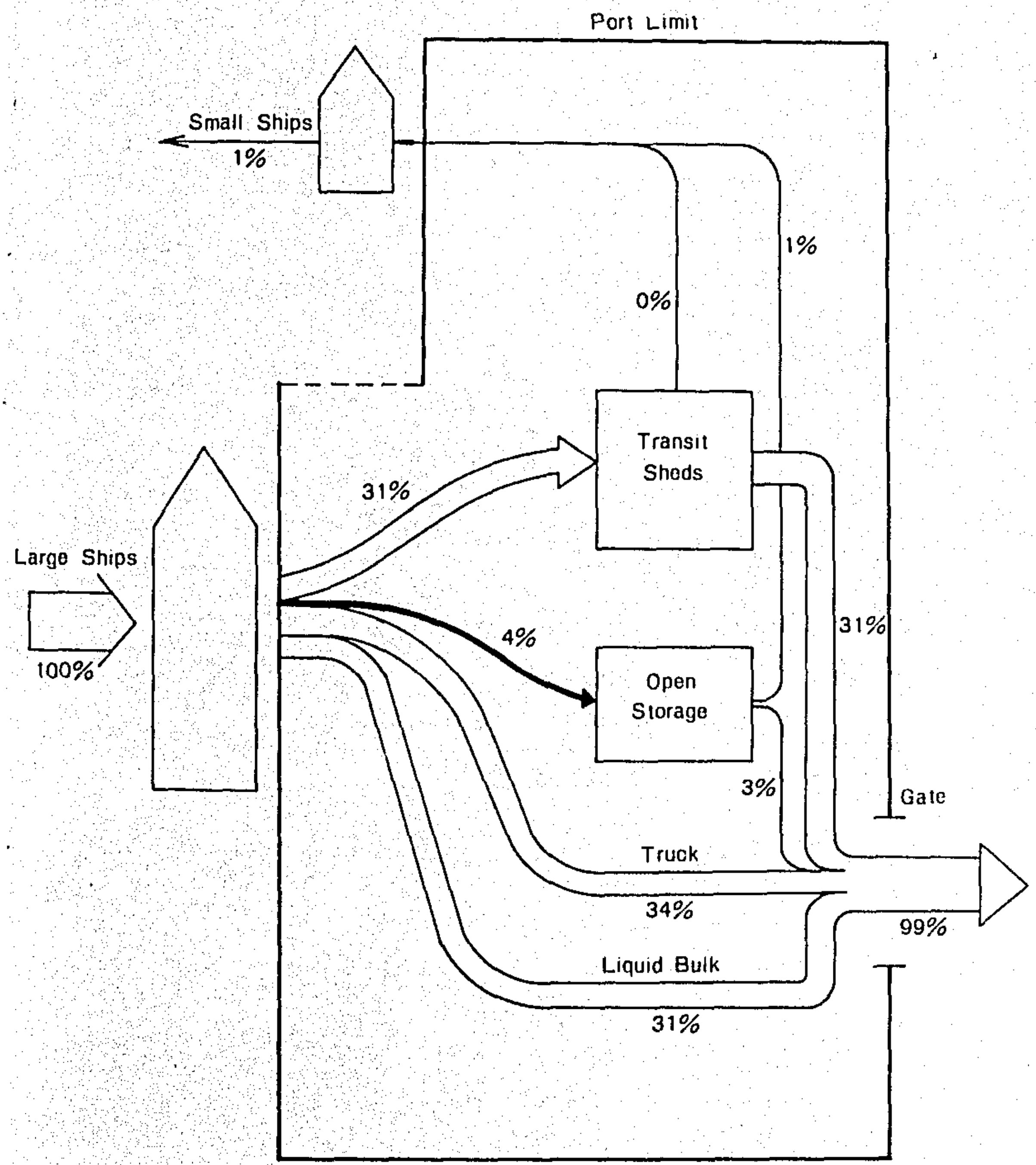


Fig. 2-1. Main Road in North Sulawesi

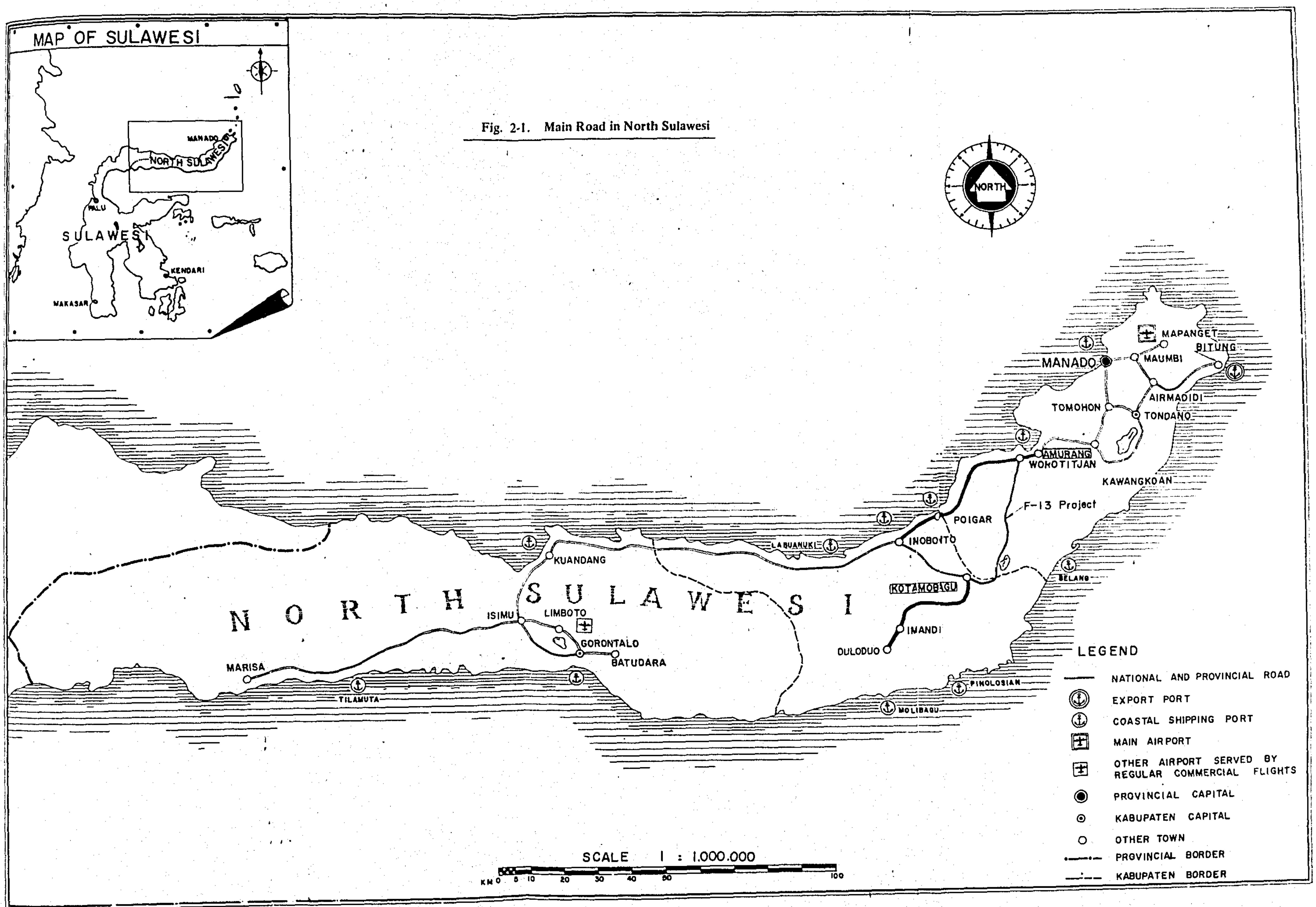


Fig. 3-1. Location of Bitung

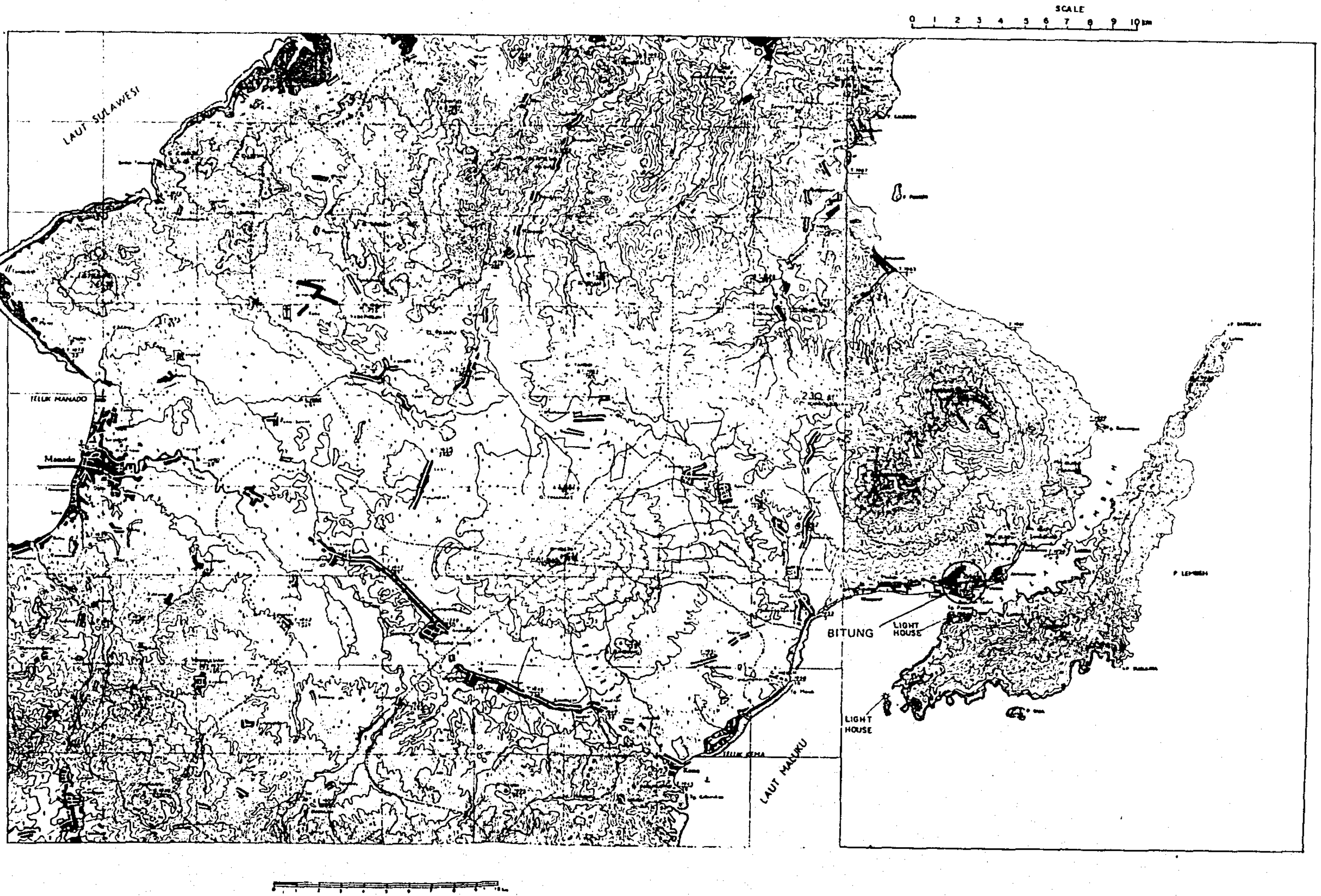


Fig. 3-2 Wind Rose (Bitung)
(February – August 1977)

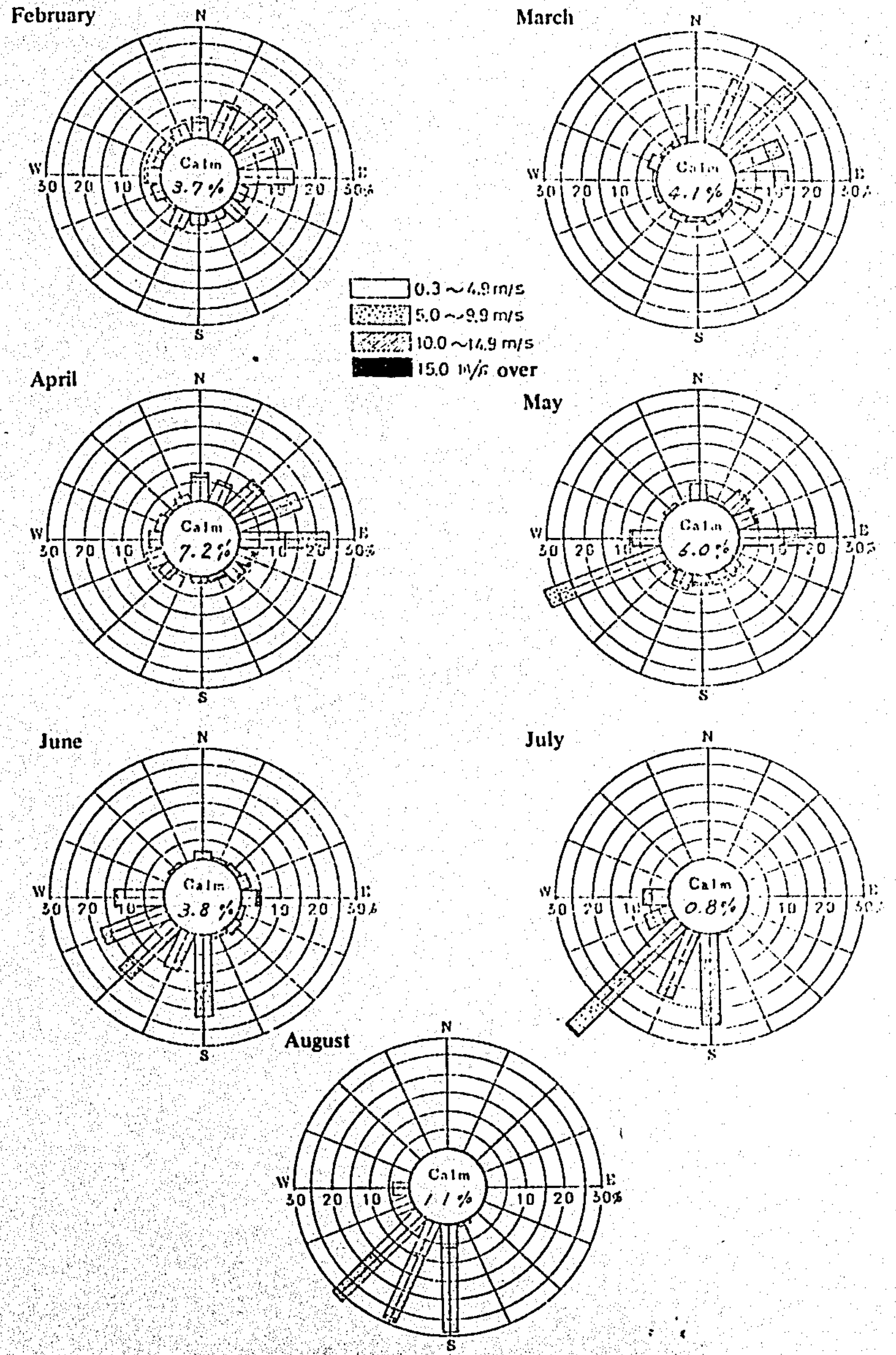


Fig. 3-3 Wind Rose (Bitung)
(February – August 1977)

February – August

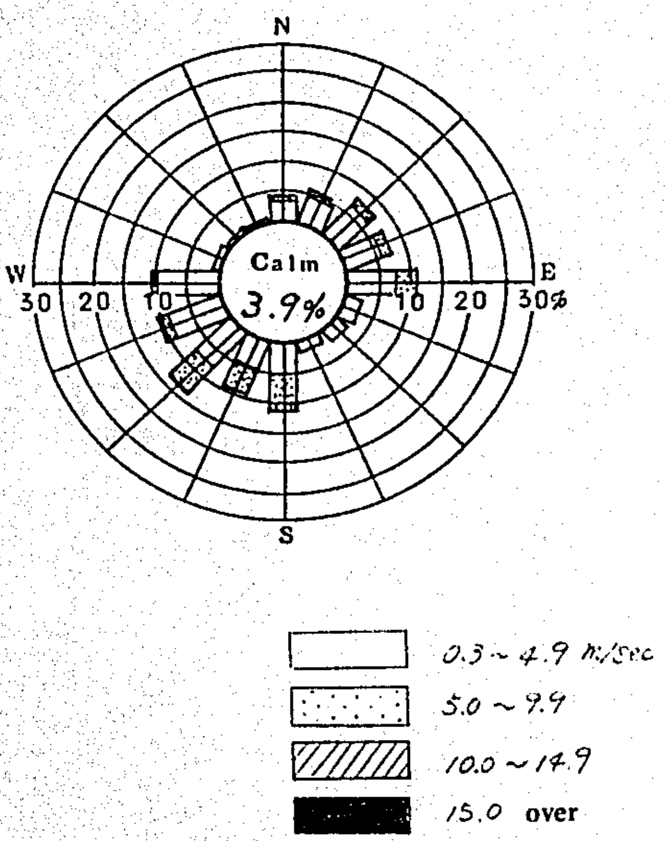
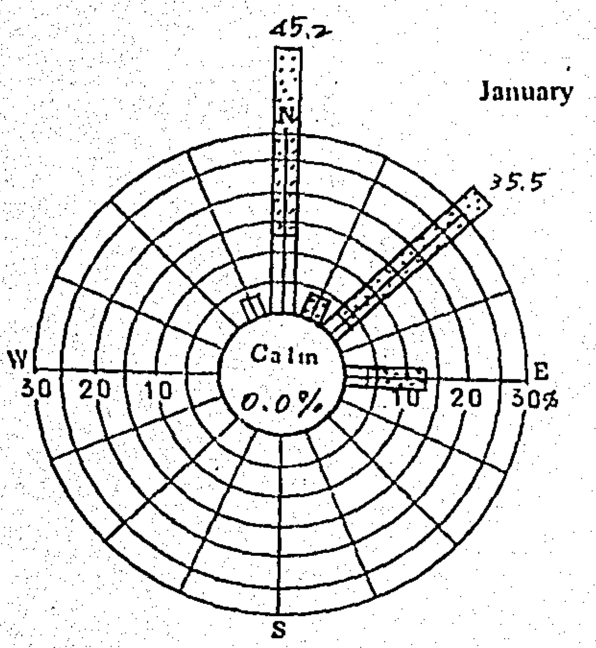
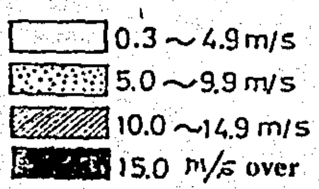
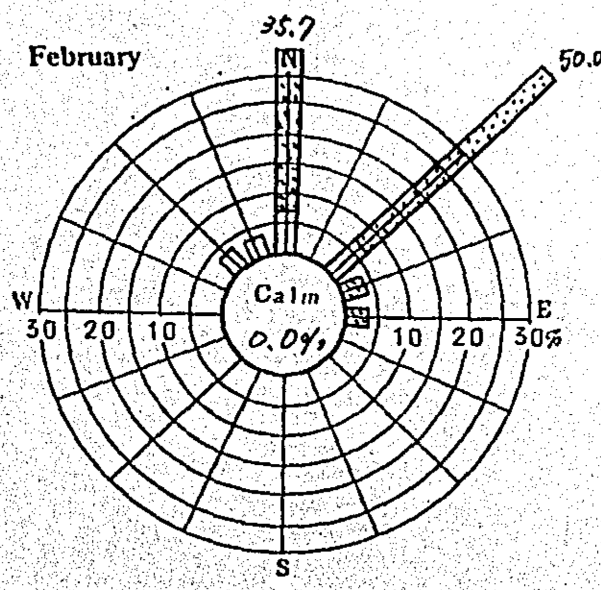


Fig. 3-4 Wind Rose (Mapanget)
(1972 – 1976)







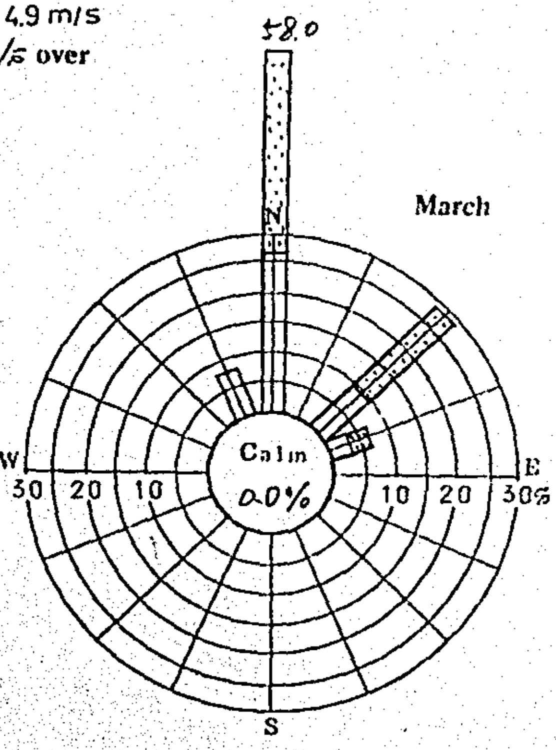
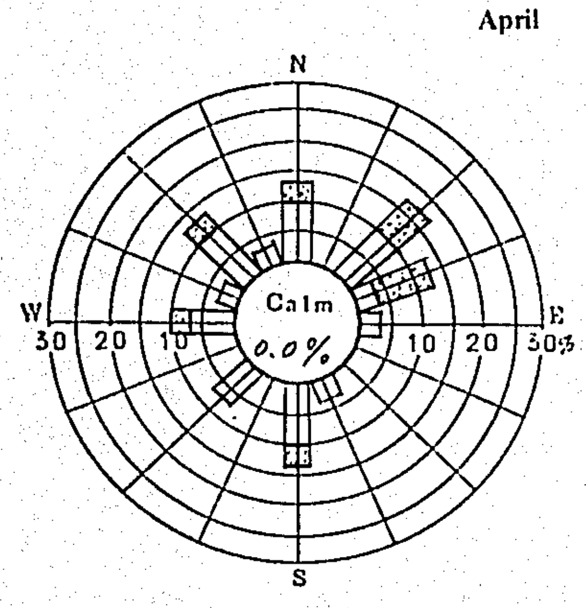
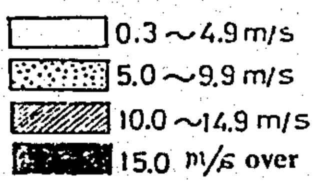
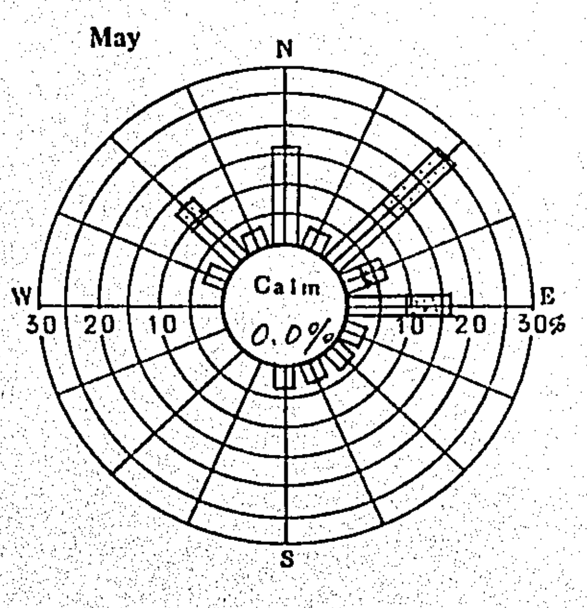


Fig. 3-5 Wind Rose (Mapanget)
(1972 – 1976)







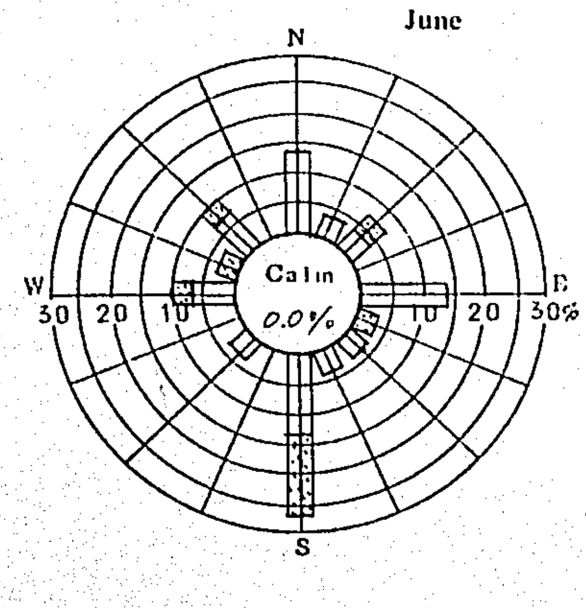


Fig. 3-6 Wind Rose (Mapanget)
(1972 – 1976)

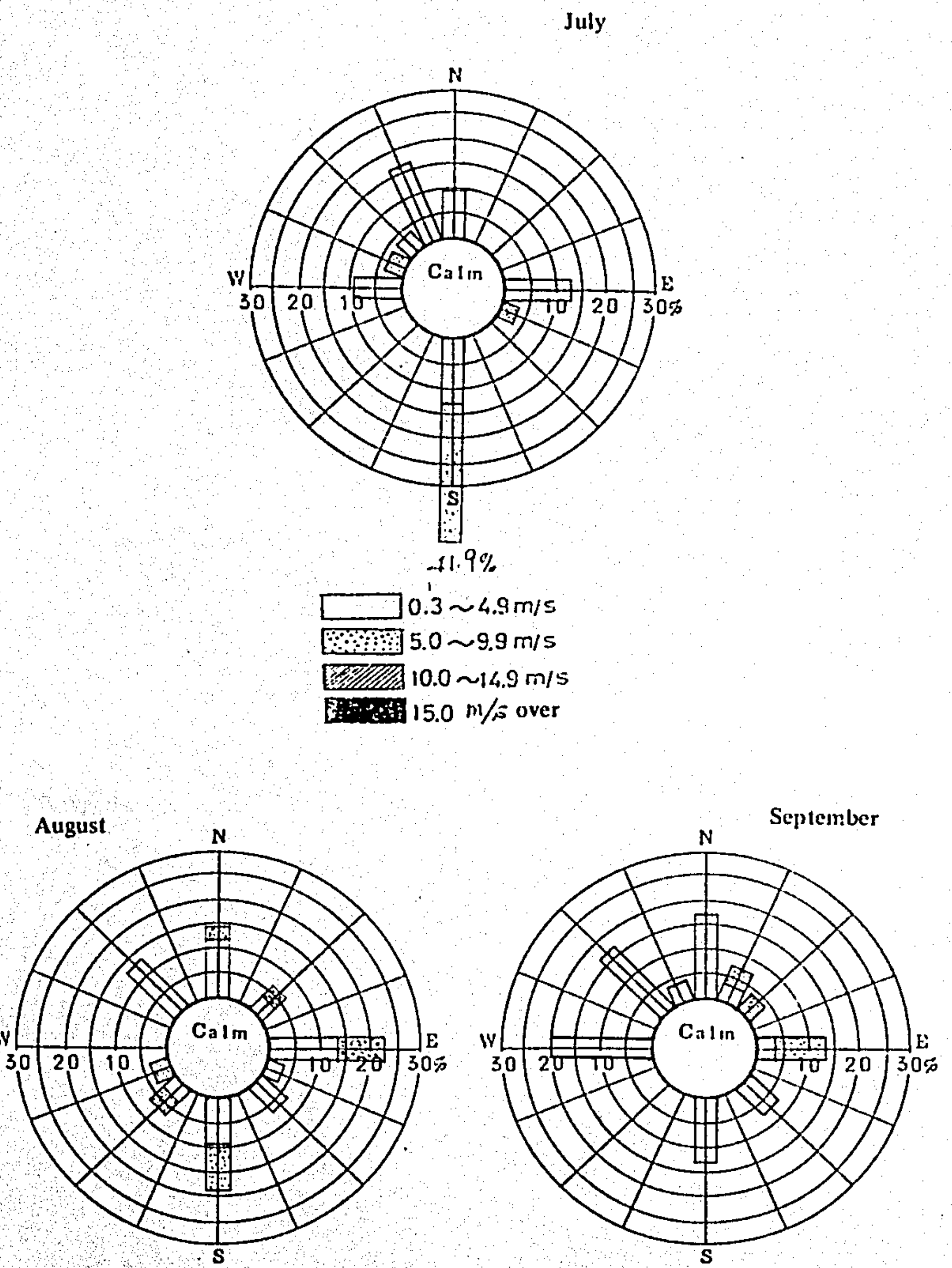


Fig. 3-7 Wind Rose (Mapanget)
(1972 – 1976)

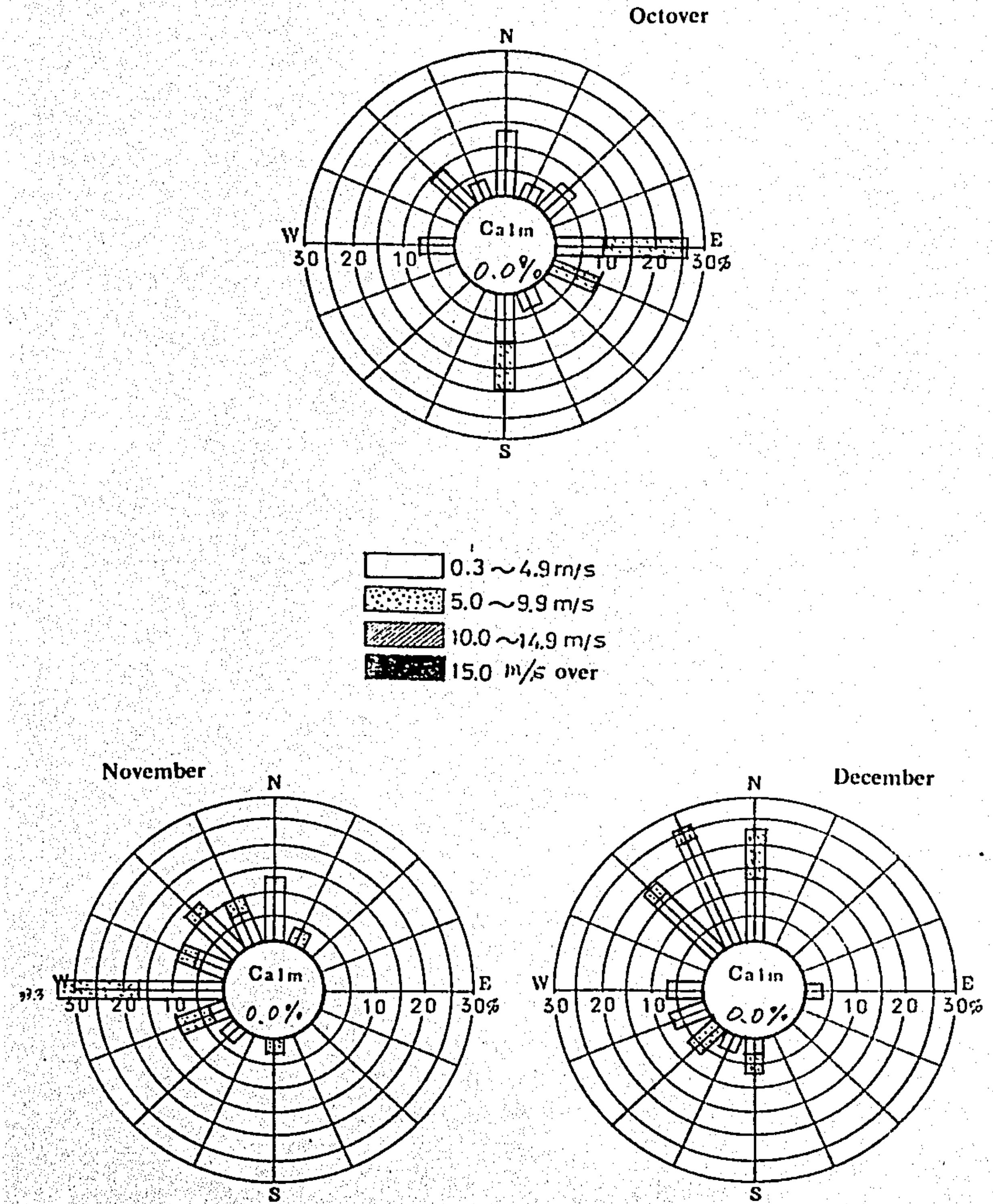


Fig. 3-8 Wind Rose (Mapanget)
(1972 – 1976)

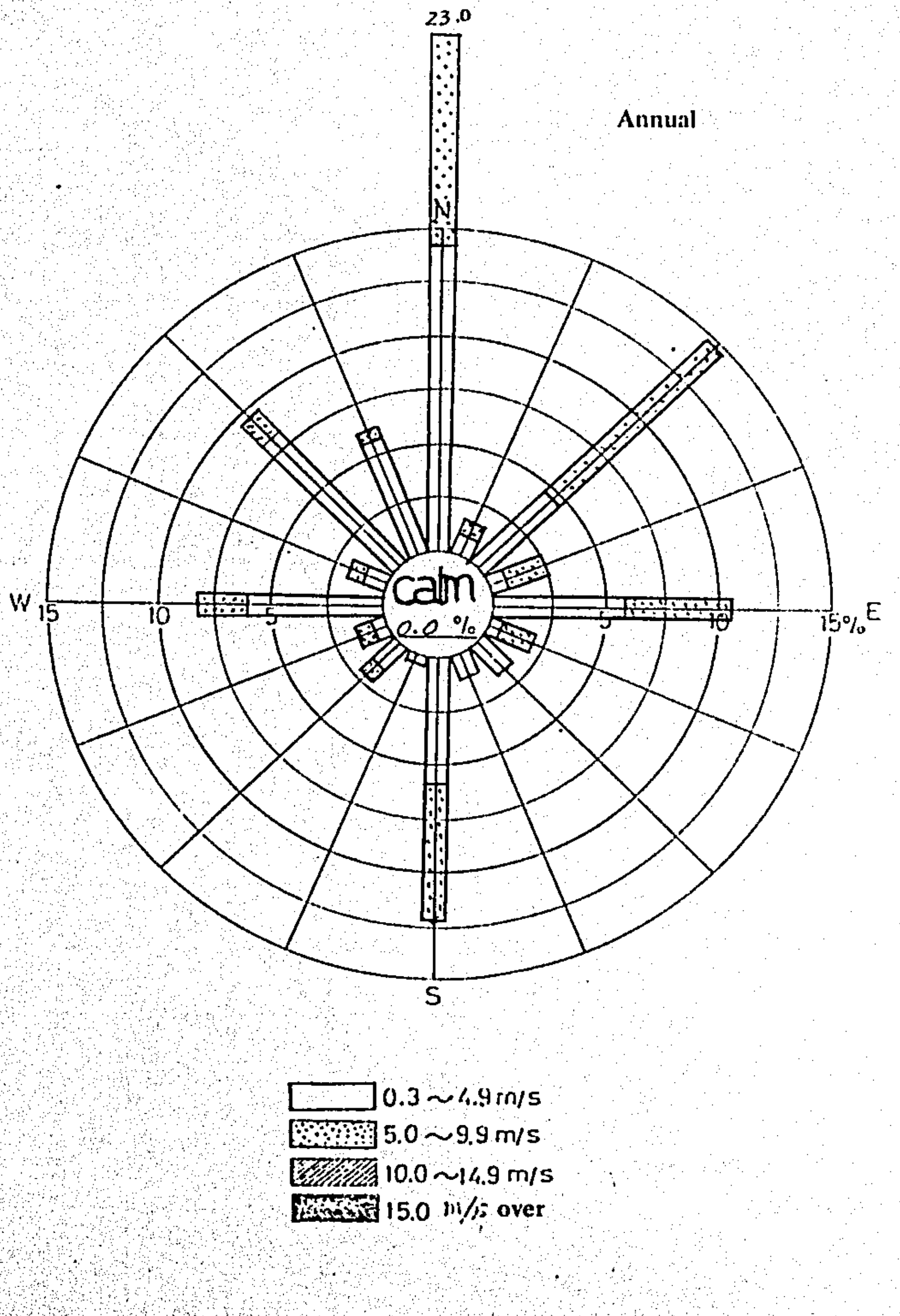


Fig. 3-9 Tide Record at Port of Bitung

(June 1977)

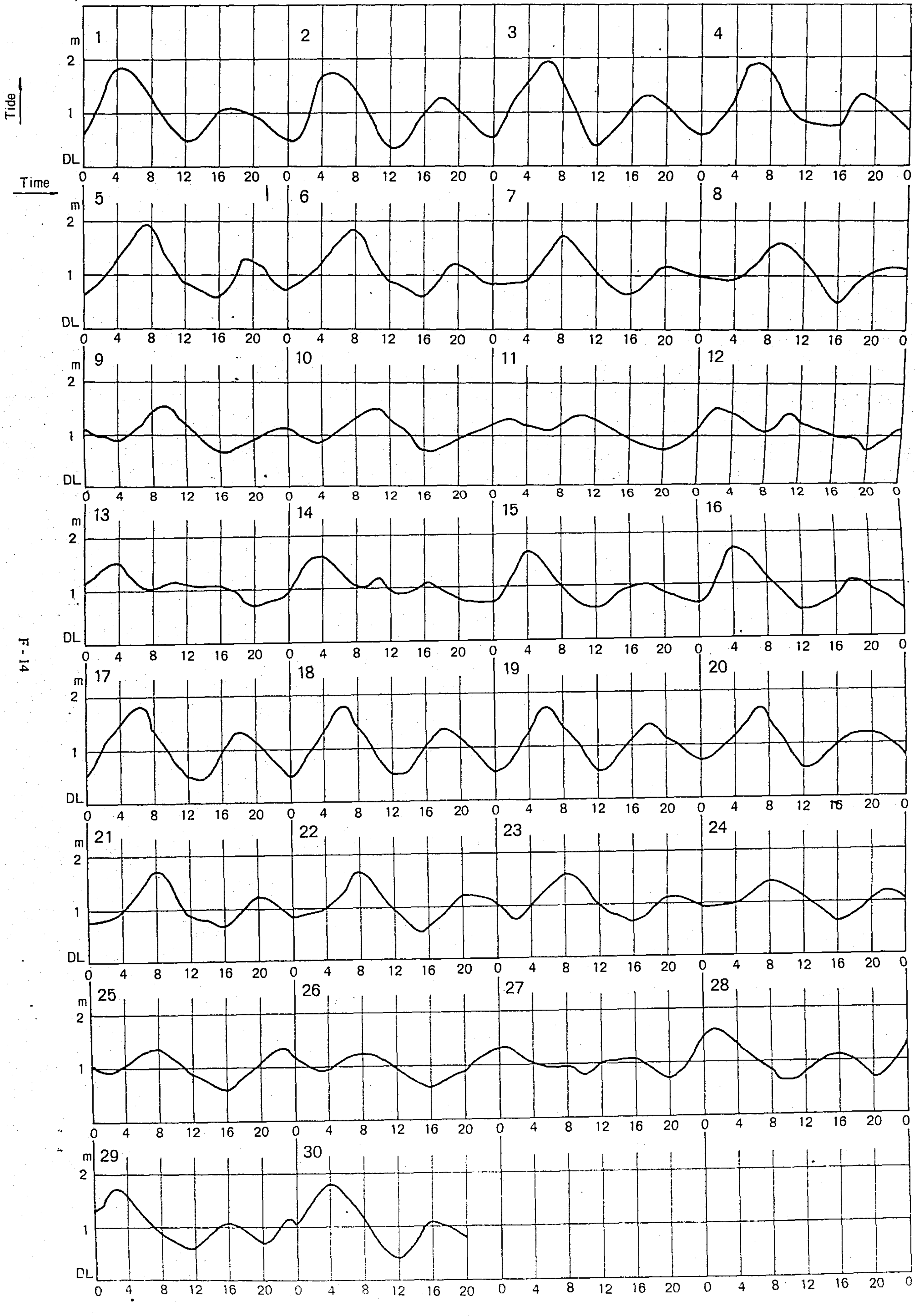


Fig. 3-10 Location of Current Survey
Scale = 1: 20,000

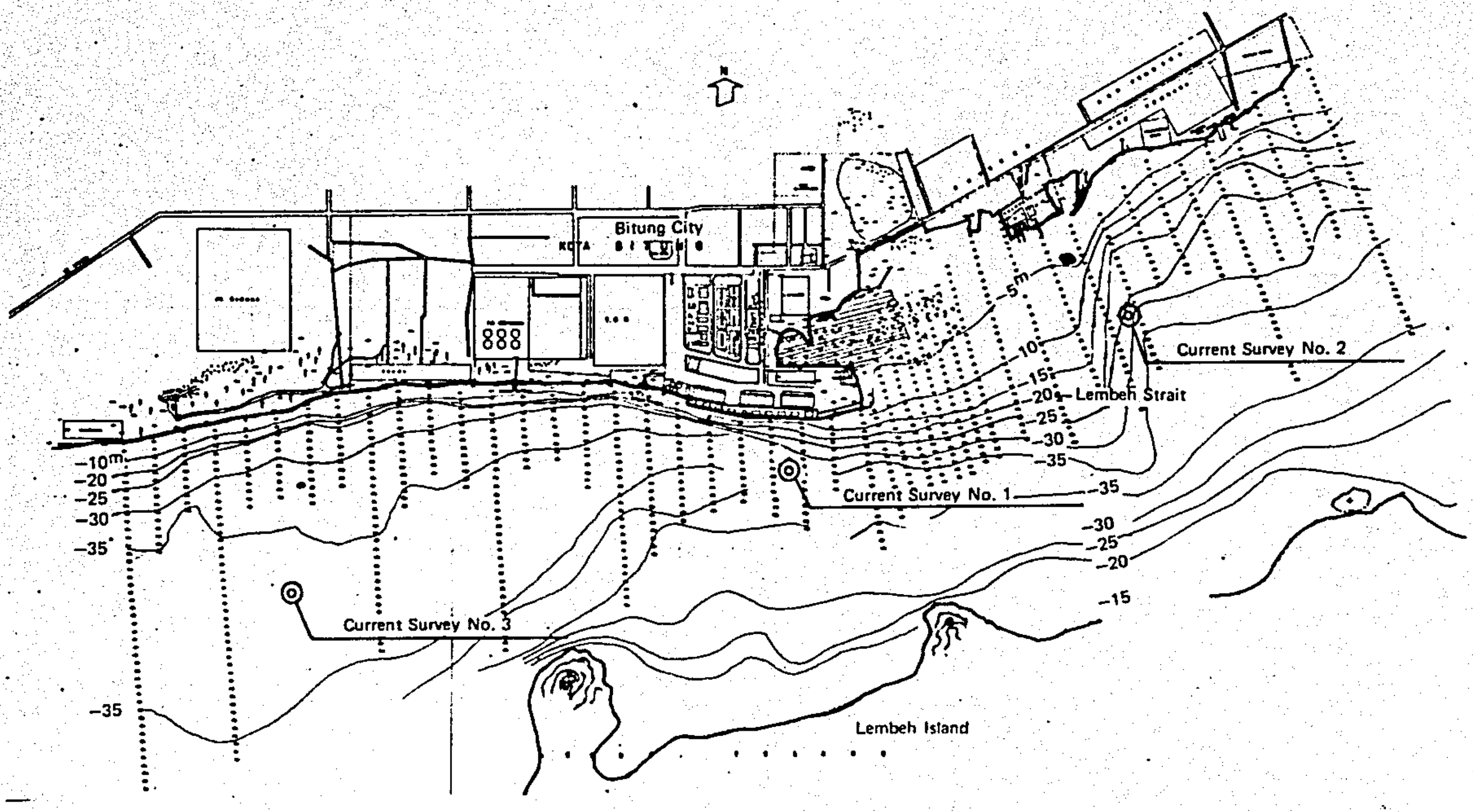
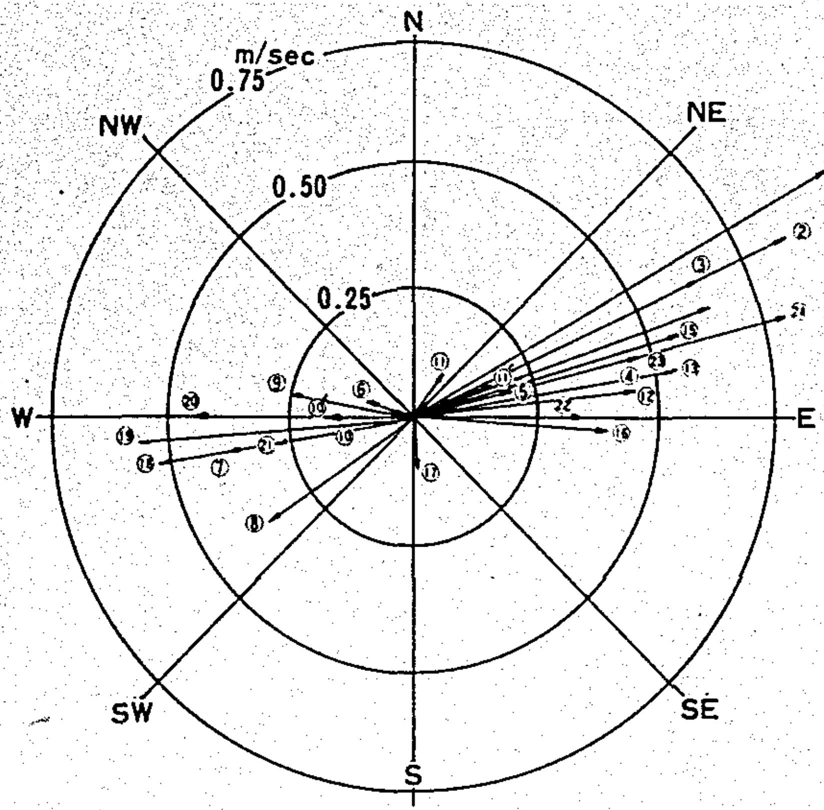
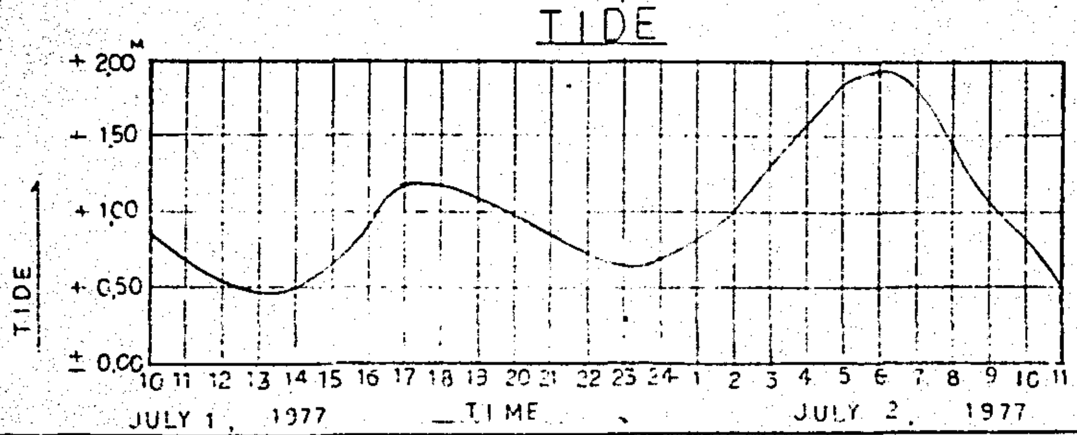


Fig. 3-11. Current Observation (No. 1, -3^m)





OBSERVED DATE: JULY 1 ~ 2 1977

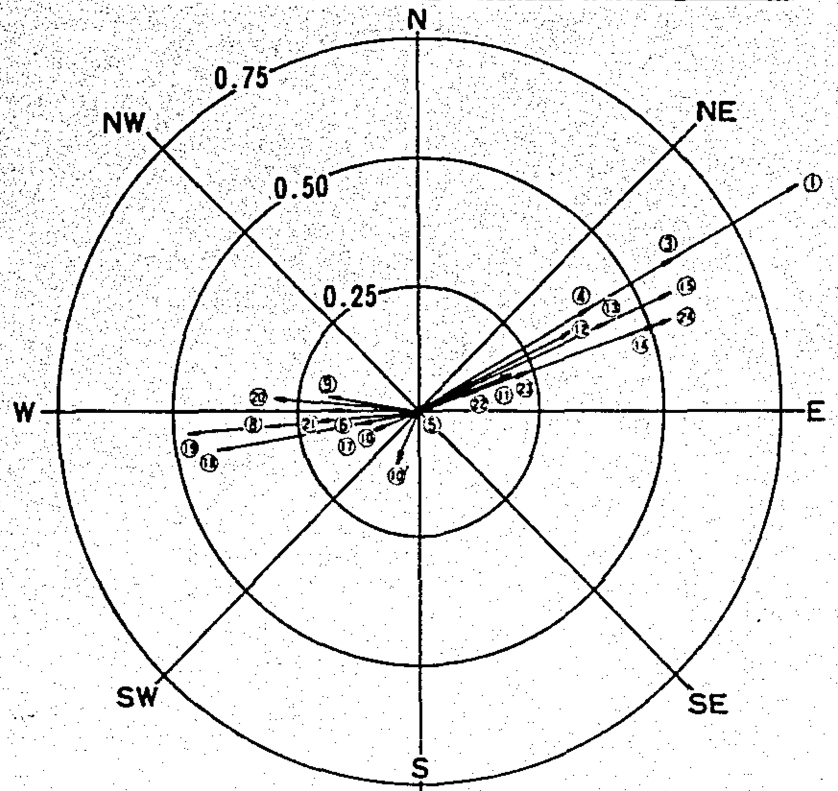
LOCATION : NO. 1 (Infront of Existing Berth)

OBSERVED DEPTH: -3^M

OBSERVATION DATA

NO.	TIME	CURRENT VELOCITY	CURRENT DIRECTION
10	10:04	0.16 (m/sec)	265 (°)
11	11:02	0.10	37
12	12:02	0.47	83
13	13:01	0.55	80
14	14:02	0.65	70
15	15:03	0.58	73
16	16:01	0.40	93
17	17:02	0.11	172
18	18:02	0.53	260
19	19:02	0.57	265
20	20:02	0.45	270
21	21:02	0.28	260
22	22:02	0.35	90
23	23:02	0.53	80
24	24:12	0.80	75
1	01:02	0.98	60
2	02:02	0.85	65
3	03:03	0.65	68
4	04:02	0.48	75
5	05:05	0.20	75
6	06:01	0.10	290
7	07:02	0.38	260
8	08:01	0.36	235
9	09:02	0.26	280
10'	10:02	0.17	270
11'	11:02	0.17	68

Fig. 3-12. Current Observation (No. 1, −30m)



OBSERVED DATE: JULY 1 ~ 2 1977

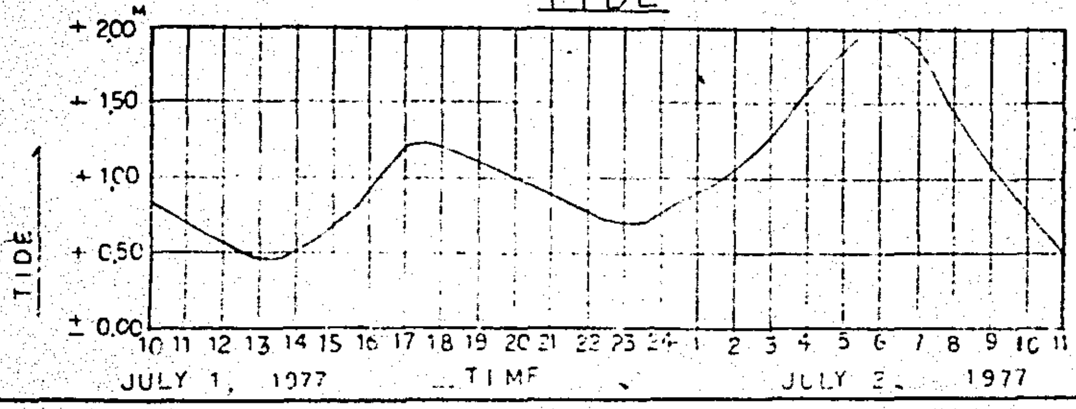
LOCATION : NO. 1 (Infront of Existing Berth)

OBSERVED DEPTH: −30 M

OBSERVATION DATA

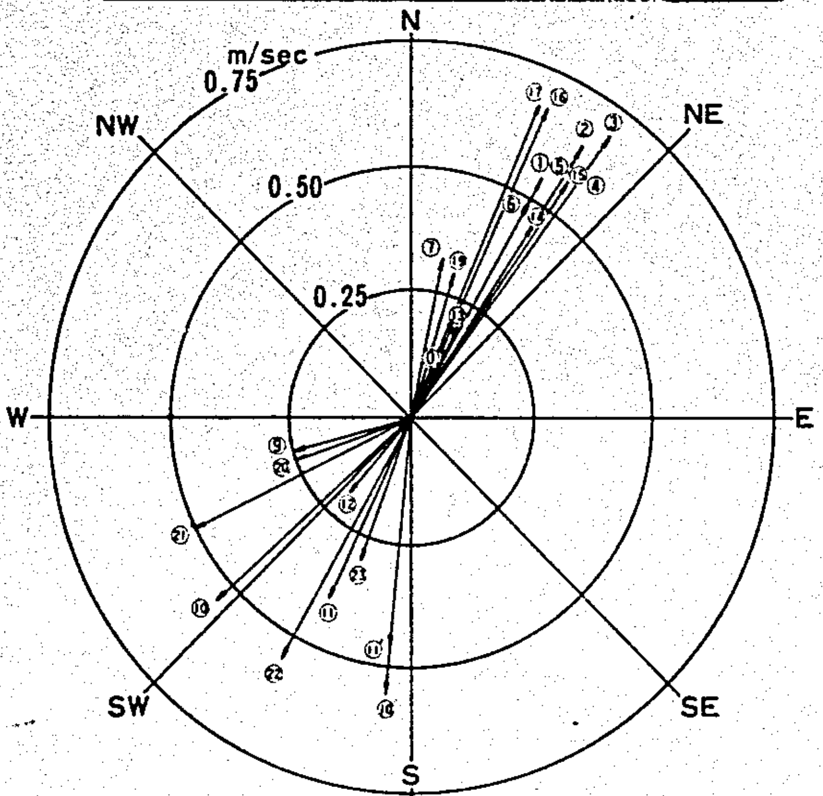
NO.	TIME	CURRENT VELOCITY	CURRENT DIRECTION
10'	10:16	0.09 (m/sec)	205 (°)
11	11:07	0.18	70
12	12:17	0.35	63
13	13:13	0.43	65
14	14:17	0.52	70
15	15:17	0.57	65
16	16:16	0.17	68
17	17:26	0.12	260
18	18:22	0.43	260
19	19:23	0.48	265
20	20:17	0.30	275
21	21:22	0.20	265
22	22:18	0.10	70
23	23:20	0.35	70
24	24:28	0.55	70
1	01:18	0.90	60
2	02:22	0.80	55
3	03:22	0.60	60
4	04:20	0.40	60
5	05:28	0.00	90
6	06:13	0.18	270
7	07:18	0.35	360
8	08:15	0.31	265
9	09:18	0.18	280
10	10:23	0.10	250

TIDE

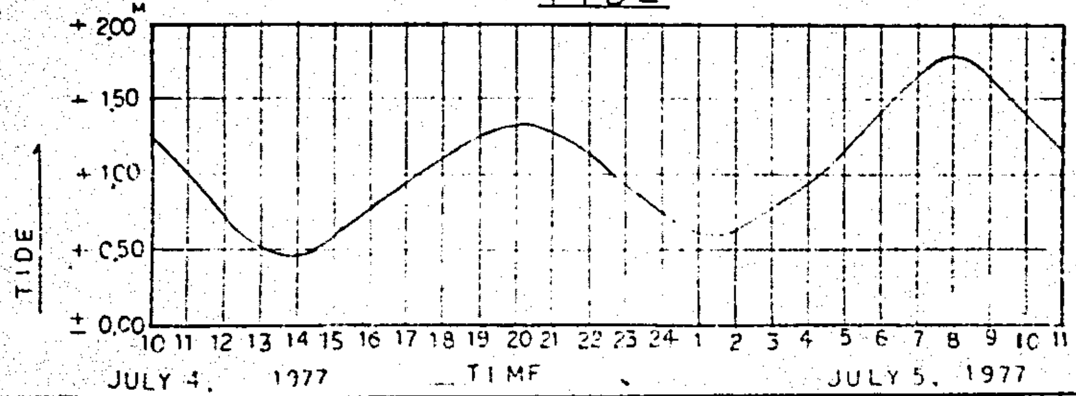


PAGE

Fig. 3-13. Current Observation (No. 2, –3m)



TIDE



OBSERVED DATE: JULY 4～5 1977

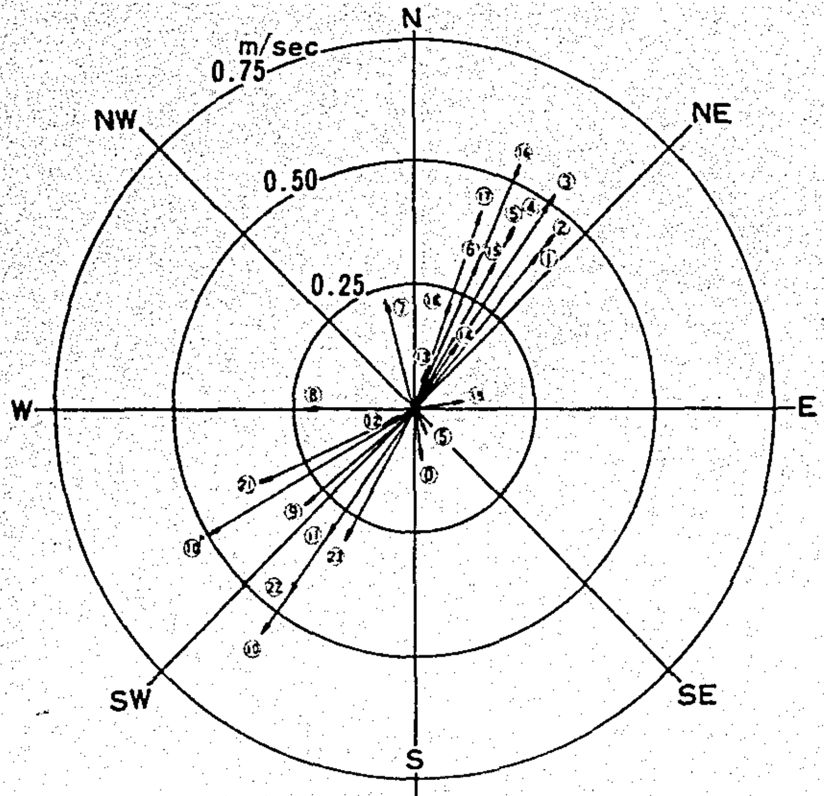
LOCATION : NO. 2 (North from Berth)

OBSERVED DEPTH: – 3 M

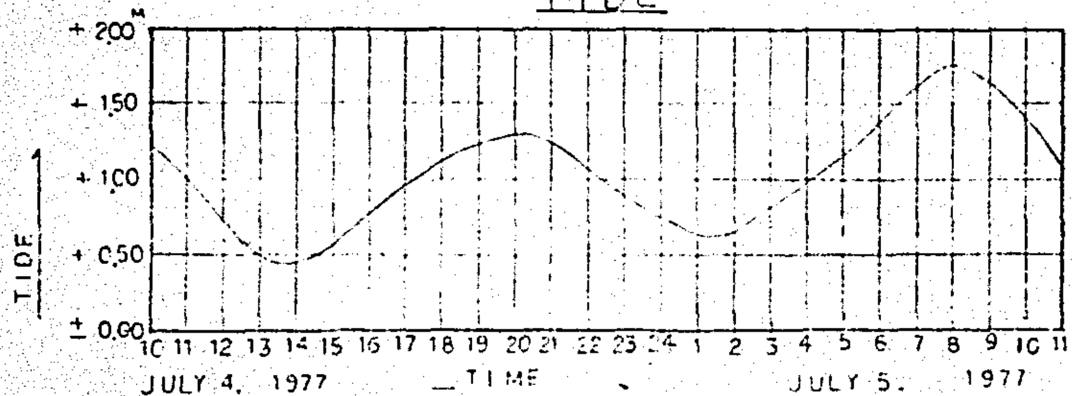
OBSERVATION DATA

NO.	TIME	CURRENT VELOCITY	CURRENT DIRECTION
10	10:01	0.55 (m/sec)	228 (°)
11	11:01	0.40	205
12	12:02	0.20	220
13	12:59	0.20	30
14	14:01	0.45	33
15	14:58	0.57	35
16	16:00	0.68	25
17	17:01	0.68	23
18	18:01	0.45	23
19	19:01	0.30	19
20	20:01	0.26	210
21	21:02	0.51	245
22	22:01	0.55	210
23	23:02	0.30	200
24	24:01	0.15	30
1	01:02	0.55	30
2	02:02	0.65	33
3	03:03	0.70	36
4	04:01	0.60	35
5	05:03	0.55	30
6	06:01	0.49	30
7	07:01	0.32	12
8	08:02	0.10	340
9	09:02	0.25	255
10'	10:02	0.55	185
11'	11:03	0.45	185

Fig. 3-14. Current Observation (No. 2, –30m)



TIDE



OBSERVED DATE: JULY 4~5 1977

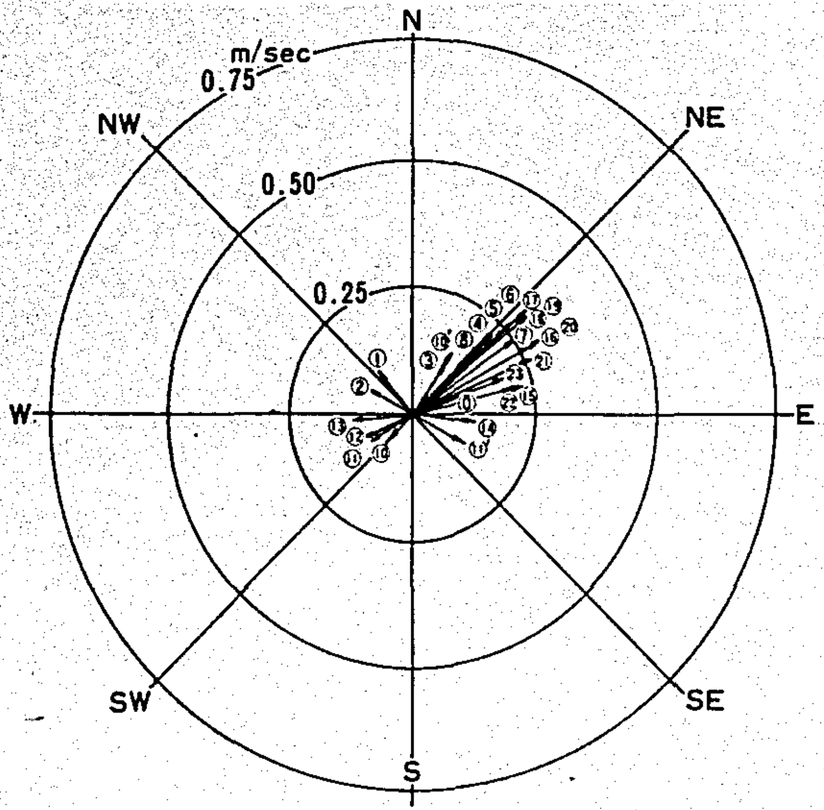
LOCATION : NO. 2 (North from Berth

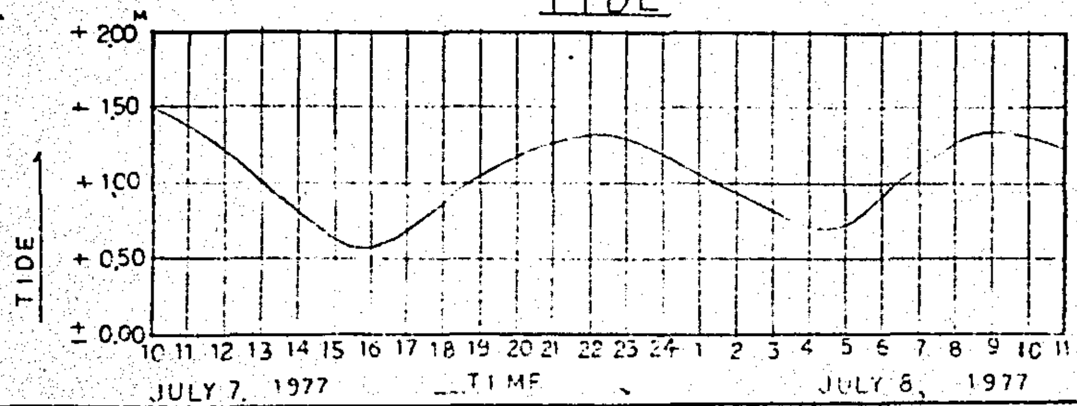
OBSERVED DEPTH: – 30 M

OBSERVATION DATA

NO.	TIME	CURRENT VELOCITY	CURRENT DIRECTION
10	10:06	0.55 (m/sec)	215 (°)
11	11:08	0.30	215
12	12:08	0.06	240
13	13:04	0.08	20
14	14:05	0.16	35
15	15:02	0.33	30
16	16:05	0.54	25
17	17:13	0.43	20
18	18:07	0.23	20
19	19:09	0.10	80
20	20:07	0.05	160
21	21:09	0.35	245
22	22:08	0.45	215
23	23:13	0.31	210
24	24:08	0.10	170
1	01:13	0.40	40
2	02:13	0.45	40
3	03:15	0.53	35
4	04:09	0.50	35
5	05:25	0.42	30
6	06:08	0.32	25
7	07:07	0.23	345
8	08:13	0.23	270
9	09:13	0.30	230
10'	10:16	0.50	240

Fig. 3-15. Current Observation (No. 3, –3m)





OBSERVED DATE: JULY 7~8 1977

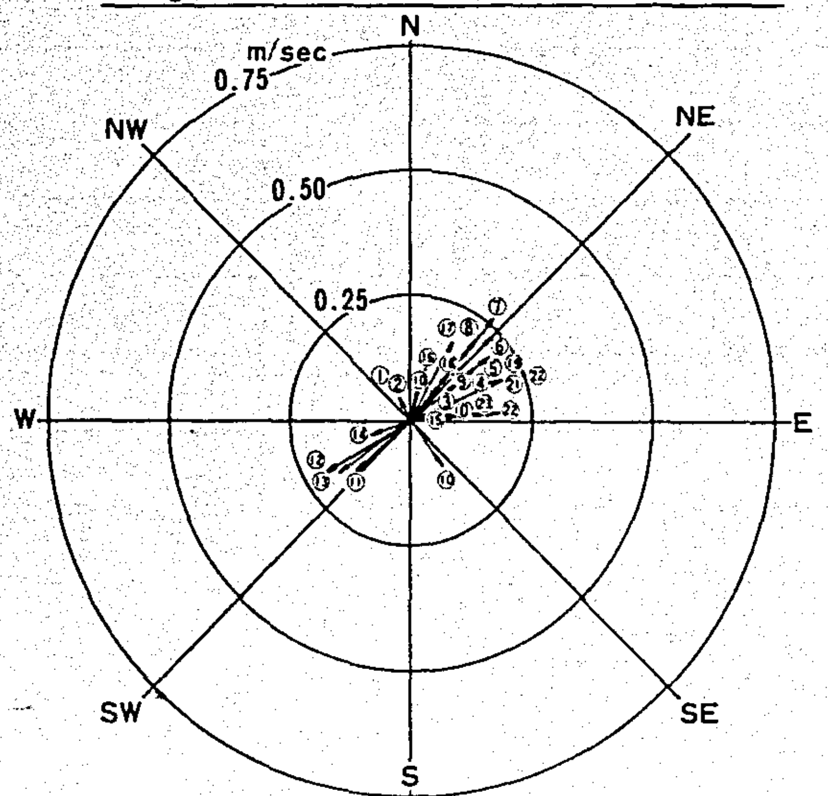
LOCATION : NO. 3 (South from Berth)

OBSERVED DEPTH: – 3M

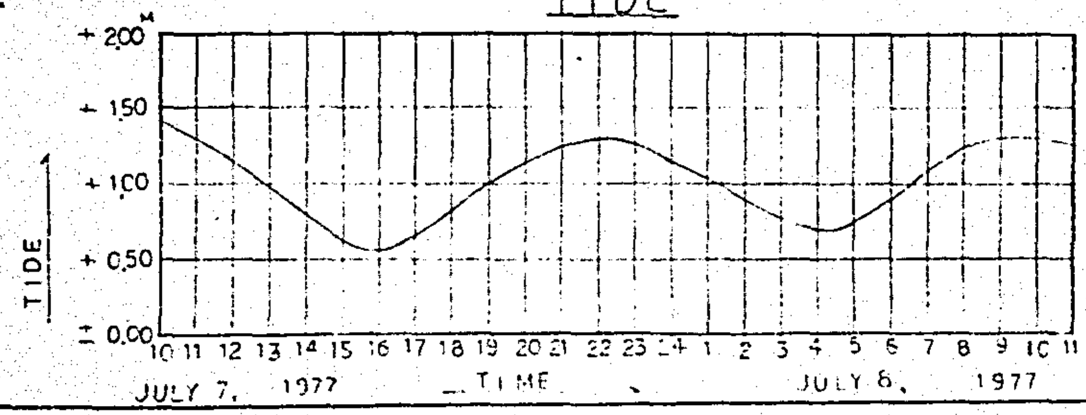
OBSERVATION DATA

NO.	TIME	CURRENT VELOCITY	CURRENT DIRECTION
10	10:01	0.05 (m/sec)	225 (°)
11	11:01	0.10	235
12	12:01	0.10	240
13	13:02	0.13	265
14	14:02	0.13	95
15	15:02	0.22	75
16	16:02	0.30	65
17	17:02	0.31	50
18	18:01	0.30	60
19	19:02	0.30	60
20	20:02	0.30	60
21	21:01	0.27	65
22	22:01	0.20	75
23	23:02	0.18	70
24	24:01	0.08	65
1	01:01	0.08	320
2	02:01	0.10	300
3	03:02	0.13	40
4	04:02	0.20	50
5	04:56	0.25	50
6	06:01	0.26	50
7	07:01	0.25	55
8	08:01	0.22	48
9	09:01	0.21	50
10'	10:01	0.15	40
11'	11:01	0.12	120

Fig. 3-16. Current Observation (No. 3, −30m)



TIDE



OBSERVED DATE: JULY 7~8, 1977

LOCATION : NO 3 (South from Berth)

OBSERVED DEPTH: − 30 M

OBSERVATION DATA

NO.	TIME	CURRENT VELOCITY	CURRENT DIRECTION
10	10:09	0.10 (m/sec)	140 (°)
11	11:09	0.14	235
12	12:10	0.20	240
13	13:11	0.17	238
14	14:14	0.08	250
15	15:14	0.05	60
16	16:11	0.12	40
17	17:13	0.18	30
18	18:09	0.19	40
19	19:12	0.19	50
20	20:14	0.20	65
21	21:09	0.20	65
22	22:11	0.18	85
23	23:13	0.14	85
24	24:09	0.08	80
1	01:09	0.04	320
2	02:09	0.05	340
3	03:12	0.12	50
4	04:14	0.16	50
5	05:08	0.20	50
6	06:09	0.28	45
7	07:09	0.26	40
8	08:10	0.20	40
9	09:11	0.14	45
10'	10:11	0.07	40

Fig. 3-17 Monthly Frequency Percentage of Wave Height

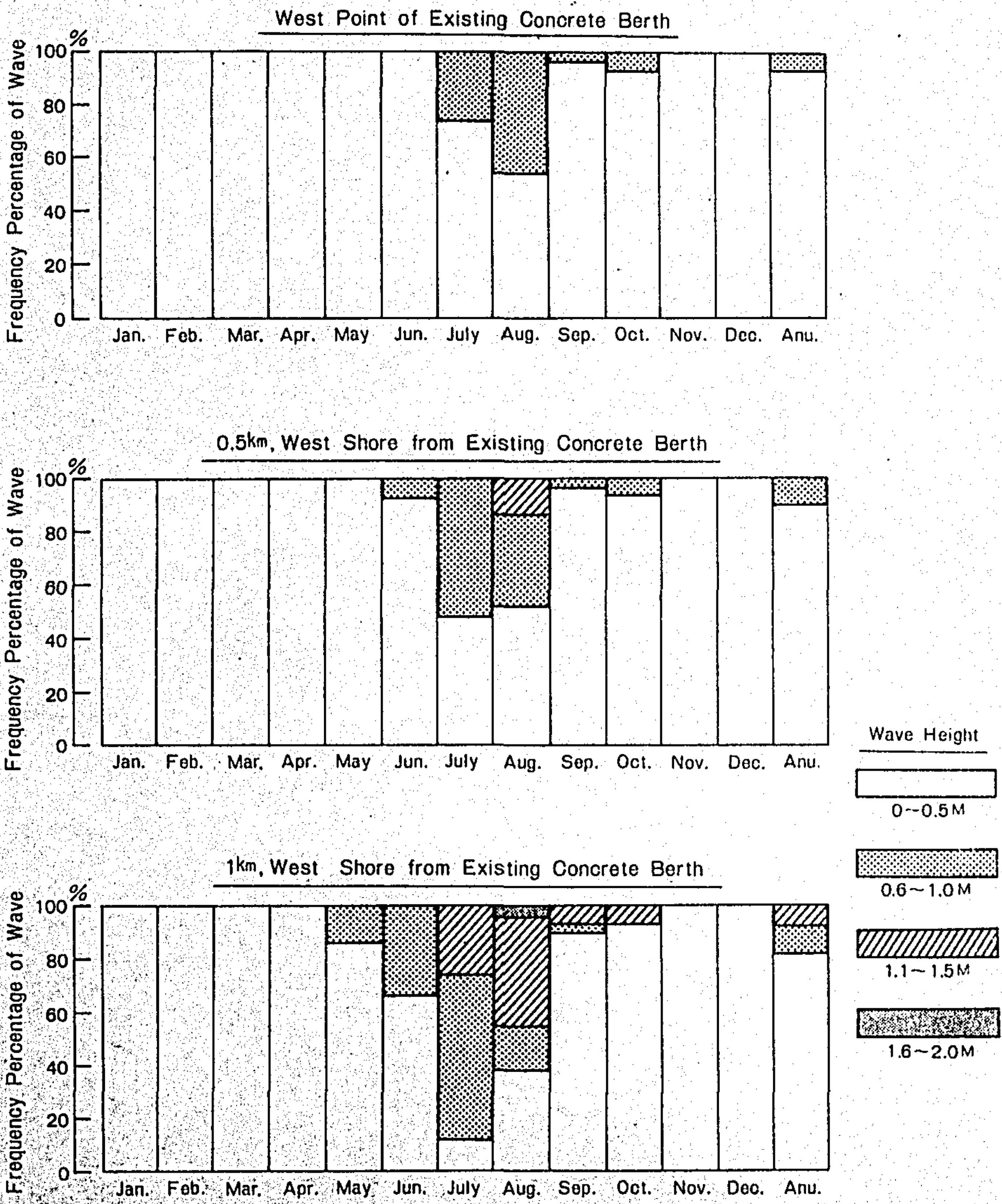


Fig. 3-18 To

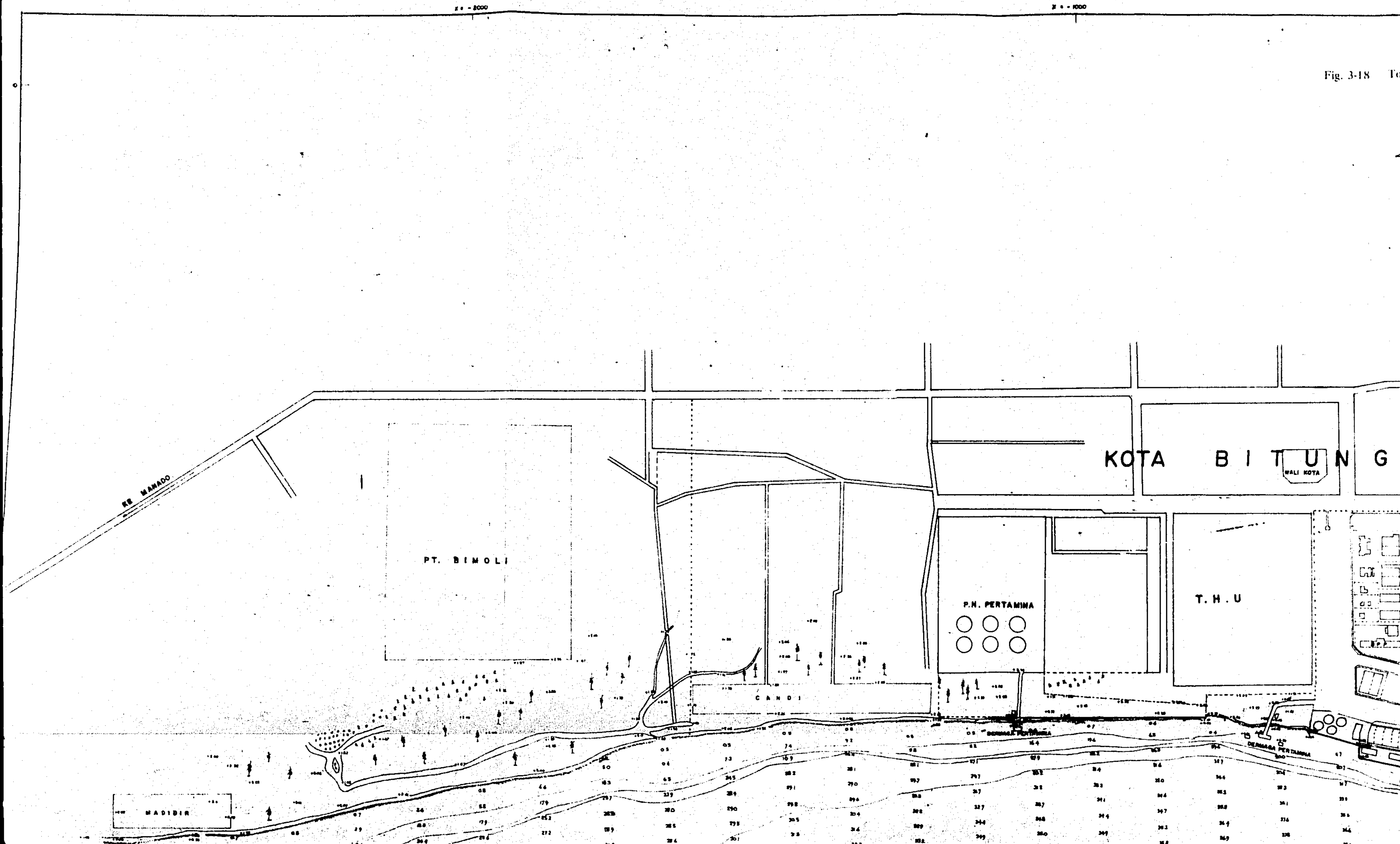
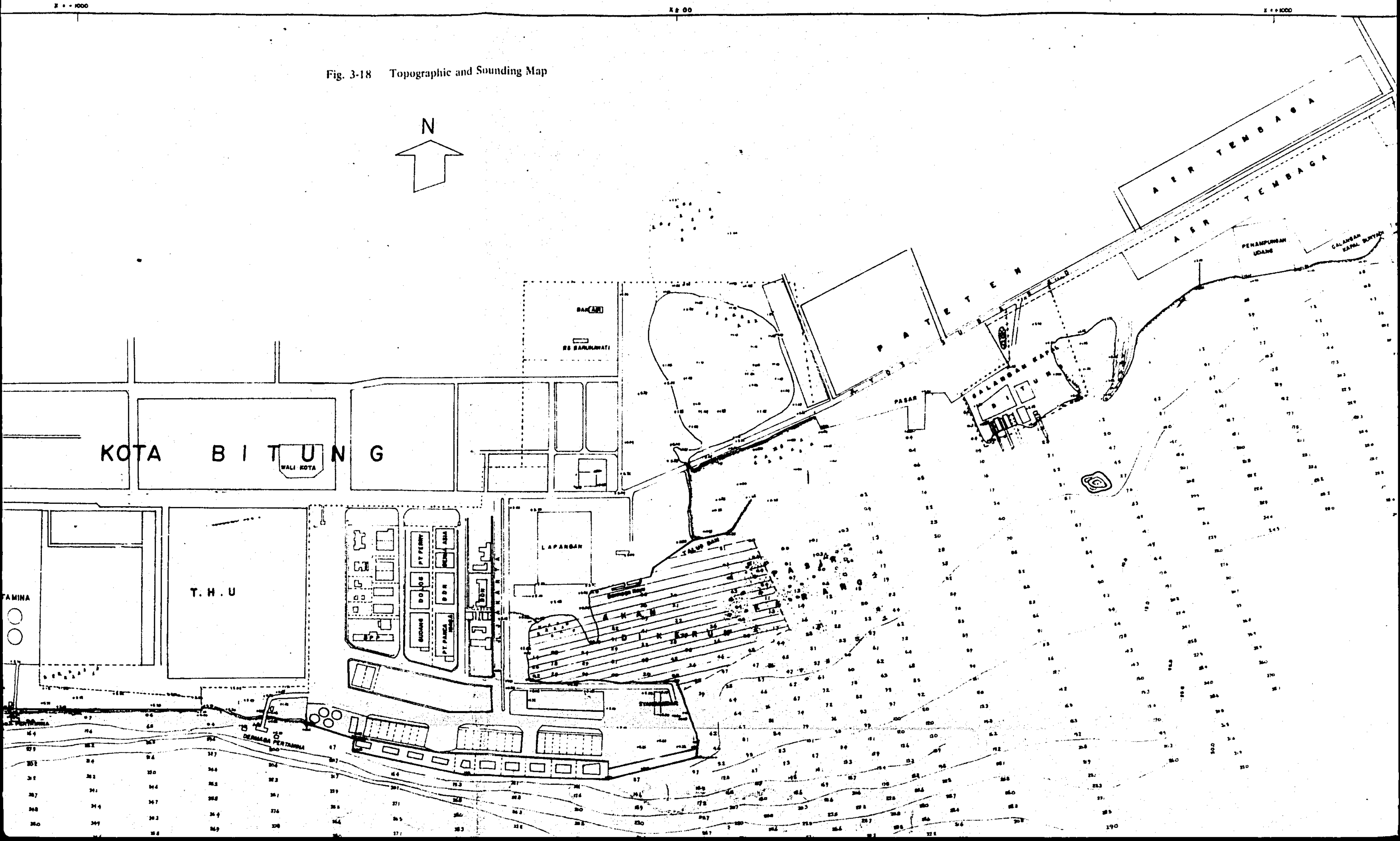
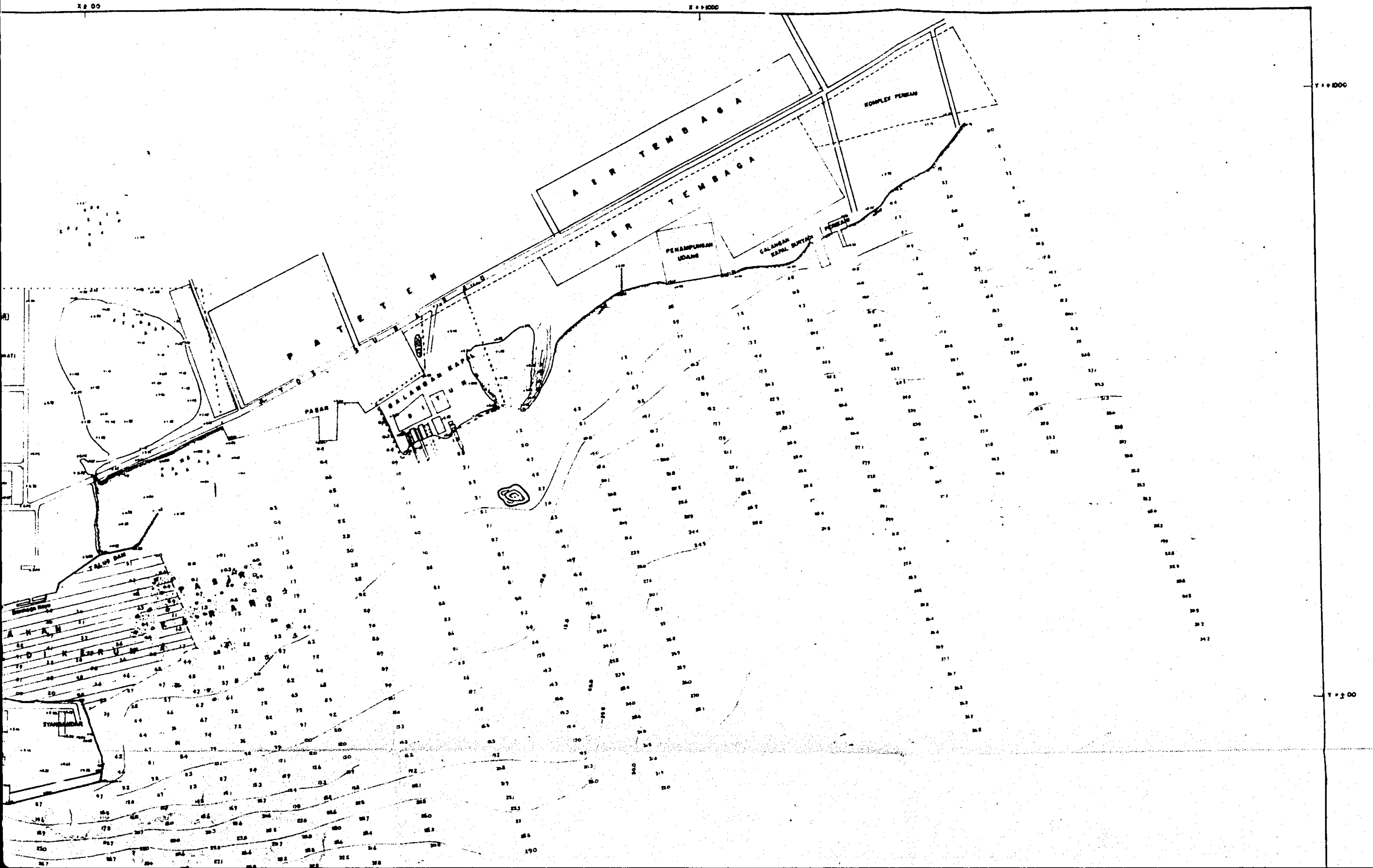
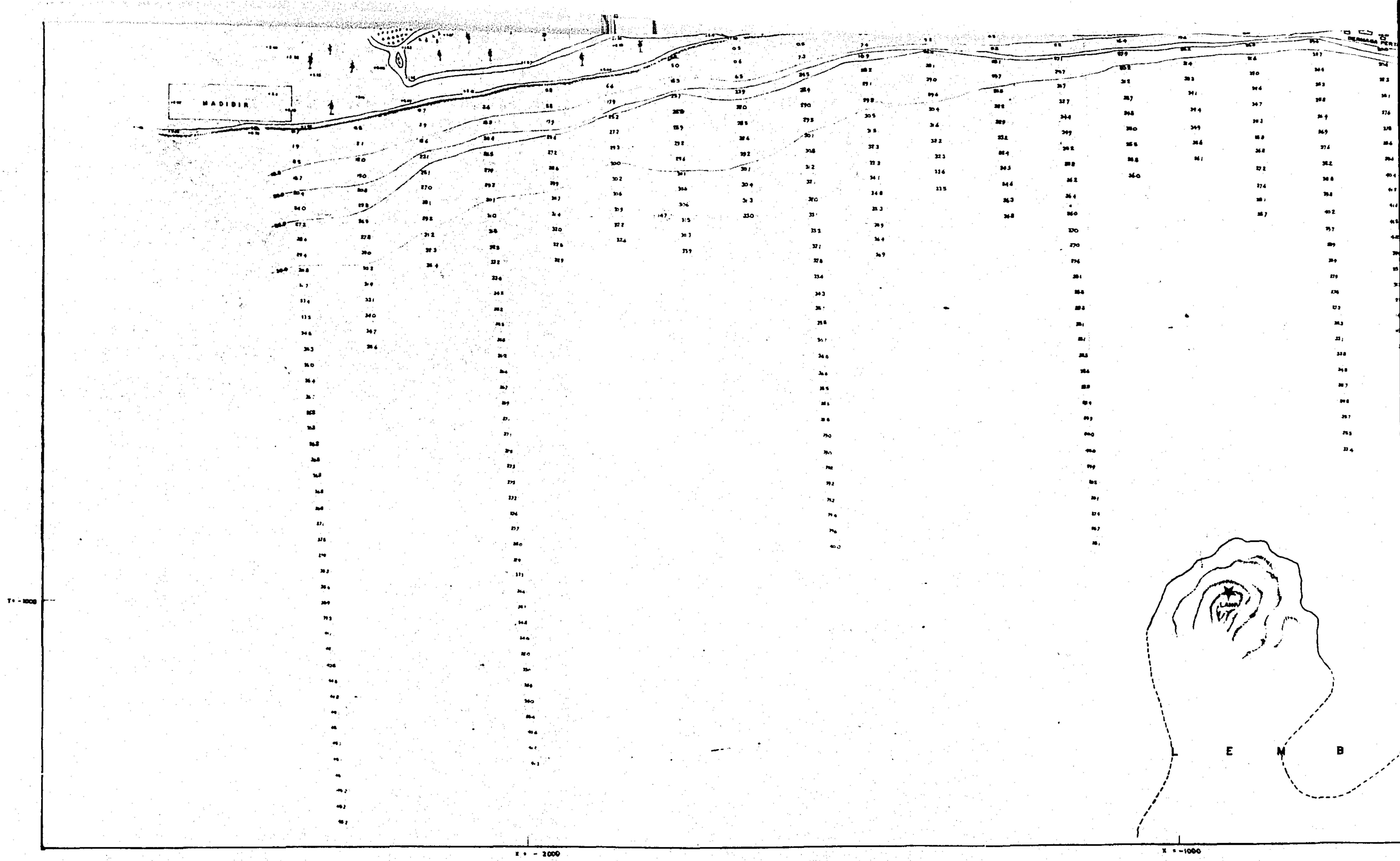
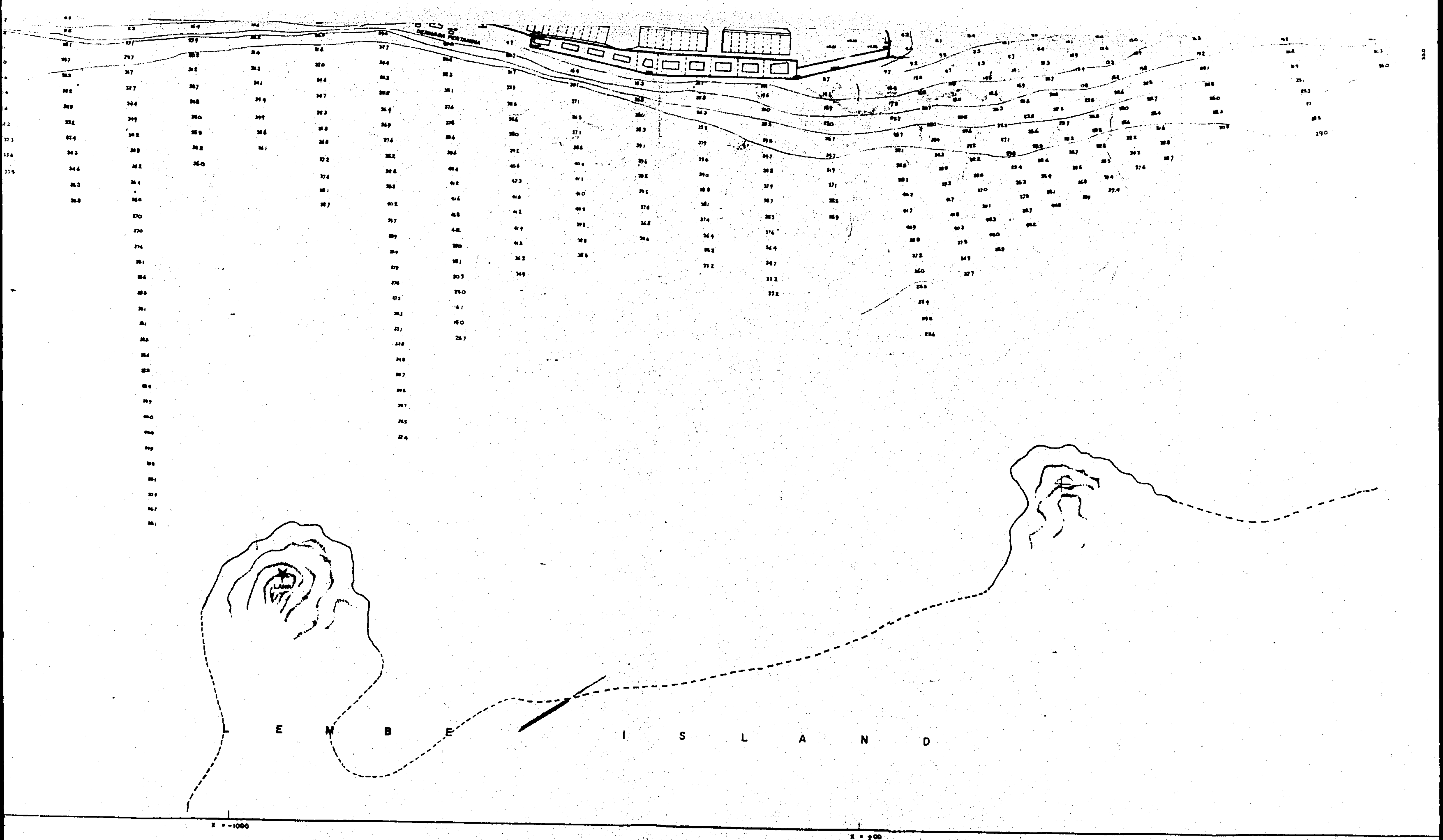

KE MANADO
PT. BIMOLI
KOTA BITUNG
WALI KOTA
P.N. PERTAMINA
T. H. U
CANDI
DERMAGA PERTAMINA
DERMAGA PERTAMINA
MADIDIR

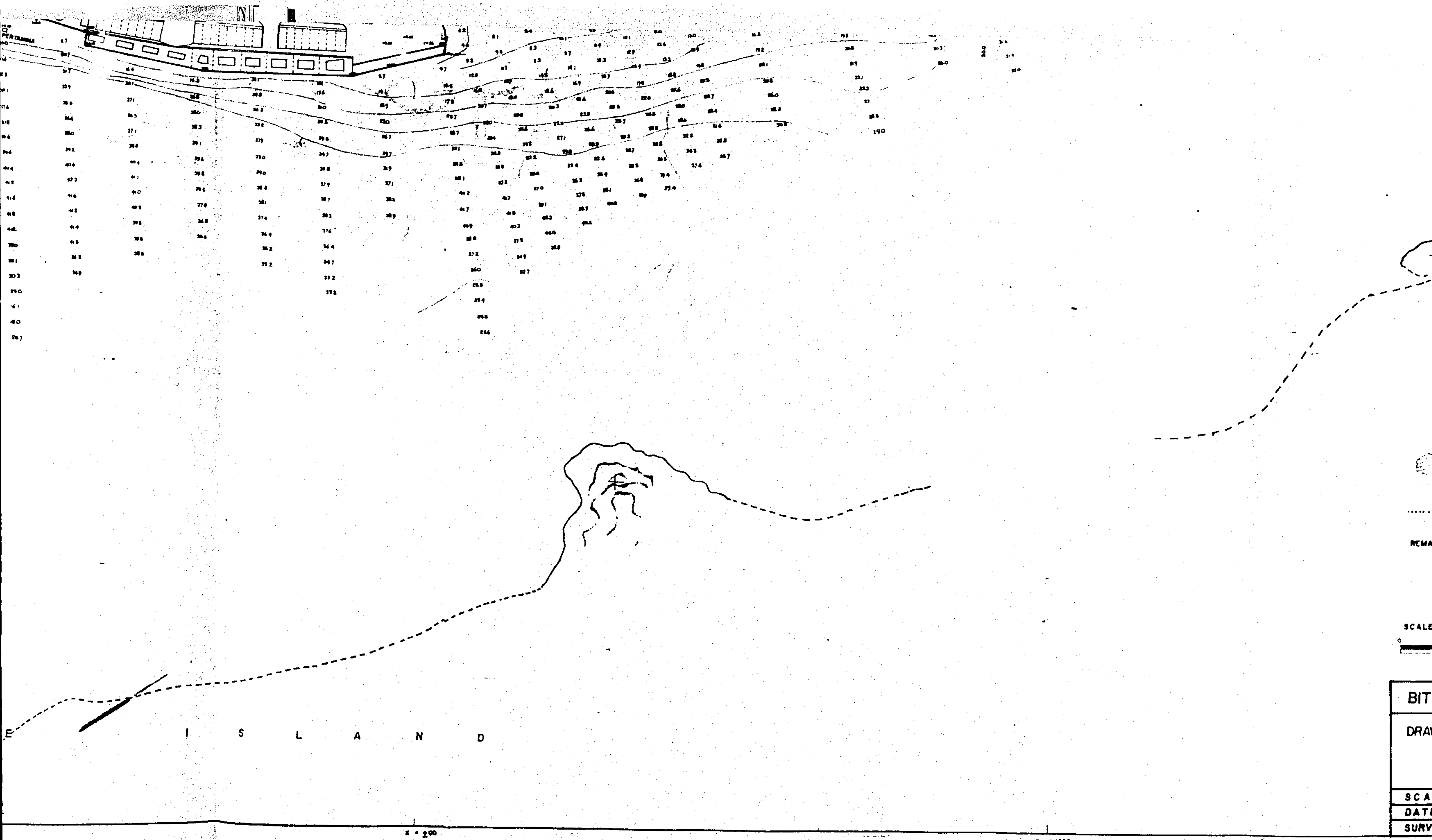
Fig. 3-18 Topographic and Sounding Map

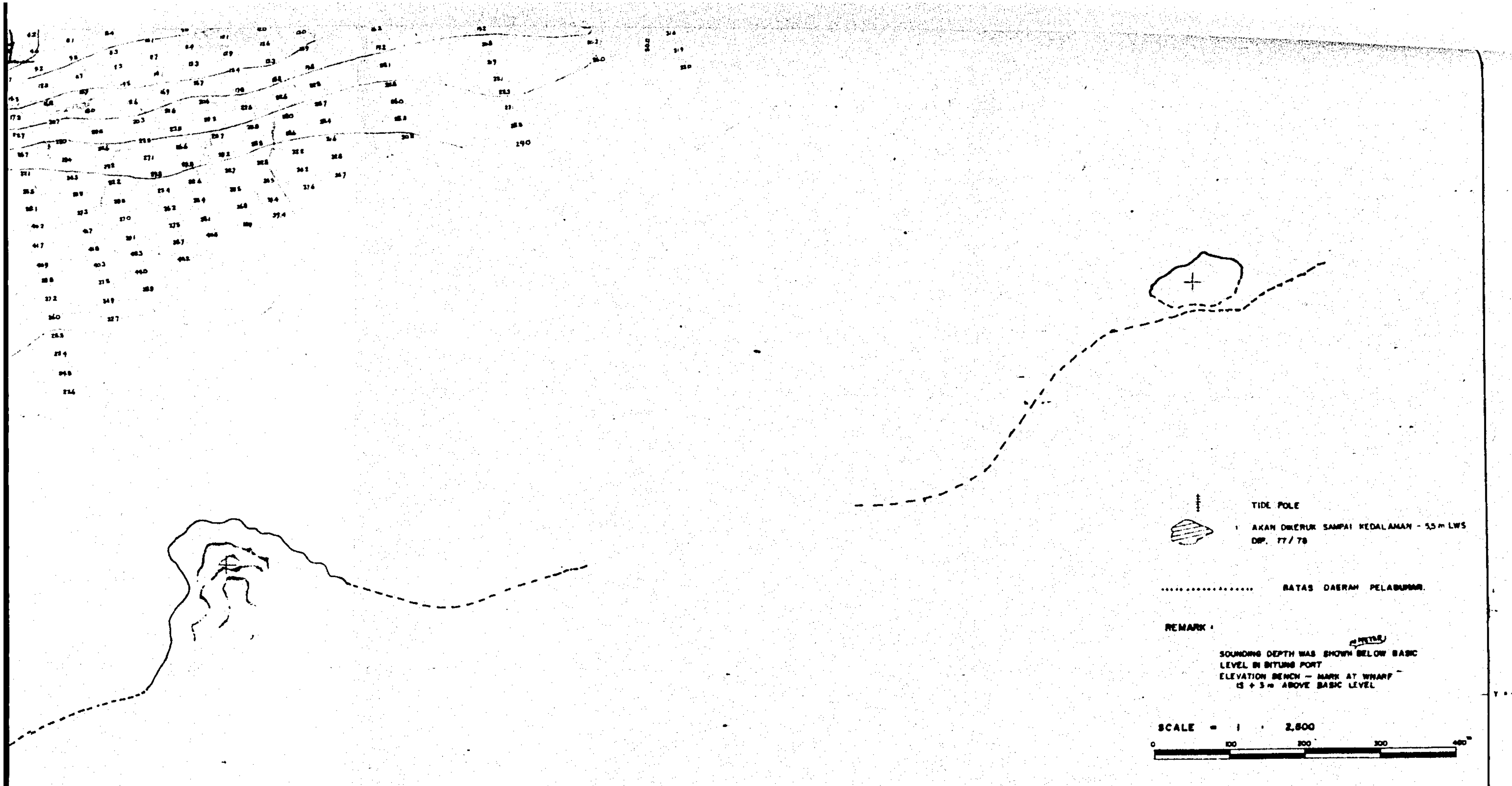



X ± 00
X + 1000
Y + 1000
Y ± 00
AIR TEMBAGA
AIR TEMBAGA
PATETEN
PENAMPUNGAN UDANG
GALANGAN KAPAL
PASAR
SYAHBANDAR


MADIBIR
Y = -1000
X = -2000
X = -1000
L E M B


L E M B E
I S L A N D
LAMP
X = -1000
X = ±00


PERTAMINA
E
I S L A N D
REMA
SCALE
BIT
DRAW
SCA
DATE
SURV



BITUNG PORT FEASIBILITY STUDY

DRAWING : PLAN OF TOPOGRAPHIC AND SOUNDING

SCALE	1 : 2500
DATE	JUNE - JULY 1977.
SURVEYED	JICA TEAM.

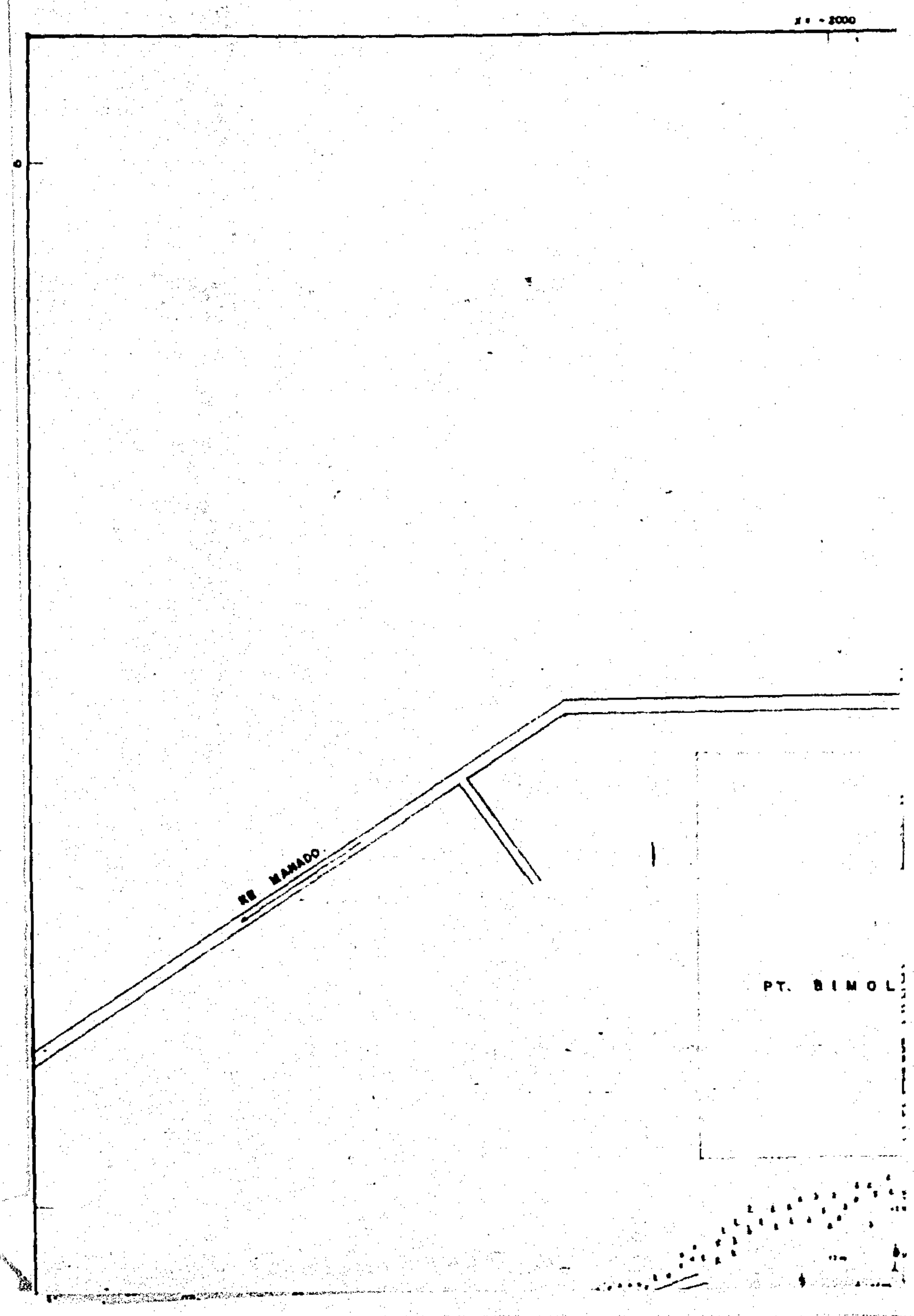
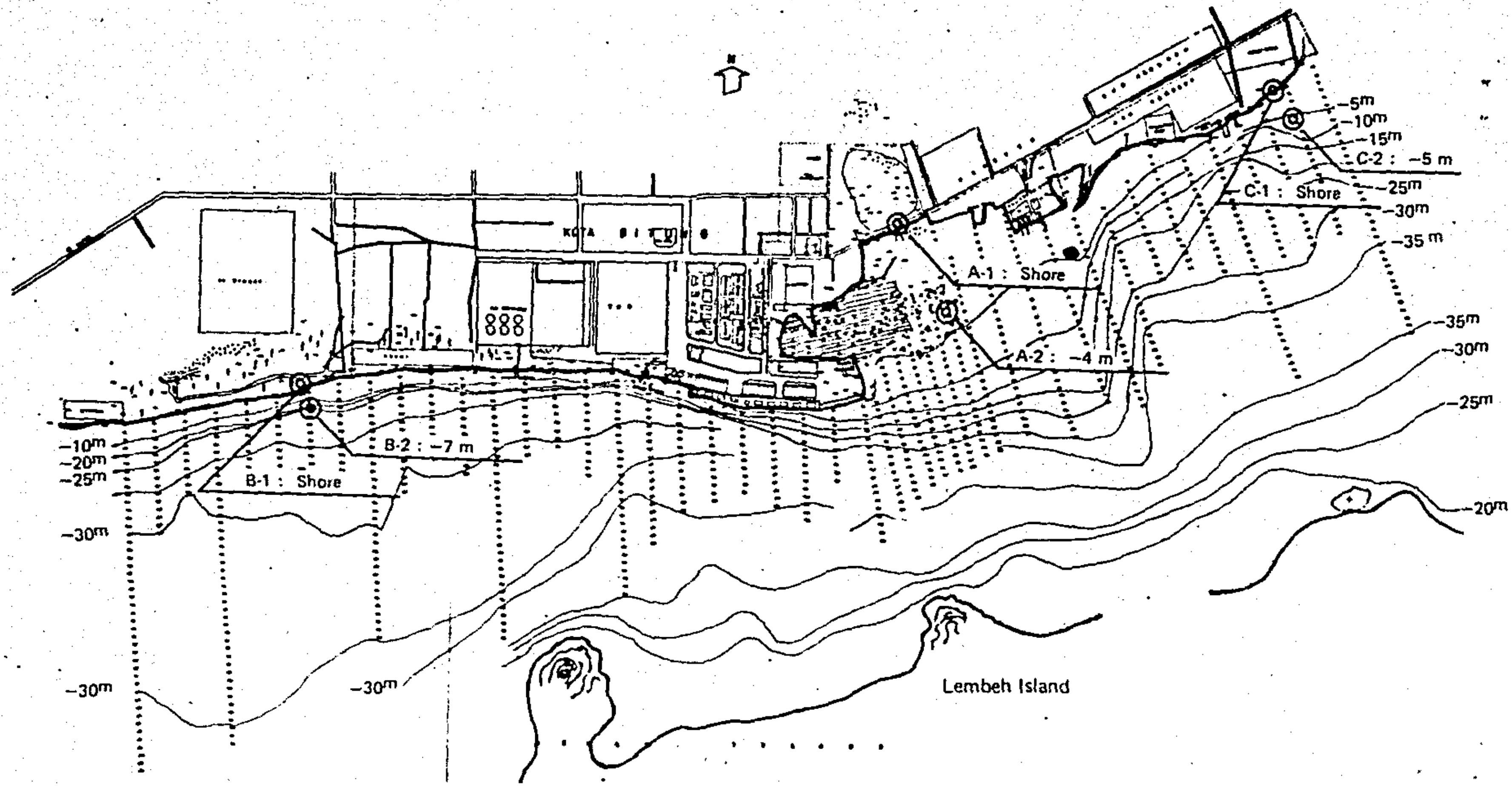

X = - 2000
0
KE MANADO
PT. BIMOL

Fig. 3-19 Location of Soil Sampling of Seashore
Scale = 1: 20,000



3-20 **Particlesize Accumulation Curve of Material of Seashore**

Date: July 16, 1977

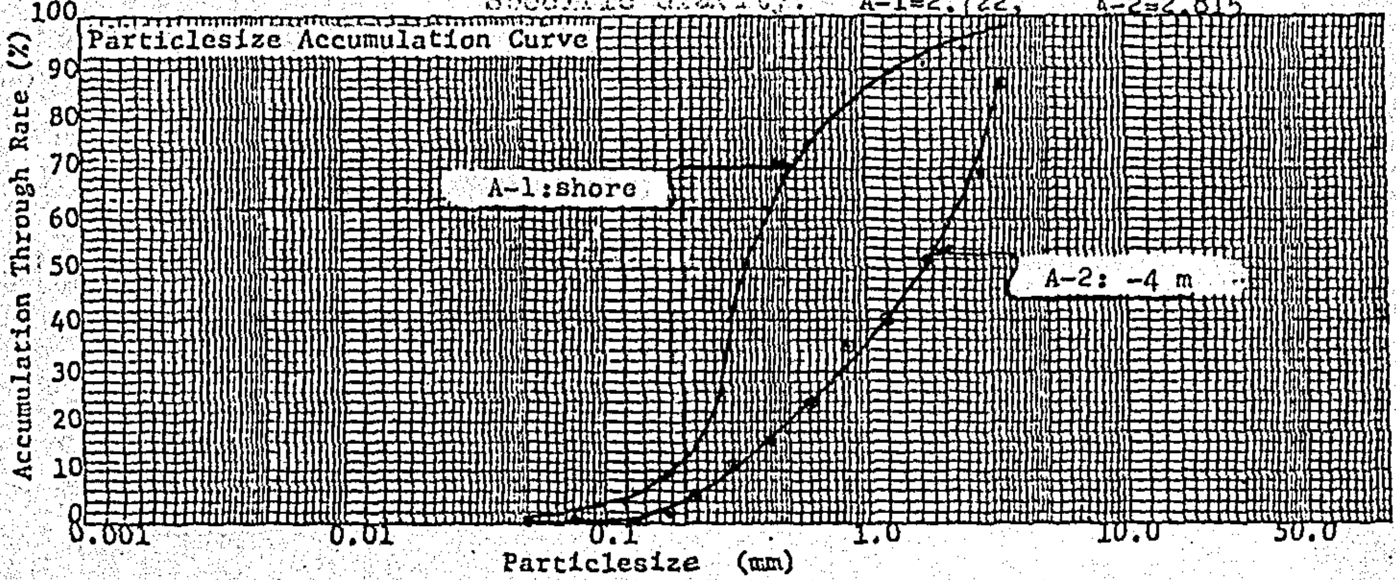
Tested by PHB. Laut

Sampling Location: A-1: Shore in bay
A-2: Seabed of -4m

Soil Classification: Gravely Sand

Soil Constituents: Gravel= 6%, Sand=92%, Silt= 2%
Gravel=43%, Sand=56%, Silt= 1%

Specific Gravity: A-1=2.722, A-2=2.815



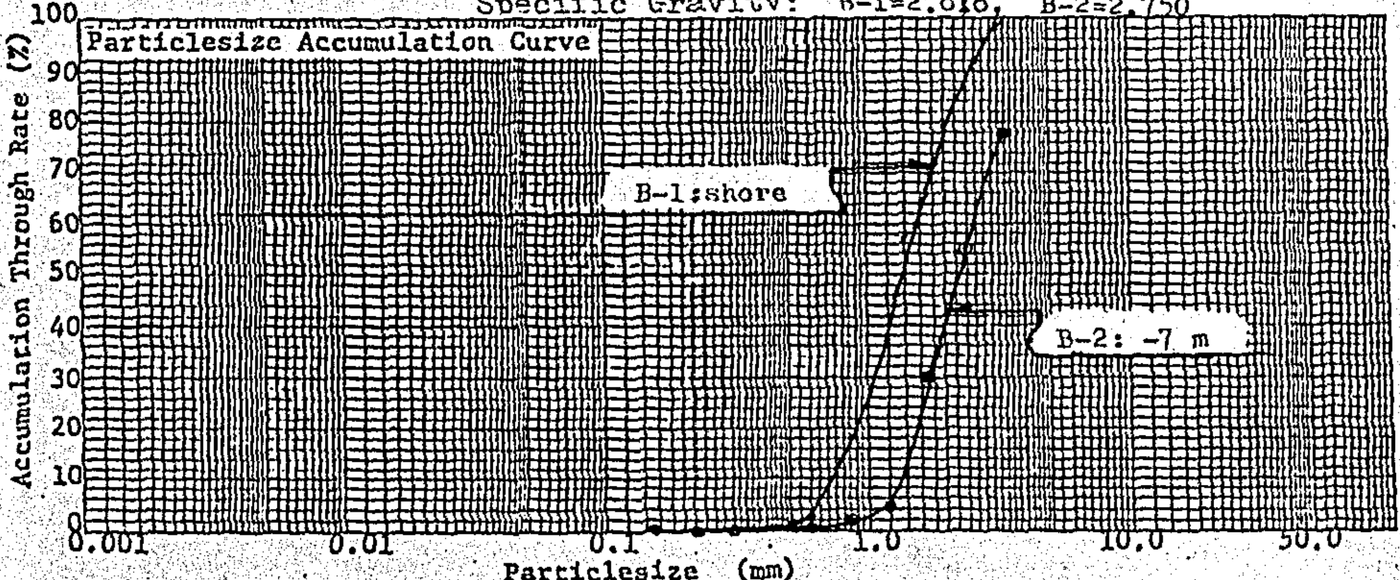
colloid	Clay	Silt	Sand	Conglomerate
0.001	0.005	0.074	2.0	

Sampling Location: B-1: Shore
B-2: Seabed of -7m

Soil Classification: B-1=Gravely Sand, B-2=Sandy Grav

Soil Constituents: Gravel=22%, Sand=78%, Silt= 0%
Gravel=63%, Sand=37%, Silt= 0%

Specific Gravity: B-1=2.818, B-2=2.750



colloid	Clay	Silt	Sand	Conglomerate
0.001	0.005	0.074	2.0	

3-21 **Particlesize Accumulation Curve of Material of Seashore**

Sampling Location: C-1: Shore
C-2: Seabed of -5m

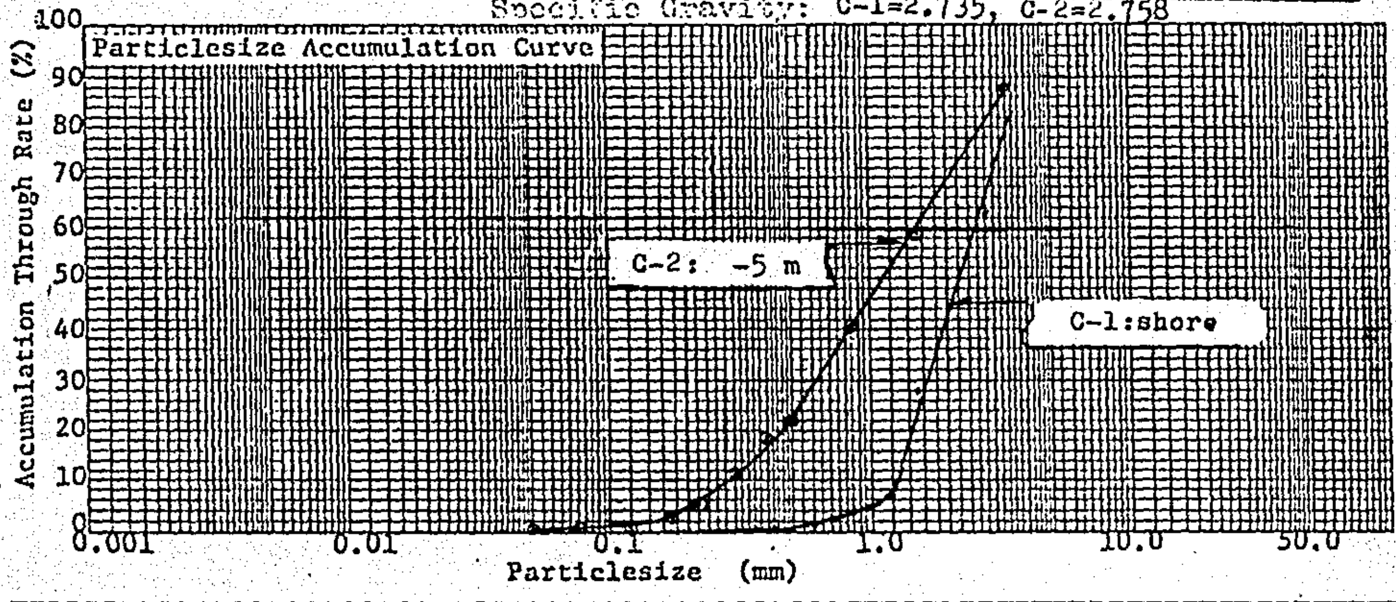
Date: July 16, 1977

Tested by PHB. Laut

Soil Classification: C-1=Sandy Gravel, C-2=Gravely Sa

Soil Constituents: Gravel=58%, Sand=42%, Silt= 0%
Gravel=31%, Sand=68%, Silt= 1%

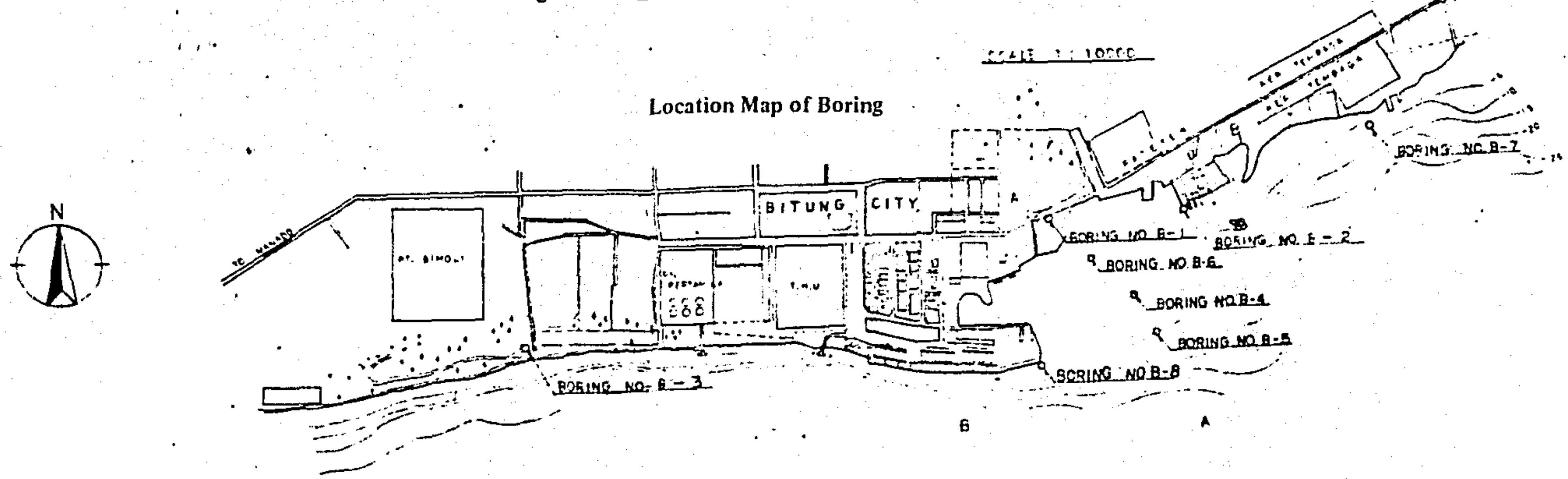
Specific Gravity: C-1=2.735, C-2=2.758



colloid	Clay	Silt	Sand	Conglomerate
0.001	0.005	0.074	2.0	

Fig. 3-22 Location of Boring and Soil Condition

Location Map of Boring



Soil Condition

SCALE. H = 1 : 2,500
V = 1 : 200

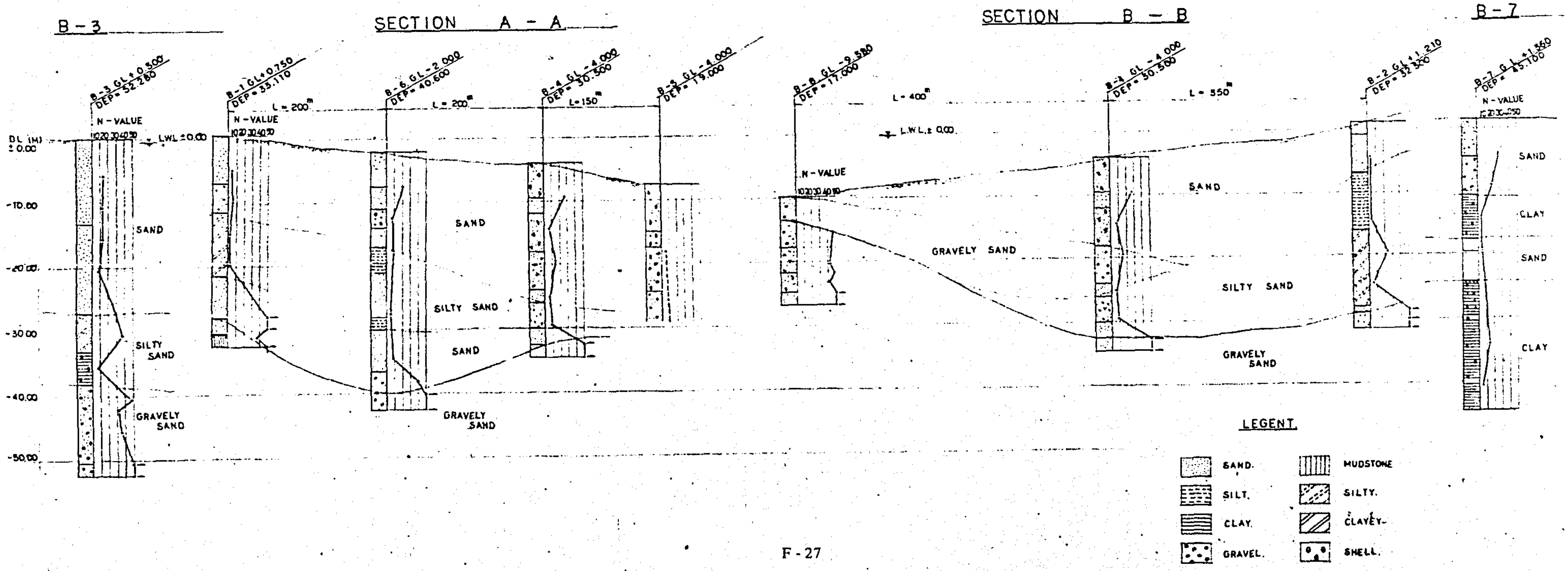
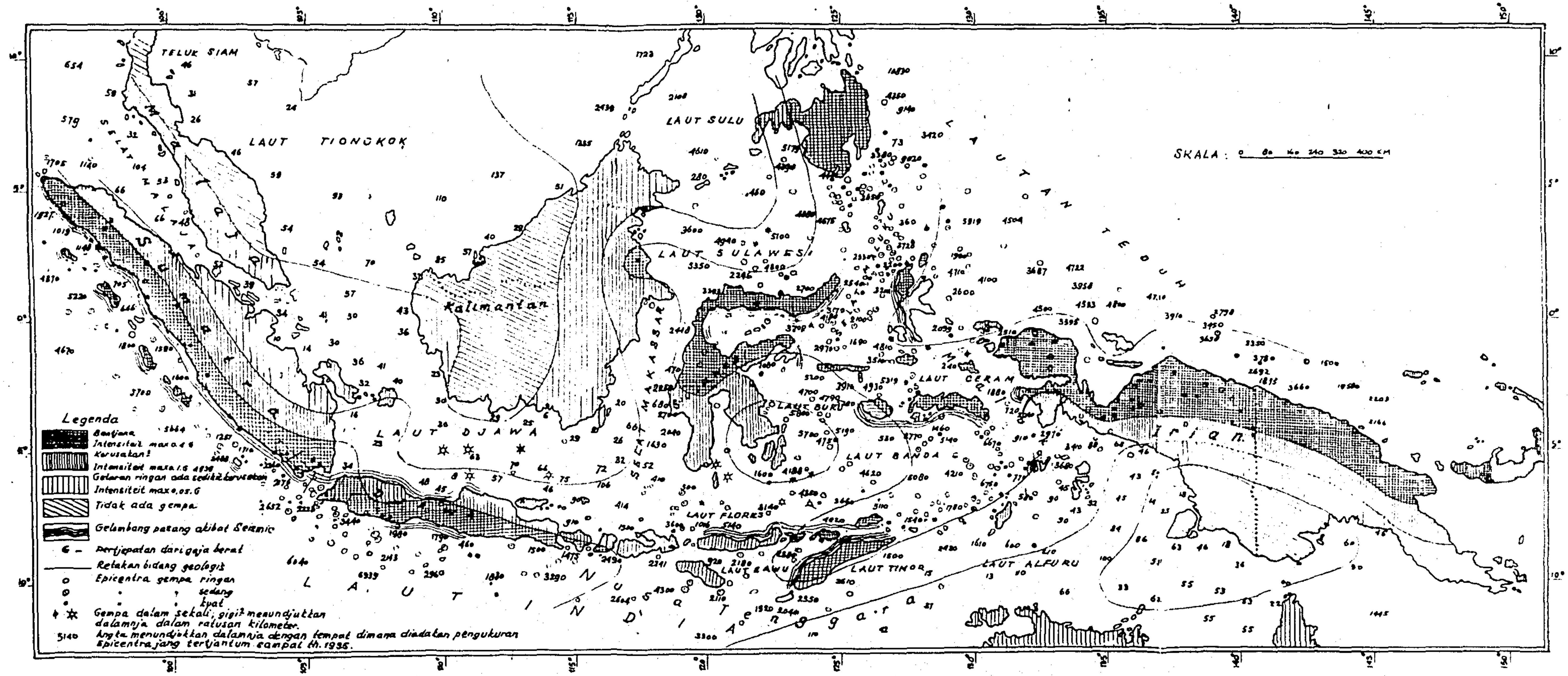


Fig. 3-23. Map of Seismic Part in Indonesia



Source : Perencanaan Bangunan TAHAN GEMPA DIREKTORAT PENYELIDIKAN MASALAH

Fig. 4-1 Estimated Transport Cost per ton by Road and Coastal Shipping

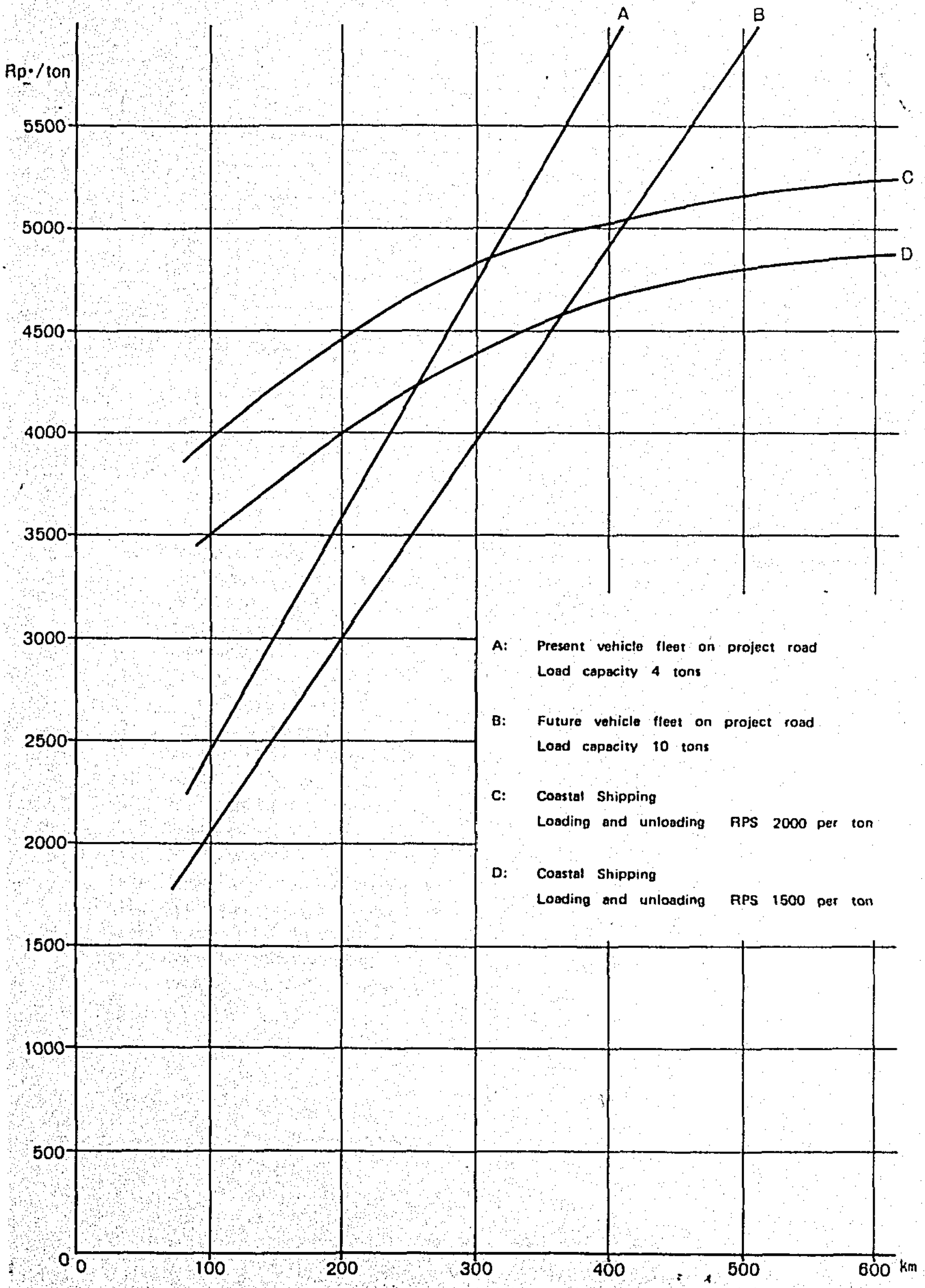
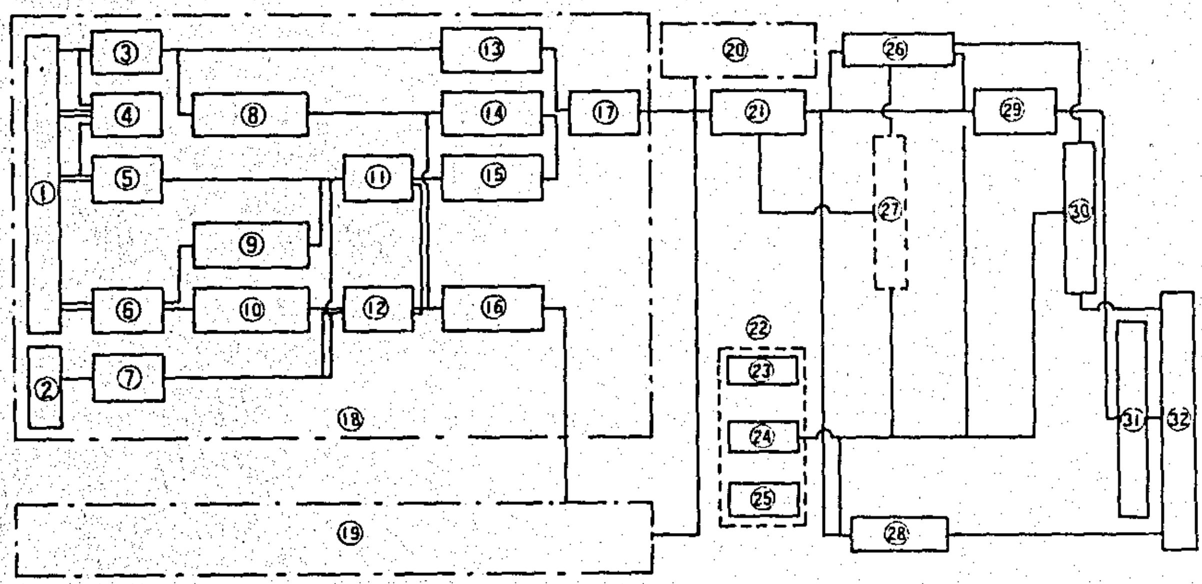


Fig. 5-1 Vessel Production Flow Chart



(1) Steel plate storage yard (including shoot blast cleaning)
(2) Shapes storage yard
(3) Flame planer
(4) Butt welding
(5) NC flame cutter
(6) NC drilling equipment
(7) Fabrication of shapes
(8) Bending of bilge and gunnel (1,000 t press)
(9) Bendn
(9) Bending of face (300 t Bending machine)
(10) Parallel cutter
(11) Piece fabrication
(12) Assembly of longitudinal number
(13) Automatic one side welding machine
(14) Assembly of bildge and gunnel
(15) Frame fabrication assembly (Longitudinal number fixing device)
(16) Cold bending of longitudinal member
(17) Block assembly
(18) Drawing board block shop
(19) Bending outside plate block shop
(20) Assembly of accommodation block
(21) Painting (pickling)
(22) Rig parts
(23) Storage warehouse
(24) Pallet assembly
(25) Pipe manufacture
(26) Block turn over equipment
(27) Rigging for living quarter
(28) Unit assembly
(29) Block Rigging
(30) Space erection of accommodation block
(31) Block storage and pre erection
(32) Building dock

Fig. 7-1 Alternative New Port Construction Sites

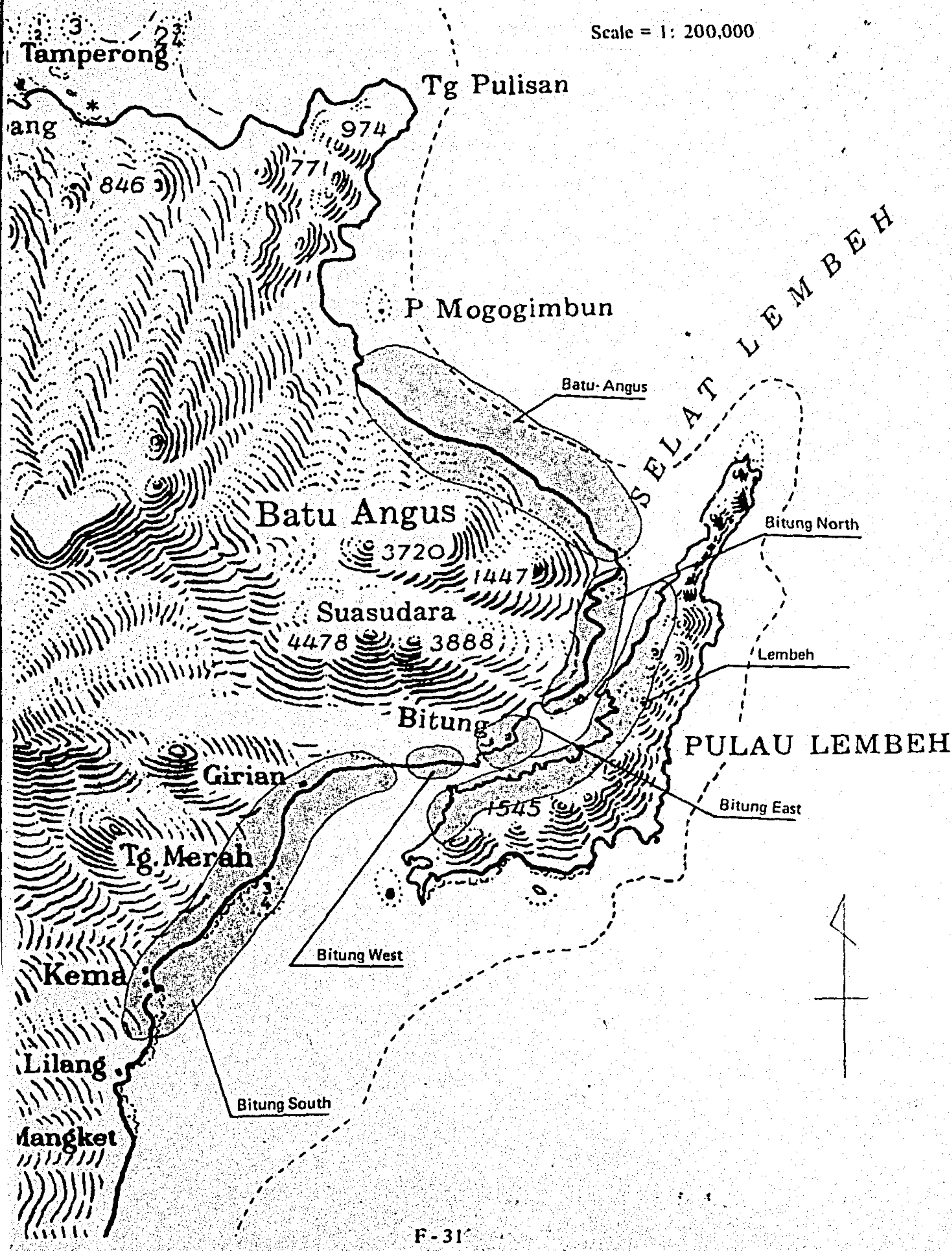
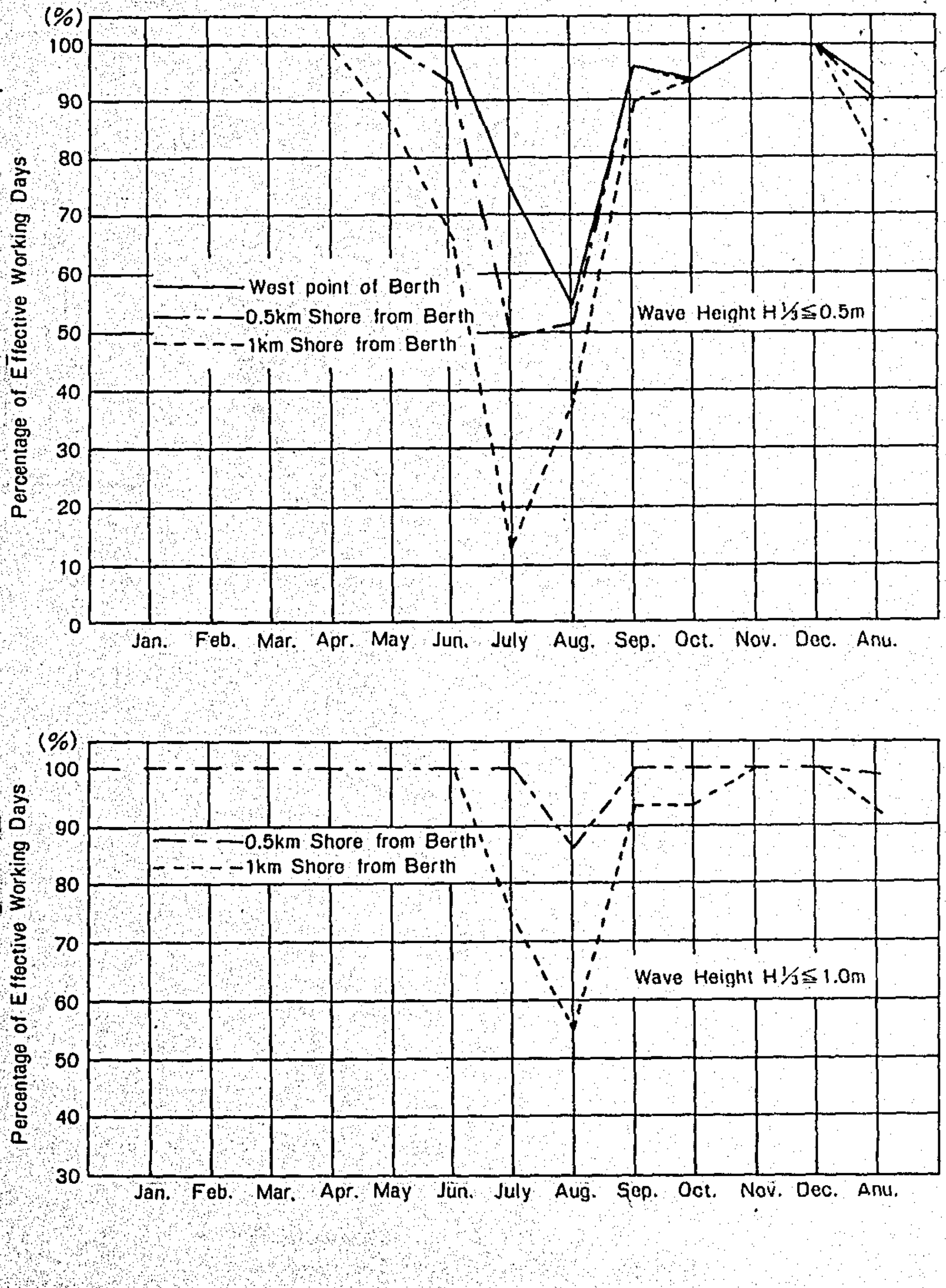


Fig. 7-2. Percentage of Effective Working Days



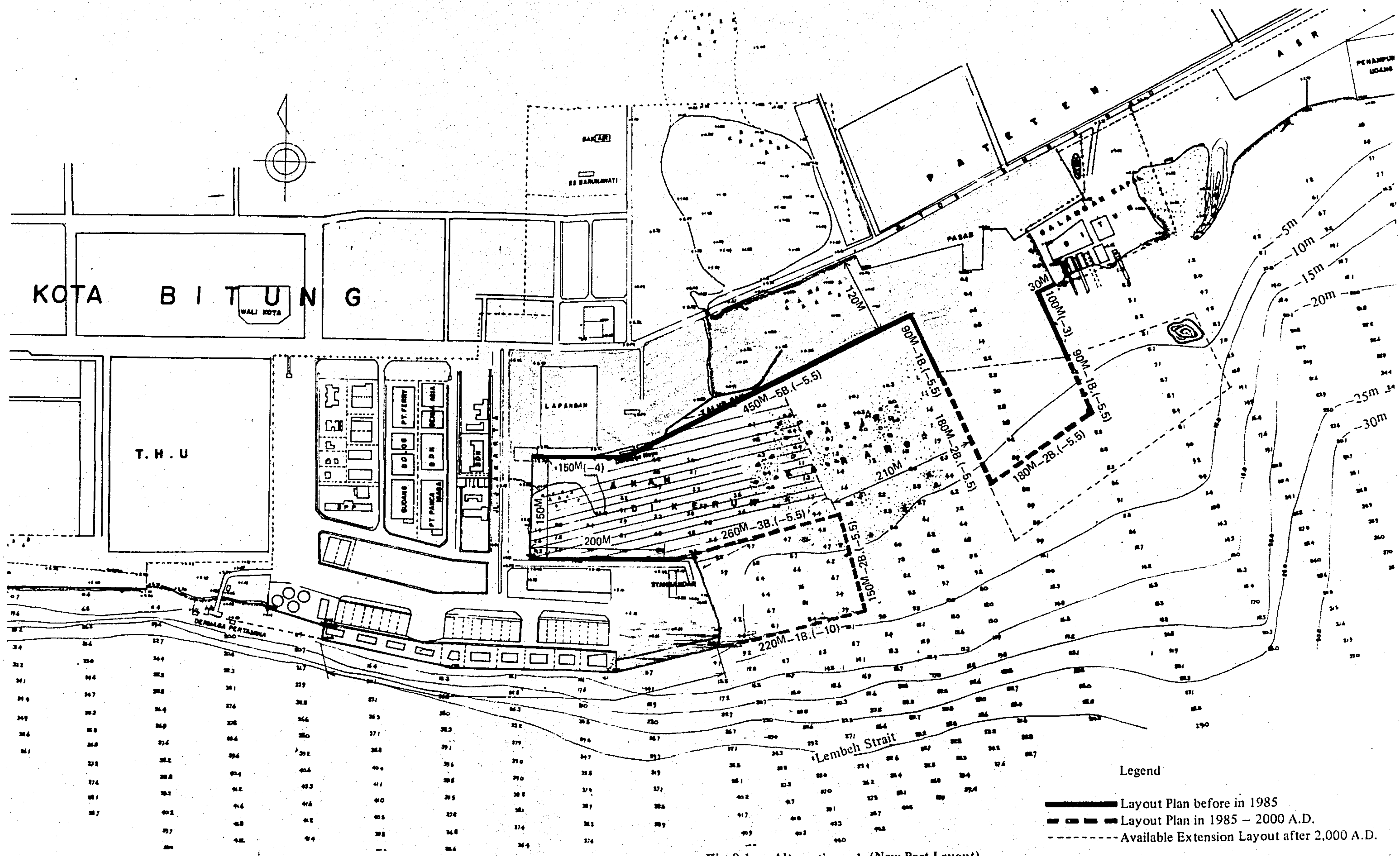


Fig. 8-1. Alternative – 1 (New Port Layout)
Scale = 1: 5,000

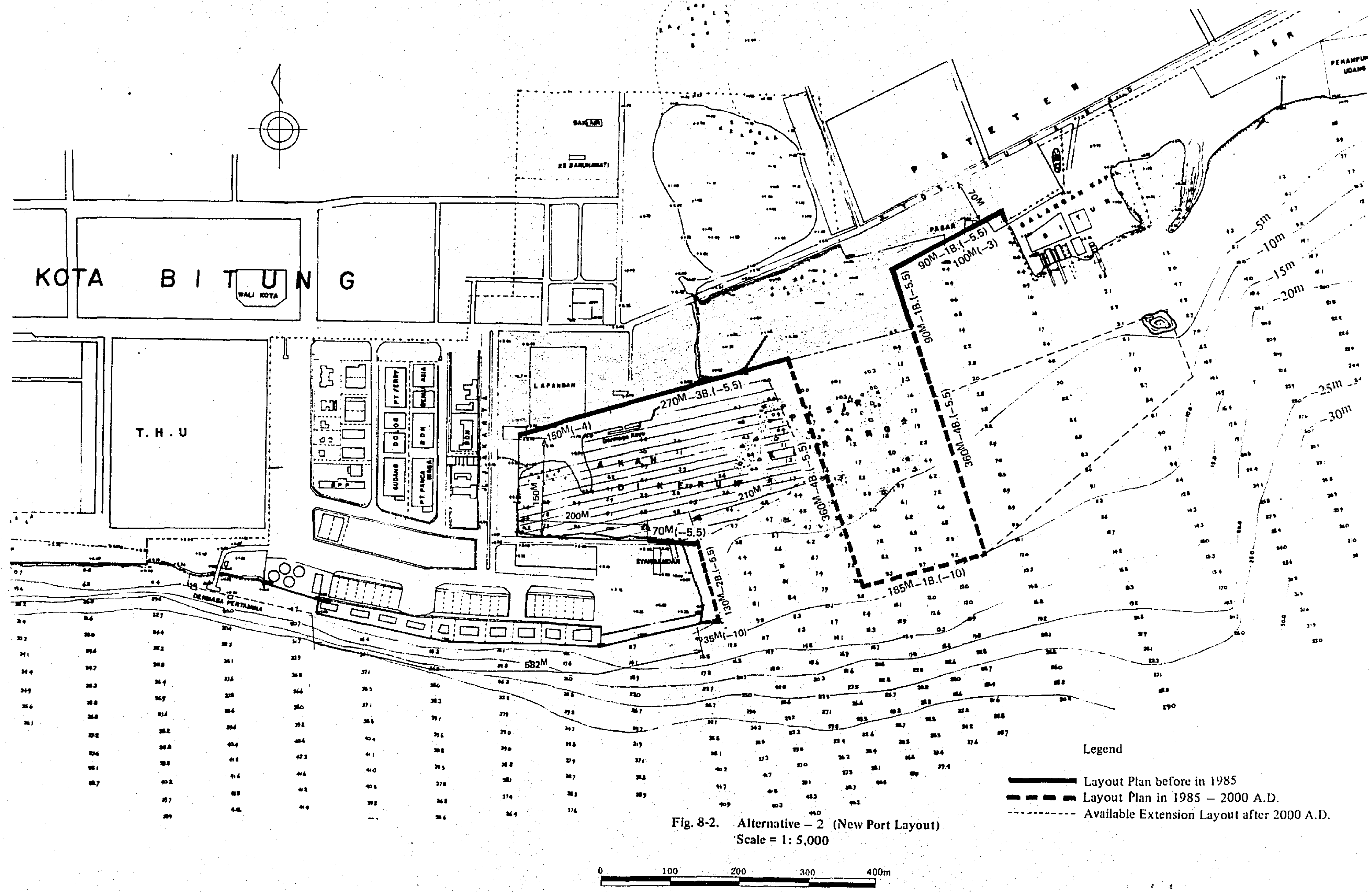


Fig. 8-2. Alternative – 2 (New Port Layout)
Scale = 1: 5,000

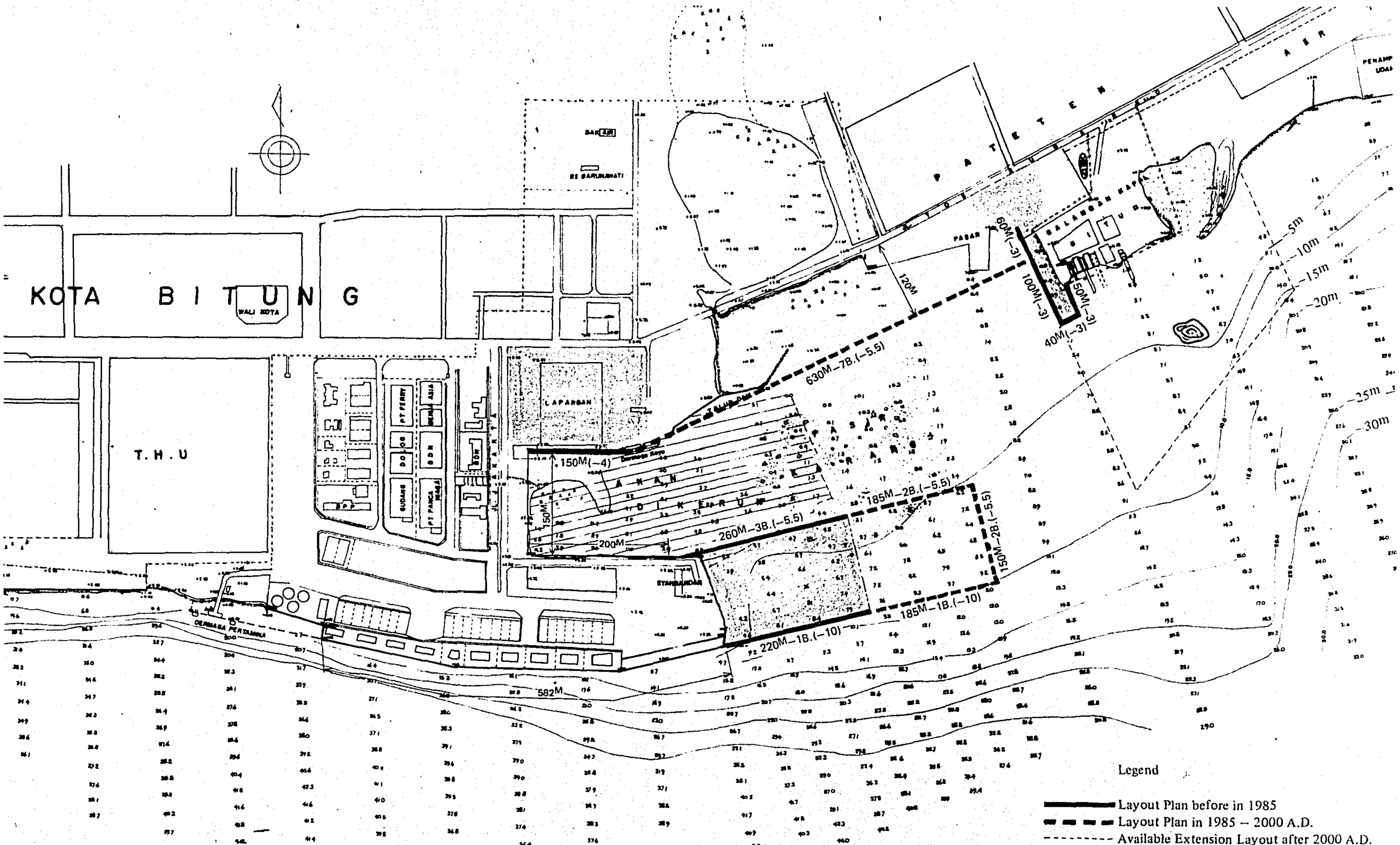
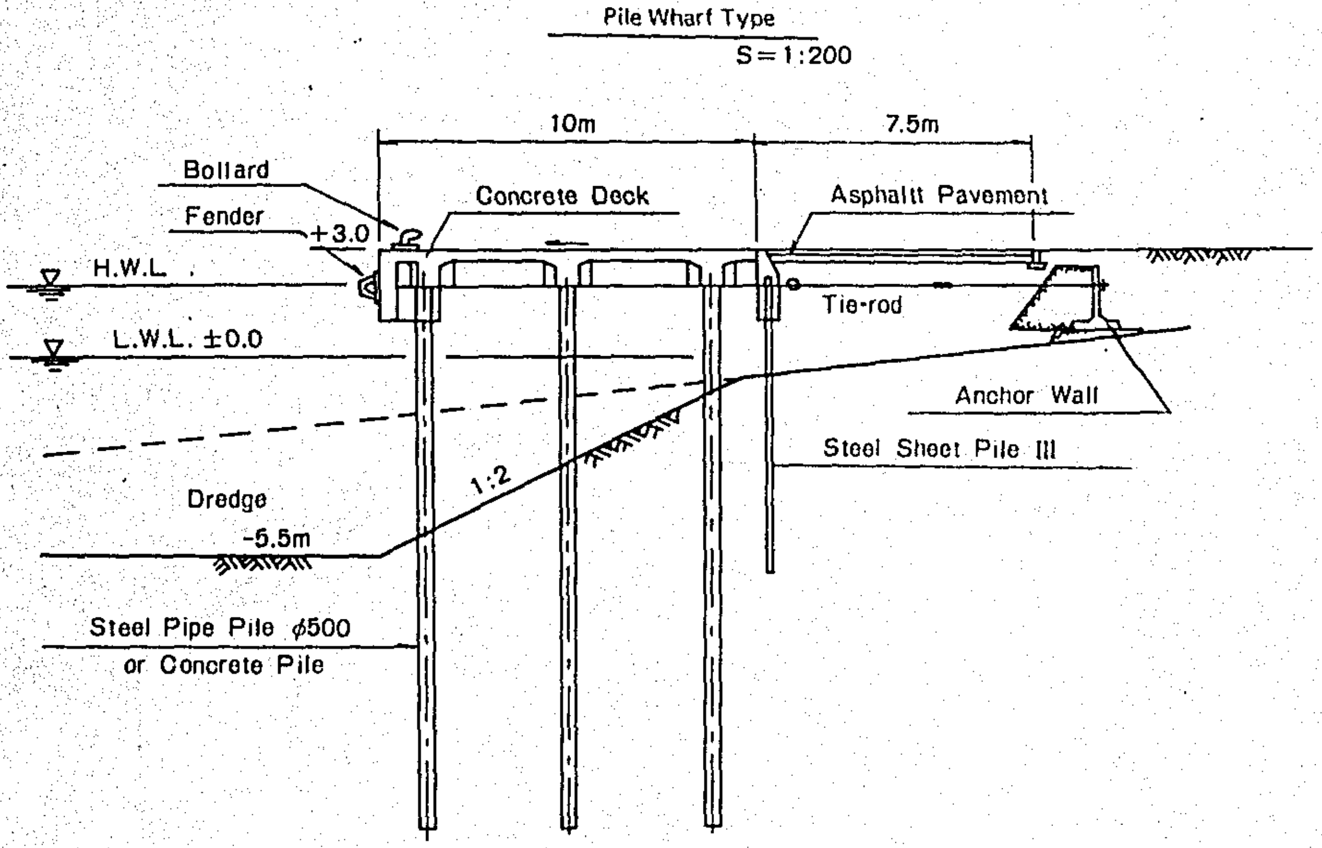
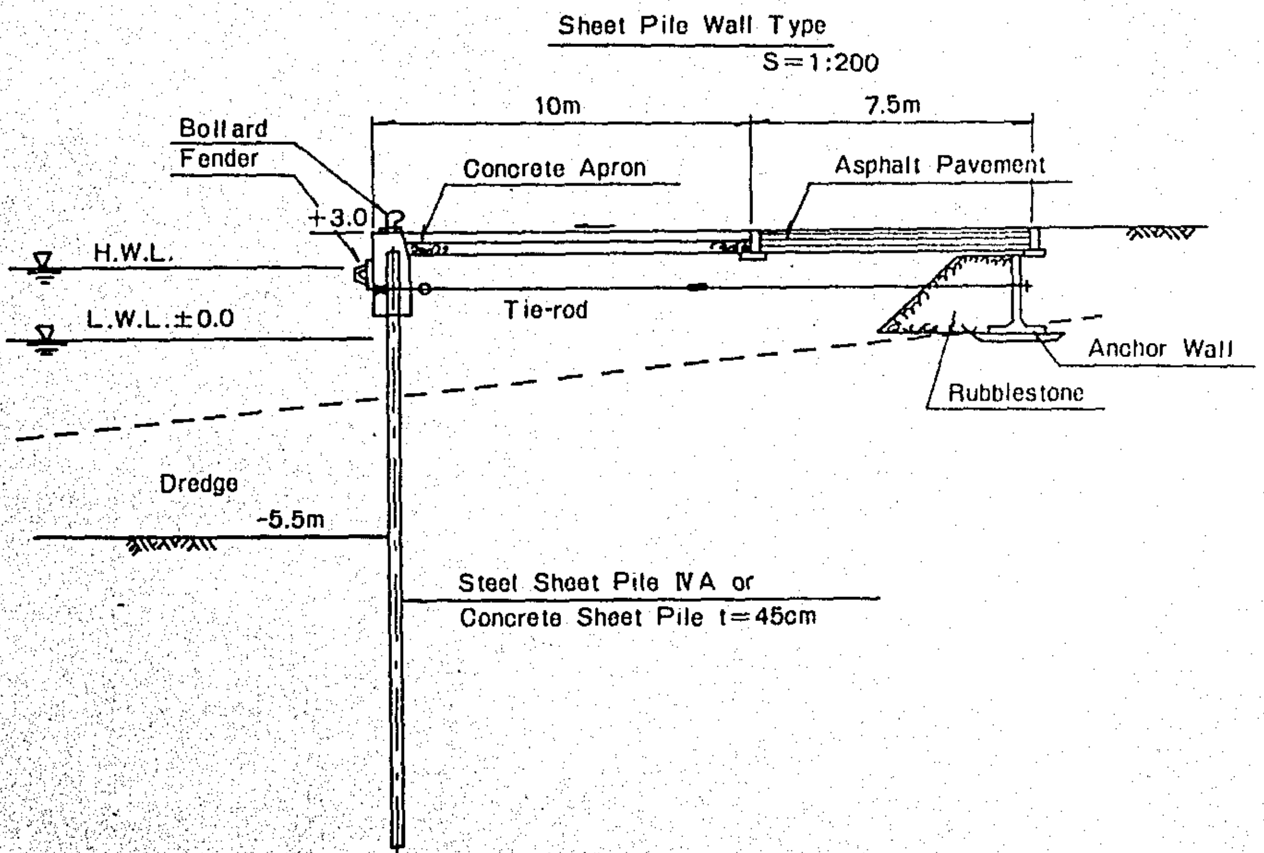


Fig. 8-3. Alternative –3 (New Port Layout)
Scale = 1: 5,000

0 100 200 300 400m

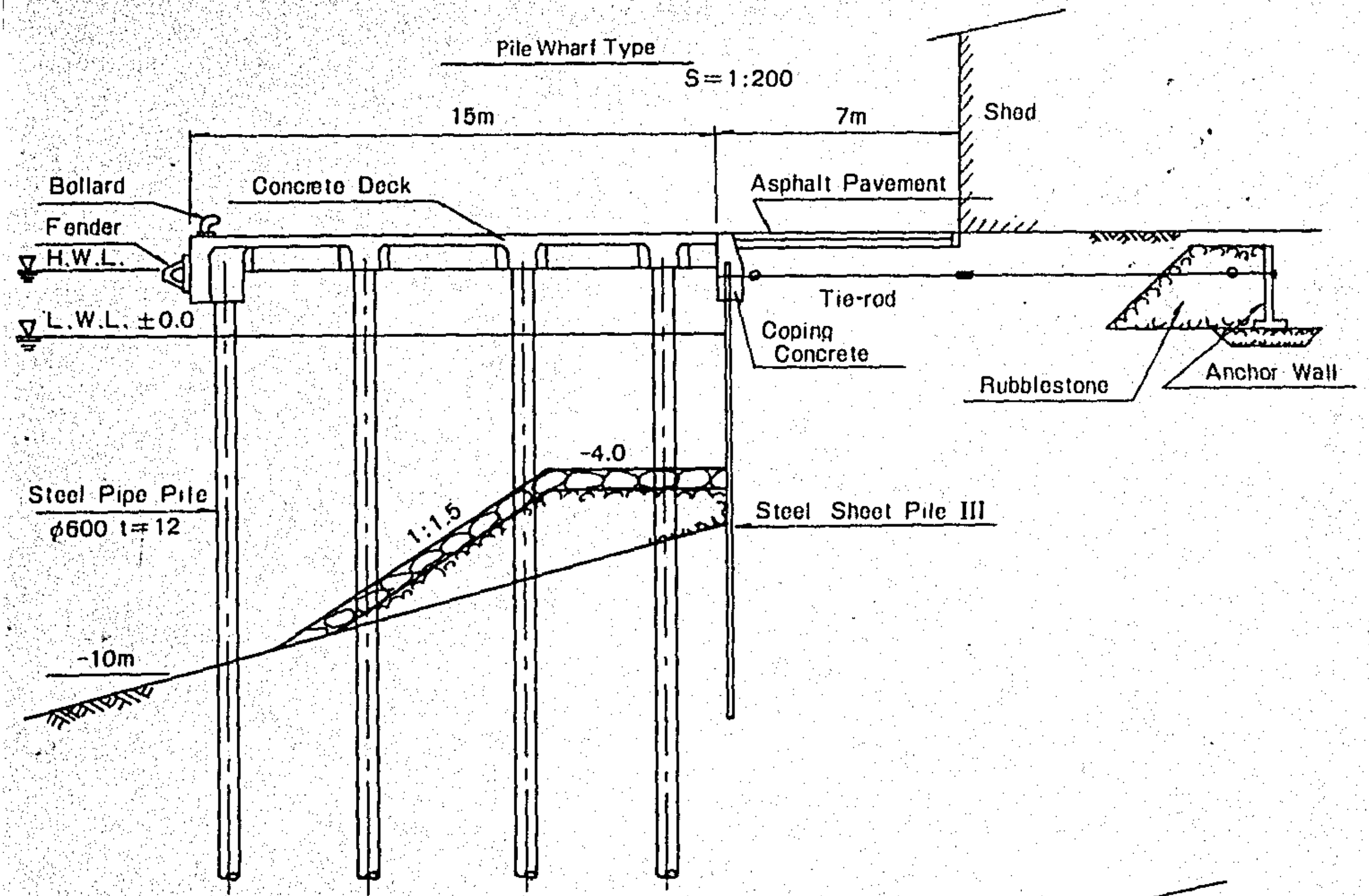
Fig. 8-4. −5.5m Wharf Structure





Pile Wharf Type

S=1:200



Steel Pipe Wall Type

S=1:200