4.9.4 Preliminary Design of Port Facilities

< Mooring Facilities >

(1) Design Conditions

Design conditions shall be determined carefully, since they have great influence upon the safety, functions and construction cost of the facilities. The design conditions for wave height, tidal level, wind velocity, rainfall, temperature and earthquake are described in Chapter 4.9.1. Soil and existing ground conditions are generally determined according to the results of investigations, surveys and tests. However, they are determined by analyzing the existing data since they are under surveying.

Table 4.9.6 shows design conditions and dimensions of berths proposed in the Master Plan.

Table 4.9.6 Design Conditions & Dimensions of Berths

Name of Berth		General Cargo	Grain	Container	Oil	Industrial JFI-North	JFI-1
Ship's Tonnage	DWT	10,000	50,000	35,000	250,000	50,000	20,000G.T
Design depth of basin	m	-10.0	-14.0	-13.0	-25.0	-15.0	-11.0
Length of berth	m	170	280	300	*520	220	260
Surcharge	tons/sq.m	3.5	3.5	4.0	2.0	4.0	4.0
Berthing velocity	m/sec	0.2	0.15	0.15	0.10	0.15	0.15
Tractive force	tf	50	100	150	250	100	100
Crown height of quayfront	m	CD+3.08	CD+3.08	CD+3.75	CD+6.0	CD+4.0	CD+4.0
Width of apron	m	18.05	18.05	50.0	25.0	18.0	25.0
Width of platform		18.05	18.05	78.2	25.0	18.0	25.0

* Length means distance between the center of North and South outer dolphins

(2) Main Port

1) Selection of an optimum structural type

New construction of berths is planned in the case of scenario (1). The most optimum type of berth may be the same structural type of existing General Cargo Berths No.1 to No.3 shown in Figure 4.9.8. However the construction of the type needs demolition of three dolphins on Phosphate Berth A. Fig 4.9.9 and 4.9.10 show an alternative structural type of -10.0 m general cargo berth and -14 m grain berth respectively. The alternatives may eliminate the demolition works of three dolphins but need newly the construction of vertical walls at both extremities of new berth.

In case of General Cargo berth, a gravity type of concrete blocks is recommended for the alternative design. The type is applied to Egyptian ports everywhere located in the Gulf of Suez. The construction cost is almost the same as the type of existing General Cargo

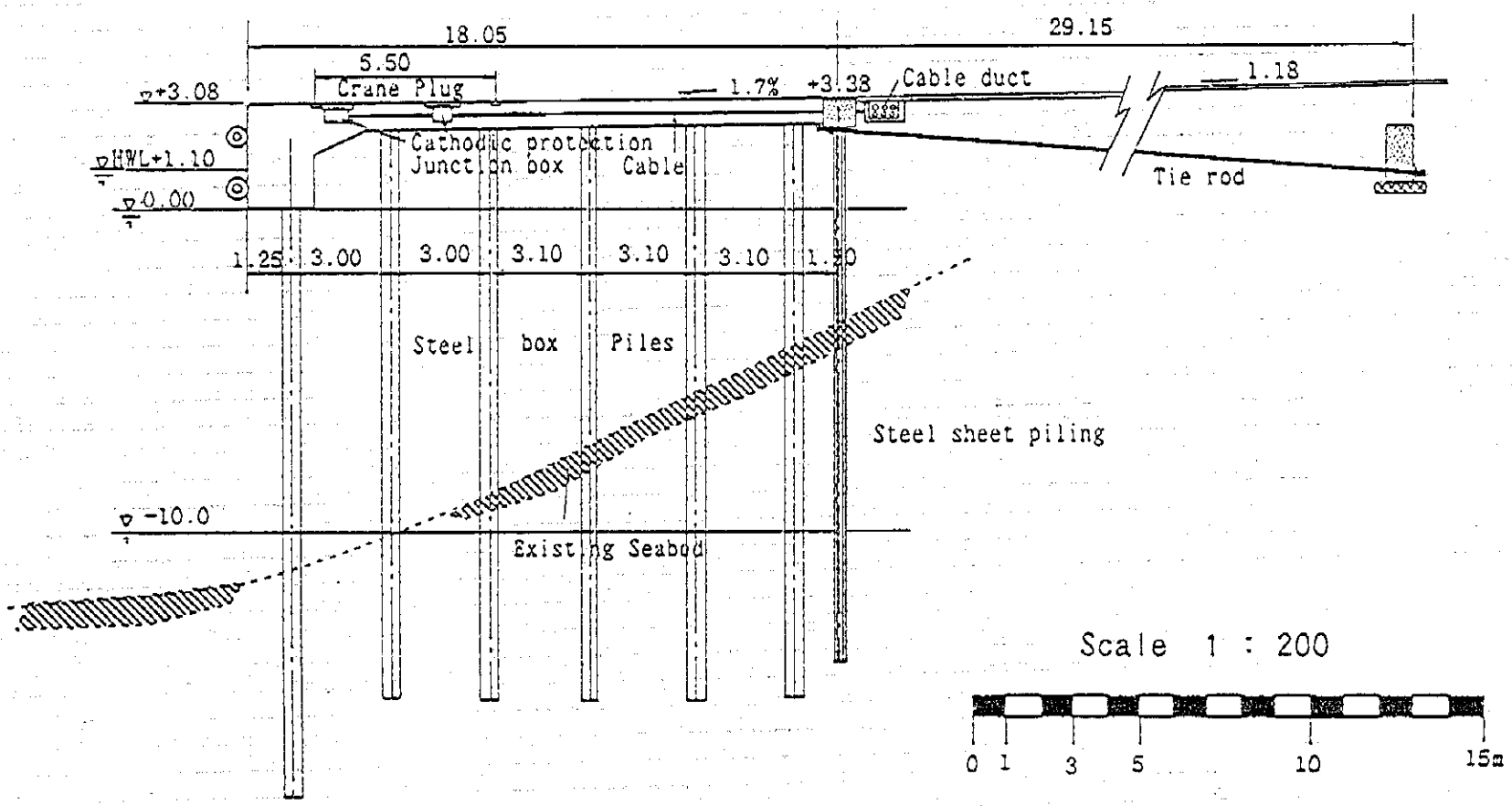


Figure 4.9.8 Existing General Cargo Berth No.1 - No.2

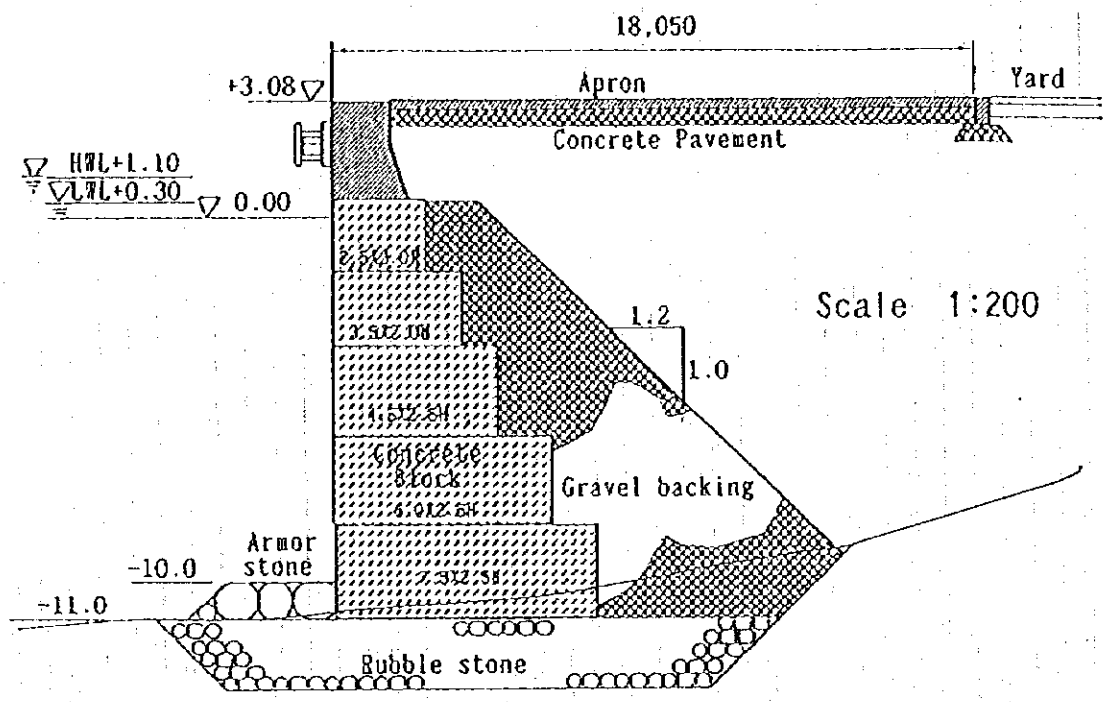


Figure 4.9.9 Alternative Design of -10 m GC Berth

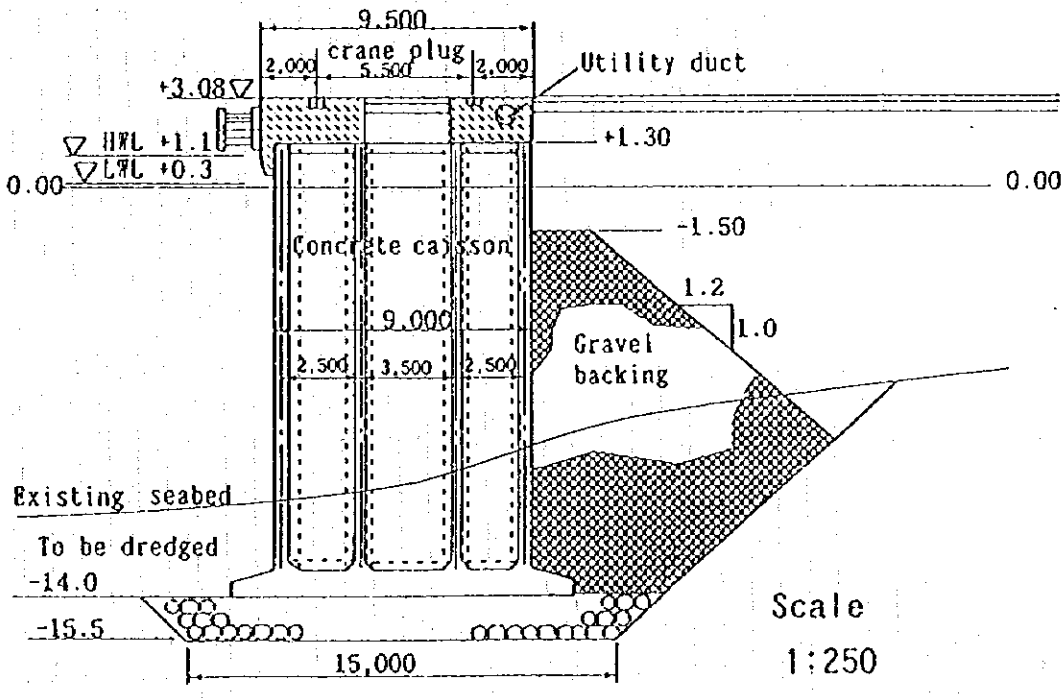


Figure 4.9.10 Alternative Design of Grain Berth

berth. The construction methods are easy as well. Where the case of scenario (1) is selected for Feasibility Study, both types shall be compared and evaluated to select the best type.

In case of Grain berth, a gravity type of concrete caissons is recommended for the alternative design. The construction cost is higher than the type of existing berth but the maintenance cost can be saved comparing open deck type with steel piling that requires continuous power supply for cathodic protection.

2) Quay-front reinforcement for deepening basin to -14.0 m

In the case 5 and 9, existing General Cargo Berth of No.1 and a part of No.2 is planned to alter a -14 m grain berth. In order to deepen the basin to - 14 m, a treatment of reinforcement is necessary for the existing facilities to keep to the status quo of the structural strength. In case of deepening to - 12 m for general cargo berth, no treatment is required.

Figure 4.9.11 shows an alternative design of grain berth for deepening basin to - 14 m. The advantage of this type is that it is easy for ships to maneuver during berthing due to the same face line of the existing marginal berth. However, construction work in this type is difficult and the cost is high.

Figure 4.9.12 shows a typical cross section of - 14 m grain berth arranged at the existing General Cargo Berth No.1 & No.2.

Figure 4.9.13 shows dredging of basin for - 12 m deepening.

3) New quay construction at Phosphate Berth A

Figure 4.9.14 shows a typical cross section of - 14 m grain berth arranged at Phosphate Berth A. The structural type is based on the existing general cargo berths. Crane rails and conveyor line of 160 meters in length are equipped on the berth. Three portable silos are moved from berth No. 1 to the new berth.

Figure 4.9.15 shows a typical cross section of - 12 m general cargo berth arranged at Phosphate Berth A. The structural type is based on the existing general cargo berths.

(3) Container Berth

Container berth is extended southward by 60 meters. The cross section of the extended container berth is based on the section of south extremity of the existing berth. One unit of panamax-type and one unit of over panamax-type gantry crane are procured in 2010.

Figure 4.9.16 shows typical section for extension of container berth.

(4) Industrial Berth

Figure 4.9.17 shows facility layout of JFI-North Berth for 50,000 DWT bulk cargo vessels. A loader having 1,500 ton/hr. handling capacity and conveyor line are equipped on the berth. A building for controlling and changing conveyor is constructed.

(5) Oil Berth

Figure 4.9.18 shows facility layout of oil berth for 250,000 DWT tanker.

< Land Preparation >

(1) Main port

A area enclosed by sheet piling is reclaimed when scenario (1) is applied. Fill material shall be brought from near hills and spread with compaction up to the formation level of subgrade.

(2) Container terminal

Three places, area behind berth extension, northern part alongside coast and existing tunnel at road crossing, are reclaimed by the fill material obtained from cutting works. Existing road and the western area as shown in Figure 4.9.6 is cut up to the formation level of subgrade. The gradient of cutting slope is applied of 1 in 1 in case of undisturbed hard soil or rock foundation. The berm of at least 1.0 meters width shall be made every 5 meters in vertical range.

< Pavement >

(1) Main port

Filling area shall be paved by 0.23 m. thick reinforced concrete. In case general cargo berths are proposed, the paved area is used for open storage yard. In case grain berth is proposed, it is used for truck loading and truck waiting.

The top level of pavement shall be formed as well as the yard of existing general cargo berths. The elevation height and gradient show below;

Face line of berth	+3.08 m.
Rear line (sheet pile coping)	+3.38 m.
Filling area	Fall 1:60 to berth side
Cutting area	Fall 1:80 to berth side

(2) Container terminal

Existing container yard is paved by 200 mm thick asphaltic concrete course. The section of pavement is applied to the technical standard of straddle carrier method. The new container yard to be improved is planned for transfer crane method. The pavement, in principal, shall be made by reinforced concrete. The gradient of existing pavement varies in the range of 1:30 to 1:80. Elevation height of new paving is planned to the gradient of 1:80 (1.25%).

Figure 4.9.19 shows typical section of pavement.

< Utilities to be improved >

Power distribution cable and water pipeline are served in berth extension and new container yard. No additional transmission and substation is necessary. A septic tank system shall be adopted for each building such as office, maintenance shop and so on.

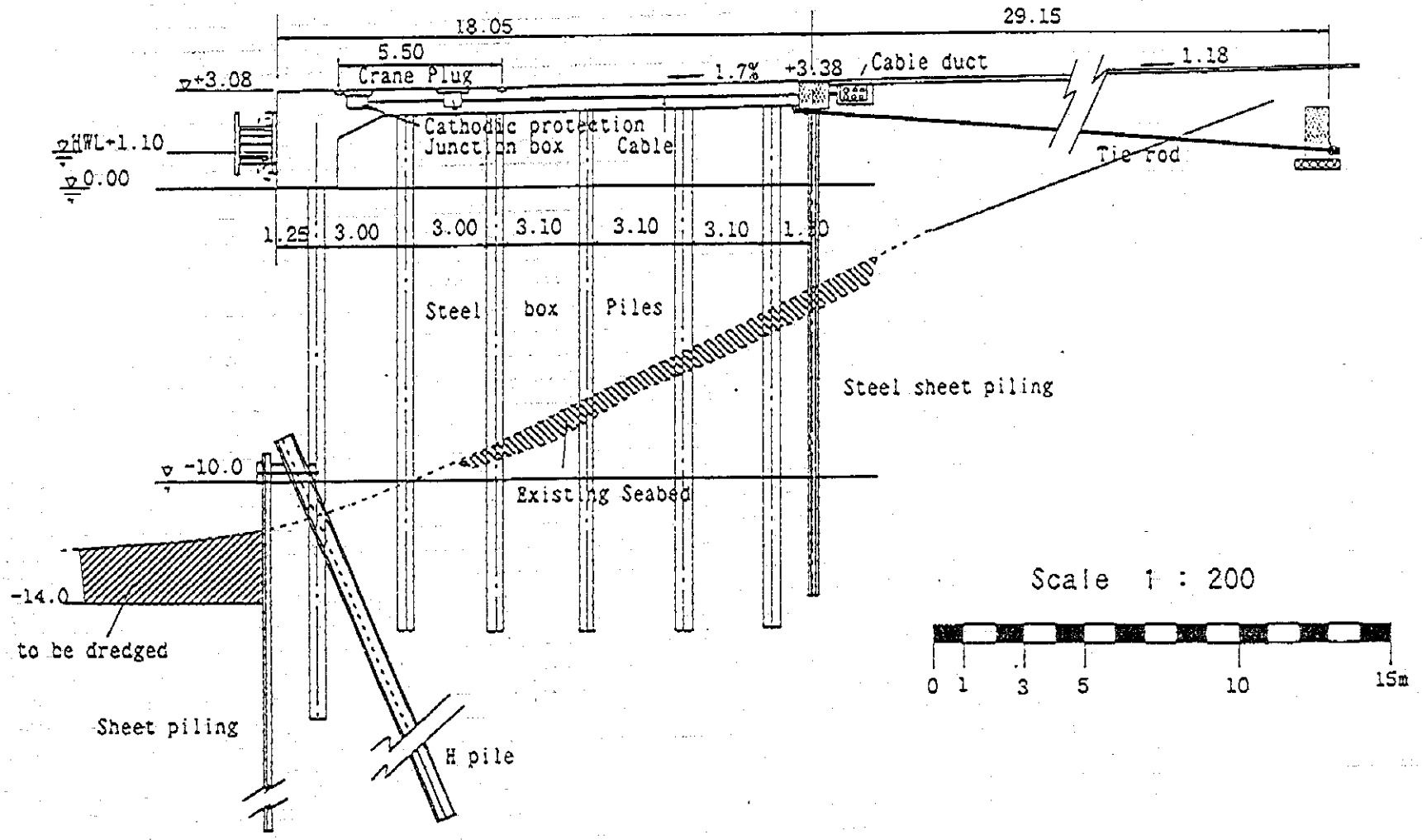


Figure 4.9.11 Alternative Design of Grain Berth at GC Berth

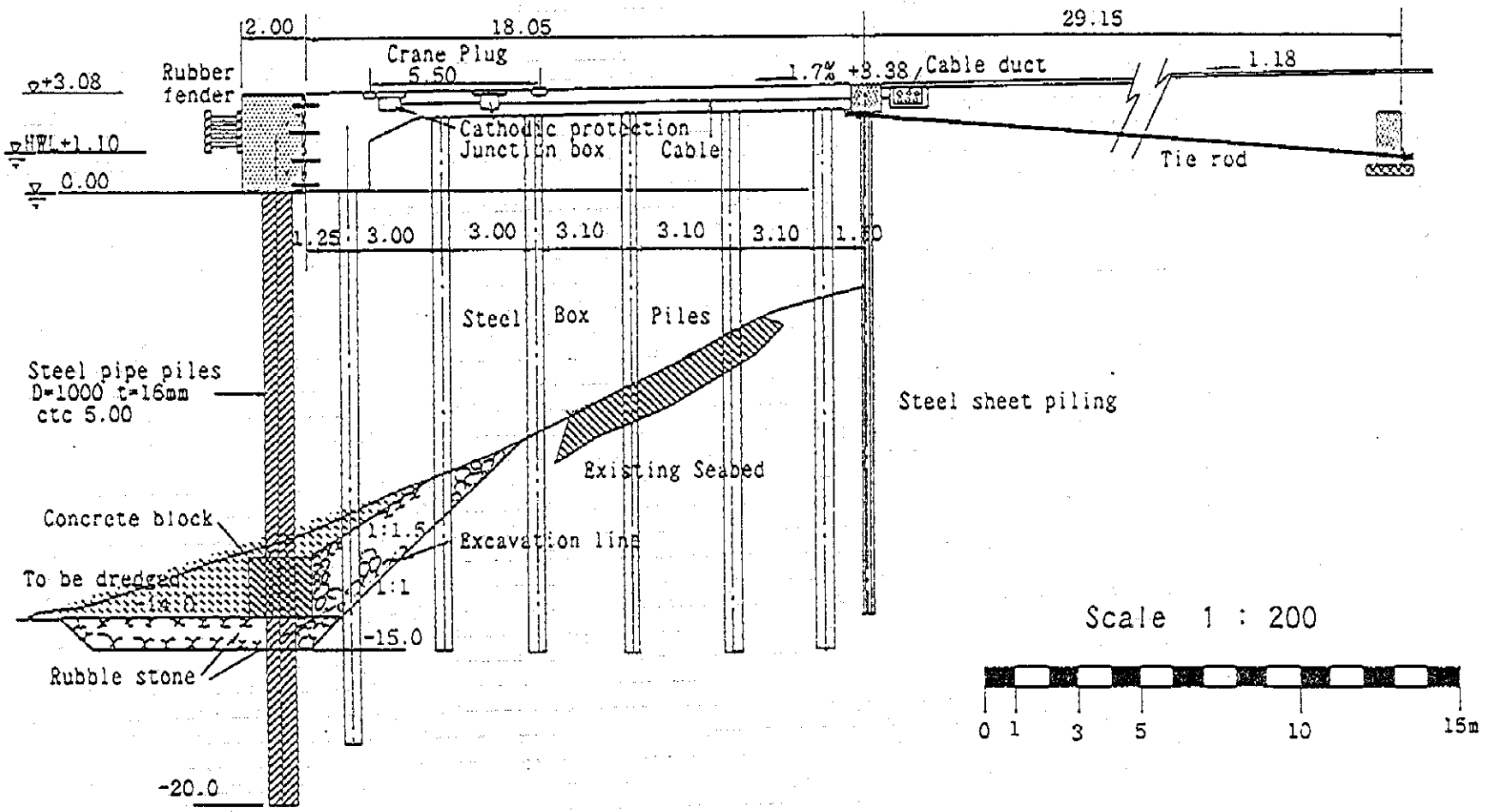


Figure 4.9.12 Typical Section of -14 m Grain Berth at existing GC Berth No.1-2

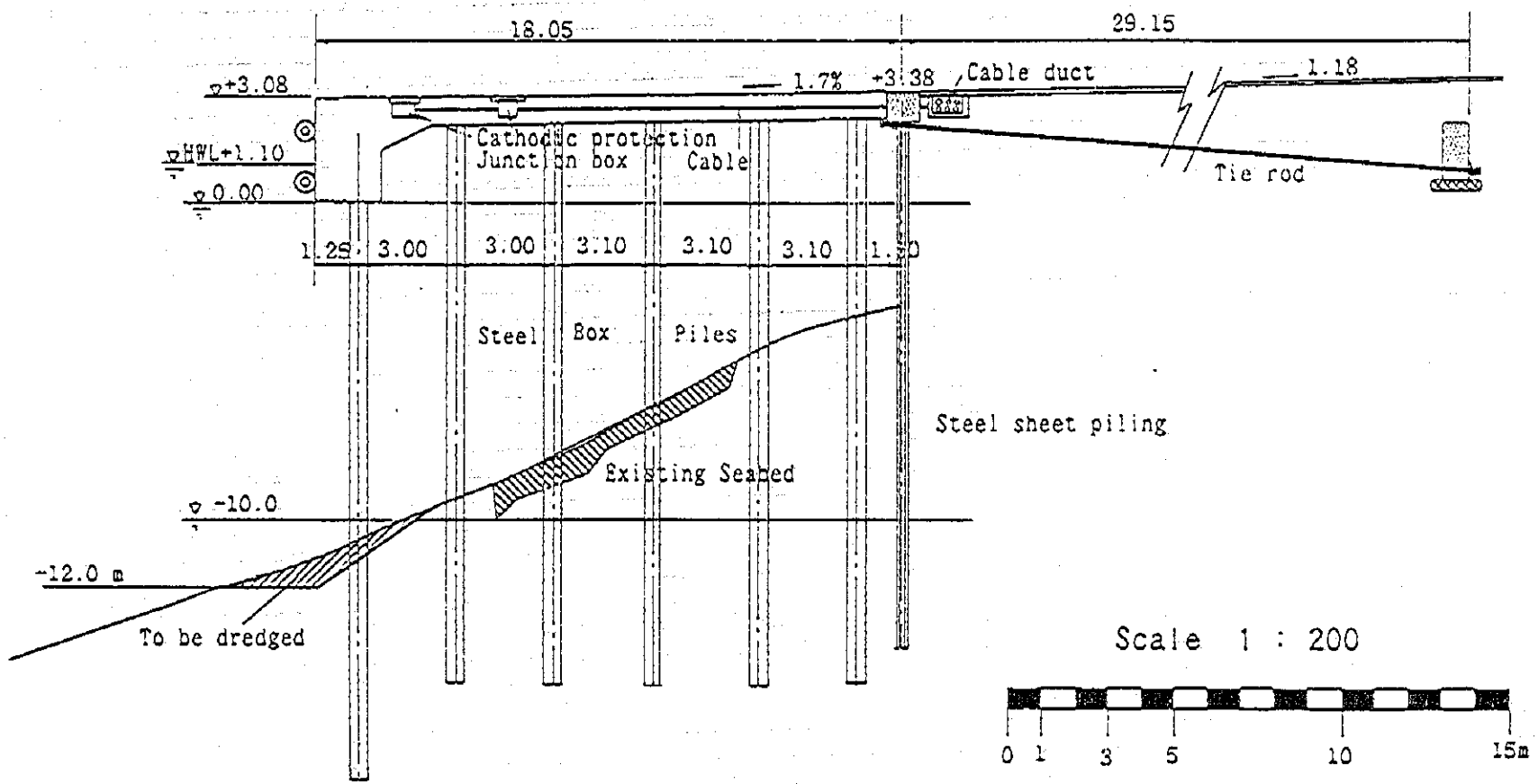


Figure 4.9.13 -12 m General Cargo Berth at existing GC Berth No.1-2

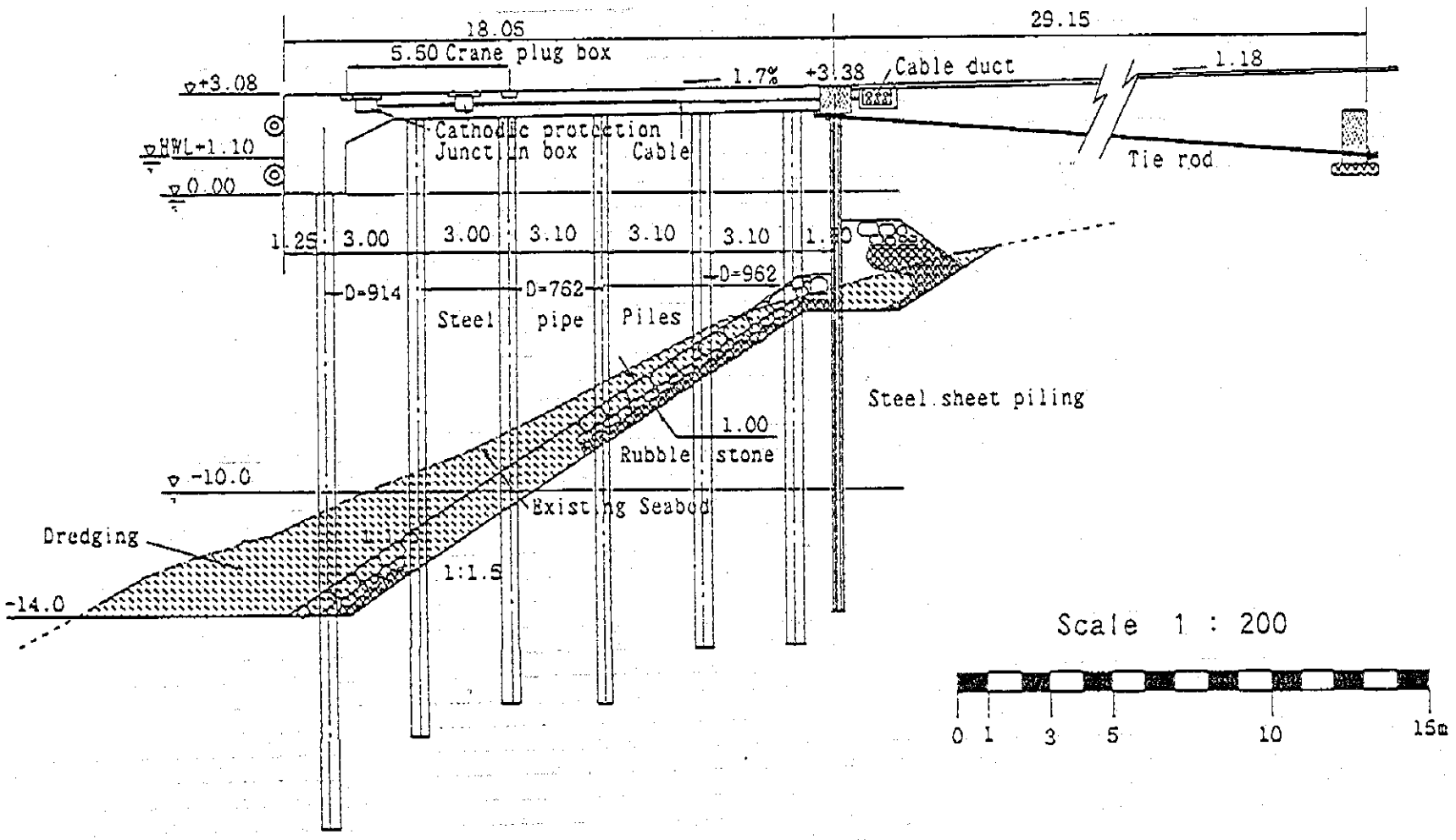


Figure 4.9.14 -14 m Grain Berth at exiting Phosphate Berth (A)

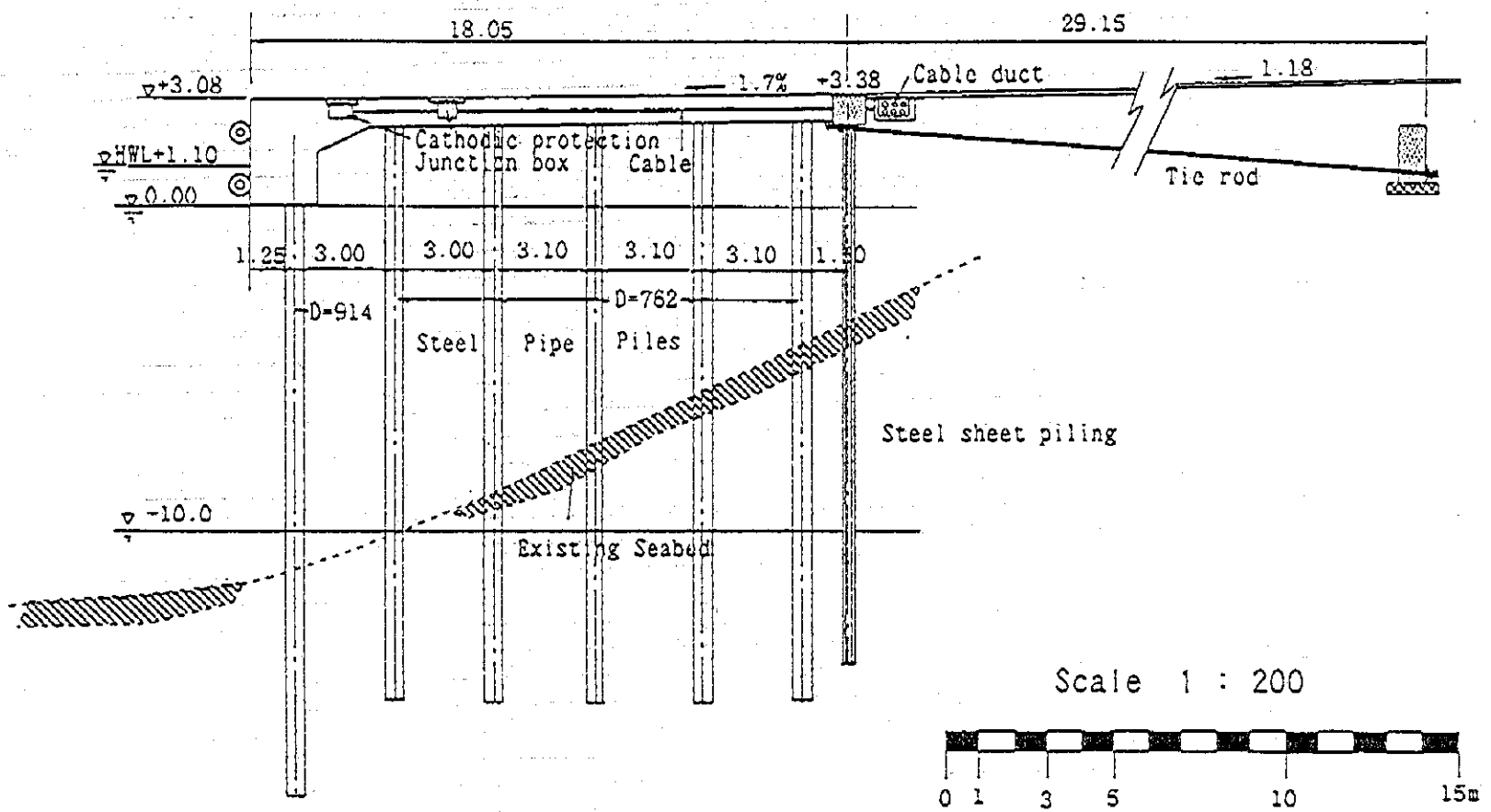


Figure 4.9.15 -10 m General Cargo Berth at exiting Phosphate Berth (A)

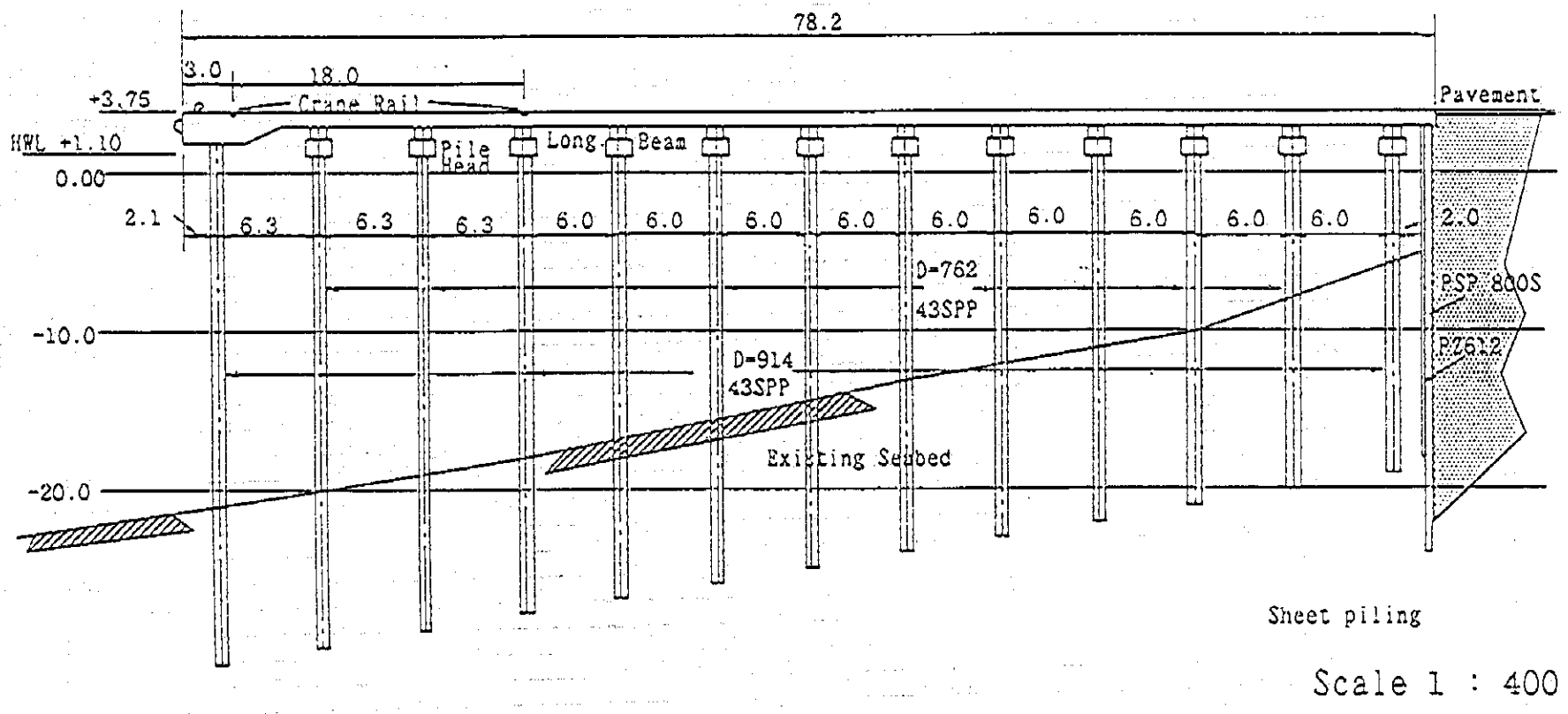


Figure 4.9.16 Typical Section for Extension of Container Berth

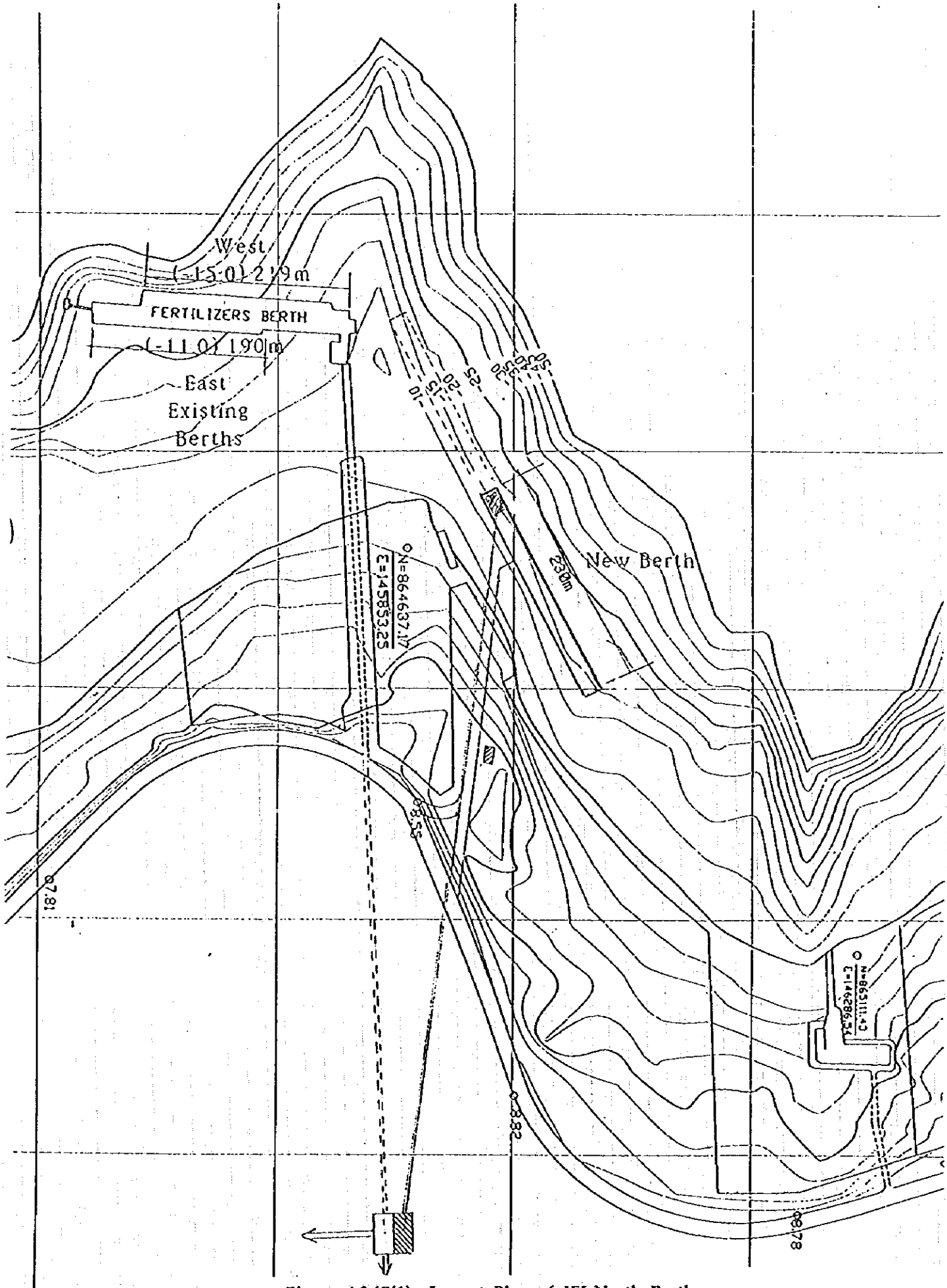


Figure 4.9.17(1) Layout Plan of JFI-North Berth

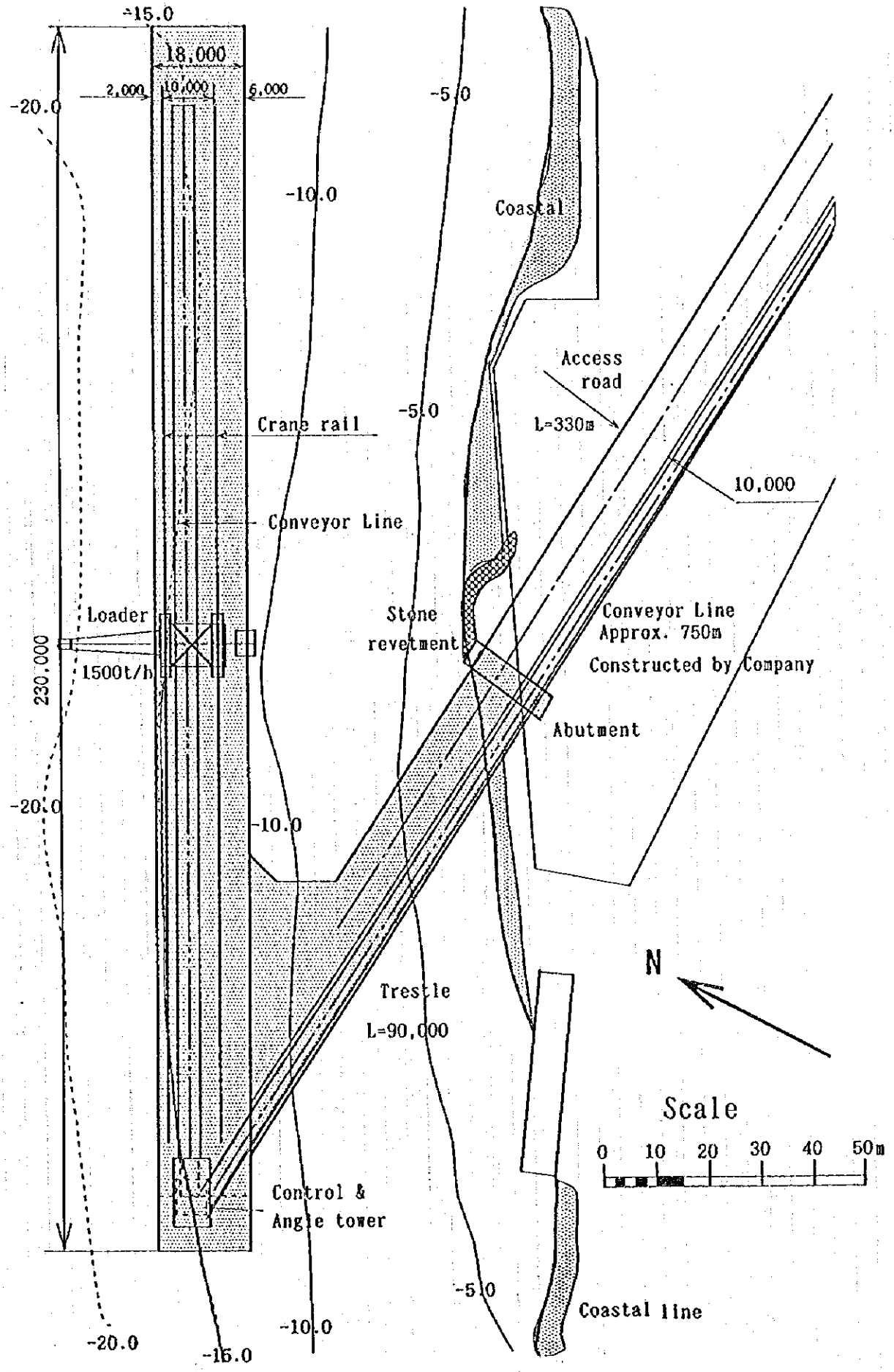


Figure 4.9.17(2) Facility Layout of JFI-North Berth

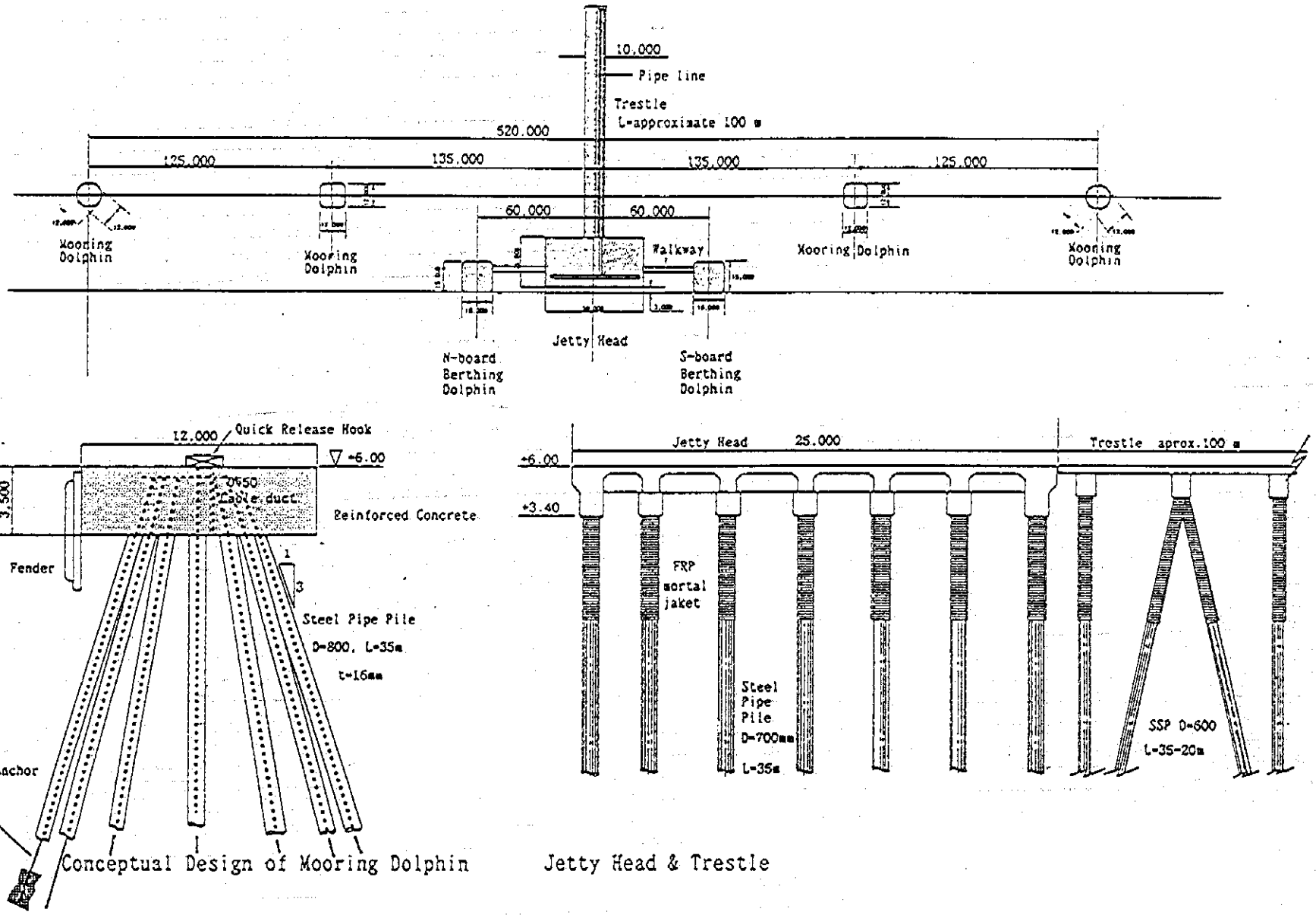
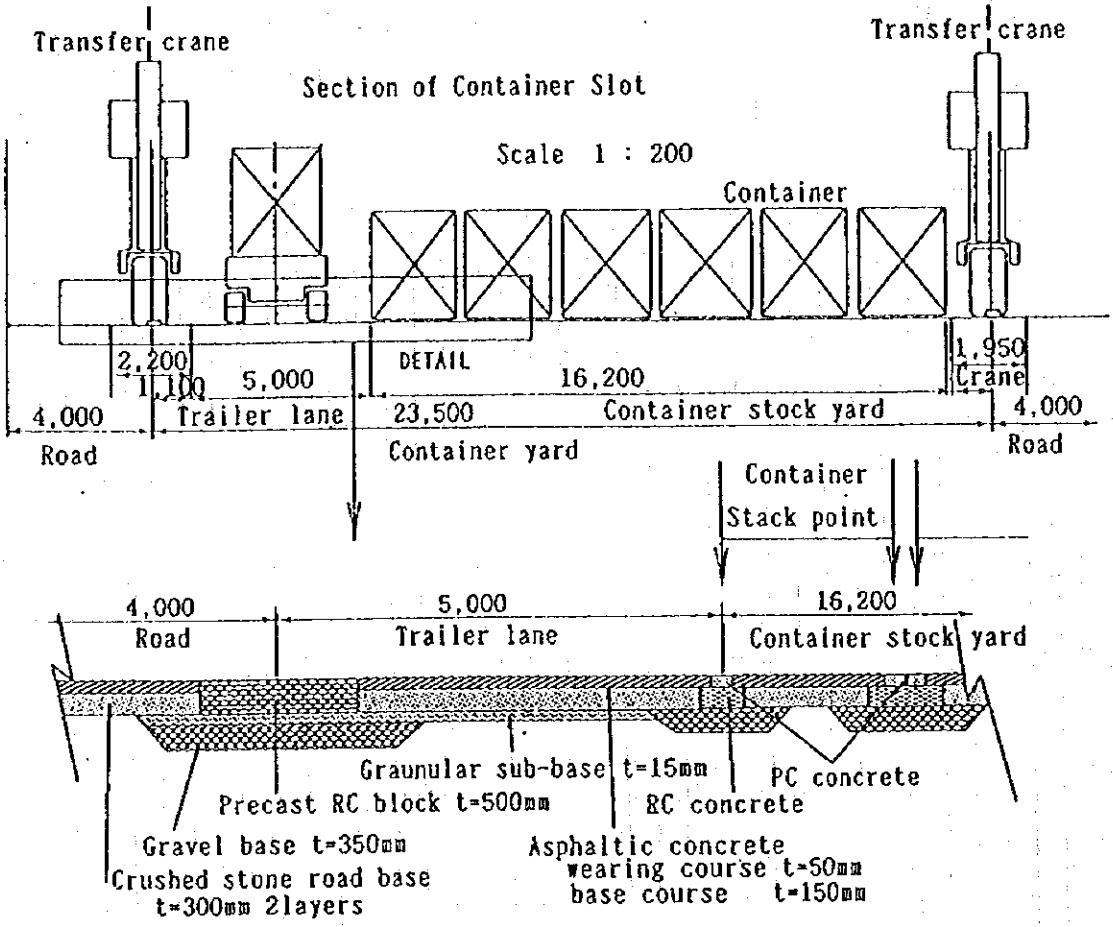
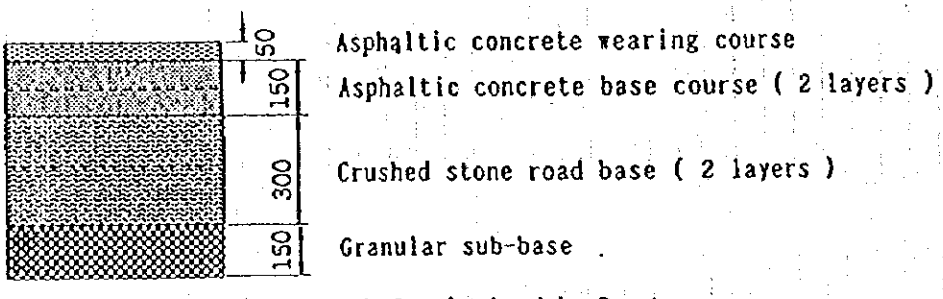


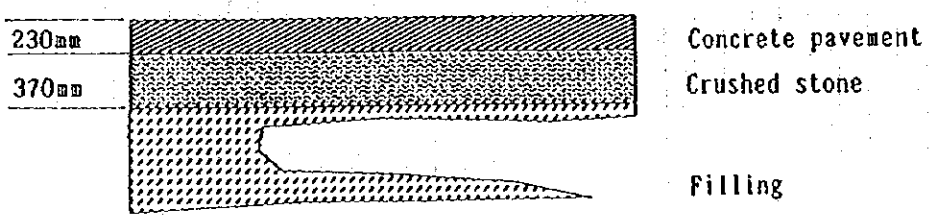
Figure 4.9.18 Facility Layout of Oil Berth for 250,000 DWT Tanker



Typical Section of Pavement for Container Yard



Section of Trunk Roads inside Ports



Section of concrete pavement

Figure 4.9.19 Typical Section of Pavement

4.10 Preliminary Staged Implementation Plan

In working out the preliminary plan for implementing the facilities construction and equipment procurement and installation, JICA Study Team takes into consideration the following presumptions:

(1) General

a) The implementation is to be generally consistent to the cargo demand forecast.
b) A facility is to be completed before the relevant demand forecast requires it.

(2) Main Port Facilities and Equipment

a) Repairing works of the coping concrete of Berth No. 7, Berth No. 8 and No. 9 will be urgently taken care by PC. So that, such works are excluded from this implementation plan.
b) In Case 1(Alternative 1), Case 5 and Case 9, Phosphate Berth A is to be kept as it is except minor repair works.

(3) Container Port Facilities and Equipment

a) The coastal road currently crossing the container terminal is to be relocated to bypass the new terminal by the relevant authority in charge.
b) Two operation systems, i.e. the straddle carrier system employed at present and transfer crane system to be employed in the future, are to be concurrently employed during the implementation.
c) Cargo handling equipment is to be gradually introduced according to both the demand forecast and anticipated improvement in handling efficiency.
d) Replacement of the damaged rubber fender of Mustarak (Cement) Berth will be urgently carried out by PC. So that, this replacement is excluded from this implementation plan.

(3) Industrial Port Facilitates and Equipment

a) An Indian Firm is to commence to operate its fertilizer plant before 2005.
b) Jordan - Iraq pipeline is to be completed before 2010.
c) Repairing works of the damaged rubber fender bases and cardinal dolphins of JFI-W/E Berth will be urgently carried out by PC. So that, these repairing works are excluded from this implementation plan.

Table 4.10.1 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 Berth 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

4.11 Cost Estimation

4.11.1 Information Sources for Cost Estimation

JICA Study Team collected information regarding the construction costs from different sources as shown in the table below:

Table 4.11.1 Information Sources and Informed Items

Information Sources	Information
1 Project Department of PC	1.1 Recent contracts 1.2 Foreign contractors and consultants employed by PC 1.3 Unit prices of construction work
2 Ministry of Public Works and Housing	2.1 Detailed construction prices of buildings for 1994 2.2 Detailed construction prices of road for 1994 2.3 Detailed construction prices of water & sewerage for 1994
3 Local Consultant Merbed Engineering Consultant P.O.Box 13178 Amman	3.1 Unit prices of construction materials 3.2 Leasing rates of construction equipment 3.3 Locally available materials 3.4 Unit prices of manpower 3.5 Regulations and customs on labor 3.6 Foreign contractors active in Jordan
4 Local Contractor National Trading P.O.Box 182 Aqaba	4.1 General information of construction materials and fuel 4.2 Wages of manpower 4.3 Leasing rates of construction equipment 4.4 Prevailing unit prices of construction works 4.5 Rock and aggregates 4.6 Taxes and duties

4.11.2 Costs for Waterborne Works

The prevailing construction cost of waterborne works such as jetty and/or wharf construction is not available with PC, for all the berths of the port, except the oil tanker berth, were constructed from 1960 to 1982. Therefore, the construction cost of the waterborne works is estimated based on the unit prices of materials, labor and equipment costs which are prevailing at Aqaba or in Jordan. The contractors and consultants previously engaged in the berth construction are tabulated in Table 4.11.2.

Table 4.11.2 Construction of Wharves of the Port of Aqaba

Project	Year	Contract Amount	Consultant	Contractor
Main Port (Commercial Port) Berth 1, Berth 2 Berth No.1 Length = 160 m Draft = 11 m Berth No.2 Length = 180 m Draft = 10 m	1960 1964	-	Rendel Palmer & Tritton 61 Southwark Street London, SEI ISA	Zublin ED. Zublin AG Overseas Department Duisburg Dusseldorfer Strabe 181-185, 4100 Duisburg 1 (West Germany)
Main Port (Commercial Port) The Fourth Berths Project (Berths 3 - 6) Berth No.3 Length = 180 m Draft = 12.5 m Berth No.4 Length = 180 m Draft = 180 m Berth No.5 Length = 180 m Draft = 180 m Berth No.6 Length = 180 m Draft = 10 m	1980	-	Persons Brown and Newton / Jouzy & Partners P. O. Box 9112 - Amman - Jordan (Jouzy & Partners) Abford House 15 Wilton Road, London SW1V1LT	Tarmac Shahin Joint Venture P. O. Box 65 Amman - Jordan and 62.72 Chiltern Street London W1M 2AD
Container Terminal Length = 540 m Draft = 14 m	1982	Approx. 13 mil. J.D.	Rendel Palmer & Tritton 61 Southwark Street London SEI ISA	George Wimpey International Ltd. Hammersmith Grove London W6 7EN
Oil Tanker Berth Length = 150 m Draft = 25 m	1988	Approx. 4 mil. J.D.	Rendel Palmer & Tritton 61 Southwark Street London SEI ISA	Zublin ED. Zublin AG Overseas Department Duisburg Dusseldorfer Strabe 181 -185, 4100 Duisburg 1 (West Germany)
Industrial Port Seaward: Length = 219 m Draft = 15 m Landward: Length = 190 m Draft = 11 m	1982	Approx. 15 mil. J.D. incl. mechanical works on berth	Persons Brown and Newton Abford House 15 Wilton Road, London SW1V1LT	PHB Weserhutte PHB Weserhutte AG Unternehmensbereich Rohrbach, Postfach 260, Hecklstr. 1.D - 6670 St. Ingbert

Source: The Ports Corporation

4.11.3 Civil Work Costs

The prevailing civil work costs are collected from each source. Table 4.11.3 summarizes the results.

Table 4.11.3 Unit Rates of Civil Works

(Unit: Jordan Dinar)

	Unit	Ports Corp.	MPWH	Local Consultant	Local Contractor	Remarks
Excavation	m^3	3	0.54 - 2			
Foundation Excavation	m^3		6			
ditto	m^3				0.500	soft
ditto	m^3			6	1.000	medium soil
ditto	m^3			10	2.000	hard soil
ditto	m^3			10		in reinforced conc.
Backfilling	m^3	3.5				
Embankment	m^3		2.0 - 5			
Filling (trench core)	m^3			11		
ditto (hardcore)	m^3			5		
Concrete 140 Kg/m2	m^3		50 - 60			
Concrete 150 Kg/m2	m^3	35				
Concrete 210 Kg/m2	m^3	60				
Concrete 250 - 265 Kg/m2	m^3		70 - 100			
Concrete (blinding)	m^3			45		
Concrete (foundation)	m^3			60		
Concrete (ground floor slab)	m^3			50		
Concrete (cast-in-place)	m^3			65		ground beam/walls
Concrete (cast-in-place)	m^3			75		elevated beam/walls
Concrete (cast-in-place)	m^3			80		column
Concrete	m^3				28	wall without steel
Concrete	m^3				40	fare face without steel
Rebar placement	ton		500 - 600	550	500	
High tensile rebar placement	ton		600			
Reinforced concrete	m^3			55 - 65		
Asphaltic pavement (30 cm)	m^3	8.75				
Leveling of sub-grade	m^3	0.35				
Sub-grade	m^3		0.72 - 2			
Sub-base course	m^3		5 - 7			
Base course (20 cm)	m^3	1.25				
Base course	m^3		5.2 - 8			
Prime coat	m^2	0.25				
Prime coat	ton		88 -150			
Tack coat	m^2	0.15				
Asphalt surfacing (6 cm)	m^2	3.75				
Asphalt surfacing (4 cm)	m^2	3				
Asphalt surfacing (5 cm)	m^2		2.6	3		
Asphalt surfacing (7 cm)	m^2		3			
Gablon	m^3		60			
Guard rails	l.m.		35			
Concrete curbs	l.m.		6.8			
Pipe culvert (90 cm)	l.m.		80			
Pipe culvert (75 cm)	l.m.		40 - 75			
Pipe culvert (60 cm)	l.m.		50			
Loose riprap	m^3		16			
Mortar riprap	m^3		30			

4.11.4 Building Work Costs

The prevailing building work costs are collected from each source. MPWH provided the actual unit prices of each item of works for schools, hospitals, and other public buildings for 1994. Local consultant also provided unit prices of each item of works for buildings. Table 4.11.4 shows the unit rates per square meter for several kinds of buildings.

Table 4.11.4 Unit Rates of Building Works

(Unit: Jordan Dinar)

	Unit	Ports Corp.	Local Contractor
Residential Buildings	m^2	150	
pen Warehouse	m^2	42	
Office Buildings	m^3	120	70
Closed Warehouse	m^3	67	80

4.11.5 Unit Prices of Construction Materials and Fuel

The prevailing unit prices of materials and fuel are collected from PC, local consultant and local contractor. Table 4.11.5 summarizes the results.

Table 4.11.5 Unit Prices of Construction Materials and Fuel

(Unit: Jordan Dinar)

	Unit	Ports Corp.	Local Consultant	Local Contractor	Remarks
Cement	ton	45			
Cement (bagged)	ton		48		ordinary on site
Cement (bagged)	ton		52		sulfate resist. on site
Gravel	m^3	2*	5		* special price for PC
Rock and aggregate	m^3			2	
Sand	m^3		5		
Hollow block	each	0.2			
Reinforcing steel	ton	315	320		
Ready-mixed concrete	m^3		35		
Binding wire	kg		2.5		
Asphalt mix concrete	ton		18		delivered to site
Building stones	m^3		25		depending on quality
Timber	m^3		300		
Petroleum	lt	0.22	0.23	0.220	
Diesel	lt	0.10	0.11	0.105	

Quarries are available in Aqaba at a distance 5 - 8 km for fine and coarse aggregates. The price varies. Contractor (Bardeny) and others daily supply 500 cubic meters from the quarry. It is advisable to buy aggregates/stones from local quarries instead of bringing in

crusher and renting a quarry. Fine aggregates should be washed because they contain salts (sulfur salt) some times more than specified for reinforced concrete.

Local consultant provided the information regarding construction materials at Aqaba as follows:

1) Fine and coarse aggregates should be tested before using.
2) There is tax on imported construction materials, ranging from 5 % to 50% depending on the materials.
3) Reinforcing bars are available by local factory. Size ranges from 6 to 32 mm. Big sizes should be imported. It is advisable to test local reinforcing bars.
4) The best sand (fine aggregate) is called "Sali Sand." The quarry is 10 km from Aqaba. The cost is 4 to 5 J.D. per cubic meter.

4.11.6 Unit Prices of Manpower

The prevailing unit prices of manpower are collected from the local consultant and local contractor. The former provided the monthly wages prevailing in Amman. The later provided the table titled "Hourly Wage Rate for Local In Jordanian Dinars" consisting of 10 wage components; namely (1) bare wage, (2) overtime premium, (3) holiday allowance, (4) vacation allowance, (5) annual leave allowance, (6) retirement allowance, (7) job allowance, (8) Social Security Insurance, (9) personal income tax, and (10) living allowance (house).

Table 4.11.6(1) and Table 4.11.6(2) summarize the information.

Table 4.11.6(1) Monthly Wages of Manpower

	Trade	J.D./month		Trade	J.D./month
1	Interpreter	400	11	Servant	100
2	Liaison	450	12	Driver-light	200
3	Secretary	220	13	Driver-heavy	300
4	Typist	200	14	Operator	150
5	Office boy	120	15	Mechanic	250
6	Draftsman	200	16	Carpenter	250
7	Clerk	200	17	Steel fixer	250
8	Watchman	120	18	Stone worker	150
9	Cook	200	19	Plasterer	200
10	Maid	100	20	Foreman	250
			21	Unskilled labor	150

Note: Wages at Aqaba are about 10 % higher than those in Amman.
Source: Merbed Engineering Consultant

Table 4.11.6(2) Hourly Wages of Manpower

	Trade	J.D./day		Trade	J.D./day
1	Foreman	1.323	16	Store keeper	1.323
2	Boiler maker	1.323	17	Guard man	0.891
3	Mill wright	1.323	18	Helper	0.891
4	Rigger	1.030	19	Engineer	1.987
5	Pipe fitter	1.323	20	Supervisor	1.460
6	Welder (TIG)	1.460	21	Typist	1.154
7	Welder	1.323	22	Clerk	1.154
8	Iron worker	1.154	23	Nurse	1.154
9	Insulator	1.030	24	Mechanic	1.323
10	Tin smith	1.154	25	Carpenter	1.154
11	Painter	1.154	26	Concrete	1.030
12	Instr. fitter	1.154	27	Brick layer	1.154
13	Electrician	1.323	28	Plasterer	1.154
14	Crane operator	1.323	29	Re-bar bender	1.030
15	Driver	1.030	30	Surveyor	1.154

For rental period of six months discount of 50% of mobilization and demobilization.
For rental period of nine months discount of 100% on mobilization and demobilization.
Source: National Trading

The local consultant also provided the JICA Study Team with the following information regarding the conditions and particulars for labor employment at Aqaba.

Table 4.11.6(3) Conditions and Particulars of Labor Employment

No.	Description	Remarks
1	Unskilled labor	Usually migrant unskilled labor from Egypt is available. It is advisable to use foreign labor. Tax on foreign labor is as follows: 1- 120 J.D./year for labor permit 2- 10 % social insurance 3- labor ministry approval should be obtained
2	Paid holidays	All Fridays and official holidays
3	Duty hours	8 hours a day
4	Overtime	1 hour = 1.25 hour
5	Diver for underwater works	50 J.D. per day or by sub-contracting
6	Operator/diver of each type of equipment	3 J.D. per hour
7	Drivining equipment + boat fully equipped	3000 J.D. per month
8	Monthly rent diver	1800 J.D. There is a contractor in Aqaba who can do the diving work, act as sub-contractor ready to supply divers, boat and equipment.

Source: Merbed Engineering Consultant

4.11.7 Equipment Costs

The prevailing leasing prices of construction equipment are collected from the local consultant and local contractor. The former provided the daily leasing rates and the latter monthly leasing ones. Table 4.11.7(1) and Table 4.11.7(2) show the information.

Table 4.11.7(1) Daily Leasing Rates of Equipment

No.	Equipment	Unit	Rate J.D.	Remarks
				8 hours for one month or less. If it is more than one month, rate could be reduced.
1	Loader (wheel loader and bachhoe)			
	Loader 966	day	200	
	Loader 930	day	100	
2	Dump truck	day	10	8 to 10 m^3
3	Dump truck	day	50	4 m^3
4	Bulldozer D8 or 155 Komatsu	day	250	
5	Grader	day	300	
6	Batching plant for ready mixed concrete			It is preferable to import it complete with pumps and dumper.
7	Compressor 180 CFM	day	25	
8	Crane up to 25 ton	day	150	Telescopic.
9	Concrete mixer & transit pump			To be imported.
10	Jack hammer (excavator COBELCO)			
	Type 909	day	250	
	Type 904	day	170	
11	Truck crane 50 ton	day	100	
12	Pile driving equipment (diesel/steam/vibrating hammer etc.)			Not available by private contractors.

Table 4.11.7(2) Monthly Leasing Rates of Equipment

Description	Capacity	Leasing Rate with Operator US$/month	Mobilization Demobilization US$	Remarks
Truck crane	180 ton	66,950	8,240	
Crawler crane	40 ton	4,120	105	
Latice crane truck	90 ton	12,160	3,500	
Hydro crane	65 ton	7,980	825	
Hydro crane	20 ton	3,610	495	
High bed trailer	30 ton	4,120	420	
Cargo truck	8 ton	2,060	420	
Generator	200 kW	3,090	310	
Compressor	600 CFM	5,670	420	
Compressor	375 CFM	3,870	125	
Pick-up	3/4 ton	2,575	155	
Dump truck	8 ton	4,000	250	
Engine welding machine	400 A	1,860	125	
Fork lift	3 ton	3,560	420	
Crawler crane	45 ton	7,500	750	
Crawler crane	35 ton	5,200	400	
Hydraulic crane	75 ton	15,000	1,000	
Low bed trailer	50 ton	4,500	440	
Electric winch	15 ton	1,800	250	Without operator, min. rent 8 months
Electric winch	5 ton	900	150	ditto
Fork lift	5 ton	2,900	300	

Note: Working hours are 10 hours per day.

The local consultant provided the following information:

- Temporary import for machinery and equipment for construction is allowed provided that once the project is completed it should be exported or left in the free zone.

4.11.8 Tentative Project Costs

This sub-section is intended to provide tentative project costs of each case or alternative selected as the port development plan. These project costs are required for the preliminary cost analysis and consequently for the selection of the port master plan.

The project costs are estimated on the preliminary design. Therefore, they are very tentative but relatively sufficient for the preliminary cost analysis.

According to the nine socio-economic scenarios, the three development plans of Aqaba Port are selected as Case-1, Case-5 and Case-9 as previously discussed. Among these cases, Case-1 is further divided to Alternative-1 and Alternative-2. The following table shows the summary of the project costs for these cases and alternatives.

An exchange rates in which 1 J.D equals to 130 Japanese Yen and 1.45 US$ is adopted.

Table 4.11.8 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 Cargo Handling Equipment	6,875	6,875	6,875	6,875
JFI-North 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

4.12 Management and Operation

4.12.1 Required Functions for PC

The port of Aqaba, which is the only port in Jordan, is managed and operated by PC. PC is a government body which belongs to Ministry of Transportation and has authority over planning, construction, management and operation and environmental preservation of the port.

However, attention must be given to the following points if the port is to be "attractive and profitable port for users".

(1) Organization

In order to make port management and operation strategy related to a basic policy and plan and ensure appropriate budgetary system for the port development, it is necessary to introduce new sections which are in charge of following functions;

a) Port Development Policy
b) Financial Policy
c) Personnel Affairs Policy
d) Port Promotion Policy

(2) Administration and Management System

In order to advance toward rational and efficient management, it is important to introduce measures for activation of administration and management system. In particular, communication among departments and divisions should be improved.

(3) Port Operation

At present, port operation, such as pilotage, towage, cargo handling, maintenance of equipment and so on is done by PC.

In principle, port operation is a kind of commercial business, so a much more flexible, business-like system of management is required. From the commercial business standpoint, following three points are commonly required by users for port operation.

1) Dealing with matters promptly

In order to ensure efficient utilization of the port facilities and port services, and to minimize the cost of transportation through the port, complying with the requests of port users quickly and dealing with problems quickly are indispensable.

2) Provision of services at reasonable charges

Port provides various services to users. If a port provides high-quality service and charges less than neighboring ports, port users will choose that port. But, if revenues become too low and management is unable to improve the port and its facilities, the quality of services will deteriorate. Thus, balancing of the above issues must be pursued.

3) Reliability and safety

Delivery/receiving or unloading/loading of cargo and arrival/departure of vessels must be carried out on time and correctly. Operation of cargo and vessels must be carried out in a safe manner.

(4) Training System

PC has a Maritime Training Center for the purpose of developing employee's faculties for port operation. However, training courses at this center do not reflect the latest advances in maritime technology.

In order to realize an efficient management and operation system, it is recommended that PC should develop a new training system.

(5) Computerization

Computer system has been introduced to port management and operation in many countries for handling port related information efficiently. However, PC has not introduced computers to all aspects of its operations. It is necessary to introduce information system in port activities such as terminal operation, payroll, stock control, financial, personnel administration etc.

In addition, several sections in PC have personal computers but these are not used very effectively. For the purpose of more effective use of personal computers, introduction of suitable software and more frequent and periodical training are required.

A detailed explanation of computerization is given in 4.8 Information System.

4.12.2 Future Port Management and Operation System

(1) Organization

1) Introduction of port planning section

Port planning section is in charge of preparing port development policy. The port development policy indicates future conditions of ports. Furthermore, the port development policy controls various kinds of activities in port areas. In other words, to execute proper port development, port operation and management should be based on the port development policy.

Also, port planning section is responsible for making port planning in the framework of the port development policy. Proper port planning and efficient management and operation are fundamental requirements in executing port projects. The functional layout and design of facilities must be based on excellent port planning to successfully realize port projects. Under an inappropriate management and operation system, the full benefits of modernized port facilities cannot be enjoyed. In this sense, there is an interdependent relationship between management and operation and facility design and installation.

2) Introduction of port management and operation strategy section

Port management and operation strategy section is in charge of preparing financial policy, personnel affairs policy and port promotion policy. These policies, mentioned below in this chapter, should be prepared as part of the strategy which leads to the establishment of a proper future port management and operation system.

3) Introduction of environment affairs section

Environment affairs will become an important issue. In PC, a section in charge of conducting monitoring and assessing environmental impact should be introduced.

4) Rationalization of organization

PC is a huge body, having over 5,000 employees. Personnel expense ratio is more than 70% of total operation expense excluding depreciation. In order to secure stable income for port development, PC should rationalize its management through simplification of its organization.

(2) Financial Policy

PC contributes to the Ministry of Finance. It is thought inevitable that the Government collects this kind of contribution from profitable institutions and uses it for un-profitable divisions.

However, this system makes financial position of PC unstable. It is necessary to secure stable income for port development. PC should appeal to the ministries concerned to define criterion for deciding the amount of the contribution and to reserve financial resources for projects of the Master Plan.

(3) Personnel Affairs Policy

1) Introduction of measures for activation of the organization

For activation of the organization, not only its reformation but also the improvement of minds of its personnel toward rational and efficient management are important. For this purpose, many private companies adopt a Quality Control (QC) circle and a proposal activity system.

A QC circle is an activity for improvement involving each individual employee. Normally it is carried out by a group within a single division or section. Members of the group identify problems concerning quality, safety, efficiency etc. and voluntarily try to solve the problems with everyone's cooperation. Many people take part in the activity and find satisfaction in seeing their suggestions implemented. Many companies hold presentation conferences or award ceremonies in order to promote it and to learn from other activities. It is also done by a project team extending through several divisions concerned.

A proposal activity system is a system whereby top managers invite proposals on new ideas and concrete improvement measures on tasks from all employees and adopt what they consider to be the best proposals.

These kinds of activities would give all personnel a good opportunity to think over their own tasks and to contribute to their rationalization. It is recommended that PC introduces and develops these kinds of activities throughout its organization.

However there are many cases where these activities begin to lose their novelty and the number of proposals decreases as time goes by, although they work well at first. Therefore it is important for top managers to make quick and effective decisions.

2) Improvement of personnel evaluation system

In order to carry out the proper management and operation of the port, it is indispensable that the business ability of personnel of PC be kept high. For that purpose, the personnel management system is required to be improved as follows.

One of the ways to improve personnel ability is to evaluate their ability properly and fairly with objective standards and reflect that evaluation in promotions and wages. Through this evaluation, the proper personnel transfer according to experience, knowledge and judgement becomes possible. Moreover it also gives personnel the incentive to work well and to display their ability because they are satisfied with the proper evaluation of their works.

The following points should be kept in mind at the time of the evaluation.

- Evaluation should be done not only for promotion and wages but also for the nurturing of personnel. So it is important to look at the shortcomings or promising points of each employee and to evaluate his/her efforts to rectify/cultivate them.

- A manager of each division should make efforts to improve abilities of personnel under him/her through training on the job or through some training courses and seminars.

- Evaluating items should include the contribution and attitude toward efficient business.

(4) Port Promotion

PC's port promotion activities are not effective enough to attract port users. PC should conduct the activities aggressively.

Port management should not sit and wait for the traffic to come but should make all efforts to attract traffic. A reasonable amount of publicity and close contact with steamship companies and their agents, local and international commerce, industrial organizations and with all actual and potential port users can greatly contribute to improving the image of the port, making known its advantages and opportunities and promoting a steady growth of traffic. Also, those activities of port promotion can bring to light current problems of the port and stimulate their quick resolution.

Once PC adopts a concrete port promotion plan, it should be divided into two phases.

First, PC should immediately make efforts to collect exported cargoes, in particular, exported container cargoes, almost all of which are currently empty. As to target commodities, vegetables and electrical machinery produced around Zarqa are proposed.

Second, based on policy and cooperation of the Central Government (for example, Ministry of Trade and Industry), manufacturing industry such as processing and assembly industry and consumer-related industry should be promoted. Part of their product is already included in forecast cargoes, but the volume is very small. National economic prosperity in Jordan is said to depend on introduction and promotion of industries mentioned above. Port activities should support industrial activities. Furthermore, increase of this type of cargo will surely have a positive effect on port activities. Therefore, PC should contact the Central Government and industrial authorities concerned and urge them to accelerate industrialization in the medium and long term.

(5) Communication

Objective of communication is shown below;

a) To promote a better understanding on the part of employees of the policies of organization and to allow employees to air requests and complaints.

b) To make communication easy and to heighten morale of employees.

c) To promote cooperation and instill in employees a sense of responsibility and to abolish sectionalism.

Channel of communication is shown below;

a) Channel from top to bottom.....Command, Notification, Instruction, etc

b) Channel from bottom to top...Report, Offering opinion, Proposal activity, etc

c) Lateral channel...Liaison meeting, Notice for circulation, Informal gathering for discussion

Lack of communication in organization is frequently caused by lack of smooth lateral relationship rather than relations between top and bottom. Withholding of information is an effective means for one section to hold power over another, however this hinders the activities of an organization as a whole.

QC circle and a proposal activity system, as mentioned above, are effective measures to activate communication.

A house journal is another means to promote communication. A house journal is a newspaper published by the management body which details the organization's prospects, imparts broad knowledge of current undertakings and can serve as a forum to hear opinions and requests of employees. A house journal should not be one-sided communication from top to bottom. Rather, it should promote mutual understanding between top and bottom and make lateral communication among employees smooth. This will result in a stronger organization.

(6) Port Operation

The most important function of a port is to serve as a terminal where sea and land transportation meet. Efficiency and safety are thus vital in the transfer of cargo and

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

1) Control of target productivity

A target productivity for loading and discharge operations of the cargo in each vessel should be established. When the target is not achieved, the causes should be analyzed and necessary countermeasures should be taken immediately.

To prepare and analyze above target it is necessary to exchange information with the Operation Department and the Maritime Department on the arrival and departure time of vessel, handled cargo volume and handling time in each berth.

2) Wage system based on handling volume

By introducing a wage system based on handling volume, if cargo handling is conducted efficiently, labors can earn the same wages as at present in a shorter time. This may raise the efficiency of port activities and with increase of handled cargoes PC will earn more revenue.

An incentive could be given if a gang handled cargoes over a certain minimum volume.

4.12.3 Privatization

Throughout the world, there is a tendency for port management and operation to move toward privatization and many port authorities have already adopted privatization or are considering its adoption.

As is commonly understood, public sector is normally not flexible in providing personnel or investment in response to the actual fluctuation of demand. In this sense, full involvement of port authority in cargo handling services is not always suitable for increasing of efficiency of such services under a competitive market, and increased situation of cargo flow in particular.

Therefore, it is necessary for PC to examine introduction of privatization corresponding to the stage of national economic development in Jordan. This will be one of the solutions to realize an efficient port operation and to contribute to improvement of the Jordanian economy in the future.

(1) Merits of Privatization

Generally speaking, the private sector runs business more efficiently than the public sector for the following reasons.

1) Incentive

When a business is run by the public sector, incentives to make the management efficient by reducing deficits doesn't work well since there is no possibility of bankruptcy. On the contrary, the prospect of bankruptcy compels private companies to run an efficient operation.

Workers in the public sector lack incentive to perform the best possible job. Wage systems are often so rigid that the diligence or ability of an employee go unrewarded. This type of situation usually results in lackadaisical efforts on the part of workers.

2) Competition

Introduction of principle of competition will induce incentives for effective management.

When services are monopolized by a single company without any competition, it is difficult to judge whether the company provides effective services or not. Participation of plural companies makes a comparison possible.

3) Flexibility

Introduction of flexible management free from budget system, seniority system, formalism, strict application of regulations which are peculiar to officialism is recommended.

(2) Systems for Construction and Operation of Terminals

The following construction and operation systems can be taken as examples even though the responsibilities of port authorities may differ from one another.

1) LAQ method and LUP method

Both of these methods are systems in which construction work is done by public sector and port services are provided by private sectors.

a) LAQ (Lease a Quay)

A private entity makes a contract with a public entity to conduct port service business, through this contract the public entity leases a terminal including quay wall to the private entity. The private company pays a lease charge.

b) LUP (License to Use a Port)

A public entity licenses private sector to conduct limited port activities in the terminal constructed by the public sector.

2) BOT method (Built, Operate and Transfer)

A public entity permits private entity to construct a terminal under the condition that the private entity uses it for a certain period (usually 10 to 15 years) to recover the construction cost. After this period the terminal is transferred to the public sector.

3) Private

A private entity constructs a terminal, owns and manages it to conduct port related business.

(3) Application of Privatization Policy

It is considered that the following guidelines be taken into account in examining the

privatization policy.

a) The ultimate objective of privatization of port operation is to maximize economic return from the port activity for both the public and private sectors under careful consideration on effective removal of possible inefficiency of public sector.

b) Port functions and activities to be privatized should be limited within the areas where the privatized activities can be fully controlled under PC, and the areas where the effects of privatization can be fully expected without any negative impact to sound performance of the port.

c) The target areas to be privatized should be planned and arranged appropriately to guarantee the necessary conditions under which the free market system can be fully activated.

d) In principle, ownership of the land and water area necessary for PC, and the basic facilities such as water area for navigation channels, anchorages and berthing basins, public wharves, utility mains, reserved space/land for public use or future expansion should be belong to PC.

e) Basic port facilities and major cargo handling equipment should be open to public use, in principle, but can be leased out to private firms on a contract basis for their exclusive use under appropriate conditions.

4.12.4 Training System

(1) Objectives

To be a port which can attract more cargo and passengers, efficient management and operation are essential. PC employees in each department should control port activities appropriately to materialize efficient management and operation - quick cargo handling, farsighted investment, profitable financial management and so on.

The objective of employee training is to improve the capability of each worker, which in turn will lead to efficient port management and operation. Through training, employees should gain expert knowledge, leadership ability, skill to operate port equipment and so on. They should understand the current port condition and manage and operate the port considering problems which are expected to occur in future. In addition, to gain more effect, they should make efforts to self-educate.

(2) Functions of Training Center

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.

Training Organs should provide both theoretical and practical training. Through theory training, trainees will gain basic and special knowledge on port management and operation. Through practical training, trainees will operate port equipment at first hand and attain a higher level of skill.

PC provides many kinds of training courses for their employees in the Marine Training Center. This center has several training-rooms for cargo handling, computer operating, etc. but does not have a training institution with port facilities and equipment for practical training.

Trainees would be able to practice operating port equipment in such a controlled environment and then utilize this experience during actual operations.

However, a considerable investment would be required to construct a training institution with port facilities, the latest equipment and so on. If PC were to bear the cost by themselves, tariff levels would have to be raised which would weaken their competitive position.

Therefore, PC should establish a practical training institution after ensuring financial resources in the future. Because PC has to raise the large amount of funds for the new port development, is desirable to provide practical training periodically using actual equipment for the time being.

(3) Training Courses and Programs

1) For all staff

Training courses for all staff begin at the time of employment and continue periodically. By attending these courses, employees gain basic knowledge on general administration and leadership ability. Employees will gradually develop a broader understanding of the nature of ports which will help them to cope with problems of port administration.

An example of the programs for all employees is shown in Table 4.12.1. Through these programs, improvement of their ability to understand present condition and problems of port is expected. In addition to the matters shown in Table 4.12.1, other programs that focus on current problems related to port should be prepared.

2) For secretaries (Staff mainly engaged in management or finance)

By attending training courses on general administration, financial management, accounts system, related laws and regulations and so on, secretaries gain a better understanding of port management, and will thus execute their duties more effectively.

3) For engineers (Staff mainly engaged in construction or maintenance and repair)

By attending training courses on civil engineering, architecture, electrical engineering, mechanical engineering and so on, engineers gain a better understanding of port construction and maintenance, and will thus execute their duties more effectively.

An example of the programs for secretaries and engineers is shown in Table 4.12.2. Through these programs, it is expected that they will gain special knowledge of various port functions. In addition to the matters shown in Table 4.12.2, the selected employees should study in colleges or universities to gain higher and the latest knowledge.

4) For operators

There are various types of operation in port activities - marine operation, cargo-handling, maintenance and repair of equipment and so on. Operators should have professional knowledge of each port function and attain a higher level of skill.

a) Staff mainly engaged in cargo handling and maintenance and repair of equipment

By attending training courses on cargo handling and operation or maintenance of port equipment, operators will attain a higher level of skill and thus the efficiency of port operations will be enhanced.

An example of program for operator is shown in Table 4.12.3 (1) (2).

b) Staff mainly engaged in marine operation

- Training for pilotage and towage

Training for pilotage and towage should be provided by on-the-job training. Skilled operators should guide unskilled ones periodically to raise the efficiency level.

- Training for port state control

To study the latest advances in port state control, the selected staffs should be sent to advanced maritime countries.

c) Staff mainly engaged in host computer operation

For the training of host computer operators, the selected staffs are sent to proper technical school.

5) For personal computer operators

By attending training courses on personal computer, personal computer operators will be able to use personal computers for daily work using application software such as word processor, calculation format and drawing processor. More quickness and accuracy of daily work will be expected.

As an example of program for personal computer operators is shown in Table 4.12.4.

(4) Trainer for Training Courses

Staffs of PC are in charge of trainer for training courses in the Marine Training Center. However, more competent trainers are required to raise training level. The following measures are recommended;

1) Invite special experts who have 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.

2) Select several suitable candidates and send them overseas to take training courses.

3) Invite part-time trainers from colleges or special schools for the training courses requiring special knowledge such as finance, civil, electrical and mechanical engineering, personnel management and so on.

(5) Review and Monitoring

In order to execute effective training, it is necessary to review and monitor the results of training and adjust contents of training courses accordingly.

For that purpose, training center should grasp opinions and requests of trainees and have power to coordinate with each department for making a annual training working plan including finance.

(6) Others

The Master Plan calls for the procurement of two additional gantry cranes and ten new transfer cranes to cope with the increase of container cargo. When PC purchases them, it is advisable to turn to the supplier for guidance on operation for a certain period; this should be clearly stated in the contract.

Table 4.12.1 Training Program for All Staff

Course	Program	Object
New Staff Training	Basic knowledge of general administration, port management	Grasp actual situation of port
Middle Staff Training	Advanced knowledge of general administration, port management	Heightening self-awareness as a middle staff
Executive Staff Training	Management, command and problem settlement ability	Enhancement of leadership capability, nurturing development of staff, raising their morale

Table 4.12.2 Training Program for Secretaries and Engineers

Course	Program
Secretaries Training	Administration, Port Management, Related laws and regulation, Finance, Procurement, Accounting, etc.
Engineers Training	Civil engineering, Architecture, Electrical engineering, Mechanical engineering

Table 4.12.3 (1) Training Program for Operators

(1) Theory

Subject	Course		Time (hr)	Details of Course
Basic	Mechanical Engineering	Hydraulics Machinery Components	60	Machine components, combustible gases and oxygen, structure of gas welding equipment etc, hydraulic circuit symbols etc.
		Gas Welding	20	
		Arc Welding	20	
	Electrical Engineering		40	General electric, telephone equipment, electrical equipment for vehicles, electrical devices for cranes and other cargo handling equipment, electrical circuits, circuit diagrams etc.
	Construction, Transportation and Machinery		40	Classification of transportation equipment, uses of transportation and loading equipment, structure and functions of motors, travel gear, operating gear etc.
	Production Engineering		20	Production planning, operations analysis, management of production stages, transportation, equipment, quality etc.
	Applied Dynamics		60	Power, center of gravity, movement and kinetics, friction, work and energy, safety factor, permissible stresses and elastic energy, bending, twisting
	Slinging Work		40	Slinging apparatus, slinging technique, slinging signalling
	Safety and Hygiene		60	The meaning of industrial safety, causes of accidents, accident prevention, maintenance of hygiene, port and harbor safety, equipment safety, first aid, examples of accidents
	Law and Regulation		40	Port related laws and regulations
Specialist	Port Management and Operation		60	Theory and policy of port management and operation, knowledge of customs, tariff and insurance contracts
	Cargo Handling		80	Type and method of cargo handling, International agreement
	Structure of Cargo Handling Machinery	Forklifts	40	Types, structures, functions, handling and related regulations of cargo handling machinery
		Shovel loaders	40	
		Mobile cranes	40	
		Cranes	40	
		Derrick	40	
	Electricity and Engines	Vehicle engineering	40	Internal combustion engines, fuel and fuel consumption, lubrication and hydraulic fluids
	Cargo Handling	Shipboard cargo handling	80	Safety operating techniques of cargo handling machinery, supervision and direction, preparation of cargo handling plan, ship structure, numerical inspection
		Onshore cargo handling	80	
	Inspection and Maintenance		40	Before and after operation of port cargo handling equipment, regular inspection and maintenance

Table 4.12.3 (2) Training Program for Operators

(2) Practical Training

Subject	Course		Time (hr)	Detailed of Course
Basic	Inspection and Maintenance		80	Structure of internal combustion engines, electrical motors and machine parts, adjustment and maintenance skills
	Sling Signalling		80	Use of tackle, selection of wire ropes, estimating weight, judging center of gravity
	Safety and Hygiene Work		80	Operating procedures for cargo handling machines, a full awareness of safety procedures and operating methods, first aid and hygiene techniques, operation of adjustment mechanisms, storage of dangerous materials
Specialist	Cargo Handling Machinery Operation	Forklift	200	Preparations before operation, driving and cargo handling skills
		Shovel loader	80	
		Mobile crane	180	
		Crane	160	
		Derrick	100	
	Inspection and Maintenance	Tool manufacturing work	20	End treatment of wire ropes and fibers, manufacture and maintenance of pallets
		Inspection and maintenance	60	Inspection and maintenance of cargo handling machinery
	Numerical Inspection		40	Method of numerical inspection using tally sheets, type of cargoes, packing, classification, remarking
	Cargo Handling	Cargo handling work	40	Pallet cargo handling, container banning, manual cargo handling, hoist work, conveyor work, handling of heavy/large objects
		Container cargo handling	20	Management and operation of container terminal,
	Welding Work	Gas welding	40	Basic welding skill
		Arc welding	40	

Table 4.12.4 Training Program for Personal Computer Operators

Course	Time (hr)	Program
Introduction of Computer	30	Basic knowledge, key operation, concept of computer programming, making program by BASIC
Practical Training of Software	60	Basic knowledge of office automation, software (word processor, calculation format, drawing processor) operation

4.13 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 in Chapter 6 indicate that no serious problems for the environment will result.

Significance of the Master Plan

The six major objectives of the Master Plan for the port of Aqaba were mentioned in the section "Basic Concept of the Port Development". All should be incorporated in the formulation of the Master Plan.

There has never been any master plan at the port of Aqaba at all. The port of Aqaba has been developed and operated since its opening without a Master Plan or any long-term plan.

The formulation of a Master Plan is crucial and urgent at this time.

As the peace process progresses, Jordan's status in the Middle East will rise as will the number of social and economic projects. If there are drastic changes in the political and economical situation around Jordan, cargo volume, in particular, industrial cargo volume related to bilateral or multi-lateral joint projects, may increase. The port of Aqaba may possible undergo significant changes.

There is, however, a lot of uncertainty concerning the long range prospects of the port of Aqaba. New international cooperation and framework have recently emerged. Lasting and steady progress is strongly hoped for but it is generally said that it will take a rather long time. Future demand at the port of Aqaba will remain uncertain until the situation becomes clearer.

Concurrently, other long-term plans related to Master Plan of the port of Aqaba such as tourism development plan in Jordan and environmental preservation of the Gulf of Aqaba are presently under study. These results may probably require coordination or reexamination between various demands or restraints in the Gulf of Aqaba in near future, since the territorial coastal line of Jordan is only 27 km.

Under the above situation surrounding the port of Aqaba, Master Plan should be made on the basis of concrete and practical perspectives, information and data. As well, Master Plan of the port of Aqaba should have flexibility in case contents of Master Plan need to be revised to meet new demands or respond to changes in the Gulf of Aqaba.

Features of the Master Plan

Features of the three proposed Master Plans are summarized as follows;

1) To make efforts to utilize the limited port area in Jordan as much as possible

2) To aim at actualization of higher cargo handling productivities in order to establish the port of Aqaba as a transit port

3) To forecast future demand taking into consideration practicable projects influential on port activities, in other words, examining to what extent such projects have matured

4) To carefully consider economic aspects i.e. budgetary situation surrounding the port of Aqaba

The Ports Corporation is considering the application of the Build, Operate and Transfer (BOT) scheme to some projects. BOT is one method for port development in developing countries. Application of BOT is concerned with many fundamental matters related to the Master Plan as follows;

1) industrial policy in Jordan related to port activities

2) overall space utilization and management policy in the Gulf of Aqaba

3) operation and management conception of the whole port of Aqaba (To which facilities should the BOT concept be applied? How does BOT affect introduction of privatization for other jobs? How does P.C. supervise entity if BOT is applied? What influence will BOT have on P.C.'s organization and employment?)

The above issues should be studied in the framework of long range policy of the port of Aqaba. In this stage, it is thought appropriate for BOT to be proposed.

Comparison of the three alternatives

Forecast cargo volume does not largely differ among all three cases, excluding exported crude oil (Jordan Iraq Joint Project) of Case 1. Therefore, except tanker berth for very large crude carriers of Case 1, the difference of required berth number is shown only in required number for general cargoes, etc. The difference in the required number of berths for general cargoes between maximum (Case 1) and minimum (Case 9) is three.

Comparing forecast cargo volume at the target year with the past maximum level, 20 million tons in 1988, growth rate of cargo volume in all cases is not high. Transit cargo volume, 90 % of which currently goes to Iraq, influences total cargo volume handled at the port of Aqaba. Local cargo volume is forecast to steadily increase while transit cargo will not. Iraqi port facilities and equipment, which were damaged during the Iraq-Iran war, are to be restored sooner or later. It is reasonable that repair works of most of those facilities will be finished by 2010 at the latest, the target year of the Master Plan of the port of Aqaba. It is also said that Iraq will manage to obtain alternative gateways other than Jordan to enhance its national security in case of emergency. Therefore, it would not be prudent to forecast a large increase in the transit cargo volume as this might lead to over-investment.

Cargoes related to industrial development projects were evaluated by degree of maturity and market situation and then cargo volume was forecast. In case that foreign aid projects, for example, production of, what is called, "Dead Sea Products", will rapidly progress, it may be necessary to revise the proposed Master Plans.

All proposed Master Plans have, however, some more capacity to handle cargoes judging from their berth assignment (No. 8 and 9 at Main Port can be provided in service

although they are not assigned for cargo handling in the Master Plan and berth occupancy (almost all berths' occupancies are under 0.7). For example, according to the Master Plans of Case 5 and 9, Phosphate Berth (A) will be assigned just in service for vegetable and bunker oil loading so that expected berth occupancy will be under 30 % and that will also result in reducing berth occupancy of other general berths.

Priority of project components

Berths which accommodate container vessels and general cargo vessels are the most important proposed project components for the following reasons;

1) Container cargoes and general cargoes are main keys whether the port of Aqaba will become prosperous as a transit port.

2) Present major jobs that PC's many workers are engaged in are general cargo and container cargo handling and this will continue in future.

3) Major port facilities that PC operate and manage are general cargo berths at Main Port and container berths at Container Port.

4) Containerization has become the main trend of maritime transport throughout the world while general cargoes have not increased. Container cargo throughput at the port of Aqaba is increasing. Manual container handling has almost reached the limit of its capacity so that facilities as well as handling system in the container terminal need to be improved.

5) Phosphate rock has been the number one commodity handled at the port of Aqaba though the quantity has been decreasing for the past five years. Phosphate will continue to be one of the most important commodities and occupy the top position for the time being. However, phosphate rock handling generates dust pollution. The world trend shows that handling of phosphate rock, raw material of fertilizer, in general, will become less and less, and instead added value products, such as fertilizer, will increase. Although relocation of Phosphate Berth is strongly desired from an environmental point of view, the berths are to be retained in the Master Plans. Beyond the target year, 2010, the berths may be replaced and present area will be assigned for other uses. In a word, phosphate berths as one of project components have some uncertainty for the future.

Comparing the three alternatives in the above context, Case 1 requires berth extension due to increasing general cargoes while Case 5 and 9 do not. The existing container terminal area (including developed area in the Master Plan) is very limited. Space for a container terminal at the area of the Phosphate Berth can be secured in Case 5 and 9 beyond the year 2010 in the event that capacity proposed in the Master Plan is exceeded due to the progress of containerization. After Phosphate Berth is replaced beyond the target year, the existing phosphate berth area will most likely become another container terminal. Case 5 and 9 are better to cope with additional future demands.

Conclusion

On the whole, the proposed Master Plans should be evaluated considering the following;

1) 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.

2) 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.

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

4) All port facilities and equipment should always be used to their best advantage so as to activate port sales and promotion.

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

Chapter 5 Short-Term Improvement Plan of the Port of Aqaba

The Short-Term Improvement Plan is to be proposed in accordance with Case 5.

5.1 Basic Concept for the Short-Term Improvement Plan

The Short-Term Improvement Plan is to be formulated within the framework of the Master Plan. The basic concept of the Master Plan is as follows:

1) To reinforce the role and function as the gateway of Jordan

2) To ensure efficient and practical operation

3) To coordinate with other activities in the Gulf of Aqaba including sufficient consideration of environment

4) To prepare rational and economic design and implementation

The Short-Term Improvement Plan is prepared as a first phase plan with a target year of 2000. Taking into account the target year, its basic concept is thought to be as follows:

1) To solve current problems caused by the existing facilities, in particular, insufficient depth and length of quay

2) To cope with demand forecast, that is, those cargoes most likely to increase in the near future, corresponding to increase of production of industries in the hinterland

3) To aim at long-range prosperity of the port of Aqaba in a strategic sense, that is to say, to promote port progress and prepare conditions in which the port can compete with neighbouring ports as a transit port

4) To make best use of the existing facilities and equipment through improvement and rehabilitation necessary to minimize new construction works and thus to result in appropriate utilization, harmonization with other activities and preservation of the severely limited coast line in Jordan

5) To introduce modernized computerization and advanced administrative measures together with training system so as to ensure efficient management and operation

6) To make efforts to maintain scheduled implementation for completion of the projects proposed in the Master Plan, taking necessary period into consideration

7) To re-examine designs of facilities and project implementation program through the results of site investigation and other related data and information from technical, economical and environmental points of view

8) To minimize the undesirable influence to port activities as much as possible during project implementation

5.2 Site Investigation for the Port Development

5.2.1 Natural Condition

(1) General

During the second site survey period from June 1995 to August 1995, natural conditions survey was performed at Main Port Area, Container Port Area and Industrial Port Area.

The contents of survey and data analysis as follows.

a) Main Port Area

· Bathymetric Survey,	Survey Run	10.7 km
· Current Observation,	3 Points	

b) Container Port Area

· Topographic Survey,	1.0 km^2	
· Bathymetric Survey,	Survey Run	8.3 km
· Current Observation,	2 Points	
· Offshore Boring,	2 Points	
· Onshore Boring,	2 Points	23 km
· Soil Laboratory Test		

c) Industrial Port Area

· Topographic Survey,	0.6 km^2	
· Bathymetric Survey,	Survey Run	23 km
· Current Observation,	1 Point	
· Offshore Boring,	2 Points	
· Soil Laboratory Test		

The location of above survey items are shown in Figure 5.2.1 ~ 5.2.3.

(2) Topographic Survey

Topographic survey was conducted at site from June to July 1995 using TOPCON TOTAL STATION SYSTEM.

The bench mark near the police official club was selected as the principal bench mark and its coordinates and elevation are as follows.

Longitude : E146 725, 847
Latitude : N873 240, 2136
Elevation : 11.567 m

Topographic maps were made by Auto-Cad using computer. For the planning of proposed port facilities, the contour line will be indicated at one meter intervals in the plan.

(3) Bathymetric Survey

Bathymetric survey was conducted at site from June to July 1995 using Echo Sounder Model TDM-9000 by survey boat.

Average interval of each sounding line is 50 meters, right angle to the existing berth face line and the depth of sounding is up to -50 meters below MLLW.

The bathymetric maps are shown in Figure 5.2.4 ~ 5.2.6. The map shows typical seabed configuration with elevations based on MLLW at proper intervals. The following features are notable from the survey.

a) In front of the main port area, the seabed slope is steep (1/4), reaching a depth of -50 m at the limit of the surveyed area.

b) In front of the container port area, the seabed slope is steep (1/3) and some coral reefs are found in the southern part of surveyed area.

c) In front of the industrial port area, the seabed slope is steep (1/6) and many coral reefs are found in whole surveyed area.

(4) Current Observation

Current observation was conducted during daytime of spring tide in June and July, 1995 using direct reading type current meter model DCM-II by survey boat.

Since the objective sites in the study are situated at inner bays of Aqaba where tide amplitude is only 0.1 m/s more or less, tide current velocity at each site is observed to be relatively small.

Table 5.2.1 shows the maximum current observed at each port site and the results of observation records are compiled in the Appendix.

As a result of current observation, the velocity is relatively low while the direction of current movement is not stable.

Table 5.2.1 Maximum Current Observed

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

(5) Soil Condition

The soil investigation work was conducted from the middle of June to the middle of July, 1995 using a rotary drilling machine.

The site investigation comprised four offshore boreholes and two onshore ones. Two offshore boreholes and two onshore ones were made at the container port area which is situated approximately 8 km South of Aqaba. The other two offshore boreholes were made at the industrial port area which is situated approximately 20 km South of Aqaba.

The depth to which each borehole was drilled ranged from 20.0 m to 24.0 m, depending on the sub-surface strata encountered.

1) Container Port Area

The subsoil condition of the offshore area is distinguished by the following kinds of soils.

Borehole No. 1 is whitish, creamish and greyish, fine to coarse, loose to very dense coral sand with some shells and its N-values are from 7 to 62. Borehole No. 2 is whitish, creamish and greyish fine branched coral filled with whitish fine to medium grained coral sand and some shells, weak to very weak banches and its N-values are from 13 to 47.

(Refer to Figure 5.2.7, Soil Profile at Offshore Area, Container Port)

The subsoil condition of the onshore area is distinguished by the following kinds of soils.

Borehole No. 5 is fine to coarse, dense to very dense, granitic sand and its N-values are from 39 t o 55. Borehole No. 6 is medium to coarse, very dense granitic sand, with some fine gravels an 39 to 71. (Refer to Figure 5.2.8, Soil Profile at Onshore Area, Container Port)

2) Industrial Port Area

The subsoil condition of the offshore area is distinguished by the following kinds of soils.

Borehole No.3 is whitish, creamish and grayish, fine branched corals, filled coral sand and shells, and its N-values are from 44 to 72. Borehole No. 4 is grayish beach sand with some fine gravels in upper two meters and the rest up to -33 m are pinkish granitic fine to coarse sand, and its N-values are from 49 to 80.

(Refer to Figure 5.2.9, Soil Profile at Offshore Area, Industrial Port)

(6) Laboratory Test

The selected representative disturbed samples from Boreholes 1 through 6 were sent to the laboratories in Amman for testing.

Samples were subjected to a grain size analysis test and a specific gravity test.

(Refer to Tests Results in Appendix)

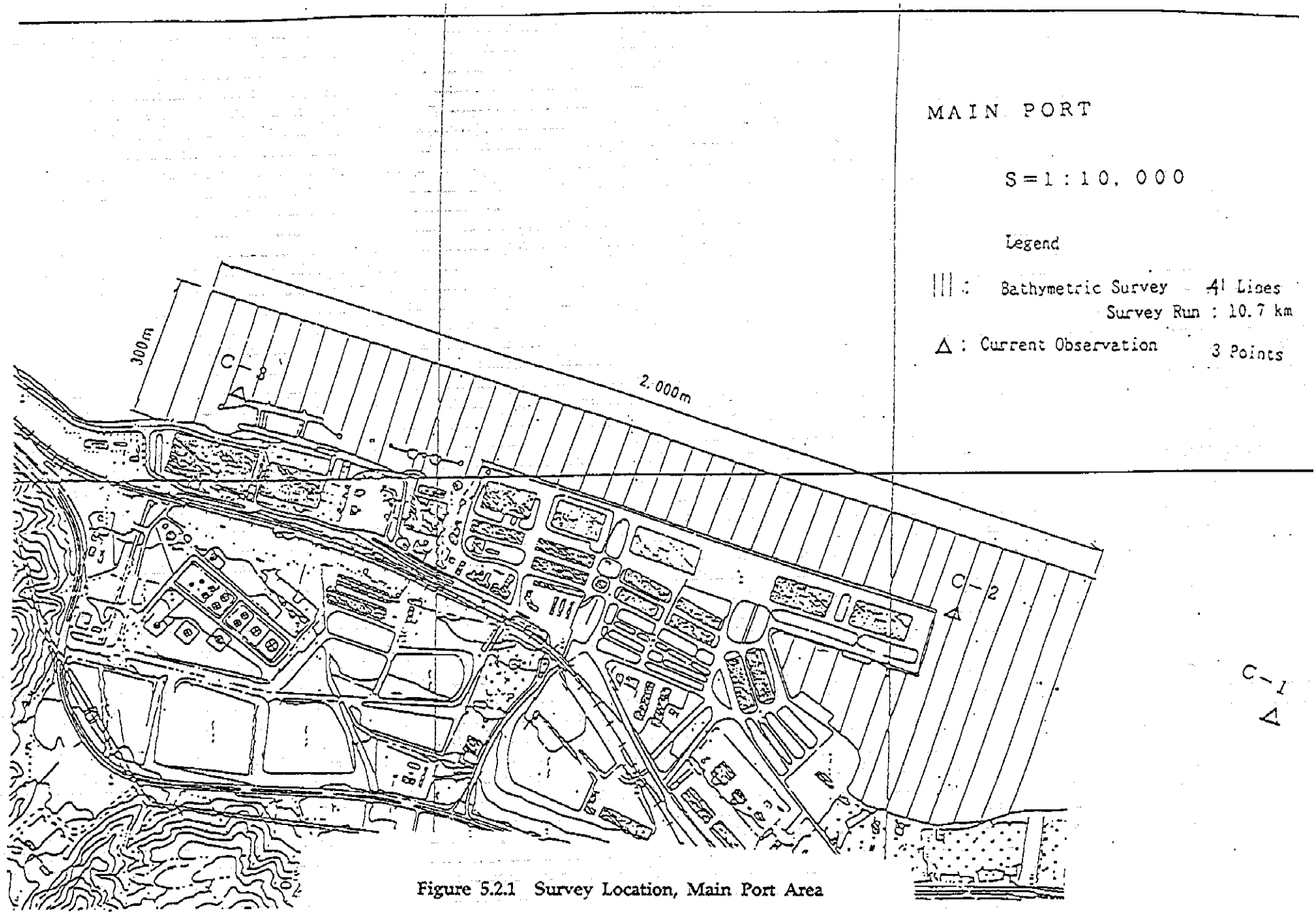


Figure 5.2.1 Survey Location, Main Port Area

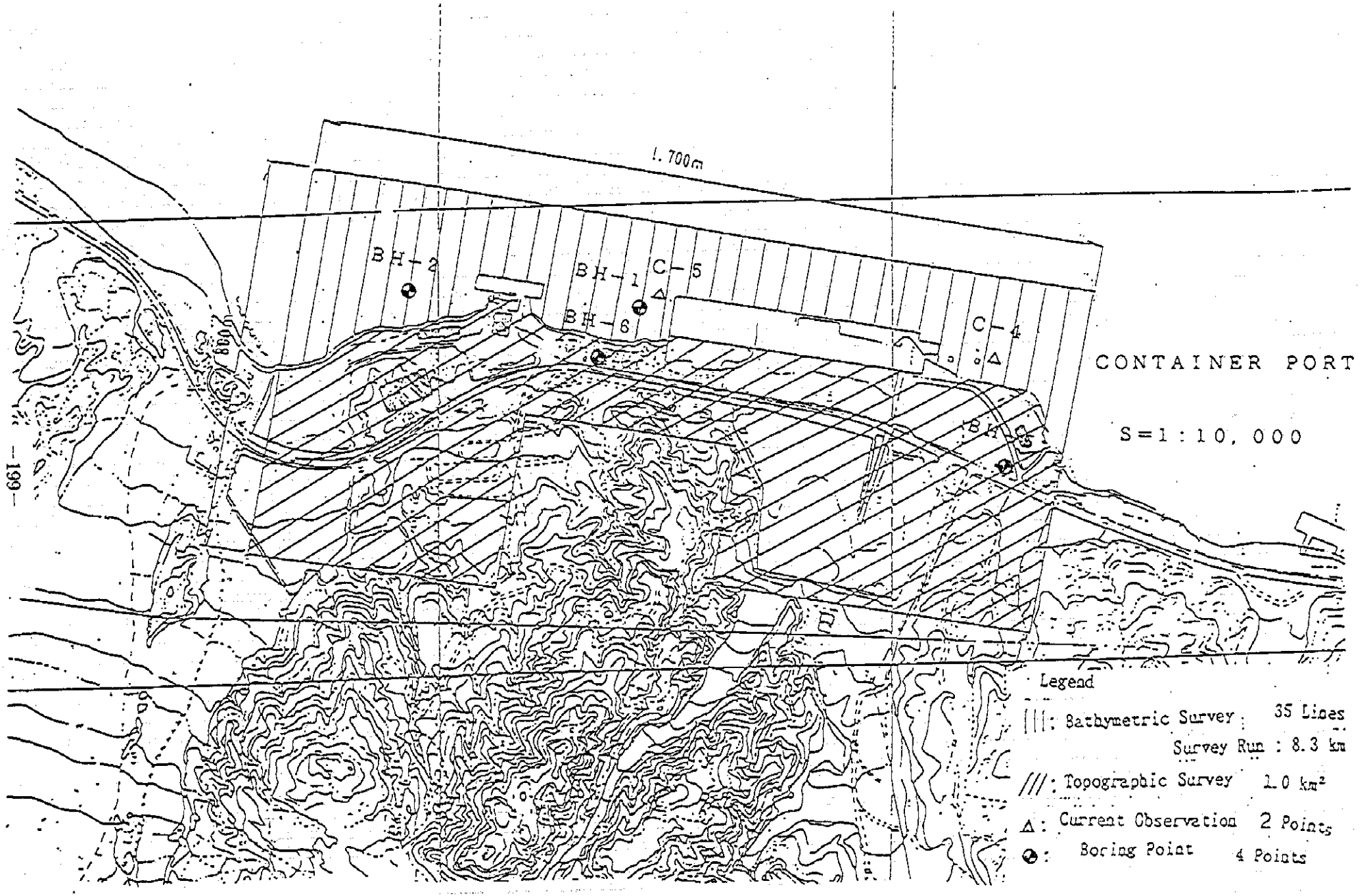


Figure 5.2.2 Survey Location, Container Port Area

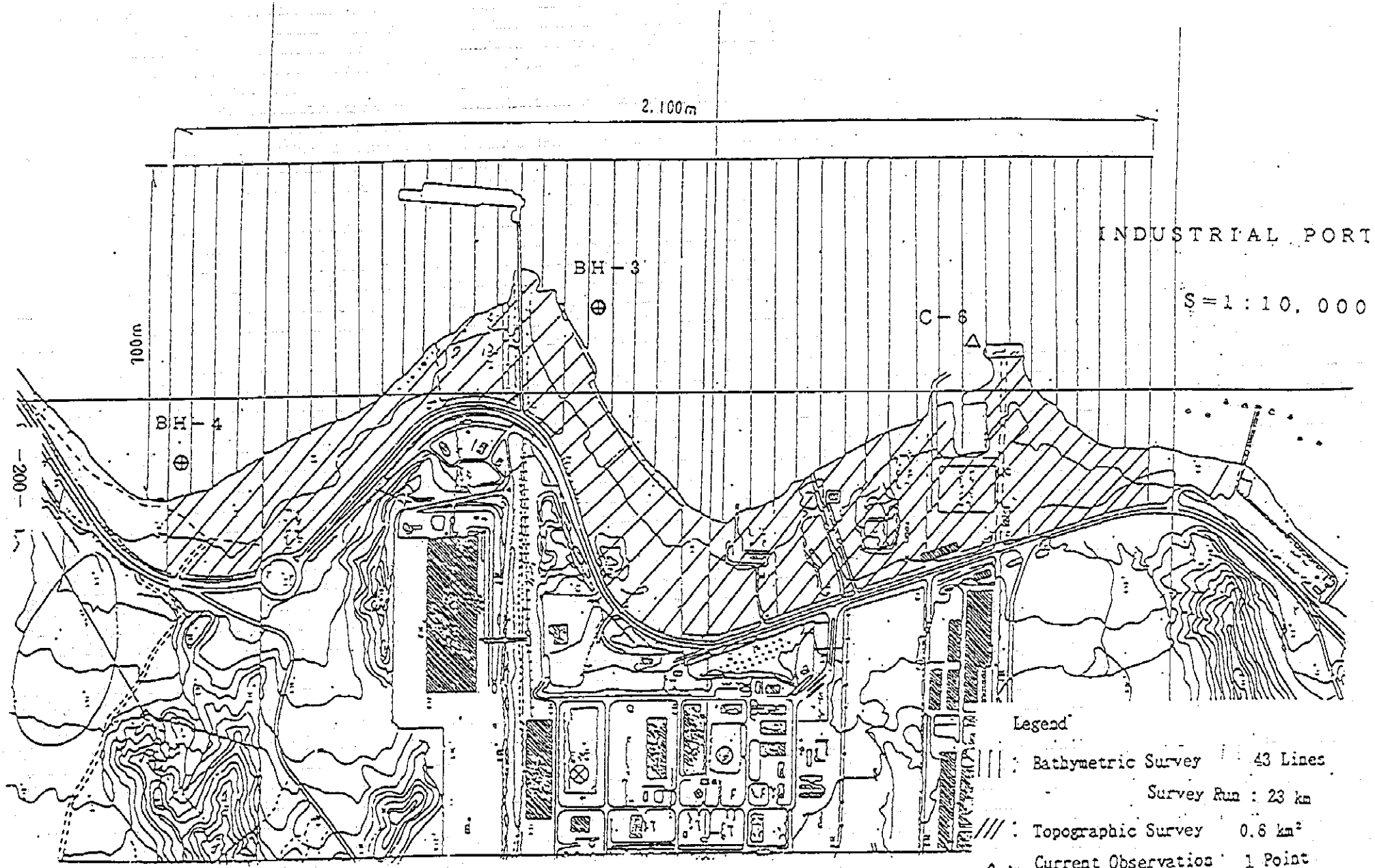


Figure 5.2.3 Survey Location, Industrial Port Area

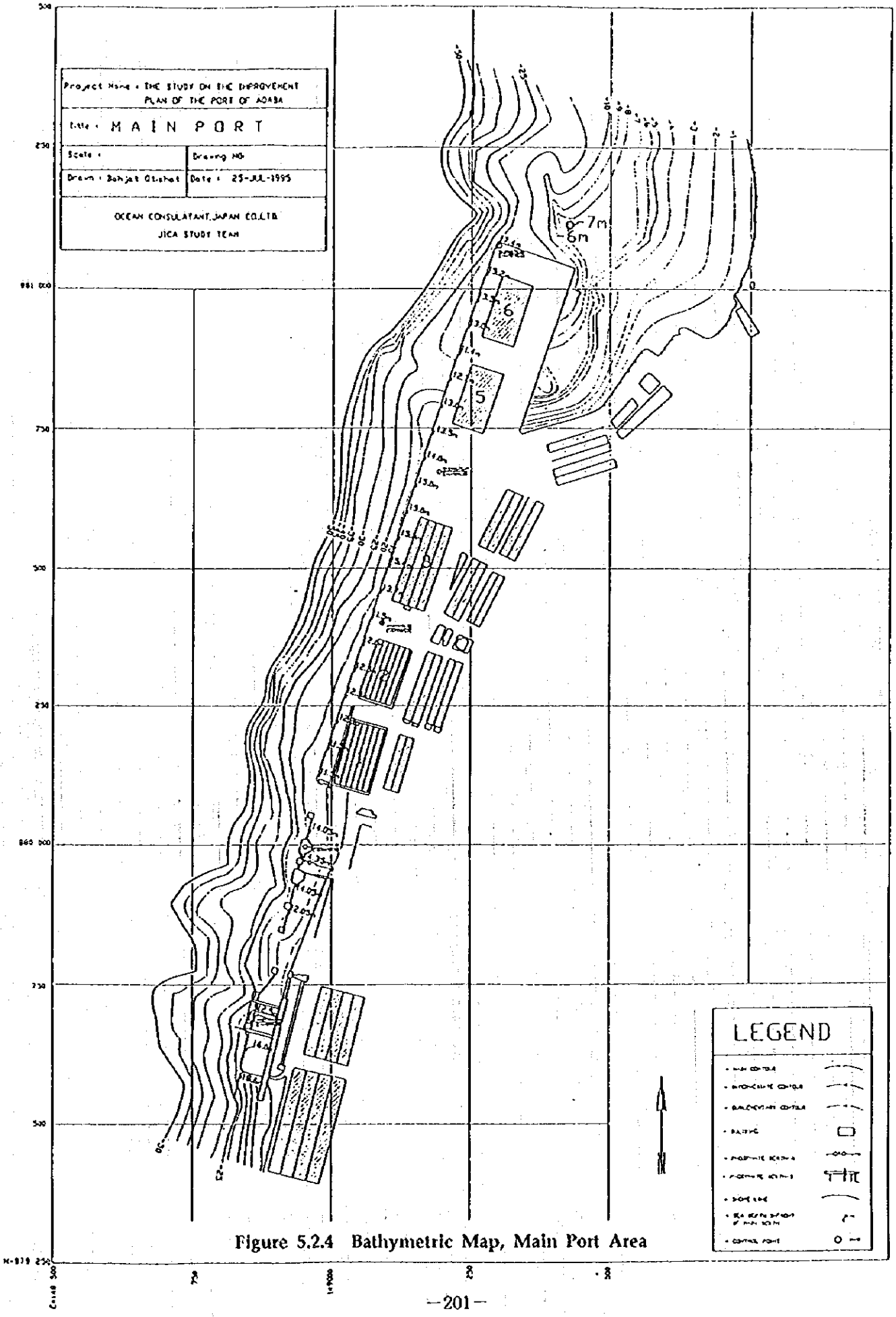


Figure 5.2.4 Bathymetric Map, Main Port Area

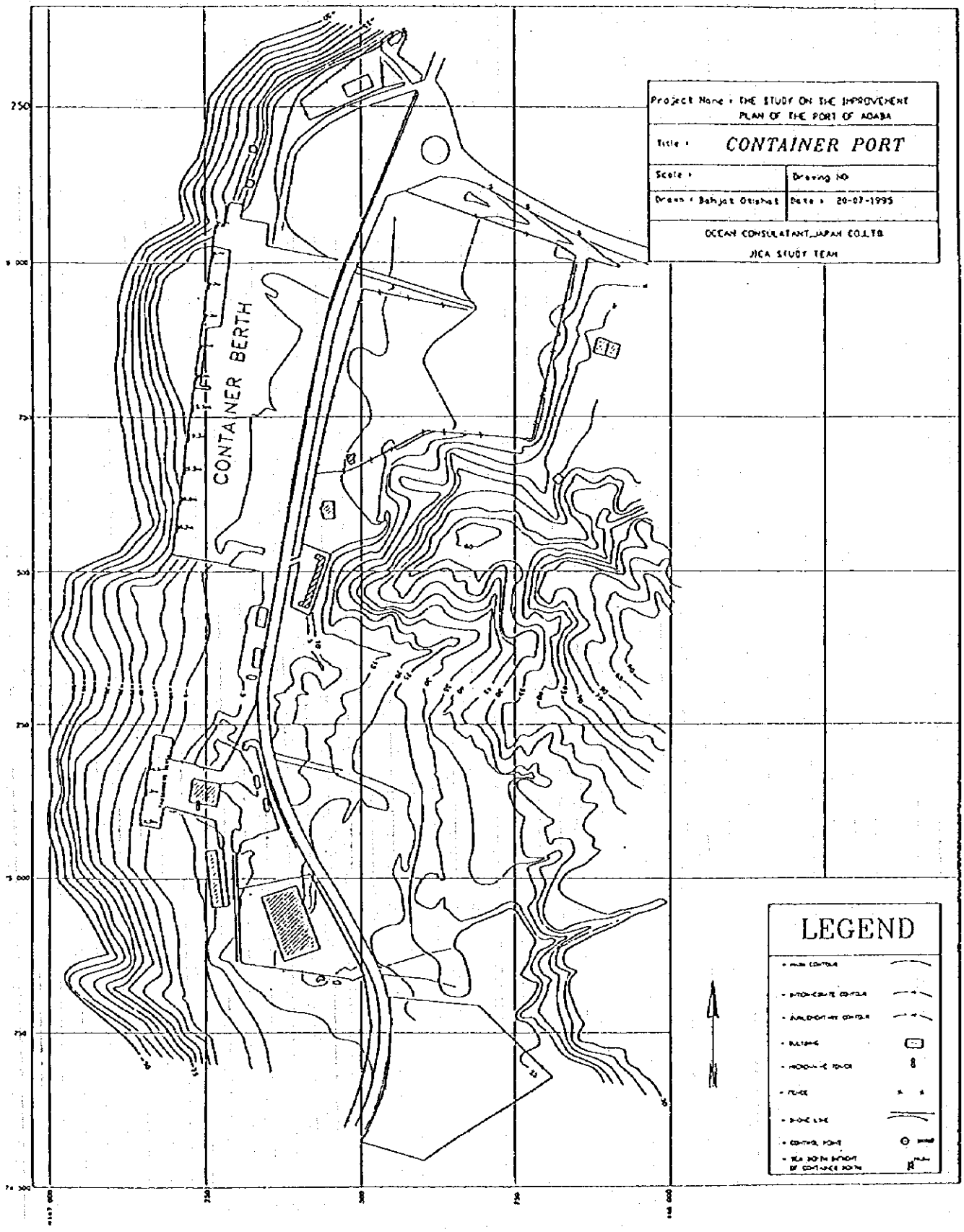


Figure 5.2.5 Bathymetric Map, Container Port Area

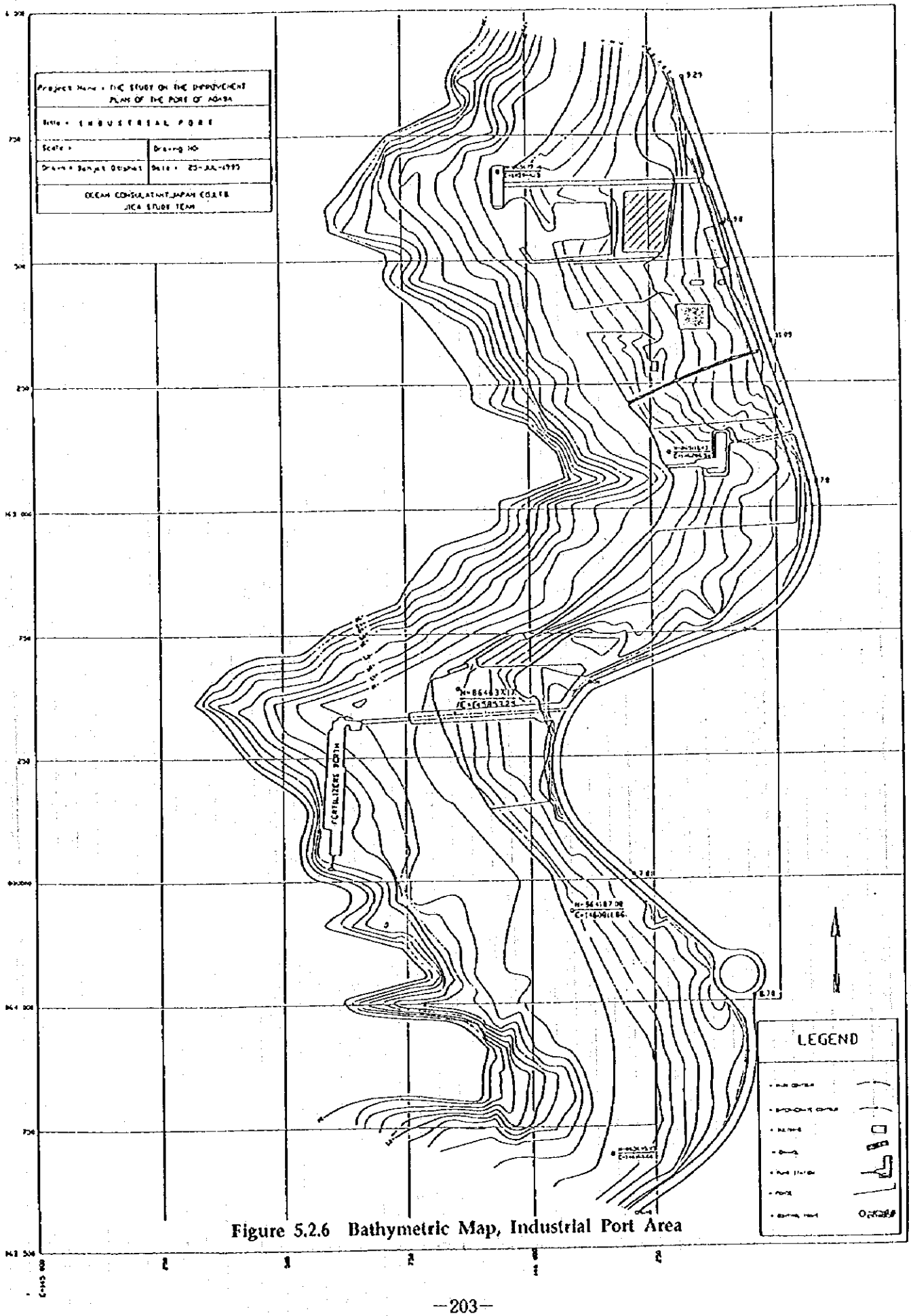


Figure 5.2.6 Bathymetric Map, Industrial Port Area

BH-1

Seabed Level	- 9.6 m	
Whitish, creamish, greyish, fine to coarse, loose to very dense coral sand with some shells.		N=7～62 ϕ=35° γ'=1.0t/cu.m
	-30.6 m	

BH-2

Seabed Level	- 9.5 m	
Whitish, creamish, greyish, fine branched coral filled with whitish fine to medium grained coral sand and some shells.		N=13～47 ϕ=35° γ'=1.0t/cu.m
	-30.5 m	

Figure 5.2.7 Soil Profile at Offshore Area, Container Port

BH-4, BH-5

Existing Ground Level	+ 4.0 m	
Fine to coarse, very dense, Granitic Sand		N=47～63 ϕ=35° γ'=1.0t/cu.m
	- 2.0 m	
Fine to dense, Silty Sand		N=39～76 ϕ=35° γ'=1.0t/cu.m
	- 8.0 m	
Fine to coarse, dense to very dense, Granitic Sand		N=45～55 ϕ=35° γ'=1.0t/cu.m
	-16.0 m	

Figure 5.2.8 Soil Profile at Onshore Area, Container Port

BH-3

Seabed Level - 9.7 m	
Whitish, creamish, greyish fine branched coral filled with fine to medium grained coral sand and shells.	N=45~72 ϕ=35° γ'=1.0t/cu.m
-22.0 m	
Greyish, very dense, fine to medium grained beach sand with some shells.	N=51~63 ϕ=35° γ'=1.0t/cu.m
-32.7 m	

BH-4

Seabed Level - 9.4 m	
Greyish, dense to very dense beach sand with fine to medium gravels.	N=49~60 ϕ=35° γ'=1.0t/cu.m
-11.4 m	
Pinkish granitic, very dense, fine to coarse sand.	N=53~80 ϕ=35° γ'=1.0t/cu.m
-33.4 m	

Figure 5.2.9 Soil Profile at Offshore Area, Industrial Port

5.2.2 Environmental Survey Results

(1) Purpose of Surveys

Purposes of the environmental surveys are as follows :

- To obtain requisite information with respect to environment for Master Plan, Short-Term Development Plan of Aqaba Port,

- To confirm the present seawater conditions of the Jordanian coast of the Gulf of Aqaba and note any particular precautions to be taken for planning the development plan.

- To confirm the present characteristics of the seabed materials of the Jordanian coast of the Gulf of Aqaba and note any particular precautions to be taken for planning and designing the waterborne structures.

- To confirm the presence of coral at Container Port where the expansion of the container berth is anticipated in Short-Term Development Plan and note any particular precautions to be taken for planning and designing the extension of the container berth.

- To confirm the ambient air conditions which are affected by phosphate handling operation at Main Port and evaluate the survey results in comparison with those in 1989 to 1990.

- To obtain data required for computer simulation of dissipation analysis of P_2O_5.

(2) Scope of Environmental Survey

Surveys and analyses of the seawater, seabed materials, corals and ambient air were conducted as recorded below.

1) Sea Water Quality Survey

a) Location: Along the coastline of Aqaba from Main Port to Industrial Port as shown in Figure 5.2.10. The sea depth at each location generally did not exceed 30 m from the water surface.

b) Number of Sampling: 18 samples at 6 locations as shown in Figure 5.2.10 at 1 m depth from the surface, mid depth and above the seabed at each location.

c) Site Survey: Temperature, Color, Salinity, pH, DO, Transparency and Depth

d) Laboratory Tests: TDS, TSS, Nitrogen (T-N, NH_4-N, NO_3-N, NO_2-N), Phosphorus (T-P, PO_4-P), Oil and Grease or N-Hexane Soluble Matter, Coliform, Organic Substance

2) Seabed Material Survey

a) Location: Along the coastline of Aqaba from Main Port to Industrial Port as shown in Figure 5.2.10. The sea depth at each location generally did not exceed 30 m from the water surface.

b) Number of Sampling: 9 samples, 7 locations as shown in Figure 5.2.10.

c) Field Survey: Color of Sludge, Odor

d) Laboratory Tests including preparation of samples: Particle Distribution Analysis, Ignition Loss, Sulfide, Total Nitrogen, Total Phosphorus, Organic Substances, Cu, Zn, Cr, Cd, Pb

e) Elution Tests: Organic Substances, PO_4, Fe, Mn, Cr^{+6}, Cd, Pb

3) Coral Survey

a) Location: At Container Port as shown in Figure 5.2.11. The sea depth subjected to the survey generally did not exceed 15 m from the water surface.

b) Field Survey: Approximately 33,000 m^2 as shown in Figure 5.2.11. Observation and estimation of percentage cover of living coral and its bathymetric distribution and area covered by sea grass beds if present.

c) Mapping of living coral and sea grass.

4) Ambient Air Survey

a) Location: 7 stations as shown in Figure 5.2.12.

1. Aqaba Port (Civil Defense Building), 0.5 km. NE of JPMC (Jordan Phosphate Mines Company) facilities
2. Manara (Residency complex of JPMC employees), 3.0 km. NE of JPMC facilities
3. Coral Beach Hotel, 4.0 km. NW of JPMC facilities
4. Abu-Ayoub Ansari School, 2.5 km. NE of JPMC facilities.
5. Police Club, 6.5 km. SSW of JPMC facilities.
6. Phosphate Wharf of JPMC
7. Phosphate Stacking Yard of JPMC at Main Port

b) Number of Sampling:

For the stations from 1 to 5 above:
- 40 pieces
- 24 hours continuously
- 8 times at 2-time-a-week interval at each location

For the stations from 6 and 7 above, the sampling was made by JICA Study Team.

c) Field Survey: Wind direction, Wind velocity, Ambient Temperature

d) Examination in Laboratory:

- 40 pieces taken at the station 1 to 5 as samples for measurement of TSP, P_2O_5
- 48 pieces taken at the station 6 and 7 as samples for measurement of weight measurement, specific gravity test

(3) Execution of Survey

Seawater quality, seabed material and coral surveys were conducted by Marine Science Station (University of Jordan - Yarmouk University)from June 7 to July 25, 1995 under the supervision of JICA Study Team. Ambient Air Survey was conducted by Royal Scientific Society from June 5 to August 2, 1995 under the supervision of JICA Study Team except the sampling at the stations from 6 and 7 and specific gravity test of the samples taken at the stations 6 and 7, which were carried out by JICA Study Team.

(4) Summary of Findings:

1) Seawater:

The normal physical and physico-chemical properties of seawater were prevailing along the Jordanian coast of the Gulf of Aqaba. Temperature(23.6 - 24.1 degree centigrade), dissolved oxygen (DO, 6.01 - 6.60 mg/l), pH (8.30 - 8.37), salinity (40.03 - 40.41 per-mil), transparency (18.30 - 22.5 m), total suspended solids (TSS, 1.80 - 3.86 mg/l) and total dissolved salts (TDS, 4.00 - 4.14%) were in the known ranges of the area. In general, the seawater is extremely clear.

Total phosphate (T-P), total nitrogen (T-N), nitrate(NO_3-N) and organic substance (OC) were generally low at all areas. Ammonia (NH_4-N), nitrite (NO_2-N) and phosphate (PO_4-P) concentrations were either low or not detected.

Total phosphorous was relatively high at the phosphate berth area (0.70 µg/l) compared with other observation points (0.05 - 0.30 µg/l).

Total nitrogen is evenly distributed in the study area as it ranged between 11.65 and 17.30 µg/l.

Oil and grease or the n-hexane soluble matter was determined and expressed as total hydrocarbons (TH). The concentration of these pollutants varied widely (1.2 - 34.30 µg/l) at the survey area and depths. The average concentrations at each survey point ranged between 6.10 and 15.10 µg /l.

Total coliform was very low ranging between 8 and 33 MPN (most probable number) per 100 ml sea water. Water samples taken at the phosphate berth, container port and hotel area showed maximum MPN of total coliform. Fecal coliform MPN was extremely low at all sites and ranged not more than 2 per 100 ml sea water.

2) Seabed Materials

Fine and very fine fractions are dominating the sediments at the hotel area, Main Port, phosphate berth at 10 m and 20 m depths, Al-Mamlah tourist area and industrial area. Medium fractions constitute high percentage (34.7%) in the phosphate berth sediment at 30 m depth. The sediments at the hotel area are characterized by their high silt and clay contents, which constitute 24.3% of these sediments.

The total sedimentary nitrogen ranged between 200 and 21,000 µg per one gram of sediment. Highest value of 21,000 µg per one gram of sediment was obtained from the sediments at Industrial Port.

Total sedimentary phosphate was very high in the sediments at the phosphate berth area: sediments at 10 m depth contain as high as 12.36% of T-P, while sediments at 20 m and 30 m depths contain 11.39% and 3.98% respectively. The sediments at the hotel area and Main Port contain 0.19% and 0.31% respectively. This is much higher than T-P levels in the sediments of the southern observation points which ranged between 0.03% and 0.10%.

Total concentration of organic matter (OC) in the sediments of the study area were in the range of 0.19 - 0.43%. Highest concentrations were found in the sediments of the north stations at the hotel Area (0.43%), Main Port (0.31%) and Phosphate Berth at 10 m (0.38%).

Total sulfide (TS) concentrations were generally low as they ranged between 0.03 µg/l and 0.14 µg/l. The highest TS concentration was in the sediments of the phosphate berth area (0.13 - 0.14 µg/l).

Spatial differences in the concentrations of Cd, Cu, Cr, Fe, Mn, Pb, and Zn in the sediments of the study area are common and wide. Relatively high concentrations of Fe and Mn were found at the hotel area. Highest concentrations of Cr, Cu, and Pb were found at the northern observation points, while highest Cd and Zn were found at the phosphate berth area which is chronically polluted with phosphate rock particles rich in these two elements.

3) Elution of Seabed Materials

Phosphate (PO_4-P) elution rates are very low (0.0004 - 1.80%) compared to elution rates of OC (4.7 - 39.5%). The ranges of the elution rates of Fe and Mn (0.1 - 6.61%) are smaller than those of Cr and Pb (3.2 - 12.4%). Elution rates of Fe, Mn and Cr seem to be higher in the northern area, while Pb elution rates are high at all observation points except at the phosphate berth and container port areas. Cadmium was not detected except at the phosphate berth area where its elution rate was high (4 - 12%). Apparently, the elution rates at the container port are relatively low for Pb and Fe, medium for Mn and OC, high for PO_4-P and Cr, and not detected for Cd.

4) Coral Survey

At the northern part of the container berth, coral survey showed that the sea floor was mainly sand with no sea-grass meadows and very low coral coverage. It showed also that the living cover of corals was only about 0.2%. Most of the coral species found belong to two families: Pocilloporidae and Acroporidae. These corals are known to have a relatively high growth rate and good tolerance to several types of pollutants.

At the southern part of the container berth, corals survey confirmed a well developed reef area with a shallow reef flat and a relatively deep fore reef. The area immediately next to the container berth is characterized by a sandy sea floor down to a depth of 11m with no coral growth. Below 11m, the reef drops steeply and reaches 30m deep by the southwestern edge of the container berth. The rest is characterized by a small reef flat (10 - 20m wide seaward from shoreline) and a well developed fore reef with very big *Porites* colonies (about 3 - 5m in diameter and high), *Lobophyllia corymbosa* colonies (8m long and 4m wide), as well as several *Acropora* and *Fungia* species and various coral species. Most of this area is damaged by boat anchors, and affected by fishing nets and various pollutants including all types of man-made litter. The high number of sea urchins (*Diddema setosum*) found at the southern part of the container berth might cause significant bio-erosion of the reef. The average total percentage living cover of corals at this area was 26.18% ± 21.42%.

The minimum percent cover of 10 m next to the container berth was about 0% while a maximum percent cover of 88% was calculated at the southern part of the container berth.

5) Ambient Air Survey

Observation of P_2O_5 has indicated that the survey station in the lee direction of the phosphate berths, even the station is at a larger distance than other survey stations, showed the highest level. It also showed that P_2O_5 in the air generally decreases according to the distance in the direction of the winds. On the other hand, the observation of TSP did not show any significant relation between TSP and their locations to the phosphate berth.

The observation of TSP has indicated that Ansari survey station (about 2.5 km NE to the phosphate berths, to be abbreviated 2.5 km NE hereinafter) exhibited the highest TSP of 473 $\mu g/m^3$ on June 28, which was due to relatively strong southern winds. Because of this, the highest daily average of TSP was observed at Ansari of 170 $\mu g/m^3$, followed by the survey station at the main port (0.5 km NE) of 113 $\mu g/m^3$, Coral Beach Hotel (4.0 km NW) of 107 $\mu g/m^3$, Police Club (6.5 km SSW) of 97 $\mu g/m^3$ and Manara (3.0 km NE) of 64 $\mu g/m^3$.

The Main Port survey station, nearest to the pollution source, exhibited 2.87 $\mu g/m^3$ as the daily average of P_2O_5. While, the highest daily average of P_2O_5 was observed at the most distant survey station at Police Club of 3.00 $\mu g/m^3$, followed by Main Port of 2.87 $\mu g/m^3$, Ansari of 2.50 $\mu g/m^3$, Manara of 1.25 $\mu g/m^3$, Coral Beach Hotel of 1.13 $\mu g/m^3$.

The results showed that the P_2O_5 this year in the ambient air was lower than 1989 to 1990. This is probably attributed to the choke feeders attached to the phosphate loaders at Phosphate Berth B. However, this has to be confirmed through observation over a longer period of time, e.g. one year.

(5) Conclusions

1) Seawater

The seawater is extremely clear along the coast of the Gulf of Aqaba. Especially, the water contains dissolved oxygen at the maximum level for its temperature and coliform found in the water seems at its minimum level.

So far as the port operation is concerned, it does not cause any significant water pollution. This is attributed to both the strict pollution control from ships materialized by PC and sewerage planning policy of ARA which prohibits discharge from city proper to the sea.

Construction of any port facilities should be of such a type that will cause no pollution to the sea. The tourism and leisure activities are also to be strictly controlled by the relevant authorities.

2) Seabed Materials

The seabed consists mainly of fine and very fine fractions and does not contain harmful substances to the environment, such as organic substances and heavy metals. In addition, elution of heavy metals and phosphate from the seabed sediments are very low. Therefore, the underwater excavation will cause no significant impacts to the environment if it is

performed carefully to the minimum extent required.

3) Coral

Generally speaking, the corals are well developed along the coast of the Gulf of Aqaba. However, many of them are dead at the existing berths, mainly due to the sediments from phosphate and other bulk cargoes.

At the southern part of the existing container berth, well-developed and living corals are confirmed through the coral survey. On the northern part, there are no such corals. Therefore, it is recommendable that southward extension of the existing berth be limited where living corals are not significant. The future extension of the container berth should be made northwards.

4) TSP and P_2O_5

All the survey stations show that the daily TSP level was in the range of 65 $\mu g/m^3$ to 207 $\mu g/m^3$ which are lower than the acceptable limit of 260 $\mu g/m^3$ of USEPA Standards, except 473 $\mu g/m^3$ recorded when the wind direction changed.

All the survey stations shows that the daily P_2O_5 level was in the range of 0 - 10 $\mu g/m^3$ which are lower than the acceptable limit of 50 $\mu g/m^3$ of USSR-YUG Standards.

However, it may require a longer-term observation to conclude how significantly the low daily P_2O_5 level is attributed to the installation of the choke feeders.

As is observed, P_2O_5 is dissipating leeward to the phosphate berths down to the southern coast where a tourism zone is planned by ARA. In planning a much longer-term development of the coast of the Gulf of Aqaba, proper location of the phosphate berths should be taken into consideration.

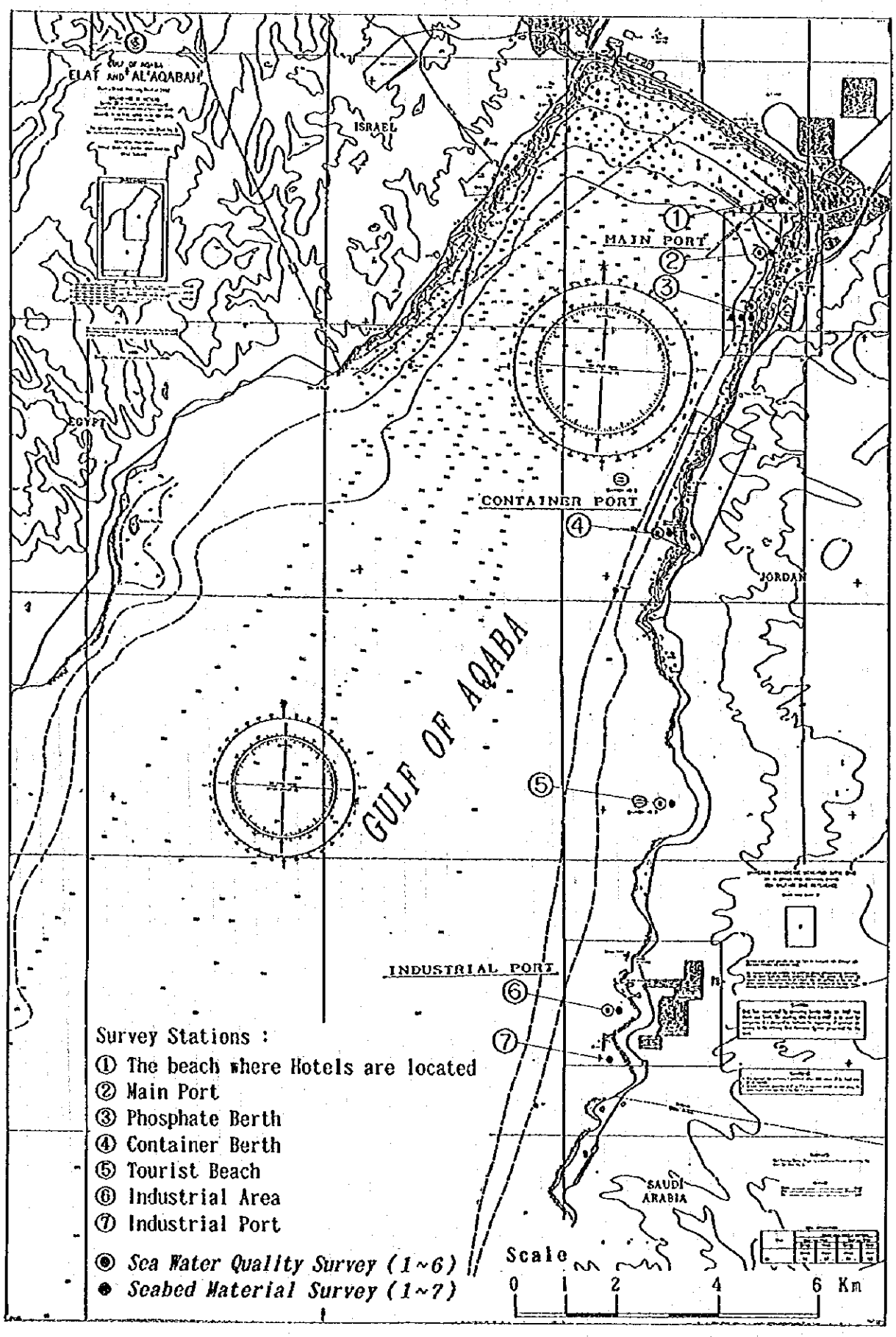


Figure 5.2.10 Sea Water Quarity & Seabed Material Survey

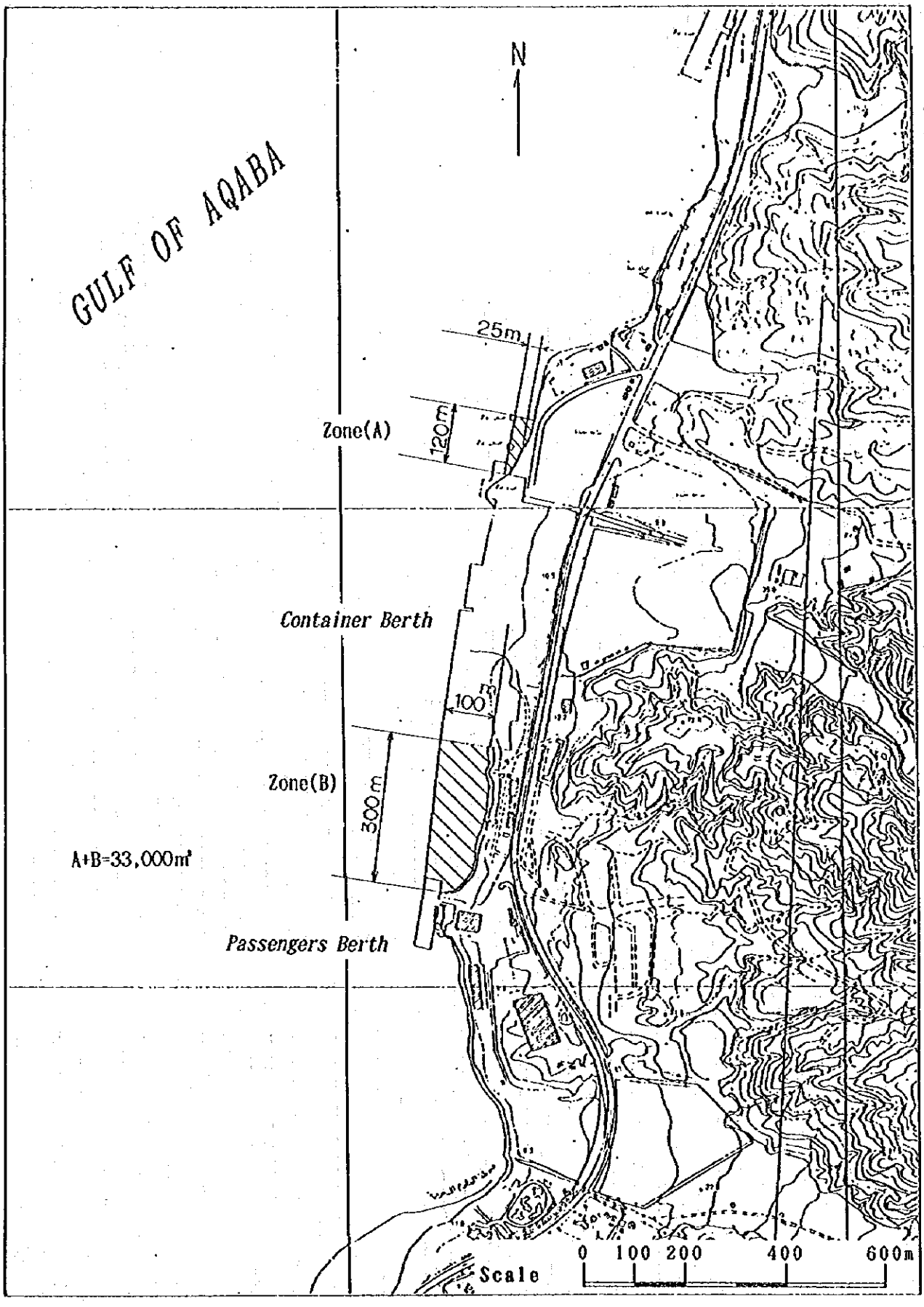


Figure 5.2.11 Coral Survey

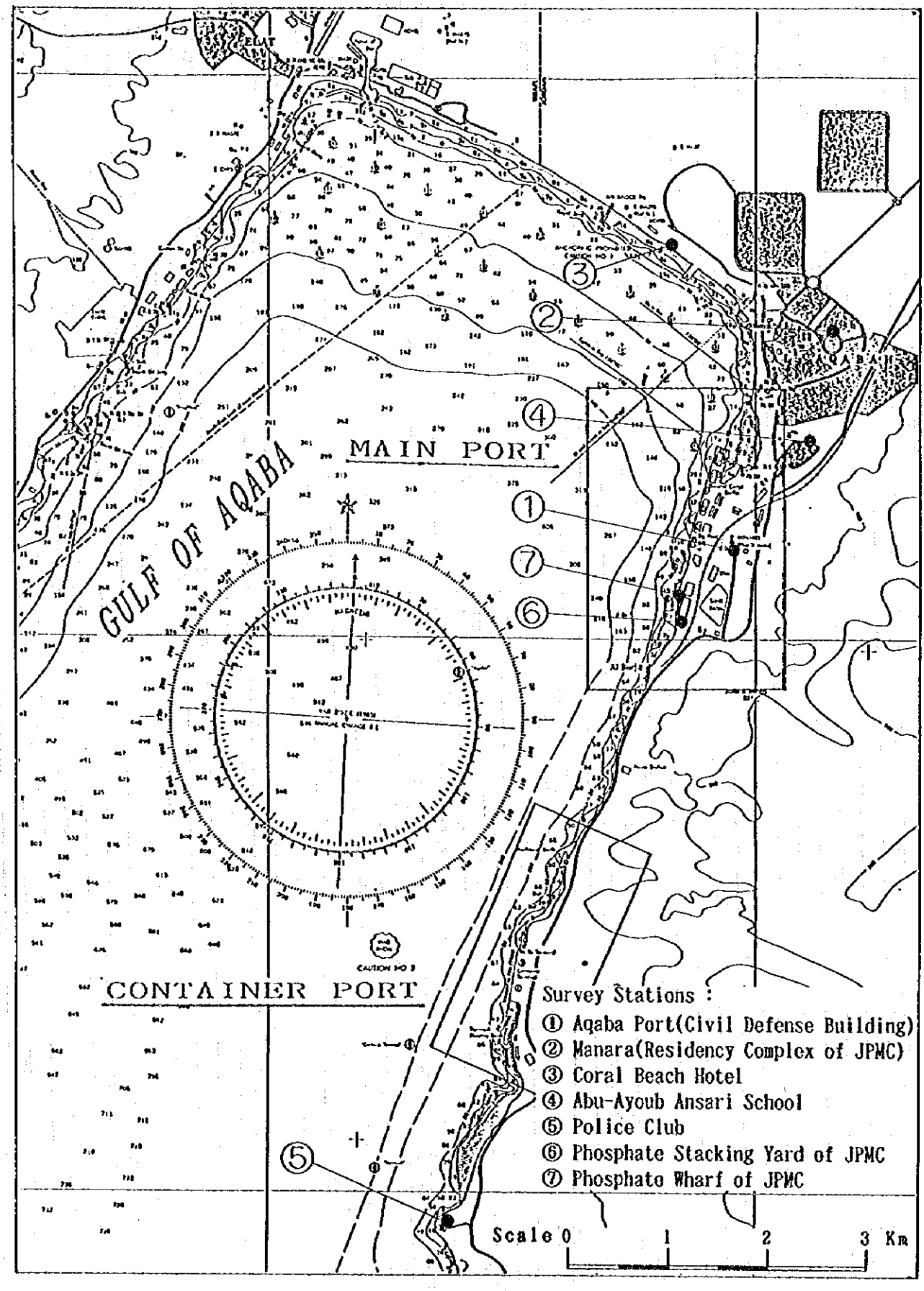


Figure 5.2.12 Ambient Air Survey

5.3 Demand Forecast for the Short-Term Improvement Plan

Demand forecast of port traffic for the target year 2010 (Master Plan) has been carried out in Chapter 4.4. Demand forecast up to the target year 2000(Short-Term Improvement Plan) is estimated in this chapter based on Case 5.

Several items shall be examined carefully. For instance, newly produced goods, newly increasing consumer goods and trend of containerization.

5.3.1 Newly Produced Goods

Shipping schedule of new industrial products is listed in Table 5.3.1. Large volume of liquid ammonia and sulfur are also to be imported as raw materials.

Table 5.3.1 New Industrial Products

Commodity	Starting Year of Shipping	Volume		Producer
		Initial (tons)	Year2000 (tons)	
Dead Sea Products 1	1996	1,200,000	1,200,000	Arab Potash Co. (Industrial Salt)
Dead Sea Products 2	1998	20,000	176,000	Break Bulk Cargo (MgO, Potash, Sulfur, Calcium Phosphate)
NPK1	1997	75,000	300,000	Nippon-Jordan Co.
NPK2	1999	750,000	1,000,000	Unspecified
Phosphoric Acid1	1997	337,500	450,000	Jordanian-Indian Co.
Phosphoric Acid2	1999	412,500	550,000	Unspecified

5.3.2 Newly Increasing Consumer Goods

Regarding livestock, three large scale importers have each established farms with storage capacity of about one million heads. Large size of livestock vessel will call at least two times per month.

Vegetable oil is planned to be imported by two new investors, namely Mediterranean Oil Co. and Solvochem.

Double volume of fuel oil of present consumption is to be imported by sea route to ready for operation of two new generators in the Aqaba thermal station.

Table 5.3.2 Newly Increasing Consumer Goods

Commodity	Background
Livestock	3 importers have established farms
Vegetable Oil	3 existing & 2 new importers
Fuel Oil	2 generators start operation in 1997

5.3.3 Container Cargo

Future container cargo is estimated by general cargo volume and container cargo ratio. Container cargo ratios to general cargo up to year 2010 are computed in Table 5.3.3.

Table 5.3.3 Container Cargo Ratio

Year	1993	1999	2000	2001	2002	2003	2004	2005	2010
Actual Ratio(%)	22								
Estimated Ratio(%)		41	43	45	47	49	50	52	59

5.3.4 Future Cargo Volume for Short-Term Improvement Plan

Computed cargo data for short term plan are listed in Tables 5.3.4, 5.3.5 and 5.3.6. Estimated data from 1999 to 2005 are sufficient for checking limit of handling productivity, financial feasibility and economic feasibility. After year 2005 up to 2010, all cargo data are estimated by proportional allotment. After that annual increase is assumed to be the same as in 2010.

Table 5.3.4 Future Port Cargo up to 2010 - Export

(unit : thousand tons)

	AQABA Year	Export								
		1993	1999	2000	2001	2002	2003	2004	2005	2010
		Modified	CASE-5	CASE-5	CASE-5	CASE-5	CASE-5	CASE-5	CASE-5	CASE-5
LOCAL	BULK									
	GRAIN									
	RICE(50%ofWhole)									
	VEGETABLE OIL									
	LIVESTOCK									
	PHOSPHATE	3,570	5,600	5,700	5,700	5,800	5,900	6,000	6,000	6,400
	SULFER									
	LIQ.AMMONIA									
	FERTILIZER(SOLID)	410	1,900	2,100	2,100	2,100	2,100	2,100	2,100	2,100
	PHOSPHORIC ACID(LIQUID)		863	1,000	1,000	1,000	1,000	1,000	1,250	1,500
	POTASH	1,450	1,900	2,000	2,100	2,100	2,100	2,100	2,100	2,200
	DEAD SEA PRODUCTS		1,101	1,200	1,200	1,200	1,200	1,200	1,200	1,200
	OIL(THERMAL PLANT)									
	MINERAL/CHEMICAL OIL		140	150	160	170	180	190	200	250
	CEMENT	700	700	700	700	700	700	700	700	700
	SUB TOTAL	6,130	12,204	12,850	12,960	13,070	13,180	13,290	13,550	14,350
	GENERAL CARGO									
	BREAK BULK	160	403	437	452	467	483	502	521	650
	CONTAINER	100	244	267	291	312	335	352	375	490
	LOCAL LOADED CONTAINER		45	49	50	52	54	56	58	70
	AQABA FREE ZONE		0	0	0	2	4	6	8	20
	OTHERS(EMPTY C.etc.)	100	199	218	241	258	277	290	309	400
	SUB TOTAL	260	647	704	743	779	818	854	895	1,140
TRANSIT	RICE(in BULK)		190	200	210	220	230	240	250	300
	VEGETABLE OIL									
	LIVESTOCK									
	BREAK BULK		78	80	82	84	86	88	90	100
	CONTAINER									
	OIL(CRUDE OIL, FUEL OIL)									
	SUB TOTAL	0	268	280	292	304	316	328	340	400
EILAT	BULK									
	PHOSPHATE									970
	POTASH									990
	SUB TOTAL			0	0			0	0	1,960
	GRAND TOTAL	6,390	13,119	13,834	13,995	14,153	14,314	14,472	14,786	17,850

NOTE:GENERAL CARGO includes following cargoes;
(SUGAR) (FROZEN CARGO) (RICE)
(FORAGES, TEA, CATTLE, SESAME, COFFEE, POTATO)
(TIMBER, TYRES, GOV.GOODS, FERTILIZER, CAR, CEMENT, CARTRIDGE)
(CONST.MAT.) (STEEL&IRON) (OTHERS)

Table 5.3.5 Future Port Cargo up to 2010 - Import

(unit : thousand tons)

	AQABA	Import								
	Year	1993	1999	2000	2001	2002	2003	2004	2005	2010
		Modified	CASE-5	CASE-5	CASE-5	CASE-5	CASE-5	CASE-5	CASE-5	CASE-5
LOCAL	BULK									
	GRAIN	1,300	1,500	1,550	1,600	1,640	1,690	1,730	1,780	2,010
	RICE(50%ofWhole)	104	85	90	90	95	95	100	100	115
	VEGETABLE OIL	174	125	130	133	137	141	145	150	170
	LIVESTOCK	25	30	31	32	33	34	35	36	40
	PHOSPHATE									
	SULFER	210	921	1,000	1,050	1,100	1,150	1,200	1,250	1,400
	LIQ.AMMONIA	130	270	310	350	390	400	400	400	490
	FERTILIZER(SOLID)									
	PHOSPHORIC ACID(LIQUID)									
	POTASH									
	DEAD SEA PRODUCTS									
	OIL(THERMAL PLANT)	0	720	720	720	720	720	720	720	720
	MINERAL/CHEMICAL OIL	240 (AVE89-93)	360	400	440	480	520	560	600	890
	CEMENT									
	SUB TOTAL	2,183	4,011	4,231	4,415	4,595	4,750	4,890	5,036	5,835
	GENERAL CARGO									
	BREAK BULK	1,580	1,560	1,590	1,670	1,670	1,670	1,710	1,710	1,780
	CONTAINER	570	983	1,090	1,210	1,304	1,408	1,482	1,586	2,090
	LOCAL LOADED CONTAINER		983	1,090	1,210	1,300	1,400	1,470	1,570	2,050
	AQABA FREE ZONE		0	0	0	4	8	12	16	40
	OTHERS(EMPTY C.etc.)							0	0	0
	SUB TOTAL	2,150	2,543	2,680	2,880	2,974	3,078	3,192	3,296	3,870
TRANSIT	RICE(in BULK)		220	230	240	250	260	270	280	330
	VEGETABLE OIL		186	190	194	198	202	206	210	230
	LIVESTOCK		48	50	52	54	56	58	60	70
	BREAK BULK	1,260	625	641	655	671	686	702	718	800
	CONTAINER	20	156	160	164	168	171	175	179	200
	OIL(CRUDE OIL, FUEL OIL)									
	SUB TOTAL	1,280	1,235	1,271	1,305	1,341	1,375	1,411	1,447	1,630
ELAT	BULK									
	PHOSPHATE									
	POTASH									
	SUB TOTAL									
	GRAND TOTAL	5,613	7,789	8,182	8,600	8,910	9,203	9,493	9,779	11,335

NOTE:GENERAL CARGO includes following cargoes;
(SUGAR) (FROZEN CARGO) (RICE)
(FORAGES, TEA, CATTLE, SESAME, COFFEE, POTATO)
(TIMBER, TYRES, GOV.GOODS, FERTILIZER, CAR, CEMENT, CARTRIDGE)
(CONST.MAT.) (STEEL&IRON) (OTHERS)

Table 5.3.6 Future Port Cargo up to 2010 - Total

(unit : thousand tons)

	AQABA	Total								
	Year	1993	1999	2000	2001	2002	2003	2004	2005	2010
		Modified	CASE-5	CASE-5	CASE-5	CASE-5	CASE-5	CASE-5	CASE-5	CASE-5
LOCAL	BULK									
	GRAIN	1,300	1,500	1,550	1,600	1,640	1,690	1,730	1,780	2,010
	RICE(50%ofWhole)	104	85	90	90	95	95	100	100	115
	VEGETABLE OIL	174	125	130	133	137	141	145	150	170
	LIVESTOCK	25	30	31	32	33	34	35	36	40
	PHOSPHATE	3,570	5,600	5,700	5,700	5,800	5,900	6,000	6,000	6,400
	SULFER	210	921	1,000	1,050	1,100	1,150	1,200	1,250	1,400
	LIQ.AMMONIA	130	270	310	350	390	400	400	400	490
	FERTILIZER(SOLID)	410	1,900	2,100	2,100	2,100	2,100	2,100	2,100	2,100
	PHOSPHORIC ACID(LIQUID)		863	1,000	1,000	1,000	1,000	1,000	1,250	1,500
	POTASH	1,450	1,900	2,000	2,100	2,100	2,100	2,100	2,100	2,200
	DEAD SEA PRODUCTS		1,101	1,200	1,200	1,200	1,200	1,200	1,200	1,200
	OIL(THERMAL PLANT)	0	720	720	720	720	720	720	720	720
	MINERAL/CHEMICAL OIL	240 (AVE89-93)	500	550	600	650	700	750	800	1,140
	CEMENT	700	700	700	700	700	700	700	700	700
	SUB TOTAL	8,313	16,215	17,081	17,375	17,665	17,930	18,180	18,586	20,185
	GENERAL CARGO									
	BREAK BULK	1,740	1,963	2,027	2,122	2,137	2,153	2,212	2,231	2,430
	CONTAINER	670	1,227	1,357	1,501	1,616	1,743	1,834	1,961	2,580
	LOCAL LOADED CONTAINER		1,028	1,139	1,260	1,352	1,454	1,526	1,628	2,120
	AQABA FREE ZONE		0	0	0	6	12	18	24	60
	OTHERS(EMPTY C.etc.)	100	199	218	241	258	277	290	309	400
	SUB TOTAL	2,410	3,190	3,384	3,623	3,753	3,896	4,046	4,192	5,010
TRANSIT	RICE(in BULK)		410	430	450	470	490	510	530	630
	VEGETABLE OIL		186	190	194	198	202	206	210	230
	LIVESTOCK		48	50	52	54	56	58	60	70
	BREAK BULK	1,260	703	721	737	755	772	790	808	900
	CONTAINER	20	156	160	164	168	171	175	179	200
	OIL(CRUDE OIL, FUEL OIL)									
	SUB TOTAL	1,280	1,503	1,551	1,597	1,645	1,691	1,739	1,787	2,030
ELAT	BULK									
	PHOSPHATE									970
	POTASH									990
	SUB TOTAL									1,960
	GRAND TOTAL	12,003	20,908	22,016	22,595	23,063	23,517	23,965	24,565	29,185

NOTE:GENERAL CARGO includes following cargoes;
(SUGAR) (FROZEN CARGO) (RICE)
(FORAGES, TEA, CATTLE, SESAME, COFFEE, POTATO)
(TIMBER, TYRES, GOV.GOODS, FERTILIZER, CAR, CEMENT, CARTRIDGE)
(CONST.MAT.) (STEEL&IRON) (OTHERS)

5.4 Required Port Facilities and Equipment up to 2000

5.4.1 General

(1) Fundamental Conception of This Study

This study is executed under the following fundamental conception.

1) Cargo working days per year is assumed to be 351 days excluding 2 national holidays and one day per month for the maintenance of cargo equipment and facilities.

2) Cargo working hours per day is assumed to be 18 hours including 16 hours for day and night shifts and 2 hours overtime in case of non specified cargoes like break bulk cargo, and to be 24 hours for specialized bulk cargo like phosphate rock, industrial materials , cement, rice, oil and grain.

3) Maximum berth occupancy is assumed to be 70 % in all cases.

4) The handling productivity of bulk cargo is calculated by undernentioned formula.

a) Actual handling productivity per hour ; Qa = Qn x En (T/H)
Qn ; Normal or designed capacity of equipment per hour (T/H)
En ; Handling efficiency (normally 0.7)

b) Berth Productivity (total actual handling productivity) per hour;
Bp = Qa x Ng (T/H)
Ng ; Number of handling equipment (exclusive berth)
Number of available gangs (non-exclusive berth)

c) Berth productivity per day ; Qd = Bp x Hd x Ew (T/D)
Hd ; Working hours per day (H/D)
Ew ; Working time efficiency (normally 0.8)

d) Berth capacity (productivity) per year ; By = Qd x Dy x Bo (T/Y)
Dy ; Working days per year (351 days)
Bo ; Berth occupancy (0.7)

5) The capacity of bulk cargo storage facilities is calculated by undermentioned formula.

a) Capacity of storage facilities per year ; Mb = (Cw x Rt x r) / p (T/Y)
Cw ; Capacity of storage facilities (T)
Rt ; Turnover ratio (times / year)
r ; Utilization ratio (normally 0.7)
p ; Peak ratio (assumed to be 1.3)

b) Permissible cargo dwelling days ; Dd = (Cw x r x 365) / (Mb x p)

"Dd" is decided by means of assuming the same cargo volume for the year as "Cw".

(2) Prospect in 2000 and the Target Year of Case 5

Forecast cargo volume to be handled through this port in the target year, 2010 (29.2 million tons), will represent an increase of about 2.8 times compared with that in 1994 (10.6 millon tons). It is, therefore, necessary to improve port facilities and equipment as well as cargo handling productivity by 2010.

Following cargo volume is forecasted in 2000 and 2010 and will be handled in the Main Port, the Container Port and the Industrial Port.

Table 5.4.1 Forecast Cargo Volume in 2000 and 2010 handled by Each Port

Kind of Ports	2000 YEAR (x 1,000 tons)	2010 YEAR (x 1,000 tons)
Main Port	10,318	13,110
Container Port	2,737	4,225
Industrial Port	8,961	11,850
Total	22,016	29,185

1) Main Port

Even in the target year, kinds of cargoes to be handled in the Main Port will not change, that is, General Cargo, Phosphate, Grain and Vegetable Oil will continue to be the main cargoes handled. But size of calling vessels for phosphate and grain will become larger than now due to increased cargo volume.

Main issue to be addressed in the Main Port will be grain operation. An exclusive grain berth capable of accommodating deep draft vessels like Panamax type with full load at any time will be required by 2000. The berths for cargoes other than grain will be utilized as they are now even in the target year, though some rearrangement will be required as well as rehabilitation of Phosphate Berth A which will be 35 years old.

Following cargo volume is forecasted in 2000 and 2010 by kinds of cargoes to be handled in the Main Port.

Table 5.4.2 Forecast Cargo Volume in 2000 and 2010 by Each Kind of Cargo handled in the Main Port

Kind of Cargo	2000 YEAR (x 1,000 tons)	2010 YEAR (x 1,000 tons)
Phosphate	5,700	7,370
Break Bulk (General Cargo)	2,748	3,330
Grain	1,550	2,010
Vegetable Oil	320	400
Total	10,318	13,110

2) Container Port

(a) Container Terminal

It is necessary that the present operation system of Container Terminal be modernized by the target era as described earlier because number of containers in the target year is forecasted to be 4 times of that in 1994. To introduce the new system, first of all, existing public road coming through the terminal must be shifted behind the terminal to allow traffic to flow smoothly and to facilitate construction work of the new container terminal.

Operation and layout of the new terminal in the target year will be as follows.

i) Two container berths with 4 container gantry cranes which shall be 600 meters in total length and more than 13 meters in depth to accommodate 2 Panamax typed container vessels simultaneously.
ii) A rectangular container yard including facilities of approximately 27 thousand square meters to be spread level except container freight station (CFS) which already exists.
iii) Container yard basically to be operated by means of transfer cranes
iv) Computerization to be introduced to terminal operations.

(b) Passenger, Cement and Rice Berths

i) Yarmouk Floating Berths can accommodate three of four existing passenger boats including one speed boat servicing between Aqaba and Nwabe at the same time (on West, North and South sides of the floating berth). The floating berth itself is maintained in good condition. Passengers and their luggage are smoothly carried a distance of 540 meters between the berth and Passenger Terminal by vehicles. These berths will be fully used for the time being.
ii) Al-Mushtarak Berth for loading Cement and Mo'ta Floating Berth for unlaoding rice in bulk are considered to be usable as well as their storage facilities as they are now, even in the target year.

Following cargo volume is forecasted in 2000 and 2010 by kinds of cargoes to be handled in the Container Port.

Table 5.4.3 Forecast Cargo Volume in 2000 and 2010 by Kinds of Cargoes handled in the Container Port

Kind of cargo	2000 YEAR (x 1,000 tons)	2010 YEAR (x 1,000 tons)
Container	1,517 (227 thousand TEUs)	2,780 (416 thousand TEUs)
Cement	700	700
Rice	520	745
Total	2,737	4,225

3) Industrial Port

(a) Industrial Berths

The industrial berths, JFI West and East, will start loading Salt, Magnesium Oxide, NPK in bulk and other Dead Sea Products for export in addition to the present handling cargoes by the year 2000, according to industry sources.

Cargo volume to be handled at these berths will be expected to increase by 3 times in 2000 and nearly 4 times in 2010 compared with that in 1994. To cope with such a large increase, it is indispensable to improve cargo handling productivity and enlarge the capacity of following cargo equipment and facilities.

i) One additional berth for Salt, Potash, DAP and so on by 2000
ii) One additional unloader for sulfur on JFI West Berth by 2010
iii) One additional loader for Phosphoric Acid on JFI East by 2010

On the other hand, tankers to discharge Crude Oil and Fuel Oil should be assigned for the Oil Jetty in near future due to full capacity of JFI East Berth, although the berth is able to handle such oil.

Regarding additional one berth (to be called JFI North Berth), it is recommended that the berth be located between existing JFI West / East and JFI-1 berths and that one loader with a capacity of 1,500 tons per hour be installed. This recommended location will be suitable for vessel berthing and unberthing, and also for loading Salt, Potash, MgO, NPK and DAP because it is adjacent to the stock yards of these cargoes.

(b) Oil Jetty

This berth currently accommodates small tankers to unload mainly chemical oil, soya oil, tallow and coconut oil for Solvochem-Holland B.V. But as the above industrial berths will reach full capacity soon, Crude oil and fuel oil should be handled at this Jetty in the near future.

(c) JFI-1 Berth

This berth is called "Timber Berth" but nowadays is used for unloading almost all of onward livestock because of its remote location.

In the Master Plan described in Chapter 4, livestock is categorized in break bulk cargoes. But in the Short-Term Improvement Plan it is examined separately from other break bulk cargoes because it requires specialized berth and volume is expected to greatly increase in the future.

Size of live stock vessels is becoming larger and these vessels are obliged to berth at other large berths because this berth is too small.

Cargo volume of live stock including transit is forecasted to increase greatly, that is, 3.7 times in 2000 and 5 times in 2010 compared with that of 1994. Considering the above aspect, length of JFI-1 Berth must be increased to 200 meters and depth to minus 11 meters by 2000 to be able to accommodate various kinds of vessels like heavy cargo and general cargo vessels as well as livestock vessels.

Following cargo volume is forecasted in 2000 and 2010 by kinds of cargoes to be handled in the Industrial Port.

Table 5.4.4 Forecast Cargo Volume in 2000 and 2010 by Each Kind of Cargo handled in the Industrial Port

Kind of Cargo	2000 YEAR (x 1,000 tons)	2010 YEAR (x 1,000 tons)
Potash	2,000	3,190
DAP	800	800
Sulfur	1,000	1,400
Phosphoric Acid	1,000	1,500
Liquid Ammonia	310	490
NPK	1,300	1,300
Dead Sea Products	1,200	1,200
Total Industrial Cargoes	7,610	9,880
Fuel/Crude Oil	720	720
Mineral Oil	550	1,140
Total Cargoes for Oil Jetty	1,270	1,860
Live Stock	81	110
Grand Total	8,961	11,850

5.4.2 Port Facilities up to 2000

(1) Main Port

1) Phosphate Berth B

(a) Berth Capacity

Cargo volume of phosphate for export through this port is expected to reach 5.7 million tons in 2000 which is 1.5 times greater than that in 1994. The study is executed in regard to the capacity of Phosphate Berth B. There are two loaders with choke feeders in this berth which are connected to 6 storage facilities by dust sealed conveyors. The designed capacity of each loader is 2,000 tons per hour. As this berth will provide 24 hour operation during vessel berthing, berth capacity per year is calculated as follows ;-

Berth Capacity ; By = 2,000 tons x 2 loaders x 0.7 x 24 H x 0.8 x 351 days x 0.7
= 13.2 million tons /year > 5.7 million tons

As far as berth capacity is concerned, this berth will be sufficient for loading phosphate even in 2000.

(b) Storage Capacity

The total design capacity of existing phosphate storage facilities is 410,500 tons. The study is executed regarding the capacity from the viewpoint of maximum permissible cargo dwelling days in the storage.

Permissible cargo dwelling days ; Dd = (410,500 tons x 0.7 x 365) / (5,700,000 tons/Y x 1.3)
= 14.2 days

As forecast cargo volume in 2000 is 5.7 millions tons, the capacity of existing storage facility is sufficient, provided that the duration of storage cargo is kept within 14 days.

As a result, existing Phosphate Berth B and the storage facility can be used in 2000 as it is now. On the other hand, Phosphate Berth A will be able to be assigned for other cargo vessels, provided berth management and handling productivity could be improved, even though the berth is still equipped with loading facilities of phosphate.

2) New Break Bulk (General Cargo) Berths

Break bulk cargo is regarded as general cargo except for that stowed in container. Kinds of these cargoes in 2000 will be expected to consist of mainly bagged cargo, steel products, cars and livestock. These cargoes will be handled in the Main Port except livestock. Cargo volume to be handled in the Main Port in 2000 is forecasted to be the same as at present. Then the capacity of existing berths and facilities in the Main Port will be sufficient in 2000 as the study of the Master Plan in 2010. But the arrangement of berths in the Main Port shall be altered compared with the existing one because New Grain Berth will be located near existing Berth No.3 in 2000 as described in the next Section.

New arrangement of break bulk berths in the Main Port is as follows ;

- 240 meters in length and 12 meters in depth for 30,000 DWT ; one berth
- 170 meters in length and 10 meters in depth for 10,000 DWT ; three berths
- 150 meters in length and 8 meters in depth for less than 10,000 DWT ; one berth

3) New Grain Berth

As mentioned in the previous Chapter, grain is one of the most important cargoes and cargo volume of grain in 2000 is forecasted as 1.55 million tons, more than 1.5 times of that in 1993. Therefore size of calling grain vessels will become larger than at present. Even now Panamax sized grain vessels with deep draft are calling and obliged to shift berth because grain berth (Berth No.1) is shallow though only the berth itself is equipped with grain unloaders. To solve this problem, the conversion of grain berth for exclusive use is introduced in the Short-Term Improvement Plan.

The New Grain Berth in the Plan is as follows ;

- 280 meters in length and 14 meters in depth for 50,000 DWT ; one berth

There are two possible locations at the new berth, one is near the existing Berth No.1 and other is near the existing Berth No.3. It was finally decided to choose the latter(Near

Berth No.3), because estimated cost of the former is nearly 3 times higher than that of the latter. The details of this matter will be described later. On the other hand, as New Grain Berth will become nearly 600 meters apart from Phosphate Berth B, contamination problem of phosphate dust coming into grain will be almost solved.

(a) Berth Capacity

Assuming existing 3 unloaders would be used by extending belt conveyor after relocating them to the new berth, capacity of existing conveyor belt is 720 tons per hour, though the capacity of 3 unloaders is 940 tons per hour. Berth capacity is calculated as follows ;

Berth capacity ; By = 720 tons x 1 conveyor x 0.7 x 24 H x 0.8 x 351 D x 0.7
= 2,378 thousand tons per year > 1,550 thousand tons

Berth capacity by existing unloaders is sufficient in 2000.

(b) Storage Capacity

Grain silos store wheat, barley and corn, and the total capacity is 150 thousand tons. Maximum permissible cargo dwelling days in the silos is calculated by the forecast cargo volume in 2000.

Permissible cargo dwelling days ; Dd = (150,000 thousand tons x 0.7 x 365)
/ (1,550,000 tons x 1.3)
= 19.0 days

As a result, capacity of grain silos is sufficient if cargo dwelling days can be reduced to 19 days from current 29 days.

4) New Oil Berth (Phosphate Berth A)

Phosphate Berth A is currently used for multi-purpose , that is not only for loading phosphate, but also for handling vegetable oil, general cargo and bunkering. In 2000, it is recommended that this berth would be used mainly for unloading vegetable oil, as Phosphate Berth B has enough capacity for phosphate and also cargo volume of vegetable oil in 2000 will increase up to 1.3 times of 1993. On the other hand, to maintain berth condition in good order some rehabilitation of this berth will be necessary because it will have been 35 years since the berth was built.

(a) Berth Capacity

Although in this berth one phosphate loader is installed of which capacity is 1,000 tons per hour and a new loader with choke feeder will be equipped in the near future, according to PC, only the study regarding vegetable oil is executed in this Section.

Capacity of three unloading lines for vegetable oil is 480 tons per hour. (1 x 4 inches; 120 tons / hour and 2 x 6 inches ; 120 tons per hour each). Berth capacity is calculated by the following method.

Berth capacity ; By = 480 tons x 0.7 x 24 H x 0.8 x 351 D x 0.7
= 1,585 thousand tons / year > 320 thousand tons

Berth capacity for this cargo is quite sufficient in 2000 as forecast cargo volume is 320 thousand tons. Meanwhile this berth can be used for break bulk cargo and bunkering if necessary.

(b) Storage Capacity

There are 12 small storage tanks adjacent to this berth of which capacity is 11.5 thousand tons in all and 8 additional tanks (16 thousand tons in all) will be constructed by private sector in the near future, according to PC. Therefore the storage capacity of 27,500 tons is anticipated in 2000. Maximum permissible cargo dwelling days in these tanks can be decided by storage tank capacity and cargo volume per year.

Permissible cargo dwelling days ; Dd = (27,000 tons x 0.7 x 365 D)
/ (320,000 tons x 1.3)
= 16.9 days

Storage capacity in 2000 will be sufficient by means of quick cargo delivery within 16 days after it is unloaded.

(2) Container Port

1) New Container Berth

Number of containers to be handled through this port are forecasted to increase approximately 2 times in 2000, 3 times in 2005 and 4 times in 2010 compared with that in 1994.

Though the final image of the New Container Terminal in the target year was introduced in the previous Chapter, it is very difficult to work out deliberately transitional facilities and equipment on the Short-term Development Plan in 2000 en route to the Master Plan, 2010, because the construction work of the Terminal must be continued simultaneously with container operation in which number of containers to be handled will be increasing.

A study regarding the prospect of the transitional terminal in 2000 is executed based on the following assumptions.

- Average container handling productivity is 16 boxes per hour.
- Average working hours is 18 hours per day.
- Number of 20 and 40 footer containers is a two-one ratio according to the current record.
- Container dwelling days in the terminal are 15 days on average for full and 12 days for empty container.
- Container stacking tiers in the yard is 2.5 tiers on average for full and 3.5 tiers for empty container.
- Average container weight per TEU is 11 tons for full and 2 tons for empty container according to records for the past 5 years.

By the above assumptions in 2000 and the final assumption of the Master Plan in 2010, following simulation is executed.

Table 5.4.5 Required Container Yard in 2000, 2005, 2010

YEAR	2000			2005			2010		
Full/Empty Container	Full	Empty	Total	Full	Empty	Total	Full	Empty	Total
Cargo Volume (x 1,000 tons) per year	1,299	218	1,517	1,831	309	2,140	2,380	400	2,780
Number of TEUs (x 1,000) per year	118.1	109.0	227.1	166.5	154.5	321.0	216.4	200.0	416.4
Container Dwelling Days	15	12		13	10		10	7	
Required Slots (TEUs)	6,561	4,844	11,405	8,014	5,722	13,736	8,013	5,185	13,198
@ Number of Stacks (TEUs)	2.5	3.5	2.8	3.0	4.0	3.3	3.0	4.0	3.3
Total Required Ground Slots (TEUs)	2,624	1,384	4,008	2,671	1,431	4,102	2,671	1,296	3,967

According to the above Table 5.4.5, more than 4,000 TEUs ground slots will be required in 2000. Taking required ground slots and marshalling yards into consideration, following scheme is introduced in the Short-Term Improvement Plan.

- To extend the berth by 60 meters to the south
- To complete yard pavement up to the southern half of the final planned yards so that transfer cranes can work
- To found new office and maintenance shop in the final planned place
- To make sure of container transferring road between new yard and the eastern half of existing Yard 2 and Yard 3 as temporary container stacking yards

(See Figure 5.4.1)

2) Al-Mushtarak Berth

This berth is exclusively used for loading cement.

(a) Berth Capacity

Cargo volume of cement in bulk for export through this berth is forecasted as 700 thousand tons, that is, 1.3 times greater than in 1994 (516 thousand tons). Berth capacity can be decided by the capacity of existing one loader which is 400 tons per hour, while the capacity of belt conveyor is 450 tons per hour.

Berth capacity ; By = 400 tons x 0.7 x 1 loader x 24 H x 0.8 x 351 D x 0.7
= 1,321 thousand tons / year > 700 thousand tons

As a result, the capacity of existing equipment is sufficient in 2000 as forecast cargo volume is 700 thousand tons.

(b) Storage Capacity

There are two cement storage domes having capacity of 18 thousand tons each behind the berth and in the near future, one additional same sized dome will be constructed,

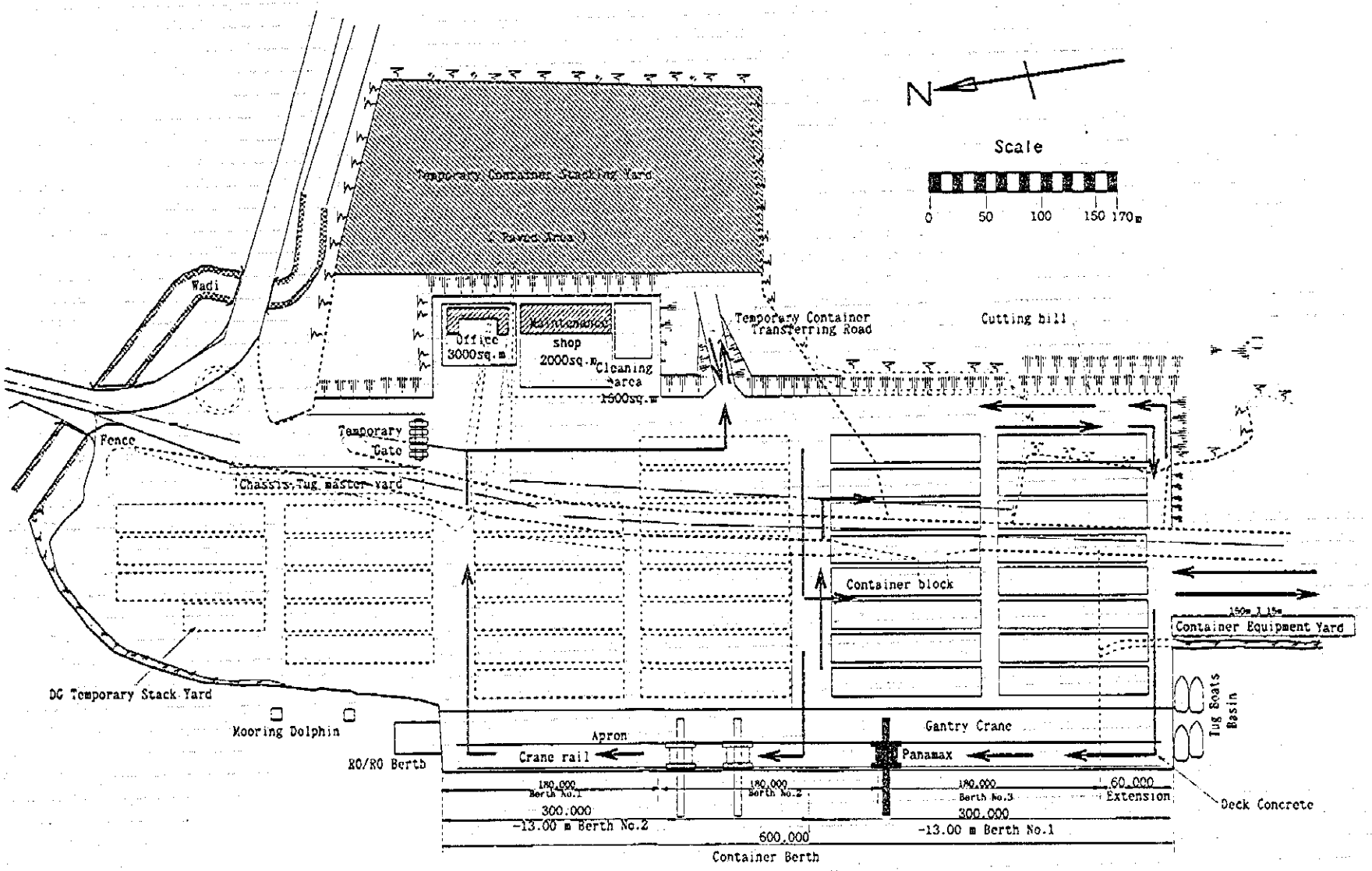


Figure 5.4.1 Container Operation System

according to Jordan Cement Factory Company. Then in 2000, a capacity of 54 thousand tons is anticipated for this berth. Maximum permissible cement dwelling days in the storage can be calculated by storage capacity and cargo volume per year.

Permissible cargo dwelling days ; Dd = (54,000 tons x 0.7 x 365 D)
/ (700,000 tons x 1.3)
= 15.2 days

As a result, as far as cargo can be received within 15 days prior to vessels arrival, the storage capacity is sufficient.

3) Mo'ta Floating Berth

(a) Berth Capacity

This berth is exclusively used for unloading rice in bulk. Cargo volume of rice in bulk for import through this berth is forecasted as 520 thousand tons in 2000. The capacity of existing conveyor belt is 500 tons per hour. Unloading operation is made by grabs of ships gears and / or mobile cranes into 3 hoppers connected to storage tanks by the conveyor. Berth capacity is calculated by the following formula.

Berth capacity ; By = 500 tons x 0.7 x 1 conveyor x 24 H x 0.8 x 351 D x 0.7
= 1,650 thousand tons / year > 520 thousand tons

As a result, the capacity of existing equipment is sufficient in 2000.

(b) Storage Capacity

There are 7 storage tanks behind the berth which have the capacity of 7.5 thousand tons each for rice (total 52.5 thousand tons) and other one tank with the capacity of 1.2 thousand tons for grain. From the above storage capacity and forecast cargo volume of rice in 2000, maximum permissible cargo dwelling days for rice in bulk is calculated as follows ;

Permissible cargo dwelling days ; Dd = (52,500 tons x 0.7 x 365 D)
/ (520,000 tons x 1.3)
= 19.8 days

It will be possible, though the company of this factory (Arab Packaging Company) delivers rice to required market after packing it in bags, to reduce cargo dwelling days in storage tanks to less than 20 days.

(3) Industrial Port

1) Industrial Berths

By 2000, more than 8 kinds of industrial cargoes might be handled at JFI West and East Berths. They are mainly Potash, DAP, NPK, Salt, Phosphoric Acid and Magnesium Oxide for export, and Sulfur and Liquid Ammonia for import. Cargo volume of these cargoes is forecasted as 7.61 million tons in 2000, nearly 3 times of that in 1994. It is definitely indispensable to improve cargo handling equipment as well as cargo handling operation.

A study is executed regarding the berth capacities of each cargo, otherwise storage capacities are not examined because future plan concerning these new industrial cargoes are not available. Total required number of industrial berths is examined later in this Section.

(a) Potash / DAP / NPK / Salt / MgO

Cargo volume of these industrial products in 2000 is forecasted as 5.3 million tons, or 2,000 thousand tons of Potash, 800 thousand tons of DAP, 1,300 tons of NPK, 900 thousand tons of Salt and 300 thousand tons of MgO. These cargoes for export are loaded at JFI West and East berths which have one loader each with the capacity of 1,500 tons per hour and are connected by 2 belt conveyors (each 1,400 mm in width) to the Tower 3. Berth capacity of these cargoes per berth is calculated by the following formula.

Berth capacity ; By = 1,500 tons x 1 loader x 0.7 x 24 H x 0.8 x 351 D x 0.7
= 4.953 million tons / year < 5.3 million tons

(b) Sulfur

This cargo operation is now a bottleneck in the industrial berth because vessel to unload sulfur occupied JFI West Berth nearly 50 percent of the time in 1994 due to low handling productivity. On the other hand, cargo volume in 2000 is forecasted to be 1 million tons, 3 times of that in 1994 (331 thousand tons). To improve the above situation, the following is needed.

- To improve current handling productivity by one mechanical unloader (designed capacity 500 tons /hour)

Berth capacity ; By = 500 tons x 1 loader x 0.7 x 24 H x 0.8 x 351 D x 0.7
= 1.65 million tons / year > 1 million tons

(c) Liquid Ammonia

Cargo volume of Liquid Ammonia for import in 2000 is forecasted as 310 thousand tons, that is nearly 2 times of that in 1994 (168 thousand tons). Designed capacity of existing two pipe lines is 680 tons per hour. Berth capacity for this cargo is calculated as follows ;

Berth capacity ; By = 680 tons x 1 unloader x 0.7 x 24 H x 0.8 x 351 D x 0.7
= 2.246 million tons / year > 310 thousand tons

(d) Phosphoric Acid

Cargo volume of Phosphoric Acid for export in 2000 is forecasted as 1 million tons, though it is currently very low. The capacity of existing loader and pipe lines for this cargo is 560 tons per hour. Berth capacity of this cargo is calculated as follows ;

Berth capacity ; By = 560 tons x 1 loader x 0.7 x 24 H x 0.8 x 351 D x 0.7
= 1.85 million tons / year > 1 million tons

(e) Required number of berths

As a result of (a), (b), (c) and (d), required number of Industrial Berths can be estimated by following calculation.

Required number of berths = (5,300 / 4,953) + (1,000 / 1,650)
+ (310 / 2,246) + (1,000 / 1,850)
= 2.35 > 2

As a result, two existing industrial berths (JFI West and East) could not handle all of forecast cargo volume in 2000, even though cargo handling productivity could be improved. Therefore an additional berth will be required by the year 2000. It is recommended that the new additional berth be located in between existing JFI West/East and JFI-1 Berth, and that one loader with the capacity of 1,500 tons per hour be installed to handle Potash, DAP, NPK, Salt and MgO, as described later.

The size of an additional industrial berth shall be as follows ;

Length of Berth ; 230 meters
Depth of Berth ; 15 meters
Allowed Scale of vessel ; 50,000 DWT

2) Oil Jetty

As fuel oil is currently imported by land transportation, only Solvochem-Holland B.V uses this berth for importing chemical oil and vegetable oil (hereunder called "mineral oil"). On the other hand, Jordan Electricity Authority located behind the jetty is expected to import fuel /crude oil through this jetty in 2000. Cargo volume of these oils in 2000 is forecasted as 550 thousand tons for the former (Mineral Oil) and 720 thousand tons for the latter (Fuel / Crude Oil). Capacity of existing pipe lines for mineral oil is 450 tons / hour and that for fuel and crude oil is planned to be 1,500 tons per hour. Therefore the berth capacities of both cargoes are calculated by the following formula.

(a) Mineral Oil

Berth capacity = 450 tons x 0.7 x 24 H x 0.8 x 351 D x 0.7
= 1.486 million tons / year > 550 thousand tons

(b) Fuel / Crude Oil

Berth capacity = 1,500 tons x 0.7 x 24 H x 0.8 x 351 D x 0.7
= 4.953 million tons / year > 720 thousand tons

(c) Required number of berth

As a result of (a) and (b), berth capacity for each cargo is quite sufficient, but it can be determined by following method whether this berth could handle both cargo volume together in 2000.

Required number of berth = (550 / 1,486) + (720 / 4,953)
= 0.52 < 1