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THE HASHEMITE KINGDOM OF JORDAN

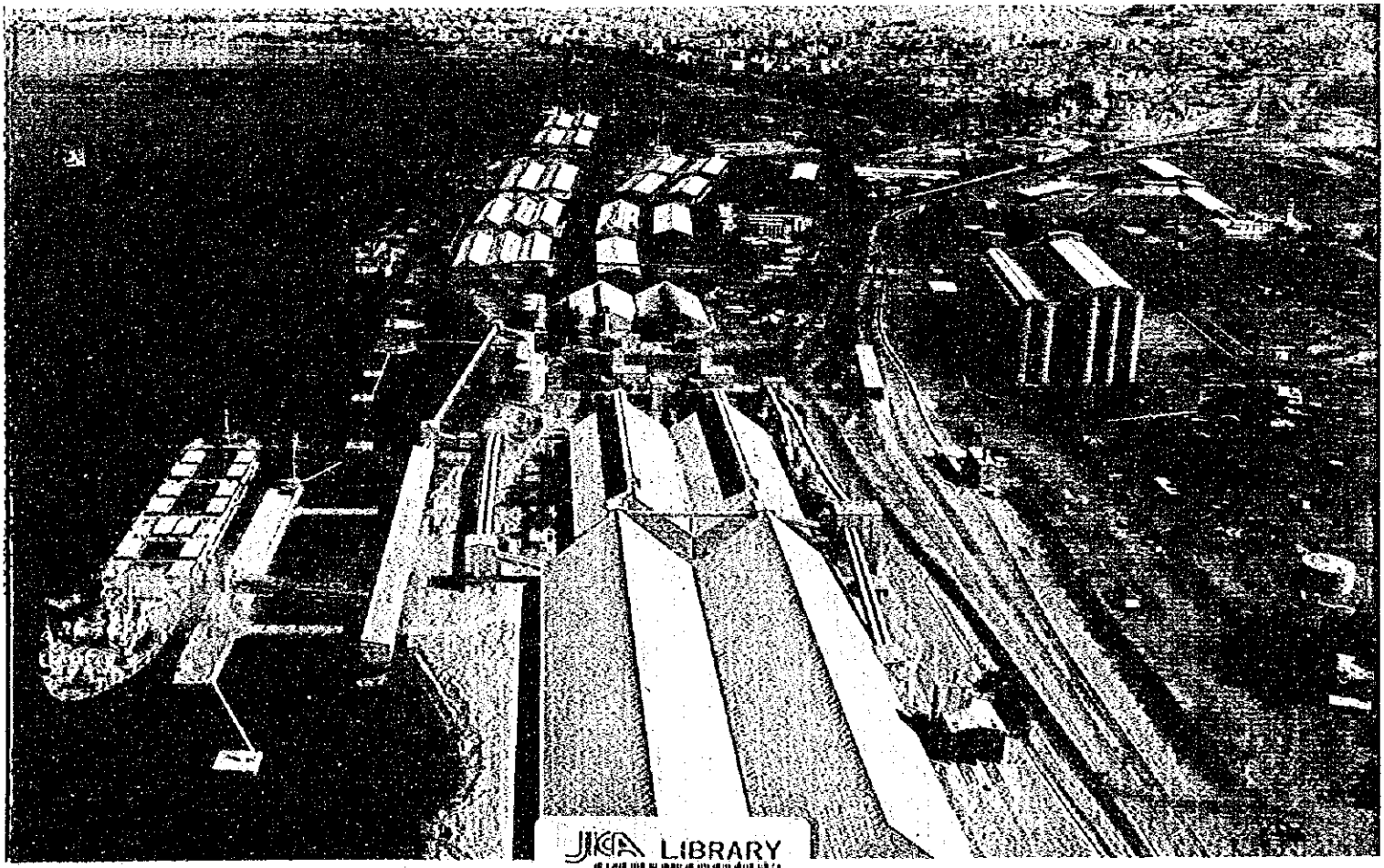
NO. 52

FINAL REPORT

THE STUDY ON THE IMPROVEMENT PLAN OF THE PORT OF AQABA IN THE HASHEMITE KINGDOM OF JORDAN

SUMMARY

FEBRUARY 1996



HE OVERSEAS COASTAL AREA DEVELOPMENT INSTITUTE OF JAPAN(OCDI)
CEAN CONSULTANT, JAPAN CO., LTD. (OCJ)
ACIFIC CONSULTANTS INTERNATIONAL(PCI)

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FEBRUARY 1996

CURRENCY EXCHANGE RATE

1 US Dollar = 0.69 Jordan Dinar = 90 Japanese Yen

(As of March, 1995)

PREFACE

In response to a request from the Government of The Hashemite Kingdom of Jordan, the Government of Japan decided to conduct a feasibility study on the Improvement Plan of the Port of Aqaba in The Hashemite Kingdom of Jordan and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent a study team to Jordan three times between December 1994 and December 1995. The study team was headed by Mr. Jiro Kano and composed of members from the Overseas Coastal Area Development Institute of Japan (OCDI), Ocean Consultant, Japan Co., LTD. (OCJ) and Pacific Consultants International (PCI).

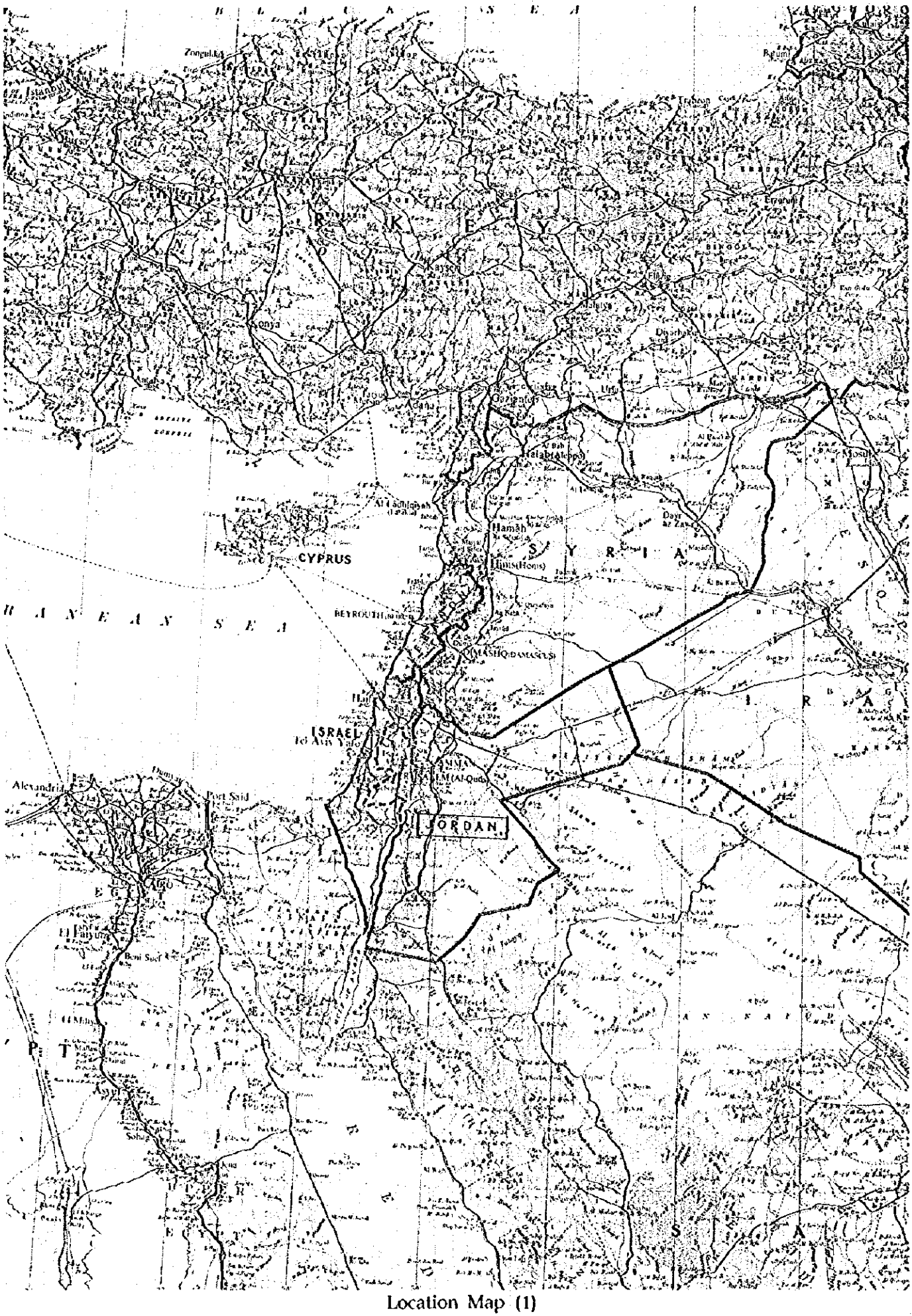
The team held discussions with the officials concerned of the Government of Jordan and conducted field surveys in the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

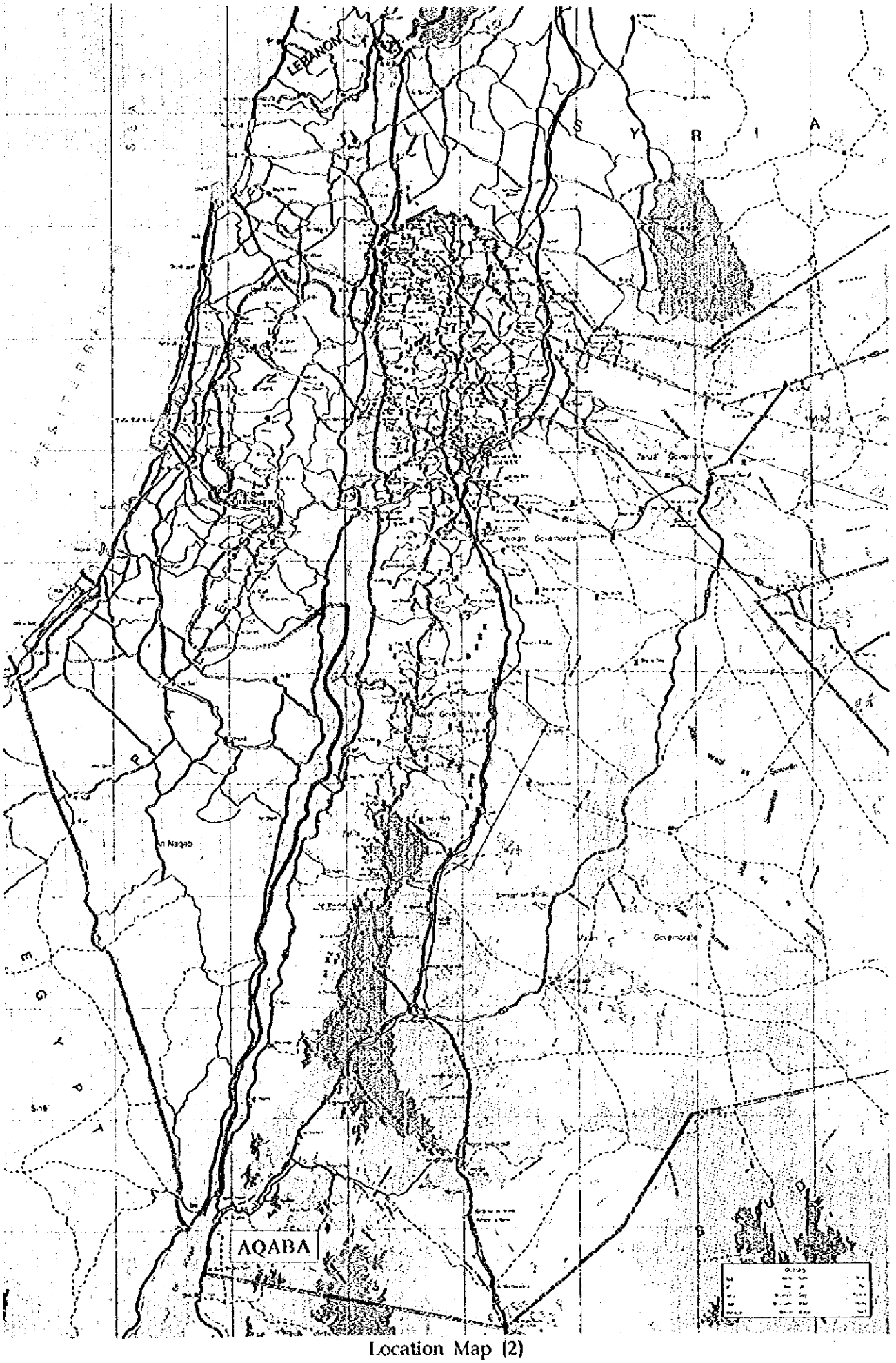
I wish to express my sincere appreciation to the officials concerned of the Government of The Hashemite Kingdom of Jordan for the close cooperation they extended to the team.

February, 1996

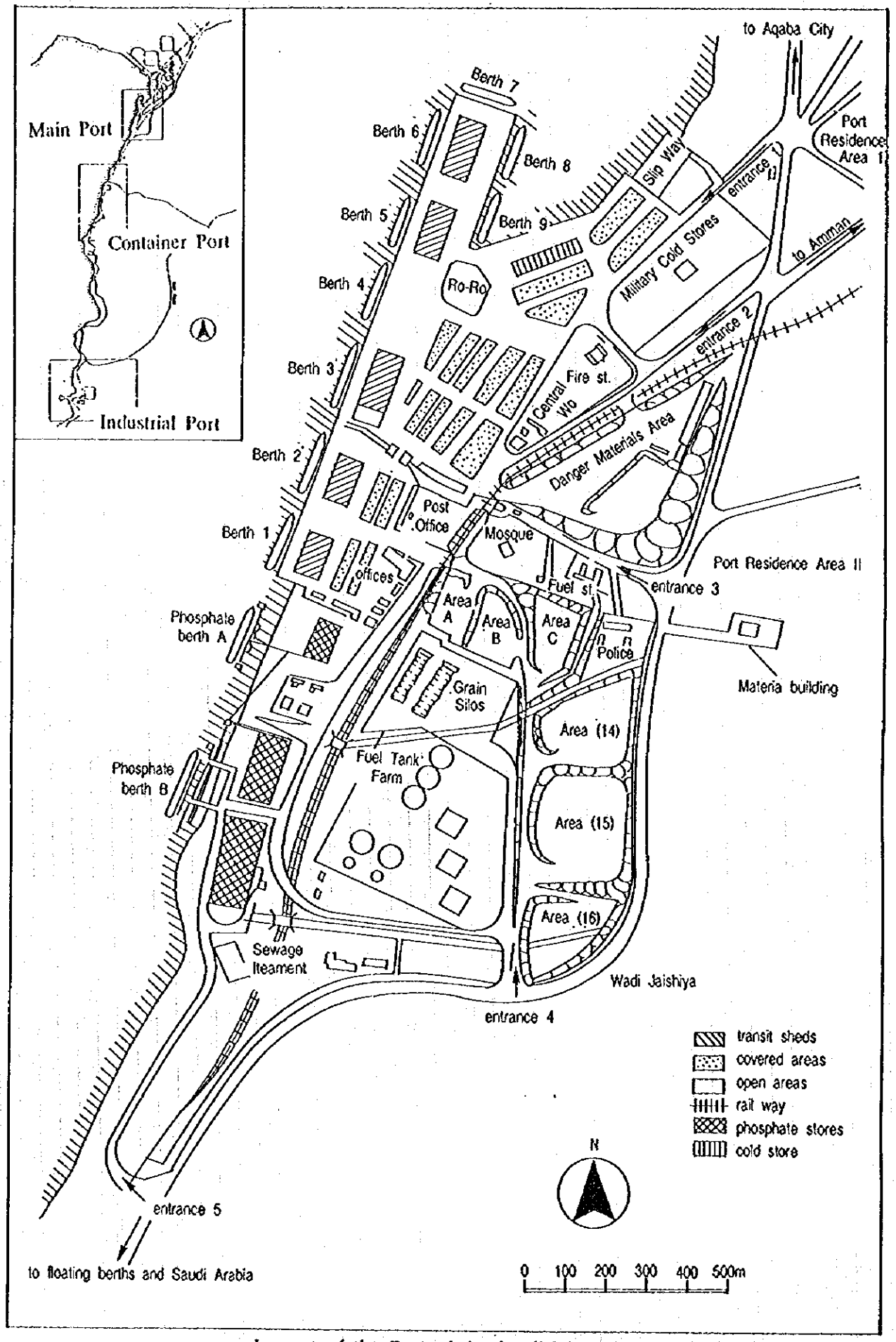
Kimio Fujita
President
Japan International Cooperation Agency



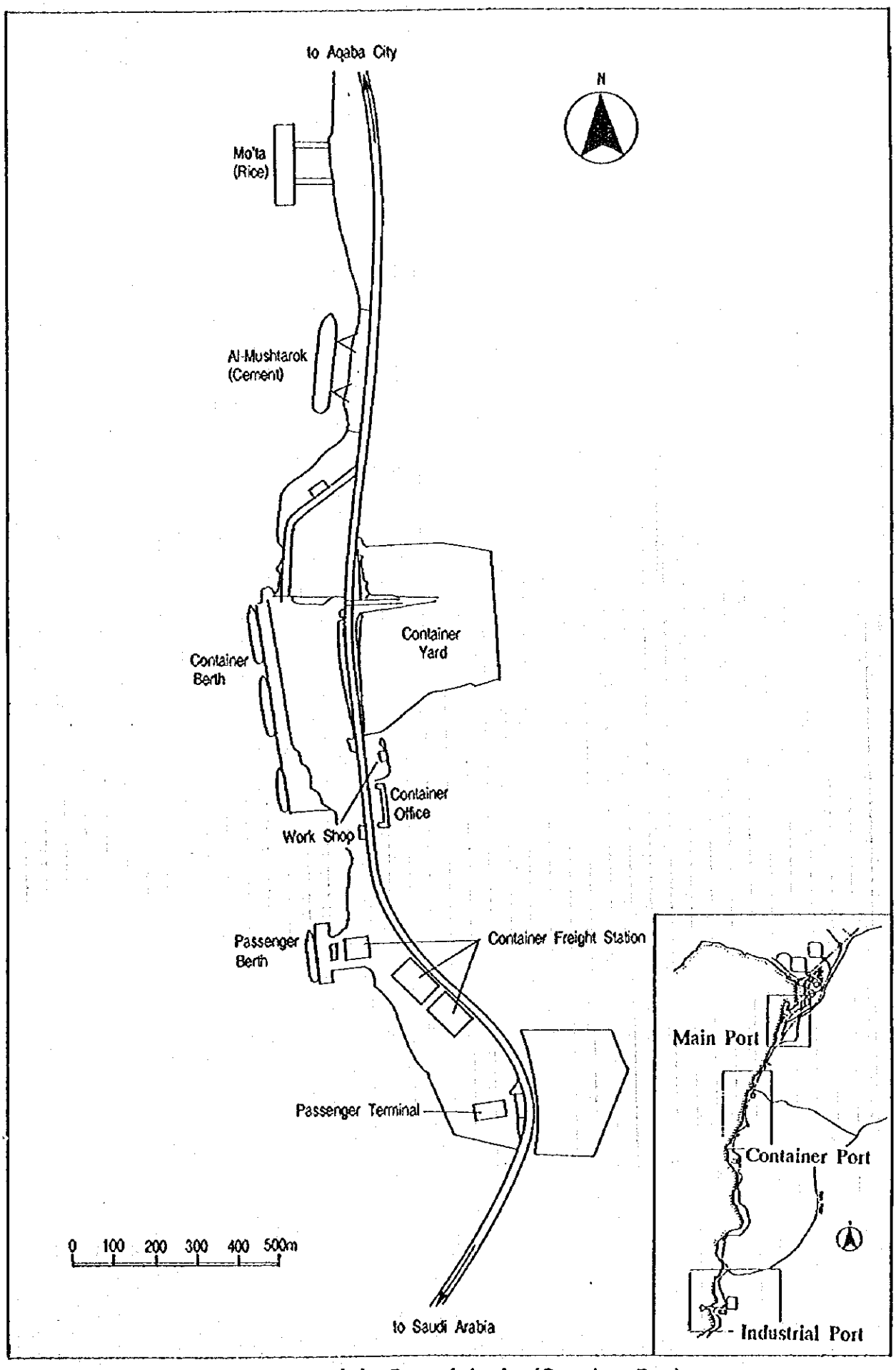
Location Map (1)



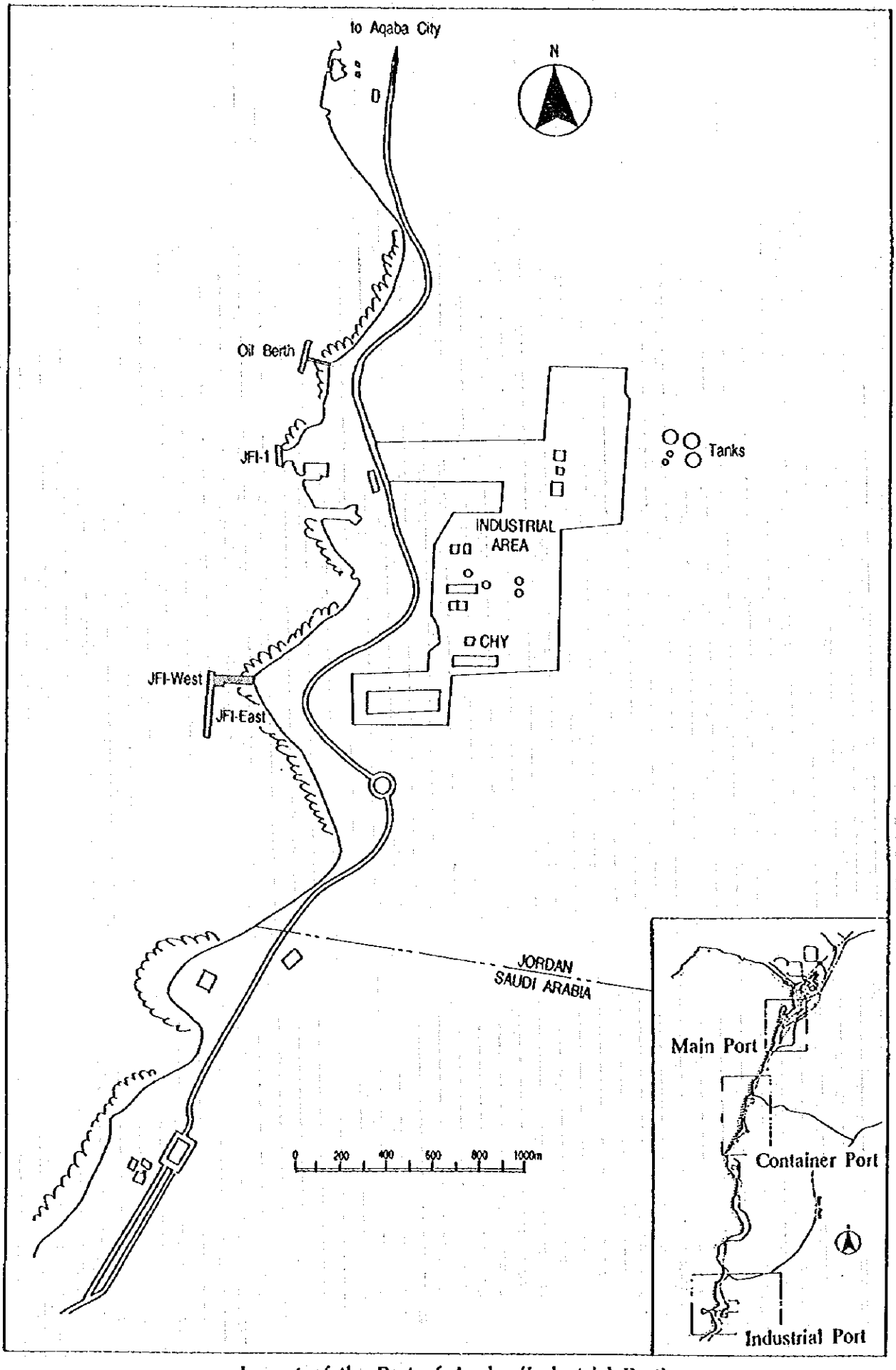
Location Map (2)



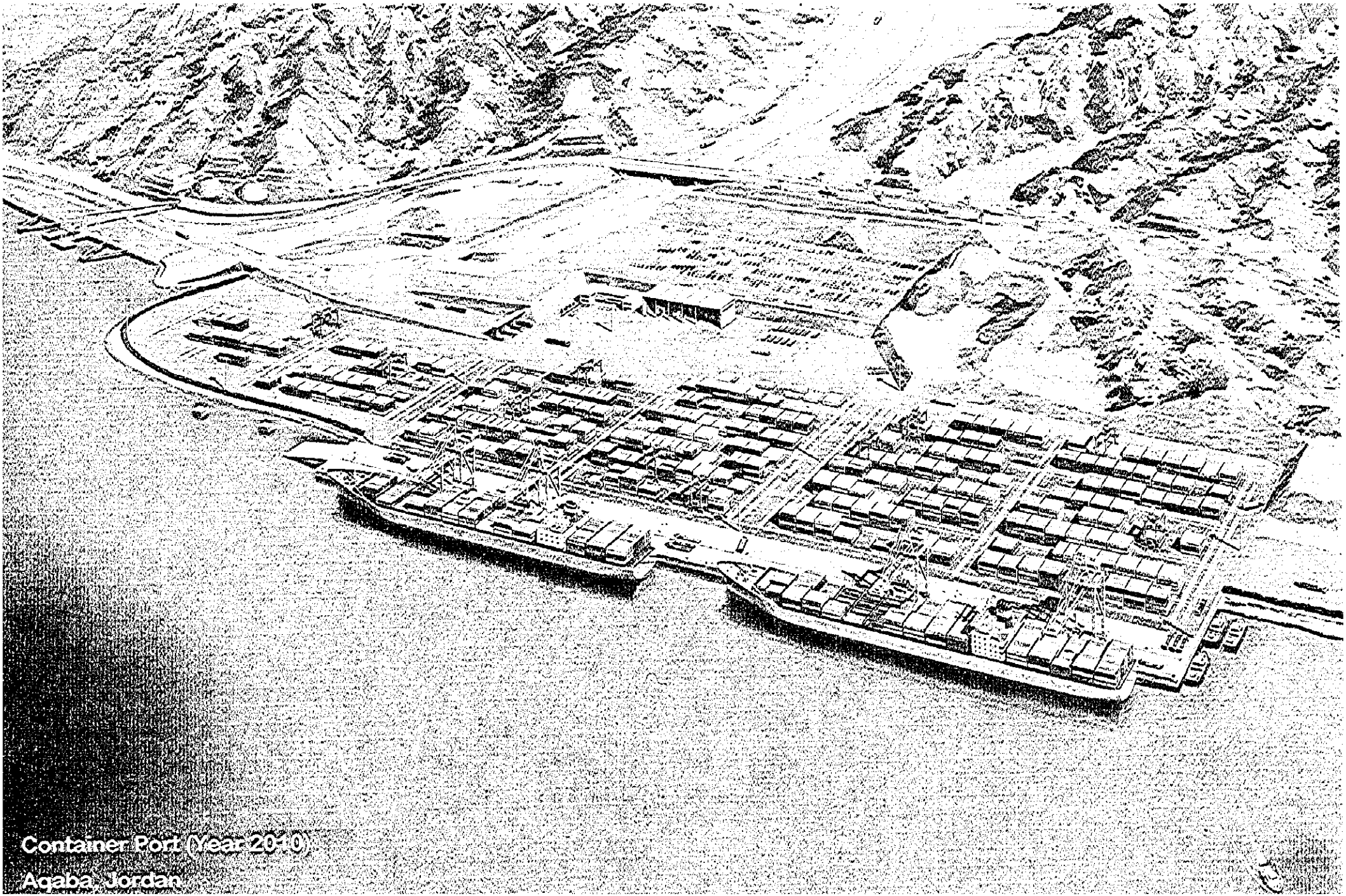
Layout of the Port of Aqaba (Main Port)



Layout of the Port of Aqabe (Container Port)

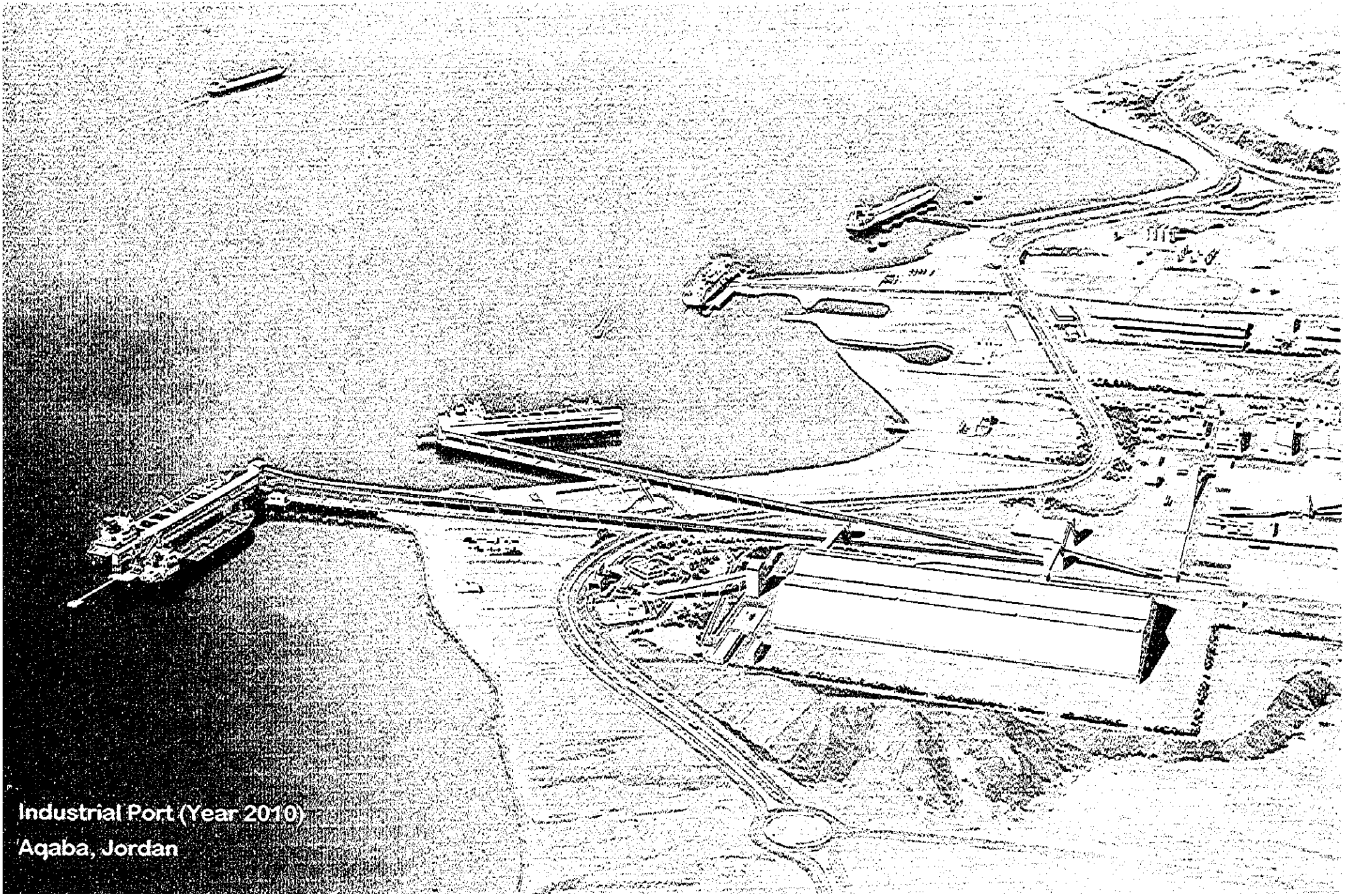


Layout of the Port of Aqaba (Industrial Port)



Container Port (Year 2010)

Aqaba, Jordan



Industrial Port (Year 2010)

Aqaba, Jordan

ABBREVIATIONS

APC	Arab Potash Company
ARA	Arab Region Authority
ARC	Arab Railway Corporation
BOT	Build, Operate and Transfer
B/L	Bill of Laden
CBR	Cost Benefit Ratio
CD	Chart Datum
CDL	Chart Datum Level
CFS	Container Freight Station
CIF	Cost, Insurance and Freight
CPU	Central Processing Unit
CY	Container Yard
CZMA	Coastal Zone Management Act
DAP	Di-Ammonium Phosphate
DG	Dangerous Goods
DO	Dissolved Oxygen
DOE	Department of Environment
DWT	Dead Weight Tonnage
EC	European Community
EIA	Environmental Impact Assessment
EIR	Equipment Interchange Receipt
EIRR	Economic Internal Rate of Return
EL	Elevation Level
ESCAP	Economic and Social Commission for Asia and the Pacific
ETA	Estimate Time of Arrival
ETD	Estimate Time of Departure
FEU	Forty-Foot Equivalent Units
F.C.	Factor Cost
FCL	Full Container Load Cargo
FIRR	Financial Internal Rate of Return
FOB	Free on Board
FTZ	Free Trade Zone
GAEAP	The Gulf of Aqaba Environmental Action Plan
GDP	Gross Domestic Products
GRT	Gross Registered Tonnage
GWh	Giga(one billion)-Watt hour
HP	Horse Power
IDECO	Irbid District Electricity Company
IEE	Initial Environmental Examination
IMF	The International Monetary Fund
ISO	International Standard Organization
JD	Jordan Dinar
JEA	Jordan Electricity Authority
JFI	Jordan Fertilizer Industry
JIEC	Jordan Industrial Estate Corporation
JPMC	Jordan Phosphate Mines Co. LTD.
JPRC	Jordan Petroleum Refinery Company
JTPI	Jordan Timber Products Industry

IMO	International Maritime Organization
LASH Ship	Lighter Aboard Ship
LCL	Less than Container Load
MARPOL	International Conference on Marine Pollution
MB	Mega Byte
MHZ	Mega Hertz
MMRAE	Ministry of Municipal and Rural Affairs and the Environment
MOF	Ministry of Finance
MOP	Ministry of Planning
MOP	Muriate of Potash
M.P.	Market Price
MOS	Ministry of Supply
MOT	Ministry of Transport
MPN	Most Probable Number
MSS	Marine Science Station
MT(M/T)	Metric Tons
NES	National Environment Strategy
NPK	Nitrogen(N)-Phosphatic(P)-Potassic(K) Fertilizer
NRT	Net Registered Tonnage
OC	Organic Substance
OECD	Organization for Economic Cooperation and Development
OECF	The Overseas Economic Corporation Fund
PC	The Ports Corporation
PLO	Palestine Liberation Organization
PSC	Port State Control
P.V.	Present Value
RO/RO Ship	Roll On / Roll Off Ship
RSS	Royal Scientific Society
SMB	The Sverdrup and Munk and Modified by Bretschneider
SS	Suspended Solid
T-H	Total Hydrocarbons
T-N	Total Nitrogen
T-P	Total Phosphate
TDS	Total Dissolved Salts
TEU	Twenty-foot Equivalent Unit
TS	Total Sulfide
TSS	Total Suspended Solids
UAE	United Arab Emirates
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
USA	United States of America

CONTENTS

CONCLUSIONS AND RECOMMENDATION

Through the course of the Study, the Study Team had many opportunities to hold discussions with counterpart personnel and has prepared various comments and suggestions on construction, maintenance, operation and management of the port of Aqaba to them. Conclusions and recommendations for the project prepared on the basis of the discussions are summarized herewith.

CONCLUSIONS

1) The Basic Concept of the Port Development

The port of Aqaba already has a lot of roles and functions. In addition, with the progress of the peace process in the Middle East, the port is to enjoy much prosperity. In order to meet such expectations and bring about prosperity of the port, the port development plan is proposed, aiming at the following basic concept:

i) to ensure the role and function as the gateway of Jordan
ii) to realize efficient operation
iii) to coordinate with other activities in the Gulf of Aqaba including sufficient consideration of environment
iv) to prepare rational and economic design and implementation scheme

2) Numerical Target

In advance of setting numerical targets, future political and economic scenarios in Jordan were examined. Although the future situation in the Middle East (including Jordan) is affected by many elements, progress of the Middle East peace process and the U.N. sanctions against Iraq were thought most important. Three alternative Master Plans were proposed corresponding to three scenarios out of combinations of the above two elements. They were based on rapid progress of peace process and complete lifting of sanctions, slow progress and continuation of sanctions and an intermediate situation. After consultation with authorities concerned, the middle case was selected as the most likely and practical one, which became the basis of the feasibility study at the target year, 2000.

Under the above conditions, future perspective related to port activities is as follows:

Table 1 Future Numerical Target

	Unit	1993	2000	2010
Population of Jordan	Number (,000)	4,152	5,173	6,686
GDP of Jordan	million JD	3,596	5,966	13,181
GDP per capita	JD	866	1,153	1,971
Total Cargo Volume	million tons	12	22	29
of which Container	TEUs (,000)	111	227	416
Passenger	Number (,000)	1,247	1,490	2,150

3) Proposed Plan

In order to meet forecast demand, the following project is proposed:

Table 2 Major Contents of the Proposed Plan

Objectives	Project Component	Place	Implementation Period	Remarks
Receiving Panamax type vessel	Enlargement of the existing berth (depth 14 m, length 280 m)	Main Port	up to 2000	Mainly to accommodate grain vessels; necessary to relocate unloading system
Receiving large conventional general cargo vessel	Enlargement of the existing berth (depth 12 m, length 240 m)	Main Port	up to 2000	
Coping with Containerization	Extension of the existing container berth (60 m)	Container Port	up to 2000	
ditto	Development of container yard	Container Port	Southern half completed up to 2000	
ditto	Installation of two gantry cranes (one is Panamax and another over-Panamax)	Container Port	One (Panamax) up to 2000	Need to procure other equipment (transfer crane and tug master) and introduce new computer system
Receiving large livestock vessel	Improvement of JH.1 Berth (Timber Berth)	Industrial Port	up to 2000	JH.1 Berth to be assigned for livestock handling in a specific use for environmental consideration
Supporting Industrial Activity	Development of new berth for fertilizer export	Industrial Port	up to 2000	need to install cargo handling system
ditto	Installation of additional cargo handling system	Industrial Port	beyond 2000	one loader and one unloader

In the Plan, it should be understood that some important prerequisites are included as follows:

- completion of new bypass road instead of the existing coastal road around the Container Port in advance of implementation of container port development
- efficient operation by improvement of cargo handling productivity, in particular, shortening of cargo dwelling time
- increase of cargo, especially, exported container cargoes through active port sales to port users
- introduction of computer system and making best use of it

4) Cost Estimate

The total cost of the Master Plan is estimated at about 76 million JD over the coming fifteen years. Out of the total, two-thirds are for gantry cranes and other equipment procurement and installation. One-third is for civil works, which covers container berth extension and yard development in the Container Port, additional pier in the Industrial Port and the grain and general cargo berth improvement in the Main Port.
The total cost of the Short-Term Improvement Plan up to 2000 is estimated at about 50.5 million JD, of which about 5 % is used for the Main Port, 53 % for the Container Port and 42 % for the Industrial Port.

5) Results of Feasibility Analysis

According to the feasibility study, the proposed Short-Term Improvement Plan is, as a whole, judged to be viable from economic, financial and environmental viewpoints.

EIRR for the total project is 20 %. This means that EIRR of the proposed project fairly exceeds 10 %, which is employed as the yardstick of feasibility in many port development projects. Careful attention, however, should be paid to individual project components. The total project is comprised of four individual project components. There is a big difference between individual EIRR values. The EIRR in case of improvement of JFI.1 Berth is about 11 %. Judging from port capacity at the target year, 2000, forecast cargo volume of livestock could be handled without improvement of JFI.1 Berth. Considering environmental issues and desirable berth allotment in future, this project is proposed. EIRR would become higher if environmental merit could be calculated numerically. But revised EIRR would not, relatively speaking, be at a good level even if this merit were quantitatively considered. There is little relation between individual project components so that they can be separately executed. In this context, the result of EIRR calculation shows the priority among project components, that is to say, the priority in economic sense, is, in due order, enlargement of grain berth, improvement of cargo handling system at the Industrial Port, development of new container terminal and improvement of JFI.1 Berth.

FIRR is 8.0 % which exceeds 2 %, the weighted average interest rate for expected foreign aid. In this calculation, current tariff rate is adopted. The Ports Corporation has been actually making a profit from port activities and contributing to the national budget revenue. Such a situation is not considered in the FIRR calculation. The budgetary statistics indicate that the contribution by PC represents about 1 %. Although this does not seem so high, this calculation precondition should be examined from the viewpoint of the national budgetary system.

Due to the contribution, PC has almost no internal resouces for future investment. Tariff is basically desirable at a proper level so that the port can make necessary investments. Accordingly, tariff level, if necessary, should be revised.

Environmental Impact Analysis shows that the proposed project will not cause serious problems on environment but that dust dispersion of phosphate should be reduced in due course through PC's scheduled countermeasures.

Recommendations

It is most strongly recommended that the proposed port development schemes should be realized in accordance with the proposed project implementation program. The following items should be taken into consideration for securing smooth and successful implementation.

1. General Issues to be considered by the Government of Jordan

The port of Aqaba is located over 300 km from the political and economic centre of Jordan. Partly due to this fact, almost all ministries of the Government in Jordan are apt to ignore the port. The Ministry of Transport (MOT) does not usually take part in conferences on annual budget of The Ports Corporation (PC). PC only submits the same documents to MOT as it does to the Ministry of Finance (MOF). Sufficient and timely communication and coordination do not seem to be made between PC and The Ministry of Planning, which has a great influence on decisions of financial aid from foreign countries and authorities. As mentioned in section 1.9, the port of Aqaba already plays many important roles not only in terms of supporting lives of citizens and domestic industries but also in terms of contribution to regional economy and stability, in particularly, in the Middle East. Under these circumstances, the following items are essential:

1) First of all, The Ports Corporation should conduct more public relation activities with respect to current port activities and facilities, competitive situation surrounding the port, expected roles and so on for the central organization concerned as well as the whole country, because PC knows such matters best.

2) The Government of Jordan should properly evaluate and recognize current and expected significance of port activities.

3) On top of that, characteristics of port development should be understood. Implementation of port projects, in general, takes a long time and requires a lot of money to realize completion. Furthermore, people and organizations concerned have to work hard through port sales promotion activities to ensure port facilities are utilized.

4) As described in section 4.1, the proposed scheme is based on some fundamental conditions, of which new road bypassing the new container terminal is prerequisite for the Short-Term Improvement Plan and improvement of railway transportation system for phosphate rocks and Backroad with steep slope is urgently required. These infrastructure investments should be implemented by governmental authorities or agencies concerned. One desirable way to secure the above is for proposed scheme to be approved by all relevant ministries. In other words, the plan should, if possible, be vested with a certain legal power by the government to promote its development scheme.

5) Container terminal is of great relevance to the prosperity and development of the port of Aqaba in future. The most important and increasing cargo in the long run is thought to be container cargo, in spite of the regretful current situation that all the export containers are empty. The most important key factor is to promote earnest port sales as soon as possible so as to increase export container cargoes, which are highly related to industrial promotion in the hinterland. In this context, future prosperity of the port depends upon the overall economic situation in Jordan,

which is the responsibility of all ministries and relevant private sectors.

2. Establishment of practical and flexible implementation program

Implementation of the project depends on how The Ports Corporation will acquire the required funds. Considering the financial situation at the port of Aqaba, most of necessary budget for the project implementation will be attained through foreign countries or international assistance aid. The Government and The Ports Corporation should examine the following items for the introduction of foreign aid.

1) To establish sound financial system and tariff policy.
The Ports Corporation presently makes a profit in its account and pays surplus to the Ministry of Finance every quarter of the year. PC's account is thought sufficient to carry out daily maintenance works but not to allow for large scale port development. Taking one typical example during the Study Team's visit, the computer system at Operation Department did not work due to lack of software, because MOF did not assign necessary budget despite PC's request. In this sense, current financial system of PC does not cause serious problems for daily operation and management but it is not good for securing the large amount of funds required for improvement of the existing facilities, new construction investment and introduction of container crane. PC and the Government of Jordan have to try to secure the budget for project investment in advance on their own before requesting any foreign aid. PC has to make efforts to cover project investment cost by its annual revenue as much as possible and to establish new continuous budget expenditure system beyond individual fiscal year.
As well, PC should seek some measures to increase revenue through setting the tariff at a proper level. Although contents of tariff are necessary to be competitive and reasonable considering neighbouring ports' ones, they should be set, at least, at a level which revenue can guarantee management and operation cost and repayment for interest and principal of loans. Current tariff may be revised on the basis of the result of income/investment analysis, in particularly, for newly planned facilities and equipment.

2) To examine financial source for implementation for the project components.
Although all of the project components are proposed to meet the forecast cargo demand at the target year, there are some differences in major objectives and scenarios with respect to realization of future perspectives corresponding to these project components. Construction of New Grain Berth is to solve the present problem that grain vessels of Panamax type already call with full draught but cannot be accommodated at present berths. New Container Terminal is to cope with worldwide trend of containerization and establish itself as a transit port. Improvement of New Timber Berth (JFI. 1 Berth) is required mainly in consideration of environmental issues. New cargo handling system of Fertilizer Berth is to handle increased fertilizer products and materials, etc. Construction of a new fertilizer factory is already being executed on schedule. Taking the above into account, financial source from foreign aid may be diversified. Unless necessary funds for the whole project can be raised, implementation schedule for the project components might have to be re-examined, because some kinds of cargoes can be handled at the existing facilities for the time being judging from cargo handling capacity, although it is not desirable to continue such a situation from the long term point of view.

3) The project implementation plan, as a matter of course, corresponds to the proposed port plan. The port plan, in general, needs to be flexible enough to adjust to possible contingencies and schemes have to be reviewed and modified in accordance with the changing socio-economic situation surrounding the port. PC should, therefore, introduce a new section, port planning division, in charge of preparing port development policy as soon as possible. This division will revise project implementation plan in harmony with amendment of the existing port plan, if necessary, following up the political and economic movements in the Middle East, etc., always aiming at higher efficiency of the port.

4) BOT is a financial scheme often considered in development countries which find it difficult to raise investment funds of their own. Even at the port of Aqaba, introduction of BOT for implementation of some project components has been discussed. In this Study, however, BOT is not proposed. The reason is as follows:

- It is generally said difficult to find BOT investors for port projects.
- PC seems reluctant to promote privatization in the field of operation which PC presently carries out.
- Prior to introducing any form of privatization, PC should clarify basic policy of utilization of the whole port area, which is largely related to the utilization and management policy of the coastal area.
- The coastal area is very limited while diversified requirements such as tourism development or environmental conservation, etc. are many. At the very moment when comprehensive utilization and management policy of the whole coastal area is strongly required, introduction of BOT without prudent consideration for implementation of a part of projects will bring about problems such as confusion, unnecessary competition between public and private sectors, and may create environmental issues.
- After the approval of the basic policy of privatization through coordination and consultation, BOT could be acceptable as one means of development.
- For instance, some of port facilities are expected to mainly serve a specific use, handling fertilizer-related cargoes and livestock. BOT would be worth examining as a means to raise investment funds for facilities and equipment with the above characteristics.
- Otherwise, investment funds may be returned from users by charge through revised tariff at a proper level.

3. Employment of appropriate training system, personnel policy and other relevant issues

The proposed plan is made on condition that more efficient port management and operation will be realized in future. In addition, The Ports Corporation has to supervise construction works and equipment procurements during the project implementation. In light of this, well designed training system and personnel policy are crucial. Major objectives of training corresponding to the proposed plan are thought as follows;

- realization of efficient, safe and reliable operation
- enforcement of the management body through reform and slimming
- smooth execution of the proposed project
- sufficient inspection works of assets and timely maintenance works

Following methods or measures of these training courses are useful.

- receiving technical experts from overseas in the field to enhance ability or capacity from the long-term strategic point of view
- use of consultants and technical transfer through them
- dispatching selected staffs to overseas and utilization of their knowledge and experience
- promotion of computer use for various divisions as soon as possible

Training is one of means to provide knowledge and technical skill for personnel. More important matter to be recognized is to instill trainees with cost-consciousness and efficiency oriented mind through training courses. Such a matter is highly related to personnel policy. Following issues are recommended with respect to personnel affairs:

- Establishment of proper personnel evaluation
- Execution of personnel transfer system (proper job rotation system)
- Creation of incentive mechanism, (for instance, bonus) based on their performance

Other than the above, Training Center of PC is expected to play a more important role as the only department in charge of training course as follows:

- Training Center should enhance function of the Information Center where available records, documents, textbooks and so on will be sorted, arranged and easy to access. Some valuable engineering records and documents could not be found in any department which hindered the progress of this Study. Training Center should immediately improve filing system of engineering records and documents which can be applicable to maintenance, rehabilitation, preparation of plan and design of future project, etc. in cooperation with related technical departments.

- Training Center is responsible for statistics. Port statistics are essential for port planning and administration. In this sense, present statistic system should be expanded to include the following items:

  1) Commodity-wise cargo volume by origin and destination
  2) Cargo handling efficiency
  3) Dimensions of calling vessels (including DWT)
  4) Cargo turnover records

4. Environmental consideration in port related activities

Aqaba is the sole gateway to the sea in Jordan. Although the coastal line is just about 27 km, there are various demands such as tourism development and coral preservation. Moreover, Aqaba is located at the very heart of the Gulf of Aqaba. Due to its geography, topography, sea conditions, etc., the Jordanian territory is suspectible to environmental impact. The current environmental condition is at a rather good level. Aqaba is said to be endowed with rich coral that attracts many tourist.

Another issue caused by port activities is dust dispersion to the port area accompanied with phosphate rock handling. Phosphate rock is forecast to continue to be the largest quantity commodity at the target year. Phosphate is one of the most important goods as it earns foreign currency, while almost all goods (food, natural resources, industrial products)

have to be imported.

Under the above situation, compatibility between port activities, port development and environment has to be ensured.

As to coral preservation, port activities do not directly bring about problems because there is no coral reef at areas where usual port activities are carried out. Thorough site investigation is required when making port plan. In this case, although some coral is found at the extension area of container berth, the plan is assessed not to cause serious damage to them. A study to transplant the coral, if required, is said to be possible, though such a study has to cover various issues (transplant technic, transplant site, cost, etc.).

As to phosphate dust pollution, PC has already made efforts to reduce dust generation from the dispersion sources. This does not look to completely eliminate the problem. The most effective idea to solve the problem is to relocate the existing phosphate berth to the Industrial Port. To do so, authorities concerned have to make a decision which would raise the investment cost (relocation of berth, storage facility, cargo handling system, railway extension, etc.). At present, the most practical way for PC to proceed is to ensure complete closure of storage to prevent dust emission outside, and this should be done on schedule or sooner, if possible.

Accordingly, PC does not seem to have to take special action for environmental consideration in accordance with the proposed plan. In other words, serious environmental issues accompanied with the proposed plan will not be caused as long as PC performs its tasks within the established rules. PC, however, need not be totally idle in this regard.

First of all, people and organizations concerned should become conscious of significance of environmental protection and upgrading of the Gulf of Aqaba and thus be ready to take actions needed. PC should become the head of the movement.

Other than the above, PC should take the following steps:

- Preparation of contingency plan such as oil spillage (making contingency plan and training for enforcement at emergency)
- Establishment of regulation that contains prohibition on disposal (especially garbage) from vessels
- Regular inspection and monitoring of environmental condition in cooperation with other authorities (ARA, MSS, RSS, etc.)
- Conducting study on treatment of ballast water, bilge, etc. from vessels, if necessary, with the increase of calling vessels in future
- Raising public awareness of the need for environmental preservation

INTRODUCTION

In response to the request from the Government of the Hashemite Kingdom of Jordan, the Government of Japan decided to conduct the study on the Improvement Plan of the port of Aqaba in Jordan (hereinafter referred to as "the Study").

In accordance with the relevant laws and regulations in force in Japan, the Japan International Cooperation Agency, the official agency responsible for the implementation of technical cooperation programs of the Government of Japan, is conducting the Study in close cooperation with the counterparts of Jordan.

This is the summary of the Final Report for the Study.

The objectives of the Study are defined as follows:

1) To formulate a Master Plan for the port of Aqaba for the period up to the year 2010

and

2) To conduct a feasibility study on the Short-Term Improvement Plan for the port of Aqaba including a port management and operation plan for the period up to the year 2000 within the framework of the Master Plan

The items and a flowchart of the Study are shown in Figure 1.

The Study Team is comprised of the following specialists.

NAME	RESPONSIBILITY
Jiro KANO	Team Leader, Overall Management
Kenichi OKUMURA	Port Planning, Environmental Consideration
Toshihiko KAMEMURA	Demand Forecast, Economic Analysis
Shinichiro USHIJIMA	Management and Operation, Financial Analysis
Takashi SAKURAI	Cargo Handling System
Sadamaru EMOTO	Regional Situation Study
Norio YAMAGUCHI	Information System
Masahiro YOKOGAWA	Design of Port Facilities
Nobuo ENDO	Construction Schedule, Cost Estimate
Takeaki HOSHINO	Natural Condition Survey
Yoichi KIMURA	Environmental Survey
Mitsunobu SHIBUYA/ Shingo SHIRATORI	Coordination

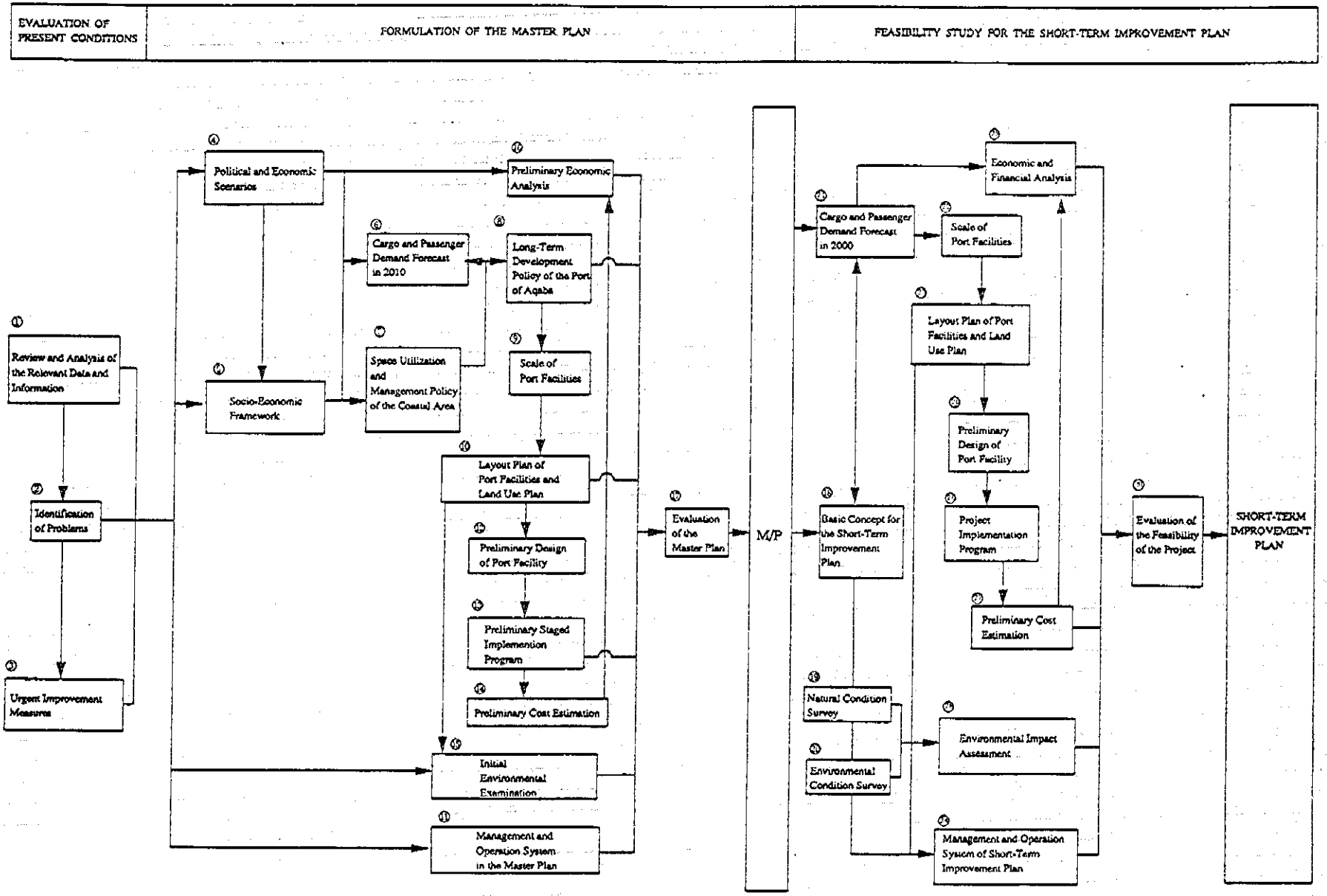


Figure 1 Flow of the Study

Chapter 1 Outline of Jordan

1.1 General

The Hashemite Kingdom of Jordan, established in 1950, is located in the northwestern part of the Arabian Peninsula, 29° 11'-33° 22' North and 34° 59'-39° 18' East, surrounded by Syria, Iraq, Saudi Arabia, Israel and the West Bank.

The land area is 88,946 sq. kilometers, of which about 80 % is semi-desert or wilderness and only 6 % is cultivated. In 1956, Jordan and Saudi Arabia agreed to a territorial exchange, moving the border on the Gulf of Aqaba 17 km south, and thus including the area of the present Industrial Port.

1.2 Topography

Jordan's topography is divided into the following three categories: Jordan Valley Region, The Mountain Heights Region and Eastern Desert. Jordan Valley Region is a part of the Great African Rift. The part of this area below mean sea is fertile and most of the crops in Jordan are produced here. The Mountain Heights Region lies along the eastern side of the Jordan Valley Region, between the Yarmouk River and Syrian border in the north, the Ghor and Wadi Araba in the west, Wadi Musa in the south and the Badia in the east and south. The altitude increases going towards the south, ranging between 600 m and 1,500 m. Almost all major cities exist in this region, and thus political, economic, social activities etc. are concentrated here. Eastern region lies in the east and comprises most of Jordan's area. It is mostly an arid plateau with an elevation of 600 m to 900 m, extending eastward.

1.3 Climate

The diverse topography of Jordan makes it difficult to definitively categorize the climate. The climate of Jordan is, as a whole, predominantly that of the East Mediterranean type which is characterized by a fairly hot and dry summer and a moderately cold winter but it could be classified into three types (semitropical, the Mediterranean and desert climate) in correspondence with the topography.

The weather in the Ghor area is semitropical with a very hot summer and warm winter. The Mountain Heights Region is characterized by the Mediterranean climate, where summer is moderate and dry while winter cold and rainy. The Eastern Desert has a typical desert climate which is a hot and dry summer but cold and windy winter with a large range between day and night and very little precipitation.

1.4 Population

Population of Jordan reached 4.15 million in 1993 and population density is 47 persons per square kilometer. Most people live in the capital city of Amman and the northern governorate. Port of Aqaba is the center of southern Jordan which is a depopulated area. Population of Aqaba governorate in 1993 was 79,200. Growth rate of Jordanian population after the year 1983 exceeded 3.5% each year, and thus future projections are made based on this level.

1.5 Economy

Boosted by foreign assistance and loans, worker's remittances, Jordan enjoyed unprecedented growth in its income during 1973-1984. This ended in the mid-eighties as a result of the rapid decline in the price of oil and subsequent slowdown in regional economies. As a consequence, Jordan experienced a drastic slowdown in growth and incurred a huge external debt, representing 180% of GDP in 1991. Jordan has sought exceptional international support under the IMF and the World Bank's structural adjustment program that aims at sustainable growth while addressing external and internal imbalances.

GDP in 1993 was 3.6 billion JD(5.2 billion US$) and GDP per capita was 866 JD(1,250 US$). Concerning sectoral contribution to GDP which is shown in Table 1.5.2, Government Services was highest while and Finance Services, Transport, Manufacturing, Wholesale follow. Tertiary industry occupied a high share of GDP.

Table 1.5.1 Main Economic Indicators

Year	GDP	Population	GDP per Capita		
	(Million JD)	(,000)	JD	US$	Ex.Rate
1983	1,766	2,495	708	1,950	0.363
1988	2,218	3,001	739	1,976	0.374
1990	2,613	3,453	757	1,140	0.664
1993	3,596	4,152	866	1,250	0.693

(Source: Central Bank of Jordan Thirtieth Annual Report 1993)

Table 1.5.2 Sectoral GDP (at Factor cost)

Year	Agri.	Mining	Manufac.	Elect.	Const.	Wholesale	Transp.	Finance	Government Service	Personal Service
1988	114.5	82.4	197.0	50.6	118.4	257.2	294.5	348.0	392.8	46.1
1990	179.6	158.8	345.2	53.3	111.6	207.9	362.0	374.5	431.2	51.2
1993	244.9	100.6	451.4	75.3	180.2	287.6	470.8	585.4	607.6	73.4

(Source: Central Bank of Jordan Thirtieth Annual Report 1993)

The Third 5 Years' Plan announced in September 1993 has the following objectives:creating conditions conductive to sustainable growth, ensuring fiscal and monetary stability, attaining a high level of self-sufficiency and self-reliance, developing a highly competitive export sector, enhancing the capabilities of all citizens etc.. It envisages a steady GDP growth of 6 percent per annum with domestic inflation at an annual rate of 4-5 percent through 1997. Domestic consumption level of 89 % of GDP is a manner to correct structural imbalance of over consumption for production. It aims also at reduction of external debt to GDP ratio to a level not exceeding 100% by 1997.

Jordanian external trade had values of 2.5, 3.1, 3.3 billion Jds in 1991, 1992, 1993 respectively. These growth rates are 23% and 6%. Imports exceeded exports by 2.4 times in 1990, and this trend continues. As trade partners, Saudi Arabia, Iraq and India were top three importers and USA, Iraq and Germany were top three exporters in 1993. Concerning transport mode, 38 % of import and 47 % of export passed through the port in 1993. For this reason the Ports of Aqaba are key ports of Jordan.

Table 1.5.3 External Trade of Jordan

Year	Total	Export (FOB)	Import (CIF)	Balance	Remittance
1989	1,867.6	637.6	1,230.0	-585.3	358.3
1990	2,431.9	706.1	1,725.8	-1,008.6	331.8
1991	2,541.4	770.7	1,770.7	-994.1	306.3
1992	3,126.3	829.3	2,297.0	-1,461.7	573.1
1993	3,318.3	864.7	2,453.6	-1,585.2	720.7

1.6 Transport

1.6.1 General

Jordan is situated in the heart of the Middle East, surrounded by Syria, Iraq, Saudi Arabia, Israel and the West Bank. Its coastline is only 27 km long.

Because of its topography, land transportation, in particular, road transportation, together with maritime transportation plays an important role in terms of international trade. In addition, one of the distinctive features in Jordanian transport is the large volume of transit cargoes passing through Jordanian territory into neighboring countries. This means that transportation is likely to be affected by the political and economic situation in neighboring countries, especially those in the Middle East.

According to the statistics, the transport sector accounted for 11 % of the GDP in 1992. The sector currently employs over 40,000 people, representing some 6.5 % of the labour force. That means that transport sector exceeds agricultural sector in terms of produced value.

Ministry of Transport is responsible for comprehensive transport planning but implementation of transport projects, administration and supervision for related business are executed by several departments of the Government of Jordan. Construction and maintenance of major roads are carried out by Ministry of Public Works and Housing. In Aqaba region, Aqaba Region Authority has made some master plans including land use and transportation.

1.6.2 Road

The road networks have been developed through the years, especially in the last 15 years. Paved roads length increased from about 1,000 km in 1950 to 6,678 km in 1993.

Because Jordan's socio-economic characteristics such as population, economy, industry etc. are centralized in the north area around Amman, Zarqa, roads connecting Aqaba with Amman are very important. In this sense, Route 15 and 25 (the Desert Highway) and Route 35 (the King's Highway) already function as the mainstream of cargo and passenger flow. However, these roads are rather steep in sections or else the pavement is partially damaged which makes it difficult for heavily loaded trucks to pass through smoothly. Another road, Route 65, runs alongside the border between Jordan and Israel. A part of it (between Ras el Ghor and Haditha) just opened in March 1995.

As to access to neighboring countries, Route 15 leads to Syria via Zarqa and plays a role in carrying cargoes to Turkey as well as Syria. To reach Saudi Arabia, Route 5, which

diverges from Route 15 (the Desert Highway) in Ma'an, and Route 30, which has its starting point in Zarqa, are currently used.

Concurrent with the Middle East peace process, a lot of projects to improve transportation are being proposed and negotiations between Jordan and Israel or related countries have in some cases been entered. In regard to road projects, Jordan River Crossings and Access Roads and Jordan Rift Valley Roads are given high priority to step forward.

1.6.3 Railway

There are two railway companies, Hedjaz Railway Corporation and Aqaba Railway Corporation, in Jordan. The former railway is presently operated for passenger transport once a week between Damascus and Amman. The latter started its operation in 1975. Following the contract with Jordan Phosphate Mines Co. Ltd., it transports phosphate rocks from El Abiad Mine and El Hassa Mine to the port, about 300 km away. Transport capacity is estimated at about 3.5 million tons of phosphate rock a year.

Both railways have several future plans. Two projects in the detailed engineering stage, named Shidiya Mines Rail Link and Wadi II Link in Aqaba, are deeply concerned with port activities. The former is the connection project between the Shidiya Mine and the existing railway line. The latter is the connection of a fertilizer complex, cement storage, container port to the rail network. Other than the above projects, link projects with neighboring countries have been proposed. The completion of Irbid-Haifa link will probably bring about the changes of traffic flow to and from Europe and America through the Mediterranean. This project is given high priority but it seems that it will be rather difficult to implement due to the topography.

1.6.4 Aviation

There are three major airports in Jordan; Queen Alia International Airport and Amman Airport (Marka) in Amman and Aqaba Airport in Aqaba. Airline services are provided by Royal Jordanian Airline, a state-run company, and connected with over forty cities, extending to Singapore and Jakarta in the Far East and New York and Chicago in America. The only domestic airline serves passengers moving between Amman and Aqaba on a daily basis. The volume of freight was only 54,062 tons in 1993.

There are future plans of airport expansion, one of which, named Aqaba Airport project, proposes to accommodate Israeli traffic together with Jordanian traffic.

1.6.5 Maritime Transport

The port of Aqaba is the only access to the sea for Jordan. It has been playing an important role for Jordan and for its neighboring countries as well. Detailed port activities are analyzed later. Current roles and functions of the port are summarized here as follows:

- To deliver daily necessities for domestic consumption
- To support the industrial activities in Jordan
- To function as the gateway for transit cargo
- To accommodate passenger boats
- To contribute to the regional prosperity and provide employment opportunities

Chapter 2 Current Situation of the Port of Aqaba

2.1 Natural Conditions

2.1.1 Meteorology

The climatological data are collected from Meteorological department and the port of Aqaba cooperation.

(1) Temperature

The Aqaba port is hot from May to October with the maximum temperature exceed 40℃. From November to April is mild with average temperature below 20℃.

(2) Rainfall

Annual precipitation ranges from 10 to 20mm and the number of rainy days are less than 10 days.

(3) Humidity

Annual humidity ranges from 60 to 70% based on the mean monthly relative humidity.

(4) Wind

Winds normally blow from North to South, that is from land to sea in Aqaba.
The wind condition is relatively calm through the year except southern storms crossing time and prevailing wind direction is Northeast.

2.1.2 Oceanography

(1) Tides

The results of tide observation at Royal Yacht Club near Main Port are very close to the design tide levels of Aqaba New Coastguard Harbours.

Tideal levels at Aqaba

MHWS	+1.10 meters	Mean Spring High Water Level
MHWN	+0.90 meters	Mean Neaps High Water Level
MSL	+0.70 meters	Mean Sea Level
MLWN	+0.50 meters	Mean Neaps Low Water Level
MLWS	+0.30 meters	Mean Springs Low Water Level
LAT	0.00 meters	Lowest Low Astronomical Tide
CDL	0.00 meters	Chart Datum Level

(2) Currents

The results of current observation at Aqaba port are as follows.

Port	No. of Station	Maximum Velocity	Direction
Main Port	C-1	0.15 m/s	NW
Container Port	C-4	0.11 〃	SE
Industrial Port	C-6	0.12 〃	SW

(3) Waves

The estimated design waves at Aqaba Port by S-M-B Method are as follows.

Wave Height (1/3) 50 years	Location
3.2 m	Offshore
1.1 m	at harbor

2.1.3 Soil Conditions

Soil characteristic for each site are as follows.

(1) Main Port Area (Previous Study Data)

The uppermost horizon is Branched Coral with thickness about 5 meters and the N-values are from 16 to 28.

The second horizon is Coral Sand with thickness about 10 meters and the N-values are from 16 to 50.

The third horizon is Igneous Gravel and the N-values are from 46 to 50.

(2) Container Port Area (JICA Study Data)

There is same horizon from -9 m to -30 m, namely whitish, creamish and greyish, fine to coarse, loose to very dense Coral Sand with some shells.

(3) Industrial Port Area (JICA Study Data)

The upper horizon is whitish and creamish Branched Coral with thickness about 12 meters and the N-values is from 44 to 72.

The second horizon is greyish, very dense, fine to medium Grained Beach Sand with some shells.

The N-values is from 54 to 63.

2.1.4 Environment

Sea water of the Gulf of Aqaba is very clear for no river runs into the Gulf. The sea water is almost free from pollution. However, the transparency decreases at Phosphate Berth, very slight oil and grease membranes were observed at several areas. Very slight higher temperature was observed at the cooling water outlet of Old Power Plant.

Preservation of corals is one of the most important issues in planning the port improvement. The most beautiful and largest coral reefs exist near Marine Science Station, north and south of the station. No significant coral colony is found at Main Port except the

south of Phosphate Berth where coral is spotted alive. Corals are alive at the south of Fertilizer and Potash Berth. The extension of this berth should take into consideration the coral preservation. The coast between Container Port and Industrial Port as designated to the tourism has three coral preservations. One diving center is being operated for tourist divers.

At Main Port, the dust emission from Phosphate Berth is considerable. The dust is generated at both the loading facilities and storage facilities even after installation of the dust collecting system of the loaders. Phosphate dust rather deteriorates the working conditions for workers and contamination to grain bulk cargoes, which is usually handled at No. 1 Berth next to Phosphate Berth. High levels of total suspended particulates (TSP) were present throughout the year in Aqaba's ambient atmosphere.

At Industrial Port, the power plant and fertilizer complex are operated. Gas emission is observed. At leeward of these plants, NH_3, CO, SO_2 are observed in the air.

European Community's study team left to ARA both the hardware and software for simulation of pollution dispersion in seawater and air in Aqaba after completing "Aqaba Coastal Resources Environmental Management Study in Jordan - October 1993." However, the computer simulation has not been run since the EC's study was conducted because no expert capable of conducting the simulation is available with ARA. The simulation can be only conducted by the EC's study team since the software is not open to experts of other agencies.

2.2 Current Situation of Port Facilities

2.2.1 Mooring Facilities

The Port of Aqaba Consists of Main Port, Container Port and Industrial Port.

The types of mooring facilities at the Port of Aqaba are mostly open-type pier structures (including dolphin type) with steel piles foundation.

The face-line of the mooring facilities has been planned at the most properly place avoiding dredging activities utilizing a good natural condition of steep seabed gradient.

All of the steel piles for foundation are controlled the corrosions by means of catholic protection.

As an exception of structural types, the type of Lighters Wharf at Main Port is gravity type of concrete blocks, and also General Cargo Berths No.8 & No.9 and Timber Jetty (JFI-1 Jetty) are gravity types of Steel Sheet Pile Walls. Moreover, there are two floating berths which were used for a temporary container wharf 10 years ago.

Table 2.2.1 shows mooring facilities at the Port of Aqaba.

2.2.2 Port Road, Yard

The Port area of Main Port was prepared the land by means of cutting hill slopes at the sea wards (west side) from the Aqaba Coastal Road.

A wadi is crossing at the center of the port area and a flood channel is constructed near the month.

At the northern area of the Wadi, there are transit sheds, open storage for general cargoes and buildings related port. At the southern area, there are grain Silos, oil tanks and phosphate storages. There are 6 port gates along Aqaba coastal road. Port roads accessing

their gates are connecting each other in the port area. Northern port is mainly handling general cargo which roads and yards are mostly paved by concrete pavement.

On the other hand, roads and yards at southern port are paved by asphalted concrete pavement.

At container terminal, container stack yards and port roads are paved by asphalted concrete pavement.

2.2.3 Utilities

All ports are well equipped with power supply, substations and power services, also portable water and sewerage system.

Table 2.2.1 Mooring Facilities at the Port of Aqaba

Port	Berth	Length (m)	Depth (m)	Structural type	Built in	Cargo Handling/Storage
Main Port	General Cargo No.1~No.2	340	11.2	Steel piles Pier type	1964	Transit Shed
	〃 No.3~No.6	720	11.5	〃	1980	〃
	〃 No.7	150	8.5	〃	1980	Open storage
	〃 No.8,No.9	300	5.8	Steel sheet Pile wall	1980	〃
	Lighters Wharf	210	4.0	Gravity type of blocks	1939	Apron
	Phosphate A	210	11.0	Dolphin	1959	Conveyor
	〃 B	180	15.0	〃	1966	〃
Container Port	Container Berth No.1	540	15.1	Steel piles Pier type	1982	Container Crane 2 units
	〃 No.2					
	〃 No.3					
	Passenger Berth	150	15.0	Floating berth	1983	Walkway
	Al-Mushtarok (Cement)	120	11.0	Dolphin	-	Conveyor system
	Mo'ta (Rice)	150	15.0	Floating berth	1983	〃
Industrial Port	JFI-West	200	15.0	Steel piles Pier type	1980	Conveyor system
	JFI-East	190	11.0	〃	1980	Pipe line
	JFI-1	80.5	7.0	Double-wall Cofferdam	1978	Open yard
	Oil Berth	140	25.0	Dolphin	1988	Pipe line

2.3 Port Related Industry

Two types of port related industry are recognized in Jordan. One is factories located around the port and the other is port users.

Existing factories operated in the surrounding port area are listed as follows:

1) Jordan Fertilizer Industry
2) Jordan Electricity Authority
3) Arab potash Company
4) Jordan Timber Products Industry
5) Solvochem Holland B.V.
6) Aqaba Packing Co.
7) Jordan Petroleum Refinery Company

Major industries related to the port of Aqaba are listed as follows:

1) Ministry of Supply (silo)
2) Jordan Phosphate Mines
3) Jordan Cement Factories Co.
4) The Free Zones Corporation
5) Jordan Industrial Estates Corp.
6) Livestock Industry

2.4 Port Activities

2.4.1 Cargo Handling Volume and Commodities

Generally speaking, the volume of cargo handled between 1952 and 1975 tended to slightly increase though there were many fluctuations and reached 1.6 million tons in 1975. The following year(1976), however, the cargo volume exploded, and this trend continued until 1988(20.1 million tons of cargo). Since then, the cargo volume has been on the decline. Finally cargo volume sank to 10.6 million tons in 1994, equivalent to the level of 1971 and 1972.

Phosphate, potash, fertilizer, cement and empty container are major export commodities, and general cargo, grain, steel and sugar are major import commodities.

Iraqi transit cargo increased rapidly in 1980s, peaking at a share of 49.0%(in 1988). Recently this volume has slightly declined due sanctions on Iraq; in 1993 the share was only 11.2%.

2.4.2 Calling Vessels

(1) Number of Calling Vessels

Average number of calling vessels during six years from 1989 to 1994 was 2,358 vessels per annum ; 2,458 vessels called in 1994.

(2) Kinds of Calling Vessels

Calling vessels were categorized into passenger boat, container ship, general cargo ship, RO/RO ship, car carrier, livestock carrier and bulk cargo ship which includes grain ship, phosphate ship, fertilizer ship, chemical tanker and so on.

Passenger boats made 976 calls per annum from 1989 to 1994, representing 40 % of the total. Number of calls are likely to increase.

Container ships made 340 calls per annum from 1989 to 1994, represented 13.6 % of the total in 1994. Number of calls does not seem to increase, but size of the ship seems to become larger because of increasing number of container year by year.

General cargo ships made 293 calls per annum during 1989 to 1994. Calling number of the vessel has the similar trend as that of container ships and shared around 10 percent out of the total through the past six years.

(3) Size of Vessels

54 vessels of more than 40,000 DWT called at this port in 1994. 94 percent out of these vessels consisted of bulk ships for unloading grain and / or loading phosphate. Maximum sized vessel in 1994 was the bulk carrier of 76,767 DWT for loading phosphate.

Maximum sized container ship was 30,450 DWT in 1994 and the second was 28,000 DWT which calls regularly.

Vessels of more than 10,000 DWT made 730 calls in 1994 and shared 50 percent out of the total (excluding passenger boats).

(4) Frequency of Calling Vessels

Number of calling vessels per month is 208 vessels from 1993 to 1994 and is relatively constant except for passenger boats which change by season.

(5) Berth Occupancies (Source ; PC and JPMC)

In the Main Port, average berthing occupancy from No.1 to No.7 Berth was 73 percent from 1989 to 1993 and that of Phosphate Berth B was 63 percent. Though 73 percent is rather high, it might be decreased by the improvement of cargo handling productivity.

In the Container Port, the highest berthing occupancy was 68 percent at Container No.3. It is guessed that vessels other than container ships were mainly assigned to No.3 from 1989 to 1993.

In the Industrial Port, the highest berthing occupancy in 1994 was 71 percent at JFI West and East. The main reason for high occupancy is due the low handling productivity.

2.5 Port Management

2.5.1 Outline of Port Management

The Ports Corporation (PC) was formed from a merger between Aqaba Port Department and Maritime Establishment in 1978. PC is a government body which belongs to Ministry of Transportation, however, PC is the only organ which is responsible for management operation and development of port in Jordan.

2.5.2 Organization

(1) Organization Structure

Port management and operation polices are drafted and executed by the Board of Directors which is comprised of the following members;

Minister of Transport (Chair Man), Director General of PC, President of Aqaba Region Authority, Director General of Custom Department, Director General of Jordan Phosphate Mines Company, President of Shipping Association and Private Sectors.

Number of employees in 1994 is 5,106 (Staff: 2,413, Worker: 1,300, Casual Labor: 1,393). PC has stopped recruiting to decrease the excessive number of employees.

However, PC cannot actively decrease the number of its employees as a government organization.

The organization structure is shown in Figure 2.5.1.

2.5.3 Administration and Management of the Port

(1) Vessel Entry and Departure in/from the Port

From the top of the Port Tower, vessels and VHF are monitored 24 hours a day. Vessel's particulars and berth usage are also recorded. Bilge record books, safety equipment, fire equipment of vessels according to the international regulations such as SOLAS, MARPOL, etc are also checked (port state control).

(2) Owner and Operator

All main facilities and equipment are owned by PC except grain silos which are owned by Ministry of Supply.

All cargoes are operated by PC except fertilizer and its materials which are operated by the JPMC.

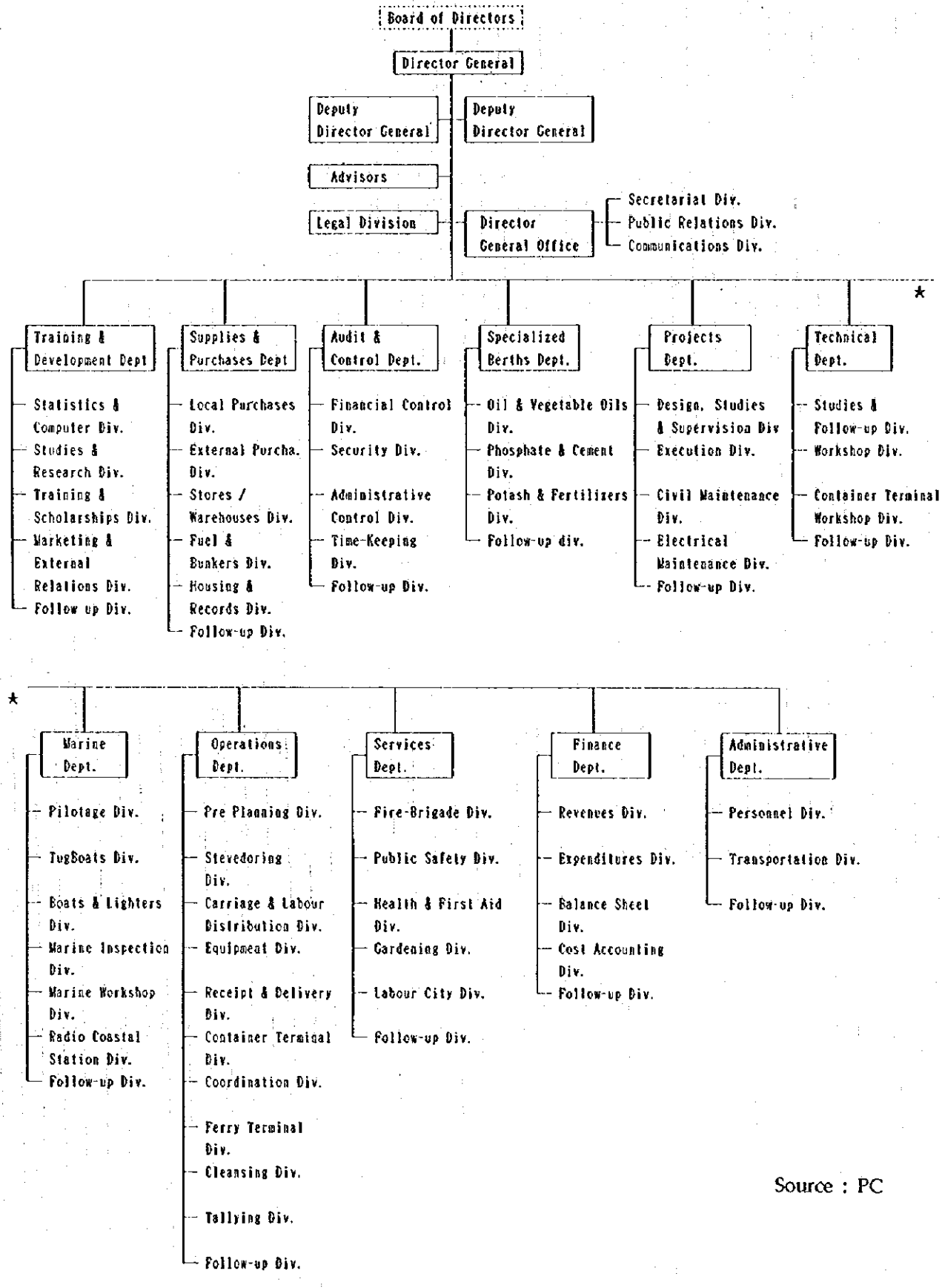
(3) Customs and Quarantine

There is a Aqaba Customs Office, Quarantine Office and Agriculture Office in Main Port.

(4) Others

PC has its own fire brigade in charge of fire in the port.

PC inspects entrance and exit of persons and documents of trucks carrying cargoes in and out at all gates.



Source : PC

Figure 2.5.1 Organization Structure of PC

2.5.4 Finance

(1) Financial Condition

PC covers expenditure from revenue which is earned by port activities and does not receive a subsidy from the Central Government.

Finance Department makes annual budget based on the requirements from each department. PC presents annual budget to Board of Directors for study and confirmation. And then PC presents it to Minister of Transport for final ratification.

PC contributes the balance of annual revenue and expenditure to Ministry of Finance.

(2) Port Tariff

Port tariff is set based on The Ports Corporation Service Charge Regulations. Under these regulations following main charges are charged; Pilotage and Towage Fees, Port Entrance Fees, Wharfage Dues, Loading and Discharging Services Charges, Lighterage, Porterage, Quay and Storage Charges.

2.5.5 Training System

PC has a Maritime Training Center which was established in 1979. Training Center is required to have sufficient facilities or equipment and qualified instructors.

2.6 Port Operation

2.6.1 Port Service

PC provides following port services;

Anchorage used for ships discharging cargo into barges and ships waiting, Navigational aids, Pilotage, Towage, Water supply, Bunker fuel, Waste matter, Radio, Medical services for first aid.

Working hours are from 7:00 until 14:00 and from 17:00 until 1:00.

2.6.2 Cargo Handling Equipment and Facilities

The port of Aqaba has following main cargo handling equipment and facilities.

(1) Equipment

Mobile crane (71), Fork lift (119), Tug master (27), Towing tractor (39), Gantry crane (2), Straddle carry (9) and Container top lift handler(16)

(2) Storage Facilities

Shed (39,484m^2), Covered hanger (34,495m^2), Open storage (87,235m^2), Open area (120,210m^2), Phosphate storage (340,000 ton) and Grain silos (150,000 ton)

(3) Slip Way (winch capacity 300 ton, area 10,000 m^2)

To maintain and repair tug-boats

2.6.3 Cargo Handling System

(1) Documentation for Cargo

The following documents are required;

Freighted manifests, Un-freighted manifest, Non-negotiable bills of loading, Separate manifest for free zone cargoes, Dangerous and hazardous cargo lists showing IMO class and UN number, The master stowage plan and hatch lists

All manifests must be received in Aqaba at least 48 hours before the arrival of the vessel.

(2) Berth Allocation

Berth allocation meeting is held twice daily. The allocation of berth is decided based on the following items;

- The distance of transferring the cargo from the ship side to the storage area.
- The capacity of berths and berths occupancy at the time of ship arrival
- All specialized berths (phosphate, fertilizer and cement) are allocated upon request from the Companies.
- Berth No.1 is allocated to all ships charted by the Ministry of Supply

2.6.4 Container Terminal

(1) Location and Layout

Container terminal, berth length 540m, is located about 5km south of main port, and divided into two areas separated by a main road. One is inland side, and the other is sea side area, there is a problem in that the land elevation in not consistent. The difference of land level is about 5m between No.3 and No.4 storage area, and few meter at the southern end of No.1 and No.2 storage area. To facilitate traffic between inland side and sea side area, a tunnel under the main road has been built trucks loaded with container can pass through the tunnel, but straddle carriers can't pass this tunnel due to the height restriction.

Average dwelling days of container in terminal is around 22 days. The figure is high compared with other ports, though deficient terminal operations may not be the reason. The main reasons of these dwelling days are originated in other organizations outside of the terminal or regulated procedures by law, those are sample analysis, inspections, finance procedure and so on.

(2) Operation of Container Terminal

This terminal has two gantry cranes and adopts a straddle carrier and trailor/chassis combination system for container operation. As mentioned above, since a straddle carrier can't pass through the tunnel under the road, this tunnel is unable to operate containers only using straddle carrier.

For yard control, the address of the container is recorded on a "T card". In this system, the last two digits of the container number are used to control the yard. Container

control tower has 100 pieces of stacking racks on the wall from 00 to 99, and the "T card" is distributed into them according to the last two digits.

2.6.5 Computerization

PC intends to introduce a computer system into their operation and works, but generally speaking, the level of computerization of PC is still low. At resent, PC has no computer system to support the management and operation in the port. In 1993 Dec., the main computer was installed into the office to computerize their operation, but the necessary software is lacking and the computer is not used practically.

The specification of the main computer is as follows;

Hewlett Packard HP-9000 Series 800/827
HP-UX 9.0 UNIX Operating System
32 Bit machine, 53 Mips, 48 MHZ, 1.3 GB Hard Disk

Finance Department and Supply & Purchasing Department introduced a mini-computer, and they operate the computer for their part of daily operation. Technical Department and Marine Department have personal computers in their office, but these personal computers are not used in full practice.

Chapter 3 Urgent Improvement Measures

3.1 Identification of Problems

3.1.1 Port Management

(1) Organization

Port management and operation strategy related to a basic policy and plan for the port development does not function effectively. Restructuring of the management organization should be considered.

(2) Communication

An obstacle to improving port management and operation is created by lack of communication and information exchange among each department in the port, private sector and the master of calling vessel. This issue is necessary to be solved urgently.

(3) Training Workers

Although almost all Departments in PC are required to train their workers and provide them with the technical skill and knowledge necessary for the future introduction of new system / machines, Maritime Training Center in PC is not effectively functioning. The main problems are lack of competent trainers, sufficient equipment and space.

(4) To Foster Competent Employees

It is required for high grade employees like computer operator, engineer, pilot, ship inspector as well as management to get the opportunity to become acquainted with information and knowledge and system regarding high level in developed countries.

(5) Upgrading port management

The introduction of ISO-9000 by PC shall be considered for management of quality control and quality assurance.

(6) Port Promotion Strategy

PC does not seem very active in pursuing potential clients. To increase clients and enlarge the scale of the port more, the active execution of port promotion and sales is necessary.

(7) Statistics and Recording System

Though management system concerning systematic collection, compilation and statistics of port data and information seems to be fair good as a whole, there remains still considerable room for improvement in its arrangement and practice.

(8) Safety of Loading / Unloading Operation

Workers who take charge of loading and unloading operation on berths and storage

area do not wear working clothes, shoes and helmets. This issue shall be solved to maintain safety and increase productivity.

(9) Computerization

At present, the management and operation of PC are not sufficiently computerized yet, as most functions are performed manually. As a result, numerous handwritten documents are exchanged within the office. On the other hand, some Departments in the port strongly desire their routine works to be computerized.

Computerization shall be required for PC to conduct the quality control / assurance, efficiency and rationalization of port management and operation.

(10) Radio Pratique System

Free Pratique by Radio " system is not available for vessels calling this port.

(11) Contingency Planning System

Emergency Committee in PC is currently not functioning. Contingency planning system is necessary for port management.

(12) Study Team of IMO

Study team joined by high level maritime experts is not available in PC though it is necessary to follow up the current information concerning IMO and judge whether this country should ratify the recommendation.

(13) Insurance against cargo damage by stevedores

PC does not insure against cargo damage caused by stevedores. Insurance is necessary for the port to become attractive and competitive in an international context.

3.1.2 Port Operation

(1) Grain Operation

The operation of unloading grain is mainly done at Berth No.1 by three unloaders and / or at Berth No.3, the deepest berth, by portable evacuators. Large sized vessel is obliged to shift her berth from No.3 to No.1 Berth after lightening her draft. This operation contributes to low productivity. The improvement of grain productivity is necessary as it is one of the most important cargoes in this port.

(2) Unified Cargo Operation

Unified cargoes like bags and cartons are basically handled by manual labors. The use of portable solid conveyors with rollers is necessary to improve productivity and decrease number of labors.

(3) Phosphate Dust

Though efforts to reduce phosphate dust emission produced from phosphate complex

have been made, the problem still remains. It is necessary to solve this issue urgently.

(4) Container Terminal

1) Handling Capacity by Manual

Though container throughput handled at this terminal in 1994 was 110,000 TEUs in 1994, PC is still controlling handling of containers in the terminal by manual process involving shipping agent. The figure shows that the capacity of this terminal has almost reached the limit of manual operation. It is necessary for PC to introduce computerization for terminal management and operation as soon as possible.

2) Container Yard Operation

The terminal does not actually control storage spaces, by the control being left in shipping agent works. All yard spaces have to be controlled by the terminal management.

3) Container Documentation

It frequently happens that the terminal cannot receive shipping documents from shipping agent or vessel operators prior to vessel arrival . The terminal should solve the problem to cope with future increasing number of containers.

4) Terminal Layout

Operation in the present terminal is hindered for the following reasons.
- The terminal is divided into two areas (Yard 1/4 and Yard 2/3) by a public road.
- Different height between the two areas is 15 m to 20 m.
- There are plural terminal gates. (Container delivery /receiving should be controlled at one gate)

(5) Passenger Berth and Terminal

It is said that there are two problems. The passenger berth is 8 km from the town while the distance between the berth and the terminal is 540m. Though transport by vehicles solves such problems currently, fundamental problem concerning the location of the berth and terminal will remain.

(6) Industrial Berth (JFI West and East) Operation

The handling productivity of industrial cargoes such as DAP, Potash, Sulfur are low ; productivity of sulfur unloading is especially due to frequent breakdown of unloader. To cope with the increasing cargo volume in future, the improvement of handling operation and maintenance system of equipment is necessary.

(7) Smoke and Dust from Factory and Industrial Berths

A considerable amount of smoke comes out from the funnels of industrial factories and dust of raw materials is emitted from Industrial Berths during loading and unloading

operation. Measures to control such smoke and dust shall be considered.

(8) Maritime Operation

1) Radar

Though there is no radar installed in the Port Control Tower, it is necessary to control and confirm vessel movement in the port by radar.

2) Tug boat Waiting Basin

There is one basin for tug boat in the Main Port. Due to the long distance between the Main Port, the Container Port and the Industrial Port, it takes a lot of time and fuel for tug boats to transfer to other ports in order to attend calling vessel. Another waiting berth for tug boats in the Container Port or the Industrial Port will be necessary.

(9) Land Transportation

There are two by-pass high ways to approach the port on Route 15. These by-pass routes are rather steep for fully loaded trucks to pass. To maintain safety, a certain modification of these two routes shall be necessary.

3.2 Urgent Improvement Measures

Urgent improvement measures are decided from the following basic criteria.

a) Problems which hinder port activities or are anticipated to become bottlenecks in the future

b) Facilities and equipment which require no large investment and are easily improved

c) Port operation and management which require no fundamental change of organization, but only small change of operational procedure or working method

d) Improvement measures without environmental destruction caused by port activities / facilities

(1) Introduction of Computerization

1) Establishment of Committee (Project Team)

PC should establish independent committee (Project Team) of which member shall be comprised of a representative of each department and computer expert. The committee determines the course and the priority of computerization.

2) Vessel Movement Network

Each department like Marine, Operation and Finance Department is required to possess common data such as vessel movement and cargo operation jointly by

means of computerization.

3) Application Software for Computer

For more effective use of existing mini/personal computers, it is required for PC to supply application software using the fastest and most economical means.

(2) Modernization of Container Operation

1) Computer System

As the capacity to handle containers manually in this terminal has almost reached the limit, a computer system to control containers in the yard should be introduced by means of the existing main host computer.

2) Layout of Container Terminal

The public road coming through the container yards should be shifted behind the terminal and then different height between existing east and west yards must be leveled. Subsequently, terminal office, maintenance office shall be placed adjacent to a gate in order to introduce computer system in the future.

3) Container Operation

Container operation such as yard control, container location control and cargo work sequence must be performed by the terminal operator. In order to accomplish it, PC must establish the system to gather all shipping documents prior to vessel arrival in advance.

4) Training

To introduce new container operation system by computer, terminal operators should be appropriately educated and trained.

(3) Upgrading Environment

1) Phosphate dust

The problem of phosphate dust emission in the Main Port must be completely eradicated, though it was partially solved through introduction of choke feeders, because the phosphate rock complex is near the town and residence area.

2) Others

- To control smoke and dust from factories and industrial berths in the industrial ports
- To make green belt along the coastline between the Main Port and the Industrial Port
- To prohibit any wastes from vessels by Port State Control
- To establish Contingency Planning System

(4) Strengthening of Communication

1) To improve mutual communication and information exchange including distribution of documents / mails in the port

2) To improve external communication and information / documentation exchange between PC and others concerned

3) For PC to make third party communication between inside and outside port by wireless radio.

4) For PC to make close communication with the master of calling vessel to improve vessel operation.

(5) Improvement of Training System

a) The maritime Training Center provides common training by gathering workers from each Department for similar kinds of training.
b) To invite some suitable experts and / or teachers to the Training Center
c) To prepare training equipment
d) To enlarge the Training Center
e) To shift the Training Center to an suitable place in the Main Port
f) To develop current training courses, upgrade and train instructors

3.3 Urgent Improvement Action Plan

This plan is selected and chosen in the " Urgent Improvement Measures " under the following conditions.

- Issues to be urgently be improved
- Issues not requiring a large amount of investment or expenses
- Issues not requiring a large fundamental changes of the organization
- Issues which will have an immediate impact upon resolution

Table 3.3.1 Urgent Improvement Action Plan

NO. OF ISSUES	CONTENTS
1	Preparation for computerization by establishing committee (project team)
2	Effective use of existing personal computer by supplying software
3	Improvement of cargo work efficiency of container terminal
4	Improvement of grain operation at No.1 Berth in the Main Port
5	Improvement of cargo work efficiency of general cargo in the Main Port
6	Improvement of cargo work efficiency of industrial cargo in JFI W & E
7	Improvement of internal and external communication of PC
8	Improvement of outside communication by use of fax / telex
9	Improvement of shipping agent communicating by use of transceiver
10	Safe control of ship movement in the port by radar
11	Prevention of drain of technical engineers and experts
12	Adjustment and repletion of port statistics
13	Dust control of phosphate berth and storage area
14	Establishment of action plan in case of emergency

Chapter 4 Master Plan of the Port of Aqaba

4.1 Basic Concept of the Port Development

4.1.1 Background of the Port Development

The port of Aqaba already has a lot of roles and functions. In addition, with the progress of the peace process in the Middle East, the port is to enjoy much prosperity. In this context, the port should play more important roles.

This port has, however, a number of problems to be solved. Among others, the following are most important issues.

a) To cope with containerization

b) To prepare facilities and equipment necessary for increasing cargoes other than container cargo

c) To improve the environment around the port

4.1.2 Basic Concept of the Port Development

In order to solve the issues mentioned above, the port development should be executed in the framework of the long-term viewpoint, that is to say, the master plan, because it takes a long time and a lot of investment to step forward into implementation. The basic concept of the port development for the Master Plan is proposed as follows, taking into consideration the analysis of background of the port development and evaluation of present conditions related to the port:

a) The role and function as the gateway of Jordan

b) Efficient and practical operation

c) The coordination with other activities in the Gulf of Aqaba including sufficient consideration of environment

d) Preparation for rational and economic design and its implementation stage

4.1.3 Fundamental Condition for proposing the Master Plan

The Master Plan of the port of Aqaba will be proposed based on several conditions.

a) Following political and economic scenarios mentioned later, the port of Aqaba will be placed as a transit port in the Middle East.

b) Other than the above, projects related to development and utilization of the Gulf of Aqaba will be implemented by individual agencies or organizations through foreign aid.

c) Another principal utilization in the Gulf of Aqaba, namely tourism development, will be steadily stepped forward so that more environmental consideration will

be required.

d) It is assumed that relevant industries will increase production plans, making it necessary to expand and prepare storage space and to upgrade the transportation system between ports and facilities to ensure higher handling productivity.

e) Taking into consideration that the port of Aqaba will certainly face keen competition with neighboring ports, preconditions to cope with such a situation and to survive as a transit port should be introduced.

f) On the recognition that space to be developed is severely limited, it is desirable to minimize extension facilities.

g) Berths will be assigned, in principle, on the basis of the current way of use. Almost all berths are used for a specific use corresponding to kinds of commodities.

4.2 Alternative Sites for the Port Development

4.2.1 Space Utilization and Management Policy of Coastal Area

Current activities and utilization of the coastal area in Jordan are well organized and ordered. Serious problems have never occurred before. There is little variation in coastal activities and it is unlikely that any will be seen in future. This is largely owing to the land use plan by Aqaba Region Authority (ARA). All public sectors such as authorities, organizations etc. and private sectors concerning the Gulf of Aqaba have been managing to adhere to the land use plan.

Therefore, it is thought appropriate to base the space utilization and management policy of coastal area on the existing land use plan. The present way of usage, in which each activity is physically separated from one another, should be basically continued, even though tourism and port activities would be expected to be activated. In other words, the basic concept of the land use plan should be kept as the space utilization and management policy of the coastal zone in the Gulf of Aqaba.

4.2.2 Site Selection for the Port Development

Following the above policy, future port development area should be, in principle, examined within the existing port area, which are separated into the main three areas (the Main Port, the Container Port and the Industrial Port area).

The Main Port area : Water depth in front of the existing quay sharply increases. Most of the land area is already occupied by port facilities, access to the hinterland, administration office etc. Relocation or conversion of existing berths is thought to be appropriate in future because there is insufficient space around Main Port.

The Container Port area : The Container Port is comprised of container terminal, passenger terminal, cement and rice handling berths. Considering available land space behind berths and existing facilities or factories, utilization of this area is as follows; cement and rice handling berths should remain unchanged; extension of the container terminal should be planned close to the existing quay; reallotment or extension of passenger berth

should be determined based on demand forecast and environmental consideration.

The Industrial Port area : Corresponding to industrial activities, berth extension should be allotted around the existing facility concerned.

Other possible area : There is very little area available for development in Aqaba. The southern area of Wadi Araba is the only possible expansion site. Therefore, it is recommended that the area should be reserved for future need.

4.3 Political and Economic Scenarios in Jordan

4.3.1 Current situation in the Middle East

September 1993 : Israel and the Palestine Liberation Organization signed an interim agreement on self-rule.

26th October 1994 : Historic peace treaty between Jordan and Israel was signed.

October 1994 : The Middle East-North Africa economic summit was held in Casablanca with the participation of representatives from some 60 countries and more than 1,000 businessman. Jordan presented 121 development projects valued at $18,000 million.

January 1995 : There were two summits between Jordan and Egypt in Aqaba and between Jordan and the PLO in Amman.

October 1995 : The second Middle East-North Africa Economic Summit took place in Amman, attended by some 2,000 government officials, business executives and financiers from some 60 countries.

4.3.2 Future Situation in the Middle East

The future situation in the Middle East will largely depend on the following elements.

a) The Middle East peace process currently taking place.
b) The U.N. sanctions against Iraq being enforced.
c) Implementation of an interim agreement between Israel and the Palestinian liberation organization on self-rule in the Gaza and the West Bank.
d) Realization of joint development projects in the region.

4.3.3 Political and Economic Scenarios in Jordan

This section is intended to focus on how the future situation in the Middle East would affect the role and function of the port of Aqaba and the Jordanian economy as a whole.

In this connection, three (3) scenarios are formulated as pre-conditions for the Master Plan by selecting Case 1, Case 5 and Case 9 from among the alternatives shown in the Table, which reflect the pictures of the possible future developments in the region resulting from the two main factors that will have an impact on the course of events in the future; the Middle East peace process and the U.N. sanctions on Iraq.

Case 1 : Jordan has and will have a stable political situation in the years to come. A peace treaty between Jordan and Israel may possibly lead to the formation of Middle East economic block. it would be beneficial for the port of Aqaba to see the lifting of the U.N. sanctions against Iraq.

Case 5 : There is The Social and Economic Development Plan 1993-1997 prepared by the Jordanian government.
In bilateral relations, economic cooperation between Jordan and Israel and between Jordan and the PLO will be promoted in various sectors.
With Jordan-Israel establishing an economic coopertion base, a regional economic block will cover Jordan, Israel, Egypt, Syria, Lebanon and the PLO.
Among the joint development projects proposed by Jordan, an Iraqi-Jordan crude oil pipeline seems feasible for planning and subsequent implementation. Once the sanctions on Iraq are eased, the project is expected to be planned. Where there are a number of projects to be implemented as in the case of Jordan now, it will be implemented according to priority of projects.

Case 9 : Recent summit in Cairo by the leaders of Egypt, Jordan, Israel and the PLO have focused on Palestinian-Israeli peace process.
As long as the Israeli-Palestinian relations are not improved and the UN sanctions on Iraq remain unchanged, regional economy will continue to be stagnant and thereby bring about decrease in volume of export of Jordanian products to Iraq.
Under such circumstances, joint development projects will be implemented at a slow pace and be limited to the Aqaba / Eilat area.

Table 4.3.1 Alternatives leading to Scenarios

Middle East Peace Process / UN Sanctions on Iraq	•To reach a comprehensive settlement. •Attain political stability in region. •Peace treaty to be signed between Israel and neighboring nations. •Peaceful co-existence in region.	•To progress steadily. •Following Egypt and Jordan, peace treaty between Israel and Syria/Lebanon to be negotiated. •Palestinian self-rule to be extended to other areas.	•To make slow progress but no setback in peace process. •Diplomatic contacts to be underway between Israel and other Arab countries.
To be lifted completely	•Economic activities to be invigorated over entire region. •Jordan enjoys foreign investment to its industry and infrastructures. •Volume of cargo and goods traffic to be increased at Aqaba port. •Changes likely in cargo/ passenger flow to and from Jordan. Case 1	•Give favorable impact on Jordan economy. •Jordan to yield peace dividend from domestic economic achievement. •Port facilities at Aqaba to be improved. •Gradual changes likely in cargo/passenger flow to and from Jordan Case 2	•Jordan-Iraq crude oil pipeline to be planned. •Amount of peace dividend differs by each nation's stability and economic development. •Port facilities at Aqaba to be improved. Case 3
To be eased or partially lifted	•Give a stimulus to Jordanian economy. •Export of mineral products and import of consumer goods to be increased through port of Aqaba. •Jordan-Iraq crude oil pipeline to be constructed. •Changes likely in cargo/ passenger flow to and from Jordan. Case 4	•Trade block to be formed on a smaller scale by Jordan, Syria, Lebanon, PLO and Israel. •More national budget to be allocated on improvement of infrastructure. •Jordan-Iraq crude oil pipeline to be planned Gradual changes likely in cargo / assenger flow to and from Jordan. Case 5	•Jordan-PLO economic coperation, trade, transport, communication and banking etc. to be observed. •Even limited oil export helps reactivate regional economy and has favorable impact on Jordan. Case 6
To remain status quo	•Limited volume of cargo/ good traffic between Jordan and Iraq through port of Aqaba. •Development of Aqaba/Eilat area to be implemented. •Construction of Jordan-Israel-Egypt highway to be executed. •Changes likely in cargo / passenger flow to and from Jordan. Case 7	•Economic relations between Jordan and Israel to be promoted. •Development of Aqaba / Eilat area to be planned and partly implemented. •Gradual changes likely in cargo / passenger flow to and from Jordan. Case 8	•Regional economy to remain stagnant. •Aqaba/Eilat cargo and passenger facilities to be constructed. •Oil refinery in Aqaba to be planned. Case 9

4.4 Demand Forecast

4.4.1 Socio Economic Condition

Referring to "the Five Year Plan 1993-1997" (Annual growth rate of GDP during 1993 and 1997 is assumed to be 6.0 %) and proposed growth rates (7.9 % per annum) by MOP which reflect the Jordanian economic trend and the recent Mid-East economic situation, three cases are adopted for the master plan study(see Tables 4.4.1 and 4.4.2).

Table 4.4.1 Growth Rates of GDP

Case	Growth Rate of GDP		Remarks
	1993-2000-2005-2010	Ave.Annum	
Case 1 (High Case)	8.5- 9.0- 8.5 %	8.6%	Advance of PeaceProcess Lift of Iraqi Sanctions
Case 5 (Middle Case)	7.5- 8.5- 8.0 %	7.9%	MOP Plan
Case 9 (Low Case)	6.0- 6.0- 6.0 %	6.0%	Five Years Plan

Table 4.4.2 Economic Indicators in Jordan

Year		GDP (JD)	Population	GDP/Capita (JD)
1993		3,596,000,000	4,152,000	866
2000	Case 1	6,365,000,000	5,173,000	1,230
	Case 5	5,966,000,000	5,173,000	1,153
	Case 9	5,407,000,000	5,173,000	1,045
2010	Case 1	14,727,000,000	6,686,000	2,202
	Case 5	13,181,000,000	6,686,000	1,971
	Case 9	9,683,000,000	6,686,000	1,448

Note : Populations are based on "World population Projection (World Bank)".

4.4.2 Macroscopic Demand Forecast

Future cargo volume is projected by correlated equation between cargo volume and population and extrapolated equation of historical trend of cargo volume.

Table 4.4.3 Macroscopic Demand Forecast

Case	Year2000	Year2010	Correlation Coefficient
By Population	22.7	30.4	0.646
By Christian Year	17.5	22.0	0.848

4.4.3 Microscopic Demand Forecast

(1) Base Cargo

Two big elements that affect political, economic and social situation of Mid-East region are the Middle-East peace process and the UN sanctions on Iraq. Socioeconomic conditions and hinterland of the port are assumed. Namely, the growth rate of GDP and condition of traffic access are thought to affect demand forecast of the port and assumed by 9 cases reflecting the former two elements.

Base cargo volume in 2010 is estimated by assumption that all Jordanian marine cargo shall pass through the ports of Aqaba.

Concerning industrial development projects related to port activities, new fertilizer products plan, new dead sea products plan and livestock farms development plans in Aqaba and Al-Quwayra are examined.

(2) Modifying Cargo Volume by Scenario

Base cargo is modified by scenario. Factors affecting demand forecast are listed bellow:

a) Consumption of Israel-Jordan joint project
b) Transit cargo
c) Aqaba-Eilat Free Trade Zone
d) Iraqi Oil Pipeline
e) Shifting of Import Container Cargo to Mediterranean Ports
f) Shifting of Export Bulk Cargo from Eilat to Aqaba

Table 4.4.4 Modified Cargo Volume by Scenario Component in 2010

(Unit : Ton/Year)

Case	Case 1	Case 5	Case 9
Israel-Jordan joint project	560,000	28,000	0
Transit cargo	2,200,000	1,100,000	0
Aqaba-Eilat Free Trade Zone	110,000	60,000	550,000
Iraqi Oil Pipeline	34,000,000	0	0
Shifting to Mediterranean Ports	-1,120,000	-510,000	0
Shifting from Eilat to Aqaba	970,000	970,000	0

Table 4.4.5 Demand Forecast in 2010

Year Case	Total (ton)	Break Bulk (ton)	Bulk (ton)	Container (TEU)
1993	12,003,000	3,000,000	8,313,000	111,000
2010 High	63,055,000	4,340,000	55,965,000	410,000
2010 Middle	29,185,000	3,330,000	23,075,000	416,000
2010 Low	26,645,000	2,540,000	21,375,000	412,000

Table 4.4.6 Ferry Passenger and Vehicle

Year	Case 1		Case 5		Case 9	
	2000	2010	2000	2010	2000	2010
Passenger(,000)	616	1,170	1,490	2,150	1,313	1,500
Vehicle(,000)	154	240	144	200	127	140

4.5 Required Port Facilities and Equipment

Required port facilities and equipment for the Master Plans are determined in accordance with the above selected scenarios (Case 1, 5 and 9).

4.5.1 Forecast of Vessel Size by Vessel Type

Taking into account present situation of calling vassels and its future projection, the maximum ship size by ship type in terms of dead weight tonnage is determined as follows:

a) The maximum size of grain carriers is 50,000 DWT, Panamax type.
b) The maximum size of general cargo carriers is 30,000 DWT. But as the predominant vessel size is estimated as 10,000 DWT, this situation is taken into account.
c) The maximum size of livestock carriers is 206 m of length and 9.8 m of full draught.
d) The maximum size of crude oil carriers for Case 1 is 250,000 DWT.
e) The maximum size of container vessels is 35,000 DWT with carrying capacity of 2,000 containers (TEU).
f) The maximum vessel size other than the above mentioned is the same as at present.

4.5.2 Required Berth Dimension by Vessel

Standard berth dimensions are, in principle, adopted here, which are determined by analyzing dimensions of vessels by type provided in Lloyd's Register (Refer "TECHNICAL STANDARDS FOR PORT AND HARBOUR FACILITIES IN JAPAN").

4.5.3 Required Number of Berth

In this Study, a method considering the frequency of ship entry and cargo handling productivity is employed.

This method is summarized as follows:

Number of berths = (Total number of berthing days) / (Annual number of workable days × Berth occupancy ratio)

where
- Total number of berthing days:
  (Number of vessel calls) × (Average berthing days per vessel)
- Number of vessel calls:
  (Annual cargo volume handled) / (Average cargo volume handled per vessel)

- Average berthing days per vessel:
  (Average cargo volume handled per vessel) / (Average cargo handling productivity per vessel per day) + (Number of days necessary other than for cargo handling)

Referring to the UNCTAD report ("Port development, A handbook for planners in developing countries"), the berth occupancy ratio will be determined.

The parameters necessary to adopt the above formula will be given on the basis of the forecast cargo volume, present situation of calling vessels or cargo handling etc.

With regard to determining the required number of container berths, a method considering the cargo handling capacity per berth per year is adopted.

With regard to passenger berth, the required berth number is determined taking into account the carrying capacity of ferry boats.

Table 4-5-1 shows the results of required number of berths.

Table 4.5.1 Required Number of Berths in 2010

Major Commodity or Passenger	Case 1	Case 5	Case 9	Utilized Facilities	Remarks
Phosphate	1	1	1	2	Existing berth (A) is used for vegetable oil, etc. loading.
Grain	1	1	1	usually 2	A part of grain is currently handled at Berth No. 3.
General Cargo, Vegetable Oil	7	5	4	usually 7 at Main Port and another (JFL1)	Berth depth and length of some existing berths are not sufficient to accommodate vessels of 30,000 DWT class.
Fertilizer, Potash	3	3	3	2	
Crude Oil, Mineral Oil	2	1	1	1	
Cement	1	1	1	1	
Rice	1	1	1	1	
Livestock	1	1	1	1	Existing berth (Timber Berth) cannot accommodate livestock vessels of more than 80 m in length.
Container Cargo	2	2	2	usually 3 (total length 540 m)	Existing berths can not accommodate two container vessels with 2,000 TEUs simultaneously as required berth length in this case is 600 m.
Passenger	3	3	3	3	

4.5.4 Required Scale of Facilities

(1) Required Scale of Berths

Required scale of berth (berth length and depth) will be determined on the basis of expected maximum calling vessel size at the target year. Maximum vessel sizes by major commodities are assumed corresponding to average cargo volume per vessel by major commodities. Based on the results of required number of berths and taking into account present situation of calling vessels and its future projection, planned berths at the target year are as follows:

Table 4.5.2 Required Scale of Berths

Major Commodity or Passenger	Place	Case 1	Case 5	Case 9	Remarks
Phosphate	Main Port	Existing Phosphate Berth (B)	Existing Phosphate Berth (B)	Existing Phosphate Berth (B)	No need to develop new berth
Grain	Main Port	One berth to accommodate 50,000 DWT vessel (L:280 m, D:14 m)	One berth to accommodate 50,000 DWT vessel (L:280 m, D:14 m)	One berth to accommodate 50,000 DWT vessel (L:280 m, D:14 m)	A part of grain is to be handled at other berths.
General Cargo, Vegetable Oil	Main Port, Industrial Port	One berth to accommodate 30,000 DWT vessel (L:240 m, D:12 m), two extension berths for 10,000 DWT vessel (L:170 m, D:10 m for one berth) and existing berths	One berth to accommodate 30,000 DWT vessel (L:240 m, D:12 m) and existing berths	One berth to accommodate 30,000 DWT vessel (L:240 m, D:12 m) and existing berths	JFI.1 berth (Timber Berth) is to be retained for use. Berths from No.1 to No.6 at Main Port are to be utilized after improvement, if necessary. No. 7 Berth is to be used in Case 1 and Case 5.
Fertilizer-related cargoes, Potash	Industrial Port	One extension berth to accommodate 50,000 DWT vessel (L:230 m, D:15 m) and existing berths	One extension berth to accommodate 50,000 DWT vessel (L:230 m, D:15 m) and existing berths	One extension berth to accommodate 50,000 DWT vessel (L:230 m, D:15 m) and existing berths	Existing berths (JFI. West and East) are to be used successively.
Crude Oil	Industrial Port	One extension berth to accommodate 250,000 DWT oil tanker and existing oil berth	Existing oil berth	Existing oil berth	
Cement	Container Port	Existing berth	Existing berth	Existing berth	No need to develop new berth
Rice	Container Port	Existing berth	Existing berth	Existing berth	No need to develop new berth
Livestock	Industrial Port	Improvementof Timber Berth	Improvement of Timber Berth	Improvement of Timber Berth	
Container Cargo	Container Port	60 m extension of the existing berth	60 m extension of the existing berth	60 m extension of the existing berth	Two container vessels loaded with 2,000 TEUs will call.
Passenger	Container Port	Existing berth	Existing berth	Existing berth	No need to develop new berth

(2) Required Scale of Water Basin

There is a coral patch in front of Berth No.7 at Main Port (according to the chart, the shallowest point is 7.6 m depth). Dredging plan of coral patch for Case 1 and 5 will be proposed.

(3) Required Scale of Storage Area at Main Port

Expansion plan of transit sheds and covered hangers is not needed for all alternative cases because existing storage capacity can meet future demand.

(4) Required Scale of Container Terminal

Assuming introduction of transfer crane and operational condition (dwelling time, peak ratio, utilization ratio, etc.), the following main facilities will be planned.

- Container yard : 37 container stacking blocks (108 TEUs per layer)
- Container freight station (CFS) : no need to be planned (existing area exceed necessary one; 8,000 m^2)
- Maintenance shop : 2,000 m^2
- Container cleaning space : 1,500 m^2
- Terminal gate : 6
- Terminal office : 3,000 m^2

4.5.5 Cargo Handling Equipment

In order to handle increasing cargo, cargo handling system will be improved or newly installed. Major equipment is as follows:

- Two container gantry cranes (one is Panamax type and another over-Panamax)
- Ten tire mounted transfer cranes and five tug masters for container handling
- Additional unloader (500t/h) for sulfur and loader (560t/h) for phosphoric acid with pipeline at the existing berth
- One loader (1,500t/h) for fertilizer at new berth

4.5.6 Safety Back-up Facilities

(1) Tugboat

Tugboats necessary to assist large ocean-going vessels of, in particularly, over 10,000 DWT class, in the final phase of the manoeuvering will be proposed as follows:

- Two tugboats of 2,000 ps for all alternative cases
- Two tugboats of 3,000 ps for Case 1 and one for Case 5 and Case 9

(2) Radar

In order to ensure vessels' safety and avoid emergency situations, radar system with computerized vessel traffic management will be introduced.

4.5.7 Other Infrastructures and Utilities

Other infrastructures and utilities (power supply, water supply, oil supply, sewage treatment, drain) necessary to operate and manage the port will be planned corresponding to berth extension, development, increase of port activities, etc.

4.6 Proposed Master Plan

4.6.1 Basic Concept

Detailed layout plan will be proposed in accordance with the conception of functional allotment and site selection, in particular, considering the following items.

1) To make best use of as many existing facilities and as much equipment as possible
2) To examine quantity and location of construction works in order to keep construction costs as low as possible and also to grasp the environmental impact

4.6.2 Layout of Facilities

Facilities described here are berths at Main Port and Industrial Port and berths, container yard and other attached facilities at Container Port.

(1) Main Port

Judging from the required number of berths for phosphate, it is not necessary to retain the existing Phosphate Berth (A). However, since vegetable oil is presently unloaded at Berth (A), it is desirable for Phosphate Berth (A) to be retained unless it will obstruct another usage in future. Comparing required berths at the target year with the existing berths (No.1 to No.7), Case 1 needs a new extension berth while Case 5 and 9 do not. Therefore, new extension berth is planned only in Case 1. It is thought appropriate that the new berth is extended southward from the No.1 berth, taking into account its expected function and cargo handling and storing system. This means that the new extension berth is to be constructed at the place of Berth (A).

There are two alternative layout plans with regard to the new extension berth, depending on where the largest berth (berth length: 280 m, berth depth: 14 m for 50,000 DWT grain vessels) will be located. In one alternative, the largest berth will be secured at the place where the existing general cargo berths are currently located by deepening. The right extension place will be finally determined considering results of coming site investigation etc. In this case, common structural design would require the quay line to be moved 2 m ashore, and thus the quay line connecting the existing berths would not be straight. In the other, the largest berth will be constructed at the place where Phosphate Berth (A) presently exists. Both alternatives require reallotment of cargo handling system.

Two alternatives are shown as follows (Figure 4.6.1 and 4.6.2):

Layout plans for Case 5 and 9 are the same. The only difference is that the former includes the existing Berth No.7 for general cargo berth while the later doesn't. They are shown in Figure 4.6.3.

(2) Container Port

The scale of berths required at the target year means that 60 m extension of container berths is necessary. Based on layout of current and future possible container yard, CFS and existing Ro-Ro berth, it is appropriate for the container berths to be extended southward. The proposed layout plan of container terminal is shown in Figure 4.6.4.

As to the passenger berths, the replacement plan has been discussed by relevant authorities. It is, however, recommended that replacement plan should be adopted, taking into account the existing berth capacity and their condition, future demand, environmental issue, etc.

As a result, other than container berth, port facilities at Container Port will remain unchanged.

(3) Industrial Port

An additional berth for fertilizer-related cargoes and potash will be required for all alternative cases and a tanker berth to accommodate 250,000 DWT class vessels will be required for Case 1.

Improvement of JFI.1 Berth (the Timber Berth) will be proposed for all cases based on the result of berth requirement.

The proposed layout plan is shown in Figure 4.6.5.

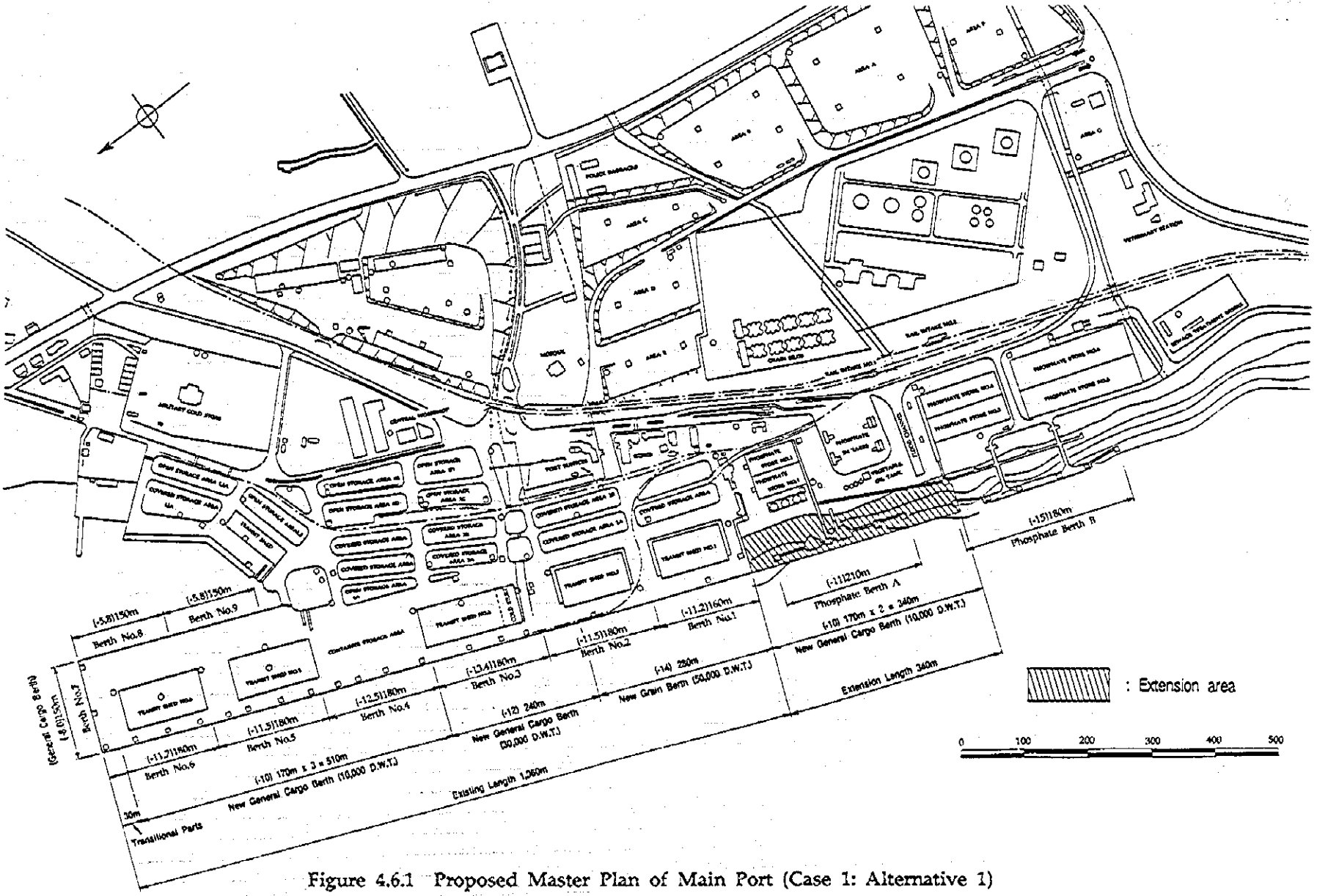


Figure 4.6.1 Proposed Master Plan of Main Port (Case 1: Alternative 1)

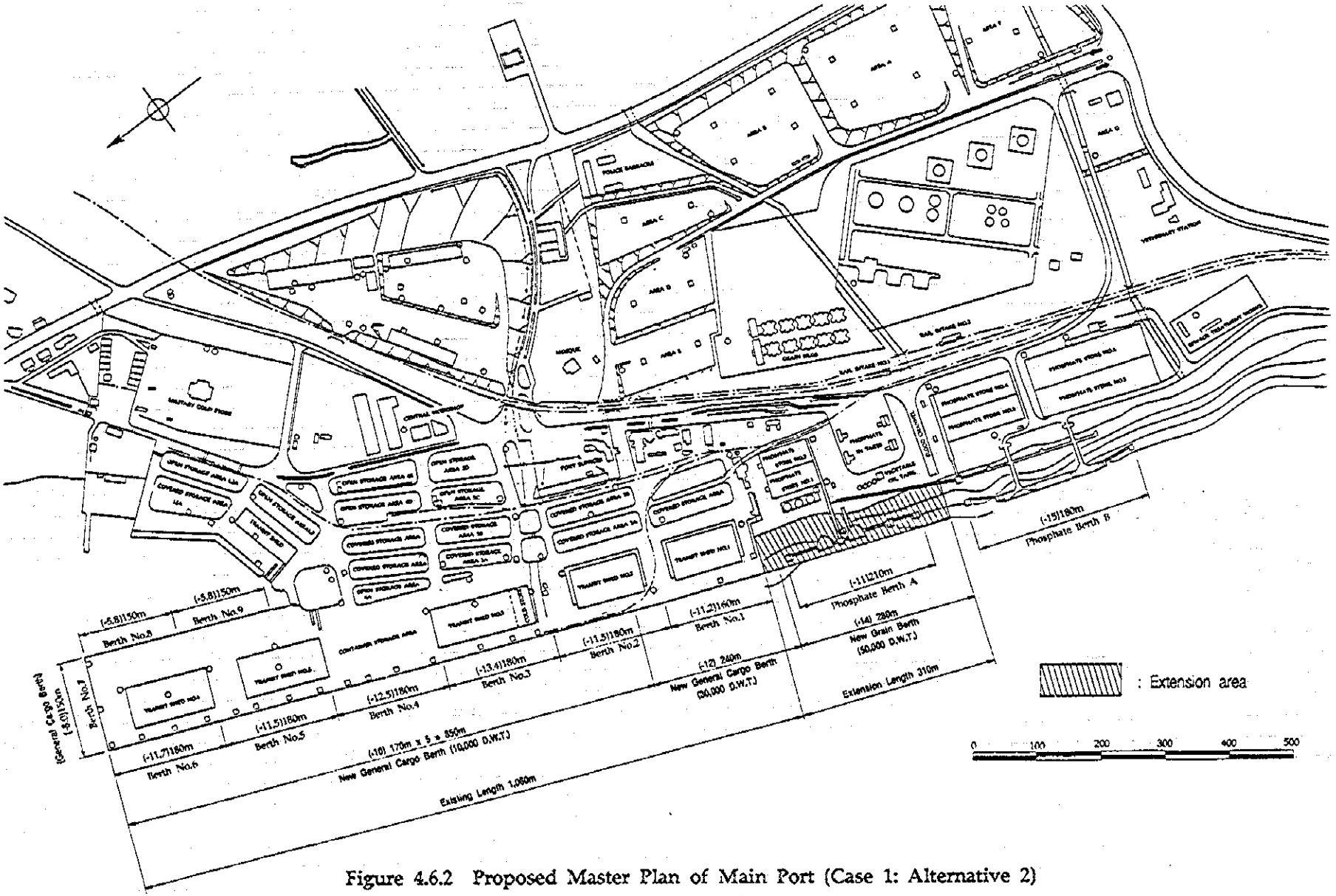


Figure 4.6.2 Proposed Master Plan of Main Port (Case 1: Alternative 2)

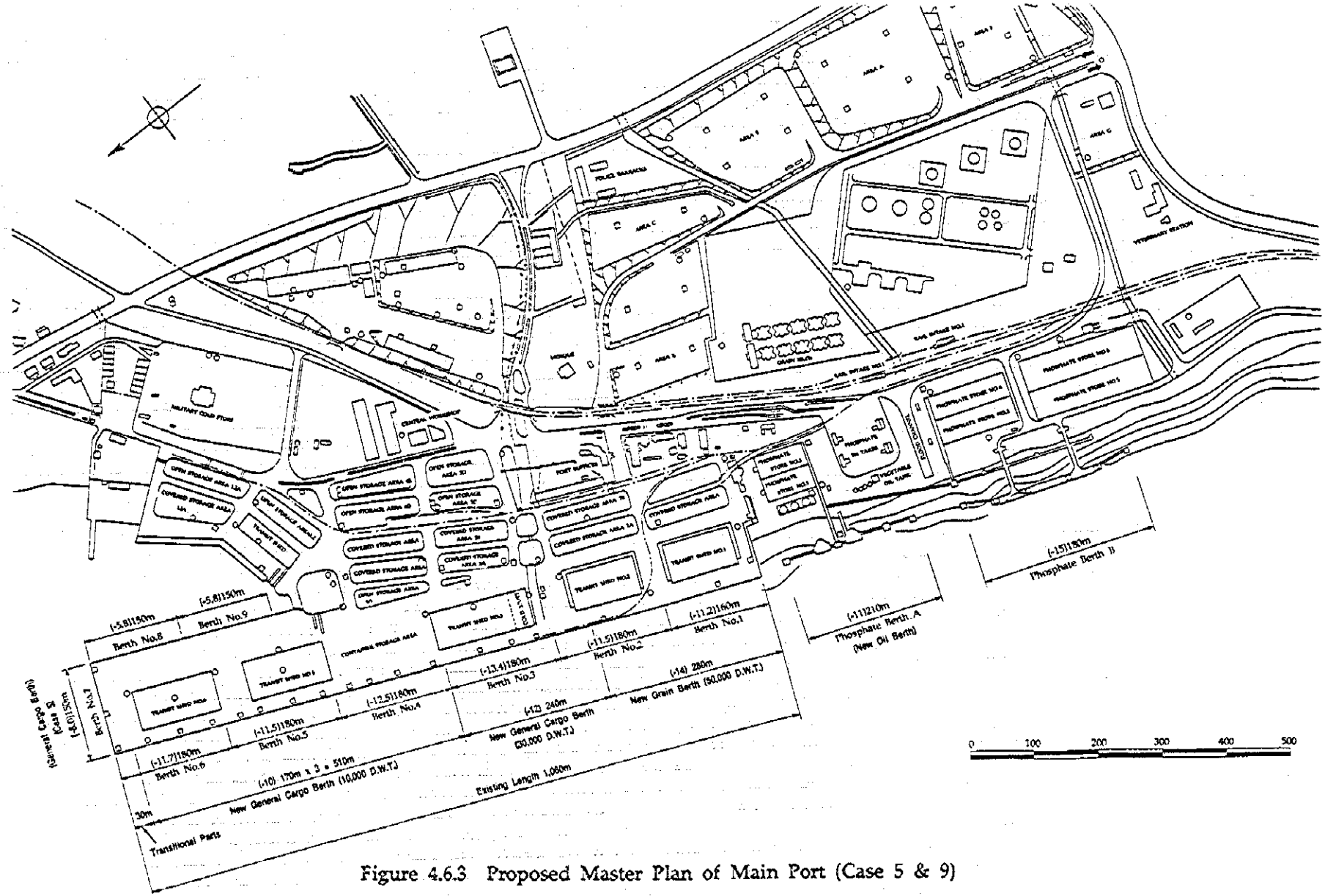


Figure 4.6.3 Proposed Master Plan of Main Port (Case 5 & 9)

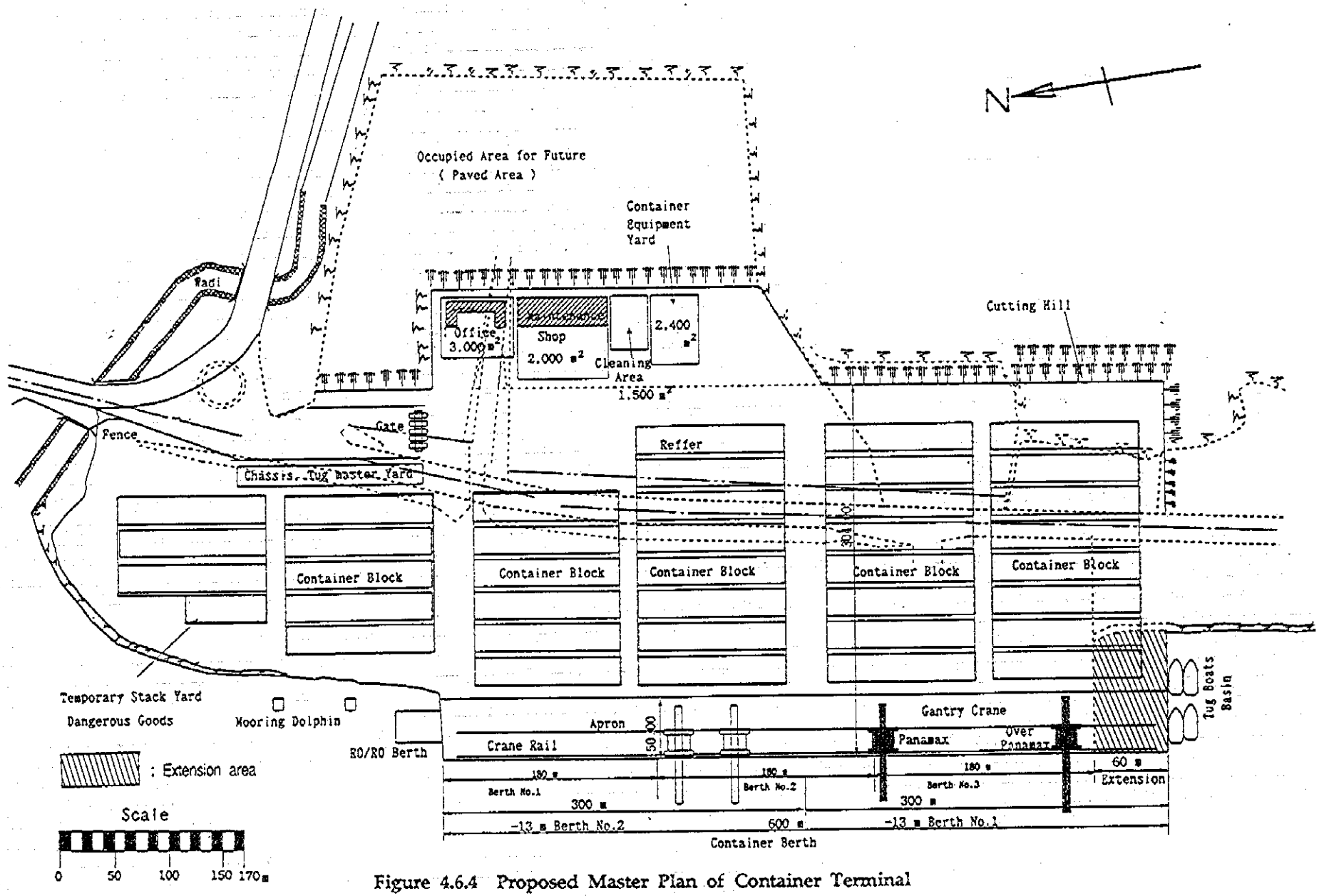


Figure 4.6.4 Proposed Master Plan of Container Terminal

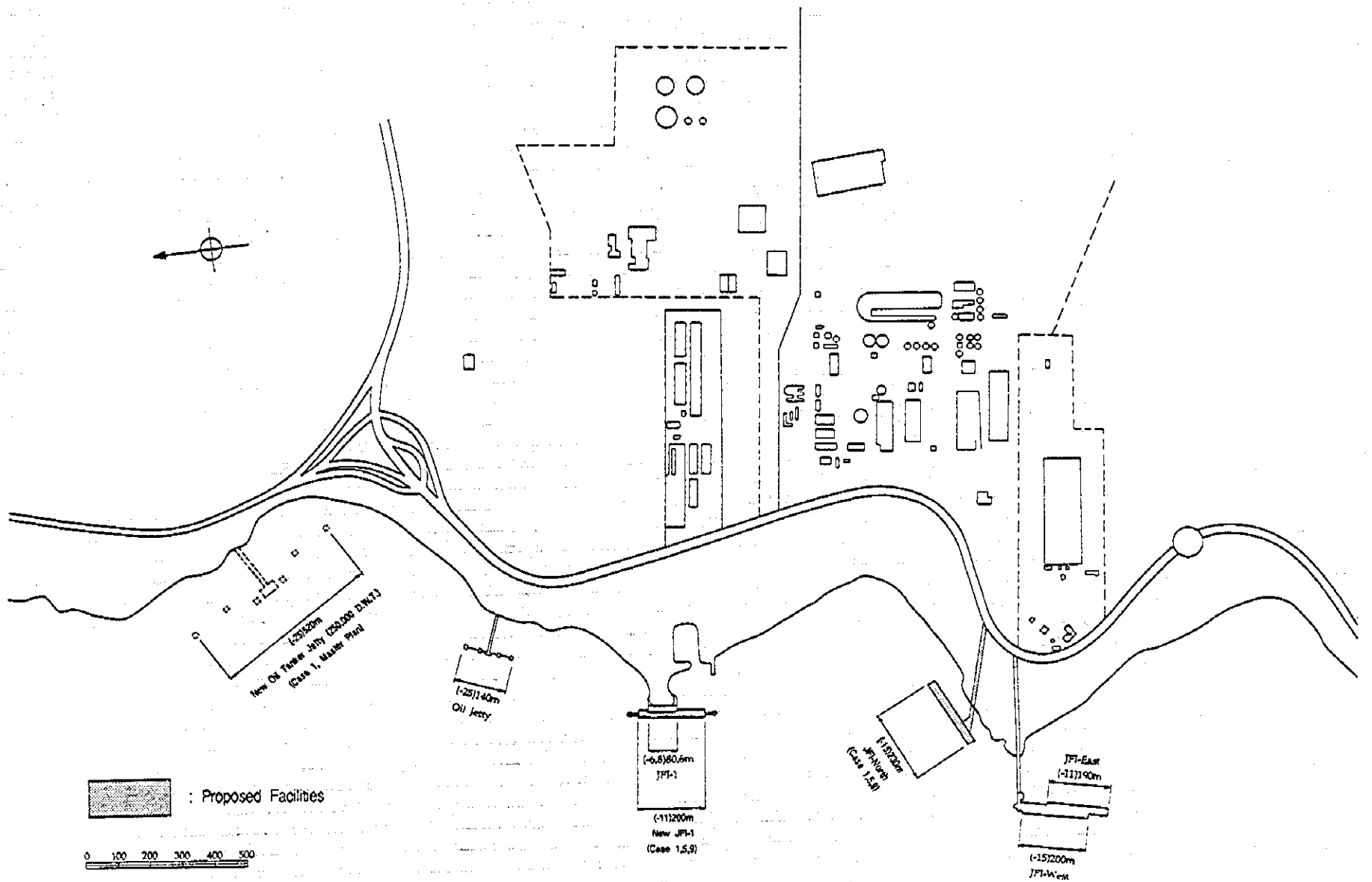


Figure 4.6.5 Proposed Master Plan of Industrial Port

4.7 Information System

4.7.1 Preparation for Computerization

The daily routine work should be systemized as tasks and jobs of computer system. To operate computer system usefully and conveniently, it is very important to analyze the daily routine works prior to introduction. The following items need to be analyzed in preparing for computerization.

a) All paper works which are processed as daily routine work
b) All daily office work procedure
c) All current data which are input and output by hand writing

4.7.2 Computer System

The arrangement and combination of computer hardware should be determined to complement design details after preparing and studying current procedure of daily works. There are many items to be studied for each piece of equipment, such as main frame, storage device, printer, reader and display.

4.7.3 Programming

The typical procedure of self-development programming design is as follows;

(1) Unity of intention

Study of the interior design of the organization, and confirmation of an indispensable condition for dividing of the program to module.

(2) Constructional design of programming

Dividing of the program to module. Processing his work step by step, and programming will be storied to constructional way.

(3) Local design of module

Module specification and test specification. Dividing of each module to some pieces of segment and part, and making of processing procedure inside of module.

4.7.4 Packaged Application Software

There are two ways to develop computer programming. One is development of computer programming privately, and the other is a purchasing and arrangement of packaged application software. There are many kinds of packaged application software in the market, but the application software has not so much flexibility to meet the exact requirement and needs of user. These application software are very useful to introduce a computer system into non-computerized office as a first stage.

4.7.5 Computer System of PC

(1) Project Team

PC intends to introduce a computer system in their office to increase economic efficiency, and each Dept. seems to have some independent ideas to perform their works and jobs. To streamline different opinions, demands and requirements of each Dept., one coordinating group which is organized from each Dept. together with person who have sufficient knowledge of computer technology must be organized.

(2) Possible Computer System

Possible computer system of each Dept. are as follows;

Marine	Ship's movement control, Port state control, Registered vessel control
Operation	Berth decision control, Stevedoring control, Warehouse and shed control
Finance	Port charge, Stevedoring charge, Storage charge, Container charge, Accounting & Balance sheet
Technical	Equipment inventory control, Equipment maintenance control
Supply & Purch.	Spare parts inventory, Spare parts order/receiving control
Administrative	Personal data control
Specialized Berth	Phosphate receiving/loading, Fertilizer loading, Cargo receiving
Project	Blue print file control, Construction contract file control
Training & Statis.	Statistics file control
Office of D.G.	Mail sending/receiving control, Circular letter control
Container Termi.	Gate control, Yard control, Loading/Discharging control

4.7.6 Computerization of Container Terminal

(1) Applicable Objective

It is said that one container terminal (350m x 300m) can handle about 60,000 TEUs per year without a computer system. In 1994, Port of Aqaba handled total 110,817 TEUs. These figure show that Port of Aqaba has almost reached the limit of its handling capacity, and PC should immediately start computerization of management and operation.

(2) Project Team

The establishment of a project team is necessary to start a computer system in the confiner terminal as a general procedure for computerization. The project team will be

constituted by persons who have enough knowledge about container terminal operation and computer technology.

(3) Training of Computerized Container Terminal

The Port of Aqaba container terminal is not computerized, nor dose the terminal have enough experience to operate a computerized terminal. This terminal currently employs the straddle carrier system, but it is said that transfer crane system can be controlled by computer easier and more efficiently than straddle carrier system. To operate a computerized terminal smoothly, terminal staffs should be trained prior to actual terminal operation. Six months training course might be required for terminal staffs.

4.8 Preliminary Design of Port Facilities

4.8.1 Main Port

Since additional berth length of general cargo berths is required in the Case 1, existing Phosphate Exporting berth A is demolished and additional new berth is constructed there. An open type pier with steel pipe piles foundation is applied in design in reference with the structural type of the existing general cargo berths. Pipe lines for vegetable oil, banker oil, water supply and so on which has being currently handled are extended to the new construction berth or existing general cargo berth in case of Alternative 1 or 2 respectively.

In the Case 5 and 9, phosphate exporting berth A is reserved as it is, but the role of it alters to new oil berth. Regardless of all scenarios except Alternative 2 of Case 1, an exclusive grain berth having water depth 14 m below Chart Datum is required to improve existing general cargo berths.

The preliminary design of the improvement involves dredging for deepening of mooring basin, protective structure of dredged slope, widening deck, reinforcement under crane rail and so on.

4.8.2 Container Port

Container terminal is a main object to be improved. Container wharf is extended by 60 m to southward. Structural type of the wharf is applied an open type pier with steel pipe piles foundation as well as the south extremity of existing berth.

In container yard, according to the facility layout plan, the preliminary design is requested to enable container handling equipments to effectively handle containers.

The deck width of the berth is very wide so that the deck is used for both apron and container stack yard. The gradient of the deck is designed as one by eighty (1:80). Therefore the sectional gradient of container yard is designed by 1:80. An economical design of pavement for roads an yard is taken in consideration with the preparation site being on cutting foundation, very dense sandy soils.

4.8.3 Industrial Port

A fertilizer berth is planned at the north ward of the existing JFI-East and West berths.

The face-line of the berth is set on -15.0 m contour to avoid dredging works. Angle tower with operation room is planned at the southern edge of the berth for future extension.

The width of berth is set on 18.0 m considering quay crane gauge and width of traffic way for trucks. Berth length is planned by 230 m and an open type pier with steel pipe

piles foundation is applied to design structure.

A JFI-1 Jetty, live stock import berth, utilizing the existing timber jetty is designed according to the facility plan to be required in the Master Plan.

4.9 Preliminary Staged Implementation Plan

In working out the preliminary plan for implementing the facilities construction and equipment procurement and installation, general presumptions are: 1) the implementation is to be generally consistent to the cargo demand forecast, and 2) a facility is to be completed before the relevant demand forecast requires it.

Table 4.9.1 Preliminary Staged Implementation Plan

Port Particular	Cases & Alternatives	Phase 1 (Target Year 2000)	Phase 2 (Target Year 2005)	Phase 3 (Target Year 2010)
Main Port	Case 1 (Alt.1)	•Conversion of Existing General Cargo Berths to Grain Berth(-14m)	•Conversion of Existing Phosphate Berth A to General Cargo Berth (-10m) •Relocation of Vegetable Oil Inlet and Bunker Oil Outlet	
	Case 1 (Alt.2)	•Conversion of Existing Phosphate Berth A to Grain Berth (-14m) •Relocation of Vegetable Oil Inlet and Bunker Oil Outlet	•Conversion of Existing General Cargo Berths to General Cargo Berth (-12m)	
	Case 5 Case 9	•Conversion of Existing General Cargo Berths to Grain Berth (-14m)		
Container Port	Case 1 (Alt.1&2) Case 5 Case 9	•60 m Extension of Berth •CY Development (Southern Half) •Terminal Bldg., Maintenance Shop, and Other Bldg. •Installation of 1-Gantry Crane (Panamax) •Procurement of Cargo Handling Equipment (5-RTG)	•CY Development (Northern Half including Access Road) •Installation of New Computer System	•Installation of 1-Gantry Crane (Over Panamax) •Procurement of Cargo Handling Equipment (5-RTG, 5-Tug Master)
Industrial Port	Case 1 (Alt.1&2)	•Improvement of JFI-1 Berth •Additional Berth (JFI-North) for Fertilizer Export •Installation of Loader and Conveyer System for Fertilizer Export		•Oil Berth Construction •Installation of Additional Unloader for Sulfur Import on JFI-W Berth •Installation of Additional Loader and Pipeline for Phosphoric Acid Export on JFI-E Berth
	Case 5 Case 9	•Improvement of JFI-1 Berth •Additional Berth (JFI-North) for Fertilizer Export •Installation of Loader and Conveyer System for Fertilizer Export		•Installation of Additional Unloader for Sulfur Import on JFI-W Berth •Installation of Additional Loader and Pipeline for Phosphoric Acid Export on JFI-E Berth
Others	Case 1 (Alt.1&2) Case 5 Case 9	•Urgent Improvement Measures •Improvement Measures of Environment		•Vessel Traffic System

4.10 Cost Estimatiton

The project costs are estimated on the preliminary design. According to the nine socio-economic scenarios, the three development plans of Aqaba Port are selected as Case-1, Case-5 and Case-9. Among these cases, Case-1 is further divided to Alternative-1 and Alternative-2. The following table shows the project costs for these cases and alternatives. An exchange rate in which I.J.D. equals to 130 Japanese Yen and 1.45 US$ is adopted.

Table 4.10.1 Summary of Cost Estimate

(Unit: 1,000 J.D.)

Work Item	Case 1		Case 5	Case 9
	Alternative 1	Alternative 2		
Civil Works				
-14 m Grain Berth	679	8,829	679	679
-10 m General Cargo Berth	9,038	730		
Dredging in front of Berth No.7	77	77	77	
Container Terminal	9,175	9,175	9,175	9,175
JFI-1 Berth	5,221	5,221	5,221	5,221
JFI-North Berth	5,522	5,522	5,522	5,522
Oil Berth	2,384	2,384		
Improvement of Environment	890	890	890	890
Civil Works Direct Cost	33,396	33,238	21,974	21,897
Consulting Services(8%)	2,672	2,659	1,758	1,752
Physical Contingency of Works (10%)	3,340	3,324	2,197	2,190
Ditto of Consulting Services (5%)	134	133	88	88
Civil Work Total Cost	39,131	38,944	25,607	25,516
Mechanical and Other Works				
Grain Berth Belt Conveyer Extension	1,230	822	1,230	1,230
Container Port Cargo Handling Equipment	27,060	27,060	27,060	27,060
Container Yard Computerization	2,618	2,618	2,618	2,618
JFI-W/E Berth Cargo Handling Equipment	6,875	6,875	6,875	6,875
JFI-North Berth Cargo Handling Equipment	4,728	4,728	4,728	4,728
Vessel Traffic System	1,000	1,000	1,000	1,000
Urgent Improvement Measures	1,653	1,653	1,653	1,653
Mechanical and Other Works Direct Cost	45,164	44,756	45,164	45,164
Consulting Services (3%)	1,355	1,343	1,355	1,355
Physical Contingency (5%)	2,258	2,238	2,258	2,258
Ditto of Consulting Services (5%)	72	71	72	72
Mechanical and Other Works Total Cost	48,849	48,408	48,849	48,849
Administration Cost	1,798	1,785	1,538	1,536
Total Cost without Tax	89,778	89,137	75,994	75,901

4.11 Management and Operation

The following points are strongly required to be a "attractive and profitable port for users".

4.11.1 Organization

New sections which are in charge of preparing the policies for port development, finance, personnel affairs, port promotion should be introduced.

It is also recommended to introduce QC circle, proposal activity and improvement of personnel evaluation system.

4.11.2 Financial Policy

PC should appeal to the ministries concerned to define criterion for deciding the amount of the contribution and to reserve financial resources for Master Plan's projects.

4.11.3 Port Operation

For cargo handling, in order to secure quickness, reliability and cost effectiveness, following issues are recommendable;

a) Control of target productivity
b) Wage system based on handling volume

It is necessary for PC to examine introduction of privatization corresponding to the stage of national economic development in Jordan.

4.11.4 Port Promotion

PC should immediately make efforts to collect exported cargoes, in particular, exported container cargoes, almost of which are currently empty.

PC should also urge industrial authorities concerned to promote manufacturing industry such as processing and assembly industry and consumer-related industry in the medium and long term.

4.11.5 Training System

As cargo volume increases and port equipment becomes more sophisticated, employees with extensive knowledge of the various port functions and port-related activities are indispensable to meet the demands of users.

(1) Functions of Training Center

Training Organs should provide both theoretical and practical training. However, a considerable investment would be required, therefore, PC should establish a practical training institution after ensuring financial resources in the future. In the meantime, it is desirable to provide practical training periodically using actual equipment.

(2) Training Courses and Programs

a) For all staff : Basic knowledge on general administration and leadership ability

b) For secretaries : General administration, financial management, accounts system, related laws and regulations

c) For engineers : Civil engineering, architecture, electrical engineering, mechanical engineering

d) For operators : Theory and practical training for cargo handling operation and maintenance and repair of equipment

(3) Trainer for Training Courses

More competent trainers are required to raise training level. The following measures are recommended;

a) Invite special experts who extensive experience and can teach workers to operate and maintain equipment. Experts should be assigned to several sections to assist in on-the-job training.

b) Select several suitable candidates and sent them overseas to take training courses.

c) Invite part-time trainer from colleges or special schools.

4.12 Evaluation of the Master Plan

The three alternative Master Plans were proposed following the three alternative scenarios. After a preliminary economic analysis was carried out, all three cases were judged to be feasible. In addition, the results of Initial Environmental Examination which will be described later indicate that no serious problems for the environment will result.

Considering the significance, features of the Master Plan, differences of the three alternatives and so on, evaluation of the proposed Master Plans should be made considering the following;

a) Since the coastline in Jordan and available area for the port is strictly limited, efforts to make best use of existing area and raise performance of port capacity should be made.

b) Political and economic situation of Jordan and the Middle East is still unsettled. Many relevant studies that may probably influence the Master Plan of the port of Aqaba are ongoing.

c) In order to cope with various new demands, as much reserved area should be secured as possible.

Taking comprehensively the above mentioned into consideration, Case 5 is thought most practical and flexible.