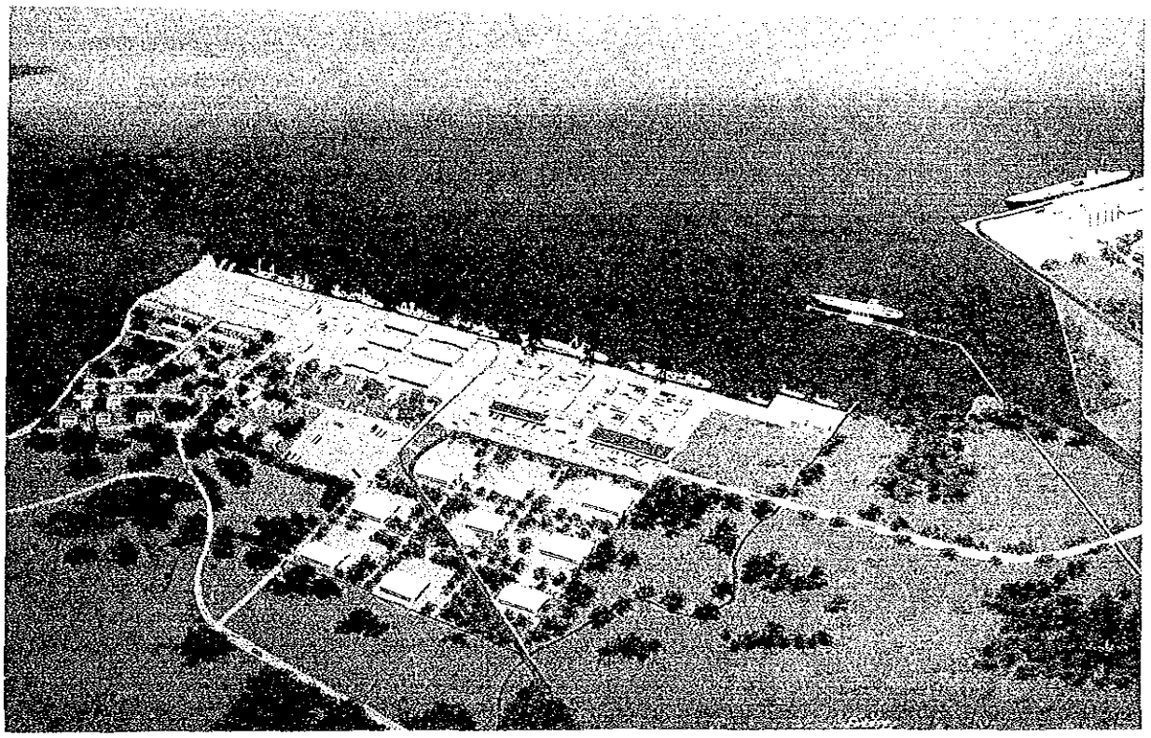
社会開発協力部報告書

FINAL REPORT

No. 7

THE STUDY ON THE DEVELOPMENT PROJECT OF THE PORT OF SANTO TOMAS DE CASTILLA IN THE REPUBLIC OF GUATEMALA



JULY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

THE STUDY
ON
THE DEVELOPMENT PROJECT OF
THE PORT OF SANTO TOMAS DE CASTILLA
IN
THE REPUBLIC OF GUATEMALA

JULY 1988

PREFACE

In response to the request of the Government of the Republic of Guatemala, the Government of Japan decided to conduct a study on the Development Project of the Port of Santo Tomas de Castilla, and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent a study team, headed by Mr. Keiichi MIYOTA and comprising experts from the Overseas Coastal Area Development Institute of Japan (OCDI) and Yachiyo Engineering Co., Ltd. (YEC) three times from June 1987 to March 1988.

The team exchanged views with the officials concerned of the Government of the Republic of Guatemala on the project, conducted field surveys and collected reference materials. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the promotion of the Development Project of the Port of Santo Tomas de Castilla and to contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to all the officials concerned of the Government of the Republic of Guatemala for the close cooperation they extended to the team.

July 1988

Kensuke Yanagiya

Kensuke Yanagaiya
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

July 1988

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency

Dear Sir:

It is my great pleasure to submit herewith the Report for the Study on the Development Project of the Port of Santo Tomas de Castilla in the Republic of Guatemala.

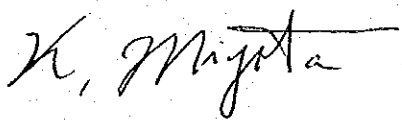
The report is the result of the studies carried out by the Overseas Coastal Area Development Institute of Japan (OCDI) and Yachiyo Engineering Co., Ltd. (YEC) at the request of the Japan International Cooperation Agency (JICA). The study team conducted the first field survey from June to August 1987 to collect a variety of data including data on natural conditions. The survey was followed by two other field surveys.

The findings of these surveys were discussed to formulate the development plan of the port of Santo Tomas de Castilla, and were compiled into this report. The study shows that the development project is extremely important for the national economy of Guatemala and the implementation of the project is feasible both economically and financially. We, therefore, earnestly hope that measures will be taken to implement this project as soon as possible.

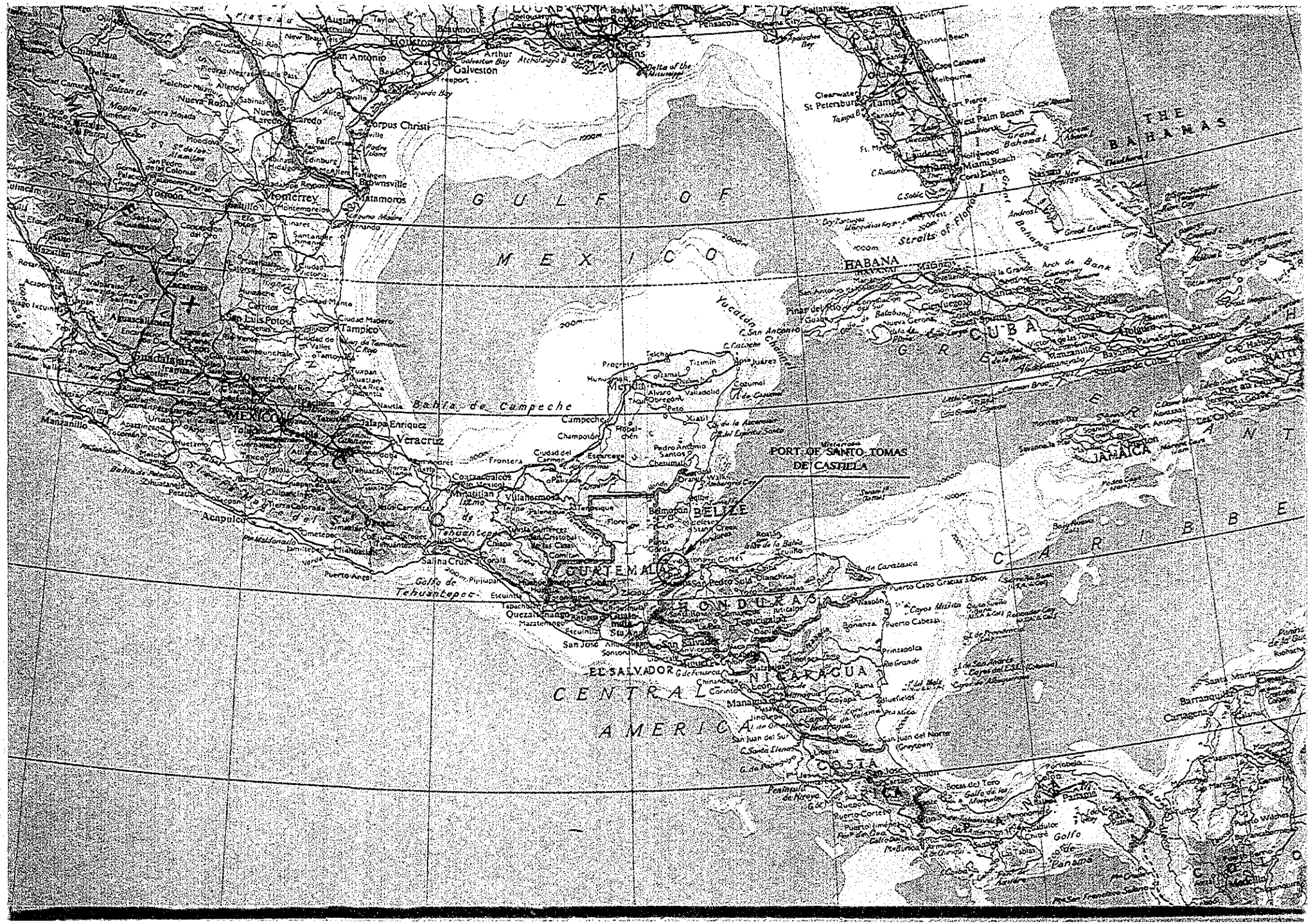
On behalf of the study team, let me express my heartful thanks to the Empresa Portuaria Nacional Santo Tomas de Castilla (EMPORNAC) and to other related agencies of the Guatemalan Government for the generous cooperation, assistance and warm hospitality which were extended to the study team during their stay in Guatemala.

Our thanks are also due to the Japan International Cooperation Agency, the Ministry of Foreign Affairs, the Ministry of Transport and the Japanese Embassy in Guatemala for their valuable advice and support during the field survey and the preparation of this report.

Yours Faithfully,



Keiichi Miyota
Head
Japanese Study Team for the Development Project of the Port of Santo Tomas de Castilla
(Executive Director, the Overseas Coastal Area Development Institute of Japan)


GULF OF MEXICO
Straits of Florida
THE BAHAMAS
CUBA
HABANA
Bahía de Campeche
PORT OF SANTO TOMAS DE CASTILLA
JAMAICA
BELIZE
GUATEMALA
HONDURAS
EL SALVADOR
NICARAGUA
COSTA RICA
PANAMA
CENTRAL AMERICA
CARIBBEAN SEA
Houston
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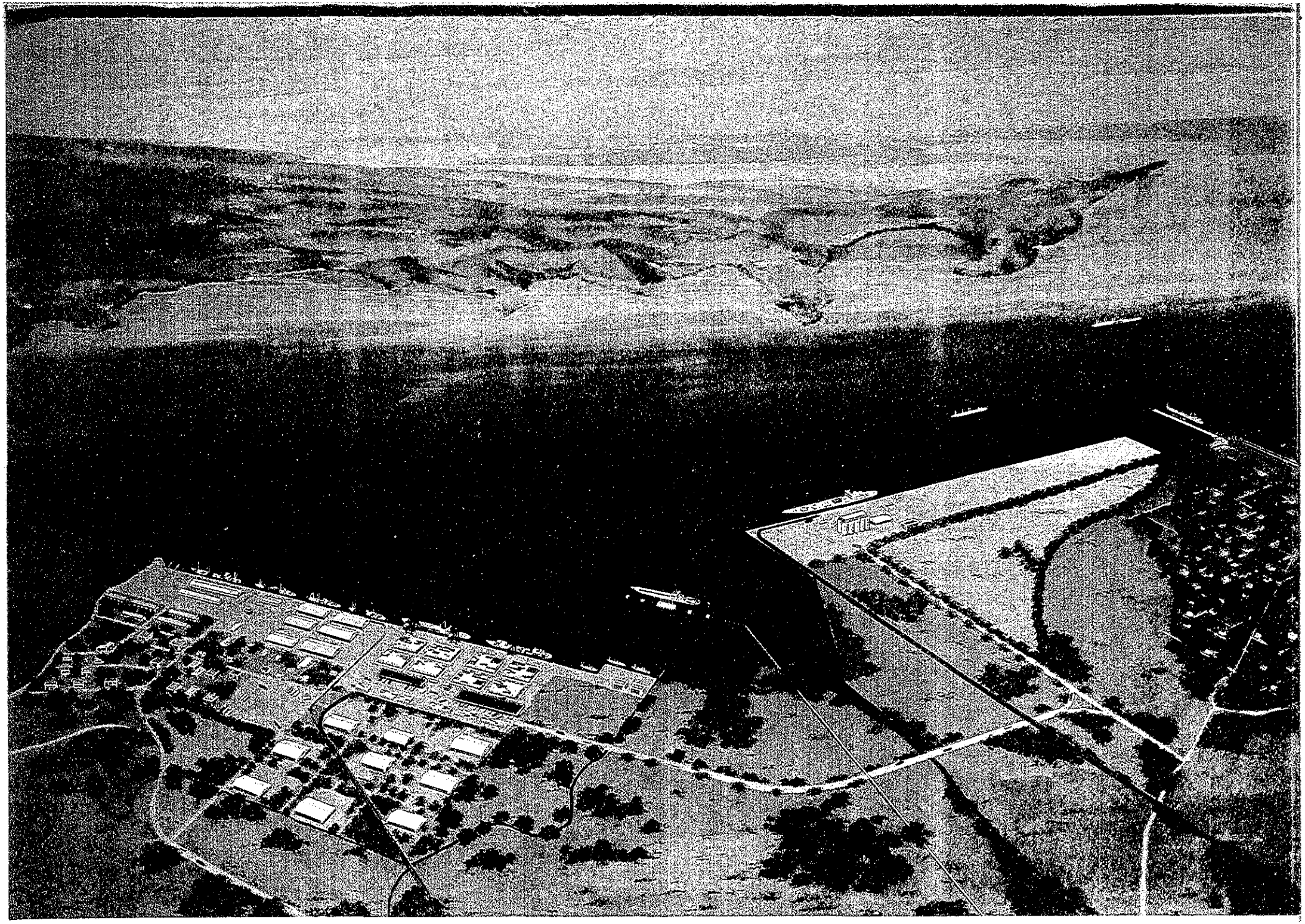

Exchange Rate

1us$ = Q 2.58
1us$ = ¥ 129.0

ABBREVIATION

DGE	:	Direccion General de Estadistica
SEGEPLAN	:	Secretaria General del Consejo Nacional de Planificacion Economica
CELADE	:	Cetnro Latinoamericano de Demografia
EAP	:	Economically Active Population
GDP	:	Gross Domestic Product
EMPORNAC	:	Empresa Portuaria Nacional Santo Tomas de Castilla
BANDEGUA	:	Bananero de Guatemala, LTDA.
HISPANOIL	:	Hispanica de Petroleos, S.A.
LPG	:	Liquited Petroleum Gas
FEGUA	:	Ferrocarriles de Guatemala
LBPE	:	Lineamientos Basicos de Politica Energetica
MEM	:	Ministerio de Energia y Minas
UNDP	:	United Nation Development Program
ANACAFE	:	Asociacion Nacional del Cafe
ICA	:	International Coffee Association
ZOLIC	:	Zona Libre de Industria y Comercio Santo Tomas de Castilla
DGH	:	Dreccion General de Hidrocarburas
DISAGRO	:	Distribuidora Agricola Guatemalteca, S.A.
FAO	:	Food and Agricultural Organization of the United Nations
DWT	:	Dead Weight Ton
JICA	:	Japan International Cooperation Agency

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CONCLUSIONS

1. Necessity of the Development of the Port of Santo Tomas de Castilla

Since the completion of the construction of the first stage in 1955 and the second stage in 1968, the Port of Santo Tomas de Castilla has played an important role in connecting maritime and land transportation as the largest port in Guatemala, and consequently has greatly contributed to the national economy and regional development.

There has been a continuous increase in the volume of cargoes handled at the port since the commencement of port operations in 1955. In the last ten years, the average increase rate of the volume per annum was 6.6 %, and in the last five years, 7.8 %. In 1986, the volume amounted to around 2.3 million metric tons, up 13.1 % over the preceding year.

Despite this great increase in the volume of cargoes handled at the port, twenty years have already passed since the completion of the second stage in 1968. As a result, the port is now congested. It seems that the port is fully used at present, close to its maximum capacity.

Moreover, the existing port has insufficient water depth to accommodate large vessels. Additionally, containers are handled inefficiently due to the inadequate location and narrowness of the container yard and the lack of a container gantry crane. On the other hand, petroleum products are handled at the No. 6 Berth without keeping a sufficient distance from other port activities at present.

Taking account of the present conditions and the further growth of port activities expected in the future, it is necessary to start an extension project as the third stage, focusing on the progress of containerization and safe cargo handling of inflammable dangerous cargoes.

2. Master Plan

The Master Plan is formulated with a target year of 2005. In that year, the volume of cargoes handled at the port is forecast to reach 5.2 million metric tons considering the historical trend and the forecast growth of the socio-economic activities in the hinterland. Hence, the port will require additional facilities.

The existing terminal is planned to accommodate mainly conventional and Ro-Ro vessels considering effective utilization of the existing facilities. To accommodate the other types of vessels comprising container ships, bulk carriers and petroleum tankers, five new berths are proposed based on the forecast traffic in the Master Plan: two for containers, one for solid bulk and two for petroleum.

The new container terminal is planned to be located east of the existing terminal, so the terminal will be constructed on land already possessed by EMPORNAC. On the other hand, the new bulk terminal will be located east of the Cacao River on land to be reclaimed using the dredged materials generated from this project. This terminal will be constructed in the second stage of the project. The new petroleum terminal will be located off the mouth of the Cacao River apart from the existing terminal and will consist of two new berths. A new access channel is also planned alongside the existing channel.

The total construction cost of the Master Plan is roughly estimated as around 488 million Quetzales.

3. Short-term Plan

(1) Port Development

The Short-term Plan is prepared as a first stage plan with a target year of 1995 for the development of the port within the framework of the Master Plan. In the target year, the volume of cargoes handled at the port is forecast to reach 4.1 million metric tons. Judging from the cargo volume, three new berths are proposed, two for container ships and one for petroleum tankers. As for a container handling system at the new container terminal, the straddle carrier system is proposed to make the best use of EMPORNAC's experienced personnel and the existing machines. A new access channel to the container and petroleum terminals is also planned including the necessary navigation aids.

Under the Short-term Plan, solid bulk cargoes will still be handled at the existing terminal. However, new cranes with a larger lifting capacity will be prepared. For the operation of the cranes, the apron of No.1 and No.2 Berths will also need to be expanded by demolishing parts of No.3 and No.6 Transit Sheds.

Disposal sites for dredged materials will be prepared on the existing land east of the new container terminal and in the waters enclosed by a revetment east of the Cacao River. The total construction cost of the Short-term Plan is estimated as around 250 million Quetzales including the necessary cargo handling equipment.

(2) Economic Analysis

The Short-term Plan is evaluated using the Internal Rate of Return (IRR) which is calculated based on a cost-benefit analysis from the viewpoint of the national economy. Benefits considered are the reductions in vessel waiting cost and cargo transportation cost, while costs are the construction, handling equipment, maintenance and administrative costs. The internal rate of return, using a calculation period of 30 years, is 19.5 %. This shows that the implementation of the Short-term Plan is feasible from the viewpoint of the national economy.

(3) Financial Analysis

The profitability of this project is analyzed by the financial internal rate of return (FIRR) using the discount cash flow method. Domestic funds are assumed to come from government funds and EMPORNAC's reserves and foreign funds from a soft loan. Revenue is calculated using EMPORNAC's tariff rates and proposed container handling charges. The analysis shows that the port management body will maintain its financial viability throughout the entire period of the project life. EMPORNAC will be able to pay all the expenditures and have a surplus even after utilizing funds for the repayment and interest of the foreign loan. Judging from this point of view, the project can be regarded as feasible, since the FIRR of the project is 7.3 %, well above the weighted average interest rate of the required funds.

RECOMMENDATIONS

Based on the results of the study, the study team recommends that the Government of the Republic of Guatemala implement the development project of the Port of Santo Tomas de Castilla starting with the Short-term Plan with the target year of 1995 to cope with increasing demand at the port.

The contents of the project are summarized as follows:

1. Construction of a new container terminal

   Location: East of the existing terminal

   Dimensions: Water depth: 11 Meters
   Berth length: 500 Meters
   Area: 25 Hectares

   Cargo handling facilities: 3 Container gantry cranes
   6 Straddle carriers
   1 Forklift for containers

   Other main facilities: Container freight station
   Repair shop
   Terminal office
   Marshalling yard
   Railway yard
   Van pool

   It is advisable to construct a quaywall which will bear deepening of the waters immediately adjacent to the quaywall from 11 meters to 13 meters in the future.

2. Construction of a new petroleum terminal

   Location: Off the mouth of the Cacao River

   Dimensions: Water depth: 11 Meters
   Berth length: 270 Meters

3. Creation of a new access channel

Location: Parallel to the existing channel

Dimensions: Water depth: 11 Meters
Width: 90 Meters

Navigation aids: 2 Lateral marks
3 Cardinal marks
1 Safe water mark

4. Procurement of two mobile cranes with a larger lifting capacity for unloading solid bulk cargoes and expansion of the apron of No.1 and No.2 Berths at the existing terminal

5. Establishment of an efficient management and operation system for the new container terminal

- The new container terminal's administrative body should be established separately from existing management bodies and have an independent accounting system in order to clearly measure the operation of the terminal.

- Responding to the increase of container cargoes, it becomes more difficult to carry out all operations manually. Hence, it is quite critical to introduce a computer system to assist terminal operations.

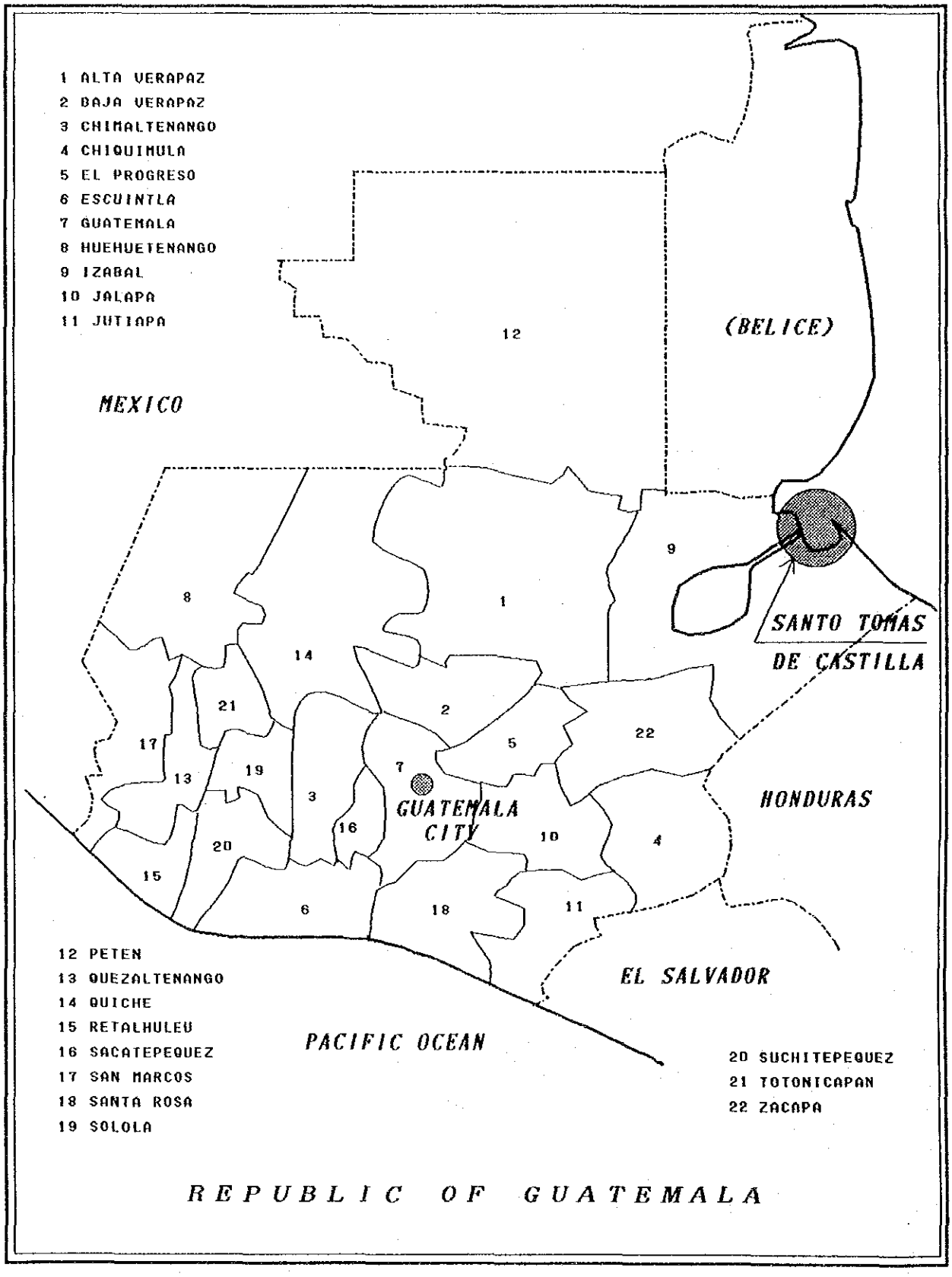
- A simplified tariff will be better for both users and for the accounting section, so it is proposed that a composite type tariff be used as much as possible to meet actual operation needs. The proposed charges are calculated based on the construction cost, purchase cost and actual personnel and maintenance costs.

6. Establishment of an adequate maintenance and repair system for the machinery and equipment including proper inventory control of spare parts and a training program for mechanics and operators

7. Further study on the participation of the private sector in the field of port operations

The Master Plan with the target year of 2005 is formulated to give a long-term framework for the Short-term Plan. However, before the Master Plan is actually put into practice after the implementation of the Short-term Plan, it should be carefully reviewed and revised as necessary. This is because there may be substantial changes in the socio-economic framework on which the plan is based during the intervening years.

SUMMARY



REPUBLIC OF GUATEMALA

1 MASTER PLAN

1.1 PRESENT CONDITIONS

1.1.1 Socioeconomic Conditions

(1) Geography

The Republic of Guatemala is located in the northern part of Central America and has an area of 108,889 sq.km (excluding the 22,900 sq.km of Belize), which is one-third the total area of Japan. Half of the country is mountainous, and the areas between 1,000-1,500 meters have fertile soil and a moderate climate. The abundant rainfall and fertile soil greatly benefit the production of agricultural products such as coffee, bananas, cotton and sugar.

(2) Demography

According to the ninth national census in 1981, the total population of Guatemala is 6,054 thousand persons with 3,016 thousand males and 3,038 thousand females. The census and adjusted population estimated by "Secretaria General del Consejo Nacional de Planificacion Economica (SEGEPLAN)" and "Centro Latinoamericano de Demografia (CELADE)" are shown in Table 1.1.1.

Table 1.1.1 Population of Guatemala

Year	Census	Estimated	Growth (%)
1950	2,790,868	2,968,976	----
1964	4,284,473	4,441,603	2.92
1973	5,160,221	5,698,802	2.81
1981	6,054,227	7,113,391	2.81

The estimated population of Guatemala in 1986 is 8,195 thousand persons with 4,143 thousand males and 4,052 thousand females. The people who live in rural areas account for about 61% of the total population, and half of the total population are illiterate. As for the population density, the Department of Guatemala, which is the center of the political and economic activity of the Republic, shows a high density of 822 persons per sq.km in comparison with the national average of 75 persons per sq.km.

(3) Economy

Prior to the 1980's, Guatemala enjoyed decades of steady economic growth. However, this era abruptly ended in 1980-81. The Gross Domestic Product (GDP) during the past 10 years is shown in the following table. The per capita GDP in 1985 is less than it was in 1975 due to the rapid growth of the population and the consequent growth in the number of the unemployed.

Table 1.1.2 GDP of Guatemala

Year	GDP	GDP/capita
1975	2,353	391
1976	2,527	408
1977	2,724	428
1978	2,860	437
1979	2,995	445
1980	3,107	449
1981	3,128	440
1982	3,017	412
1983	2,940	391
1984	2,954	382
1985	2,925	367

The international trade of Guatemala follows the typical pattern of most developing countries, with exports of agricultural products and primary goods such as coffee, cotton, bananas, cardamom, sugar, meat, nickel and crude oil, and imports of capital goods, durable goods and consumption goods such as fertilizer, petroleum products, chemical goods, machinery and equipment. The most important trading partner of Guatemala is the United States for both exports and imports, followed by other Central American countries, especially El Salvador, and West Germany, Mexico, Venezuela and Japan.

(4) Transport

There are five major ports in Guatemala. Three are located on the Pacific Ocean and the other two face the Atlantic Ocean. The total maritime transport in 1985 is 3,877 thousand tons with 2,736 thousand tons of import and 1,141 thousand tons of export. The Guatemalan

railway has a long history of more than one hundred years. FEGUA operates 694 km of railway. However, due to the superannuation of facilities and the competition with trucks, the transport volume has gradually decreased. The railways carried 647 thousand tons and 4,804 thousand passengers in 1986. Guatemala has a permanent road network spread over the Republic with a total length of 11,665 km which is composed of 2,978 km of paved road and 8,687 km of unpaved road in 1986. According to the traffic movement survey for CA-1, CA-2 and CA-9 in 1984, 2,308 million ton-km of cargo and 4,437 million passenger-km of passengers were transported.

(5) National Development Plan

In order to reconstruct the damaged economy and improve the social conditions related to nutrition, employment, education, etc., the Government of Guatemala developed the National Development Plan 1987-1991. The development plan presents a macroeconomic scenario in the target year 1991 with the following target annual growth rates:

Gross Domestic Product	3.5 %
Per capita Income	0.5 %
Exports	7.7 %
Imports	6.0 %

The unemployment rate is projected to be 8.0 % in the target year.

1.1.2 Natural Conditions

(1) Meteorology

a) Wind

The frequency of calmness is twenty-four percent (24%) and the frequency of wind velocity less than 5.1 m/sec is seventy-five percent (75%), so it is generally very calm. Strong winds over 15 m/sec appear only in the directions of W and WSW (from the land side), so they have little chance to cause waves.

b) Precipitation

Annual precipitation varies from 2,631 mm to 3,673 mm. On average, there are 210 rainy days each year.

c) Temperature

During summer (April-September) high temperatures of more than 30° are observed, and in winter (November-March) relatively low temperatures of 26° - 30° are observed.

(2) Sea conditions

a) Tidal level

In Guatemala there are two tidal standard levels, the Atlantic tidal and the Pacific tidal.

At Santo Tomas de Castilla, the Atlantic tidal standard level is utilized. Fig. 1.1.1 shows the Atlantic tidal standard level.

M.L.W is adopted as datum zero on the chart and bathymetrical map, and M.W.L is adopted on the topographical map.

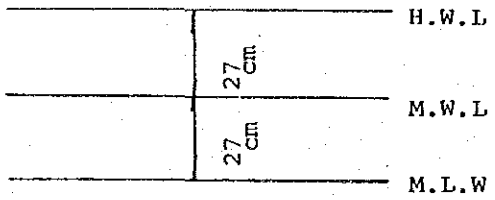


Fig. 1.1.1 Tidal Level

b) Seabed condition

The seabed of Santo Tomas Bay is relatively flat and shallow. The water depth of the existing navigational channel varies from -9.4 to -10.5 m from datum level.

The seabed material of the turning basin and of the navigational channel consists of very soft marine clay to a depth of at least -15 m from datum level.

(3) Geographical conditions

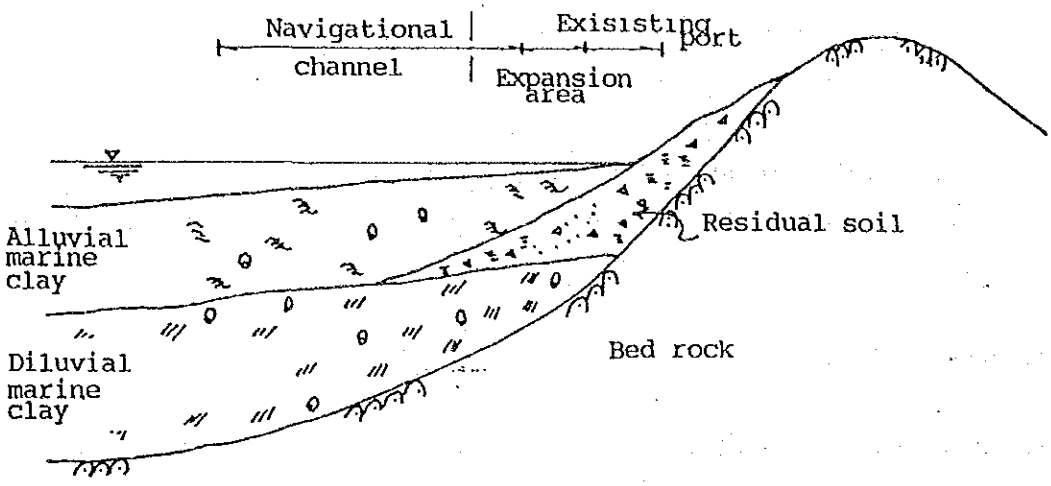
a) Topographical conditions

The topography around the bay is divided into a highland area consisting of third era rock and its highly weathered deposits (residual soil), and part of an alluvial plain which has been formed by rivers flowing into the bay. The port of Santo Tomas de Castilla is located on the transition area between the highland and the alluvial plain. But the expansion area is located on the swampy area of the plain.

b) Geological conditions

Fig. 1.1.2 shows a sketch of the geological structure of the surroundings of the project area. It can be assumed that the geological structure of the project area is composed of four strata, namely bedrock, diluvial marine clay, residual soil and alluvial marine clay. Existing port facilities are located on the residual soil stratum, and the port expansion area and navigation channel are located on the alluvial marine clay stratum.

Fig 1.1.2 Sketch of Geological Structure



(4) Seismo-geological location of Santo Tomas port

Guatemala is divided into three seismic zones, and Santo Tomas port is in zone III where the seismic acceleration value is the highest. Therefore the factor of seismic force to be used in the detailed design should be considered seriously.

(5) Hindcasting of waves

Wave height and period in front of the Santo Tomas wharf are calculated by the S.M.B. method using wind data observed at Puerto Barrios airport from 1968 through 1973.

Based on the calculation, the following wave is adopted for facility design.

Wave direction: North
Wave period : 4.0 second
Wave height : 0.6 meters

1.1.3 Port Activities

(1) Port Facilities

The Atlantic coast of Guatemala offers appropriate natural locations for deep seaports. Especially Santo Tomas Bay is an excellent natural bay extending back from Amatique Bay. The present port facilities consist of 914 m of wharves, container yards, roads, sheds, and oil handling facilities.

Fig 1.1.3 shows the layout of the existing port facilities.

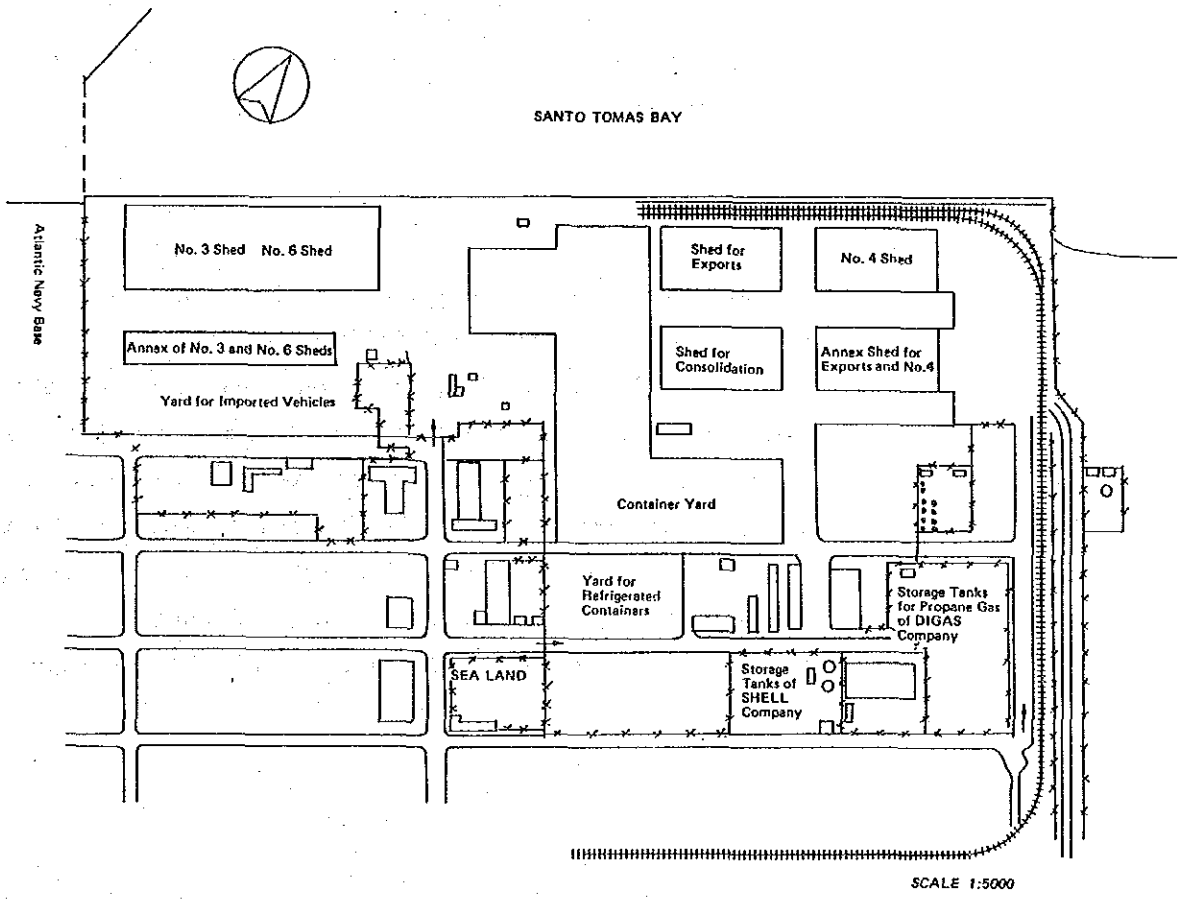


Fig 1.1.3 Layout of the existing port

The present wharves constructed in 1955 and 1968 were damaged slightly by the earthquake in 1976. The repair works for the damages by the earthquake were executed by a local contractor from 1981 through 1983. Several surveys of the existing wharf structures have been executed to confirm their safety.

As part of the current study, the following tests were carried out.

- Topographical survey of the deflection and undulation of the structures.
- Visual inspection of cracks of beams and slabs.
- Schmit Hammer test of the strength of beams and slabs.
- Chemical analysis to check the strength of beams.
- Soundings of the slopes under the platforms.

Generally these surveys proved that the structures are safe but it is advisable to repair cracks in the beams.

(2) Cargo handling machinery and equipment

The cargo handling machinery and equipment of EMPORNAC is used for various services such as stevedoring, transfering commodities in the port and marshaling, stuffing and unstuffing of containers. A number of machines and equipment comprising a fixed crane, truck cranes, forklifts and tractors are used for cargo handling at the port. However, some of these machines remain in the repair shop for a long period due to their age and the inadequate inventory control of spare parts. The operating ratio of each machine remaine from 19.9% to 45.6%. Around 84.5% of the machines were purchased before the year 1980 and are already overaged.

(3) Cargo Handling in the Port

a) Cargo Handling Volume

Since it was opened in 1955, the port of Santo Tomas de Castilla has been the most important port in Guatemala in terms of both foreign trade and total handling volume. The cargo handling volume at the Port has gradually increased, and 2,323 thousand tons of cargo with 1,092 thousand tons of exports and 1,231 thousand tons of imports were handled in 1986. The average annual growth rate of the handling volume in the past 11 years is 5.7%. The major export commodities handled at the Port are bananas, coffee and crude oil, which account for 73.6% of total export cargo in 1986. The major import commodities are fertilizer, diesel oil, chemical goods, petroleum products, propane gas and paper which together account for 60% of the total import volume.

b) Cargo flow at the Port

The major trade partners of the Port are the United States, Europe and Antilles, which together account for more than 90% of the total cargo handling volume. The three major export commodities of coffee, bananas and crude oil account for 73.3% of total export volume to the United States, and the shares of these commodities sent to the U.S. are 70.0%, 66.3% and 100%, respectively. On the other hand, the major import commodities of fertilizer, diesel and other fuel oils, gasoline, paper, LPG and wheat imported from the U.S. account for 37.2%, 83.0%, 74.3%, 49.1%, 97.8%, and 100% respectively of the total import volume of these commodities at the Port.

(4) Present Port Activities

Cargo handling at the Port is divided into five categories: containers, break bulk, trailers, solid bulk and liquid bulk. The existing terminal with a berth length of 914 meters and a water depth of 9 meters accommodates these cargoes.

a) Containers

Most of the containers are transported by full container ships and ply two main routes, the Europe route and the U.S.A. route. In 1986, container volume handled at the Port totaled 68,492 TEU, and the ratio of containerized cargoes is 38.8 %. The average increase rate over the

seven years from 1980 to 1986 is 11.7 %. Containers are loaded and unloaded mainly at No.3 and No.4 Berths, and there is a container yard behinds these berths. In the case of import containers, after being unloaded from the container ship they are transferred from the apron to the container yard by chassis and then piled up on the yard mainly by straddle carriers. The container yard is managed and operated directly by EMPORNAC without leasing it to any private company. Accordingly, EMPORNAC is responsible for the containers from the apron to the gate. In the case of export containers, the same procedure is applied in reverse. The cargo-handling productivity of containers transported by full container ships in 1986 is 6.2 TEUs per hour.

b) Break bulk

Break bulk cargoes are transported by conventional vessels. The volume of such cargoes in 1986 is 610,170 metric tons. The volume of bananas accounts for 54.2 % of the total and most of the rest is various manufactured products imported from abroad. Bananas are loaded into vessels specialized for banana transportation. At the Port, palletized bananas are loaded by ship crane for the U.S.A. routes. For Europe and Saudi Arabia, bananas are loaded by specialized loading machines for banana export with belt conveyers. On the other hand, excluding bananas and fertilizer, most of the cargoes carried by conventional vessels are stored at No.3 and No.6 Transit Sheds or at the open storage yard behind the sheds. Cargo handling productivity in 1986 is 36.7 tons per hour.

c) Trailers

Trailers are transported by Ro-Ro vessels. A small amount of containers on chassis and containers directly laid on holds are also transported by Ro-Ro ships. Theses vessels call mainly at ports in the U.S.A.. The net volume of cargoes carried by these vessels in 1986 is 154,651 metric tons. The volume of export agricultural and marine products accounts for 52.6 % of the total. Most of the rest is imported and exported manufactured products. At the Port, No.1, No.3, No.4 and No.6 Berths accommodate Ro-Ro vessels. Open yards are located behind these berths and they are used as marshaling yards for trailers. Cargo handling productivity in 1986 is 88.3 tons per hour.

d) Solid bulk

Solid bulk cargoes such as fertilizer, wheat and maize are mainly

transported by bulk carriers. The volume of cargoes transported by bulk carriers in 1986 is 252,515 metric tons. Almost all the cargoes are imports, and fertilizer accounts for 68.7 % of the total. At the Port, fertilizer is unloaded by clamshell bucket type ship cranes or by EMPORNAC's truck cranes of the same type. Then the fertilizer is loaded into trailers or freight cars and transported outside of the Port directly. Wheat and maize are also unloaded by the same type of crane. Pneumatic unloaders are also used for discharging the grains. Wheat and maize are brought out from the Port by trailers or freight cars directly. Cargo handling productivity in 1986 is 44.4 tons per hour.

e) Liquid bulk

Liquid bulk is carried by petroleum and chemical tankers. The volume of cargoes loaded and unloaded from those tankers at the Port in 1986 is 618,147 metric tons. The volume of exported crude petroleum accounts for 37.1 % of the total. The volumes of imported refined petroleum fuels and propane gas in the same year account for 33.0 % and 11.6 %, respectively. At the Port, liquid bulk is handled at No.6 Berth. Pipelines are installed along the east end of the existing port, and run from inland depots to the berth. The liquids are loaded and unloaded to and from tankers using flexible hoses which connect the tankers with the pipelines. Cargo handling productivity in 1986 is 164.0 tons per hour.

(5) Actual condition of management and operation

In the year 1955, the Port of Santo Tomas de Castilla was constructed as a communications port, and EMPORNAC was established under the jurisdiction of the Ministry of Finance. As Guatemalan ports have a varied historical background, the port administration system in Guatemala is quite complicated.

a) The Organizations Responsible for The Ports

In Guatemala, the following governmental organizations are responsible for port administration within their respective jurisdictions. Basic affairs are the responsibility of the Ministerio de Finanzas (Mnt. Finanzas) and the Ministerio de Comunicaciones, Transporte y Obras Publicas (Mnt. C.T.O.P) the Comision Portuaria Nacional (C.L.P.N), and port development is the responsibility of Mnt. C.T.O.P and Secretaria General del Consejo de Planification Economica (SEGEPLAN). SEGEPLAN and Mnt. C.T.O.P are responsible for port planning.

A new organization solely responsible for port administration is to be established in the near future so as to centralize all the port administrative affairs which are under the control of various government organizations at present.

b) Organization of EMPORNAC

EMPORNAC is a public organization which was established under the jurisdiction of the Ministerio de Finanzas. EMPORNAC is the sole body responsible for the management and operation of the Port.

i) Principal Purposes of EMPORNAC

EMPORNAC provides the following services for port related activities:

- Assistance service to ships
- Pilotage and Tug boat service
- Coastal trading service
- Cargo loading and unloading service

ii) Functions

In order to fulfill the above-mentioned services, EMPORNAC has four major functions:

- To carry out necessary port operational functions
- To execute indispensable maritime operations for the ships which call at the port
- To carry out basic financial operations
- To carry out all the administrative actions and to support the other activities of EMPORNAC.

In order to execute the above-mentioned functions, EMPORNAC is organized as shown in Fig. 1.1.4.

iii) Present Financial Condition

According to the financial statement shown in Table 1.1.3, there was a surplus in the year 1969 immediately after the completion of the construction of the second stage project. After that, profits have been accumulated along with the increase of the cargo volume handled at the Port.

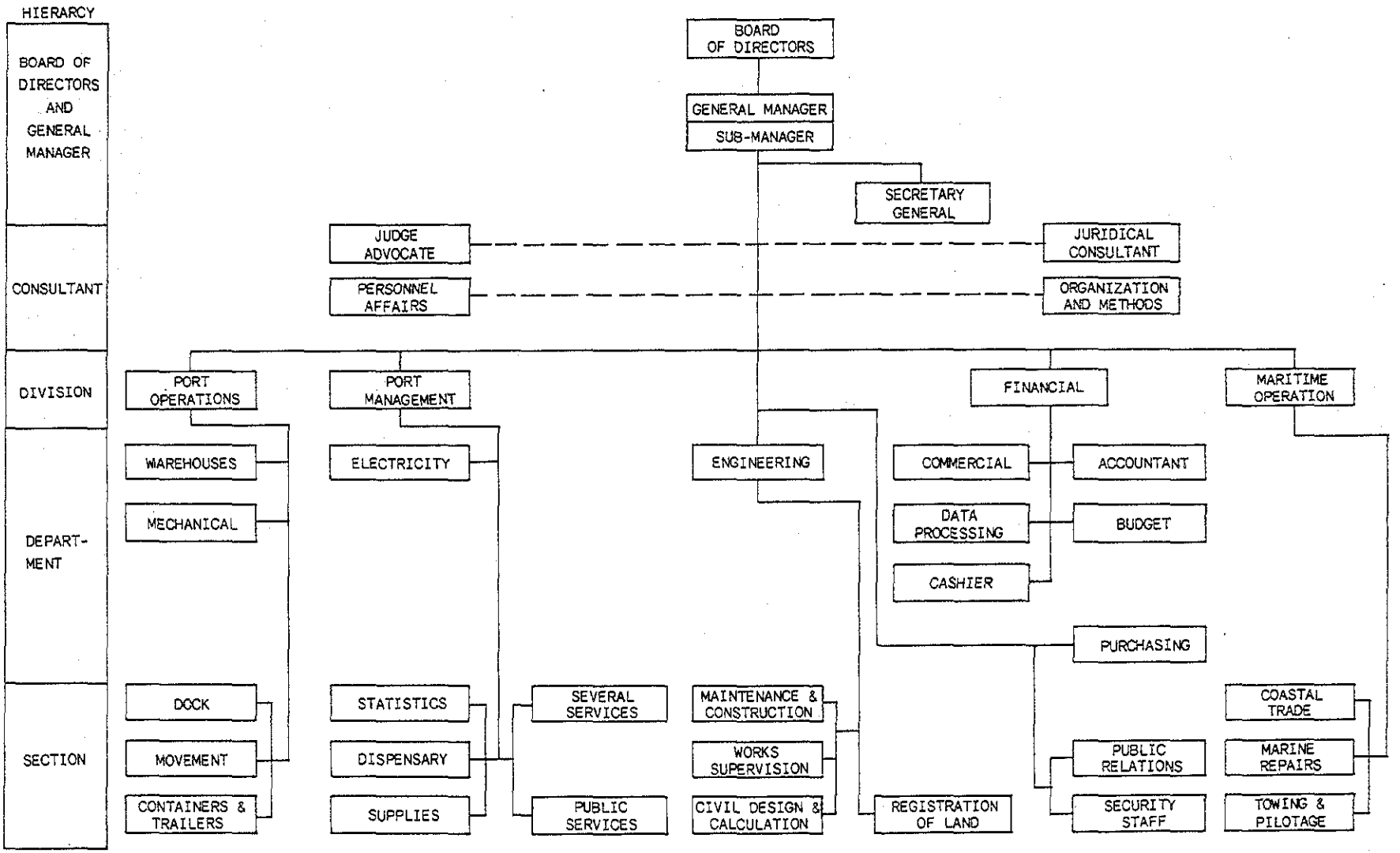


Fig. 1.1.4 Organization of Empresa Portuaria Nacional Santo Tomas de Castilla

Judging from the small long-term liability, the financial condition of EMPORNAC seems to be sound.

Table 1.1.3 Financial Statement (Summary)

(unit: Quetzales)

Year	Income	Expense	Net Income
1967	2,524,460.82	1,950,317.17	574,143.65
1968	3,333,712.52	2,449,762.10	883,950.42
1969	2,595,749.37	2,192,012.19	403,737.18
1970	3,033,799.97	2,807,467.85	226,332.12
1971	3,057,006.88	2,609,561.20	447,445.68
1972	3,620,515.42	2,903,664.17	716,851.25
1973	4,884,911.65	3,637,631.94	1,247,279.71
1974	6,567,583.21	4,786,178.64	1,781,404.57
1975	6,324,881.10	5,011,996.98	1,312,884.12
1976	8,911,740.42	5,810,537.36	3,101,203.06
1977	11,304,117.20	7,628,513.91	3,675,603.29
1978	12,761,181.55	8,721,381.56	4,039,799.99
1979	14,930,076.22	9,834,419.94	5,095,656.28
1980	16,258,752.14	11,214,171.37	5,044,580.77
1981	18,310,020.80	12,893,724.28	5,416,296.52
1982	16,481,791.81	13,983,629.76	2,498,162.05
1983	13,372,550.63	12,482,277.68	890,272.95
1984	17,578,184.48	13,289,743.18	4,288,441.30
1985	21,638,262.18	15,914,659.90	5,723,602.28
1986	30,586,793.39	24,002,145.02	6,584,648.37

(6) Present Situation of Access Channel

a) Access Channel

The access channel is located offshore of Cabo Tres Puntas, 15°-39'-00"N, 88°-37'-24"W. The course is toward 42°-222°, and at Bajo de ox Tonque 2 kilometers westward, (15°-53'-36"N, 88°-42'-30"W), it turns 90°. Then finally the channel is connected with Boya de Mar offshore of the entrance channel 316°-136° (Fig. 1.1.5).

The outline of the entrance channel is as follows:

1) Length between "Boya de Mar" and quaywall: about 12.4km.
2) Width of channel: 90m
3) Depth: 9.0m
4) Type: Straight Channel
5) Channel Line: 10°-190° (T.N) and almost due North - South.

b) Navigation Aids

Guatemala belongs to the Maritime Bouyage System of the International Association of Lighthouse Authorities (IALA), and all Light Buoys were changed based on the new system in January 1984.

1)	Safe Water Marks	1
2)	Lateral Marks	8
3)	Isolated Danger Marks	6
4)	Leading Lights	1

c) Tug Boats

There are currently 3 tug boats used at the Ports. The "Victoria" is used for carrying pilots to and from the vessels. The other two tug boats are actually used as tug boats. The tug boats tow vessels within the turning basin inside the approach channel, i.e., inside no.7 and no.8 buoys. The operation time of "30 de Junio" and "20 de Octubre" is very long. The Port also has 2 sets of launches for carrying pilots to and from the vessels. However, these launches are not being used.

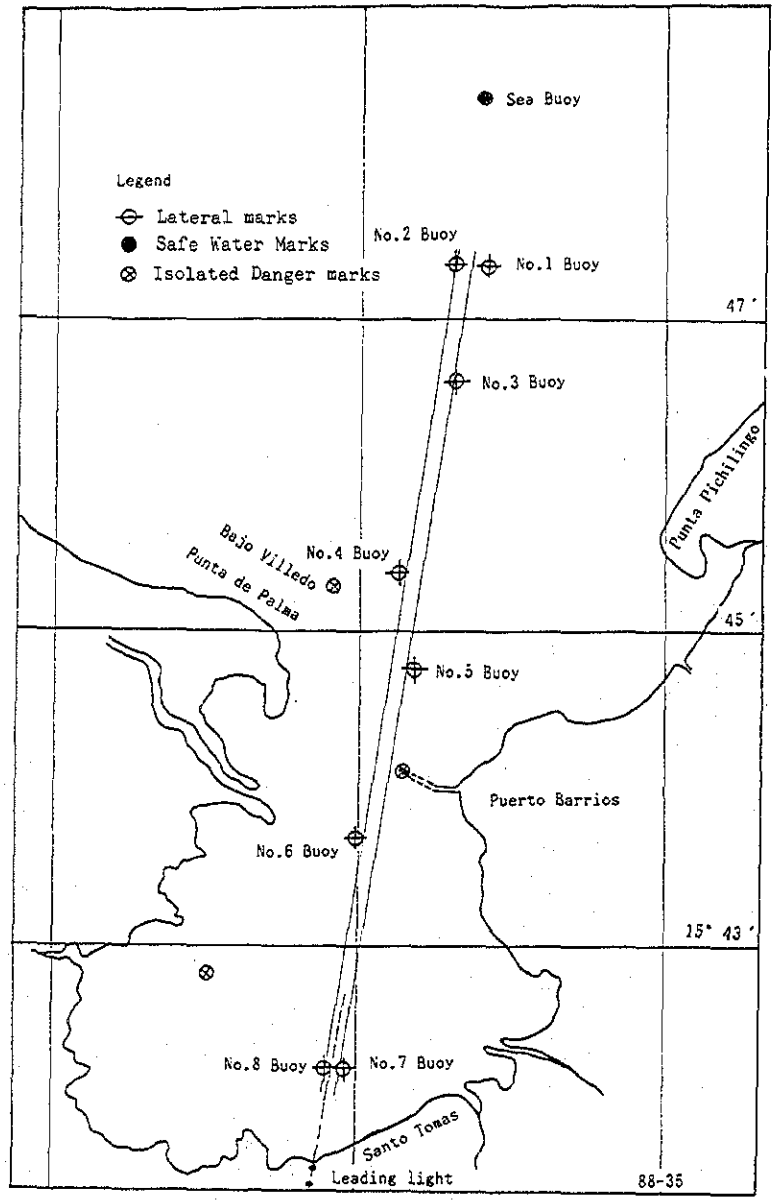


Fig. 1.1.5 (b) Light Buoy Station

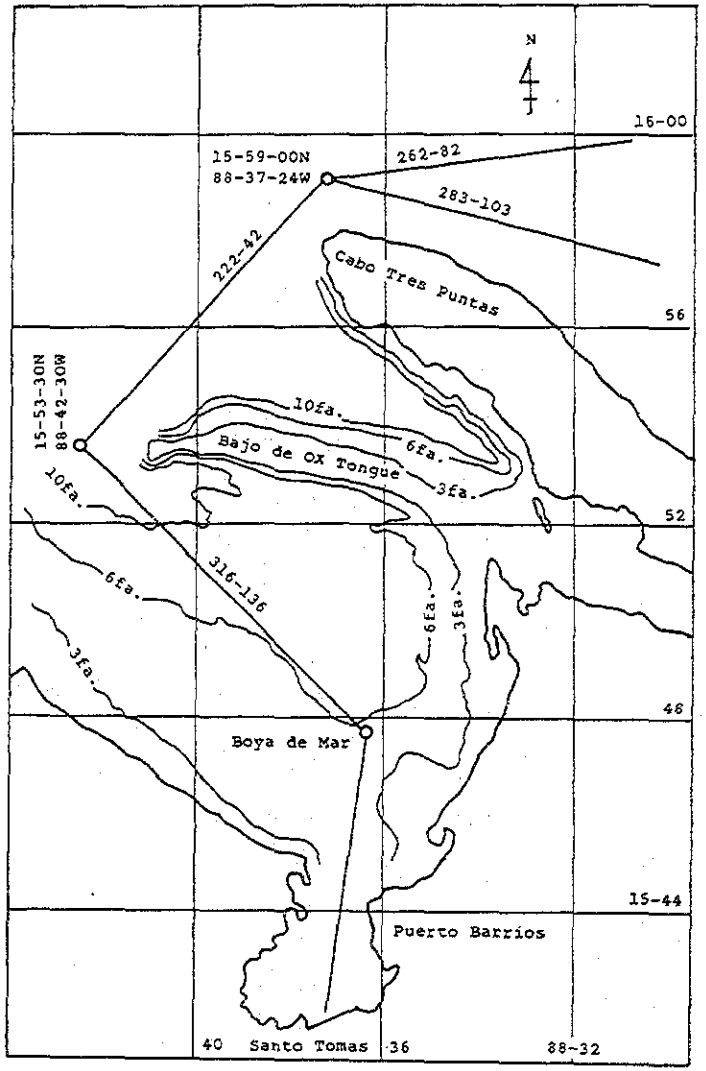


Fig. 1.1.5 (a) Access Channel

1.2 DEMAND FORECAST

1.2.1 General

(1) Method of Traffic Forecast

The cargo volume to be handled at the Port in this study is estimated by using the micro forecast method based on the national development plan. The future cargo volume by packing type is estimated considering the historical transition.

(2) Major Commodity Groups

The port of Santo Tomas de Castilla handles many commodities. However, the following commodity groups are selected for the forecast.

Export commodities : Bananas, Coffee, Fresh Fruit and Vegetables, Sesame and Cardamom, Maize, Other Agricultural Products, Crude Oil, Minerals, Manufactured Products

Import commodities : Wheat, Basic Grain, Other Agricultural Products, Gasoline, Diesel and Fuel Oil, LPG, Kerosene, Other Petroleum Products, Fertilizer, Paper and Printing Paper, Machinery and Equipment, Fiber Resin and Plastic Materials, Chemical Products, Metal Products, Vegetable and Animal Oil, Textile and Leather Products, Other Foods, Other Manufactured Products

1.2.2 Socioeconomic Framework

(1) Economy and Demography

This study assumes that the Guatemalan economy achieves the target growth rate of 3.5 % under the intermediate national plan, and that growth continues at the same rate up to the year 1995. Thereafter, the growth rate up to the year 2005 is assumed to be 3.0 % considering the LBPE projection.

As for the population increase in Guatemala, "Direccion General de Estadistica (DGE)" and "Centro Latinoamericano de Demografia (CELADE)"

executed three alternative population projections in 1985. The intermediate scenario is adopted for the study. Based on the above assumptions, GDP and population up to the year 2005 are estimated as shown in Table 1.2.1.

Table 1.2.1 GDP and Population

Year	GDP (million Q)	Population (thousand)	p.c. GDP (Quetzales)
1985	2,925	7,963	367
1990	3,474	9,197	378
1995	4,126	10,621	388
2000	4,783	12,222	391
2005	5,545	13,971	397

Source : Study team estimates

Note : Values in constant 1958 prices

(2) Sectoral GDP

The future sectoral GDP is estimated as shown in Table 1.2.2 considering the historical trend and the intermediate national development plan.

Table 1.2.2 Future Sectoral GDP

(unit : million Q)

Sectors	1985	1990	1995	2000	2005
Agriculture	750	869	1,011	1,148	1,303
Industry	467	556	681	813	970
Commercial	745	869	1,052	1,244	1,431
Construction	49	87	103	120	139
Transport & Comm.	209	243	297	359	416
Others	705	850	982	1,099	1,286
GDP	2,925	3,474	4,126	4,783	5,545

Source : Study team estimates

Note : Values in constant 1958 prices

1.2.3 Cargo Forecast

(1) Cargo Traffic Forecast

The estimated cargo volume based on the major commodity groups is shown in Table 1.2.3.

Table 1.2.3 Estimated Cargo Volume at the Port

(unit : thousand tons)

Commodity Group	1990	1995	2000	2005
(Export)				
Bananas	414	482	547	621
Coffee	213	223	249	279
Fresh Fruits and Veg.	45	57	69	84
Sesame and Cardamom	32	42	54	69
Maize	-	-	22	66
Other Agriculture Prod.	44	51	58	66
Crude Oil	663	1073	805	537
Minerals	5	10	15	20
Manufactured Products	92	148	189	241
Sub Total	1508	2086	2008	1983
(Import)				
Wheat	111	152	222	262
Basic Grains	25	35	41	47
Other Agriculture Prod.	2	2	3	4
Gasoline	75	120	178	237
Diesel and Other Fuel Oils	189	276	362	469
LPG	75	110	153	206
Kerosene	29	31	39	66
Other Petroleum Products	51	61	71	82
Minerals	5	10	15	20
Fertilizer	230	284	319	385
Paper and Printing Paper	145	202	259	324
Machinery and Equipment	49	65	92	128
Fiber Resin and Plastic Mat.	54	64	74	84
Chemical Products	118	142	169	202
Metal Products	92	110	131	157
Vegetable and Animal Oil	62	82	103	124
Textiles and Leather Prod.	24	28	32	38
Other Foods	70	105	137	178
Other Manufactured Prod.	85	137	175	223
Sub Total	1491	2016	2575	3236
Grand Total	2999	4102	4583	5219

Source : Study team estimates

(2) Forecast by Cargo Packing Type

The estimated cargo volume by packing type in the target year is summarized in Table 1.2.4.

Table 1.2.4 Cargo volume by Packing Type

(unit : thousand tons)

Year	Container	Furgon	Bulk	Liquid	Others	Total
(Export)						
1990	362	105	0	663	378	1,508
1995	457	118	0	1,073	438	2,086
2000	549	134	22	805	498	2,008
2005	656	155	66	537	569	1,983
(Import)						
1990	318	55	338	468	312	1,491
1995	497	62	436	664	357	2,016
2000	665	75	542	888	410	2,575
2005	851	96	646	1,165	478	3,236
(Total)						
1990	680	160	338	1,131	690	2,999
1995	954	180	436	1,737	795	4,102
2000	1,214	209	564	1,693	908	4,583
2005	1,507	251	712	1,702	1,047	5,219

Source : Study team estimates

1.3 LONG-TERM PLAN FOR THE PORT DEVELOPMENT

1.3.1 The Basic Concept of the Port Development

The purpose of the Master Plan is to serve as a target and guideline for the port development. The Master Plan shall be an integrated plan covering the layout of port facilities, land use and effective management and operation systems. In 1986, the volume of cargoes amounted to around 2.3 million metric tons, and the berth occupancy rate of the existing mooring facilities was more than 70%. In the year 2005, the target year of the Master Plan of this project, 5.2 million metric tons are forecast to be handled at the Port, more than double the present volume. Hence, the Port will require additional facilities. In formulating the Master Plan, many items should be taken into account, especially economic transportation and safe operations.

In the first step of the planning, effective utilization of the existing facilities is critical. In the year 2005, if containers were handled at the existing terminal, almost all the berths would be occupied by container ships due to the large amount of containers and the low productivity of cargo handling without container gantry cranes and with only a narrow yard. In this case, only small size container ships would be received due to the shallow water depth along the berths, resulting in costly transportation. Moreover, new terminals to accommodate other types of vessels which do not require a deeper water depth would have to be constructed. Hence, it is not economical to use the existing terminal for container ships in the future. On the other hand, from the standpoint of safe operation at the Port, it is advisable to separate the petroleum terminal from the other terminals by constructing a new petroleum terminal as soon as possible. As for handling of solid bulk cargoes, one specified berth with cranes with a larger lifting capacity than the existing ones will be required. To prepare such a bulk terminal, there are two alternatives, improvement of the existing terminal or construction of a new terminal. The latter alternative is selected as the optimum case from the economic point of view. From the above, the following new terminals are planned in the Master Plan:

- Container Terminal
- Bulk Terminal
- Petroleum Terminal

When planning the container and bulk terminals, the optimum number of berths and water depth are examined mainly from the economic point of view taking the dredging cost of the access channel into account. The petroleum terminal is also planned emphasizing safe operation in the port area. Though the year 2005 is adopted as the target year, new terminals will continue to function after the target year. Hence, in this planning, the period after the year 2005 is also considered to select the optimum plan among the proposed alternatives.

1.3.2 Required Scale of New Terminals

The optimum number of berths of the container and bulk terminals is determined by comparing alternative numbers and their respective costs comprising port costs and ship waiting costs. The ship waiting costs are computed using queuing theory. Thus, the required number of berths is calculated by water depth. The optimum water depth is selected by comparing the total cost comprising transportation costs of containers and solid bulk cargoes and dredging cost of the access channel. The transportation cost comprises transportation cost by ships, terminal construction and operation costs and ship waiting cost at ports. To select the optimum water depth, various water depths from 9 meters to 14 meters are proposed as alternatives. The total transportation costs by water depth and benchmark year are indicated in Table 1.3.1. According to the Table, in the middle of the service life of the new terminals, namely from the year 2015 to the year 2025, 13 meters is selected as the optimum water depth. However, in the year 2005, the optimum water depth is 11 meters. Considering the durability of the infrastructures through their service lives and the capability of flexible dredging along with an increase in cargo volume, it is advisable to construct new terminals with water depth of 13 meters around the target year. As for the access channel and the basins in front of the new terminals, it is advisable to dredge up to 11 meters around the year 2005 and to deepen the basins to 13 meters later on. In the year 2005, three berths will be required, two for container ships and one for bulk carriers.

As for the new petroleum terminal, two berths, one for propane gas tankers and the other for crude and refined petroleum tankers, are proposed for securing safe port operations in the year 2005. Water depths along the former and latter berths are 7.5 meters and 11 meters, respectively.

Table 1.3.1 Total Transportation Cost by Container Ships and Bulk Carriers

Year: 2005 Unit: Questzales
Cargo Volume: Containers: 192,000 TEU, Solid Bulk: 646,000 MT

Case	Berth Depth M	Transportation Cost Container Mil/Year	Solid Bulk Mil/Year	Channel Dredging Mil/Year	Total Cost Mil/Year	Least Cost	Berth No. Container	Solid Bulk
1	9	55.20	16.51	0.00	71.71		2	1
2	11	51.30	13.58	0.99	65.89	X	2	1
3	12	51.77	13.17	2.09	67.04		2	1
4	13	51.19	12.89	3.00	67.07		2	1
5	14	50.73	12.74	4.79	68.26		1	1

Year: 2015
Cargo Volume: Containers: 284,000 TEU, Solid Bulk: 956,000 MT

Case	Berth Depth M	Transportation Cost Container Mil/Year	Solid Bulk Mil/Year	Channel Dredging Mil/Year	Total Cost Mil/Year	Least Cost	Berth No. Container	Solid Bulk
1	9	80.12	24.28	0.00	104.40		3	1
2	11	70.09	19.49	0.99	90.58		2	1
3	12	69.79	18.67	2.09	90.56		2	1
4	13	68.23	17.94	3.00	89.17	X	2	1
5	14	67.38	17.55	4.79	89.72		2	1

Year: 2025
Cargo Volume: Containers: 420,000 TEU, Solid Bulk: 1,415,000 MT

Case	Berth Depth M	Transportation Cost Container Mil/Year	Solid Bulk Mil/Year	Channel Dredging Mil/Year	Total Cost Mil/Year	Least Cost	Berth No. Container	Solid Bulk
1	9	115.19	35.04	0.00	150.23		4	2
2	11	101.05	28.40	0.99	130.44		3	2
3	12	100.51	27.17	2.09	129.78		3	2
4	13	98.28	26.27	3.00	127.55	X	3	2
5	14	97.07	25.70	4.79	127.56		3	2

Year: 2035
Cargo Volume: Containers: 622,000 TEU, Solid Bulk: 2,095,000 MT

Case	Berth Depth M	Transportation Cost Container Mil/Year	Solid Bulk Mil/Year	Channel Dredging Mil/Year	Total Cost Mil/Year	Least Cost	Berth No. Container	Solid Bulk
1	9	166.58	51.03	0.00	217.61		5	2
2	11	145.60	40.45	0.99	187.04		4	2
3	12	144.25	38.57	2.09	184.91		4	2
4	13	140.56	36.56	3.00	180.12		4	2
5	14	137.01	35.45	4.79	177.25	X	3	2

1.3.3 Land Use Plan

As part of the Master Plan of the port development, it is necessary to prepare a comprehensive land use plan for the coastal area in and around the project site to harmonize land use for port activities with other uses such as for industrial and urban activities. As for EMPORNAC's land, a zoning plan has already been proposed. When making the Master Plan, however, areas outside of EMPORNAC's land need to be considered to cope with the long term beyond the year 2000. Here, a land use plan is proposed referring to the existing zoning plan.

The area to the west of the existing port is mountainous and there is a park adjacent to the port. On the other hand, the area to the east of the existing port is flat, and is reserved for the future extension of the Port. Water areas near the river mouths of the Seca River and the Cacao River cannot be reclaimed as they are necessary for the river flows. The costal areas outside of the east end of EMPORNAC's land are mainly used for urban activities. Water areas in front of the coastline along the access channel can be reclaimed economically owing to their shallowness.

Thus, the area extending to the east of the existing port and the water area between the Cacao River and the Port of Barrios are proposed for the port development in the future (see Fig. 1.3.1).

1.3.4 Layout of the New Terminals

The container, bulk and petroleum terminals are located taking account of their required scales, related natural conditions, the land use plan, etc.

The container and bulk terminals need vast yards immediately behind their berthing facilities. Hence, it is advisable that these terminals be located in the area to the east of the existing port or to the east of the Cacao River along the access channel.

On the other hand, the petroleum terminal needs only berthing facilities which can be located off the coast and connected with depots located on land by pipelines. The petroleum terminal has to be separated from the existing port, the container and bulk terminals, populated districts, etc. Thus, the water areas off the river mouths of the Cacao and Seca Rivers are proposed for the berthing facility of the petroleum terminal.

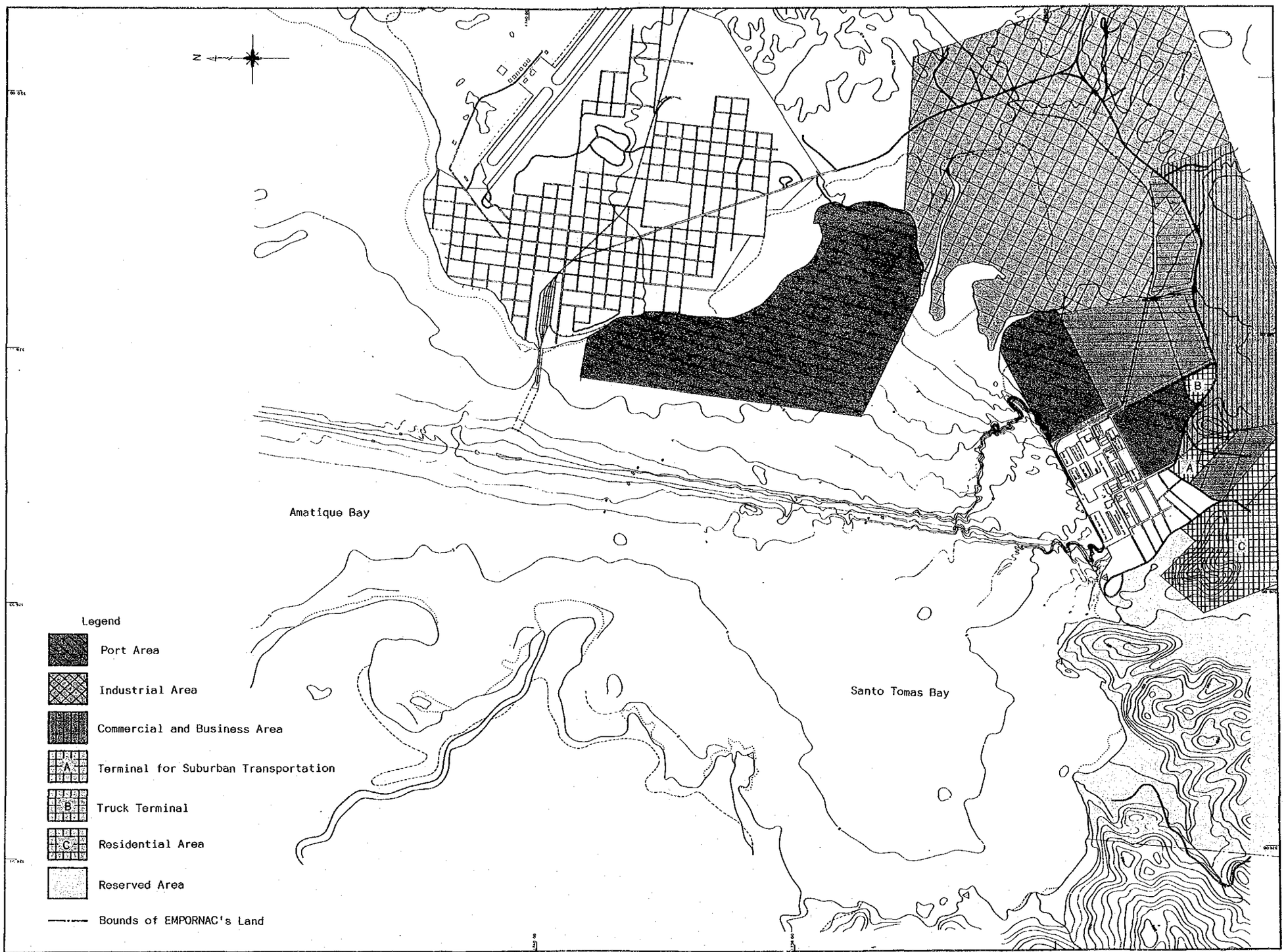


Fig. 1.3.1 Land Use Plan

1.3.5 Access Channel and Basins

The width of the access channel is decided so as to allow two-way traffic of oceangoing vessels, following the international standard. Judging from the forecast traffic, the traffic capacity of the access channel will be sufficient far beyond the target year of the Master Plan.

Basins in front of the proposed terminals are considered assuming the use of tug boats when mooring and unmooring. A circle with a diameter double the maximum L.O.A. of calling vessels is considered as the minimum area of the basins.

1.3.6 Roads and Railways in the Port Area

At present, not only trucks but also freight trains are used for transportation between the Port and its hinterland. For example, around 50 % of Bananas, 40 % of wheat and 20 % of fertilizer are transported by freight trains. Coffee is also being transported by train. In addition to such bulk cargoes, some containers are also transported by train. Considering the present conditions and interviews with related organizations, railways are expected to continue to play an important role in the future. Hence, both roads and railways are considered in the port plan.

1.3.7 Alternative Layout Plans

Considering the layout of the terminals, access channel and basins, and roads and railways in the port area, alternative layout plans of the Master Plan are proposed as follows (see Fig.1.3.2 - Fig.1.3.4):

	Location of the Terminals		
	Container Terminal	Bulk Terminal	Petroleum Terminal
Case 1 :	East of the Existing Terminal	East of the Cacao River	Off the Mouth of the Cacao River
Case 2 :	East of the Cacao River	East of the Existing Terminal	Off the Mouth of the Cacao River
Case 3 :	East of the Cacao River	East of the Cacao River	Off the Mouth of the Cacao River
Case 4 :	--	--	Outside of Santo Tomas Bay

The comparison of the alternatives is shown in Table 1.3.2. Though these alternatives have various advantages and disadvantages as mentioned in the Table, there is no decisive difference between them in the Master Plan itself with the target year 2005. However, taking account of construction works including the works based on the Short-term Plan, Case 1 has a great advantage by using the existing land possessed by EMPORNAC as the site for the new container terminal. Moreover,in the first stage, reclaimed land will be created using dredged materials which can then be used for the second stage with sufficient time to stabilize the reclaimed soft soil. Thus, Case 1 is selected as the optimum plan.

1.3.8 Navigation Aids Planning

(1) Navigation aids

To secure the safety of navigation at sea, establishment of navigation aids and other relevant facilities is necessary. Visual and electronic navigation aids are complementary. Neither one is sufficient by itself. The visual range is limited and affected by weather, while the electronic range is extended and not affected by the weather.

The number of visual aids and electronic aids to navigation in the Long-term Plan is as follows:

a) Visual Navigation Aids

1)	Safe Water Marks	2
2)	Lateral Marks	14
3)	Cardinal Marks	3
4)	Isolated Danger Marks	4
5)	Lighthouse	3

b) Electronic Navigation Aids

Radar beacon stations are planned primarily for the entrance channel and its vicinity.

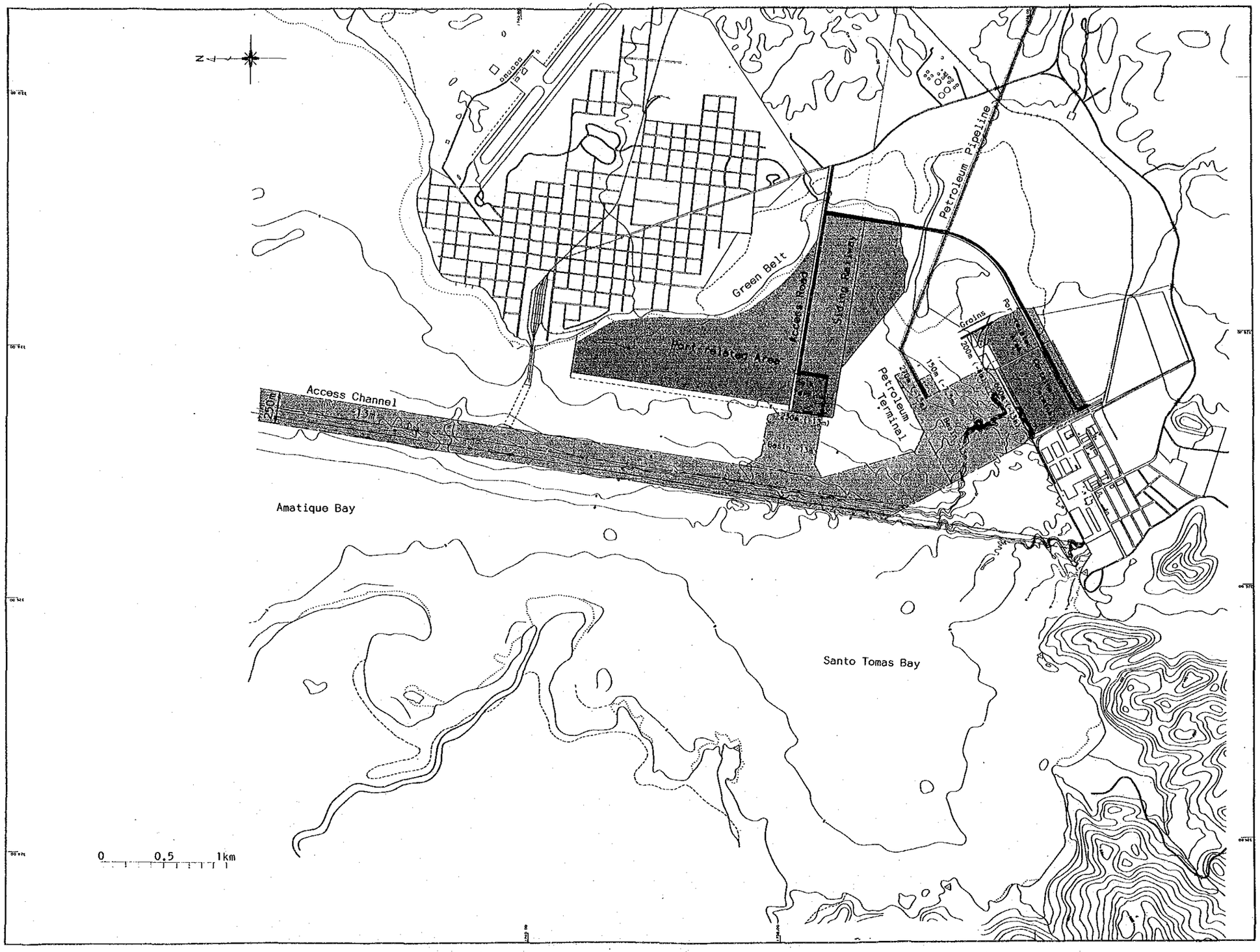


Fig. 1.3.2 Alternative Layout Plan -- Case 1

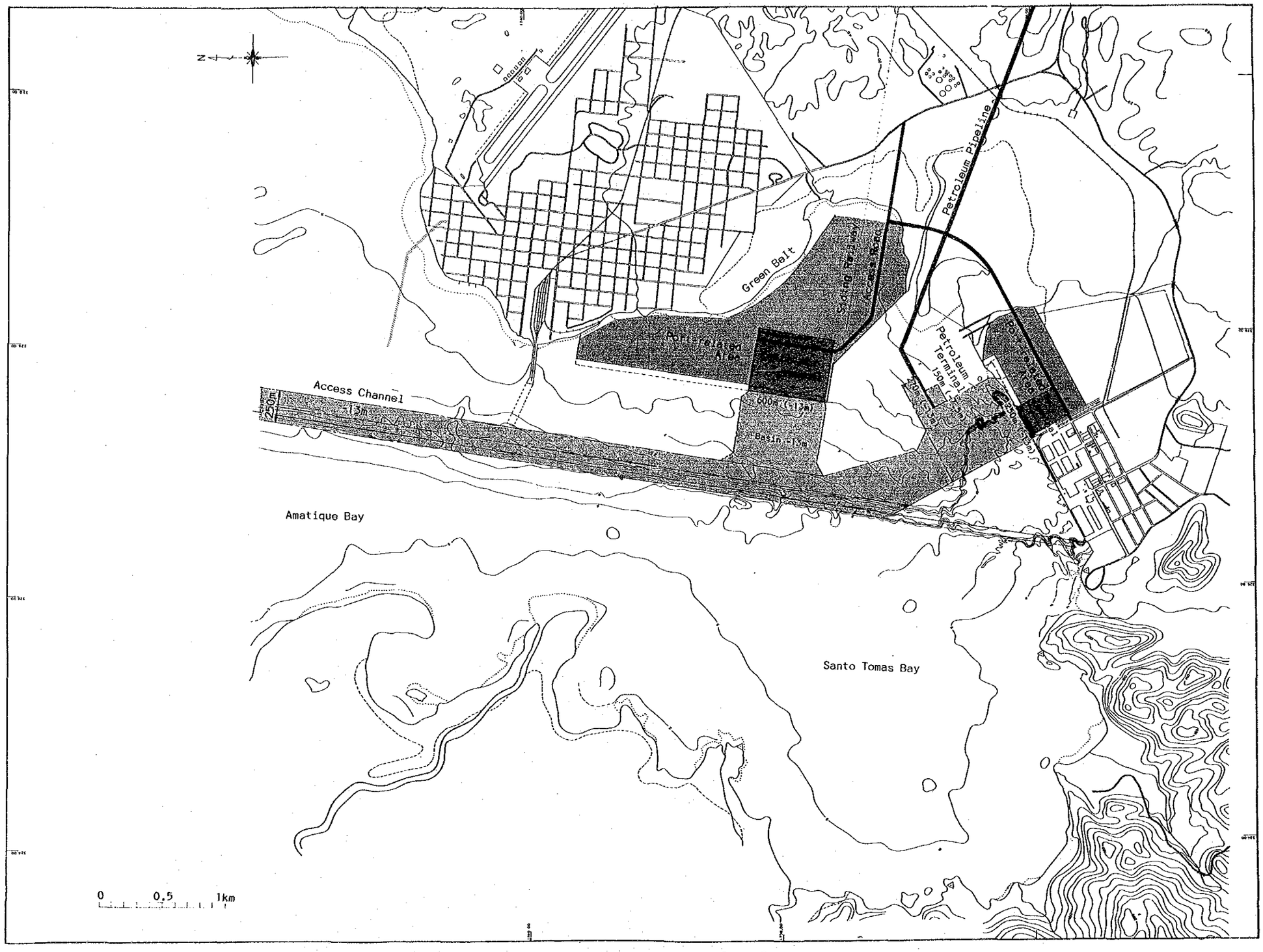


Fig. 1.3.3 Alternative Layout Plan -- Case 2

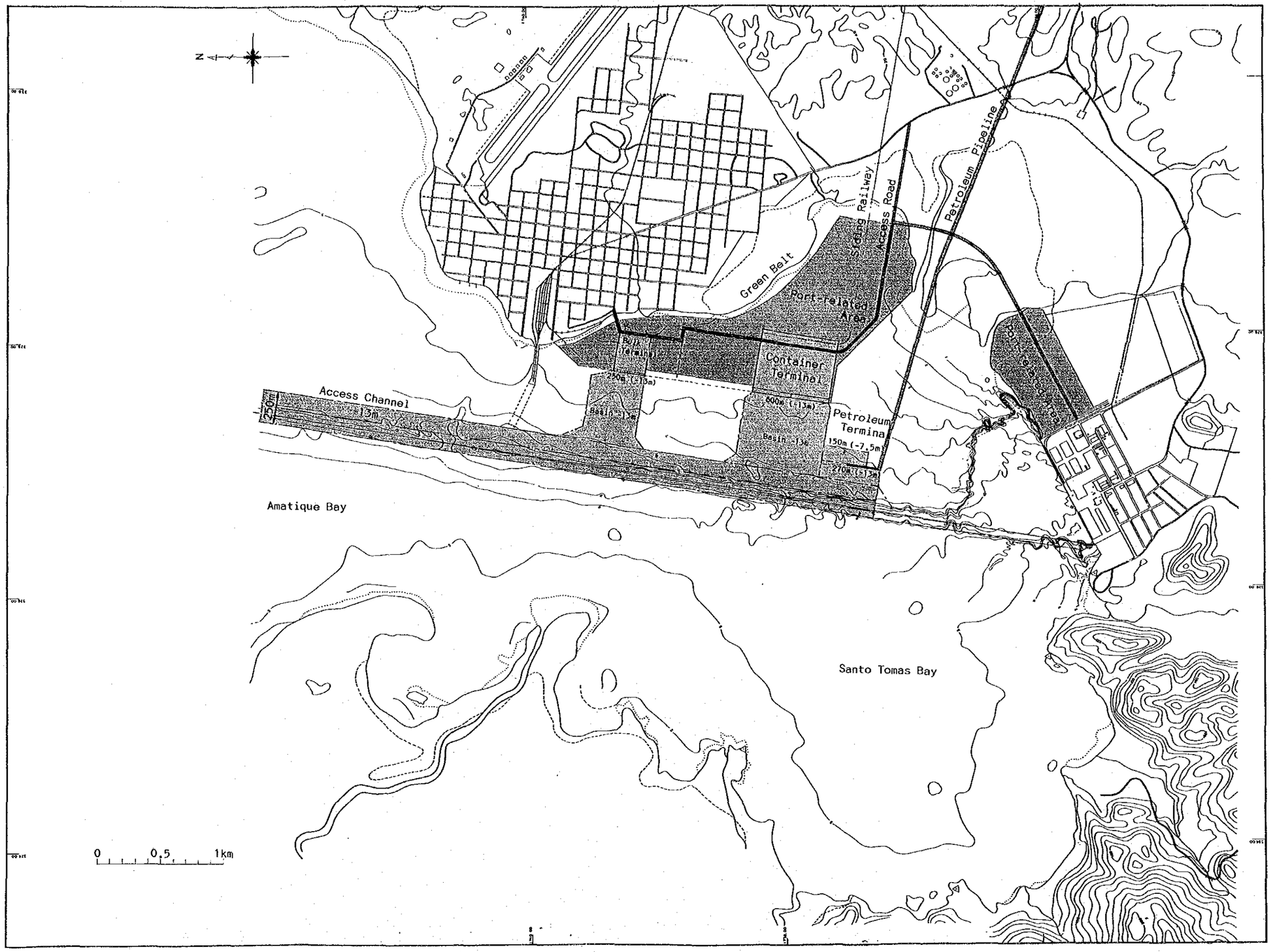


Fig. 1.3.4 Alternative Layout Plan -- Case 3

Table 1.3.2 Comparison of the Alternative Layout Plans of the Master Plan

Item	Case 1	Case 2	Case 3	Case 4
1. Acquisition of sites for the Container and Bulk Terminals	It is not necessary to acquire the site for the proposed container terminal since that is already possessed by EMPORNAC. However, there is no sufficient space behind the site for port-related industries or business due to the location of ZOLIC. On the other hand, the site for the bulk terminal must be reclaimed using dredged materials from the access channel and basins. As the dredged materials seem to be soft, after reclamation, soil stabilization will be needed.	The site for the proposed container terminal must be reclaimed using dredged materials. After reclamation, soil stabilization will be needed. On the other hand, the site for the bulk terminal is already possessed by EMPORNAC.	The sites for the proposed container and bulk terminals must be reclaimed using dredged materials. After reclamation, soil stabilization will be needed. The area neighboring the existing terminal will remain unused.	
2. Construction Cost Excluding Cost for the Petroleum Terminal	456 Mil. Quetzales	454 Mil. Quetzales	430 Mil. Quetzales	
3. Port Administration and Operation	At the site for the container terminal neighboring the existing terminal, only two berths can be constructed due to the limited area. Hence, additional container berths required beyond the target year 2005 will be separated from the proposed first stage container terminal which will be constructed east of the Cacao River.	Additional container and bulk berths required beyond the target year 2005 can be constructed adjacent to the respective proposed first stage terminals. Thus, each of the terminals can be administrated and operated as a single unit, even in the far future.	The same as Case 2.	
4. Handling of Dangerous Cargoes	Dangerous cargoes will be separated from other cargoes by construcing a new petroleum terminal.	The same as Case 1.	The same as Case 1.	Dangerous cargoes will be separated from other cargoes by constructing a new petroleum terminal. As the distance between the terminal and existing or planned storage tanks located near the existing port is great, this case is costly compared with the other alternatives.

(2) Need for Administrative Structure for Maintenance

At present, because of the lack of an appropriate administrative structure, efficient maintenance is not conducted even for routine services, and emergency services for immediate remedy of sudden failures are also not sufficient. The deployment of the total buoy replacement maintenance system on a biannual base is proposed to maintain reliable effective operational performance of the lighted buoys.

1.3.9 Dredging Plan

(1) Channel and Basin Dredging

The existing channel is not sufficiently wide for navigation of vessels. Therefore, the existing channel will be dredged to increase its depth and width.

To minimize the obstruction to navigation of vessels during the dredging work, the channel will be relocated 90m east of the existing channel.

Basins in front of the new wharf, oil berth and bulk terminal shall also be dredged.

(2) Dredging

a) Dredging volume

The dredging volume of the channel and basins for the planned water depth is shown in Table 1.3.3

Table 1.3.3 Dredging Volume of Channel and Basins

Depth	Channel	Container	Bulk	Total
11.0m	3,100,000m^3	3,100,000 m^3	940,000 m^3	7,140,000 m^3
12.0	6,500,000	5,500,000	1,330,000	13,330,000
13.0	9,300,000	6,800,000	2,130,000	18,230,000
14.0	14,900,000	8,000,000	2,780,000	25,680,000

The channel and basins shall be dredged to a depth of -13m below C.D.L under the master plan and -11m below C.D.L under the short-term plan

considering the dredging volume and the draft of calling vessels.

b) Disposal of dredged materials

Dredged materials should not be dumped into open water areas. Revetments should be constructed to prevent the spread of the dredged materials into the water.

1.3.10 Cost Estimation

The estimated costs of facilities and equipment under the master plan of the new port are shown in Table 1.3.4.

Table 1.3.4 Construction Cost

Unit: Million Quetzales

Item	Case 1	Case 2	Case 3
1. Container Terminal	265.68	238.32	238.32
2. Bulk Terminal	99.13	124.41	96.86
3. Oil Terminal	31.42	31.42	42.54
4. Common Facilities	91.32	91.32	94.91
Total	487.55	485.47	472.63

1.4 PORT MANAGEMENT AND OPERATION

1.4.1 Port Management and Operation System

EMPORNAC is the sole body responsible for the planning, construction, management and operation of the port. In developed countries, both the public and private sectors play important roles to ensure smooth and efficient activities in and around port areas. The structure of the port management body at each port is slightly different depending on historical, socio-economical and institutional factors.

A worldwide tendency has been observed whereby the participation of the private sector is increasing, especially in the field of port operation. While cargo volume is not so great, one organization may be able to provide all the required services at a port. However, port activities develop year by year. In the near future the scale of the port activities at Santo Tomas may exceed the moderate size which can be efficiently managed by one organization.

Public sector management has advantages as well as disadvantages. Port facilities including water areas are regarded as public property, or social infrastructure. Thus the administration of port facilities should strictly follow the national interest. In addition, since the initial investment for port facilities is huge and requires a long recovery period, only the public sector can bear such a heavy burden. Furthermore, the public sector can enjoy lower interest rates utilizing foreign aid loans.

However, as the public sector lacks the profit motive, there are sometimes problems such as rigid organization, slow decision making, fixed budget and inefficient performance.

In order to realize smooth and effective cargo flow in the port area, the participation of the private sector in the field of port operation should be considered in the near future. It is quite reasonable to let the private sector participate in some activities step by step. At any rate, it is advisable for EMPORNAC to study a privatization plan.

1.4.2 Handling Systems

There are many different systems to transport containers from the quaywall to the marshaling yard, and to stack containers in the yard.

The main handling systems are as follows;

a) Chassis system
b) Straddle carrier system
c) Tire-mounted transfer crane system

Based on studies on the efficiency, investment and operation costs, storage capacity, operation control and expandability for each handling system, the tire-mounted transfer crane system is desirable at the Port. However the straddle carrier system is preferable at the port of Santo Tomas de Castilla considering the existing handling system.

1.4.3 Terminal Operation

(1) Container terminal

As for the management and operation systems for the new container terminal under the Master plan, the following three types are considered.

a) Public sector management and operation of the container terminal,
b) Public sector management and operation of areas behind the apron such as the marshaling yard, and private sector operation of other facilities.
c) Private sector management and operation of the entire terminal, with the basic infrastructure leased by the public sector.

(2) Petroleum terminal

As for the new petroleum terminal, the following systems are considered.

a) EMPORNAC executes all of the works

EMPORNAC constructs all of the facilities which will be required for the petroleum terminal including the loading and unloading facilities, and manages and operates the terminal.

b) EMPORNAC prepares the infrastructure, and users prepare other facilities such as loading and unloading facilities and then operate the terminal.

c) The private sector constructs all of the facilities

The private sector constructs all of the facilities for exclusive use, and manages and operates the terminal.

On the other hand, as for the management and operation systems of the existing terminals for break bulk and solid bulk, the present systems seem to be appropriate.

1.4.4 Maintenance of Cargo Handling Machines

All maintenance work is carried out by EMPORNAC. However, as mentioned in Chapter 3, the condition of the existing machines is not so good due to certain problems in the maintenance section despite their great efforts.

EMPORNAC's maintenance system consists of regular checks including oil changes, changing brake shoes, etc. and repair of damaged machinery. In Japan, a daily check is carried out and parts are changed at regular intervals. Therefore the operating ratio is raised by minimizing downtime. EMPORNAC should commence a study to formulate the most effective maintenance system as soon as possible.

1.4.5 Computerized Automated Container Terminal

Responding to the increase of container cargoes, it will become more difficult to carry out all the operations manually. Container terminals of international standard size can handle more than 100,000 T.E.U. per year. To prevent confusion at the terminal and improve handling efficiency, it is crucial to introduce a computer system to assist terminal operations.

The computerization of container terminals may be divided into four steps as follows:

a) Plan and Management Control System
b) Yard Operation Control System
c) Crane Operation Control System
d) Automation System

The computerization of the container terminal at the port should proceed according to these four steps.

2 SHORT-TERM PLAN

2.1 SHORT-TERM PLAN FOR THE PORT DEVELOPMENT

2.1.1 *The Basic Concept of the Short-term Plan*

The Short-term Plan is prepared as a first stage plan with a target year of 1995 for the development of the port of Santo Tomas de Castilla. The Short-term Plan is made within the framework of the Master Plan.

In order to formulate the Short-term plan, the use plan of the existing terminal is studied. From the standpoint of safe operations and considering the increasing volume of dangerous cargoes handled at the Port, it is advisable to construct a new petroleum terminal in the first stage. On the other hand, judging from the present high rate of berth occupancy at the existing terminal and the future increase of cargo volume, even if petroleum cargoes are shifted to a new terminal, it will be impossible to handle all the remaining cargoes at only the existing facilities in the future. Furthermore, it would not be economical to use the existing terminal for container ships because the existing terminal cannot accommodate full container vessels. As for the handling of solid bulk cargoes in the year 1995, there are three alternatives: preparation of new cranes with a larger capacity at the existing terminal, use of the present cargo handling system at the existing terminal and construction of a new terminal equipped with larger cranes. The former alternative is selected as the optimum case from the economic point of view. From the above, the following new terminals are planned in the Short-term Plan:

- Container Terminal
- Petroleum Terminal

When planning the container terminal, the optimum number of berths and water depth are examined using the same method adopted in Section 1.3.2.

2.1.2 Required Scale of New Terminals

(1) Container Terminal

The number of containers to be handled at the new container terminal in the year 1995 is forecast as 116,000 TEU.

The optimum number of berths is calculated by water depth by using the same method presented in Section 1.3.2. Herein, two alternative water depths, -9 meters and -11 meters, are considered. The optimum number of berths by alternative water depth is one in both cases. The optimum required water depth is selected by comparing total costs including access channel dredging cost. The total transportation costs are summed up and compared between the two alternative cases. Thus, in the year 1995, 11 meters is selected as the optimum water depth. For the same reasons mentioned in Section 1.3.2, it is also advisable to construct a quaywall which will be able to bear deepening of the waters immediately adjacent to the quaywall from 11 meters to 13 meters in the future. Through the above examination, a container terminal with the following dimensions and facilities is considered economical:

Water Depth: 11 meters
Berth Length: 250 meters
No. of Container Gantry Cranes: 2

In this case, the terminal can serve only one container ship at a time. From this case, a derivative alternative can be considered. Without changing the water depth, superstructures and cargo handling facilities from the base case, the following alternative is proposed to be examined:

Water Depth: 11 meters
Berth Length: 500 meters
No. of Container Gantry Cranes: 2

In this alternative case, two container ships can berth at the same time. Though the container gantry cranes can serve only one ship at the same time, the other ship can receive other services such as mooring and unmooring, preparation of cargo handling, preparation and procedures of departure and draft check. Hence, in the alternative case, ship waiting time at the Port will be saved compared with the base case. Judging from the comparison between the two cases, 500 meters is proposed as the optimum berth length in the year 1995.

In the above examination, it is proposed to prepare two container gantry cranes without considering the case where a crane may become unusable due to regular maintenance or repair. Taking account of this, the necessity of an additional crane is examined. In the case where only two gantry cranes will be prepared, there will be heavy congestion in those periods when one crane is under regular maintenance or repair. On the other hand, in the case when an additional crane will be prepared, even if one crane is unusable, there will be no congestion and ship waiting cost can be reduced during ordinary times by using all three cranes. According to the comparison between the two cases, three gantry cranes are proposed in the year 1995.

As for the cargo handling system at the container yard, three systems, straddle carrier, transfer crane and chassis systems, are considered and these systems have various merits and demerits. Taking into account that straddle carriers are being used at the existing terminal, and to make the most use of EMPORNAC's experienced personnel and the existing machines, the straddle carrier system is proposed for the new container yard.

According to the above, the required dimensions and facilities of the new container terminal are computed and summarized as follows:

- Water Depth: 11 Meters
- Berth Length: 500 Meters
- Apron: 500 Meters x 40 Meters
- Marshaling Yard: 500 Meters x 116 Meters
- Container Freight Station: 143 Meters x 40 Meters
- Terminal Office: 30 Meters x 25 Meters
- Repair Shop: 40 Meters x 25 Meters
- Van Pool: 216 Meters x 70 Meters
- Railway Yard: 480 Meters x 60 Meters
- Number of Cargo Handling Machines: Container Gantry Cranes: 3
  Straddle Carriers: 8*
  Forklift: 1

*Two straddle carriers are expected to be shifted from the existing terminal.

(2) Petroleum Terminal

As noted in Section 2.1.1, a new petroleum terminal is planned to be constructed apart from the existing terminal and the new container

terminal for securing safe port operations. According to the demand forecast, the volume of cargoes to be carried by petroleum tankers through the Port in 1995 is estimated as 1,616,000 metric tons.

For the cargo volume, one berth with a water depth of 11 meters is proposed. The berth occupancy ratio is estimated as 0.59 in the year 1995.

2.1.3 Dimensions of the Access Channel and Basins

Judging from the forecast traffic through the access channel, less than five ships daily on average, the target width of the channel for only one-way traffic will be sufficient in the year 1995. The target water depth of the channel in the same year is determined in Section 2.1.2. Thus, the target dimensions of the access channel to be created are shown as follows:

Water Depth: 11 Meters
Width : 90 Meters

Basins in front of the proposed terminals are considered assuming the use of tug boats when mooring and unmooring. A circle with a diameter double the maximum L.O.A. of calling vessels is considered as the minimum area of the basins.

2.1.4 Layout of the New Terminals and the Access Channel

The required terminals proposed in Section 2.1.2 including container and petroleum terminals are located according to the Master Plan. Thus, the container terminal and the petroleum terminal are located east of the existing terminal and off the mouth of the Cacao River, respectively.

A new access channel is planned alongside the existing access channel. Specifically, the center line of the new channel will run parallel to and 100 meters east of the center line of the existing channel. Alternatively, the new channel could also be dredged just by deepening the existing channel. However, the waters adjacent to the existing channel are deep enough and there is not much difference in the dredging cost between the two cases. Moreover, in the latter case, dredging works at the existing channel would hinder the traffic of ships, and consequently the dredging works would be costly. Hence, the latter case is not adopted.

A layout plan of the port facilities under the Short-term Plan is shown in Fig. 2.1.1.

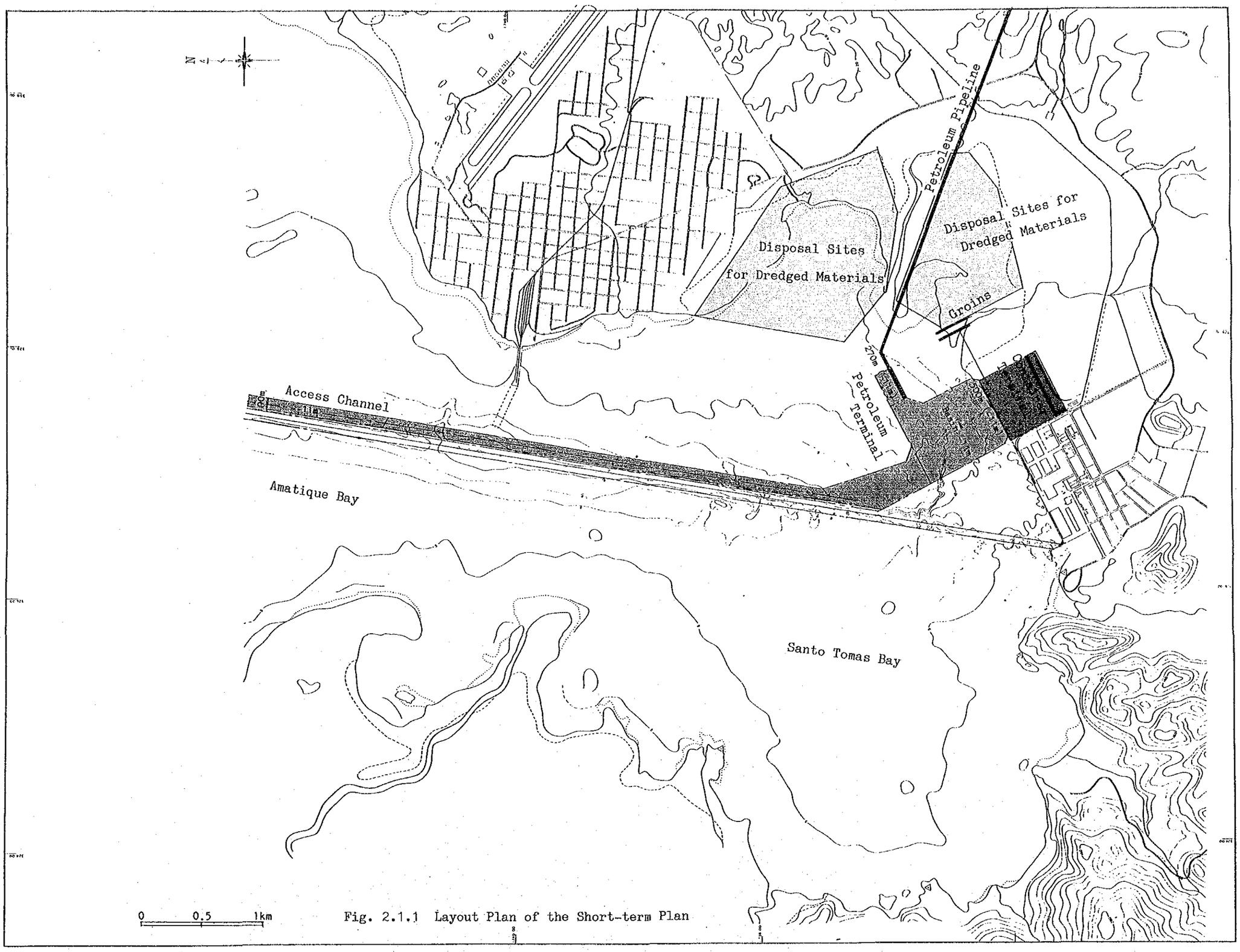


Fig. 2.1.1 Layout Plan of the Short-term Plan

2.1.5 Layout of the Required Facilities of the Container Terminal

The new container terminal will be located east of the existing terminal. Since ZOLIC is located behind the site for the container terminal, the maximum depth which can be planned is 500 meters. However, the necessary depth of the site in the year 1995 is less than 500 meters. The remaining area is reserved for future expansion beyond the target year of the Short-term Plan. The required facilities proposed in Section 2.1.2 are arranged taking account of the future expansion. The layout plan is shown in Fig. 2.1.2.

Judging from the reserved area for the marshaling yard, the cargo handling capacity of the container terminal to be constructed east of the existing terminal is estimated as 199,000 TEU per annum.

2.1.6 Navigation Aids

For the creation of the new access channel and basin, new navigation aids, two lateral marks and three cardinal marks will be required. Furthermore, to secure safe navigation at the mouth of the Amatique Bay, a safe water mark is planned to be installed in the waters.

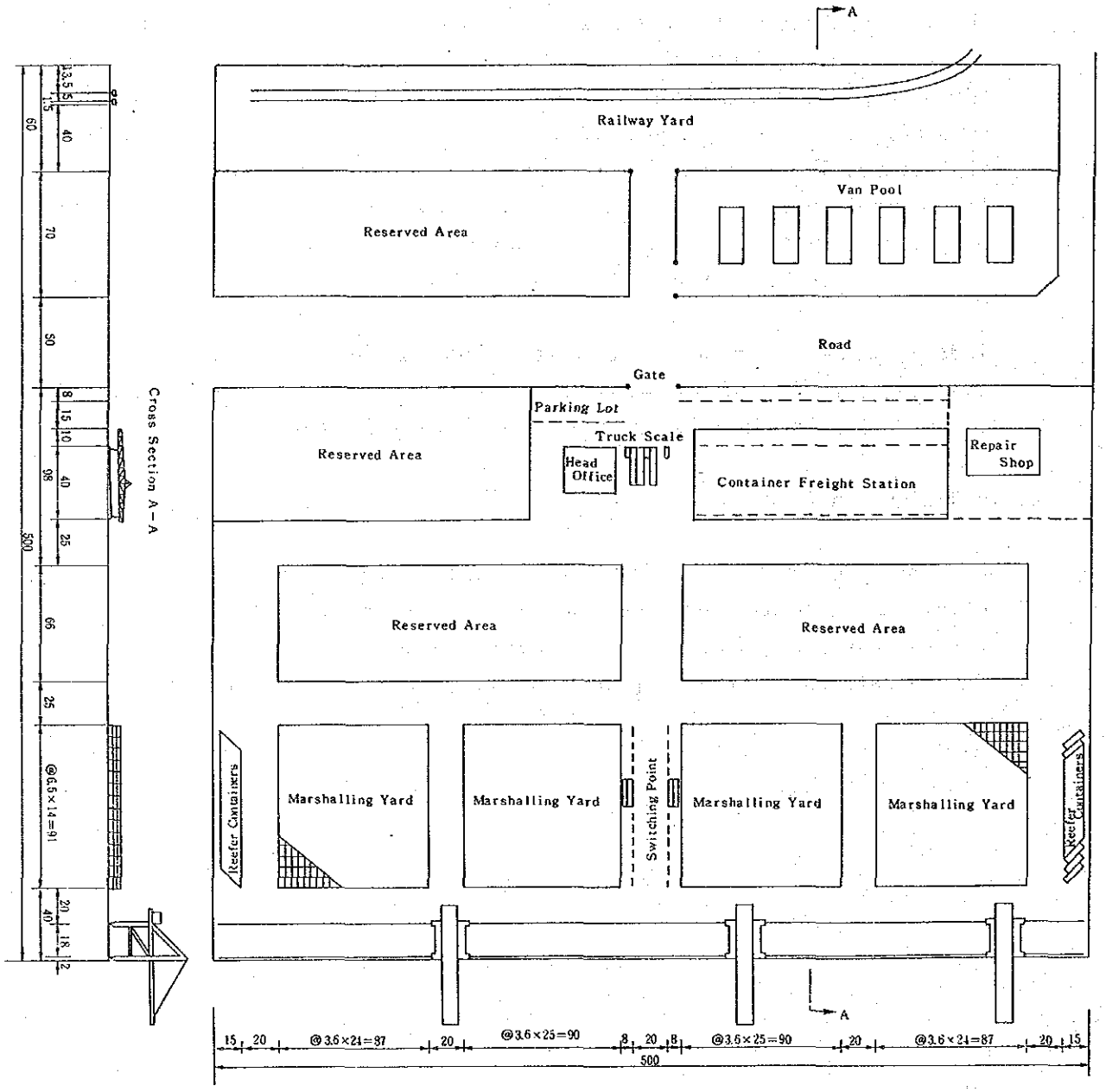


Fig. 2.1.2 Layout Plan of the Facilities of the Container Terminal

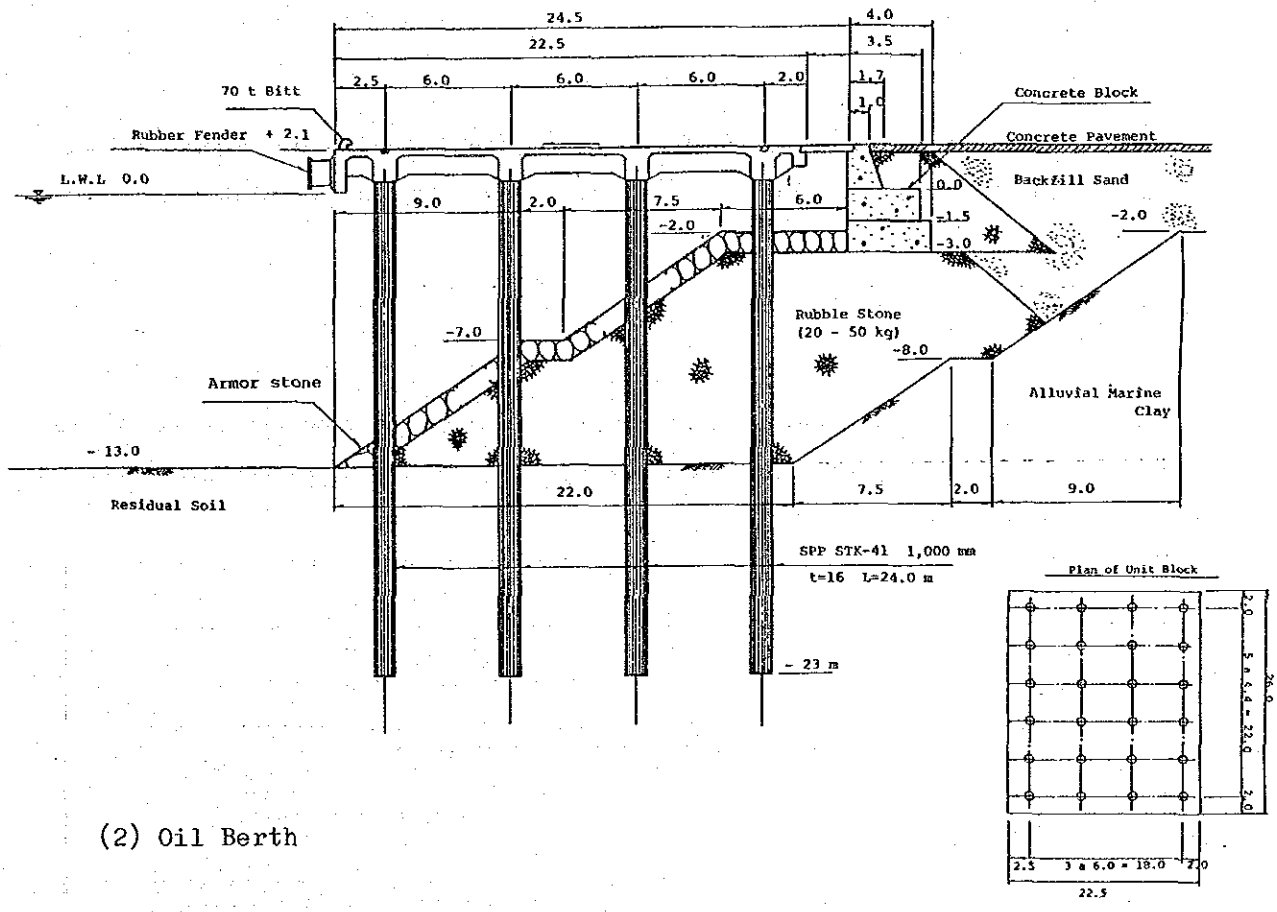
2.2 Design, Construction and Cost Estimation

2.2.1 Design of Main Structures

(1) Wharf

A comparative analysis on the structural types for the wharf is carried out. The open deck type with steel pipe piles is considered preferable. Fig 2.2.1 shows the standard cross section of the wharf.

Fig 2.2.1 Standard Cross Section of the Wharf



(2) Oil Berth

A dolphin type pier is planned 500 m away from the other port facilities to minimize potential damage from any accident involving the inflammable cargoes.

(3) Container Yards and Roads

The yards are paved taking into consideration the soil conditions and the planned use of each yard.

(4) Navigation Channel and Basins

The new channel, 90 meters in width, will be located 90 m east of the existing channel. Both the channel and the basins are 11 meters in depth below C.D.L.

(5) Buildings

Designs are prepared for the main buildings including the container freight station, the port office, and the maintenance shop.

(6) Related Facilities

Related facilities include the drainage system, the water supply system, the electric power supply facilities, the lighting system and cargo handling equipment.

2.2.2 Construction planning

The construction plan and construction schedule are devised based on the port plan and the port facillity design. Fig 2.2.2 shows the proposed construction schedule.

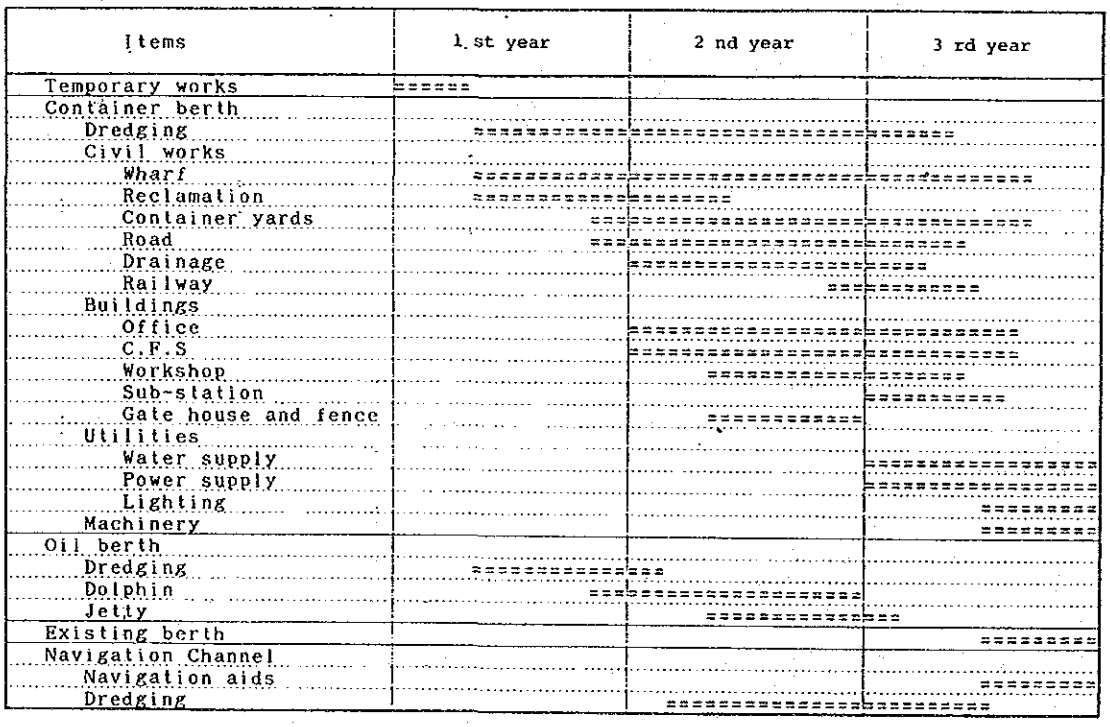


Fig 2.2.2 Proposed Construction Schedule

2.2.3 Cost Estimation

(1) Estimation conditions

Construction costs are estimated in accordance with the following conditions.

a) The costs are based on the market prices as of January 1988.
b) Unit prices of construction materials are based on the data obtained through the site survey.
c) Taxes such as import duties and enterprise taxes are not included at all.
d) Land rents and compensations related to this project are not included.
e) The exchange rates between the Guatemalan quetzale, Japanese yen and U.S. dollar are assumed as follows.

US$1.0 = Q2.58 = ¥129

(2) Approximate construction cost

The approximate construction cost of the Short-term Plan is shown in Table 2.2.1

Table 2.2.1 Construction Cost

Items	Foreign	Local	Total
Temporary works	3,515,000	1,456,000	4,971,000
Container berth			
Basin dredging	16,120,000	5,580,000	21,700,000
Civil works	36,706,400	42,947,400	79,653,800
Buildings	5,980,400	7,192,100	13,172,500
Utility	7,014,000	1,816,900	8,830,900
Machinery	42,970,400	119,400	43,089,800
Sub total	108,791,200	57,655,800	166,447,000
Oil berth	21,775,000	5,096,000	26,871,000
Existing berth	5,760,000	107,000	5,867,000
Navigation channel	10,032,000	3,496,000	13,528,000
Total	149,873,200	67,810,800	217,684,000
Enginering fee	8,968,000	3,379,000	12,347,000
Contingency	13,203,000	7,108,000	20,311,000
Total	172,044,200	78,297,800	250,342,000

Unit: Quetzale

2.3 PORT MANAGEMENT AND OPERATION

2.3.1 General

The main elements of proper port management and operation systems are appropriate form and structure of the port administrative body, efficient port operations, a sound financial system using modern accounting methods, a reasonable level of port dues, accurate port statistics, skillful promotion and publicity, and regional cooperation with neighboring ports. Here, an administration and operation system for the container terminal at the port of Santo Tomas de Castilla is proposed as follows.

2.3.2 Management Body

(1) New Management Organization

The new terminal's administrative body should be separated from existing ones and have an independent accounting system. The organizational structure should be clear and simple, and the new organization should have a sufficient number of skilled officers and workers.

(2) Container Terminal Operation Method

Efficiency of operation and quality of the terminal service are governed by the selection of the container handling system and the kinds and numbers of cargo handling machinery equipped at the container terminal.

As mentioned in Part 1 Section 9.3.3, container handling systems are classified by the handling machinery installed such as the chassis system, the straddle carrier system and the transfer crane system, and each system has various merits and demerits.

The straddle carrier system is proposed for the new container terminal because EMPORNAC has experience using this system at the present terminal.

2.3.3 Containers and Containerized Cargo Flow in the Terminal

The following container flow is an outline of the proposed container terminal operation system.

(1) Import Container Operation Procedure

Containers unloaded from ships are placed on the apron according to the "unloading sequence list" drawn from the "import stowage plan", and transferred to the yard by straddle carrier and stacked in two layers.

The containers should be stacked according to the "yard stacking plan". Schematic representations of the yard stacking plans are usually available in the terminal control center.

(2) Export Container Operation Procedure

Full containers for export are received at the gate and moved to the marshaling yard directly. Export containers should be stacked in the marshaling yard, again in accordance with "the yard stacking plan", to confirm the container number to be loaded, and to allow drafting of the "loading sequence list".

The export containers are moved under the gantry crane according to the "loading sequence list" and loaded on ship.

2.3.4 Container Terminal Operation System

(1) Facility Utilization System

As for the utilization system of port facilities at the container terminal, three systems, namely open use, priority use and exclusive use, are considered. The open use system is proposed for the new container terminal at the initial stage of operation, considering the socio-economic condition in Guatemala.

(2) Management and Operation System

As for the management and operation system at the terminal, three systems are considered and these systems have various merits and demerits. Considering the present situation, management and operation of almost all the facilities by EMPORNAC is proposed for the new container terminal operation. But van pool operation should be handed over to the private sector.

(3) Privatization of Terminal Operation

In order to realize smooth and effective cargo handling in the terminal, it is quite reasonable to let the private sector participate in some activities step by step in the near future.
In making the privatization plan, the following viewpoints will be considered.

i) Cargo handling efficiency should be raised by private sector participation.
ii) In the future, profit will increase by raising productivity.
iii) Privatization will proceed step by step.

The following works may be easy to privatize in the early stages:

- Van pool lease
- Maintenance shop works
- C.F.S works

2.3.5 Organization of Container Terminal

(1) Organization

The numbers and functions of workers which will be required for effective performance of the container terminal operations depends on various factors at the port. The proposed organization and number of workers at the container terminal are assumed based on modifications from the Japanese standard.

Section	Number
Operation management	25
Control of container terminal	22
Operation of cargo handling	134
Container freight station	95
Maintenance and repair	30
Grand Total	306

(2) Training

It is recommended that EMPORNAC should investigate the operational systems of container terminals in developed ports, so as to provide detailed training on container terminal operation procedures to the staff and workers.

The key staff members responsible for yard operation should be trained by workers at actual jobs at already developed container terminals. As for the engineers who will be responsible for maintenance and repair of highly complex cargo handling equipment, they should also be trained at an already developed terminal. The workers who will operate container handling machinery should be trained at an operating terminal, if possible.

It is proposed that such machinery should be purchased well in advance of the terminal's opening for hands-on training at the site.

2.3.6 Computerized works at the container terminal

The port of Santo Tomas de Castilla will be attractive for regular container services by providing a system matching the high requirements for information flow. The shippers want information from other ports of trade, and stowage planning has to be executed before the ships arrive. Shipping companies require quick dispatch of their ships. Many container terminal operators have developed computer programs for their terminal operations to meet such requirements.

Several of the above items will utilize the computer system.

2.3.7 Container Handling Tariff

A simplified tariff will be better for both users and for the accounting section of the terminal, so it is proposed that the composite type of tariff be used as much as possible to meet actual operational needs.

The charges should be calculated based on construction cost, purchase cost and actual personnel and maintenance cost. Then the new tariff rate should be checked to see whether it can be accepted by users considering the present tariff and the improved service level of the new system.

2.3.8 Petroleum Terminal

(1) Operation System

At present, petroleum such as crude petroleum, refined oil and propane gas are loaded and unloaded at No.6 berth. But in order to minimize the

possible damage from accidents, the new oil terminal should be constructed apart from the existing terminal (See Part 1 Section 8.2.4). There are three possible development and management methods for the new terminal as noted below.

i) EMPORNAC executes all of the works

EMPORNAC constructs all of the facilities which will be required for the petroleum terminal including loading and unloading facilities, and manages and operates the terminal.

ii) EMPORNAC prepares the infrastructure, and users prepare other facilities such as loading and unloading facilities, and then operate the terminal.

iii) All of the facilities are constructed by the private sector

Private companies construct all of the facilities for exclusive use, and manage and operate the terminal.

Case (ii) above is proposed for the new petroleum terminal.

(2) Allocation of Construction Cost

The infrastructure will be constructed by EMPORNAC and leased to private sector firms, and the pipeline and loading-unloading facilities will be prepared by the private sector firms.

2.4 ECONOMIC ANALYSIS

2.4.1 Purpose and Methodology of the Economic Analysis

The purpose of the economic analysis is to appraise the economic feasibility of the Short-term Plan for the port development from the viewpoint of the national economy. Thus, the analysis focuses on whether the net benefits of this development project exceed those which could be derived from other investment opportunities in the Republic of Guatemala (e.g. the opportunity cost of capital). All benefits and costs in the economic analysis are evaluated using economic prices based on the border price concept. The economic internal rate of return (EIRR) based on the cost-benefit analysis is used to appraise the feasibility of this project. The EIRR is calculated using the following formula:

$$\sum_{i=0}^{n} \frac{Bi - Ci}{(1 + r)^i} = 0$$

where, Bi : Benefits in the i-th year
Ci : Costs in the i-th year
r : Discount rate
n : Period of the project life

2.4.2 "Without Case"

In the cost-benefit analysis, both the benefits and the project costs are defined as the difference between the "Without" the project and the "With" the project cases. In this study, the following conditions are adopted as the "Without" case.

(1) Considering ship staying conditions at the Port, the cargo volume may exceed the maximum cargo handling capacity of the port by the year 1991.

(2) The additional cargo volume after the year 1991 would have to be handled at alternative ports. However, the following cargoes are selected to be handled at the alternative ports considering the characteristics of the cargoes.

a) Container cargo
b) Furgon (Ro-Ro) cargo
c) Dry cargo (except bananas)

(3) The cargo exceeding the port capacity will be transported on land, mainly by trucks, from the alternative ports to Guatemala City.

2.4.3 Prerequisites of the economic analysis

In order to estimate the costs and benefits under the "With" and "Without" cases, the following prerequisites are assumed for the analysis.

(1) The cargo not transferred to the alternative ports will be handled at the Port. Although no additional investment will be made to enlarge the existing port facilities, the required funds will be provided to maintain the existing facilities at their current level of service.

(2) The alternative ports under the "Without" case are selected as the ports of Cortes, Acajutla and Quetzal, and these ports have enough capacity to handle the overflow cargo from the port of Santo Tomas de Castilla.

(3) The land transportation capacity from the alternative ports is also assumed to be sufficient.

(4) Under the "With" case, the short-term plan for the port development will be implemented from the year 1990 and the new container terminal and petroleum terminal will start operations in 1993.

2.4.4 Economic Prices

For the economic analysis, prices are expressed in economic prices rather than market prices, based on the border price concept. The border prices (economic prices) are calculated by eliminating transfer items, such as taxes, subsidies, etc.

2.4.5 Benefits of the Project

In line with the objectives of the development and the significance of the Short-term Plan for the development of the port, the following items are identified as major benefits arising from the short-term development from the viewpoint of the national economy.

a) Savings in ships' staying costs
b) Savings in transportation costs by ships
c) Savings in transportation costs by alternative routes
d) Promotion of regional economic development
e) Increase in employment opportunities and incomes
f) Reduction of damage from accidents at the port

It would be difficult to evaluate all these benefits in monetary terms, but here the following items are considered countable and the monetary benefits of these items are calculated.

a) Savings in ships' staying costs
b) Savings in transportation costs by ships
c) Savings in transportation costs by alternative routes

2.4.6 Costs of the Project

The costs arising from the implementation of this project are as follows:

(1) Construction Costs
(2) Maintenance Costs
(3) Operation Costs
    a) Personnel costs
    b) Administration costs
    c) Other costs
(4) Replacement Costs for Handling Equipment

2.4.7 Evaluation

(1) Results of the EIRR

The lifespans of the various port facilities and infrastructures vary. Here, the average lifetime of the facilities, 30 years, is taken as the

project lifetime. The cost-benefit analysis is carried out starting in 1990 and ending in 2022.

The results of the calculation of the EIRR are as follows:

Alternative Case 1 : EIRR = 23.4 %
Alternative Case 2 : EIRR = 20.1 %
Alternative Case 3 : EIRR = 19.5 %

(2) Sensitivity Analyses

In order to estimate the variation of the EIRR, sensitivity analyses are made for three cases for each alternative and the results are as follows:

Case	Alter-1	Alter-2	Alter-3
Base	23.4	20.1	19.5
A	21.9	18.7	18.1
B	20.2	16.9	16.4
C	18.9	15.7	15.1

Case A : The construction costs increase by 10 %
Case B : The forecast cargo volume decreases by 10 %
Case C : The construction costs increase by 10 % and the cargo volume decreases by 10 % simultaneously

2.4.8 Conclusion

From the above calculations, the EIRR of this project is more than 19.5 %. The results of the EIRR calculation, only taking into account the major three quantitative benefits, show a return of more than 15 % under every probable case. Therefore, this Short-term Development Project is feasible from the viewpoint of the national economy.

2.5 FINANCIAL ANALYSIS

2.5.1 Purpose and Methodology of Financial Analysis

(1) Purpose

The purpose of the financial analysis is to ascertain the impact of the present project on the financial condition of the port management body and to examine the profitability of the project itself, to determine whether or not the project is sound from the financial viewpoint.

(2) Methodology of the Financial Analysis

The investment effects of this project are analyzed by the following two methods.

a) Analysis by financial statements

The financial viability of the management body is appraised based on the projected financial statements (income statement, statement of source and application of funds) and analyses of the statements and fund raising conditions.

b) Analysis by discount cash flow

The profitability of the project itself is analyzed by the financial internal rate of return (FIRR) using the discount cash flow method (D.C.F.). The FIRR is a discount ratio which makes the net present value of the cash flow (revenue minus cost) equal to zero.

2.5.2 Prerequisites for Financial Analysis

The following points are assumed for the analysis:

a) All of the port activities of EMPORNAC are analyzed.
b) The accounting is carried out under the business accounting system.
c) The financial analysis covers the period from 1990 to 2019.
d) The funds necessary to execute this project are to be raised as follows:

- Domestic currency portion: Government funds (Government subsidy and EMPORNAC's reserves)

- Foreign currency portion: Soft loan from a foreign country.

e) The revenue is calculated based on the current port tariff rate authorized by the Guatemalan government and the new container handling tariff which is proposed by the study team.

f) The fixed assets consist of the existing facilities and the additional investment. Depreciation is calculated using the straight line method, considering the residual value.

2.5.3 Revenues

As indicated in the above assumptions, the revenue is calculated using EMPORNAC's tariff rates and the proposed container handling charges. The types of dues and charges are as follows.

a) Ship charges
   Port dues, Pilotage, Tug boat fee, Mooring-Unmooring charges
b) Berthage
c) Water supply
d) Cargo handling charge
e) Storage charge
f) Others

2.5.4 Expenditure

The expenditure is calculated as follows:

a) Personnel cost and administration cost
b) Maintenance and repair cost
c) Fuel expenses
d) Replacement cost
e) Depreciation expense
f) Interest on long-term loans

2.5.5 Results of Financial Analysis

(1) Evaluation of Financial Ratios

a) Working Ratio

The working ratio is very good compared with that of ports in Europe, North America and Australia.

b) Operating Ratio

Like the working ratio, the operating ratio has a very favorable value.

c) Debt Service Coverage

The high value of this ratio shows that there will be no problem in repaying the loans.

(2) Evaluation by Discount Cash Flow (DCF)

In evaluating the financial profitability of the project, the financial internal rate of return (FIRR) using the discount cash flow (DCF) method is used. In this project, 69% of the overall construction cost (i.e. the foreign portion) is assumed to be raised by a soft loan. The FIRR is required to exceed the weighted average interest rate for all the project funds. Judging from this point of view, this project can be regarded as feasible, since the FIRR of the project is 7.37%, well above the weighted average interest rate.

(3) Result

As shown by the foregoing financial ratios and by the FIRR, there are no problems in balancing revenues and expenditures or in raising funds. With the new investments the financial soundness of the port management body is easily secured and the financial viability clearly demonstrated.

2.5.6 Sensitivity Analysis

(1) Identification of Cases

Sensitivity Analysis is executed for the following cases;

Case A cargo handling volume decreases by 10%
Case B port tariff increases by 10%

(2) Result

The calculation results are Case A 5.15% and Case B 8.06%. Every FIRR exceeds the lower limit. The results of the sensitivity analysis prove that each would be feasible.

(3) Conclusion

From the viewpoint of the profitability of the project itself and the financial viability of the management body, this project can be regarded as feasible.

INTRODUCTION

INTRODUCTION

(1) Background

The Republic of Guatemala is primarily an agricultural country. Agricultural products and processed goods are Guatemala's main exports, and they are shipped mostly to the United States, Central and South America, Western Europe and Japan through the five principal ports: Santo Tomas de Castilla and Puerto Barrios on the Atlantic Ocean and San Jose, Champerico and Quetzal on the Pacific Ocean.

As Guatemala has major ports on both the Atlantic and the Pacific Ocean coasts, the nation is in a good position to conduct maritime trade. The port of Quetzal was opened in 1983 as the first deep seaport on the Pacific Ocean coast of Guatemala. On the other hand, on the Atlantic coast, the Port of Santo Tomas de Castilla serves as the main terminal for the trade between Guatemala and the eastern coast of the the United States and Western Europe. The volume of cargo handled at this port in 1986 was around 2.3 million metric tons.

Santo Tomas de Castilla is thus the biggest port in Guatemala in terms of cargo throughput. The Port accounted for approximately sixty percent of the total national maritime cargo throughout at Santo Tomas over the last five years, with the average annual growth rate of 7.8% indicating a steady increase of cargo flow.

Construction work at the Port of Santo Tomas began in the mid-1950's and the Port was designed as the first modern seaport in Guatemala at that time. However, the water depth along the 914 meter quaywall is only 9 meters, and thus the facilities are insufficient to accommodate vessels larger than 10,000 DWT, which have become common in international maritime transport. Moreover, the cargo handling areas are small, and the cargo handling equipment is old. Thus the cargo handling system is relatively inefficient, and it is difficult to adapt the current facilities to modern innovations in cargo handling including increased containerization.

(2) Circumstances

Under these circumstances, the Government of Guatemala requested the

Government of Japan to conduct a feasibility study on the development project of the Port mainly aiming at the following objectives:

- Expansion of quaywalls to increase berthing capacity,
- Deepening and expansion of the access channel and basin for larger vessels,
- Improvement and installation of land facilities including container yards, silos for bulk cargoes such as grains and land transportation terminals in the port district,
- Improvement and renewal of cargo-handling equipment,
- Construction of facilities for port administration.

In response to the request, the Government of Japan decided to conduct the Study on the Development Project of the Port of Santo Tomas de Castilla. Based on the agreement between both Governments, JICA organized a study team headed by Mr. Keiichi Miyota, Executive Director, OCDI and the study team executed the study from June of 1987 to June of 1988.

(3) Objectives of the Study

The objectives of the study are to prepare a Master Plan for the development of the Port for the period up to the year 2005, and to conduct technical, economic and financial feasibility studies on a Short-term Development Plan for the target year 1995 based on the Master Plan.

(4) Study Schedule

The study was conducted as follows:

1) First field survey, presentation of the Inception Report	: June - August, 1987
2) Presentation of the Progress Report	: August, 1987
3) Preparation of the Interim Report	: Sep. - Nov., 1987
4) Presentation of the Interim Report	: November, 1987
5) Preparation of the Draft Final Report	: December, - March, 1988
6) Presentation of the Draft Final Report	: March, 1988
7) Preparation of the Final Report	: May - June 1988
8) Submission of the Final Report	: July 1988

(5) Organization of the study team

The Japanese study team was comprised of 10 specialists from OCDI, YEC and a representative of JICA as follows:

Title	Name		Responsibility	
Study Team				
Team Leader	Keiichi	MIYOTA	Overall Management	(OCDI)
Co-leader	Yugo	OHTSUKI	Port Planning	(OCDI)
Specialist	Nobuyuki	MANABE	Port Administration and Operation, Financial Analysis	(OCDI)
Specialist	Takashi	YAMAMOTO	Demand Forecast, Economic Analysis	(OCDI)
Specialist	Mitsuo	IGARASHI	Navigational Channel Planning	(OCDI)
Specialist	Shuji	SEKIGUCHI	Design and Cost Estimation	(YEC)
Specialist	Katsutoshi	SUZUKI	Natural Conditions (Soil investigation)	(YEC)
Specialist	Shuichi	ONDA	Natural Conditions (Sounding survey I)	(YEC)
Specialist	Ryoichi	MINAMI	Natural Conditions (Sounding survey II)	(YEC)
Interpreter	Sachiyo	SANO	Interpreter	(OCDI)
Coordinater				
	Kenichi	KOJIMA	Coordination	(JICA)
	Toshiichi	MINATANI	Coordination	(JICA)

(6) List of EMPORNAC's counterparts

Ing. Antonio Garicia	(Chief of Engineering Department)
Lic. Jose Roland Alivato	(Director of Financial Division)
Ing. Carlos Quinto	(Director of Mechanical Department)
Ing. Roland Chorosajev	(Director of Port Operation Division)
Sr. Hugo Sierra	(Chief of Comercial Division)
Sr. Rigoberto Chavarria Panlencia	(Sub-Director of Port Operation Division)
Sr. Andres Hora Lyanceva	(Sub-Director of Maritime Operation Division)