

**VOLUME 1**  
**SUMMARY**

**THE STUDY ON  
THE DEVELOPMENT PROJECT  
OF THE PORT OF  
SAN PEDRO DE MACORIS  
IN THE DOMINICAN REPUBLIC**



**FINAL REPORT**

**DECEMBER 1987**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

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**DICEMBER 1987**

国際協力事業団	
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## PREFACE

In response to a request from the Government of the Dominican Republic, the Japanese Government decided to conduct a survey on the Development Project of the Port of San Pedro de Macoris, and entrusted the survey to the Japan International Cooperation Agency (JICA).

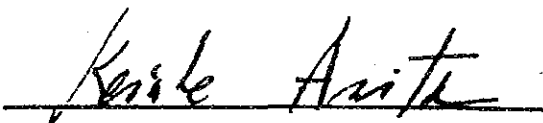
JICA sent to the Dominican Republic a survey team headed by Mr. Fujio Saigusa comprising experts from the Overseas Coastal Area Development Institute of Japan (OCDI) and Nippon Tetrapod Co., Ltd. three times from September 1986 to September 1987.

The team exchanged views on the Project with the officials concerned of the Dominican Government, conducted field surveys and collected reference materials. After the team returned to Japan, further studies were made and the present report was prepared.

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

I wish to express my deep appreciation to the officials concerned of the Government of the Dominican Republic for their close cooperation extended to the team.

December, 1987

A handwritten signature in dark ink, reading "Keisuke Arita", is written over a horizontal line.

Keisuke Arita

President

Japan International Cooperation Agency





## LETTER OF TRANSMITTAL

December 1987

Mr. Keisuke Arita  
President  
Japan International Cooperation Agency

Dear. Mr. Arita:

It is my great pleasure to submit herewith the Report for the Study on the Development Project of the Port of San Pedro de Macoris in the Dominican Republic.

This report is the result of studies carried out by the Overseas Coastal Area Development Institute of Japan and Nippon Tetrapod Co., Ltd. at the request of the Japan International Cooperation Agency (JICA). Regarding this project, the study team conducted three series of field surveys, one of which took place for the 75 days from September 16, 1986 to collect a variety of information including data concerning natural conditions.

The findings of these surveys were discussed to prepare the Master Plan, the Short-term Development Plan and to study the feasibility of the Short-term Development Plan, and were then compiled into this report. The study shows that the Project is extremely important, so I hope the Project is executed promptly.

On behalf of the study team, let me express my heartfelt thanks to the Ministry of Public Works and Communications and to the other related agencies of the Dominican Republic Government for the generous cooperation, assistance and warm hospitality which were extended to the study team during their stay in the Dominican Republic.

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

Yours faithfully,

*Fujio Saigusa*

Fujio SAIGUSA

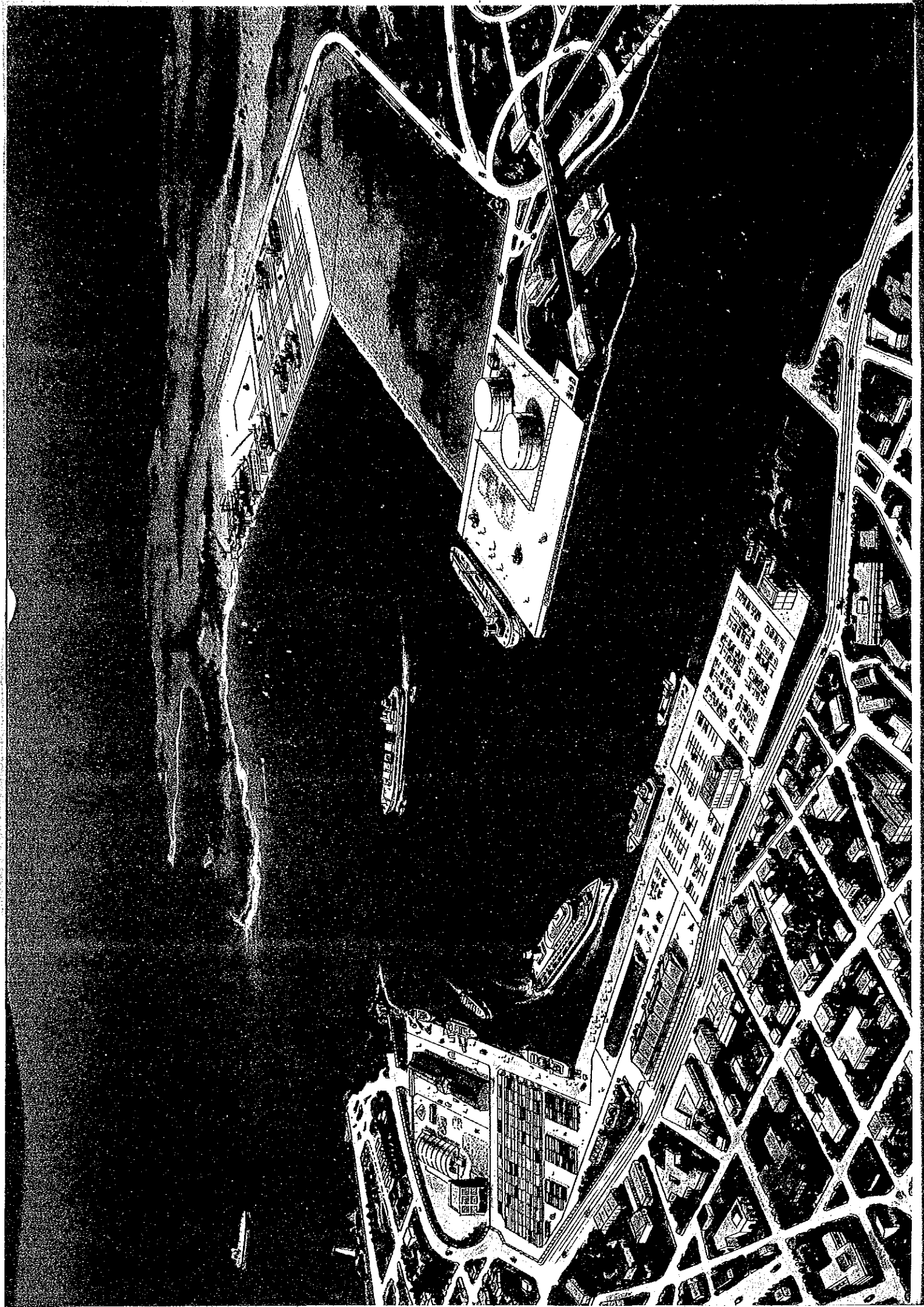
Head

Japanese Study Team for the Development  
Project of the Port of San Pedro de Macoris  
(Senior Advisor, the Overseas Coastal Area  
Development Institute of Japan)











### EXCHANGE RATE

US\$ 1 = RD\$ 3.08

RD\$ 1 = ¥ 52.42





## ABBREVIATIONS

	Full Name (Spanish)	Full Name (English)
APD	Autoridad Portuaria Dominicana	Dominican Port Authority
CDE	Corporación Dominicana de Electricidad	Dominican Electric Power Corporation
CEA	Consejo Estatal del Azúcar	State Council of Sugar
CEDOPEX	Centro Dominicano de Promoción de Exportaciones	Dominican Center on Promotion of Export
CELADE	Centro Lationamericano de Demografía	Latin American Demographic Center
CFS		Container Freight Station
CIF	Coste, Seguro y Flete	Cost, Insurance and Freight
DWT	Tonelaje de Peso Muerto	Dead Weight Tonnage
FCL		Full Container Load
FERQUIDO	Fertilizantes Químicos Dominicanos, S.A.	Dominican Chemical Fertilizer Corporation
FOB	Franco a Bordo	Free on Board
FUNDESIRE	Fundación para el Desarrollo Integral de la Región Este	Foundation for the Integral Development of East Region
GDP	Producto Interno Bruto	Gross Domestic Production
GRT	Tonelaje Bruto de Registro	Gross Registered Tonnage
JICA	Agencia de Cooperación Internacional del Japón	Japan International Co-operation Agency
LCL	menos que contenedor carga	Less than Container Load
LOA		Overall Length
lo/lo		lift-on/lift-off system
LWL	Nivel de Bajamar	Low Water Level
MHWL	Nivel de Pleamar Media	Mean Springs High Water Level
MLWL	Nivel de Bajamar Media	Mean Springs Low Water Level
MSL	Nivel Medio del Mar	Mean Sea Level

ONAPLAN	Oficia Nacional de Planificación	National Planning Office
ONE	Oficina Nacional de Estadística	National Statistics Office
ro/ro		roll-on/roll-off system
SEA	Secretaría de Estado de Agricultura	Ministry of Agriculture
SEOPC	Secretaría de Estado de Obras Públicas y Comunicaciones	Ministry of Public Works and Communications
TEU		Twenty-foot Equivalent Unit
RD \$	Peso de la República Dominicana	Peso of the Dominican Republic
US \$	Dólar de Estados Unidos	US Dollar
¥	Yen de Japón	Japanese Yen

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## **CONCLUSIONS AND RECOMMENDATIONS**



## CONCLUSIONS

### 1. Necessity of the Development of the Port of San Pedro de Macoris

The port of San Pedro de Macoris is one of the most important ports in the Dominican Republic and plays an essential role in the development of the Nation.

However, the facilities at the Port have become superannuated and some of the facilities have reached a very dangerous condition. The cargo handling activities are mostly carried out by manual labor and are being hindered by the outdated facilities.

To promote the national and regional socioeconomic development, appropriate and timely action must be taken by the Government to develop the Port.

### 2. Master Plan

The port of San Pedro de Macoris is an estuary port, and it is blessed with good natural conditions including available land and a sufficiently large water area sheltered by a cape. A positive vision of the Port is set out as the Master Plan based on the locational advantages of the Port and the natural conditions of the Study Area.

The Master Plan is formulated with a target year of 2005. At Present, sugar is the main cargo item at the Port. In this study, after careful assessment of the national and regional economic conditions, it is projected that various commodities will be handled at the Port in the future. The estimated cargo volume at the Port in the target year is about 1.3 million tons considering the historical trend, the forecast growth of the socioeconomic activities and the economic transport of cargo in the hinterland.

The Master Plan is based on the required scale of the facilities as estimated from the projected traffic. Judging from the technical evaluation, 7 public berths are required: 5 berths for cargo handling and passenger ships, 1 berth for ferry boats and 1 berth for small craft. All of these wharfs are planned to be newly constructed because the existing wharfs cannot meet the requirements of the Master Plan such as increased

ship size and the promotion of efficient and safe cargo handling. Considering the maximum utilization of the existing port facilities other than the wharfs, six new berths are planned on the east side of the river. One additional berth is planned on the west side thereafter as there will be no further room for the construction of additional berths on the east side at that time. The maximum average sizes of vessels which will call at the Port in the future will be 20,000 DWT for cargo ships and 20,000 GRT for passenger boats.

The project cost is roughly estimated at about 200 million pesos and the foreign portion of the cost is about 133 million pesos (in October 1986 prices).

### **3. Short-term Development Plan**

The target year of the Short-term Development Plan is 1995. The Plan is formulated based on the Master Plan. The estimated cargo volume in 1995 is about 1.0 million tons.

The Short-term Development Plan includes 6 public berths on the east bank: 4 berths for cargo handling and passenger ships, 1 berth for ferry boats and 1 berth for small craft.

In order to achieve efficient cargo handling, new handling systems are proposed. It is also proposed to set up a port authority to administrate, manage and operate the Port.

The project cost is estimated at about 145 million pesos comprising 99 million pesos of foreign currency and 46 million pesos of local currency (in October 1986 prices). Half of the cost is for the construction of wharfs and the repair work of the breakwater, and it is assumed that this cost shall be borne by the national government. The construction period is around 3 years.

### **4. Economic and Financial Analysis of the Short-term Development Plan**

#### **1) Economic Analysis**

The Short-term Development Plan is evaluated in terms of the Economic Internal Rate of Return (EIRR) which is calculated based on cost-benefit analysis using the Discount Cash Flow Method from the viewpoint of the



national economy. Considering the savings in ships' staying costs and land transport costs as tangible benefits, and using 30 years as the period of economic calculation, the internal rate of return is calculated as 20%.

This shows that the Short-term Development Plan is feasible from the viewpoint of the national economy.

## 2) Financial Analysis

The Short-term Development Plan is evaluated in terms of the Financial Internal Rate of Return (FIRR) from the viewpoint of the financial viability of the port management body.

The revenues which will be considered as arising from this project are the port tariffs, while expenditures are the project cost mentioned above excluding the cost borne by the national government, maintenance costs of all the port facilities and operating costs.

The FIRR is 7.0%, and it can be said that the projected financial condition is favorable.

This project is evaluated as profitable enough from the viewpoint of the national economy.

From the financial viewpoint, in order to execute this project successfully it is necessary for the Dominican Government to establish a practical system and organization which will enable the government to grant funds for the Project based on the projected financial situation at the port including the port management system and port tariff system proposed in this study.

## RECOMMENDATIONS

The facilities of the port of San Pedro de Macoris are seriously superannuated and this project should be started as soon as possible. Determination of the development plan, fund raising, detail design and construction will be carried out based on this study.

Execution of this project should be well coordinated with the development plan for the Eastern Region and other development plans and projects.

Some works should be carried out previous to the commencement of the execution of the Project considering the time requirements.

The Study Team would like to make the following recommendations concerning various matters which were noticed while conducting the Study.

(1) At present, there is no one organization which comprehensively administers, manages and operates the Port. In order to achieve the goals of this project, a unified port management body, which will be responsible for the promotion of port utilization and development, should be established as soon as possible, and the duties of the body should be clearly defined as follows.

- (i) The Port should be placed under the control of APD as soon as possible.
- (ii) The limits of the port area of San Pedro de Macoris should be exactly defined, and the port authority should have administrative control of the entire port.
- (iii) The port authority should regularly examine the conditions of the port facilities and should carry out the necessary maintenance works.
- (iv) In order to maintain sound finances, the port authority should prepare financial plans for the administration and management of the Port including the determination of port tariffs, and should operate the Port in accordance with these plans.
- (v) The port authority should keep accurate statistics concerning ships, cargoes and tariffs, and collect information concerning cargo demand. The basic data such as "entrance/clearance notices," "cargo handled," and "revenue/expenditure statements" should be compiled every year.
- (vi) By carrying out tide observations, wave investigations, sounding

surveys and soil investigations periodically, the port authority should be well-informed concerning the natural conditions of the Port, and should utilize this information for the port administration and development.

(2) In order to maintain smooth port activity, it is necessary to carry out customs clearance, quarantine, medical inspection and immigration in a timely manner as well as to construct port facilities and to establish a port management body.

(3) The construction works of the Project should be executed based upon the proposed work schedule without interfering with regular port activities.

(4) It is recommended that the dredging work planned by SEOPC prior to the commencement of the Short-term Development Plan should be executed by incorporating the plan proposed in this study to avoid unnecessary duplication of efforts and delays.

(5) The following should be implemented before the commencement of the Project.

- (i) The maintenance work presently being executed mainly on the concrete decks of the wharfs should be upgraded in quality and the engineers should adopt a larger cross section.
- (ii) An adequate fendering system should be installed at the frontage of the existing wharfs in order to avoid damage to ships as well as to the wharfs.
- (iii) The port authority should reserve all land within the port area, if possible. This will facilitate smooth port development.
- (iv) The dock road and the trunk road should be improved and properly connected to ensure the smooth distribution of cargoes.



## INTRODUCTION



## INTRODUCTION

### 1. Background

The Dominican Republic occupies the eastern two-thirds of the island of Hispaniola, lying almost in the center of the Greater Antilles which separate the Caribbean Sea from the Atlantic Ocean.

Because of its geographical conditions, almost all of the country's foreign trade relies on marine transportation, making the role of ports in the Dominican Republic quite important. The Government of the Dominican Republic regards ports as centers of regional development. It encourages the development of each of its ports in an effort to promote suitable distribution of population and balanced regional development, particularly in light of the extremely heavy concentration of population in Santo Domingo, the national capital.

The port of San Pedro de Macoris is located 64 kilometers east of Santo Domingo and faces the Caribbean Sea. The peak volume of cargo handling at this port was about 400,000 tons in the past, ranking fifth in the country. The main export commodities are sugar and molasses.

Although the port of San Pedro de Macoris plays an important role in the marine transportation network of this country, its facilities are becoming superannuated because almost 40 years have passed since their construction. It is urgently necessary to develop the port facilities in order to cope with the increased size of calling vessels and to handle cargo efficiently. So, the Government of the Dominican Republic has requested the Government of Japan to provide technical cooperation in the creation of a plan for developing the port of San Pedro de Macoris which will become a base for promoting the economic development of the Dominican Republic.

### 2. Objectives of the Study

The objectives of the study are to prepare a Master Plan and a Short-term Development Plan of the port of San Pedro de Macoris and to conduct a feasibility study on the Short-term Development Plan.

The target years for the Master Plan and for the Short-term

Development Plan are 2005 and 1995, respectively.

### **3. Circumstances**

The Government of the Dominican Republic requested the Government of Japan to carry out a feasibility study on the Development Project of the port of San Pedro de Macoris.

In response to the request, the Government of Japan decided to undertake the study and dispatched the Japanese Preliminary Study Team headed by Mr. Fujio Saigusa, to the Dominican Republic from February 10 to February 22, 1986. The team had a series of discussions about the project with the Ministry of Public Works and Communications. The Scope of Work for the Study was agreed upon on February 18, 1986 by Mr. Fujio Saigusa, leader of the Japanese Preliminary Study Team, and Mr. Pedro Delgado Malagon, Minister of Public Works and Communications.

Based on the Scope of Work, JICA organized a study team headed by Mr. Fujio Saigusa, Senior Adviser, OCDI. The study team executed the study including field surveys from September of 1986 to September of 1987.

### **4. Scope of the Study**

In order to achieve the objectives, the Study tasks include the following items.

#### **4.1 Natural conditions**

- (1) To review existing data on natural conditions
- (2) To conduct supplementary field surveys
- (3) To analyze the natural conditions

#### **4.2 Present Situation**

- (1) To investigate the superannuation of port structures
- (2) To evaluate the present condition of port facilities and port activities
- (3) To examine the bottlenecks blocking efficiency in port activities
- (4) To analyze the activities in the hinterland



#### 4.3 Master Plan

The development plan of the Port in the target year 2005 is prepared as the Master Plan. The goals of the Master Plan include the following items.

- (1) To study the proper role of the Port
- (2) To formulate the basic concept of port development
- (3) To forecast future demand for the Port
- (4) To make a land-use plan of the port area and its vicinity.
- (5) To make a basic layout plan of major port facilities
- (6) To make a rough cost estimation for the Master Plan

#### 4.4 Short-term Development Plan and Feasibility Study

A feasibility study is conducted on the Short-term Development Plan which includes the rehabilitation program. The goals of the Short-term Development Plan include the following items.

- (1) To forecast future demand for the Port
- (2) To identify the facilities to be rehabilitated and/or developed
- (3) To define the Short-term Development Plan
- (4) To make basic designs of the major port facilities
- (5) To make a cost estimation and prepare an implementation program
- (6) To conduct economic analysis
- (7) To conduct financial analysis
- (8) To prepare recommendations on port management and operation

#### 5. Study Schedule

The study was conducted as follows.

- |  |               |           |
|--|---------------|-----------|
| (1) Presentation of the Inception Report   | : Sep.,       | 1986      |
| (2) Field Surveys                          | : Sep.- Nov., | 1986      |
| (3) Presentation of the Progress Report    | : Nov.,       | 1986      |
| (4) Preparation of the Interim Report      | : Nov.- Mar., | 1986-1987 |
| (5) Presentation of the Interim Report     | : Mar.        | 1987      |
| (6) Preparation of the Draft Final Report  | : Apr.- Aug., | 1987      |
| (7) Presentation of the Draft Final Report | : Sep.,       | 1987      |
| (8) Preparation of the Final Report        | : Sep.- Dec., | 1987      |
| (9) Submission of the Final Report         | : Dec.,       | 1987      |

## 6. Organization of the Study Team

The Study Team is comprised of seven experts and two JICA representatives. Their names, titles and responsibilities are as follows.

<u>Title</u>	<u>Name</u>	<u>Responsibility</u>
Team Leader	Fujio Saigusa	Overall Management
Co-leader	Taketo Fujii	Demand Forecast and Economic Analysis
Specialist	Toshiro Tsutsumi	Port Planning
Specialist	Iwao Toyoda	Financial Analysis, Port Administration and Operation
Specialist	Hisanori Kato	Design and Cost Estimation
Specialist	Ikunosuke Tsurushima	Natural Conditions (Soil Investigations)
Speicalist	Minoru Hanzawa	Natural Conditions (Sounding Survey)
Coordinator	Chisa Hara	JICA
Coordinator	Izumi Ohno	JICA

## 7. List of Counterparts

<u>NAME</u>	<u>POSITION</u>
Eng. Nelson M. Peña Medina	Chief of port and harbor department of SEOPC
Eng. Nelson Lopez D.	"
Eng. Felipe Medina	Vice-chief of port and harbor department of SEOPC
Eng. Antonio Vidal M.	Engineering adviser of the minister of SEOPC
Eng. José Susana A.	Engineer of port and harbor department of SEOPC
Eng. Alexander T. Holsteinson H.	"
Eng. Ana Logroño	"
Eng. Hamlet A. Jiménez	"
Eng. David Tavares Osses	"
Eng. Rhina Rosario	"
Eng. Adolfo Bienvenidoz	"

## SUMMARY



# **PART I    OUTLINE OF THE DOMINICAN REPUBLIC           AND DEVELOPMENT GOALS OF THE PORT**

## **CHAPTER 1    DEVELOPMENT GOALS OF THE PORT OF SAN PEDRO               DE MACORIS**

### **1.    Background of the Port Development**

(1) The national economic plan and the regional development plans are expected to play a significant role in the economic development of the nation. Regional development plans were formulated for the Southeast, Cibao and Western regions in 1975, 1983 and 1986, respectively.

(2) The government is presently preparing the new national economic plan and a development plan for the Eastern Region.

(3) The comprehensive plan for the natural resources use, industrial development and population distribution will be set in the regional development plan.

(4) The fundamental development goals are comprehended based upon information obtained by the study team during their stay in the Dominican Republic as follows:

#### **1) The national development goals**

- ① The Dominican Republic is one of the largest nations in the Caribbean Sea, and is located in the center of the Caribbean, near the American Continent. Thus, the Dominican Republic is favorably located for marine transportation.

The fundamental national development goals are to realize economic growth developing the nation's resources actively and taking advantage of its good location.

#### **② The major development strategies are identified as follows:**

- (i) To increase agricultural production and productivity.
- (ii) To increase the production of export and import-substitute goods

in the manufacturing sector.

- (iii) To promote the development and enlargement of free zones.
- (iv) To promote tourism through the development of tourist facilities and the improvement of the relevant infrastructure.
- (v) To improve the quantity and quality of housing, water supply and sewage.
- (vi) To formulate an energy supply plan through short-term and long-term studies and to make appropriate investments.
- (vii) To improve and develop the transportation infrastructure.

## 2) The regional development goals

- ① In the population projections of the Dominican Republic, the average rate of annual growth is expected to be 2.0% from 1985 to 2000. This feature is roughly equal to the average for developing countries.

According to the projections, the total population of the Dominican Republic will increase from 6.4 million in 1985 to 9.3 million in 2005. The population will be intensively concentrated in the Metropolitan Area.

The increase of the population without planned economic development will result in urban sprawl around the Metropolitan Area. On the other hand, local economic activities will stagnate and the land use will be imbalanced.

- ② Therefore, the fundamental regional development goals are set as follows.

- (i) Productivity shall be improved and production shall be increased taking advantage of regional resources.
- (ii) Forest resources shall be protected to secure water resources, and the enlargement of the arable land area shall be limited. Therefore, the share of the manufacturing sector in the industrial structure shall be increased and manufacturing shall be promoted to increase the national income.
- (iii) Regional development projects shall make a major contribution toward the industrialization and decentralization of the Nation. The development of the transportation infrastructure shall stimulate the growth of industrial activities in local areas,

indirectly generate growth in other sectors and help to eliminate the regional imbalances.

- (iv) Regional development projects shall be planned making the best use of the existing infrastructure and considering the integrated land use of the Nation.

## **2. Development Goals of the Port**

The development project of the port of San Pedro de Macoris should be oriented towards the national and regional development goals. The development goals of the Port are defined as follows.

- (1) As the Dominican Republic has historically flourished as a center of world trade, and as the nation has traditionally emphasized marine transport, the marine transport sector should be positively developed to continue to play a major role facilitating export of main products and promoting national economic development.

Ports should be improved and developed in accordance with the innovations of marine transport.

The Port of San Pedro de Macoris should be developed to achieve these requirements.

- (2) The provision of adequate infrastructures should help to increase the locational advantages for the manufacturing sector and accelerate regional economic development.

In this regard, the development of ports, industrial estates and industrial free zones is in accordance with the national goals of increased manufacturing and economic development.

Specifically, the port of San Pedro de Macoris should help to increase the locational advantages for the manufacturing sector including firms located in the new free zones in the hinterland, and should be especially effective in promoting economic growth.

- (3) The population and economic activities of the Dominican Republic are excessively concentrated in the Santo Domingo metropolitan area. It is necessary to promote the decentralization of population and economic activities through the development of local and regional economies.

Ports should be located in such a way as to support this local and regional economic development.

In the hinterland of the port of San Pedro de Macoris, there are trunk roads which connect the Port to the eastern region and to the metropolitan area.

The development of the port of San Pedro de Macoris will help to promote the development of the eastern region of the Dominican Republic.



## CHAPTER 2 OUTLINE OF THE DOMINICAN REPUBLIC

### 1. Population

The census of 1920 counted 0.9 million persons. In 1981, there were 5.7 million persons. During the 60 year interval, the population of the country increased by almost 6.3 times. Also a progressive increase can be seen in the migration from rural to urban areas.

According to the projections, the total population of the Dominican Republic will increase from 5.7 million in 1980 to 11.4 million in 2025. Table I.2.1 shows the projection until 2005.

Table I.2.1 Future Population of the Dominican Republic

(Unit: persons)								
Year	1985	1986	1987	1988	1989	1990	1995	2000
Population	6,416,289	6,560,381	6,707,710	6,858,347	7,012,367	7,169,846	7,915,317	8,620,870

Source: República Dominicana en Cifras 1986, ONE

### 2. Economic Profile

More than 10.0% annual economic growth was maintained from 1969 to 1973. However, the oil shock in late 1973 greatly affected the Dominican economy. The annual growth rate was reduced by over 50%. Through the first and second oil shocks the country's economic growth rate gradually declined and the average growth rates in the late 1970's and early 1980's were respectively 4.7% and 3.2%.

As shown in Table I.2.2, the production share of agriculture in 1960 was 24.2%, the share of commercial services was 17.0%, manufacturing accounted for 14.9%, and the government accounted for 9.1% of the gross domestic production. In order to change the dependency on primary products, the Government has attempted to enlarge the manufacturing sector.

Table I.2.2 Gross Domestic Production by Sector

Unit: Thousand Pesos

Item \ Year	1960	1965	1970	1975	1980	1985
Agriculture	(24.2%) 187,923	(17.8%) 157,481	(15.7%) 232,766	(11.5%) 262,793	(10.2%) 297,475	(10.0%) 314,700
Stock Raising	(7.6) 59,104	(7.9) 69,877	(6.9) 103,118	(5.5) 125,495	(5.8) 168,186	(6.2) 193,900
Silviculture and Fishing	(1.0) 7,477	(1.1) 9,415	(0.6) 9,255	(0.5) 11,624	(0.6) 18,537	(0.7) 22,100
Mining	(1.6) 12,100	(1.4) 12,067	(1.5) 22,742	(5.3) 121,735	(4.3) 124,623	(4.3) 135,000
Manufacturing	(14.9) 115,294	(12.7) 112,229	(18.6) 275,366	(18.7) 428,496	(18.3) 530,179	(16.9) 531,300
Construction	(2.8) 21,407	(3.3) 29,259	(4.9) 72,655	(6.7) 152,575	(6.8) 197,548	(6.1) 190,100
Commercial Services	(17.0) 131,733	(15.3) 135,560	(16.1) 237,612	(16.9) 385,900	(16.3) 473,624	(15.8) 495,900
Transportation	(4.2) 32,323	(5.3) 46,764	(7.0) 104,500	(7.1) 161,452	(6.9) 199,595	(6.7) 209,300
Communications	(0.5) 3,847	(0.6) 5,338	(0.7) 10,314	(0.9) 21,165	(1.1) 30,891	(1.3) 41,400
Electric Power Supply	(1.0) 8,088	(1.2) 10,390	(1.2) 17,538	(1.3) 29,997	(1.7) 49,018	(1.9) 59,400
Finance	(1.7) 12,948	(1.8) 15,488	(1.8) 27,049	(2.1) 48,689	(2.4) 70,442	(2.8) 88,300
Real Estate	(6.9) 53,346	(8.0) 70,939	(6.7) 100,166	(6.5) 149,047	(6.8) 198,128	(6.8) 212,200
Government	(9.1) 70,725	(15.4) 136,038	(10.2) 152,134	(8.0) 183,107	(9.7) 280,259	(10.7) 335,100
Other Services	(7.5) 59,290	(8.2) 72,032	(8.1) 120,323	(9.0) 206,859	(9.1) 265,418	(9.8) 305,900
Total	(100.0) 775,605	(100.0) 882,877	(100.0) 1,485,538	(100.0) 2,288,934	(100.0) 2,903,923	(100.0) 3,134,600

- Note: (1) Figures for 1960 and 1965 are in constant 1962 prices and figures from 1970 are on a 1970 basis.  
 (2) Figures for 1985 are estimated.  
 (3) Sources: Cuentas Nacionales and Boletín Mensual Mayo de 1986, Banco Central

### CHAPTER 3 PORT ACTIVITY IN THE DOMINICAN REPUBLIC

There are 15 ports in the Dominican Republic: 7 ports on the north coast facing the Atlantic Ocean, and 8 on the south coast facing the Caribbean Sea. 4 of the 7 north coast ports are located along Samana Bay and thus experience relatively calm sea conditons. The port locations are shown in Fig. I.3.1.

In recent years, the national cargo volume has varied from five to six million tons, and since 1981 the total cargo volume has decreased slightly. The ratio of foreign trade to domestic trade is about 35 to 1. Foreign trade is predominant. In foreign trade, the volume of import cargo is gradually increasing while exports are decreasing.

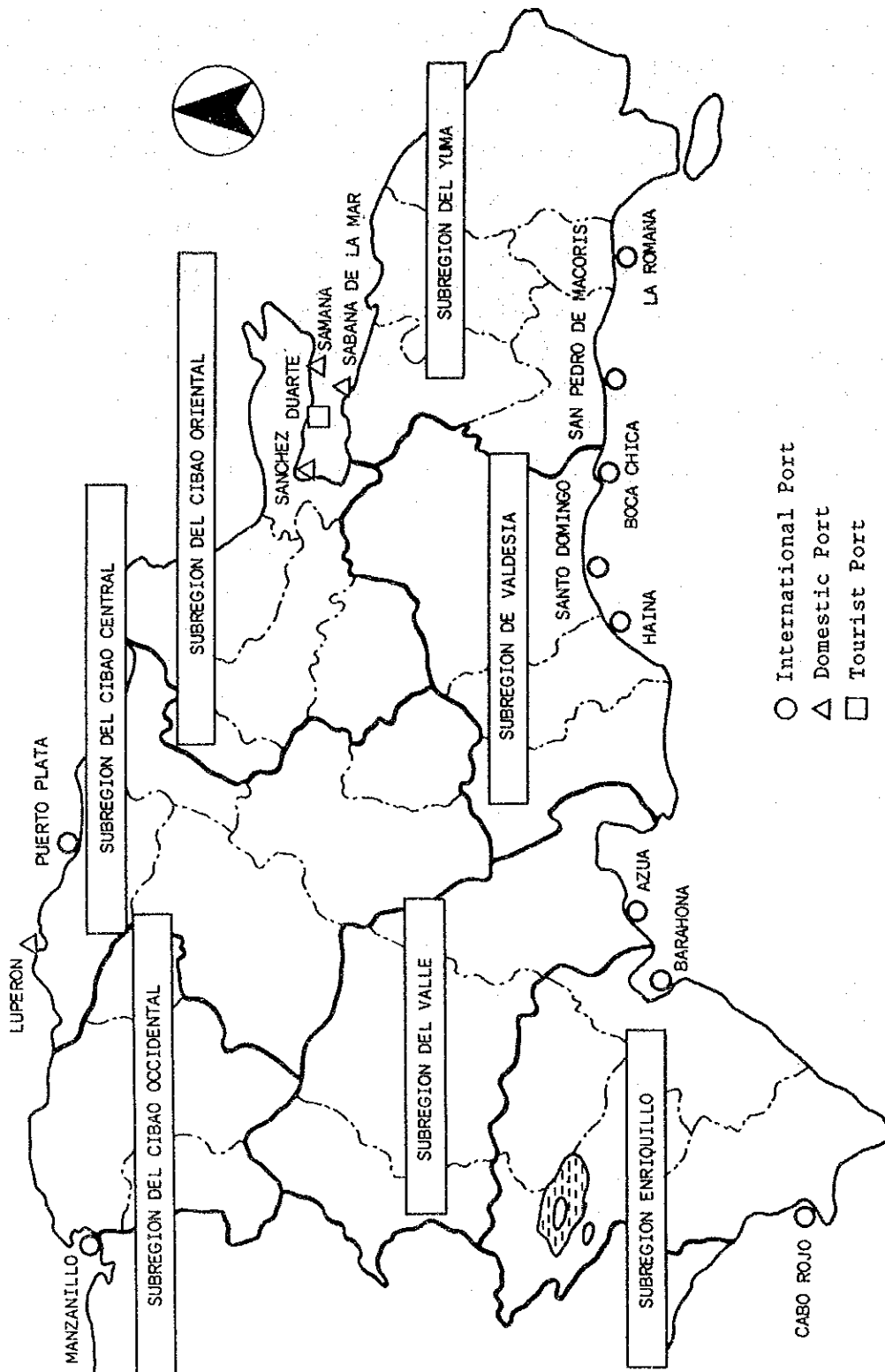


Fig. I.3.1 Location Map of Ports

## **CHAPTER 4    PRESENT SITUATION AT THE PORT OF SAN PEDRO DE MACORIS**

### **1.    General**

The port of San Pedro de Macoris is located 64 km east of the capital city, Santo Domingo, and faces the Caribbean Sea.

The Port is connected by a highway with Santo Domingo, and also has good road connections with Hato Mayor and La Romana, local commercial centers in the eastern region.

The Port is located on the east bank of the Higuamo River and the city of San Pedro de Macoris is expanding toward the north and the east in recent years, supported by the Port.

### **2.    Port Layout**

The port layout is shown in Fig. I.4.1.

### **3.    Soil Conditions**

A soil investigation was carried out at six bore holes in the port area including drilling, sampling and in-situ tests. The locations of the six bore holes are shown in Fig. I.4.2. The soil profile and the characteristics such as N-value and grain size distribution along the existing wharfs and along the transverse line of the Higuamo River are shown in Fig. I.4.3 and Fig. I.4.4, respectively.

The soil characteristics along the existing wharves are summarized as follows.

The top layer is organic mud consisting of very soft sediment. This layer is considered to have accumulated after the construction of the existing port facilities and to have been mixed with stone blocks or concrete fragments which fell into the layer during or after the construction of the wharfs.

The second layer is gravel. The caliche of the bearing stratum is relatively shallow, about -18 m under the second layer.

A very thick third clay layer lies about 30-40m under the sediment and sand layers at No.2 and No.3.

The bearing stratum, therefore, is located at a very deep level of -50

to -60m at Wharf No.3 in marked contrast to the soil conditions at Wharf No. 1.

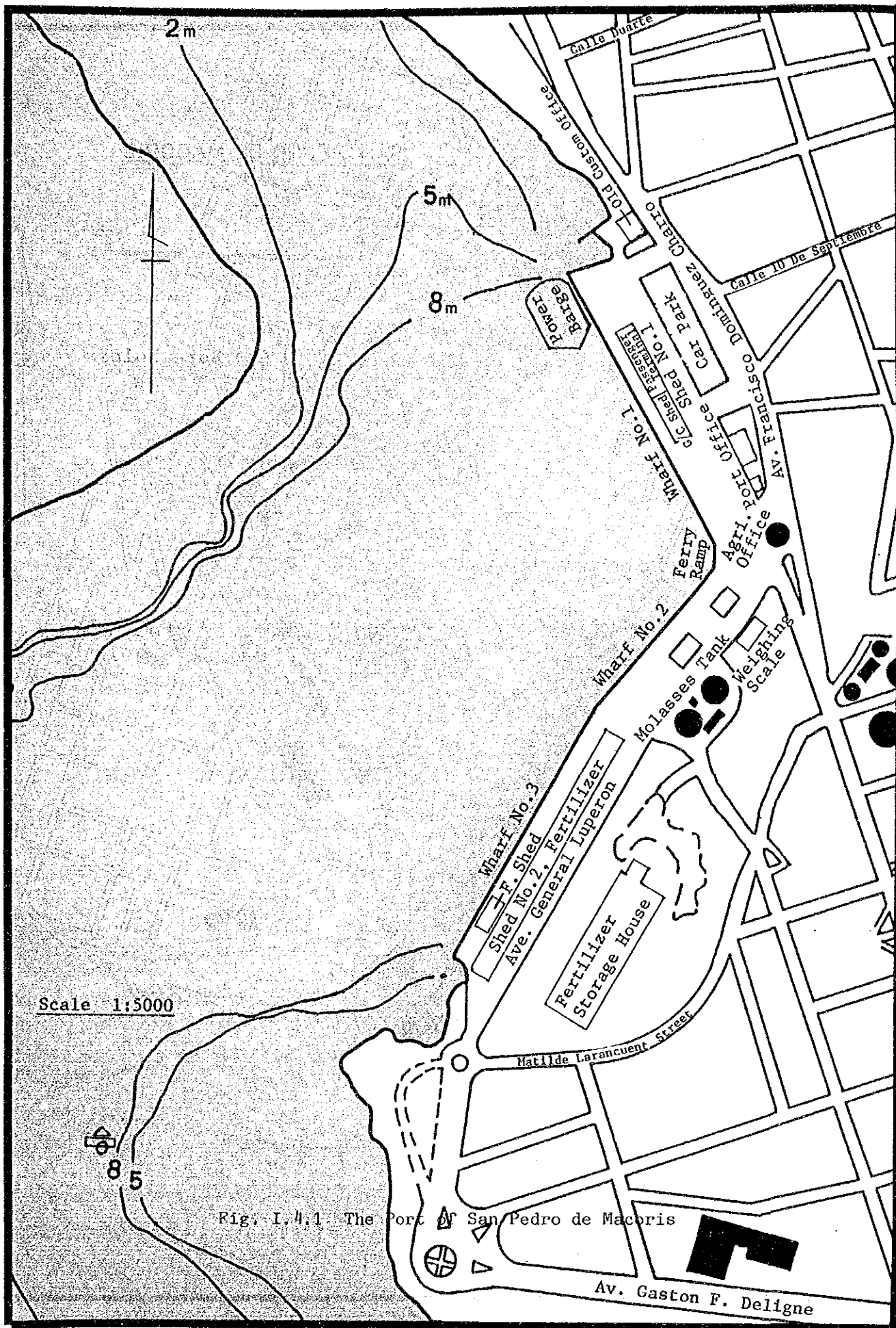
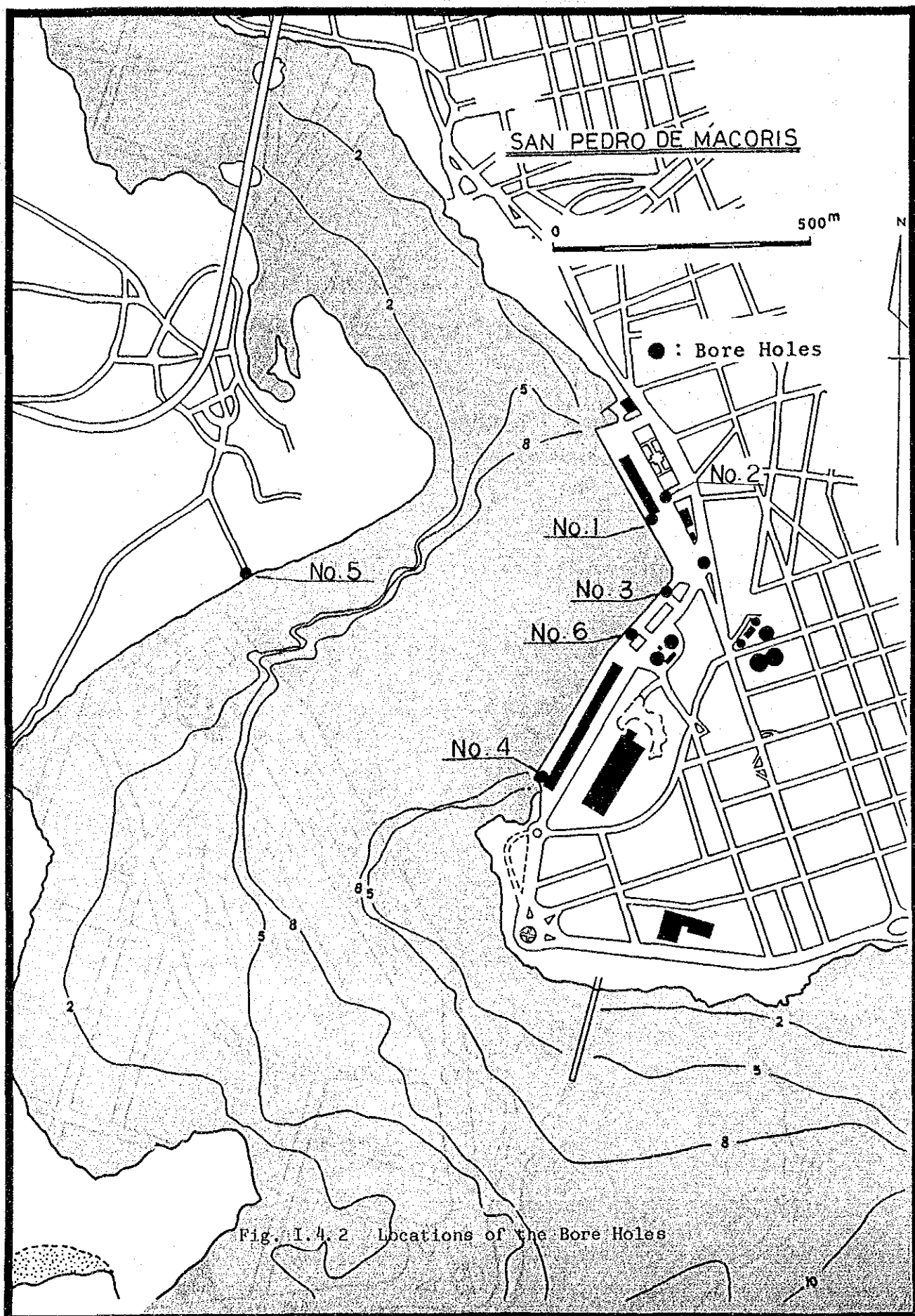


Fig. I.4.1. The Port of San Pedro de Macoris







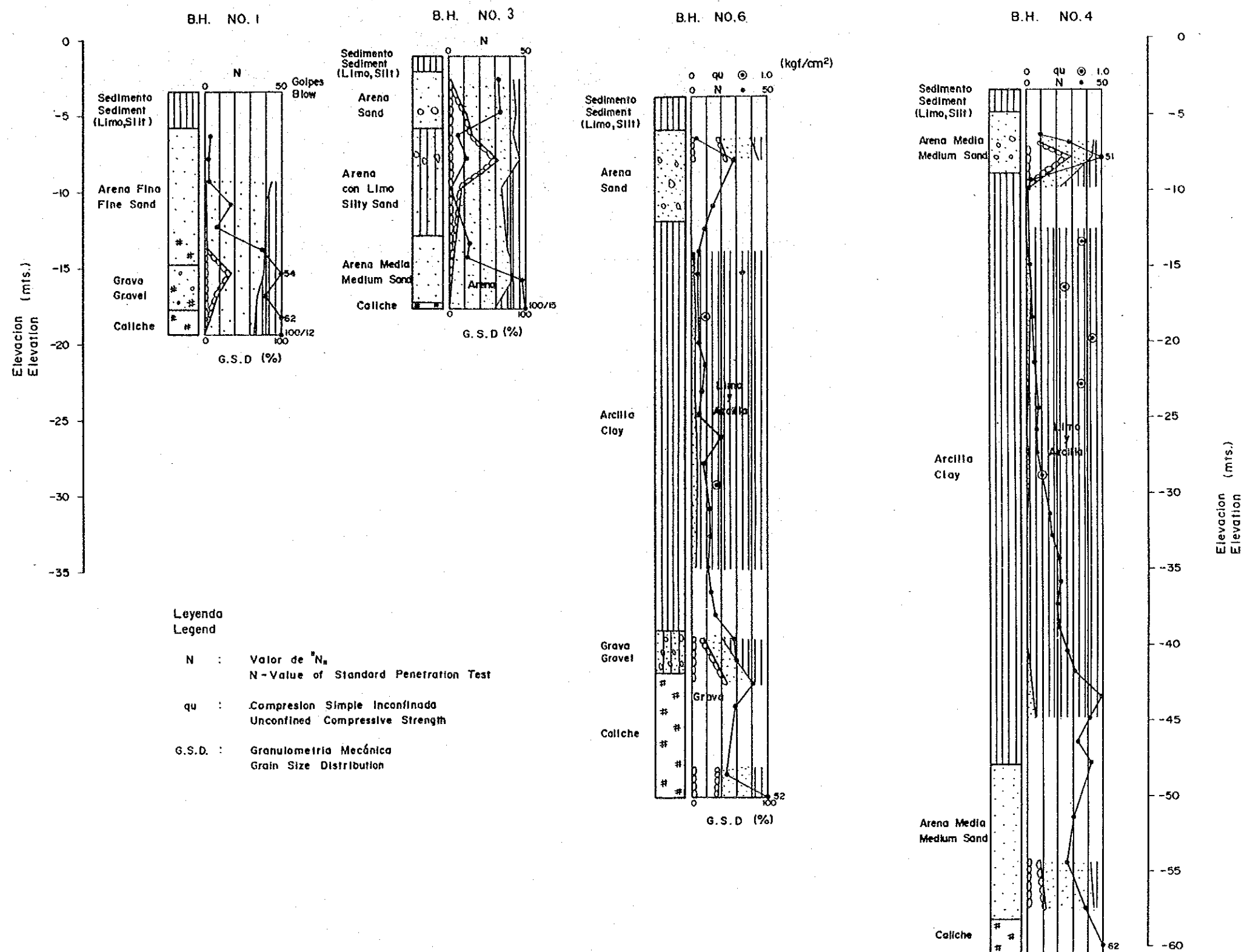
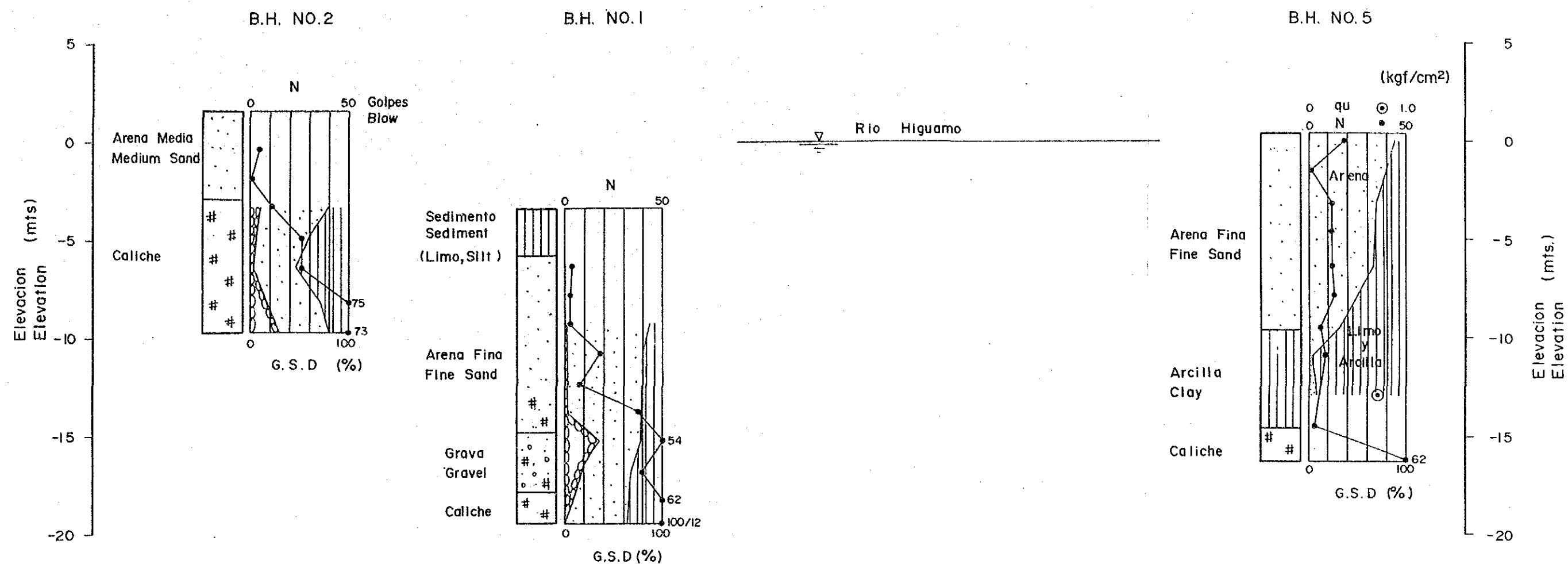


Fig. I.4.3 Soil Profiles (1)





**Leyenda  
Legend**

N : Valor de "N"  
N-Value of Standard Penetration Test

qu : Compresion Simple Inconfineda  
Unconfined Compressive Strength

G.S.D : Granulometria Mecánica  
Grain Size Distribution

Fig. I.4.4 Soil Profiles (2)





#### **4. Present Situation of the Existing Port Facilities**

##### **4.1 Existing Port Facilities**

The existing port was constructed in 1946, and all the wharfs have become badly deteriorated through their long service period of over 40 years. The adverse effects of the deteriorated wharfs on efficient and safe cargo handling operations have long been recognized, but no major rehabilitation work has taken place.

The supporting concrete piles are 40-50 feet long at Wharf No.1, about 60 feet at No.2 and about 75 feet at No.3, and were driven from both land and sea by 1 ton class steam hammers.

##### **4.2 Results of the Investigations**

The deterioration of the existing wharfs is relatively simple in nature and is characterized by concentrated damage on the decks and sub-beams. A summary of the deterioration survey is shown in Fig. I.4.5.

###### **(1) Damage to Wharf Decks**

The damage to the wharfs is concentrated on the decks and the sub-beams. The approximately 5 cm thick concrete surface layer covering the reinforcing steel bars has widely spalled off, and the bars are exposed and corroded over most of the under surfaces. The concrete work is inadequate in both quality and design necessitating continual repair work.

The following are the major reasons for this serious damage:

- i) surcharge larger than the original design load
- ii) insufficient cross-section of the decks and sub-beams
- iii) poor quality of maintenance work
- iv) deterioration of concrete/steel members

###### **(2) Subsidence of the Wharfs**

A clear non-uniform subsidence is observed near the ferry ramp on Wharf No.2. The difference of the elevation there is measured at about 20 cm.

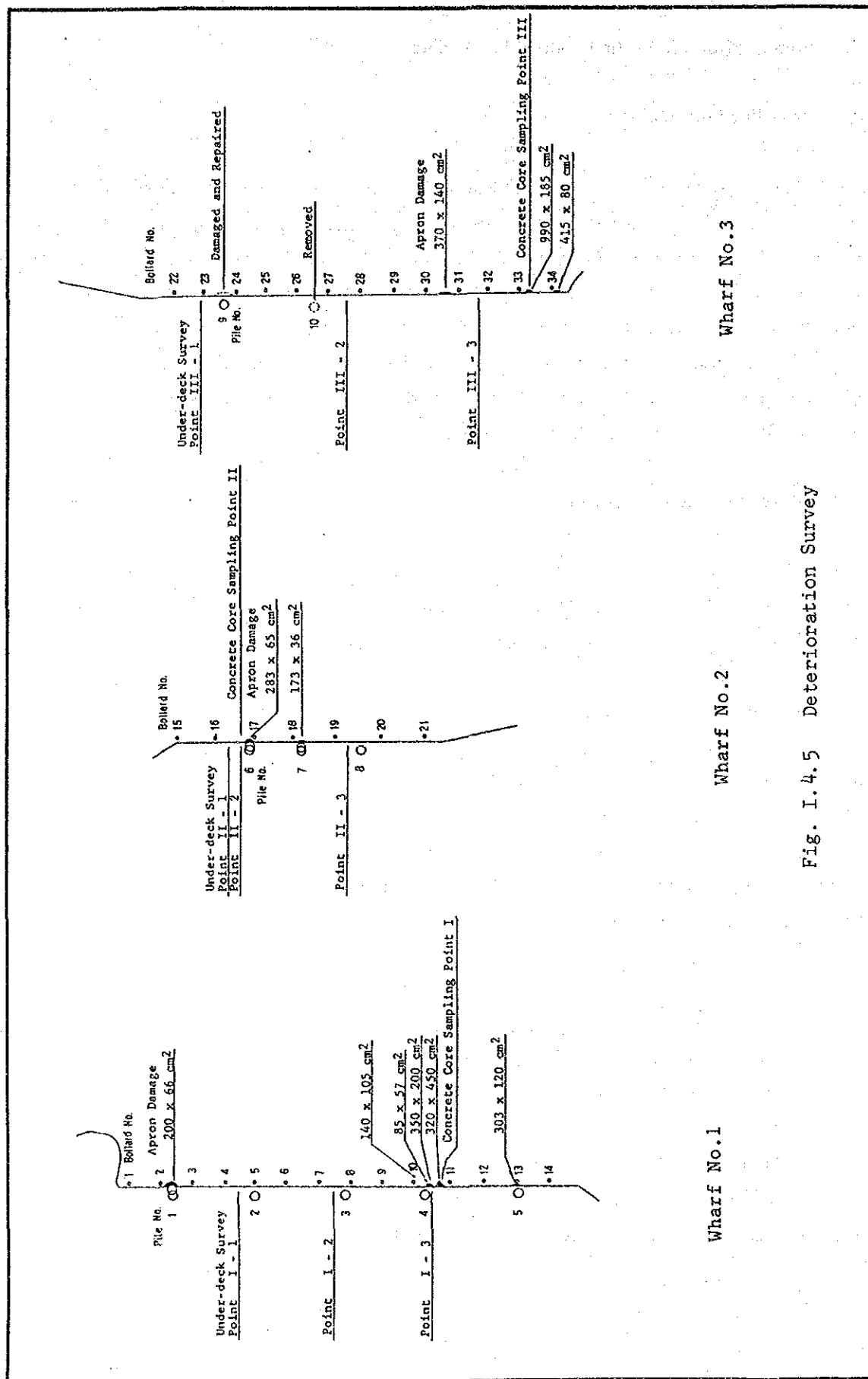


Fig. I.4.5 Deterioration Survey



### (3) Damage to Sub-beams

Most of the sub-beams are badly damaged with clear structural cracks of 1-3 cm in width and from 1 m to the entire span in length.

### (4) Damage to Main Beams

The cross sections of the main beams are designed large enough to carry the present live load, and no significant damage is observed.

### (5) Supporting Piles

Though inspection revealed that the concrete surface is, in some cases, deteriorated with a very thin surface layer spalling off, no cracks or buckling were observed.

### (6) Steel Sheet Cellular Piles

The piles break the frontage of the wharfs when pushed by berthing ships, and some piles were observed to have moved into the concrete decks.

### (7) Present Strength of Concrete/steel Members

The present compressive strength of the concrete is in the range of 98 - 196 kg/cm<sup>2</sup> and the strength of the reinforcing steel bar is 43 - 90 kg/mm<sup>2</sup> for the breaking point and 37 - 39 kg/mm<sup>2</sup> for the yield point.

## 4.3 Structural Analysis of Existing Wharfs

(1) The concrete decks of existing wharfs have a thickness of only 13 cm and a small quantity of reinforcing steel bars, and are badly deteriorated. Therefore, they could not support the load of cargo handling machines.

(2) Most of the sub-beams are badly damaged by corrosion of reinforcing steel bars and spalling off of the concrete cover layer. Therefore, they cannot support the traffic load and are very dangerous.

(3) The main beams and the supporting piles are not critical. But judging from the structural stability, they will not allow the increase of the water depth of the wharfs.

## **5. Cargo and Vessel Movement**

The annual change of cargo volume by major commodity is shown in Table I.4.1 and Fig. I.4.6.

A summary of the analysis of shipping is shown in Table I.4.2.

## **6. Cargo Handling**

Since the present port condition is limited, a primitive method is used. The current situation of cargo handling is summarized as follows:

- (1) Heavy equipment is not used because of the limited port condition and the deterioration of the wharfs.
- (2) There is no crane on the wharf. Only ship cranes are used for loading and unloading of cargo.
- (3) The cargo handling activities are mostly carried out by manual labor.
- (4) Cargo handling productivity is low except for bulk cargo.

Table I.4.1 Cargo Throughput at the Port of San Pedro de Macoris

	Comodity	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
E	Raw Sugar	215,383	195,320	148,957	188,042	164,574	191,069	176,355	131,163	133,612	184,730	129,412	36,977
X	Refined Sugar				321							11,454	38,744
	Molasses	79,802	122,059	93,702	70,057	84,862	74,509	46,031	19,803	93,321	38,746	34,475	28,082
P	Fertilizer	10,883			1,808		16,782	22,543	22,053	10,624	3,250	17,201	7,598
	Cement						7,961	29,905	54,222	52,995	12,190	46,087	52,392
O	Clinker							444	8,550			25,420	12,452
	Agriproduct, Foods				37	57	100	16	22	17	68	246	607
	Feed				502		211	410	454	130	71		
R	Chemical Products						5	5	2,811			132	33
	Printed Matter	381					4						3
T	Machinery		486					51					27
	Bricks, Ceramics				2			77	117	700	13	4	39
	Others	0	2	1,083	2	5,031	40	3	9,949	22	8	313	1
	Sub Total	306,449	317,867	243,742	260,771	254,524	290,681	275,840	249,144	291,421	239,076	264,744	176,955
I	Fertilizer(Raw Material)	46,369	23,522		81,886	50,733	73,906	119,033	46,714	70,288	74,720	23,745	47,262
M	Coal												49,636
	Coke				3				1,700	8,474	200	11,675	
P	Diesel, Fuel oil							15	3		7,014	83,734	16,094
	Chemical Products				3			108	28	1,154	9		
O	Textiles	2,673	67		3,136	91	3,546	103	185	2		7	4,841
	Machinery	344	211		1,019			1	10				183
	Metal	847	1,784		169								
R	Agriproducts, Foods												
	Others	74	22		12	98	109	242	1	33	8	1	
T	Sub Total	50,307	25,606		86,228	50,922	77,561	119,502	48,641	79,951	81,965	119,209	118,432
	Total	356,756	343,473		346,999	305,446	368,242	395,342	297,785	371,372	321,041	383,953	295,387

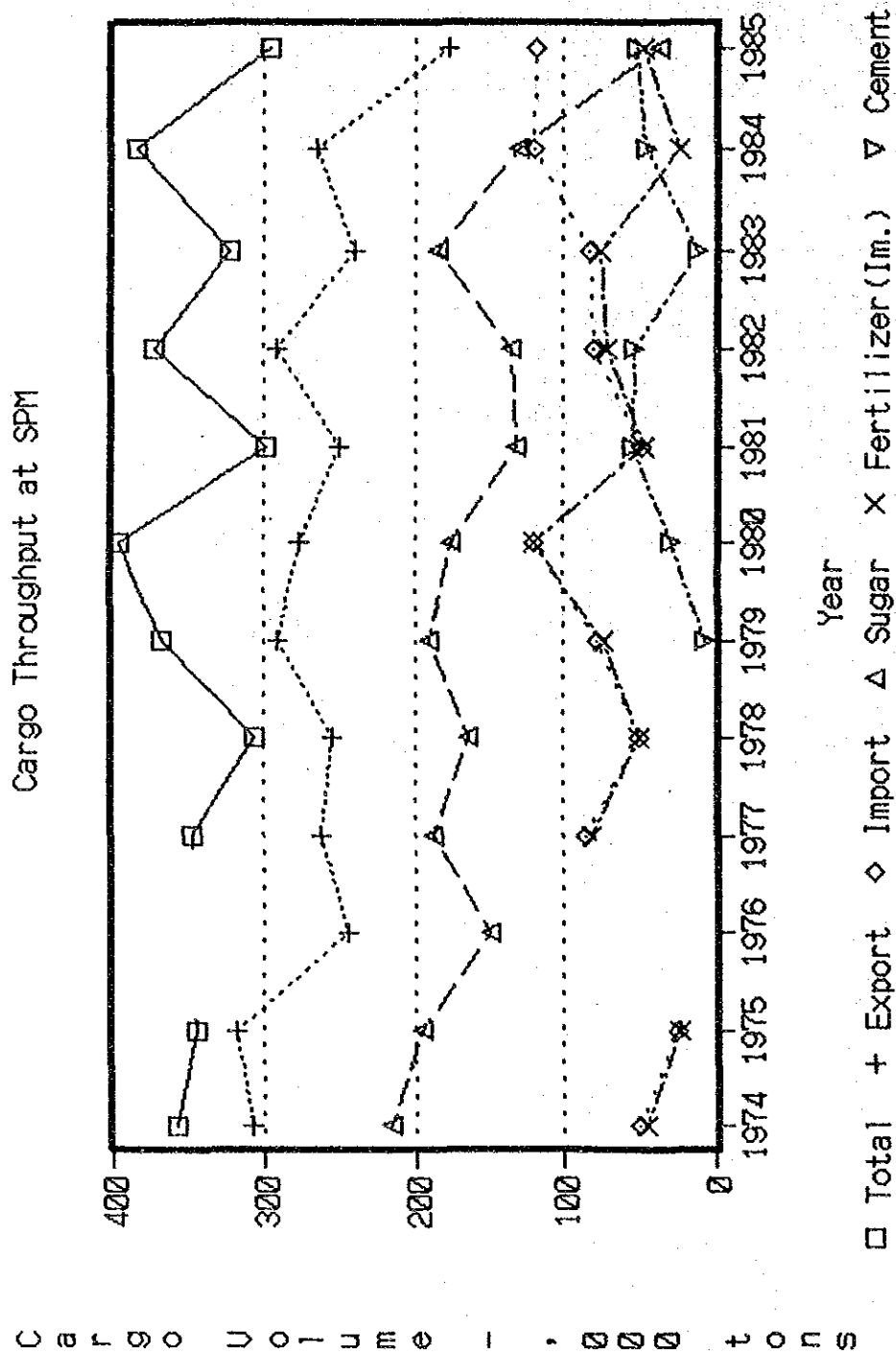


Fig. I.4.6 cargo Throughput at SPM Port

Table I.4.2 Summary of Present Shipping at SPM in 1985

		Number of Ship Calls	Share (%)	Average Ship Size (GRT)	Cargo Volume (tons/yr)	Avg. Cargo Volume per Ship (tons)	Average Mooring days
Export	Sugar	28	19.10	2,800	75,715	3,493	10.8(1)
	Fertilizer	8	5.40	850		686	4.8(2)
	Cement	88	59.90	560			6.3(3)
	Clinker	2	1.40	2,890			2.8(3)
Import	Fertilizer	14	9.50	3,510		3,640	3.1(2)
	Coal	3	2.00	12,700		13,100	3.4(3)
	Fuel Oil	4	2.70	11,200		3,928	1.3(3)
T o t a l		147	100.00				

Notes:(1) Average from Jan. 1984 to Sep. 1986, excluding extremely long mooring data.

This data is used in the simulation.

(2) Average mooring time in 1985 based on the cargo volume data.

(3) Overall average of the data from Jan. 1984 to Sep. 1986.

## **PART II MASTER PLAN**

### **CHAPTER 1 BASIC CONCEPTS AND DEVELOPMENT SCENARIO**

#### **1. Basic Concepts**

The purposes of the Master Plan are:

- To set the right course for the development, clarifying the functions of the port,
- To determine the appropriate scale and type of facilities required in the target year in accordance with the demand forecast.
- To draw up the land and water use plans.
- To formulate the layout of the breakwaters and entrance channel and to define the limits of the land and water areas, and
- To establish a major access road between the port and its adjoining area.

#### **2. Development Scenario for the Master Plan**

The first target of the port development is to ensure that the Port has sufficient facilities to handle all the cargoes for the eastern provinces. Containers, general cargo and industrial cargoes to and from this region will be handled at the Port.

For this purpose, it will be necessary to construct a ro/ro wharf and to provide new physically stable wharfs with sufficient water depth and appropriate mechanized handling systems.

The second target of the port development is to encourage the development of regional industry and promote the location of industries at inland, port and coastal areas. Agro-industrial development will be accelerated because of reduced transportation costs due to the improved infrastructure.

The target year of the Master Plan, 2005, is set for the initial stage of the second target. In this stage the expanded free zone will start full operation and CDE's new floating power plants will begin full production with a total output of 60,000 kw.

Sugar will mostly be shipped in bulk, but sugar shipped to the Antilles Islands will be shipped in bags. The bulk sugar will be handled

using an improved mechanized system.

Cement and clinker will continue to be exported and the fertilizer factory will be operating at capacity. The recently proposed shipyard will be completed and will begin operations.

Ferry boats between San Pedro de Macoris and Mayaguez will continue their five day a week service. In addition, Caribbean cruise passenger boats will call frequently, say once a week, and tourism will also be developed.

Further growth can be expected. For example, a large-scale coal powered electric power plant and tourism development combined with coastal and residential development projects like Puerto Plata and La Romana. However, at this moment it is not possible to estimate the type, size and timing of the location of such industries. So, it is strongly recommended that portions of the west side of the Higuamo estuary be reserved for the future development of the Port. The action required to reserve this area should start immediately, if possible.

In 2005, according to the land use plan, the east side of the Higuamo estuary will be considered as a clean cargo area for the handling of containers and general cargo. On this side the residential area is very close to the port area. Coal and clinker shall be handled on the west side of the river where there are very few residents.

It is also recommended that dry and liquid bulk cargoes be handled on the west side of the river, but the raw materials for fertilizer can be handled on the east side as the fertilizer factory (FERQUIDO) is expected to remain at its present location. It would be ideal for FERQUIDO to move to the west bank in the future and to use the site of the current FERQUIDO facilities for a container terminal, but this may not be practical prior to 2005.

## CHAPTER 2 DEMAND FORECAST

Table II.2.1 is a summary of the traffic forecast for the port of San Pedro de Macoris.

The future size of ships is summarized in Table II.2.2.

Table II.2.1 Summary of Estimated Future Port Traffic at the Port of San Pedro de Macoris

(Unit: 1,000 tons, TEU)

Commodity		1995		2005	
		Cargo Volume	TEU	Cargo Volume	TEU
Export	Sugar	151	-	151	-
	Molasses	56	-	56	-
	Fertilizer	39	-	60	-
	Cement	99	-	132	-
	Clinker	90	-	120	-
	Cargo of the F.Z.	24	3,700	38	5,900
	Agr. products*,**	38	3,000	66	5,900
	Miscellaneous general cargo**	51	4,100	71	6,400
	Total Export Cargo	548	10,800	694	18,200
Import	Raw materials for fertilizer	130	-	200	-
	Coal	113	-	150	-
	Fuel Oil	120	-	157	-
	Cargo of the F.Z.	22	3,300	36	5,400
	Miscellaneous general cargo**	69	5,500	79	7,100
	Total Import Cargo	454	8,800	622	12,500
Total		1,002	19,600	1,316	30,700
Regular ferry service		5 times a week		5 times a week	
Regular passenger boats		twice a month		once a week	

Remarks: \*) Containerized ratio of exported agricultural products is presumed to be the same as that of miscellaneous general cargo, 80% in 1995 and 90% in 2005.

\*\*\*) The number of containers is estimated assuming that the unit load is 10 tons per TEU.



Table II.2.2 Estimated Average Ship Size

	1995				2005			
	Average Ship Size		Cargo Volume (tons/year)	Average Cargo Volume per Ship (tons)	Average Ship Size		Cargo Volume (tons/year)	Average Cargo Volume per Ship (tons)
	(GRT)	(DWT)			(GRT)	(DWT)		
Exp. Cargo								
Sugar (bags)	700	1,050	15,000	600	25	700	1,050	600
Sugar (bulk)	7,000	10,500	136,000	7,000	19	7,000	10,500	7,000
Fertilizer (bags)	1,000	1,500	39,000	1,000	39	1,000	1,500	1,000
Cement (bags)	3,000	4,500	99,000	3,000	33	3,000	4,500	3,000
Clinker (bulk)	5,000	7,500	90,000	5,000	18	5,000	7,500	5,000
Free Zone (containers)	3,000	4,500	24,000	460	52	3,000	4,500	730
General Cargo	8,000	12,000	89,000	1,700	52	8,000	12,000	2,600
Imp. Cargo								
Fertilizer (bulk)	7,000	10,500	130,000	6,000	22	7,000	10,500	6,000
Coal (bulk)	13,000	19,500	113,000	15,000	8	13,000	19,500	15,000
Fuel Oil (bulk)	13,000	19,500	120,000	15,000	8	13,000	19,500	15,000
Free Zone (containers)	3,000	4,500	22,000	420	52	3,000	4,500	690
General Cargo	8,000	12,000	69,000	1,300	52	8,000	12,000	1,500
Ferry	3,000	4,500	-	-	260	3,000	4,500	-
Passenger Boats	20,000	30,000	-	-	24	20,000	30,000	-

## **CHAPTER 3 PORT PLANNING**

The required port facilities are identified in accordance with the basic concept and the demand forecast.

The main required facilities are as follows.

- (1) An exclusive ferry wharf
- (2) Wharfs for ro/ro ships and containers
- (3) Wharfs for general cargo and bulk cargo
- (4) A transit shed
- (5) Open storage yards and a parking area
- (6) Cargo handling equipment
- (7) Buildings for offices and other purposes.

### **1. Scale of the Port Facilities**

It is recommended that the maximum depth of the wharf be set at -11.0m (36.1') which corresponds to a ship size of 20,000 DWT and also permits 20,000 GRT passenger boats, which are common in the Caribbean, to enter the Port.

Proposed principal port facilities for the Master Plan are summarized as shown in Table II.3.1.

### **2. Evaluation of the Existing Port Facilities**

To meet the requirements of the Master Plan, completely new wharfs with sufficient water depth must be constructed, and all of the existing wharfs should be retired.

### **3. Port Layout and Land Use**

Based on the basic concept and the facilities requirements, the proposed Master Plan is shown in Fig. II.3.1.

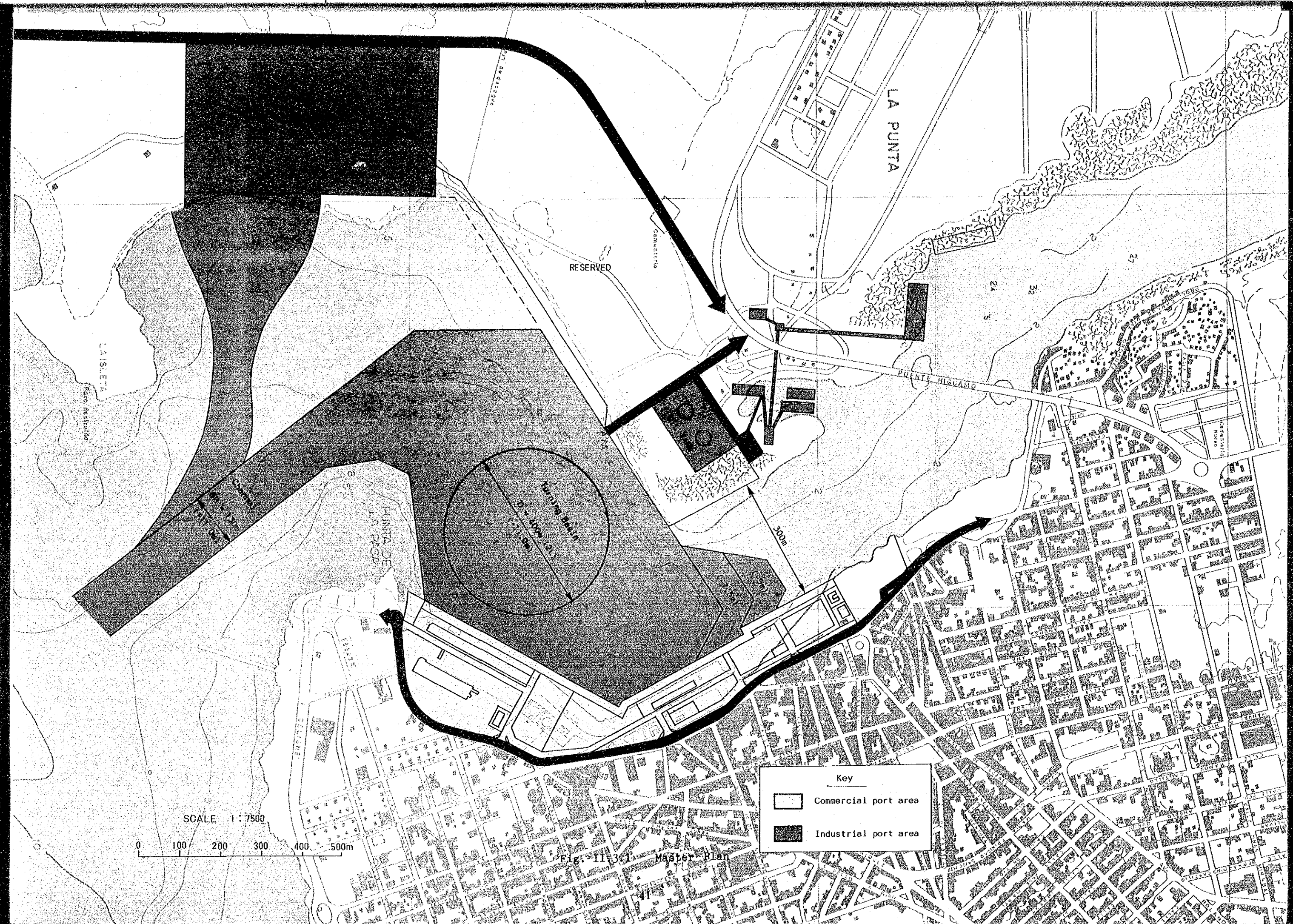
The land use and the layout of the port facilities for the Master Plan are shown in Fig. II.3.2.

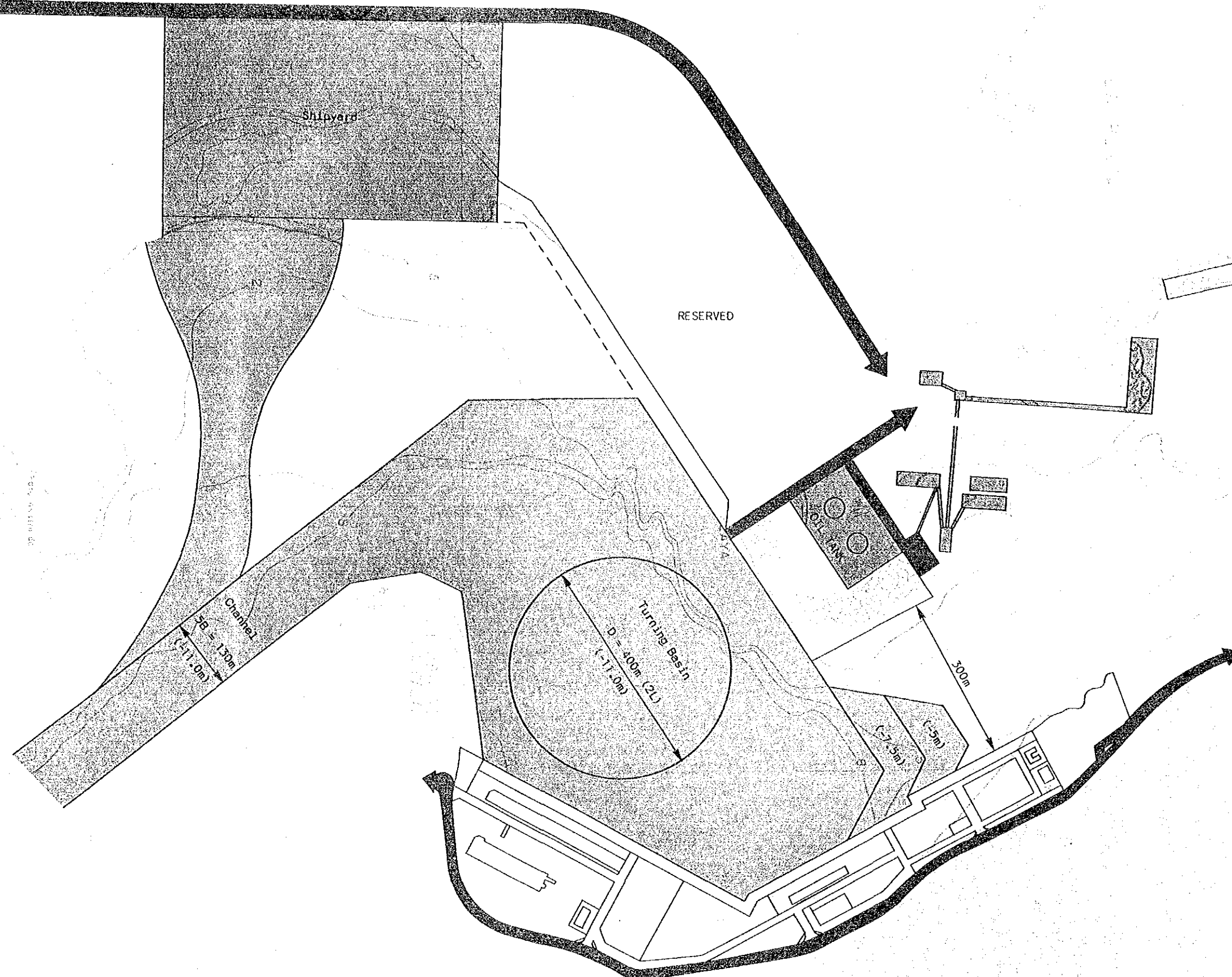
Table II. 3.1 Proposed Port Facilities for The Master Plan of The Port of San Pedro de Macoris

Facility	Function	Dimensions or Contents
i) Basin and channel	(a) Turning basin (b) Channel	Diameter = 400m, Depth = -11.0m Width = 130m, Depth = -11.0m
ii) Breakwater		Repair work of the existing structure
iii) Mooring facilities	(a) Service boat wharf (E-1) (b) Ferry berth (E-2) (c) Main wharf (E-3) " (with ro/ro ramp) (E-4) " (E-5) " (E-6) " (W-1)	L = 100m Depth = -5.0m L = 130m Depth = -7.5m L = 210m Depth = -11.0m L = 210m Depth = -11.0m L = 210m Depth = -11.0m L = 130m Depth = -7.5m L = 210m Depth = -11.0m
iv) Storage facilities	(a) Container yard (Chassis) " (Forklift) " (Reefer) (b) CFS (c) Transit shed (d) Open yard (coal) (e) Fuel oil tanks	9,500m <sup>2</sup> 16,300m <sup>2</sup> 1,500m <sup>2</sup> 70m x 30m = 2,100m <sup>2</sup> 1,840m <sup>2</sup> 7,500m <sup>2</sup> 50,000 kl (26,400m <sup>2</sup> )
v) Ferry terminal	(a) Terminal building (b) Parking area	20m x 40m x 2 stories = 1,600m <sup>2</sup> 16,800m <sup>2</sup>
vi) Port administration facilities	(a) Administration office (Building) (Parking) (b) Commander's office	600m <sup>2</sup> 1,500m <sup>2</sup> 1,700m <sup>2</sup>
vii) Maintenance shop	Maintenance shop (Building) (Area)	800m <sup>2</sup> 1,750m <sup>2</sup>
viii) Road		
ix) Green area		









SCALE 1 : 7500

0 100 200 300 400 500m

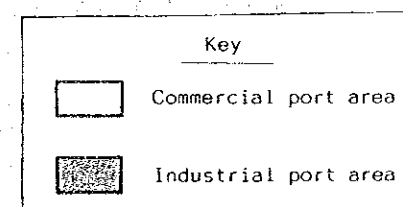
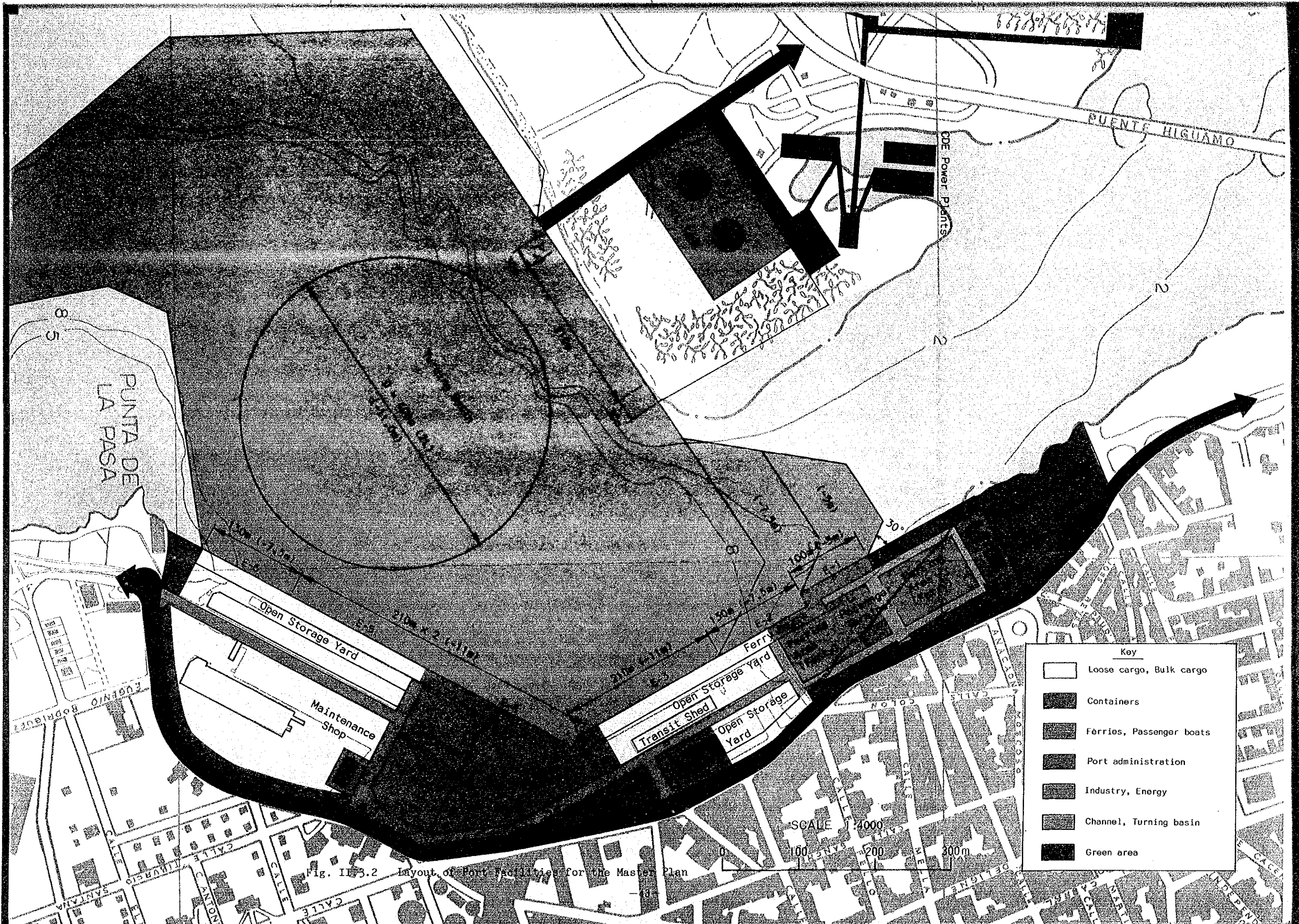


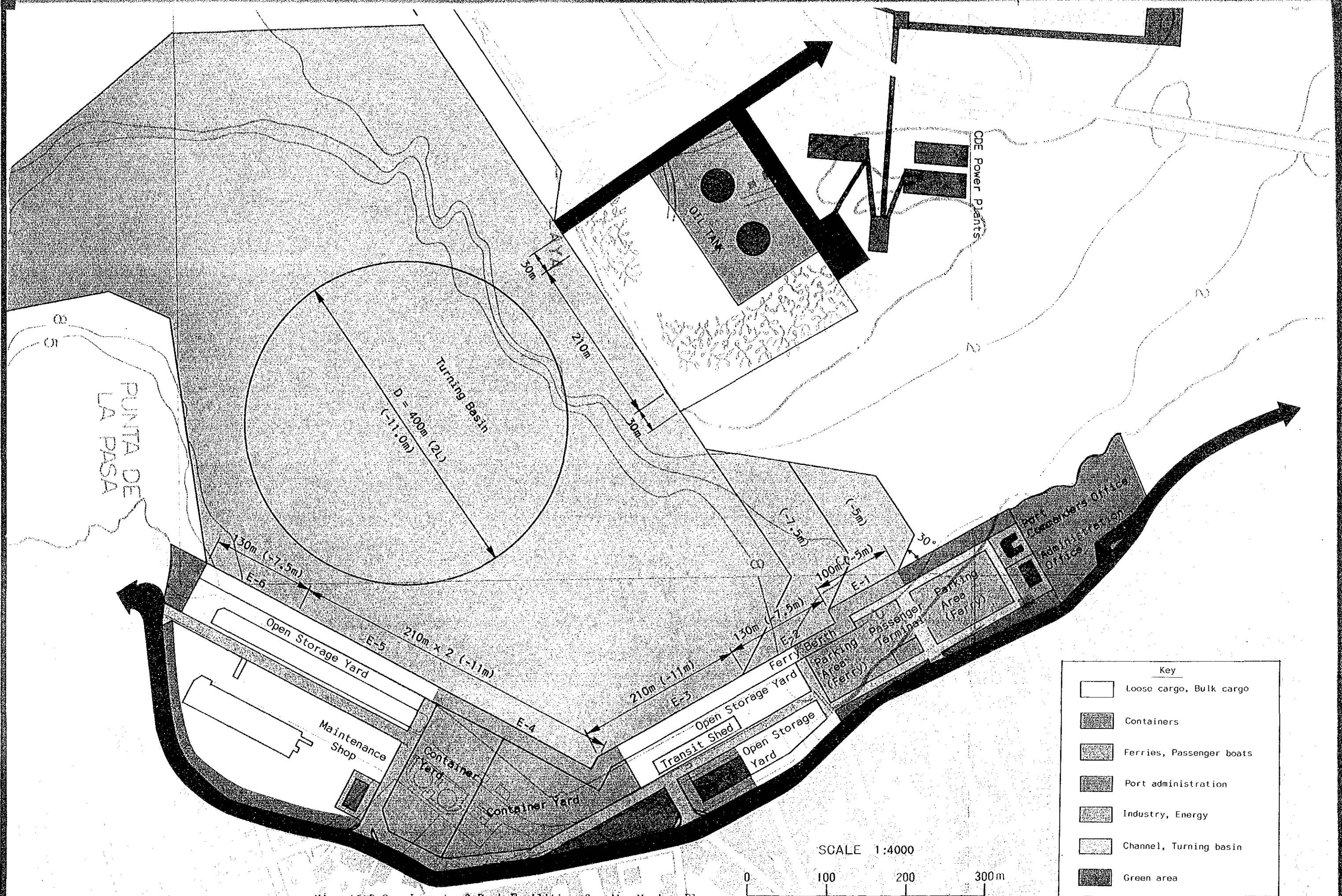
Fig. II.3.1 Master Plan











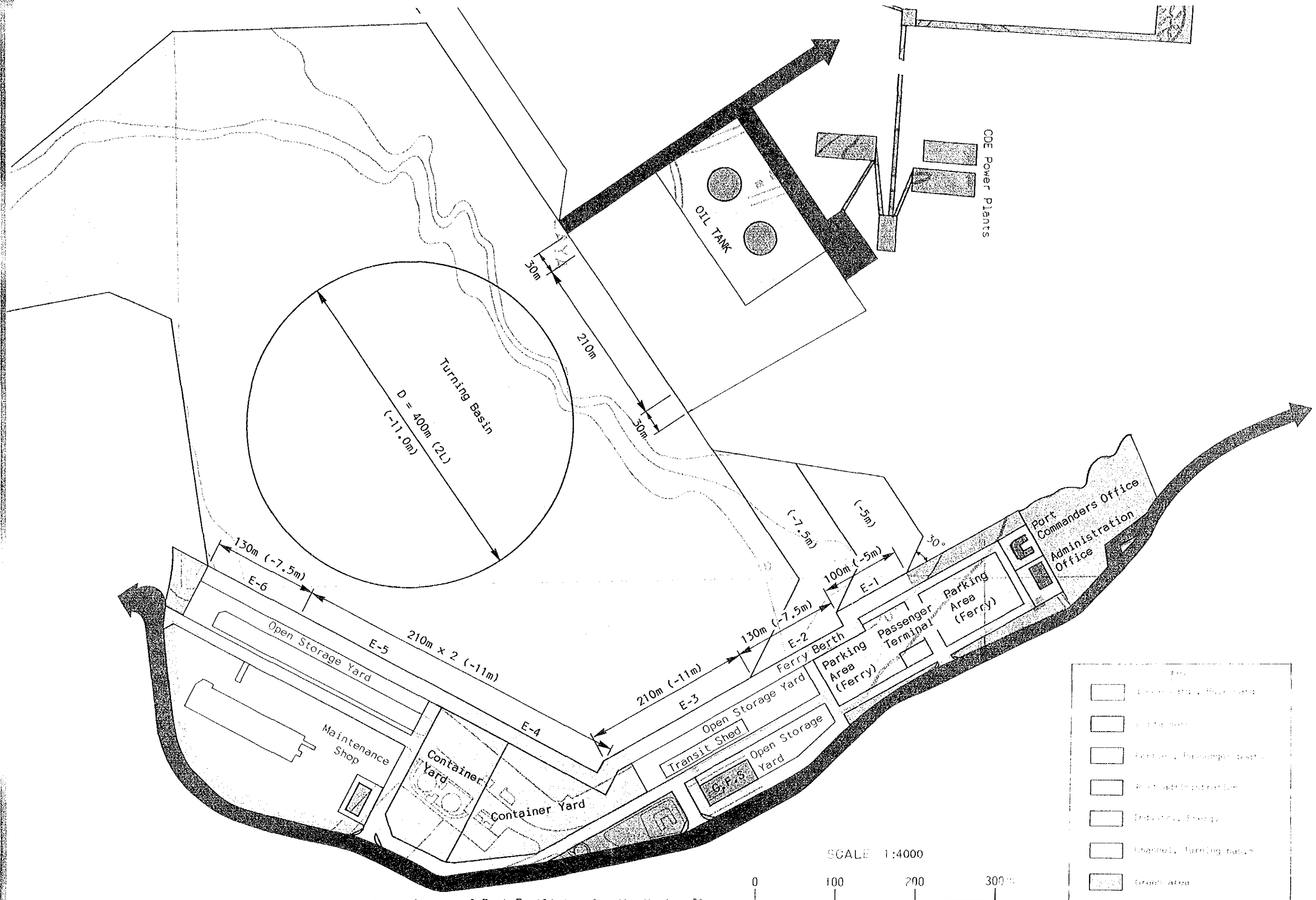


Fig. 11.3.2 Layout of Port Facilities for the Master Plan





## CHAPTER 4 STRUCTURAL DESIGN AND COST ESTIMATE

### 1. Structural Design

A steel pipe pile open type structure was adopted for all the wharfs. Fig. II.4.1 shows the cross section of Wharf W-1 (L = 210 m) as the standard cross section of all the wharfs.

### 2. Cost Estimate

The total project cost of Master Plan is estimated at about 199 million RD\$ broken down as follows:

Wharf Construction	88 million RD\$	44 %
Pavement	15	8
Offices and Buildings	16	8
Cargo Handling Equipment	12	6
Oil Storage Tank	25	13
Breakwater Repair	2	1
Harbor Craft	5	2
Other Facilities	2	1
Mobilization/Demobilization	7	3
Engineering Service	5	3
Physical Contingency	22	11
Total	199 million RD\$	100 %

Table II.4.1 shows the detail of the project components and their costs.

Table II.4.1 Project Cost of the Master Plan  
(1,000RD\$)

Project Items	Unit	Qty	Unit Cost	Foreign Total	Local Total	Grand Total	Remarks
Wharf Construction				56867.6	31178.1	88045.7	
Wharf E-1 (-5)	m	100.0	41.22	2238.5	1883.7	4122.2	on east bank
" E-2 (-7.5)	m	130.0	56.27	4254.1	3060.5	7314.6	
" E-3 (-11)	m	210.0	68.27	8904.8	5432.4	14337.2	
" E-4 (-11)	m	210.0	100.61	13702.4	7426.5	21128.9	
" E-5 (-11)	m	210.0	86.07	12819.0	5255.6	18074.6	
" E-6 (-7.5)	m	130.0	67.47	5665.7	3106.0	8771.7	
" W-1 (-11)	m	210.0	68.08	9283.1	5013.4	14296.5	on west bank
Pavement				5966.0	9458.9	15424.9	
Heavy Duty	m <sup>2</sup>	63620.0	.122	3031.9	4729.7	7761.6	Cont. Yard, etc.
Light Duty	m <sup>2</sup>	77040.0	.098	2890.2	4659.7	7549.9	Open Storage, etc.
Concrete	m <sup>2</sup>	950.0	.119	43.9	69.5	113.4	Maint. Shop Area
Breakwater Repair	m	51.0	41.81	1120.2	1012.4	2132.6	
Channel Buoy	Nos	5.0	78.14	371.2	19.5	390.7	
Office & Building				11753.7	4228.0	15981.7	
Administ'n Office	m <sup>2</sup>	1200.0	2.44	2151.9	778.3	2930.2	2 stories
Port C. Office	m <sup>2</sup>	380.0	2.44	681.4	246.5	927.9	
Passenger Terminal	m <sup>2</sup>	1600.0	1.71	2008.4	726.4	2734.8	2 stories
CFS	m <sup>2</sup>	2100.0	1.95	3012.6	1089.7	4102.3	
Maintenance Shop	m <sup>2</sup>	800.0	1.71	1075.2	365.5	1440.7	
Transit Shed	m <sup>2</sup>	2250.0	1.71	2824.3	1021.6	3845.9	
Cargo H. Equipment				10745.9	772.6	11518.5	
Sugar Container	Nos	60.0	19.08	572.3	572.3	1144.6	
Pallet	Nos	3300.0	.114	188.9	188.9	377.7	
Forklift (2.5t, E)	Nos	6.0	50.55	303.3	.0	303.3	
" (2.5t, B)	Nos	5.0	83.17	415.9	.0	415.9	for CFS use
" (30t, E)	Nos	2.0	820.30	1640.6	.0	1640.6	for yard use
Mobile Crane (100t)	Nos	2.0	2460.89	4921.8	.0	4921.8	
Tractor	Nos	9.0	162.15	1459.4	.0	1459.4	
Chassis	Nos	22.0	36.25	797.4	.0	797.4	
Truck (10t)	Nos	2.0	133.54	267.1	.0	267.1	
Truck Scale	No	1.0	190.77	179.3	11.4	190.8	
Oil Tank	Pcs	2.0	12438.2	16280.6	8595.8	24876.4	on west bank
Harbor Craft				5055.3	.0	5055.3	
Tug Boat (1500ps)	Nos	1.0	3605.49	3605.5	.0	3605.5	
" (500ps)	Nos	1.0	1354.44	1354.4	.0	1354.4	
Pilot Boat	No	1.0	95.38	95.4	.0	95.4	
Others	L/S	1.0	-	873.6	504.6	1378.2	drainage, etc
Mobilization/Demob.	L/S	1.0	-	7062.8	.0	7062.8	
Engineering Services			-	3643.6	1888.6	5532.2	
Detailed Design	L/S	1.0	-	1840.9	1116.0	2956.9	
Const. Supervision	L/S	1.0	-	1802.7	772.6	2575.4	
Physical Contingency	L/S	1.0	-	13658.3	8071.7	21730.0	0 - 15 %
Total				133398.8	65730.2	199129.0	

Fig. II.4.1 Standard Cross Section of Wharfs

(Unit:m)

