社会開発調査部報告書

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

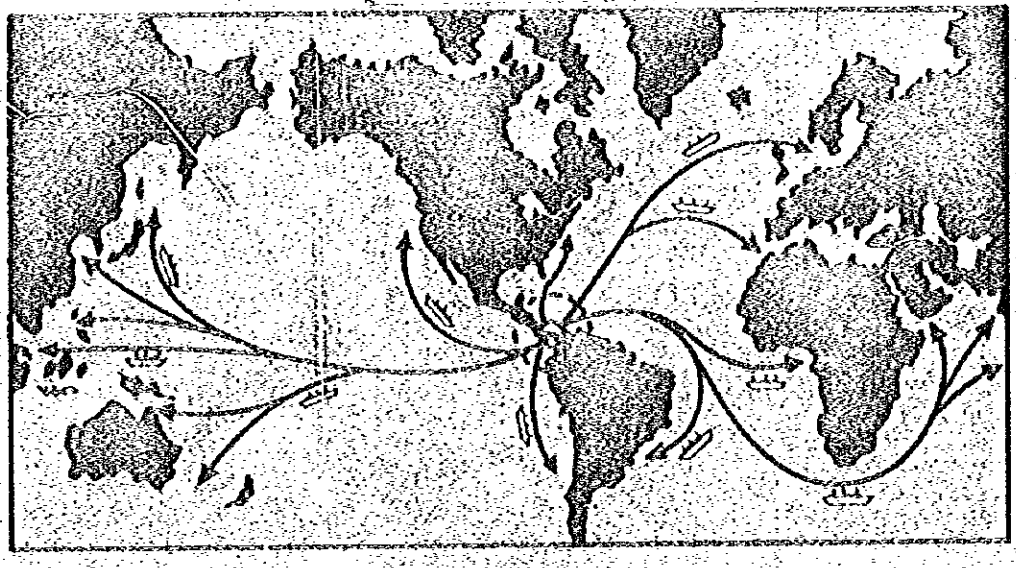
No. 52

NATIONAL PORT AUTHORITY
THE REPUBLIC OF PANAMA

THE STUDY ON THE DEVELOPMENT PLAN OF THE PORT OF BALBOA IN THE REPUBLIC OF PANAMA

FINAL REPORT

PART III SHORT-TERM PLAN



JUNE 1997

THE OVERSEAS COASTAL AREA DEVELOPMENT INSTITUTE OF JAPAN (OCDI)
PACIFIC CONSULTANTS INTERNATIONAL (PCI)

EXCHANGE RATE

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(as of September 1996)

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PREFACE

In response to a request of the Government of the Republic of Panama, the Government of Japan took pleasure in conducting a study on the development of the port of Balboa and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Panama a study team headed by Mr. Takao HIROTA, President of the Overseas Coastal Area Development Institute of Japan (OCDI), and composed of members from this institute and another company, Pacific Consultants International (PCI), three times between May 1996 and March 1997.

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

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

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Panama for the close cooperation they extended to the team.

June 1997

Kimio FUJITA
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

June 1997

Mr. Kimio FUJITA
President
Japan International Cooperation Agency

Dear Sir,

I have the honor to submit herewith the Final Report for the Study on the Development Plan of the Port of Balboa in the Republic of Panama.

This report is the outcome of works between March 1996 and June 1997 which included three field surveys. The work was undertaken by the Overseas Coastal Area Development Institute of Japan (OCDI) and Pacific Consultants International (PCI) as per the contract with the Japan International Cooperation Agency (JICA).

Based on the findings of these surveys and utilizing data and information collected, and along the line of the scope of work which was agreed upon by both governments, the report is formulated to cover the following subjects;
(1) To formulate a master plan for the existing port and new terminals for container cargoes, etc., up to the year 2015
(2) To conduct a feasibility study on a short-term plan up to the year 2005 based on the master plan.

The study shows the importance of the overall development of the Port of Balboa and its proper administration, management and operation. I earnestly hope that necessary measures will be taken to implement the projects and recommendations.

I would like to note that the completion of the study is greatly owed to the collaboration with APN (Autoridad Portuaria Nacional) and other related ministries, government agencies, authorities, shipping lines and agents.

I am also greatly indebted to JICA, the Ministry of Foreign Affairs, the Ministry of Transport and the Embassy of Japan in Panama for giving us valuable advice and assistance at every step throughout the course of the study.

Yours sincerely,

Takao Hirota

Takao HIROTA
Team Leader for the Study
on the Development Plan of the Port of Balboa

ABBREVIATION LIST

A	APN	National Port Authority
	APSA	Atlantic-Pacific, S.A.
	ARI	Interoceanic Regional Authority
B	B/L	Bill of Lading
	BNP	Panama National Bank
	BOD	Biochemical Oxygen Demand
	BOT	Build, Operate and Transfer
C	CCT	Colon Container Terminal
	CFC	Conversion Factor for Consumption
	CFS	Container Freight Station
	CIF	Cost, Insurance and Freight
	CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
	COD	Chemical Oxygen Demand
	COFRISA	Consortium for the Development of Folk River, S.A.
	CPC	Centerport Concept
D	DO	Dissolved Oxygen
	DWT	Dead Weight Tonnage
E	EIA	Environmental Impact Assessment
	EIRR	Economic Internal Rate of Return
	EIS	Environmental Impact Study
	EPZ	Export Processing Zone
F	FCL	Full Container Load
	FEU	Forty-foot Equivalent Unit
	FIO	Free In and Out
	FOB	Free on Board
G	GCO	Office of General Comptroller
	GDP	Gross Domestic Products
	GT	Gross Tonnage
H	HHW	Highest High Water
	HIT	Hongkong International Terminals
I	IDB	Inter-American Development Bank
	IEE	Initial Environmental Examination
	IMF	International Monetary Fand
	IMO	International Maritime Organization

	INRENARE	National Institute for the Renewable Natural Resources
L	LAQ	Lease a Quay
	LCL	Less than Container Load
	LLW	Lowest Low Water
	LPG	Liquid Propane Gas
	LUP	License to Use a Port
M	MARPOL	Prevention of Pollution of the Sea from Ships 1973 and the Protocol of 1978
	M/O or O/M	Maintenance and Operation, or Operation and Maintenance
	MHW	Mean High Water
	MIPPE	Ministry of Planning and Economic Policy
	MIT	Manzanillo International Terminal
	MLB	Mini Land Bridge
	MLW	Mean Low Water
	MLWS	Mean Low Water Spring
	MSL	Mean Sea Level
N	NPV	Net Present Value
O	ODA	Official Development Assistance
P	PCC	Panama Canal Commission
	PLD	Precise Level Datum
	PPC	Panama Ports Company, S. A.
	PTP	Petroterminal de Panama, S.A.
R	Ro-Ro	Roll-on Roll-off
S	SCF	Standard Conversion Factor
	SPM	Suspended Particulate Matter
	SS	Suspended Solid
T	TEU	Twenty-foot Equivalent Unit
	T-N	Total Nitrogen
	T-P	Total Phosphorus
U	UN	United Nations
	UNCTAD	United Nations Conference on Trade and Development
	US	United States of America
Z	ZLC	Colon Free Zone

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PART III SHORT-TERM PLAN AND FEASIBILITY STUDY

I SHORT TERM PLAN FOR PORT DEVELOPMENT

1.1 Basic Policy for Short Term Plan

1. The physical and management plan for the short term with the target year of 2005 shall be illustrated in accordance with the overall concept and scenario of the long term development and layout plan proposed in the Master Plan of 2015 in PART II.

2. Taking into consideration various requirements for the current situation of the port and overall demand of future port traffic, the core objectives of the plan are identified as follows:

(1) Improvement and expansion of total capability of the port in handling cargoes and serving ships, in particular, to meet as soon as possible the potential traffic demand of transshipment container on the Pacific side.

(2) Identification of scale and substance of the physical development project as an intermediate step of development in achieving the proposed goal of the Master Plan.

(3) Strengthening port management and operation system to effectively run the public port under the current situation surrounding APN.

1.2 Physical Plan of Port Facilities

3. Physical plan of recommended project in short term stage is described in this chapter.

1.2.1 Development of New Container Terminal

4. A new container terminal is planned to be developed at Diablo. Transfer crane system is adopted as cargo handling system. Annual throughput of container cargo of this terminal in the year 2005 (medium case) is estimated as follows;

	(thousand TEUs)	
Laden	409	
(Import)		(44)
(Export)		(13)
(Transship)		(352)
Empty	28	
Total	437	

(1) Construction of Terminal Facilities

5. Layout plan of wharf and terminal area are shown in Figure 1-2-1.

1) Wharf

6. One container berth for Post-Panamax type container vessels will be constructed. Major specifications are as follows:

Length 350 m × 2 berths (consecutive berths)
Depth*) -13 m
(capable of being deepened up to -14 m in future)

*) at berthing space just in front of the berth
(area : 350 m × 50 m × 2 berths)

2) Terminal Area

7. Terminal has area equivalent to 122,500 m² (350 m × 350 m). This area consists of apron, marshaling yard and back yard. Readjusted area for future expansion equivalent to 52,500 m² (350 m × 150 m) is attached to it just in the back.

3) Waterway and Basin

8. Access navigation routes to the container berth should be provided from both the northward and the southward directions through the Canal. Area for turning basin is secured for Post-Panamax size vessels in front of the terminal. The area is a circle of a diameter of 600 m (=2L) with a minimum depth of 12 m. Vessels call at the berth during high tide in case of need.

9. Most of this area is maintained at a depth of 12 m. It is also used by other vessels which call at existing wharves at the port of Balboa.

4) Others

10. Layout plan of major facilities and container cargo handling equipment required for operation of the new terminal is explained in the chapter on cargo handling system.

(2) Improvement of Existing Major Facilities (Urgent Plan)

11. In order to cope with the urgent requirement for upgrading the service level, improvement of existing major facilities is planned early in the short term stage.

12. Container yard will be expanded mainly just in the back of Pier No.14, 15 and 16 (See Figure 3-11-1 of PART II). The expanded area will be used for container marshaling area for the time being until Diablo terminal starts operation. The investment for it, therefore, should be the minimum necessary. Container cargo handling equipment required for the operation is explained in the chapter on cargo handling system.

13. Pier No.14 will be assigned for the expansion of activities of ship repair after the container terminal at Diablo starts full operation.

14. As well, Pier No.15 and 16 will be utilized mainly for cargo handling such as grain and automobile. The urgent container yard will be utilized as a large area of back up space to secure smooth and efficient activities at these piers. (For example, more than 20 ha is necessary for car stocking yard in 2005 as aforementioned. As well, silos could be equipped at need for improvement of cargo handling.)

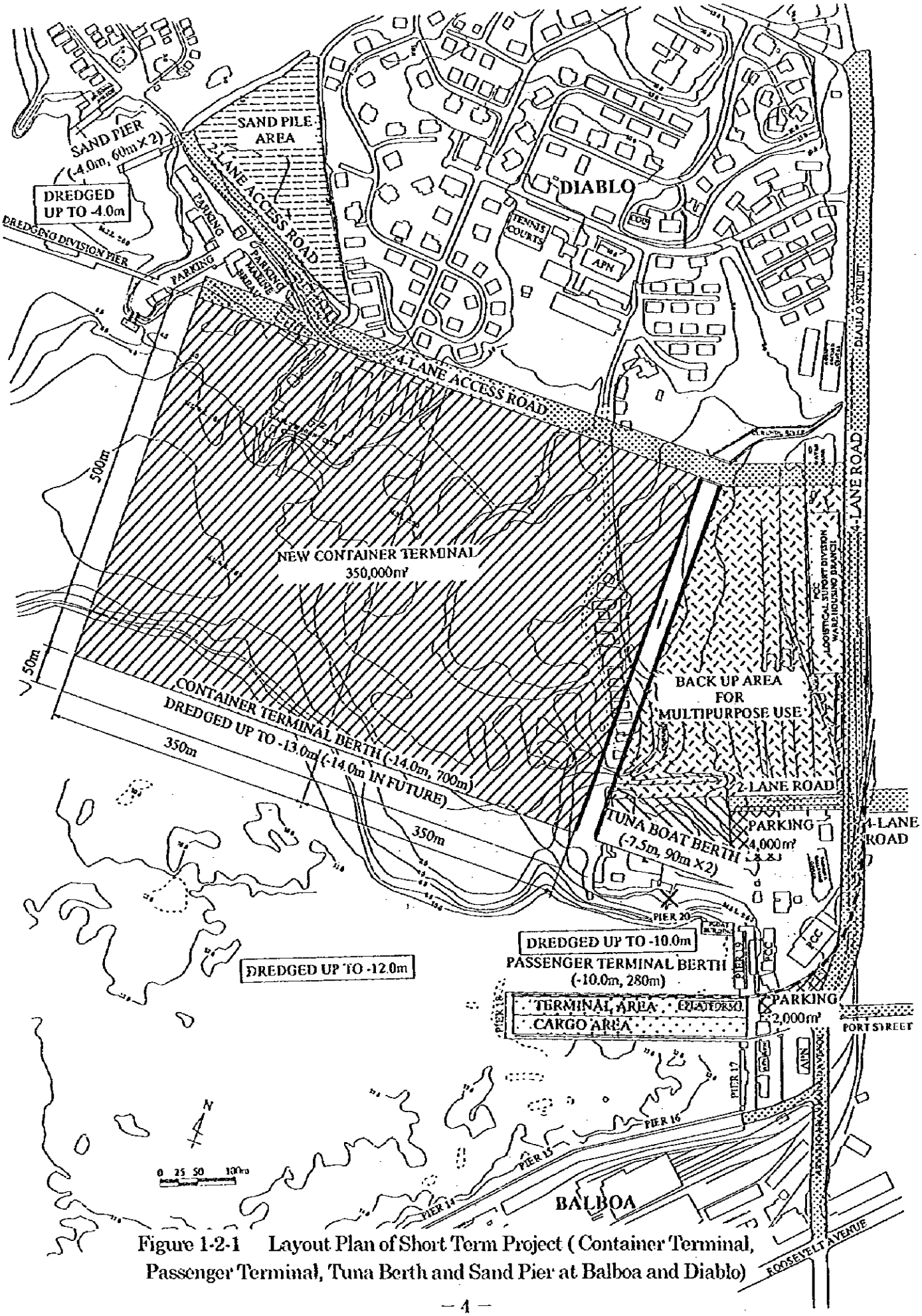


Figure 1-2-1 Layout Plan of Short Term Project (Container Terminal, Passenger Terminal, Tuna Berth and Sand Pier at Balboa and Diablo)

1.2.2 Improvement and Arrangement of Other Major Facilities

(1) Pier No.6

15. Bunker handling should be concentrated at this pier. It is desirable to construct the new integrated facilities at north Amador as soon as possible without waiting for the target year 2015 of the Master Plan. Therefore, no special reconstruction or improvement is planned for the time being, if existing bunkering facilities are maintained in good condition.

16. (On the other hand, Pier No.1 and 2 at Rodman Base has been in operation for the same purpose.)

(2) Pier No.7

17. Pier No.7 will be assigned for the expansion of activities of ship repair like Pier No.7. Accordingly, no special reconstruction or improvement is planned.

(3) Pier No.17

18. Port service launches will stay at this pier as at present. No special reconstruction or improvement is planned.

(4) Pier No. 18

19. Pier No. 18 is the only pier with a quay shed of 15,000 m^2 in the port. Southern part of the pier will be used mainly for cargoes such as general cargo, valuable cargo under a guard and cargo to be kept dry.

20. To check the maximum capacity of transit shed for general cargo handling, required area is estimated as shown below. Part of the shed will be sufficient for it.

120,000 metric ton/ year (cargo volume in high case of 2015)
/ 20 cycle/ year (cycle rate) × 0.5 (utility rate) / 1.0 t/ m^2 (area utility rate)
= 3,000 m^2

21. The west end of the pier is used for tugboat.

22. Northern part of the pier will be almost fixed for large passenger cruisers

with an active branch line of railroad under investigation for tourism connected with them. The mooring length of 280 meters is assured from the west end of the pier. It is necessary to keep the front slip at the depth of at least 10 meters.

23. Existing shed house is modified to passenger terminal building. Renovation of the quay shed will be limited to the least necessary scope. Therefore, space allotment described here is only an example and not to be understood as fixed.

24. Expected land access means to this terminal are railroad, buses and passenger cars. A platform for passenger will be integrated around the shed entrance. In front of Pier No. 18 to the north, a parking area for bus and passenger car with an area of around 2,000 m^2 can be prepared after demolishing a small building of No. 56.

25. Space utilization plan of Pier No.18 is shown in Figure 1-2-1. In the northern part of the shed are located terminal facilities (around 3,000 m^2) such as terminal office, waiting room and baggage office; immigration and customs; tourist information center; restaurants and coffee shops; and shopping center (duty free shop, etc.) which serves not only passengers but also crews and employees.

26. These are separated from the cargo handling and stacking areas on the south side in the viewpoint of security and control of passenger and cargo. Walking area is limited to the north side of terminal facilities along the waterfront and through the terminal facilities..

(5) Pier No. 19

27. This pier should be made to serve domestic ferries as soon as PCC integrates the function of Pier No. 19 in Corozal together with other facilities. Its basic structure is of floating type convenient for small crafts.

28. Ticket windows, waiting rooms, administration offices for passenger should be concentrated and integrated at the buildings behind the pier. The parking area in front of Pier No.18 is also utilized for bus and car access to Pier No. 19. In addition to it, a parking area of 4,000 m^2 (with a capacity of 200 passenger vehicles) in total is prepared mainly for passenger and employee use to the north (See Figure 1-2-1).

(6) Tuna Berth

29. Two (2) berths for tuna boats will be constructed for ship supply and repair as follows:

Wharf	Length	90 m × 2
	Depth	-7.5 m
	Apron	180 m × 20 m (3,600 m^2)

30. Space with area of 6,000 m^2 on the north side will be used as open area for multiple use such as handling fishing gear. On the west side, the alignment of Curundu River will be arranged along the container terminal. The river effectively serves as a boundary separating container handling zone from other activity zones. The existing PCC storage area at the back will be reserved and used as a green park area until an additional area becomes necessary (See Figure 1-2-1).

31. At the same time, the port of Vacamonte should be fully improved to comply with the requirements of tuna boats for supply and repair as aforementioned.

(7) Sand Pier (Pier No. 20)

32. Two (2) berths for sand barge will be constructed near PCC pier at Diablo, as Pier No.20 will be demolished.

33. A jetty type pier with a depth of 4.0 m and a length of 60 m is planned here. More than the current storage area (around 7,000 m^2) could be secured behind it. Greenery should be arranged around the sand pile. The details will be confirmed with the current concessionaire of Pier. 20 (See Figure 1-2-1).

1.2.3 Construction and Improvement of Access Road

34. A new access road from the new container terminal to the Diablo Road should be constructed. Two lane road will be sufficient during the short term stage (One lane is planned to be 3.5 meters or 3.25 wide). However, space for possible future expansion to four lanes should be reserved along the road. This area can be tentatively used as a parking area for trucks and trailers, which will also make it easier for these vehicles to turn corners (See Figure 3-11-1 of PART II and Figure 1-2-1).

35. In addition, existing roads should be strengthened as follows:

a) At least two lanes with one lane of a width of 3.5 meters or 3.25
   From new Sand Berth to a new access road aforementioned above
   From Tuna Berth to the Diablo Road
   The Roosevelt Avenue
b) At least four lanes with one lane of a width of 3.5 meters or 3.25
   Two roads from the existing port to the Diablo Road
   The Diablo Road, the new Gaillard Road and the roads connecting them

36. These roads should be well paved, marked, and improved around corners, and crossings should be equipped with traffic lights where necessary.

II PRELIMINARY DESIGN AND TECHNICAL FEASIBILITY

2.1 Natural Conditions

2.1.1 Topographic Conditions

1. Figure 2-1-1 to Figure 2-1-5 show the topography of Diablo that the JICA Study Team has prepared in November to December 1996.

2. Immediately north of the Port of Balboa lies the mangrove area, where the Curundu River and Maria Salas River flow into the canal. Reclamation is made for allocating small workshops for small ship repair and chandler's warehouse, etc. The lowest elevation of the mangrove area is about +/- 0 m MSL (about + 2.6 m MLWS) and the highest is + 7.8 m MSL (about + 10.4m MLWS) at the reclamation.

3. North of the mangrove area lies Diablo Height, PCC's housing complex, which has been already reverted to Panama. The Diablo Height is slightly uphill to the north from the mangrove area from about + 5 m MSL (+ 7.6 MLWS) to 21 m MSL (+ 23.6 m MLWS). The highest is +26.7 m MSL (+ 29.3 m MLWS), the top of a small hill.

4. Between the canal and Diablo Height lies a low flat area about +4 m to + 5 m MSL (+ 6.6 m to + 7.6 m MLWS), where the pier of PCC and workshops for small boat repair have been built. Swampy areas where mangrove partly grows, are scattered around this area.

5. Further north along the canal, a low flat area whose elevation is about + 3 m MSL (+ 5.6 m MLWS) lies and is used as a transmitter antenna field.

2.1.2 Bathymetric Conditions

6. Figure 2-1-6 shows the bathymetry offshore Diablo. The map is prepared by combining the results of bathymetric survey conducted by the JICA Study Team in November 1996 together with the bathymetric maps of Balboa Inner Harbor that APN prepared in 1995 and 1996.

7. The APN's bathymetric survey confirmed that the center of the inner harbor is maintained - 12 m to - 13 m (MLWS) deep in 1995 and 1996. The seabed slightly

tends shallower to the north (anchoring area) up to - 10 m MLWS. The bathymetric survey conducted by the JICA Study Team indicates that the seabed is steep and becomes shallow up to - 2.0 m MLWS at the north of the anchoring area.

8. The top elevation of the Diablo Island is about +/- 0 m MSL (+ 2.6 m MLWS). This means that the "island" is underwater almost half of the time.

2.1.3 Geotechnical Conditions

9. The JICA Study Team conducted at Diablo three borehole subsoil exploration at the locations shown on Figure 2-1-7. The boring logs are also shown in Figure 2-1-8 to Figure 2-1-10.

10. At all the locations, the top soil is composed of fill materials; thickness of about 2.5 m (silty clay), 4 .0 m (mixtuer of silty sand, organic clay and rubble) and 6.5 m (mixture of silt and silty clay) at Boreholes No. 1, No. 2 and No. 3 respectively.

11. Below the fill, there exist marine origin sediments, with a thickness of 5.6 m (Borehole No. 1), 6.0 m (No.2) and 9.2 m (No.3). The N-Value varies from 4 to 40, increasing to the depth. This layer is too soft to support the heavy structures such as quay wall.

12. Underlying the marine origin sediments, the residual soil, which have been created from the parent rock, exists. The residual soil is very hard (N-value is more than 50) and capable of supporting the foundation of heavy structures. The thickness is 2.1 m at Borehole No. 1 and 5.3 m at No. 2. However, this layer extends deeper than - 15 m MLWS at Borehole No. 3 as it does at existing Pier No. 18.

13. Underlying the residual soil, the parent rock (sedimentary) exists. The JICA Study Team conducted confirmation drilling, wherever encountered, 2 m deep into the parent rock and took their cores, which were subjected to the compression test. The core taken at Borehole No. 1 indicates 57.1 kg/cm2 axial compression strength and the core at Borehole No. 2 indicates 74.2 kg/cm2.

14. The three borehole subsoil exploration confirmed that the subsoil formation at Diablo is "La Boca Formation."

15. Property and physical tests of the samples taken by the JICA Study Team are shown in Tale 2-1-1 to Table 2-1-3.

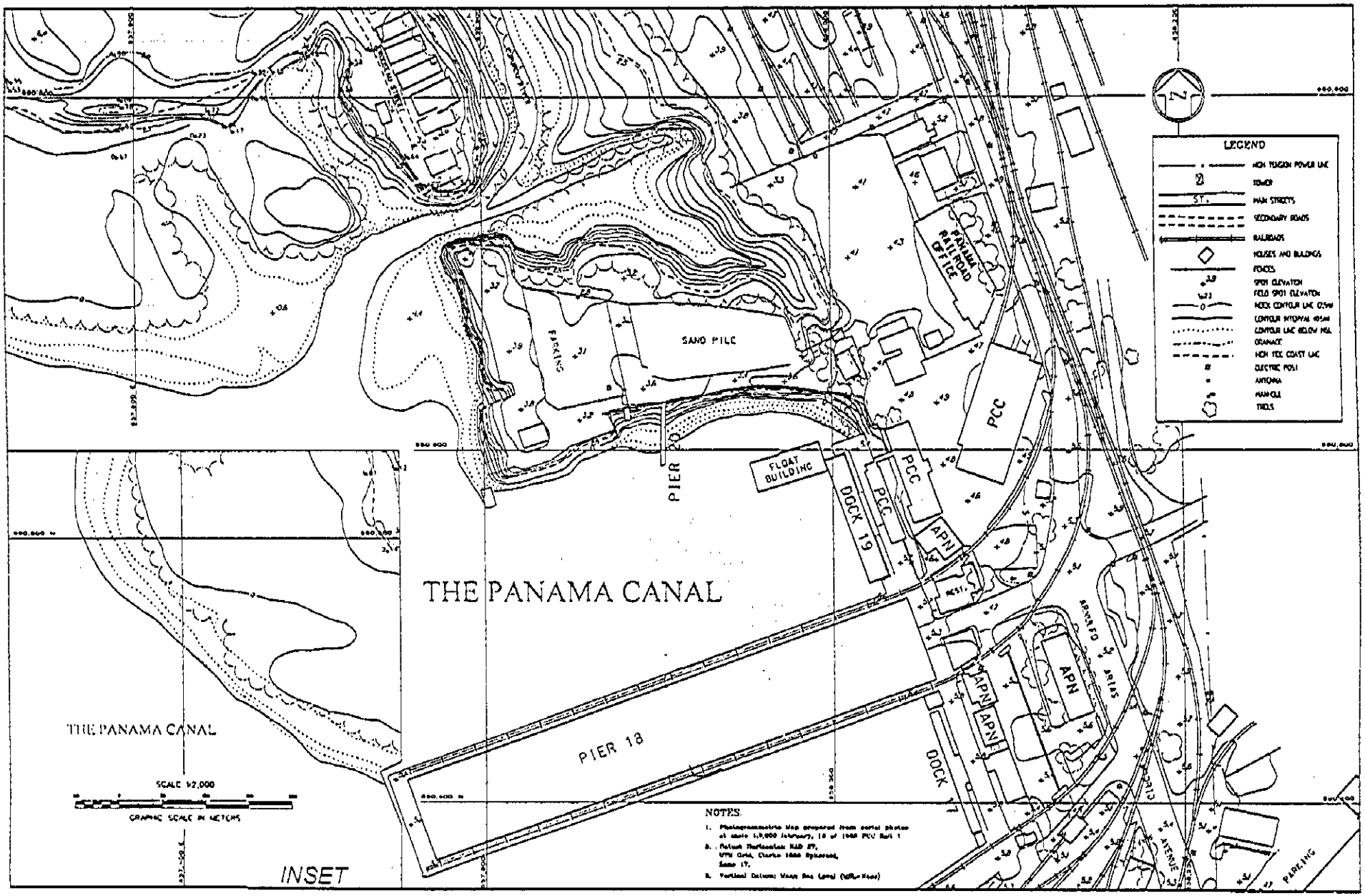


Figure 2-1-1 Topographic Map, 4/10

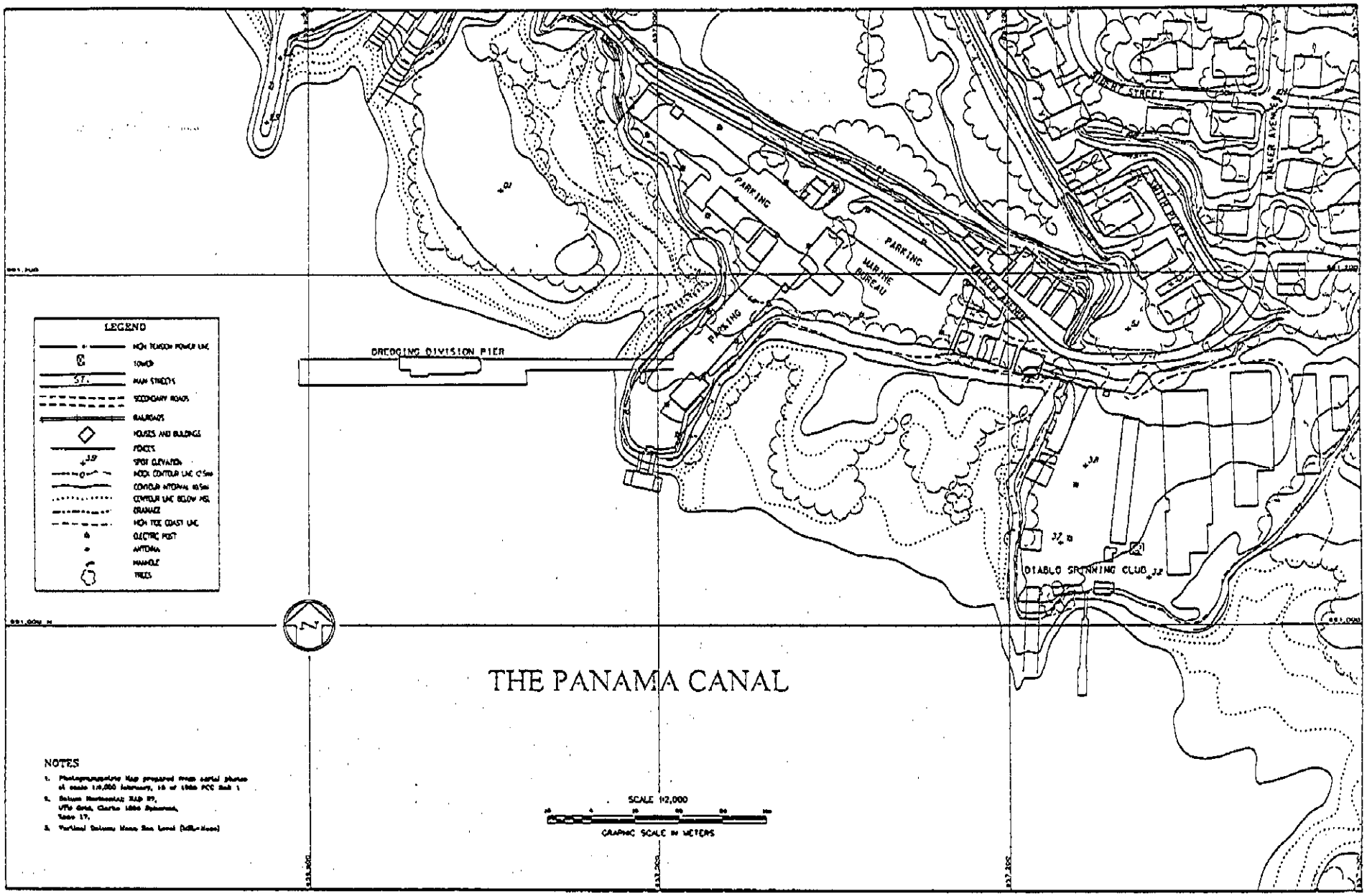


Figure 2-1-2 Topographic Map, 5/10

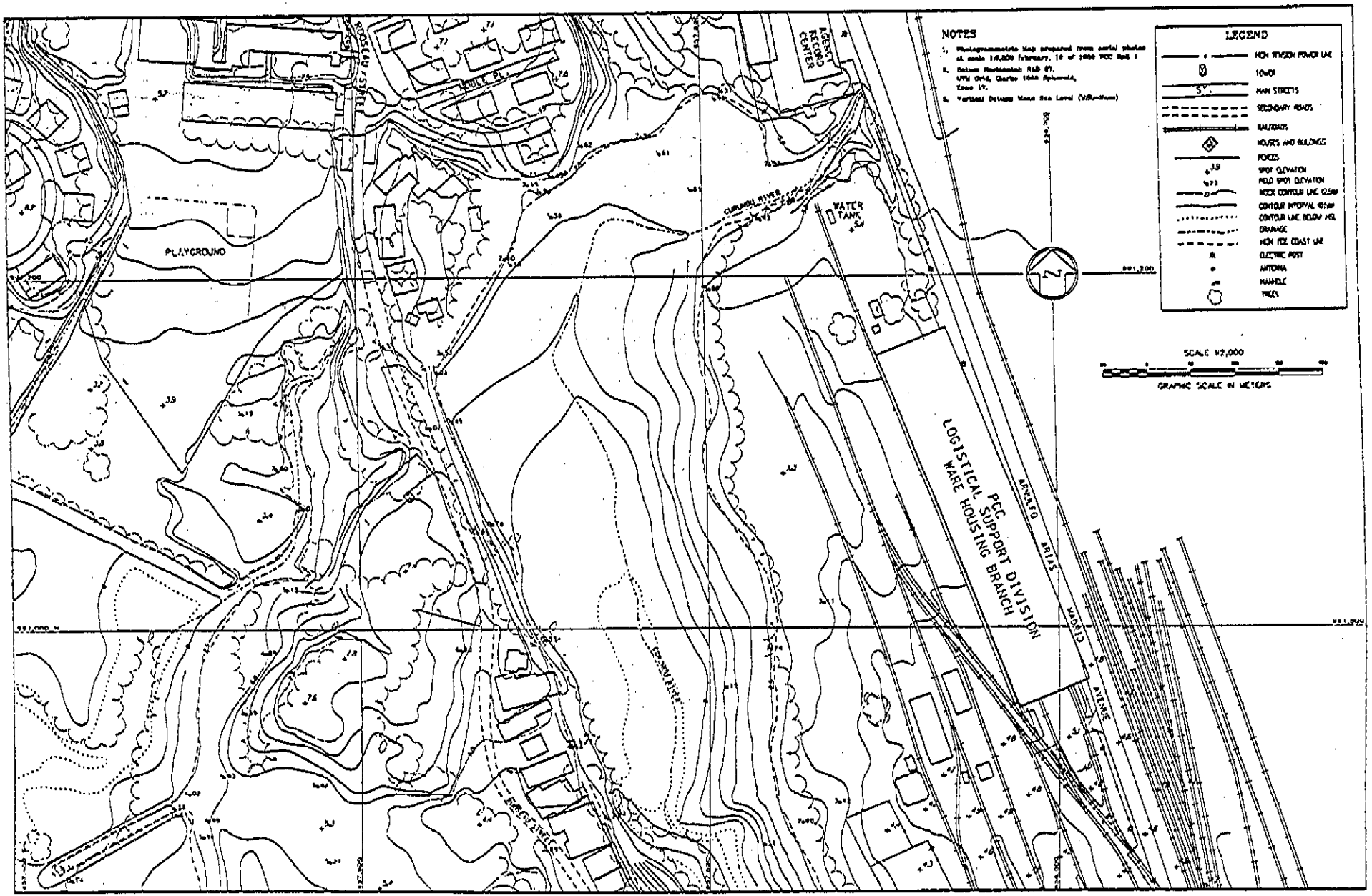


Figure 2-1-3 Topographic Map, 6/10

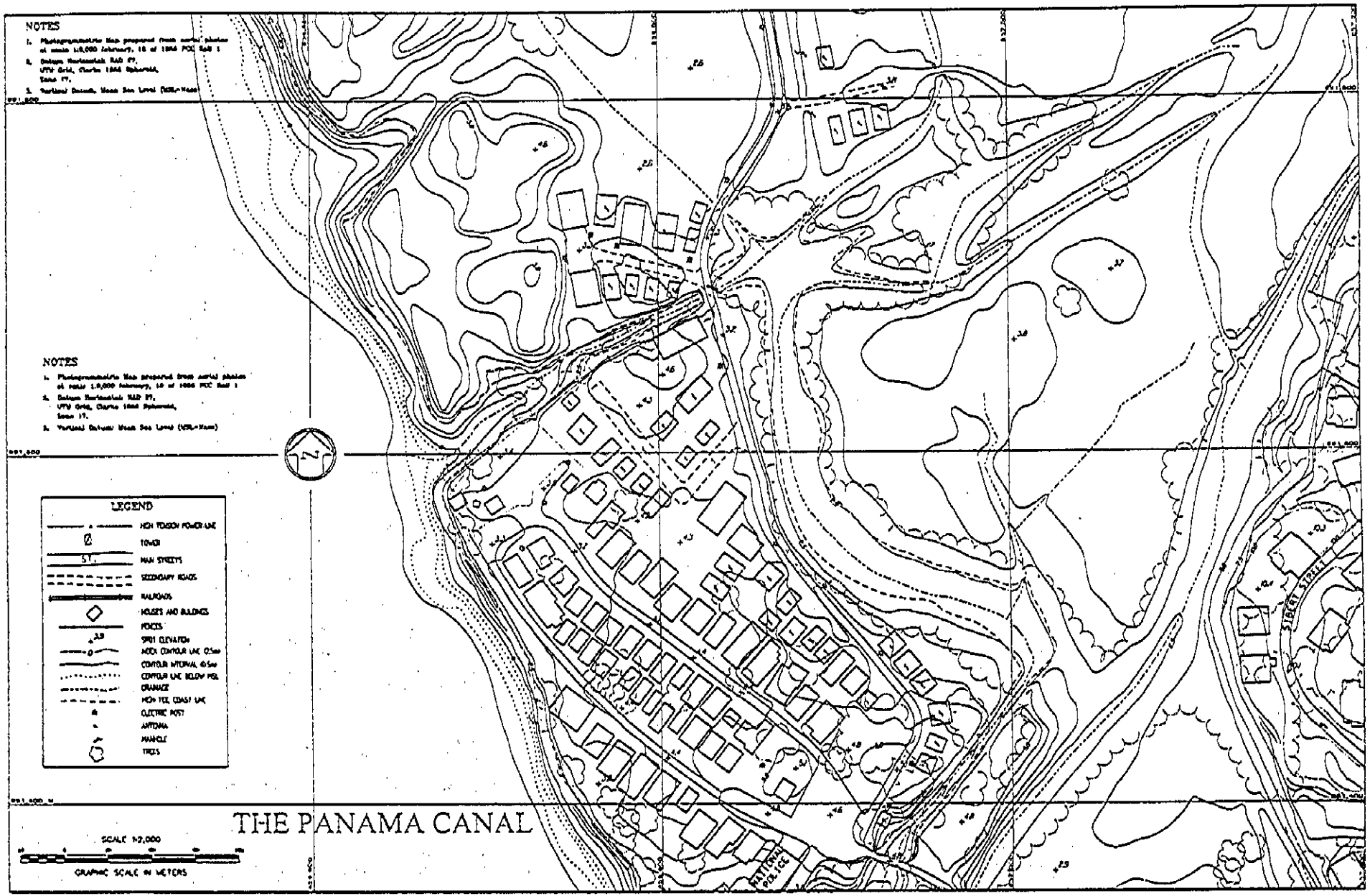


Figure 2-1-4 Topographic Map, 7/10

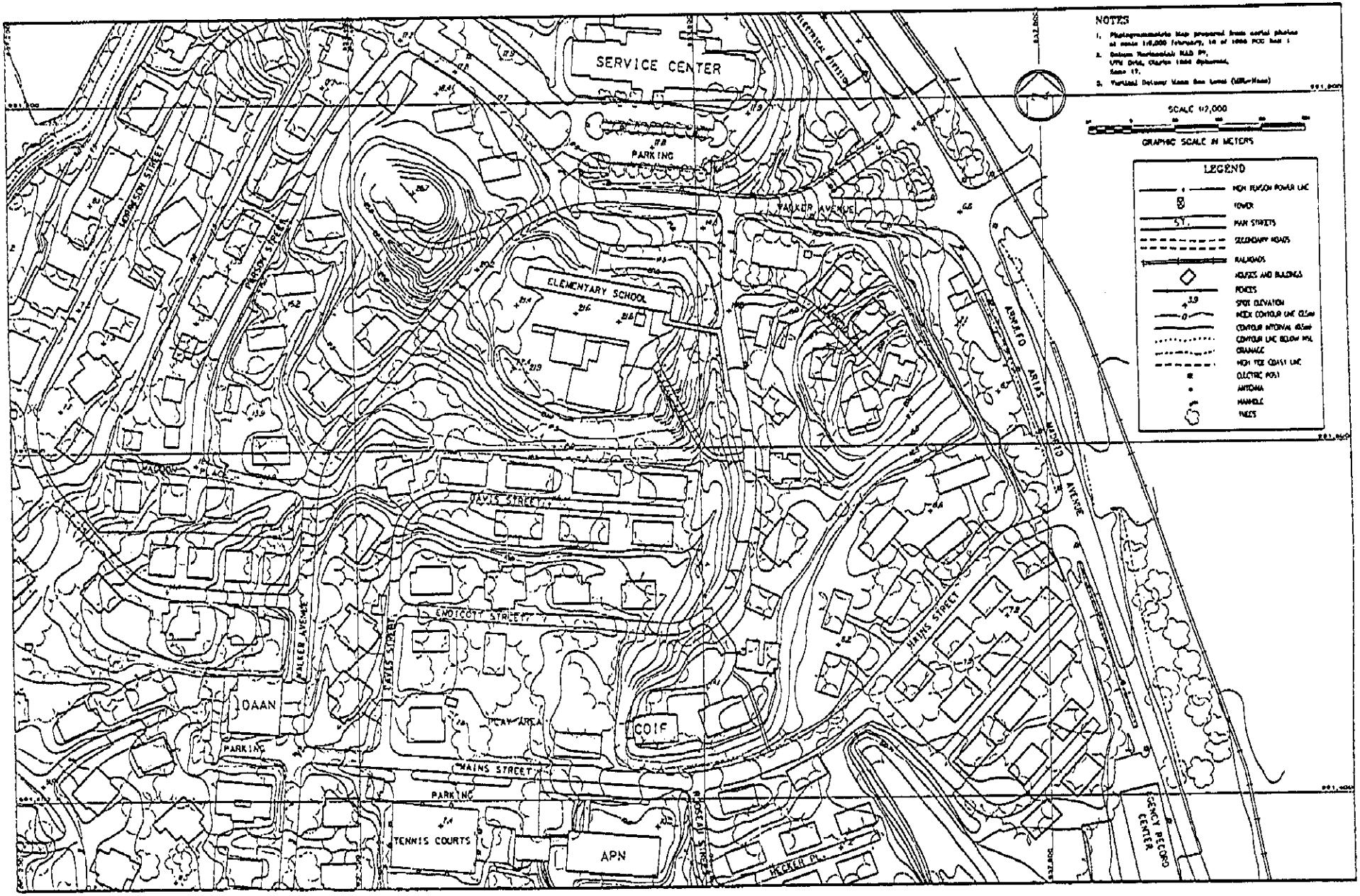
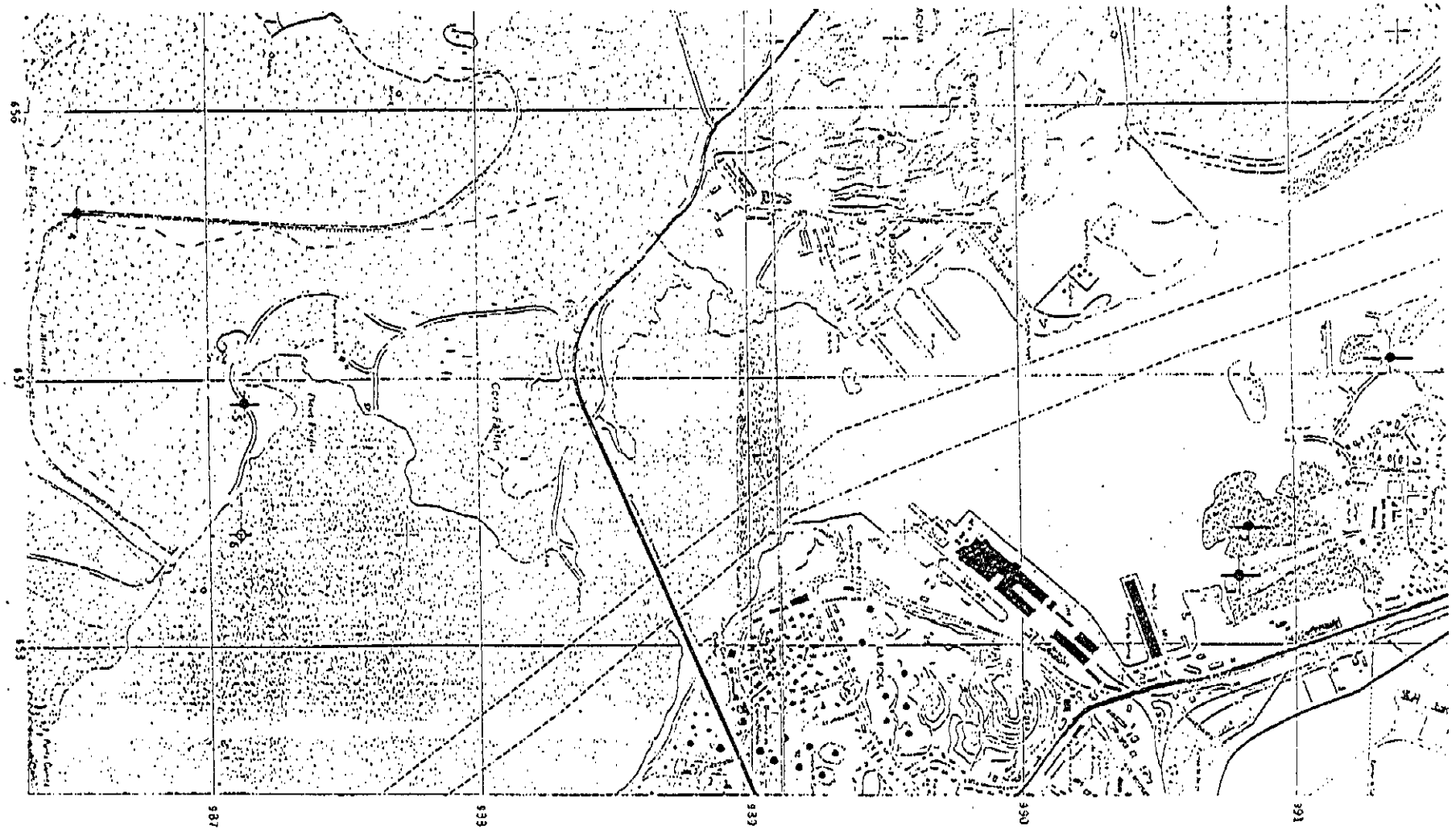


Figure 2-1-5 Topographic Map, 8/10

Figure 2-1-6 Bathymetric Map Offshore Diablo



LOCATION DETAIL

Job No. 4-171
Project : Development of the Port of Balboa
Location: The Bay of Panama, entrance to the Panama Canal, Republic of Panama
Client : PACIFIC CONSULTANTS INTERNATIONAL
Date : December 1996

Figure 2-1-7 Location of Borehole Exploration

JOB No. 4-171 HOLE No. 1 DRILL TYPE MECHANICAL

PROJECT DEVELOPMENT OF THE PORT OF BALBOA

LOCATION WALKER STREET, DIABLO

CLIENT PACIFIC CONSULTANTS INTERNATIONAL DATE November 19, 1995

Metres DEPTH	ELEV.	SYMBOL	DESCRIPTION OF MATERIAL VISUAL ELEV. +39.377 (MSL)	SAMPLE No.	TYPE OF SAMPLE	STANDARD PENETRATION TEST N Blows	P cm	q_u Kg/cm²	RECOVERY %	WATER CONTENT %	REMARKS
0.10			TOPSOIL								0.00
0.30											
0.60			DARK BROWN CLAYEY SILT FILL, FIRM, MEDIUM PLASTICITY	1	D	5 5 5	15 15 15	1.16	69.8	47.6	
1.50			OCHRE WITH WHITE SPOTS SILTY CLAY FILL, MEDIUM FIRM TO FIRM, MEDIUM PLASTICITY, MEDIUM WATER CONTENT. CL	2	D	3 2 2	15 15 15	0.50	100.0	35.2	
2.40											
3.00			GRAY ORGANIC CLAY, SOFT TO VERY SOFT WITH DEPTH; MEDIUM PLASTICITY; HIGH WATER CONTENT	3	D	9 3 1	15 15 15	0.50	100.0	55.4	C TCB
4.50			OH	4	D	W	45	0.20	44.4	86.9	
4.90				1	UD		60		83.3		
6.00				5	D	3 6 6	15 15 15	1.48	22.2	60.2	
6.20											
7.00			GRAY WITH WHITE SPOTS (SHELLS) ORGANIC CLAY WITH SAND AND SHELLS, FIRM, MEDIUM PLASTICITY, HIGH WATER CONTENT.								
7.50			GRAY SILTY SAND WITH SHELLS AND GRANULAR MATERIAL, MEDIUM DENSE, LOW PLASTICITY, LOW WATER CONTENT	6	D	11 9 8	15 15 15	2.26	72.7	23.9	7.50
8.00											
9.00			GRAYISH GRAY CLAY, VERY DENSE, HIGH PLASTICITY, LOW WATER CONTENT CH	7	D	75	12	+10.0	100.0	24.0	TCB
10.00											10.00
10.07			SAME MATERIAL DESCRIBED ABOVE	8	D	75	7	+10.0	100.0	22.5	10.00
10.87			CREAM WITH GRAY STREAKS SOUND ROCK, SOFT, HIGH WATER CONTENT	1 9	R D	50	83 4	+10.0	71.2 100.0	23.4	DTB CB
11.31				2	R		100	74.2	100.0		
11.91				10	D	50	7	+10.0	100.0	28.1	
11.98											11.95
			END OF BORING								

ABBREVIATIONS

DHT - DROP HAMMER TABLE
D - DISTURBED
UD - UNDISTURBED
R - ROCK
B - ROCK BIT
P - PENETRATION
W - WASHED THROUGH
RQD - ROCK QUALITY DESIGNATION %
HT - HAMMER WEIGHT
C - CASING
DTB - DOWEL TIPPED BIT
FB - FISHTAIL BIT
TB - TOOTHED BIT
CB - CARBIDE BIT
DB - DIAMOND BIT

REMARKS:

W.T. + 3.90 AFTER 24 HOURS

W.T. IS AFFECTED BY THE TIDE

Figure 2-1-8 Borehole Profile Hole No.1

JOB No. 4-171 HOLE No. 2 DRILL TYPE MECHANICAL

PROJECT DEVELOPMENT OF THE PORT OF BALBOA

LOCATION ROOSEVELT STREET, DIABLO

CLIENT PACIFIC CONSULTANTS INTERNATIONAL DATE November 21, 1995

Metres DEPTH	ELEV.	SYMBOL	DESCRIPTION OF MATERIAL VISUAL ELEV. +4.0924 (MSL)	SAMPLE NO.	TYPE OF SAMPLE	STANDARD PENETRATION TEST N (Blows)	P cm	q_u Kg/cm²	RECOVERY %	WATER CONTENT %	REMARKS
0.05			TOPSOIL								0.00
0.60			FILL; LIGHT TO DARK BROWN MIXTURE OF SILTY SAND, ORGANIC CLAY AND RUBBLE; MEDIUM DENSE TO VERY SOFT; MEDIUM TO LOW PLASTICITY, LOW TO MEDIUM WATER CONTENT	1	D	11 8 6	15 15 15	1.80	44.4	14.9	
1.50				2	D	1 1 1	15 15 15	0.25	15.5	23.7	
3.00				3	D	8 3 7	15 15 15	1.16	33.3	41.1	C TCB
4.00											
4.50			GRAY ORGANIC CLAY; VERY SOFT TO SOFT WITH DEPTH; MEDIUM PLASTICITY; HIGH WATER CONTENT	4	D	1 1 2	15 15 15	0.37	44.4	56.2	
5.60				1	UD		60		50.0		
6.00			OH	5	D	HW	45	0.20	77.7	91.5	
7.50				6	D	1 2 2	15 15 15	0.50	100.0	79.9	7.50
7.55 8.00			GRAY WITH WHITE SPOTS (SHELLS) ORGANIC CLAY WITH SAND AND SHELLS, SOFT, MEDIUM TO HIGH PLASTICITY, MEDIUM WATER CONTENT	2	UD		60		100.0		
9.00				7	D	2 3 2	15 15 15	0.50	68.8	35.5	TCB
10.00			OH								10.00
10.00 10.50			LIGHT OCHRE CLAY WITH SAND; DENSE TO VERY DENSE WITH DEPTH; MEDIUM PLASTICITY, MEDIUM TO LOW WATER CONTENT	8	D	15 15 25	15 15 15	5.00	22.2	23.8	
12.00				9	D	11 13 22	15 15 15	4.50	100.0	41.3	TCB
13.50			CH	10	D	25	10	+10.0	100.0	25.4	
15.00 15.30				11	D	50	5	+10.0	100.0	21.3	15.00
15.75			GRAY SOUND ROCK, HARD, LOW WATER CONTENT	1	R		100	57.1	54.0		DTB
16.05 16.10				12	D	50	5	+10.0	100.0	15.2	CB 15.10
			END OF BORING								

NOMENCLATURE

DMT - DISPLACEMENT METHOD
D - DISTURBED
UD - UNDISTURBED
R - ROCK
W - WATER
P - PENETRATION
D - DISPLACEMENT PRESSURE

RQD - ROCK QUALITY DESIGNATION %
HW - HAMMER WEIGHT
C - CASING
DB - DOWNLOAD BIT
FS - FISHTAIL BIT
TB - TOOTH BIT
CB - CARBIDE BIT
DB - DIAMOND BIT

REMARKS:

W.T. = 2.40 m. AFTER 24 HOURS

W.T. IS AFFECTED BY THE TIDE

Figure 2-1-9 Borehole Profile Hole No.2

JOB No. 4-171 HOLE No. 3 DRILL TYPE MECHANICAL

PROJECT DEVELOPMENT OF THE PORT OF BALBOA

LOCATION END ROOSEVELT STREET, DIABLO

CLIENT PACIFIC CONSULTANTS INTERNATIONAL DATE November 23, 1955

Metres DEPTH	Metres ELEV.	SYMBOL	DESCRIPTION OF MATERIAL (VISUAL ELEV. +3.5308 (MSL))	SAMPLE No.	TYPE OF SAMPLE	STANDARD PENETRATION TEST N (Blows/ft)	P (cm)	q_u (Kg/cm²)	RECOVERY %	WATER CONTENT %	REMARKS
0.08			TOPSOIL								0.08
0.60			FILL; MIXTURE OF LIGHT BROWN HARDPAN SILT AND REDDISH BROWN SILTY CLAY, MEDIUM DENSE, MEDIUM TO LOW PLASTICITY, LOW TO MEDIUM WATER CONTENT	1	D	6 14 8	15 15 15	2.91	65.6	15.8	
1.50				2	D	4 2 10	15 15 15	1.49	17.7	29.2	
3.00				3	D	6 9 12	15 15 15	2.28	22.2	36.5	C TCB
4.10											
4.50			FILL: GRAY HARDPAN SILT WITH CLAY, MEDIUM DENSE, MEDIUM TO LOW PLASTICITY, MEDIUM WATER CONTENT	4	D	9 7 4	15 15 15	1.32	22.2	34.6	
6.00				5	D	9 9 8	15 15 15	2.00	65.6	27.1	
6.60											
7.50			GRAY WITH WHITE SPOTS (SHELLS) ORGANIC CLAY WITH SAND AND SHELLS, HARD, MEDIUM PLASTICITY, HIGH WATER CONTENT OH	6	D	30 16 16	15 15 15	4.20	65.6	74.0	7.50
8.00											
9.00			GRAY ORGANIC CLAY, VERY SOFT TO MEDIUM FIRM WITH DEPTH, MEDIUM PLASTICITY, HIGH WATER CONTENT OH	1	UD		60		50.0		
				7	D	2 3 2	15 15 15	0.50	69.8	58.9	TCB
10.00											10.00
10.00			GRAY ORGANIC CLAY, VERY SOFT TO MEDIUM FIRM WITH DEPTH, MEDIUM PLASTICITY, HIGH WATER CONTENT OH								10.00
10.50				8	D	1 1 1	15 15 15	0.25	100.0	75.2	
11.00				2	UD		60		75.0		
12.60				9	D	1 1 1	15 15 15	0.25	77.7	85.6	
13.50				10	D	1 2 3	15 15 15	0.50	84.4	110.0	
15.00				11	D	15 11 14	15 15 15	3.30	84.4	83.0	TCB
15.80											
16.50			DARK BROWN WITH GRAY STREAKS CLAYEY SILT, DENSE TO VERY DENSE WITH DEPTH; MEDIUM TO LOW PLASTICITY; LOW WATER CONTENT ML	12	D	14 21 28	15 15 15	5.45	55.5	35.5	
18.00				13	D	24 34 52	15 15 15	6.55	95.5	28.2	
19.50				14	D	50 52	15 10	+10.0	100.0	23.0	19.50 DTB CB 20.60
20.00											20.00
20.75			SAME MATERIAL DESCRIBED ABOVE	1	R		100		15.0		DTB
20.90				15	D	69	15	+10.0	100.0	21.6	CB 20.90
			END OF BORING								

NON-COHESIVE

GW - GRAVELLY WELL GRADED
B - BOULDERS
CB - COBBLES
R - ROCK
S - SAMPLER
P - PENETRATION
C - UNCONFINED COMPRESSION

MGS - MODERATELY GRADED SANDY GRAVEL
MW - MODERATELY WELL GRADED
C - CORING
DTB - CONTINUED
TB - STANDARD
TCB - TRIPLE CORE BIT
CB - CORE BIT
DB - DIAMOND BIT

REMARKS:

W.L. = 2.50 m. AFTER 24 HOURS

W.L. IS AFFECTED BY THE TIDE

Figure 2-1-10 Borehole Profile Hole No.3

Table 2-1-1 Results of Single Compression Test

Borehole No.	Sample No.	Depth m.	w%	γ_m	γ_d	qu	C
1	1 UD	4.90 - 5.50	79.2	1.455	0.812	0.95	0.475
2	2 UD	8.00 - 8.60	78.0	1.582	0.889	0.58	0.29
3	2 UD	11.00 - 11.60	73.0	1.360	0.786	0.76	0.38
4	1 UD	6.80 - 7.40	87.7	1.402	0.747	0.51	0.26

Where:

W = Natural Water Content, %
γ_m = Wet Density, g/cm^3
γ_d = Dry Density, g/cm^3
qu = Single Compression, Kg/cm^2
C = Cohesion, Kg/cm^2

Table 2-1-2 Results of The Consolidation Test

Borehole No.	Sample No.	Depth m.	w %	γ_m t/m³	γ_d t/m³	G_s %	e_o	S_s	C_c	M_v m²/t	C_v m²/min.	a_v m²/t	P_c t/m²
1	1 UD	4.90 - 5.50	78.0	1.480	0.831	92.0	2.382	2.81	1.257	1.61×10^{-3}	12.256×10^{-3}	6.43×10^{-3}	6.46
2	2 UD	8.00 - 8.60	78.0	1.526	0.857	96.6	2.245	2.78	1.328	1.52×10^{-3}	18.96×10^{-3}	6.43×10^{-3}	10.76
3	2 UD	11.00 - 11.60	83.0	1.530	0.836	99.4	2.313	2.77	1.16	1.22×10^{-3}	4.01×10^{-3}	4.57×10^{-3}	5.38
4	1 UD	6.80 - 7.40	80.0	1.484	0.824	93.4	2.398	2.80	1.20	1.83×10^{-3}	8.74×10^{-3}	5.65×10^{-3}	6.57

Where:

W	=	Natural Water Content, %
γ_m	=	Wet Density, t/m³
γ_d	=	Dry Density, t/m³
G_s	=	Saturation, %
e_o	=	Void Radio
S_s	=	Specific Gravity
C_c	=	Compression Index
M_v	=	Volumetric Compressibility Coefficient, m²/t
C_v	=	Consolidation Coefficient, m²/min.
a_v	=	Compressibility Coeficient, m²/t
P_c	=	Preconsolidation Pressure, t/m²

Table 2-1-3 Laboratory Test Results Summary

HOLE No.	SAMPLE DISTURBED No.	DEPTH m.	NATURAL MOISTURE %	MECHANICAL ANALYSIS PERCENT PASSING						ATTERBERG LIMITS			SPECIFIC GRAVRRY	WET VOL WEIGHT Ke/m^3	CLASSIFI-CATION (S.U.C.S)
				#4	#10	#20	#40	#100	#200	L.L	L.P.	I.P.			
1	2	1.50 - 1.95	35.7	95.4	92.6		85.7		76.0	48.0	24.0	24.0	2.82		CL
1	8 y 9	10.00 -11.98	22.9	89.0	80.9		66.2		42.3	89.0	24.8	60.6	2.43		CH
2	4 y 5	4.50 - 6.45	56.2-91.5	98.1	89.6		79.1		74.0	67.0	36.4	30.6	2.76		OH
2	8,9 y 10	10.50 -13.60	26.4-41.3	98.6	97.1		92.4		79.0	60.4	27.2	33.2	2.68		CH
3	6,7,8 y 9	7.50 -12.00	58.9-86.6	93.8	88.9		82.4		69.2	54.9	30.9	24.0	2.77		OH
3	13,14 y 15	18.00 -20.90	21.6-28.2	93.5	90.4		79.9		70.2	34.1	24.5	9.6	2.64		ML
4	5,6,7 y 8	6.00 -10.50	79.4-83.3	98.3	95.4		91.4		85.2	49.6	28.3	21.3	2.73		OL
4	10 y 11	13.50 -15.00	28.7-38.6	98.8	95.1		80.3		72.7	58.2	23.0	35.2	2.62		MH
5	3 y 4	6.00 - 9.00	14.2-16.5	95.5	86.2		34.0		9.2	NON	PLASTIC		2.74		SW
5	6	12.00 -12.50	29.2	82.1	70.8		56.2		45.1	35.1	19.6	15.5	2.71		SC
6	1	1.50 - 1.95	21.6	98.8	84.5		26.6		16.4	30.0	14.0	16.0	2.72		SC
6	4	6.00 - 6.45	24.4	100.0	97.0		87.2		57.3	33.8	28.5	5.3	2.65		ML
1	1 UD	4.90 - 5.50	79.2	100.0	100.0		96.1		92.4	68.4	37.0	31.4	2.66	1.455	OH
2	2 UD	8.00 - 8.60	78.0	95.3	90.4		59.6		53.5	46.0	27.8	18.2	2.66	1.582	OL
3	2 UD	11.00 -11.60	73.0	98.8	89.8		74.4		67.4	57.1	32.1	25.0	2.70	1.360	OH
4	1 UD	6.80 - 7.40	87.7	93.5	76.8		73.0		71.1	58.0	30.2	27.8	2.68	1.402	OH

2.2 Preliminary Design of Major Port Facilities

2.2.1 Dredging and Reclamation

16. In view of the existence of the parent rock at Diablo, the face-line alignment of the quay wall is one of the decisive elements to determine the short-term development plan.

17. The face-line is technically selected on the verge of the existing anchoring area of the Balboa Inner Harbor as shown in Figure 2-2-1 so that the underwater rock excavation can be avoided.

18. The very soft marine origin sediments layer, about 5 m to 9 m thick, underlies the existing surface fill. The surface of the reclamation, therefore, is expected to settle 2 to 3 m where there is no reclamation yet and 0.3 to 0.5 m where fill has been already placed.

19. The dredging volume is about 850,000 m^3 and the required fill is estimated about 1,170,000 m3. However, the dredged materials will be probably unsuitable for the reclamation since the dredging is mainly to excavate the marine origin sediments.

20. In order to minimize the development cost, it is therefore suggested that the dredged materials should be disposed of to the shallow sea between Campo de juego and Anador. The reclamation should be made, in principle, with dry fill. However, should the suitable dredged materials from the canal are available with PCC (the dredged materials from the Culebra Cut, for example) and they be disposed of at the short-term development area at a reasonable cost, the use of the PCC's dredged materials should be negotiated.

21. In view of the existence of the soft sediments layer, the filling work is recommended to be carried out at the first stage development for both the first and second developments of the container terminal so that the consolidation can be expedited for the second development.

2.2.2 Container Terminal Facilities

1) Quay Wall

22. Along the selected face-line of the quay wall, very hard residual soil may

exist from about -9.5 m MLWS to deeper than -15 m MLWS, and no sound rock may be encountered shallower than -15 m MLWS (Borehole No. 3). Therefore, both of the two alternatives which are proposed in Part II of this report are technically valid. As an open concrete deck supported by cast-in-situ concrete piles, however, is more flexible to rock encounter than a concrete caisson bulkhead. In view of this, a concrete open deck supported by cast-in-situ piles is recommended. It is recommended that detailed subsoil investigation be conducted along the selected face-line, and the final decision on the type of the quay wall be made based on the results.

23. Figure 2-2-2 shows the cross section of the quay wall. As mentioned previously, the gauge of the crane rails is 30.26 m so that one quay-side container crane will be transferred from Pier No. 14 or Pier No. 15 of the Port of Balboa.

24. The top elevation is + 7.0 m MLWS which is about 1.1 m higher the highest water as it is at the existing piers. The front depth is to be - 13.0 m MLWS capable of accommodating over-panamax container vessels which are currently in operation.

25. The fender system is to absorb the berthing energy carried by an over-panamax container vessels of 6,000 TEU with a 0.15 m/sec speed and 10 degree angle of berthing. Bitts should resist a 90 ton mooring force.

26. The wheel loads of the container quay-side cranes and other live loads should be as set forth for the improvement of the Port of Balboa by APN.

2) Yard Pavement

27. The container yard is to be developed for RTG (Rubber-tyred Transfer Gantry crane) system and suitable for computerization of the cargo handling. To this end, a monolithic pavement is preferable. Meanwhile, the yard should be flexible to the settlement since the reclamation is made on the very soft marine origin sediments and uneven settlement is more or less inevitable. In this view, asphalt pavement is to be applied.

28. For allowing a heavy duty vehicle to handle a loaded containers, the yard pavement should be, for example, comprised of 90 mm asphaltic concrete, 200 mm base course and 200 mm sub-base course.

3) Buildings

29. Major buildings to be built for the container terminal are Gate Complex (26 m x 20 m), Terminal Complex (30 m x 30 m, 4 story), CFS (40 m x 40 m), Maintenance Shop (26 m x 30 m).

30. Gate Complex and Terminal Complex will be of a column and beam reinforced concrete structure with flat roofs and brick walls. Meanwhile the CFS and Maintenance Shop will be the same type of structure except the roofs, which should be steel truss beams with light roofing materials because of their large span.

31. In case that the container terminal is developed in two stages, all the buildings should be built at the first stage for their functions are necessary for the terminal operation.

2.2.3 Tuna Boat Berths

32. Tuna Boat Berths are to be built near the existing Pier No. 20. The subsoil information provided by APN and obtained by the borehole exploration (Borehole No. 3) indicates that the marine origin very soft sediments exist from about -0.5 m MLWS to - 9.5 m MLWS. Therefore, no gravity type bulkhead structure like concrete blocks, concrete caissons, can be economically built.

33. A concrete open deck supported by cast-in-situ concrete piles is technically recommended because the parent rock supposedly exists not much deeper than - 15 m MLWS. Neither precast concrete piles nor steel piles can be driven into the parent rock. Figure 2-2-3 shows the recommended cross section.

34. The fender system should be similar to the existing one at the north side of Pier No. 18, which is composed of vertical steel piles attached to the pier with horizontal steel member and rubber fenders.

35. The apron should be concrete pavement since oily wastes from tuna boat may damage the pavement if it is asphaltic.

2.2.4 Sand/Gravel Landing Berths

36. Sand/Gravel Landing Berths is allocated at the shore north of the pier of PCC at Diablo. As this water area is currently shallow (approximately +/- 0 m MLS or + 2.6 m MLWS), this area is to be dredged up to - 4 m MLWS. The dredging may encounter a small quantity of sound rock as the borehole exploration in this vicinity

(Borehole No. 1) confirmed the rock at - 3.5 m MLWS. The dredged materials, as they will be mainly composed of the residual soil, should be disposed of to the nearby swampy area across the existing road so that this disposal area can be used for sand stacking.

37. As sand and gravel are hydraulically unloaded at present, the same method will be applied for the new berths. In this regard, a pontoon 60 m long and 10 m wide is moored and used as the landing berths. The access will be a flexible ramp. The pontoon is horizontally fixed by 4 steel pipe piles driven into the seabed by a pre-boring method as rock will be encountered. The pontoon shall be vertically movable to the tidal changes being guided by these piles. Figure 2-2-4 shows the recommended cross section.

2.3 Maintenance and Rehabilitation

38. Since succeeding the Port of Balboa from PCC, APN has maintained all the facilities, periodically rehabilitating all the piers (deteriorated reinforced concrete beams and slabs of the apron deck have been patched with concrete) and conducted maintenance dredging of the Balboa Inner Harbor.

39 However, the repair of Pier No. 18 is urgent. It is observed that reinforcing steel bars of the beams and slabs are exposed and heavily rusted so that they have already destroyed the concrete and are intensifying damages.

40. The Balboa Inner Harbor has been maintained - 12 m to -13 m MLWS. It is reported that the siltation takes place at a rate of 24 cm per year. As urbanization is expected at the catchment area of the Curundu River, which flows in the inner harbor, the siltation will increase in near future. APN is to be responsible for maintaining the inner harbor sufficiently deep.

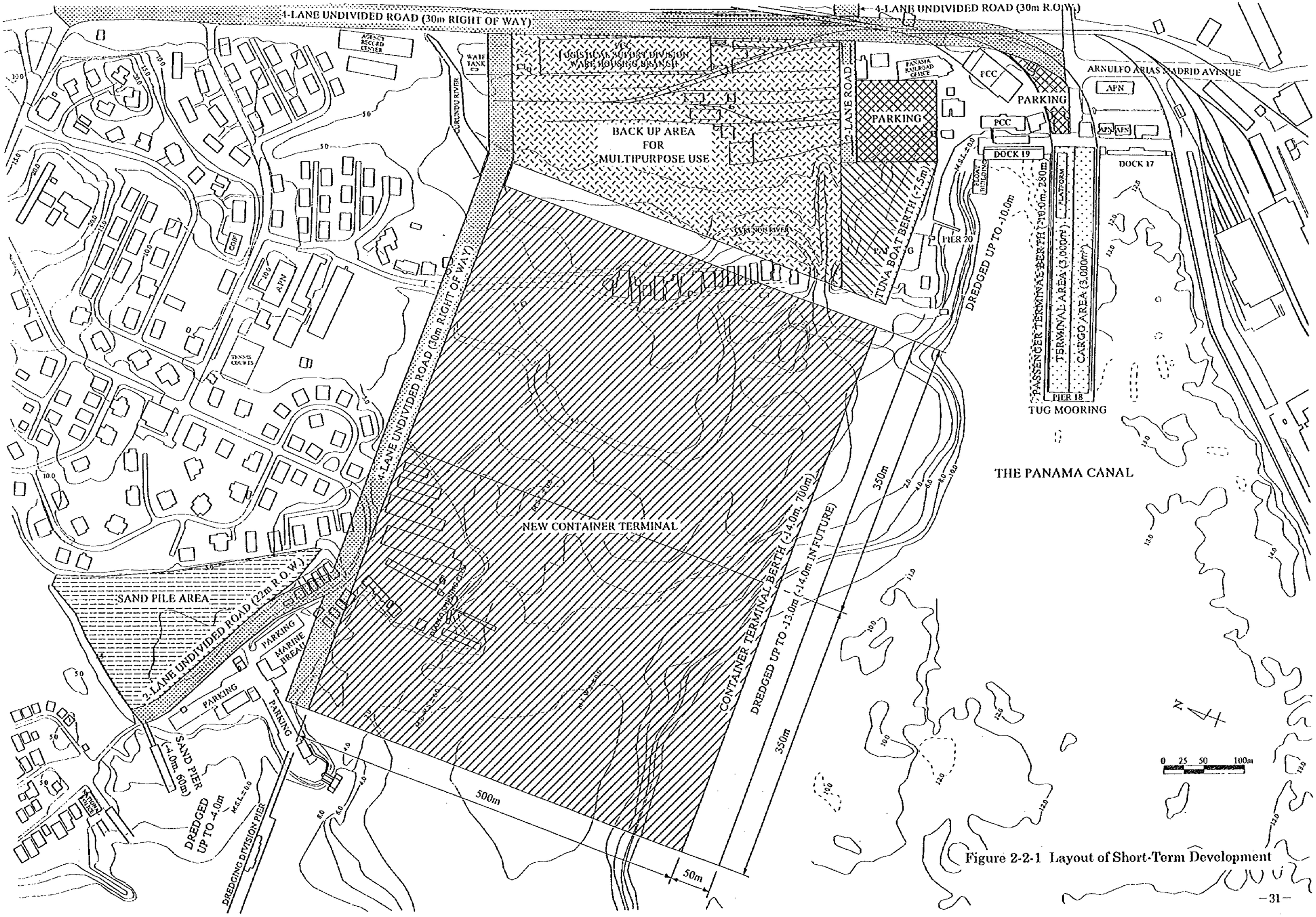


Figure 2-2-1 Layout of Short-Term Development

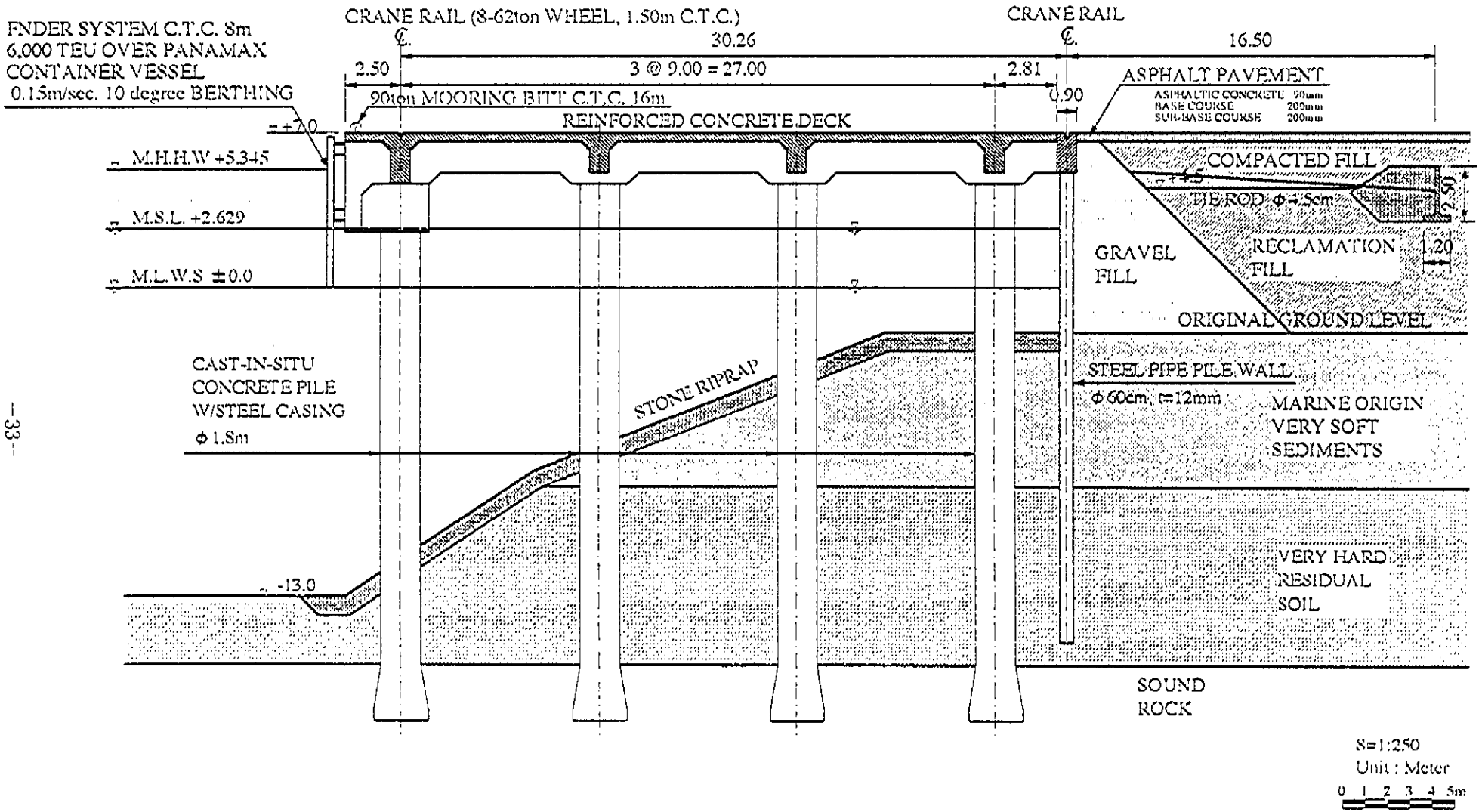


Figure 2-2-2 Recomended Cross Section of Container Terminal Quay

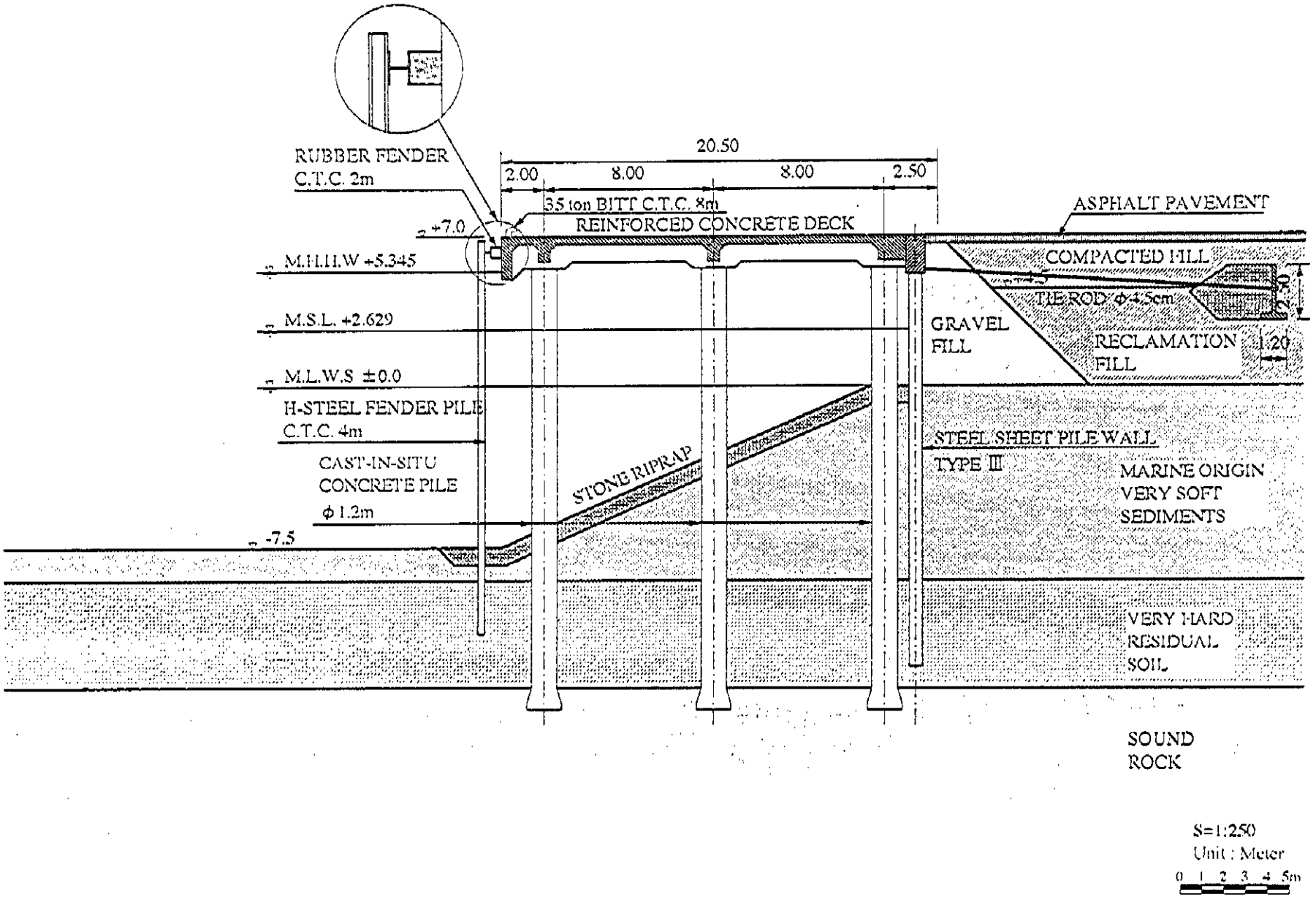


Figure 2-2-3 Recomended Cross Section of Tuna Boat Berths

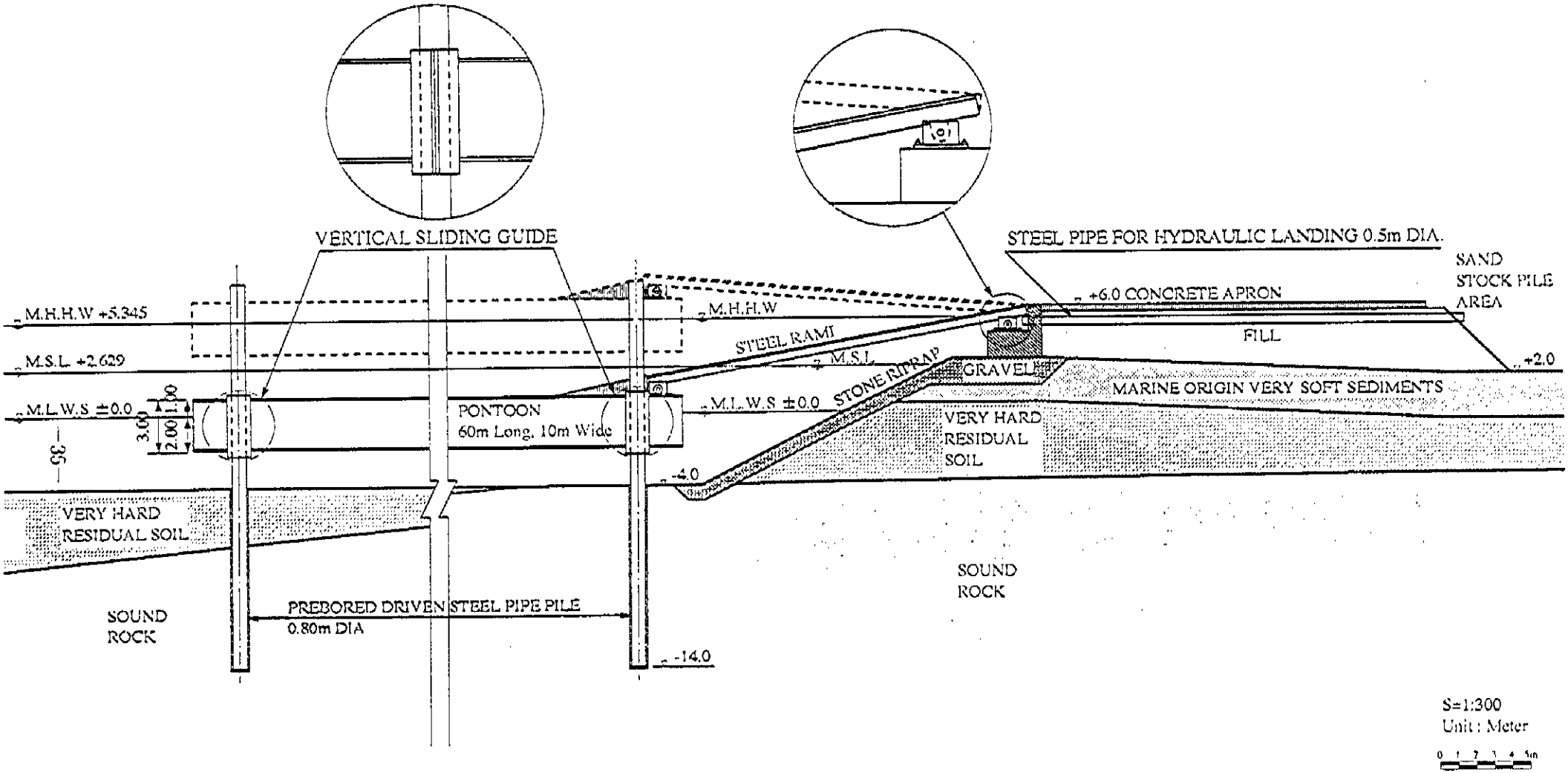


Figure 2-2-4 Conceptual Cross Section of Sand/Gravel Landing Berth

III PROJECT COST ESTIMATION AND SHORT TERM IMPLEMENTATION SHCHDULE

3.1 Cost Estimate

(1) Assumptions

1. The cost for the urgent measures of the existing pier of the Port of Balboa is fixed US$ 45,000,000 as informed by APN, regardless of the concession contract between APN and HIT.

(2) Quantities

2. The construction cost is estimated for the recommended structures of each port facility. Dredging and reclamation quantities are based on the topographic and bathymetric surveys that the JICA Study Team conducted.

(3) Unit Rates

3. Instead of detailed cost breakdown, unit rates are determined based on the indicative items such as dredging, reclamation, quay wall, pavement, building, etc. The costs of the ancillary works are in proportion to the major work costs. In estimating the cost, the unit prices of main construction works in Panama are referred to.

(4) Cost for Short-Term Development

4. Table 3-1-1 shows the cost estimate of the short-term development and Table 3-1-2 and Table 3-1-3 show the annual disbursement of the cost in accordance with the implementation schedule of the project in case of the low-case and high-case demands respectively.

5. The construction cost of the civil works of the Short-Term Development is estimated about 128 million US$ (the engineering cost included) while the procurement and other costs for the equipment is about 19 million US$ (the engineering cost included).

Table 3-1-1 Cost Estimate of Short-Term Development

Item No.	Description of Work	Unit	Quantity	Unit Rate	Total Amount
				(US$)	(US$)
A	Urgent Measures				
1	Improvement of Piers	l.s.	1	45,000,000	45,000,000
2	Equipment				
	a. Panamax Container Quay-side Cranes	each	2	4,500,000	9,000,000
	b. Transfer Crane	each	3	1,000,000	3,000,000
	c. Reach Stackers	each	1	350,000	350,000
	d. Top Lifters	each	3	70,000	210,000
	e. Trailers	each	10	60,000	600,000
	f. Chassis	each	12	20,000	240,000
					13,400,000
	Urgent Measures, Civil Works				45,000,000
	Ditto, Equipment				13,400,000
	Ditto, Total				58,400,000
B	Short-Term Development				
1	Container Terminals (Diablo 1st Stage)				
1.1	Dredging (-13m)	cu.m.	850,000	2.0	1,700,000
1.2	Reclamation	cu.m.	350,000	6	2,100,000
1.3	- 14m Quay	l.m.	350	67,500	23,625,000
1.4	Pavement	sq.m.	110,000	150	16,500,000
1.5	Building	sq.m	6,500	200	1,300,000
1.6	Electrical Works	l.s.	1	1,600,000	1,600,000
1.7	Utilities Works	l.s.	1	800,000	800,000
1.8	Access Road	l.m.	520	2,400	1,248,000
1.9	Miscellaneous Works	l.s.	1	4,890,000	4,890,000
					53,763,000
1.10	Post-Panamax Container Quay-side Crane	each	2	5,000,000	10,000,000
1.11	Transfer Cranes	each	3	1,000,000	3,000,000
					13,000,000
2	Container Terminals (Diablo 2nd Stage)				
2.1	Reclamation	cu.m.	820,000	6	4,920,000
2.2	- 14m Quay	l.m.	350	67,500	23,625,000
2.3	Pavement	sq.m.	123,000	150	18,450,000
2.4	Electrical Works	l.s.	1	400,000	400,000
2.5	Utilities Works	l.s.	1	200,000	200,000
2.6	Access Road	l.m.	350	2,000	700,000
2.7	Miscellaneous Works	l.s.	1	4,830,000	4,830,000
					53,125,000
2.10	Post-Panamax Container Quay-side Crane	each	1	5,000,000	5,000,000
2.11	Transfer & Reinstall of Panamax Container Quay-side Crane	l.s.	1	750,000	750,000
					5,750,000

Item No.	Description of Work	Unit	Quantity	Unit Rate	Total Amount
				(US$)	(US$)
3	Tuna Boat Berths (Balboa)				
3.1	Dredging	cu.m.	190,000	1.5	285,000
3.2	- 7.5 m Quay	l.m.	180	50,000	9,000,000
3.3	Pavement	sq.m.	3,600	100	360,000
3.4	Access Road	l.m.	240	1,000	240,000
3.5	Electrical/Utilities/Miscellaneous Works	l.s.	1	1,980,000	1,980,000
					11,865,000
4	Sand/Gravel Landing Berth (Amador)				
4.1	Dredging	cu.m.	170,000	2.5	425,000
4.2	- 4.0 m Quay (pontoon type 60 m)	l.s.	1	200,000	200,000
4.3	Electrical/Utilities/Miscellaneous Works	l.s.	1	31,250	31,000
					656,000
5	Renovation of Pier No.18				
5.1	Passenger Terminal (3,000 m2)	sq.m.	3,000	150	450,000
5.3	Parking (6,800 m2)	sq.m.	6,800	50	340,000
5.4	Electrical/Utilities/Miscellaneous Works	l.s.	1	39,500	40,000
					830,000
6	Substitute Mangrove at Amador	cu.m	850,000	1	850,000
6.1	Soil Transport and Fill	l.m.	1,200	550	660,000
6.2	Submerged Dike	ha	14	4,500	63,000
6.3	Plantation				1,573,000
	Short-Term Development, Civil Works				121,812,000
	Ditto, Equipment				18,750,000
	Ditto, Total				140,562,000
	Civil Works, Total				166,812,000
	Equipment Total				32,150,000
	Total				198,962,000
	Engineering Cost				8,984,000
	Grand Total				207,946,000

Table 3-1-2 Annual Disbursement of Short-Term Development (Low-case Demand)

		Total Amount	1.997	1.998	1.999	2.000	2.001	2.002	2.003	2.004	2.005
		(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)
A	Urgent Measures										
1	Improvement of Piers	46,000,000	16,000,000	16,000,000	16,000,000						
2	Equipment (longer life time)	9,000,000		3,000,000	6,000,000						
2	Equipment (shorter life time)	4,400,000		2,200,000	2,200,000						
		58,400,000	16,000,000	20,200,000	22,200,000						
B	Short-Term Development										
1	Container Terminals (Diablo 1st stage)										
	Civil Works										
	Dredging (-13m)	1,700,000		1,700,000							
	Reclamation	2,100,000		1,050,000	1,050,000						
	- 14m Quay	25,625,000			16,750,000	7,875,000					
	Pavement	16,500,000				16,500,000					
	Building	1,300,000				1,300,000					
	Utilities and Other Works	8,638,000				8,638,000					
	Civil Works Sub-Total	55,763,000		2,750,000	16,800,000	34,213,000					
	Equipment (longer life time)	10,000,000			6,000,000	6,000,000					
	Equipment (shorter life time)	3,000,000			1,500,000	1,500,000					
2	Container Terminals (Diablo 2nd Stage)										
	Civil Works										
	Reclamation	4,920,000			1230000	2460000	1230000				
	- 14m Quay	25,625,000							16,750,000	7,875,000	
	Pavement	18,400,000								18,400,000	
	Utilities and Other Works	6,130,000							3,066,000	3,066,000	
	Civil Works Sub-Total	55,125,000			1,230,000	2,460,000	1,230,000		19,816,000	29,350,000	
	Equipment (longer life time)	6,750,000								6,750,000	
	Equipment (shorter life time)										
3	Tuna Boat Berths (Balboa)										
	Dredging	285,000						285,000			
	- 8.5 m Quay	9,000,000							9,000,000		
	Other Works	2,580,000							1,720,000	860,000	
	Sub-Total	11,865,000						285,000	10,720,000	860,000	
4	Sand/Gravel Landing Berth (Diablo)										
	Dredging	425,000						425,000			
	- 4.0 m Quay (pontoon type 60 m)	200,000					160,000	40,000			
	Other Works	31,000						31,000			
	Sub-Total	656,000					160,000	496,000			
5	Renovation of Pier No.18	830,000								830,000	
6	Substitute Mangrove at Amador	1,673,000		1,673,000							
	Civil Works Sub-total	160,812,000	16,000,000	19,323,000	33,030,000	36,673,000	1,390,000	781,000	29,636,000	31,080,000	0
	Civil Engineering Cost (6%)	8,341,000	760,000	966,000	1,652,000	1,833,000	70,000	39,000	1,477,000	1,554,000	0
	Equipment (longer life time) Sub-total	24,750,000	0	3,000,000	11,000,000	6,000,000	0	0	0	6,750,000	0
	Equipment (shorter life time) Sub-total	7,400,000	0	2,200,000	3,700,000	1,500,000	0	0	0	0	0
	Mechanical Engineering Cost (2%)	643,000	0	104,000	294,000	130,000	0	0	0	115,000	0
	Total	207,946,000	16,760,000	26,593,000	49,676,000	46,136,000	1,460,000	820,000	31,012,000	38,499,000	0

Table 3-1-3 Annual Disbursement of Short-Term Development (High-case Demand)

		Total Amount	1.997	1.998	1.999	2.000	2.001	2.002	2.003	2.004	2.005
		(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)
A	Urgent Measures										
1	Improvement of Piers	46.000.000	16.000.000	16.000.000	15.000.000						
2	Equipment (longer life time)	9.000.000		3.000.000	6.000.000						
2	Equipment (shorter life time)	4.400.000		2.200.000	2.200.000						
B	Short-Term Development										
1	Container Terminals (Diablo 1st stage)										
	Civil Works										
	Dredging (-13m)	1.700.000		1.700.000							
	Reclamation	2.100.000		1.060.000	1.060.000						
	- 14m Quay	23.625.000			16.750.000	7.875.000					
	Pavement	16.500.000				16.500.000					
	Building	1.300.000				1.300.000					
	Utilities and Other Works	8.638.000				8.638.000					
	Civil Works Sub-Total	53.763.000	0	2.760.000	16.800.000	34.213.000	0	0	0	0	0
	Equipment (longer life time)	10.000.000			6.000.000	6.000.000					
	Equipment (shorter life time)	3.000.000			1.600.000	1.600.000					
2	Container Terminals (Diablo 2nd Stage)										
	Civil Works										
	Reclamation	4.020.000			1.640.000	2.460.000	820.000				
	- 14m Quay	23.625.000					16.750.000	7.875.000			
	Pavement	18.450.000					6.150.000	12.300.000			
	Utilities and Other Works	6.130.000					1.230.000	4.900.000			
	Civil Works Sub-Total	53.125.000	0	0	1.640.000	2.460.000	23.950.000	25.075.000	0	0	0
	Equipment (longer life time)	6.750.000					750.000	6.000.000			
	Equipment (shorter life time)										
3	Tuna Boat Berths (Dalbos)										
	Dredging	285.000							285.000		
	- 7.6 m Quay	9.000.000							3.000.000	6.000.000	
	Other Works	2.580.000								2.580.000	
	Sub-Total	11.865.000	0	0	0	0	0	0	3.285.000	8.580.000	0
4	Sand/Gravel Landing Berth (Diablo)							0			
	Dredging	425.000							425.000		
	- 4.0 m Quay (pontoon type 60 m)	200.000							200.000		
	Other Works	31.000							31.000		
	Sub-Total	656.000							656.000		
5	Renovation of Pier No.18	830.000								830.000	
6	Substitute Mangrove at Amador	1.673.000		1.673.000							
	Civil Works Sub-total	160.812.000	16.000.000	19.323.000	33.440.000	36.673.000	23.950.000	25.075.000	3.941.000	9.410.000	0
	Civil Engineering Cost (6%)	8.341.000	760.000	906.000	1.072.000	1.833.000	1.198.000	1.254.000	197.000	471.000	0
	Equipment (longer life time) Sub-total	24.750.000	0	3.000.000	11.000.000	6.000.000	750.000	6.000.000	0	0	0
	Equipment (shorter life time) Sub-total	7.400.000	0	2.200.000	3.700.000	1.500.000	0	0	0	0	0
	Mechanical Engineering Cost (2%)	643.000	0	104.000	204.000	130.000	16.000	100.000	0	0	0
	Total	207.946.000	16.760.000	26.503.000	50.106.000	46.156.000	26.913.000	31.429.000	4.138.000	9.881.000	0

3.2 Construction Schedule

6. The short-term development shall meet the demand forecast, both the low-case and high-case demands; Urgent Improvement must be completed before 2000 and the first stage of the short-term development before 2001 in both cases. The second stage shall be completed before 2005 in the low-case demand and before 2003 in the high case demand.

7. The construction schedule is made based on quantities of the major work items such as dredging, reclamation, quay wall, pavement, etc.

8. In both the low and high demand cases, the reclamation is scheduled to continue from the first stage development to the second stage in order to expedite the consolidation. The renovation of Pier No. 18 can be commenced when Tuna Boat Berths are completed.

9. Figure 3-2-1 shows the construction schedule for the low-case demand while Figure 3-2-2 shows the high-case demand.

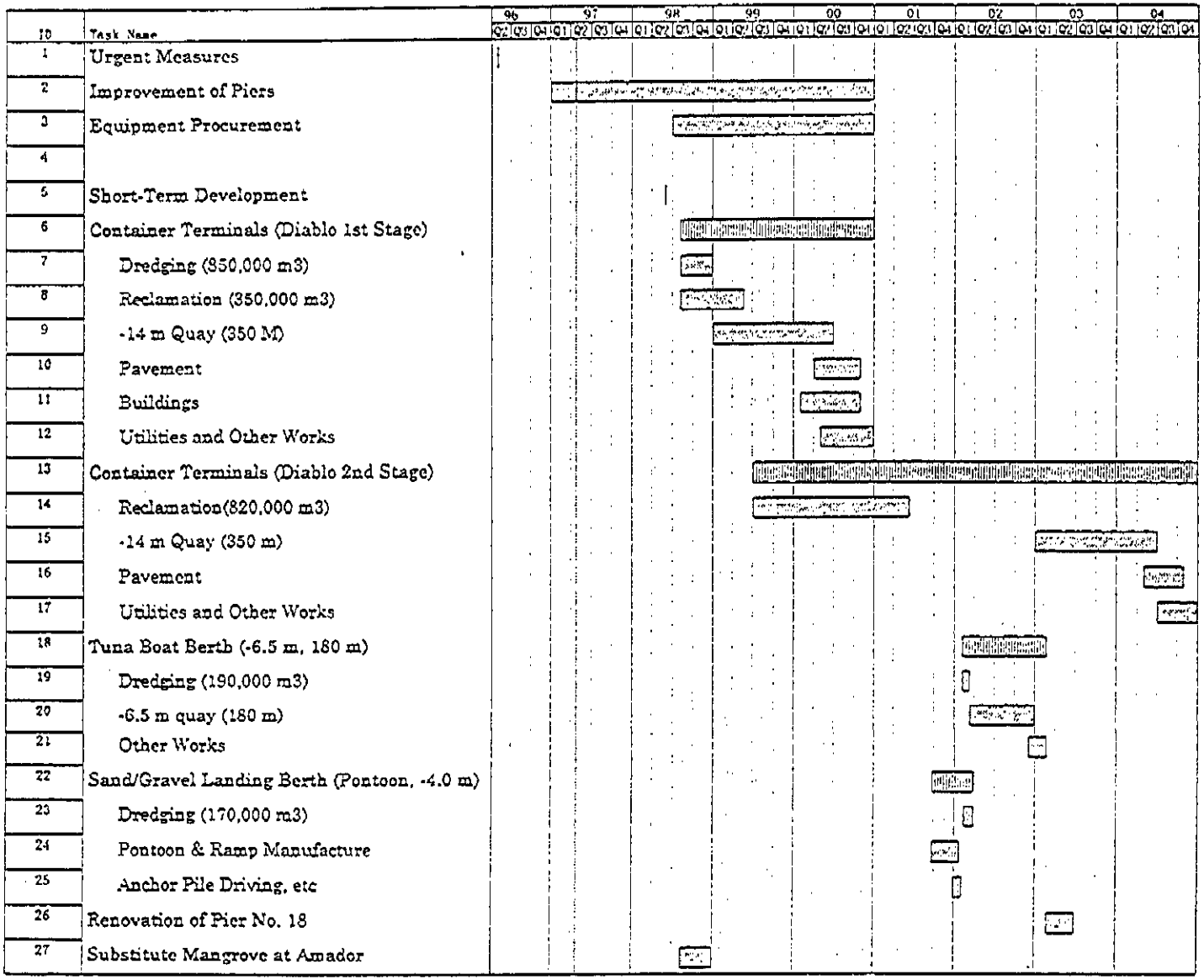


Figure 3-2-1 Construction Schedule of Short-Term Development
(Low-case Demand)

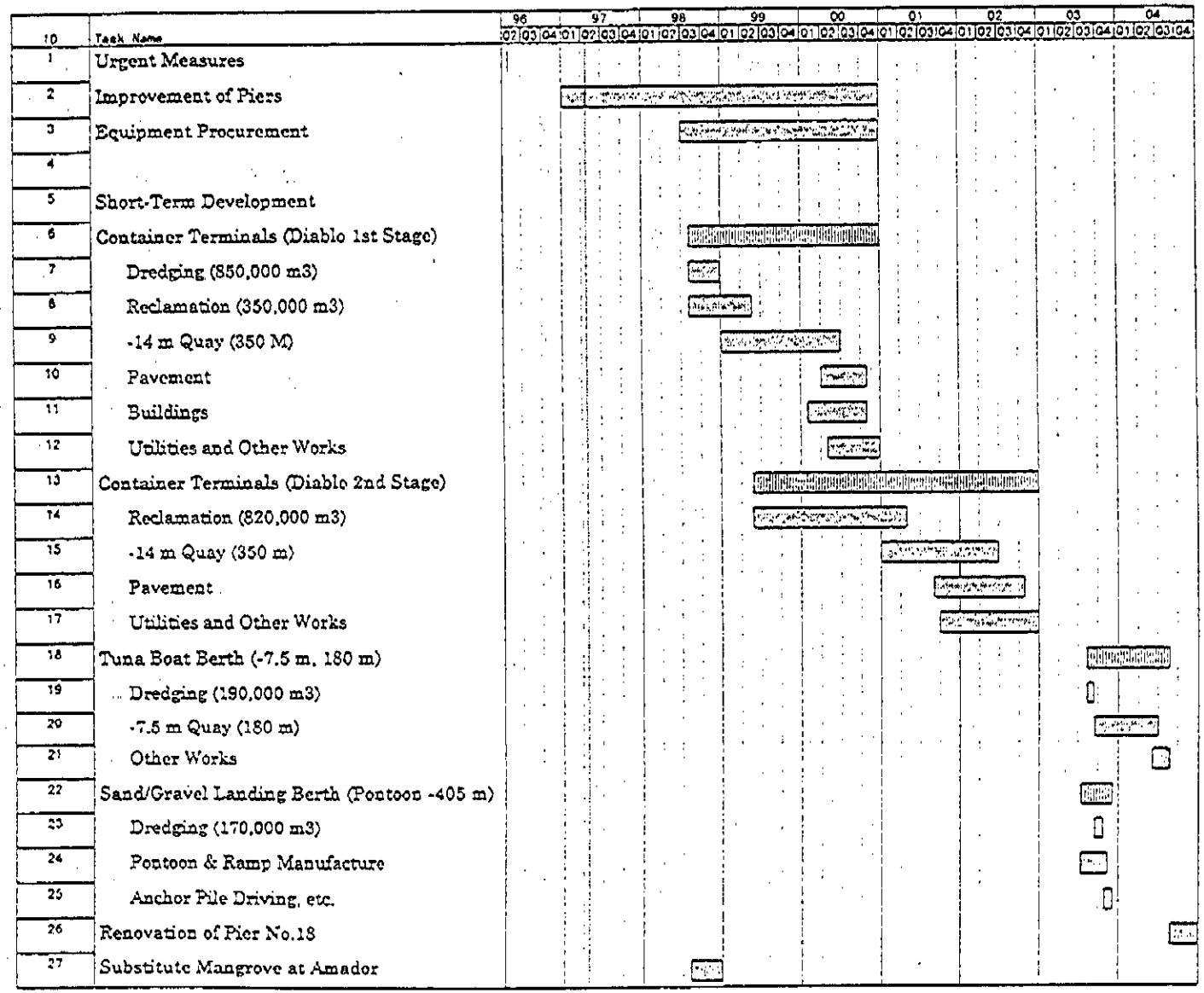


Figure 3-2-2 Construction Schedule of Short-Term Devleopment
(High-case Demand)