Chapter 8 Demand Forecast

1. Basic assumptions

(1) Since the roles and functions of ports vary with the socio-economic structure of their hinterlands which are largely influenced by national and regional socio-economic development policy, the future functions or roles of the Port of Calcutta and thus the basic direction of the port development should be determined in coordination with the socio-economic policy.

Now, in India, the national economic development policy is presently under the Seventh Five Year Plan 1985-90 and the work for the new economic development policy, the Eighth Five Year Plan 1990-95, is going to start soon (some work may already have started). At present the fundamental future direction of the national economic policy is not yet clear except as described in the Seventh Five Year Plan 1985-90. Thus in this Study, it is assumed that the basic direction of national and regional development will not greatly change from the recent past, and the future growth of the Indian economy is forecast considering the historical growth and the forecast growth of the world economy.

(2) Future Socio-economic framework

In this study, three alternatives, that is high, medium and low projection, are prepared. Table 8-1-1 shows the projected GDP and sectorial GDP from 1990 to 2005 and Table 8-1-2 shows the projected population from 1990 to 2005.

Table 8-1-1 Future Socio-Economic Framework (GDP Projection)

(Unit: Rs, Crores)

	India (1970-71 prices)					Annual Growth Rate				Share (%)				
	1985	1990	1995	2000	2005	90/85	95/90	00/95	05/00	'85	'90	'95	'00	'05
Medium Case														
G D P	61,693	78,738	100,492	128,256	163,691	5.0	5.0	5.0	5.0	100	100	100	100	100
Agriculture	24,924	29,527	33,564	37,579	42,076	3.4	2.6	2.3	2.3	40.4	37.5	33.4	29.3	25.7
Industry	14,066	18,503	26,329	36,938	52,748	5.6	7.3	7.0	7.4	22.8	23.5	26.2	28.8	32.2
Services	22,703	30,708	40,599	53,739	68,867	6.2	5.7	5.8	5.1	36.8	39.0	40.4	41.9	42.1
High Case														
G D P	61,693	78,738	105,369	141,007	188,699	5.0	6.0	6.0	6.0	100	100	100	100	100
Agriculture	24,924	29,527	35,193	41,315	48,496	3.4	3.6	3.3	3.3	40.4	37.5	33.4	29.3	25.7
Industry	14,066	18,503	27,607	40,610	60,761	5.6	8.3	8.0	8.4	22.8	23.5	26.2	28.8	32.2
Services	22,703	30,708	42,569	59,082	79,442	6.2	6.8	6.8	6.1	36.8	39.0	40.4	41.9	42.1
Low Case														
G D P	61,693	78,738	95,797	116,552	141,803	5.0	4.0	4.0	4.0	100	100	100	100	100
Agriculture	24,924	29,527	31,996	34,150	36,443	3.4	1.6	1.3	1.3	40.4	37.5	33.4	29.3	25.7
Industry	14,066	18,503	25,099	33,567	45,661	5.6	6.3	6.0	6.3	22.8	23.5	26.2	28.8	32.2
Services	22,703	30,708	38,702	48,835	59,699	6.2	4.7	4.8	4.1	36.8	39.0	40.4	41.9	42.1

Assumption: We assume 5 percent of GDP annual growth rate as medium case by the reasons that 1) GDP annual growth rate during 1975 to 1985 is approximately 5 percent, and 2) Seventh Five Year Plan 1985-90 assumes 5 percent as GDP annual growth rate during 1985 to 2000. Then we assume 6 percent as high case and 4 percent as low case.

Table 8-1-2 Projected Population

India (in millions)

	1986	1990	1995	2000	2005	90/86	95/90	00/95	05/00
Medium Case	758	820	897	972	1,052	2.0	1.7	1.6	1.6
High Case	758	826	922	1,030	1,151	1.7	2.2	2.2	2.2
Low Case	758	816	884	941	1,002	1.5	1.6	1.3	1.3

Assumption: we adopt the projection by "A Social and Economic Atlas of India" as medium case, the projection by CPT data as high case, and the projection by IBR as low case.

2. Cargo Traffic Method

Two methods are used to forecast the cargo volume to be handled at the Port of Calcutta. One is a macro forecast which is a method to estimate the total cargo volume as a whole including many commodities, regardless of the volume of each commodity. The other is micro forecast, which is a method to estimate the cargo volume of each commodity group individually.

3. Summary of Cargo Traffic Forecast

As a conclusion, Table 8-1-3 shows a summary of the cargo forecast. The table is a comparison of the total cargo volumes obtained by the macro and micro forecast methods.

Herein, the future cargo volumes to be handled at Calcutta/Haldia in the target years are assumed equal to those forecast in the medium case of the forecast by commodity group, that is the micro forecast.

Table 8-1-3 Comparison of Cargo Forecasts

(Unit: '000 tonnes)

	Case	1995	2000	2005
Macro forecast	Medium	20,000	27,200	36,990
	High	21,700	31,030	44,370
	Low	18,390	23,470	29,960
Micro forecast	Medium	20,660	24,710	28,955
	High	21,025	25,585	30,360
	Low	20,370	24,040	27,885

Table 8-1-4 Summary of Cargo Forecast (Unit: '000 tonnes)

		1995			2000			2005		
		Calcutta	Haldia	Total	Calcutta	Haldia	Total	Calcutta	Haldia	Total
IMPORT	POL(Crude)	-	2,610	2,610	-	2,610	2,610	-	2,610	2,610
	POL(Products)	900	5,120	6,020	1,420 (1,340- 1,490)	6,030	7,450 (7,370- 7,520)	1,945 (1,895- 1,995)	7,100	9,045 (8,995- 9,095)
	Foodgrain	200	-	200	400	-	400	400	-	400
	Finished Fertilizer	20	25	45	25	30	55	30	35	65
	Raw Materials for Fertilizer	380	530	910	470	1,350	1,820	630	1,800	2,430
	Iron, Steel & Machinery	260 (220- 370)	-	260 (220- 370)	325 (285- 545)	-	325 (285- 545)	465 (385- 780)	-	465 (385- 780)
	Coking Coal	-	1,800 (2,500 as high case)	1,800 (2,500)	-	1,800 (2,500 as high case)	1,800 (2,500)	-	1,800 (2,500 as high case)	1,800 (2,500)
	Cement	150	-	150	185	-	185	230	-	230
	Edible Oil	190	-	190	235	-	235	285	-	285
	Other Liquid Cargo	30	280	310	50	500	550	70	890	960
	Salt	10	-	10	10		10	10		10
	Other Cargo	1,950 (1,840- 2,070)	410 (380- 430)	2,360 (2,220- 2,500)	2,480 (2,220- 2,760)	680 (600- 750)	3,160 (2,820- 3,510)	3,240 (2,770- 3,760)	880 (760- 1,020)	4,120 (3,530- 4,760)
	Total	4,090 (3,940- 4,320)	10,775 (10,745-10,795)	14,865 (14,685-15,115)	5,600 (5,220- 6,170)	13,000 (12,920-13,070)	18,600 (18,140-19,240)	7,305 (6,705- 8,190)	15,115 (14,995-15,255)	22,420 (21,700-23,445)
EXPORT	POL (Product)	90	300 (705 as high case)	390	140 (135- 150)	360 (751 as high case)	500 (495- 510)	195 (190- 200)	430 (788 as high case)	625 (620- 630)
	Coal	-	4,150	4,150	-	4,150	4,150	-	4,150	4,150
	Iron, Steel & Machinery	65 (60- 75)	-	65 (60- 75)	70 (50- 90)	-	70 (50- 90)	80 (40- 125)	-	80 (40- 125)
	Jute & jute Products	265 (225- 305)	-	265 (225- 305)	230 (175- 280)	-	230 (175- 280)	195 (135- 255)	-	195 (135- 255)
	Tea	100 (85- 110)	100 (90- 115)	200 (175- 225)	105 (80- 135)	105 (85- 135)	210 (165- 270)	120 (70- 165)	120 (75- 165)	240 (145- 330)
	Cast Iron Goods	125	-	125	175	-	175	245	-	245
	Other Cargo	405 (380- 435)	195 (180- 205)	600 (560- 640)	445 (395- 500)	330 (295- 370)	775 (690- 870)	570 (485- 675)	430 (365- 505)	1,000 (850- 1,180)
	Total	1,050 (965- 1,140)	4,745 (4,720- 4,770)	5,795 (5,685- 5,910)	1,165 (1,010- 1,330)	4,945 (4,890- 5,015)	6,110 (5,900- 6,345)	1,405 (1,165- 1,665)	5,130 (5,020- 5,250)	6,535 (6,185- 6,915)
Grand Total		5,140 (4,905- 5,460)	15,520 (15,465-15,565)	20,660 (20,370-21,025)	6,765 (6,230- 7,500)	17,945 (17,810-18,085)	24,710 (24,040-25,585)	8,710 (7,870- 9,855)	20,245 (20,015-20,505)	28,955 (27,885-30,360)
CONTIANER	Import('000 tonnes)	580 (545- 635)	195 (180- 205)	775 (725- 840)	1,010 (905- 1,145)	390 (340- 425)	1,400 (1,245- 1,570)	1,460 (1,245- 1,730)	520 (445- 600)	1,980 (1,690- 2,330)
	No.of TEU's	55 (50- 59)	28 (26- 31)	83 (76- 90)	92 (84- 103)	50 (43- 56)	142 (127- 159)	134 (117- 155)	65 (53- 73)	199 (170- 228)
	of which Loaded	45 (42- 49)	17 (16- 18)	62 (58- 67)	78 (70- 89)	34 (29- 37)	112 (99- 126)	113 (97- 134)	45 (38- 52)	158 (135- 186)
	of which Empty	10 (8- 10)	11 (10- 13)	21 (18- 23)	14 (14- 14)	16 (14- 19)	30 (28- 33)	21 (20- 21)	20 (15- 21)	41 (25- 42)
	Export('000 tonnes)	530 (480- 550)	210 (190- 230)	740 (670- 780)	640 (600- 685)	320 (280- 380)	960 (880- 1,065)	775 (695- 865)	415 (325- 510)	1,190 (1,020- 1,375)
	No. of TEU's	55 (50- 59)	28 (26- 31)	83 (76- 90)	92 (85- 103)	50 (43- 56)	142 (128- 159)	134 (117- 155)	65 (53- 73)	199 (170- 228)
	of which Loaded	42 (38- 44)	19 (17- 21)	61 (55- 65)	51 (48- 55)	29 (25- 34)	80 (73- 89)	62 (56- 69)	37 (30- 45)	99 (86- 114)
	Empty	13 (12- 15)	9 (9- 10)	22 (21- 25)	41 (37- 48)	21 (18- 22)	62 (55- 70)	72 (61- 86)	28 (23- 28)	100 (84- 114)

Main Source of Projection

Cargo	Main Source of Projection	Reference (Vide Main Report)
Import		
P.O.L. (Crude & Products)	O.C.C, I.O.C data and CPT data	
Foodgrains	CPT data	
Finished Fertilizer	CPT data	
Raw Materials for Fertilizer	CPT data	
Iron, Steel & Machinery	SAIL data, CPT data	
Coking Coal	SAIL data, "Master Plan Study" of Vizag Port, CPT data	
Cement	CPT data	
Other Liquid Cargo	CPT data	
Other Cargo	CPT data	
Export		
P.O.L. (Products)	OCC and CPT data	
Coal	"Master Plan Study" of Tuticolin Port, CPT data	
Iron, Steel & Machinery	"Seventh Five Year Plan 1985-90" CPT data	
Jute and Jute Products	Data of India Jute Mills Association, CPT data	
Tea	Data of the Consulative Committee of Plantation Associations, CPT data	
Other Cargo	CPT data	

8-2-1 Vessel Traffic Forecast

(1) Calcutta Dock System

Accordingly, the estimated number of vessels calling at Calcutta can be summarized as follows.

Ship Type	Ship Size	Average Handling Volume		Number of Calling Vessels	
		in 1995	in 2005	in 1995	in 2005
Liquid Bulk Carriers	10,300 DWT	6,405 tons	7,905 tons	170	300
Dry Bulk Carriers	10,300 DWT	8,024 tons	9,259 tons	76	116
Container Vessels	(7,300 DWT in 1995) 8,900 DWT	3,885 tons 385 TEUs	4,835 tons 580 TEUs	286	190
General Cargo Vessels	9,400 DWT	4,785 tons	5,735 tons	462	507

(2) Haldia Dock System

The estimated number of vessels calling at Haldia can be summarized as follows.

Table 8-2-1 Estimated Number of Vessels Calling at Haldia

Ship Type	Ship Size	Average Handling Volume		Number of Calling Vessels	
		1995	2005	1995	2005
Crude Tanker	87,400 DWT 144,000	50,000 tons 63,000	-- 75,000 tons	26 21	-- 35
Product Tanker	35,000	28,000	32,000	194	235
Other Liquid Tanker	12,000 - 25,000	11,000 - 23,000	11,000 - 23,000	17	52
Ore Carrier (Coal)	35,000	29,500	32,500	141	131
Dry Bulk Carrier (Fertilizer/Material)	20,000 - 30,000	10,000	23,000	54	79
Ore Carrier (Coking Coal)	30,000 - 40,000	29,500	32,000	61	56
Conventional Carrier (General Cargo) (Bagged Fertilizer)	5,000 - 20,000 GRT	5,000 11,000	5,000 11,000	60 1	99 2
Container Ships	300/400 TEUs 500 TEUs over	250 TEUs --	-- TEUs 600	224 --	-- 480

8-2-2 IWT Traffic Forecast

The Report on the promotion of the inland waterways transportation (IWT) entitled "Master plan Development of the Inland Waterway Transport Terminals at Haldia and Calcutta" was prepared in 1987 for the Government of India.

IWT container throughput to be handled at Haldia and Calcutta, particularly container traffic between Calcutta and Haldia, are reviewed based on the newly forecasted maritime container traffic, and assuming the same traffic volume to/from Assam and FEPZ as estimated in the above Report.

The result revealed no major difference from the estimate in the above IWT Report, as follows.

(Unit: TEUs)

Year	Case	Dock System	IWT Report(*)	Review
1995	-	Calcutta	24,200	20,200
		Haldia	22,400	18,400
2005	Alternative-1	Calcutta	-	44,700
		Haldia	-	42,800
	Alternative-2	Calcutta	51,600	62,000
		Haldia	49,680	60,000

Note:(*) Number of TEUs are Calculated based on the numbers of boxes estimated in the IWT Report, assuming the ratio of TEU/Box No. = 1.1 in 1995, 1.2 in 2005.
Alternatives are those of container allocation (See p44.)

8-3 Port Traffic Forecast

8-3-1 General

In this section, the future traffic volume was forecast in each mode based on the present modal split, the cargo volume forecast in the previous section and the consideration stated as follows.

(1) At Calcutta port, the cargo volume transported by trucks is increasing. Most export cargoes and import general cargoes are carried by trucks at present. This trend seems likely to continue through 2005.

(2) The main role of railways is to carry cargoes over a long distance by block rake. Cargoes suitable for railway transportation are bulky cargoes viz. cement, fertiliser, oil products, coal, etc.

(3) The volume of cargoes which are transported by rail after being carried by road from Calcutta port seems likely to increase and cause congestion at nearby stations in the future. Therefore, the construction of a new loading terminal for block rakes seems necessary.

(4) Most cargoes handled at Haldia port are bulky cargo and are delivered by railway. This trend shall continue through 2005.

8-3-2 Bulky Cargo at Calcutta

(1) Premises

1) Considering the future modal split of imported bulky cargoes at Calcutta port, following scenarios are envisaged.

Scenario-1 Present modal share will continue

Scenario-2 Road cargo being taken to nearby stations will be shifted to railway after completion of a new loading terminal for block rakes.

Scenario-3,4 Modal share for Nepal cargo will change as follows.

	Fertilizer			Cement		
	Rail	:	Road	Rail	:	Road
Scenario-3	55	:	45	50	:	50
Scenario-4	70	:	30	65	:	35

2) Considering the cargo volume, especially of railway cargo, it seems reasonable to forecast the future cargo movement as follows.

In 1994/95 : The modal split follows Scenario-2.

In 2004/05 : The modal split follows Scenario-3 or Scenario-4.

(2) Traffic Volume

Accordingly, the railborne traffic volume in 1994/95 will be around 250 thousand tonnes and 80% of this will be handled at the new loading terminal. The balance will be handled at the quay side tracks behind the sheds.

In 2004/05, the railborne traffic volume will increase up to 500 thousand tonnes and most of this will be handled at a new loading terminal to be located at the EJC yard.

8-3-3 Bulky Cargo Volume at Haldia

(1) Premises

Coal and coking coal are transported by railway only at Haldia.

As for P.O.L, the modal split of P.O.L at Haldia at present is estimated as follows.

Road : 10%, waterway : 10%, pipeline 55%, Railway 25%

(2) Traffic Volume

Assuming the present modal share will not change through 2005, the future P.O.L traffic volume by rail is forecast as shown in Table 8-3-1.

Table 8-3-1 Estimated Bulky Cargo Volume by Rail at Haldia Port

		('000 tonne) Volume	Rail
COAL	1987/88	2,624	2,540
	1994/95	4,150	4,150
	2004/05	4,150	4,150
C/COAL	1987/88	500	510
	1994/95	1,800	1,800
	2004/05	1,800	1,800
P.O.L	1987/88	4,302	860
	1994/95	5,120	1,280
	2004/05	7,100	1,775

8-3-4 General Cargoes and Containers at Calcutta/Haldia

(1) Premises

1) General cargoes including containers will be transported in six modes as shown below.

For long distance

1 by railway in container

2 by road in break bulk

3 by IWT in container

For short distance in/around Calcutta

1 by road in container

2 by road in break bulk

3 by IWT between Calcutta/Haldia in container

2) The share of containers which will not be stuffed/unstuffed in the port and will move door to door is estimated as follows.

In 1995 50%

In 2005 80%

3) It is estimated that 20% of the total containers will be delivered as FCL by railway by 1995 and 30% by rail and IWT by 2005.

(2) Traffic Volume

Considering the above and the IWT demand forecast in Section 8-2-2, the future general cargo volume via each mode is estimated as shown in Table 8-3-2 (1995)and 8-3-3 (2005).

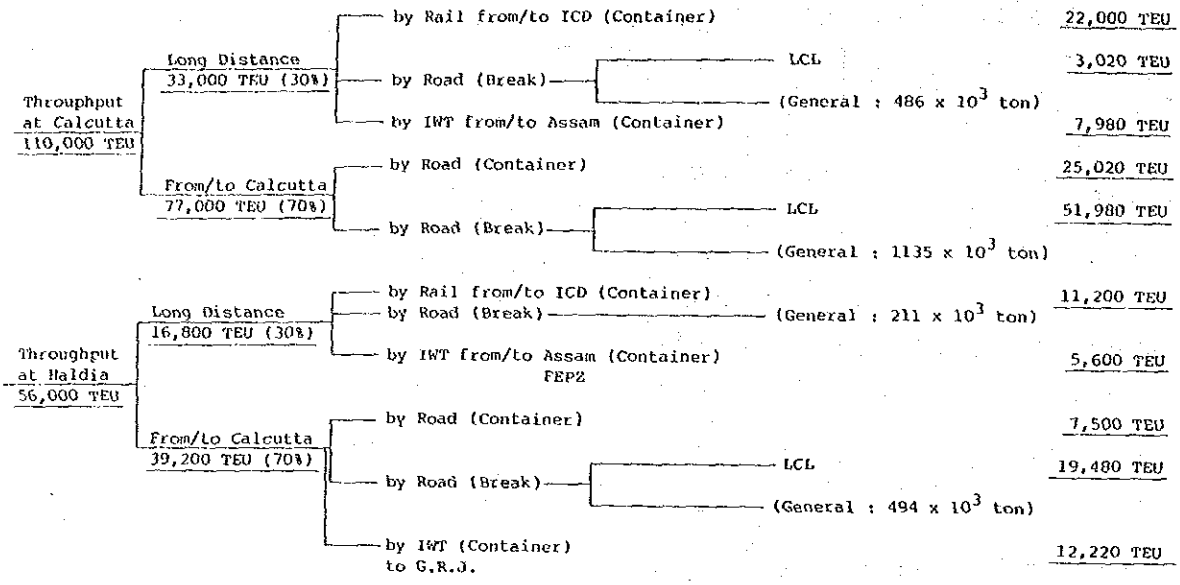


Table 8-3-2 Container/(General) Cargo Movement in 1995

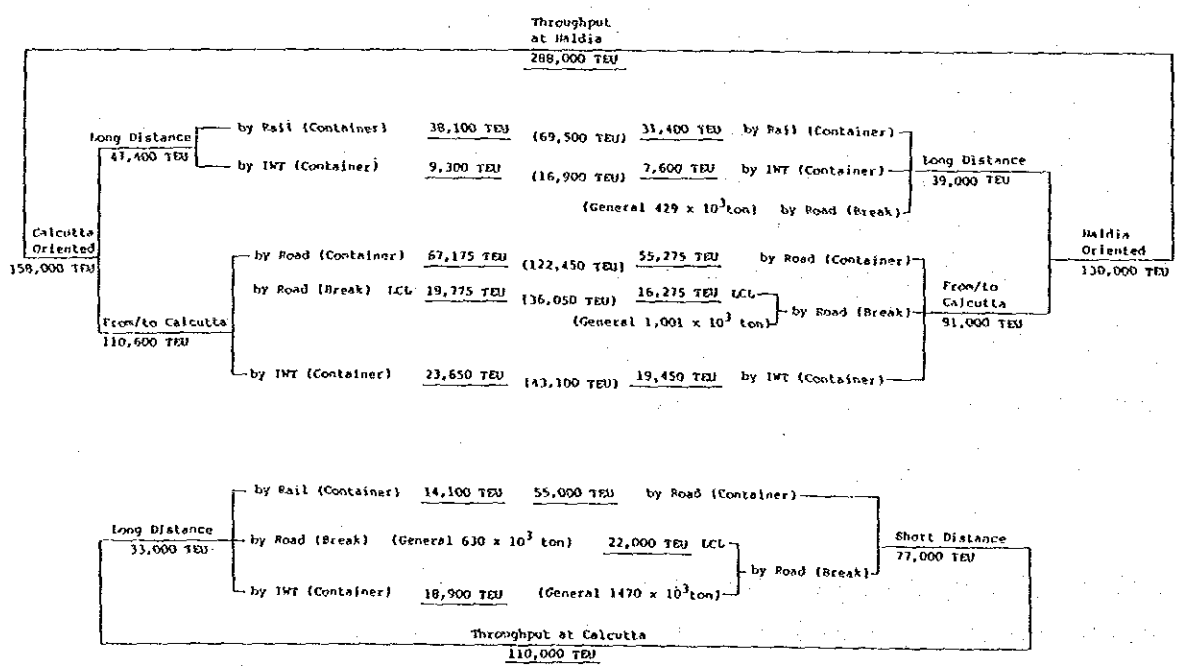


Table 8-3-3 Container/(General) Cargo Movement in 2005 (Alternative-2)

Chapter 9 Port Development Policy

9-1 Allocation of Functions between the Ports

9-1-1 General Concepts of Functional Allocation

The Calcutta Dock System is a very old port as KPD1 and KPD2 were opened to traffic in 1893 and NSD in 1928. In order to receive the deep draft vessels that cannot use the Calcutta Dock System, the Haldia Dock System began operations in 1977, as a complimentary port to the Calcutta Dock System.

After the development of port facilities at Haldia, liquid bulk cargo and dry bulk cargo have been transferred from the Calcutta Dock System and the facilities at Budge budge to the Haldia Dock System and the oil jetty.

The main port of liquid bulk cargo is surelly Haldia, but some firms with production facilities near the port will continue to handled liquid bulk cargo at Calcutta at the target year of the Master Plan.

At present, salt, food grains, fertilizer and raw materials for fertilizer are handled as dry bulk cargoes at the Calcutta Dock System, and coal, coking coal, fertilizer and raw materials for fertilizer are handled at the Haldia Dock System.

The berth to handle food grains should be maintained at the Calcutta Dock System.

The import of salt will decrease in the future.

The import of coking coal will continue at the Haldia Dock System.

All coal will eventually be handled at the Haldia Dock System.

The import of fertilizer and raw materials for fertilizer is gradually being transferred to the Haldia Dock System, but most of this cargo is still handled at the Calcutta Dock System. Then we assume fertilizer and raw materials for fertilizer will continue to be handled at the Calcutta Dock System.

In conclusion, fertilizer and raw materials for fertilizer will be the only dry bulk cargoes to be handled at the Calcutta Dock System in the future. The facility to handle food grains will be maintained as an emergency berth.

At present, passenger liners from the Calcutta Dock System to the Andaman Islands carry passengers 2times per month. This trend will continue in the future.

As mentioned in Chapter 8, the total volume of general cargo will increase in the future. Also more of the general cargo will be containerized. The total volume of other cargo had fluctuated around 2.5 million tonnes, but has recently increased since 1983-84. The share of the Haldia Dock System has recently increased also since 1983-84 according to the increase of container cargo. The allocation of container traffic should be fully taken into consideration in the cargo projection.

9-1-2 Container Traffic Allocation

Among two Alternatives, which are formulated for container traffic allocation for the Master Plan, Alternative-2 (Shifting to Haldia case) seems more desirable than Alternative-1 (Trend case) from the viewpoint of regional policy perspective and transport economy. However, the realization of Alternative-2 presumes policy initiatives or incentives to users which are as follows.

(a) Development of efficient container transport links

Above all, it is crucial to modernize the existing sub-standard container terminal and establish efficient marine terminals as well as port operation systems at Haldia so as to ensure efficient handling of container flow. Additionally, the development of efficient inter-modal inland transport links comprised of road plus ICDs and IWT between Haldia and Calcutta Area are also crucial to exploit the potential advantages in transport economy. In contrast, the present inland transport link is sub-standard and insufficient for ensuring the shift of containers to Haldia in that the available inland transport mode is only the road transport by a monopolized trucking company at a high tariff and cargoes are subject to contamination and pilferage during transportation. When the efficient inter-modal inland transport links are established, all these problems will be resolved or diminished through competition between modes and introduction of FCL container transport.

(b) Tariff differentiation

Given the above development of inland container transport links no major arbitrary tariff differentiation between Calcutta and Haldia Dock system as is presently set would be required. It is fair to

expect container transport to gradually shift to Haldia from Calcutta led by the invisible hand, i.e. the profit motive of users. However, some policy action, might be required particularly in the transient period to overcome the various inertia acting against the shift and to facilitate the shift. In that situation, tariff differentiation will be effective as a price incentive to the users. Even in this case, a small differentiation will be sufficient judging from the inherent comparative cost advantage of handling at Haldia compared to that at Calcutta.

(c) Improvement of communication system between Calcutta and Haldia Dock System

It is fair to expect that the ancillary supporting facilities such as banking and clearance facilities will follow without any major difficulties, following the trend of increased throughput at Haldia. Communication systems linking Haldia and Calcutta/ICDs/IWT terminal at Calcutta should be improved so as to ensure efficient bonded transport between them, so that the requirement of the shift of banking/clearance facilities may be minimized.

(d) The preferential use or entrusting of terminal operation of some of the container berths at Haldia to particular shipping lines, etc. while Calcutta is restricted to common use might also be effective, with the increase of container throughput and ship waiting time at Calcutta.

In conclusion, the Team recommends Alternative-2 (Shifting to Haldia Case) as the proper functional allocation because this is justifiable from the economic and social viewpoint and also because it seems feasible provided that the policy initiative or incentives to users as discussed in this section are provided in an appropriate manner.

(Allocated Container Traffic)

(unit: TEUs)

	(Year 1987/88)	(1995)	(2005)
Calcutta	47,635	110,000	110,000
Haldia	18,842	56,000	288,000
Total	66,477	166,000	398,000

9-2 Need for a Deep Seaport

9-2-1 Requirement for Further Improvement of Draft of the Approach Channel to Haldia

From the analysis of the future trends of the shipping technology, the following vessel range will expand its share in the total cargo carriying capacity.

		Full Load Draft
(a) Liquid Bulk Carriers	25,000 - 40,000	10.0 - 11.3m
	Suez-max tankers	14.5 - 17.0m
	80,000 - 100,000 DWT	13.7 - 14.5m
	60,000 - 100,000 DWT	12.6 - 14.5m
(b) Dry Bulk Carriers	25,000 - 40,000 DWT	9.8 - 11.0m
Food Grain Carriers	30,000 - 50,000 DWT	10.5 - 12.0m
Ore Carriers	60,000 - 150,000 DWT	12.9 - 16.9m
(c) Container Vessels	Over 2,500 TEU Type	12.4m-
(d) General Cargo Vessels	5,000 - 10,000 DWT	6.6 - 7.9m

According to the result of interviews with the user Ministries, Canalizing Agencies and other parties concerned, the required vessel size commoditywise is as follows.

	Present	Future	Full Load Draft
1. Grain :	(5-6,000 tons)*	15-20,000 DWT (Break Bulk Vessel)	10.3 m
		50,000 DWT (Dry Bulk)	11.7 m
2. Fertilizer & Raw Materials :	(5-6,000 tons)	20-30,000 DWT	10.3 m
3. Coking Coal :	30-40,000 DWT	65,000 DWT	11.0 m
4. Crude Oil :	87,000 DWT (30-35,000 tons)	150,000 DWT	17.0 m
5. POL Products :		20,000 DWT	9.5 m
6. LPG :	5,000 DWT	7-10,000 DWT	
7. Edible Oil :	(5,000 DWT)	20,000 DWT	9.5 m

* Note: Presently handled volume per ship due to draft restriction.

By taking the above results into consideration, the conclusion regarding need of a new deep seaport is as follows.

① If the future allowable draft is 10.67m, then it will be necessary to explore the possibility of a new deep seaport over 10.67m.

② If the future allowable draft is expected to be 12.00m, then it will not be necessary to explore the possibility of a new deep seaport excluding the consideration of crude oil tankers.

Chapter 10 Navigation Safety and Navigation Aids

10-1 New Pilotage System and Navigation Aids

1. The Basic Policy of the New Pilotage System

Like the port of Calcutta, there are many riverine ports in the United States such as New York, Portland, Philadelphia and so forth.

The pilot boarding points of those ports are generally designated at the river mouth and masters of the inbound vessels command the vessels themselves along the buoyed channel from the open sea to the pilot station.

In the estuary of the River Hooghly, though there are some hazardous sands and bars, circumstances are similar to those of American ports and the navigable channel from Sandheads through Upper Gasper Lightship is wide enough and almost straight.

The results of our first field survey show that traffic in this area is rather light, especially crossing vessels are very rare.

Consequently, it is possible for the vessels to navigate safely from Sandheads through upper Gasper Lightship under command of their masters, provided that navigation aids are improved and well-maintained.

Furthermore, if a widened fairway, navigation aids complying with international standards and an appropriate traffic control system are established and well-maintained, masters of the vessels will be able to pass the Middleton Channel without the assistance of pilots and reach the pilot boarding point at Sagar Roads.

At the time of the first field survey, questionnaires were delivered to captains and pilots of inbound and outbound vessels asking about the possibility of passing Middleton Channel without the assistance of pilots.

In total, 37 answers were returned and 65% of the captains and pilots indicated the possibility of safe transit of the channel under certain conditions, mainly improvement of the navigation aids.

Fundamentally, the realization of the following items will be effective in improving the efficiency of pilotage and the pilots' working conditions.

(1) Set the pilot boarding point as close to Sagar Roads as possible.
(2) Abolish the existing station vessels with expensive operating costs.

(3) Set up a shore pilot station with the necessary facilities.

(4) Utilize smaller motorboats between the shore pilot station and the pilot boarding point.

Navigation from Sandheads through Sagar Roads should be studied dividing the route into two parts according to the degree of difficulty of navigation. One is the part below Middleton Channel and the other is Middleton Channel and the upper part.

The lower part, the channel from Sandheads through Upper Gasper Lightship, is wide enough and almost straight, so it is not difficult for masters of the vessels to navigate this part along the lightships provided that light buoys are properly laid on both sides to indicate the limit of the channel.

However the upper part, because of the narrow width and strong tidal current at Middleton Channel, is dangerous for masters to navigate without the assistance of pilots.

To secure safe navigation in this part, it is necessary to widen the navigable waterway at Middleton Channel, and new traffic lanes with navigation aids which comply with international standards must be established.

On top of this, a proper traffic control system using radar and communication devices must also be set up.

Based on the above-mentioned views, the following three kinds of new pilotage systems are proposed.

(1) Plan-1 : System with newly-built station pilot vessels.
("Station vessels system")

(2) Plan-2 : System of pilots boarding at Sagar Roads with a shore pilot station.
("Sagar Roads system")

(3) Plan-3 : System of pilots boarding at Gasper Lightships with a shore pilot station.
("Lower Middleton Channel system")

These systems are explained below.

Any new system will require a large initial investment and also considerable running expenses, and safety must be given top priority.

Therefore, it is important to carry out thorough investigations and examinations before the introduction of a new system.

Since navigation aids are strongly connected with each of the proposed new pilotage systems, they are considered in detail in each plan.

2. Outline of the New Pilotage System

(1) Plan-1 : Station vessel system

This is fundamentally a revision of the current system replacing the old station vessels with new automated, reduced-crew vessels.

New traffic lanes between Sandheads and Gasper Lightships must be established in order to make it possible to transfer the pilot boarding point upward. With adoption of this system, the pilotage distance to Calcutta will be reduced to 95 miles, which is about 31 miles shorter than the current system.

This system, is easiest to introduce, but has the problem of the costs for construction, operation and maintenance of the station pilot-vessels. Newly built pilot vessels will make it possible to reduce the number of crew to less than half, but as for the maintenance costs, there will not be much difference.

It is said that when a vessel becomes more than 10 years old its maintenance cost increases rapidly. So it is necessary to consider that this plan has the same risk of high operational cost in the future as under the current system.

Furthermore, in case the number of vessels calling at Calcutta/Haldia increases drastically in the future, say to three times the present number, this system may not be able to accommodate all those vessels.

(2) Plan-2 : Sagar Roads system

The special features of this system are the pilot station on the southwest part of Sagar Island and the pilot boarding point at Sagar Roads. It is about only 2 miles from the pilot station to the pilot boarding point. This system will greatly improve the safety, efficiency and working environment of pilotage. But this system, on the other hand, requires a large initial investment for establishment of the traffic lanes in the upper part of the approach channel including Middleton Channel, navigation aids and the traffic control system. Also, the maintenance costs of this

system would be considerably expensive.

This plan is indeed a fundamental and drastic review of the pilotage system and it is the most effective in improving the efficiency of pilotage service and pilots' working conditions.

If the number of vessels calling at the port increases drastically in the future, the other two systems may not be able to handle all the traffic.

It is predicted that cargo movement will increase to more than 1.5 times the current level by around 2000-2005. If the number of vessels calling at the port increases in proportion to the increase of the cargo movement, Plan-2 should be adopted within ten years for efficient port operation, because this is the only plan that can handle all those vessels.

Therefore, this Plan-2, is to be considered as a future objective, and in the process of revising port operations related items such as the financial and technical possibility of maintenance of traffic lanes and the rate of increase of vessel traffic should be examined and confirmed in order to avoid unnecessary investment.

(3) Plan-3 : Lower Middleton Channel System

This system is an intermediate system of Plans 1 and 2.

A shore pilot station will be established in stead of using station vessels.

The pilot boarding point will be set around Gasper Lightship as under Plan-1, and pilots will travel between the shore station and the vessels using tug-boat type pilot boats.

The abolition of station pilot vessels would be effective in reducing expensive operational costs. This plan does not require the establishment of upper traffic lanes and a traffic control system, and the shift to this new system is comparatively easy. These are the favorable aspects of this plan, but despite the considerable investment for tug-boats, the shore pilot station and the basin/pontoon, the improvement of efficiency and working conditions is much less than under Plan-2.

Therefore, Plan-3 should be considered as a temporary plan during the revision of port operations and as a step towards the realization of Plan-2.

(4) Recommendations

Based on the above analysis, it is recommended that the reconstruction of the pilotage system in the approach area of the River Hooghly be carried out in accordance with the following program and procedure.

1) First, lay light buoys in the channel from Sandheads to upper Gasper Lightship and make other arrangements to prepare the Lower Traffic Lanes.
2) Transfer the pilot boarding point to the area around Gasper Lightships and start shorter-distance pilotage service as quickly as possible. In this stage, existing pilot vessels will still be used.
3) Start building the tug-boats, and as soon as they are delivered use them for embarking and disembarking of pilots. One of the pilot vessels is to be at anchor at Sagar Roads and used as a temporary pilot station.

   The number of crew of the pilot vessel should be reduced as much as practicable. This stage is to be considered as a modified application of Plan-3, the temporary arrangement.
4) Review and check cargo movement and vessels calling at the port to see if they are increasing as predicted.

   A thorough study should be made about the possibility of construction and maintenance of the upper traffic lanes from both the financial and the technical aspects.
5)-(A) If circumstances require stepping up to Plan-2, start construction of the pilot station, basin and pontoon for pilot boats as well as establishment of the traffic control system and traffic lanes.

   Local navigation rules are to be prepared during this period.
5)-(B) If circumstances do not require the adoption of Plan-2 for economic or technical reasons, Plan-3 should be adopted. Construction of the pilot station and basin and pontoon for pilot-boats should be commenced.

   The pilot station is to be designed considering possible modification to include a traffic control system in the future.

Note : In this report, all four lightships will be used in each new system. However, the operational costs of the lightships is unfavorably expensive, so it is recommended that those lightships be replaced by reliable, cost-saving light buoys as soon as possible.

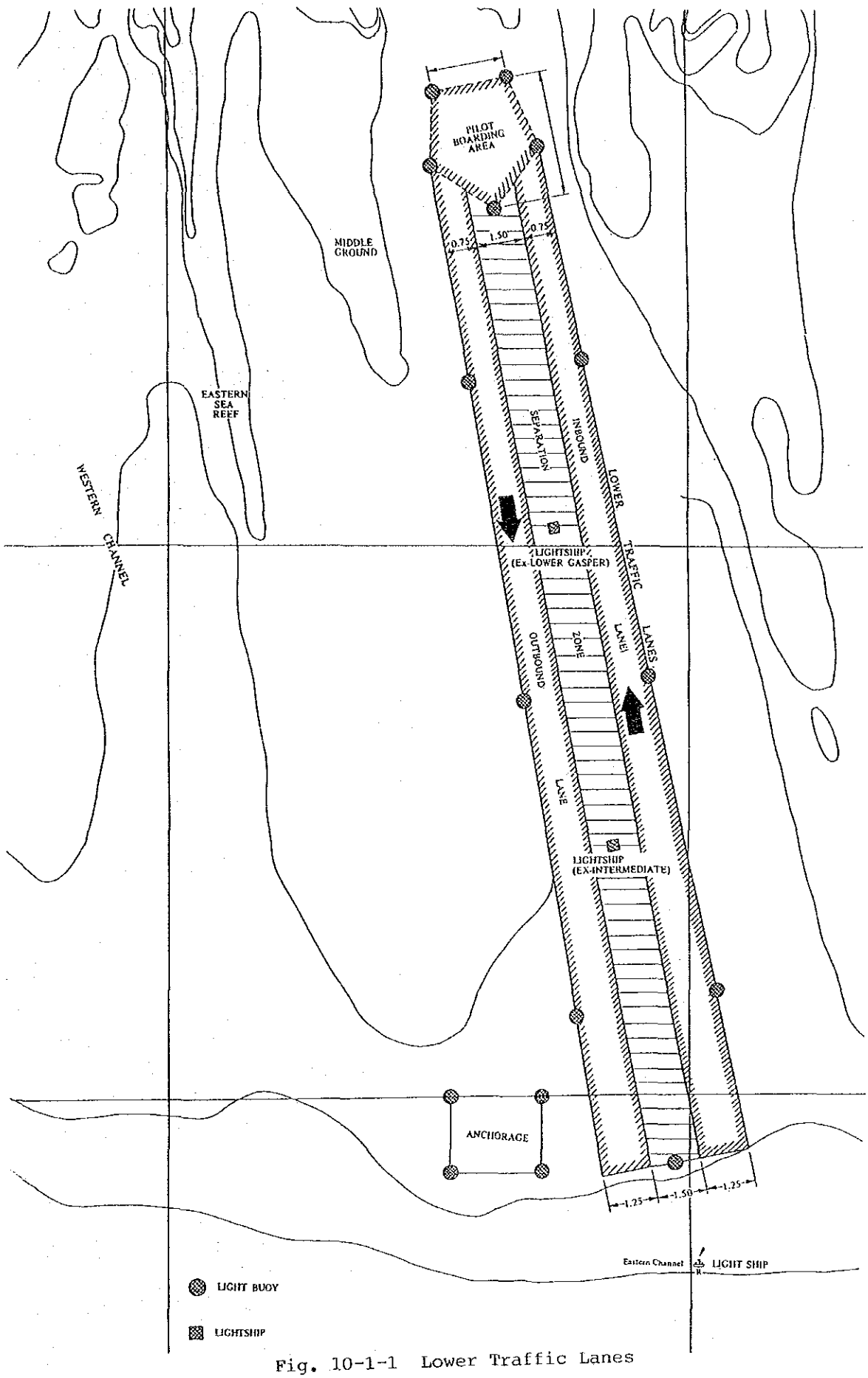


Fig. 10-1-1 Lower Traffic Lanes

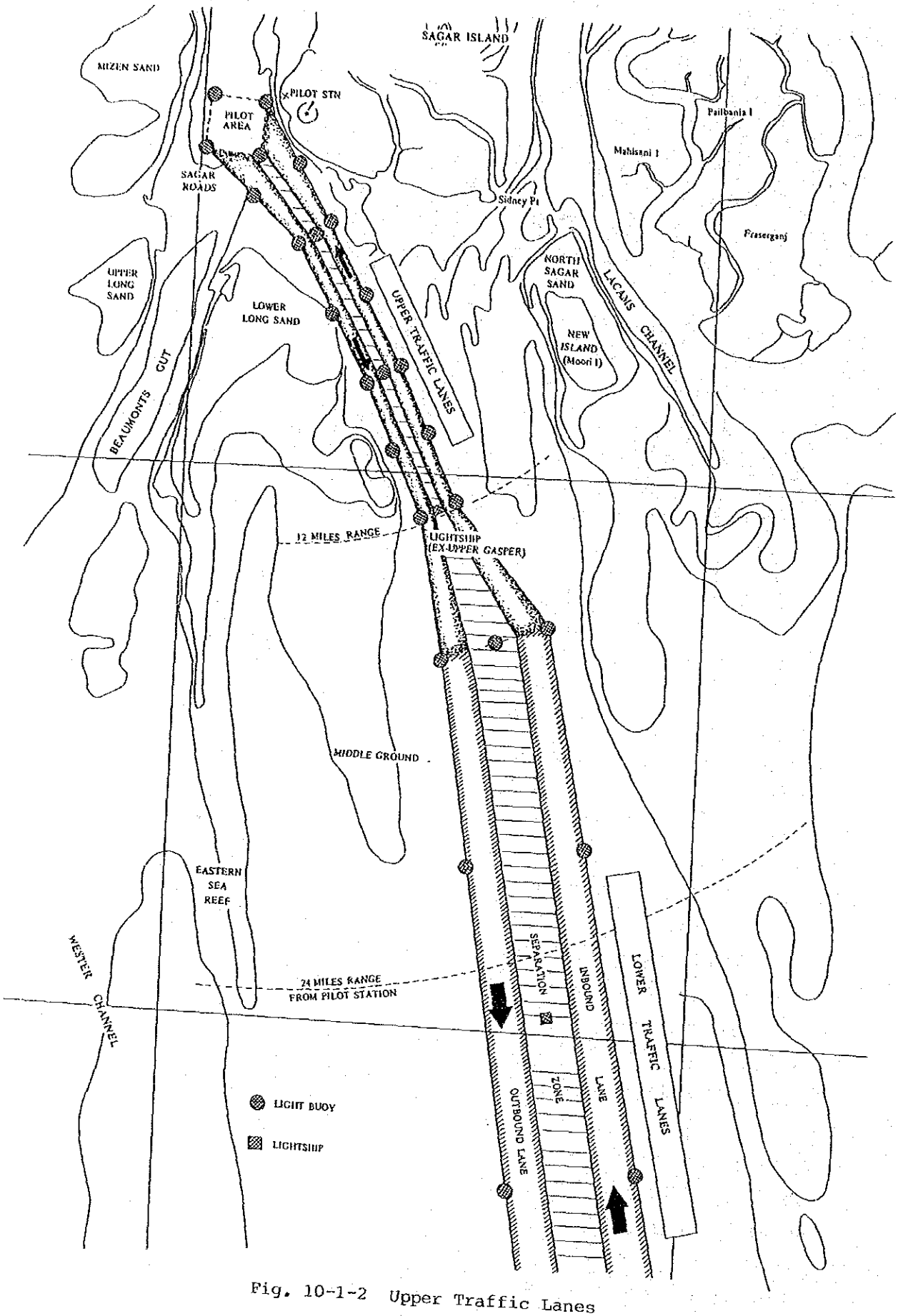


Fig. 10-1-2 Upper Traffic Lanes

10-2 Salient Point raised by the Marine department of CPT

1. The most salient points raised by the DMD on the initial recommendation are as follows.

(1) Plan-2 would be considerably expensive, and the safety aspect would also be compromised as compared to the present system. (station vessel system)

(2) Regarding Plan-3, whereas boarding at Gasper during the fair weather season will not prove at all difficult, boarding during the monsoon months at Gasper would be hazardous both to tugboat type pilot vessel and to pilots due to ground swells.
Also, the overall costs (initial investment plus running costs) of Plan-3 would be greater than the costs of the present station vessel system.

(3) It is not clear in what manner either system improves the efficiency of the pilotage service.

(4) The present Station Vessel System is advocated by DMD considering the safety of the ships and the economic aspects.

(5) There is a possibility that the navigation channel will be shifted from the present Eastern Channel to the Western Channel.

2. The point raised by the DMD are useful for the formulation of a better alternative.

(1) In formulating this better alternative, the following points should be taken into account.

1) Cost comparison
Considering the overall costs (initial investment plus running costs), Plan-3 is cheaper than the present Station Vessel System as indicated Table 10-2-1.
A detailed study will be required to estimate the cost of Plan-2 because it involves the maintenance dredging cost in running cost.
The overall cost can be minimized through counter-siltation technology which requires a detailed study.

2) Efficiency of the pilotage service

① Plan-2 is the most flexible and Plan-3 is more flexible than Plan-1 to overcome unexpected shortages of inbound pilots and therefore to reduce ship waitings by transporting the required pilots by land or by boat.

In more detail, in the cases of Plan-2 and Plan-3, pilots can be transported to the pilot station on Sagar Island anytime, and it will also be possible to send pilots as required for inbound vessels.

② Plan-2 requires the least number and Plan-3 a lesser number of pilots than Plan-1, because Plan-2 and Plan-3 can easily supplement the inbound pilots by land or boat.

③ Improvement of competitiveness through reduction of pilotage charges derived from shorter distance.

3) Working environment of pilots

① Living on shore or waiting at home under Plan-2 and 3 :

Pilots off duty or waiting are able to have sufficient rest at home or at the pilot station.

Plan-1 : Pilot have to come down to the Hooghly River on a vessel while on duty or off-duty through the night and must wait their turn on the pilot vessel.

② Transportation

The rudder propeller special tug-boat is safer and more comfortable than a small pilot boat mounted on the station vessel.

③ Pilotage distance

The pilotage distance will be reduced about 90 miles by Plan-2 and about 60 miles by Plan 1 and 3.

4) Safety aspect

Which alternative is more safe for the embarking and disembarking of pilots is controversial, because it depends upon varied factors such as the skill or expertise of pilots, local weather and sea conditions, craft and equipment and so on.

In connection with this, the following points should be noted.

① The rudder propeller type tug-boat is far more maneuverable, powerful and modernized than the tractor-type.

Which is used at present is extremely small and primitive, and the

proposed rudder propeller type tug-boat seems far more safe than the present boats.

The salient features are as follows:

(a) High steering performance

Propulsion thrust can be pointed to any direction with twin rudder propeller drive and the boat can quickly halt, start, spinning or side stepping.

(b) Powerful thrust

Input power is made maximized use of the Kaplan propeller with a Kort nozzle.

The rudder propeller drive needs but small input power for developing the same magnitude of thrust compared with conventional equipment.

(c) Simplified stern out fitting

The equipment is an easy-to-install packaged unit with a built-in swiveling mechanism.

Power is received from the engine through its input line formed with universal joints and drive shafts.

(d) Easy maintenance

There is no need of docking the boat to inspect the rudder propeller unit and can be lifted off the boat in the water.

(e) Compact remote control stand

The remote steering control is matched to the rudder propeller drive in every respect to enhance the advantages of this drive.

Its control stand has all controls grouped together and arranged for easy steering.

② Pilotage has been carried out safely by the proposed method without any difficulty at all in the outer sea of Tokyo Bay which appears to have similar sea conditions to those at the site.

A comparison of the sea conditions is shown as Fig. 10-2-1.

However, this needs further detailed study.

③ All Japanese pilots have a master's license and sufficient experience. They receive the pilot's license after severe tests and examination.

Every year they have to pass a physical examination.

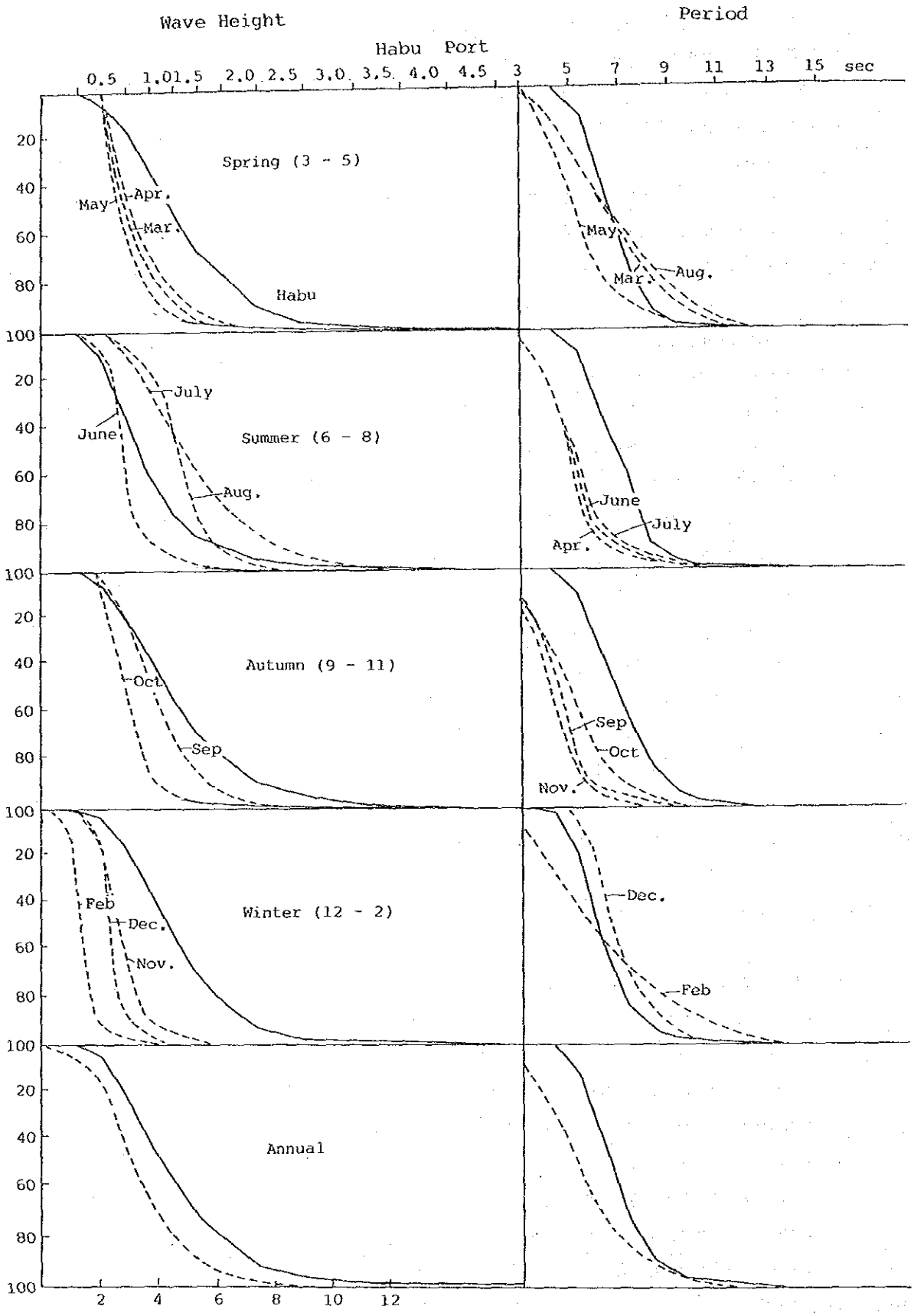

Wave Height
Period
Habu Port
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5
3 5 7 9 11 13 15 sec
Spring (3 - 5)
May
Apr.
Mar.
Habu
May
Mar.
Aug.
Summer (6 - 8)
July
June
Aug.
June
July
Apr.
Autumn (9 - 11)
Oct
Sep
Sep
Oct
Nov.
Winter (12 - 2)
Feb
Dec.
Nov.
Dec.
Feb
Annual
20
40
60
80
100
2 4 6 8 10 12

Fig. 10-2-1

④ A lot of ports have changed their pilotage systems to the proposed type (Plan-2 or Plan-3) from the Station Vessel System, from the view point of improved safety, efficiency of port operation and economy.

For example, the following ports have changed their Pilotage systems from the Station Vessels System to the new system.

Table 10-2-2 Ports Adopted New Pilotage System

Port	Station Vessel	New System
San Francisco (USA)	Sailing Vessel	85' type x 2, Speed 13 kt, Pilot: 10 65' type x 1, Speed 13 kt, Pilot: 4 service every 4 days by turns, Reported more economical and efficient, than before.
New York (USA)	New Jersey G/T 988 LOA: 192' Pilot 26 New York G/T 779 LOA: 182' Pilot 38	Service time -2 months Service time -10 months Chapel Hill G/T: 60, LOA: 64.5 ft Pilot: 40, Speed 24 kt Reported that the Station Vessels will be replaced by Chapel Hill type pilot boats in the future.
Folk Stone (U.K)	Station Vessel was replaced by VTS center	Established VTS center on the shore and transporting pilots by speed motor boats.
Rotterdam (Holland)	Spica type x 3 LOA 213', Pilot 24 ea, No. of crew: 22 ea,	3 spica type boats (one for inbound and the other for outbound and the third one stand-by for emergency or repair) Recently the cabins of pilot vessels are not used practically, because the pilot tender boats (LOA: 75' and 17 1/2 kt) and helicopters are used properly. Pilot boats for sea pilots:

Type	LOA	Speed	No. of pilot
Spica type Pilot Vessel x 3	213 ft		24 each
Pilot launch x 4	16 ft		
Pilot tender x 4	75 ft	17 1/2 kt	

(2) Considering all these factors, it seems that the proposed system (Plan-2 and Plan-3) are viable, possible and beneficial to the port and the pilots.

However, there are many things which should be taken into account

before a complete shift from the present Station Vessel System, which are as follows :

1) Shiting to the new system takes time and should be carried out step by step because :

① there may be unforeseenable hidden difficulties, and those should be overcome during the shifting process.

② familiarization pilots and masters of the ships requires time.

2) Further detailed studies as well as discussions among Indian experts concerned will be required to proceed to the final stage (Plan-2), as follows:

① natural conditions including

-- wave/tidal current conditions in the area of Middleton and Gasper Channel

-- siltation and the counter-measures to minimize it in the area of Middleton and Gasper Channel

-- condition of the Western Channel

② the details of the electrical devices

③ implementation programs

Taking all this into consideration, the final conclusions as the Team's recommendation is set forth in the next section.

10-3 Conclusions

The following phased plan is recommended by the study team.

Table 10-3-1 Phased Plan

Step No. Plan Name	Description	Supposed Timing of Implementation
Step - 1 Plan - 4	i) 2 pilot boarding points will be used such as Sandheads and Gasper Lightships area. ii) Sandheads area is used in the SW Monsoon season by the present Pilot Vessel System and Gasper lightships area will be used in smoother seasons by tugboats as under Plan-3. iii) an approach channel will be established from Sandheads to Gasper pilot boarding point with navigation aids. iv) in the mean time, the problems which were discussed before, should be examined and clarified. v) the present pilot vessels will be used as a temporary pilot station anchoring at Sagar Roads	- 1994/95 (8th Plan)
Step - 2 Plan - 3	i) the pilot boarding point will be set at Gasper Lightships area only. ii) pilots shall be transported between the shore pilot station and the vessel utilizing tug-boat type pilot boats. iii) the approach channel is as same as under Plan-4.	1995-2000 (9th Plan)
Step - 3 Plan -2	i) the pilot station is on Sagar Island. ii) the pilot boarding point is at Sagar Road. iii) traffic lanes will be established and maintained constantly as planned iv) navigation aids will be laid in accordance with IALA's Standard. v) a traffic control system consisting of Radar computer, display and control console and communication devices will be installed in the traffic control center. vi) this system will greatly improve the safety, efficiency and working environment of pilotage.	2000/2005 (10th Plan)

Plan-4 : Combination System

(A) Outline of the plan

This is fundamentally a combined system with the current system and Plan-3.

In the SW Monsoon season, the current system will be carried out by the present station vessels.

And in the fair weather season, the pilots boarding point should be shifted to the Gasper Lightship area and pilots will travel between the station vessel anchoring at Sagar Roads and the vessels using tug-boat type pilot boats.

New traffic lanes between Sand-heads and Gasper Lightships must be established in order to make it possible to transfer the pilot boarding point upward.

In the meantime, further detailed studies should be carried out to proceed to the final stage of the pilot system.

(B) Pilot boarding point

1) In the SW Monsoon season, the same area as under the current system.

2) In the fair weather season , pilots will embark and disembark at the same area as under Plan-1.

(C) Pilot vessels and pilot boats

1) Pilot vessels

The current station vessels will be used and operation is basically the same as under the current system.

2) Tug-boat type boats

Basically rudder propeller tug-boat type pilot boats will secure safe embarkation and disembarkation of the pilots.

(D) Traffic lanes

An approach channel will be established from Sandheads to the Gasper pilot boarding point.

This channel shall consist of an inbound lane, an outbound lane and the center line, at least.

Navigation aids will be properly laid as described below, and all obstructions in the channel such as wrecks and shallow spots must be removed.

As for the appropriate depth of water, this should be studied and determined in relation to the depth of the upper route and docks.

(E) Navigation aids

1) Light buoys

At least 6 buoys will be laid at the boundary of the traffic lanes and at the pilot boarding area.

3 buoys will be laid on the center line. These buoys must comply with IALA's buoyage system.

They should not only be highly reliable and easy to maintain, but they

must also be able to bear strong winds and high waves during cyclones and in SW monsoon season.

All buoys should be equipped with radar reflectors.

2) Lightships

The arrangement of the Lightships is as described in Plan-1.

(F) Shore pilot station

After confirmation of the possibility of the Plan-3, the shore pilot station will be built on the sagar island.

The arrangement of the above facilities are as described in Plan-3.

(G) Anchorage

The anchorage will be the same as under Plan-1.

(H) Traffic control system

No particular traffic control system is necessary at this stage, and the system will be the same as under Plan-3.

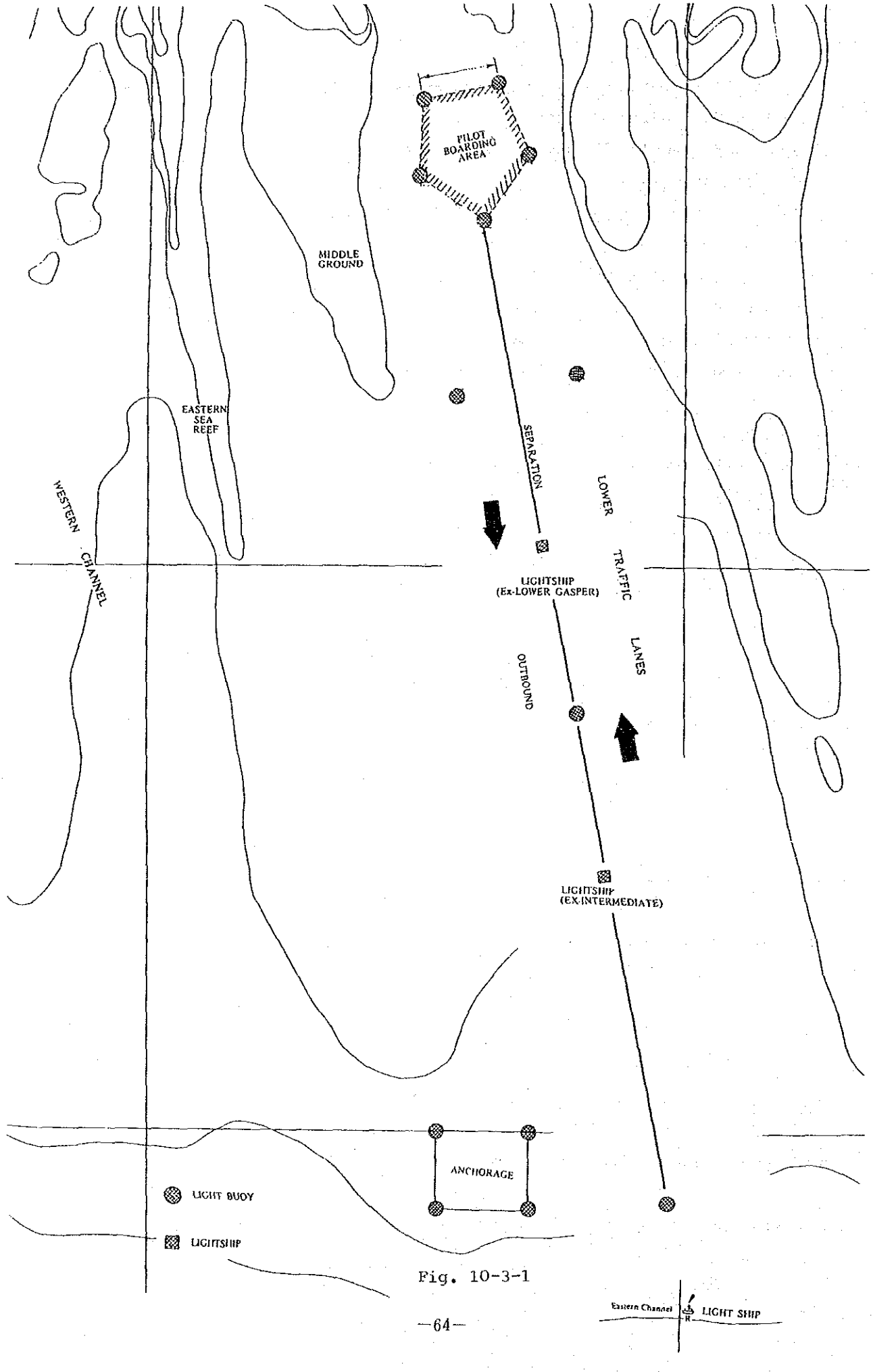

PILOT BOARDING AREA
MIDDLE GROUND
EASTERN SEA REEF
WESTERN CHANNEL
SEPARATION
LOWER TRAFFIC LANES
OUTBOUND
LIGHTSHIP (Ex-LOWER GASPER)
LIGHTSHIP (EX-INTERMEDIATE)
ANCHORAGE
LIGHT BUOY
LIGHTSHIP

Fig. 10-3-1

Eastern Channel
LIGHT SHIP

Chapter 11 Formulation of Master Plan

11-1 Calcutta Dock System (Including Budge Budge District)

11-1-1 Fundamentals of Master Plan

Calcutta Dock System will continue to handle mainly break bulk cargo and container cargo in the future with the exception of some liquid cargo and dry bulk cargo, such as petroleum products, food grains, fertilizer and raw materials for fertilizer.

The total number of the current working berths in the Calcutta Dock System is 32, of which 10 is in KPD1, 8 in KPD2, 9 is NSD and 5 at Budge Budge. At present, liquid bulk cargoes are handled at the berths of Budge and 1 berth in NSD. They will be handled at the same berths in the future. Dry bulk cargoes, especially fertilizer and raw materials for fertilizer, are now handled at various berths in KPD and NSD, but in the future they will be handled at the contiguous berths in order to provide good measures to prevent pollution. Container cargoes and break bulk cargoes are now handled at multi purpose berths, but in the future they will be handled at the exclusive container berths and the exclusive break bulk berths in order to heighten the respective cargo handling productivity.

The Calcutta Dock System are very old and the port facilities, such as wet docks, quays, aprons and transitsheds, and equipment, such as cargo handling equipment and working vessels and crafts are not always in good conditions. It is needless to say it is important to keep the existing facilities and equipment in good conditions by repairment and replacement. However, it is also important to utilize fully the existing facilities before considering the construction of new facilities.

The Calcutta Dock System is located along the River Hooghly some 200 km away form the river estuary. Presently, the approaching channel has the allowable draft of 6.8 m, but CPT intends to improve it to 7.4 m by 1995 and 7.9 m by 2005, by the comprehensive river trainning scheme.

We took the above mentioned situation into consideration as the fundamentals to formulate the Master Plan.

11-1-2 Planning Premises

In addition to the above fundamentals of the Master Plan, we placed the following planning premises to formulate the Master Plan.

(1) Project Cargo Volume

① Liquid Bulk Cargo

Import POL (Products)	1,945	x 1000 tons
Export POL (Products)	195	
Total POL (Products)	2,140	
Import Edible Oil	285	
Other Liquid Cargo	70	
Grand Total	2,495	

② Dry Bulk Cargo

Import Food Grains	400	
Import Fertilizer	30	
Import Raw Materials for Fertilizer	630	
Import Salt	10	
Grand Total	1,070	

③ Container Cargo

Grand Total	2,235	
Loaded Containers	175	x 1000 TEUs
Empty Containers	93	
Total Containers	268	

④ Other General Cargo

Import Other General Cargo	2,475	x 1000 tons
Export Other General Cargo	435	
Grand Total	2,910	

(2) Projected Vessel Size

① Liquid Bulk Carriers	10,300	DWT
② Dry Bulk Carriers	10,300	
③ Container Vessels	8,900	
④ General Cargo Vessels	9,400	

Parcel Size per Ship

① Liquid Bulk Carriers	7,905 tons
② Dry Bulk Carriers	9,259
③ Container Vessels	4,835 (580 TEUs)
④ General Cargo Vessels	5,735

(3) Basic Concept to Formulate Alternative Master Plans

The alternative Master Plans will mainly consider the container cargo terminals as follows.

① Conservative Alternative (Trend Case)
② Rather Radical Alternative (Shifting to Haldia Case)

1) Conservative Alternative

This alternative is to handle all potential container cargoes at the Calcutta Dock System. That is the total forecast container cargo in 2004/05, 2,235,000 tons or 268,000 TEUs, will be handled at the Calcutta Dock System.

2) Rather Radical Alternative

This alternative is to restrict the container cargo handling at some level, such as the capacity of Berth D of NSD and the present handling volume at other berths. The capacity of Berth D NSD is estimated as 75,000 TEUs by CPT. The cargo volume which was handled at Calcutta Dock System excluding D NSD was about 35,000 TEUs in 1986-87. This alternative is to restrict the container cargo handling at this level. The cargo volume is just the same as the project container cargo volume in 1994-95. In other words, this alternative is to limit the increase of container cargo at the 1994-95 level.

The forecast container volume in 2004-05 is 268,000 TEUs. Then 158,000 TEUs would be transferred to the Haldia Dock System, and only 110,000 TEUs would be handled at Calcutta Dock System.

11-1-3 Alternative Formulation

By taking the improvement of cargo handling productivities and the berth allotment to respective cargoes into consideration, we formulate the following alternatives.

In 2004/05 (Conservative Plan)

	Container Berth			Dry Bulk Berth			General Cargo Berth			Lost Cost due to vessel waiting
Cargo Volume	x 1,000 tons 2,235			x 1,000 tons 1,070			x 1,000 tons 2,910			
No. of Vessel	(268 x 1,000 TEUs) 462			116			507			
	1,266			0.317			1,389			
	No. of B	Prod. TEUs/hour	$\overline{Wq}$ day	No. of B	Prod. tons/hour	$\overline{Wq}$ days	No. of B	Prod. tons/hour	$\overline{Wq}$ days	
Alternative 1	4	20	0.2	4	1,728	4.0	18	600	1.2	1,083 Long Waiting Time for Dry
2	4	15	0.8	4	"	"	18	"	"	1,267 Bulk Carriers
3	4	20	0.2	5	"	0.98	17	"	2.4	1,320 Long Waiting Time for General
4	4	15	0.8	5	"	"	17	"	"	1,504 Cargo Carriers
5	5	20	0.2	4	"	4.0	17	"	"	1,608 Long Waiting Time
6	5	15	0.8	4	"	"	17	"	"	1,654

The average waiting time of dry bulk carriers of alternatives 1 and 2 seems to be too long, and the average waiting time of general cargo vessels of alternatives 3 and 4 seems to be too long. The average waiting time of both vessels of alternatives 5 and 6 seems to be too long. Accordingly, if it is impossible to increase the productivity of respective berths, it would be necessary to construct some new berths.

In 2004/05 (Rather Radical Plan)

	Container Berth			Dry Bulk Berth			General Cargo Berth			Lost Cost due to vessel waiting
Cargo Volume	x 1,000 tons 917,351			x 1,000 tons 1,070			x 1,000 tons 2,910			
No. of Vessel	(110 x 1,000 TEUs) 190			116			507			
λ	0.5198			0.317			1.389			
	No. of B	Prod. TEUs/hour	$\overline{Wq}$ day	No. of B	Prod. tons/hour	$\overline{Wq}$ day	No. of B	Prod. tons/hour	$\overline{Wq}$ day	
Alternative 1	3	20	0.06	5	1,728	0.98	18	600	1.2	697
2	3	15	0.19	5	"	"	18	"	"	712 ◎
3	3	10	0.98	5	"	0.98	18	"	2.4	811 ○

Although the lost cost of alternative 1 is the lowest, a productivity of 20 TEUs/hour without gantry cranes is not so easy. Then alternative 2 is the best selection.

By taking the site of container berths into consideration, we formulated the following 4 alternatives.

ⓐ Conservative Alternative 1 (Fig. 11-1-1)

①	Liquid Bulk Cargo	1B 1,925 tons/day	at C of NSD
②	Dry Bulk Cargo	5B 1,728 tons/day (per working time at berth)	at A, B of NSD and 6, 8 of KPD1 and 23 of KPD1
③	International Container Cargo	4B 15 - 20 TEUs/Hour	at D of NSD and 28, 29 of KPD2 and 1 New Berth
④	Inland Water Way Container Cargo	1B	at Garden Reach Jetty
⑤	General Cargo	18B 600 tons/day (per working time at berth)	at other berths

ⓑ Conservative Alternative 2 (Fig. 11-1-2)

①	Liquid Bulk Cargo	1B 1,925 tons/day	at C of NSD
②	Dry Bulk Cargo	5B 1,728 tons/day	at A, B of NSD and 6, 8 of KPD1 and 23 of KPD2
③	Container Cargo	4B 15 - 20 TEUs/Hour	at D and 4, 5 of NSD and 1 New Berth
④	Inland Water Way Container Cargo	1B	at Garden Reach Jetty
⑤	General Cargo	18B 600 tons/day	at other berths

ⓒ Rather Radical Alternative 1 (Fig. 11-1-3)

This alternative is to restrict the container cargo handling to the volume of 110,000 TEUs. The rest of the containers, 158,000 TEUs, would be transferred to the Haldia Dock System, but a volume of 62,000 TEUs containers would have to be carried by barges back to the hinterland of the Calcutta Dock System. If the retransferred cargo were handled at the Calcutta Dock System, it would be necessary to prepare a Container Terminal for the Inland Water Way

transport. The site of the Inland Water Way Terminal could not be inside NSD and KPD according to the above plan. Then the IWT terminal would be located at Garden Reach Jetty.

① Liquid Bulk Cargo	1B	1,925 tons/day	at C of NSD
② Dry Bulk Cargo	5B	1,728 tons/day (per working time at berth)	at A, B of NSD and 6, 8 of KPD1 and 23 of KPD2
③ International Container Cargo	3B	10 - 15 TEUs/hour	at D of NSD and 28, 29 of KPD2
④ Inland Water Way Container Cargo	1B		at Garden Reach Jetty
⑤ General Cargo	18B	600 tons/day	at other berths

ⓑ Rather Radical Alternative 2 (Fig. 11-1-4)

① Liquid Bulk Cargo	1B	1,925 tons/day	at C of NSD
② Dry Bulk Cargo	5B	1,728 tons/day	at A, B of NSD and 6, 8 of KPD1 and 23 of KPD2
③ International Container Cargo	3B	10 - 15 TEUs/hour	at D, 5 and 4 of NSD
④ Inland Water Way Container Cargo	1B		at Garden Reach Jetty
⑤ General Cargo	18B	600 tons/day	at other berths

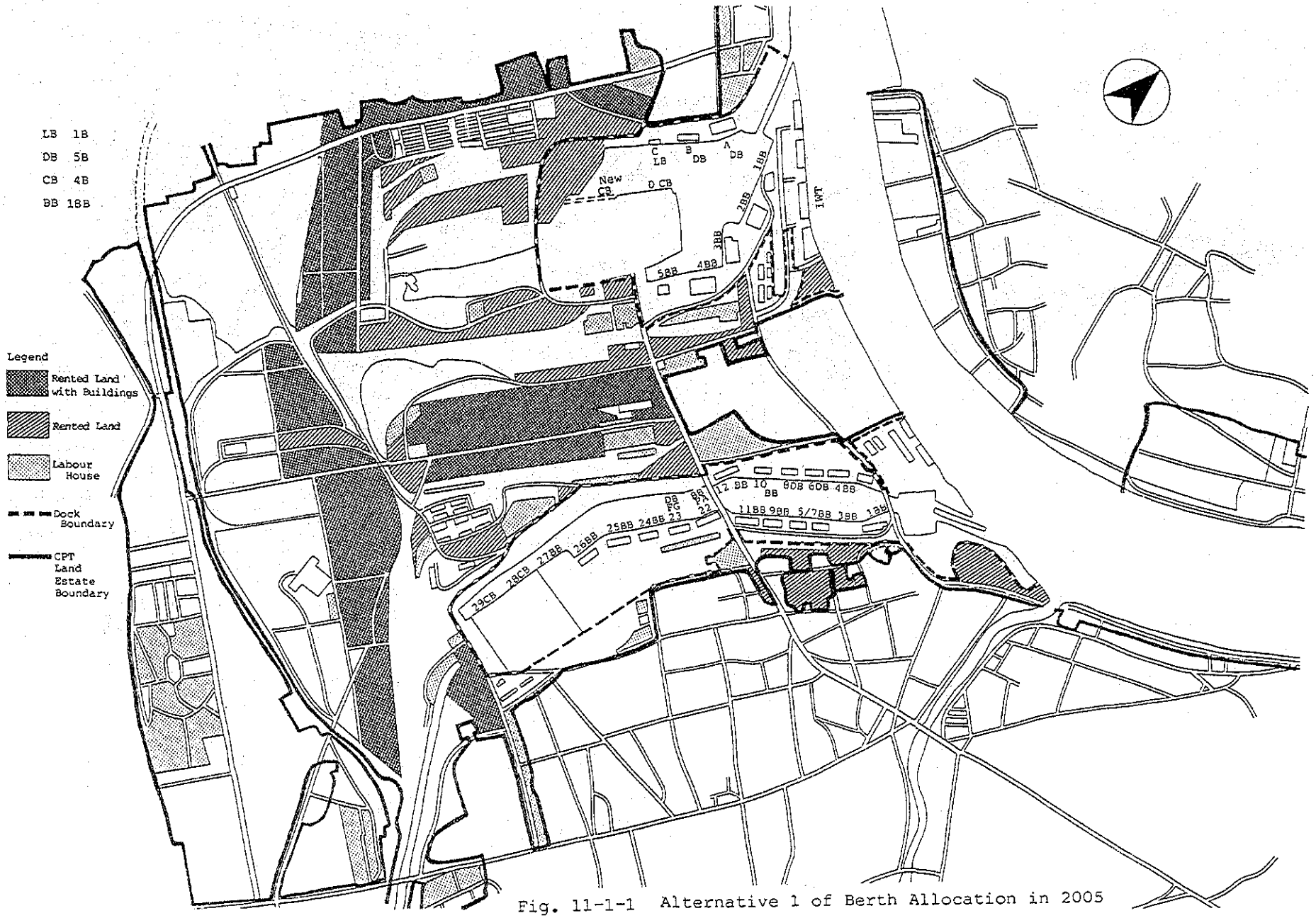


Fig. 11-1-1 Alternative 1 of Berth Allocation in 2005

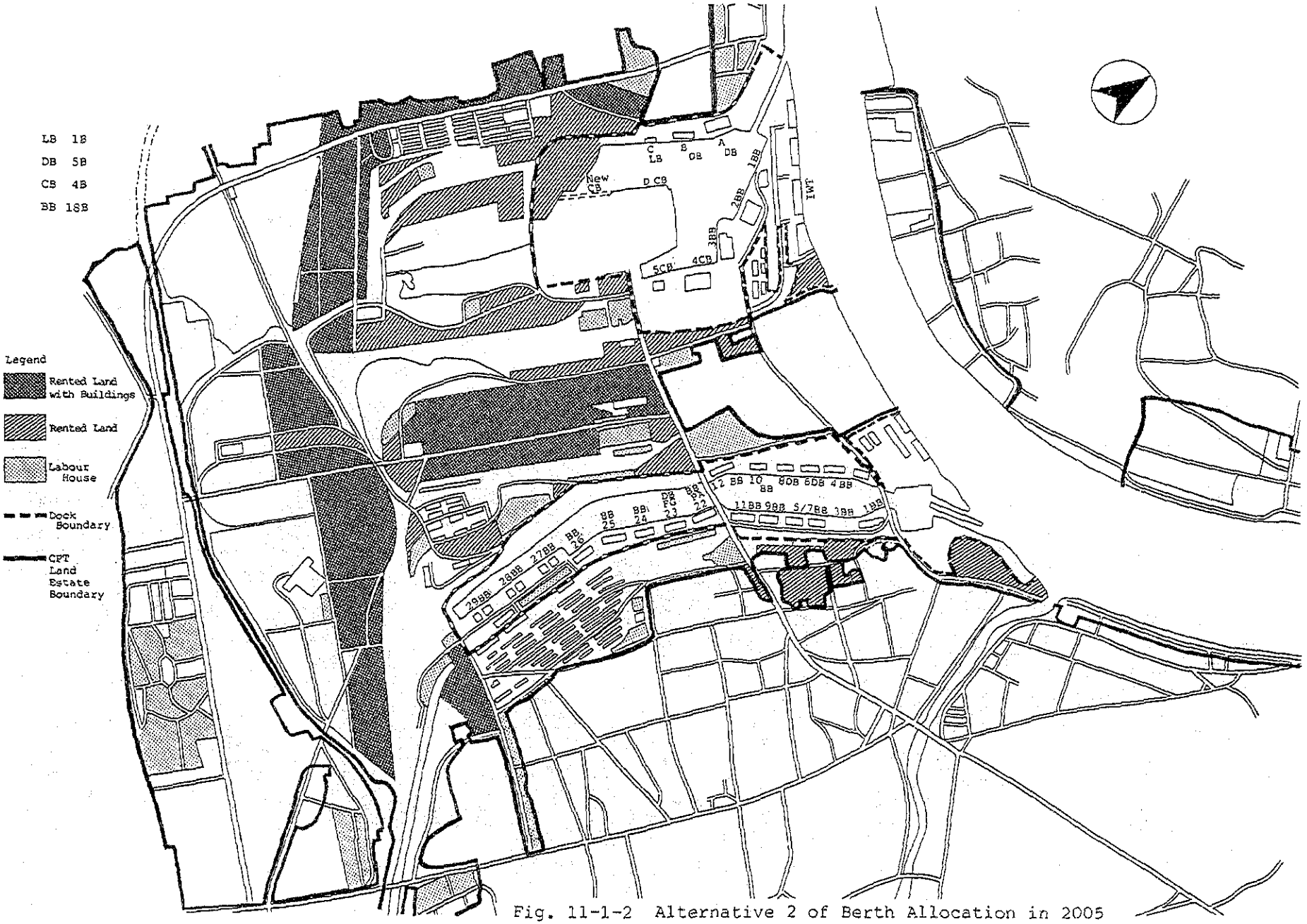


Fig. 11-1-2 Alternative 2 of Berth Allocation in 2005

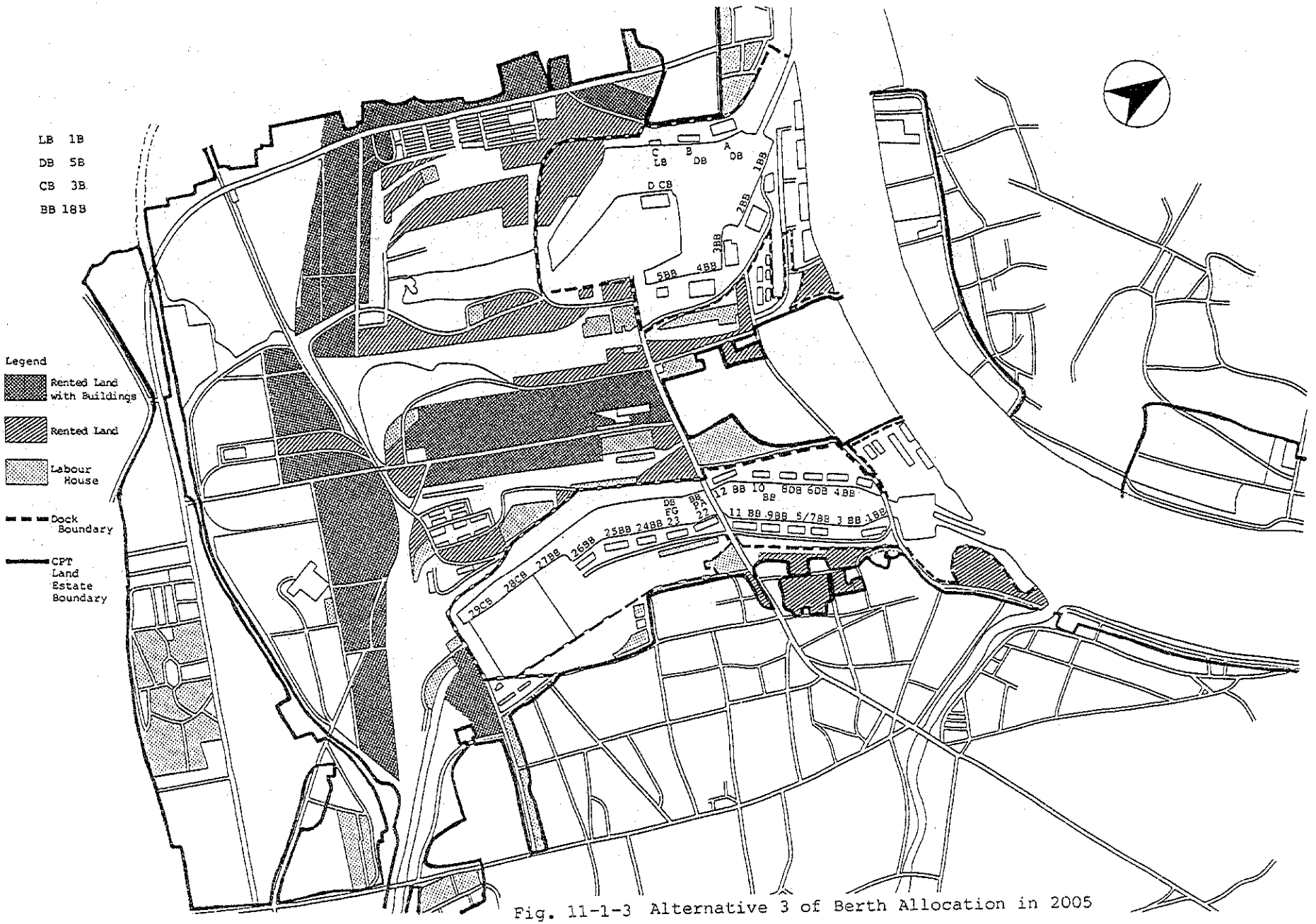


Fig. 11-1-3 Alternative 3 of Berth Allocation in 2005

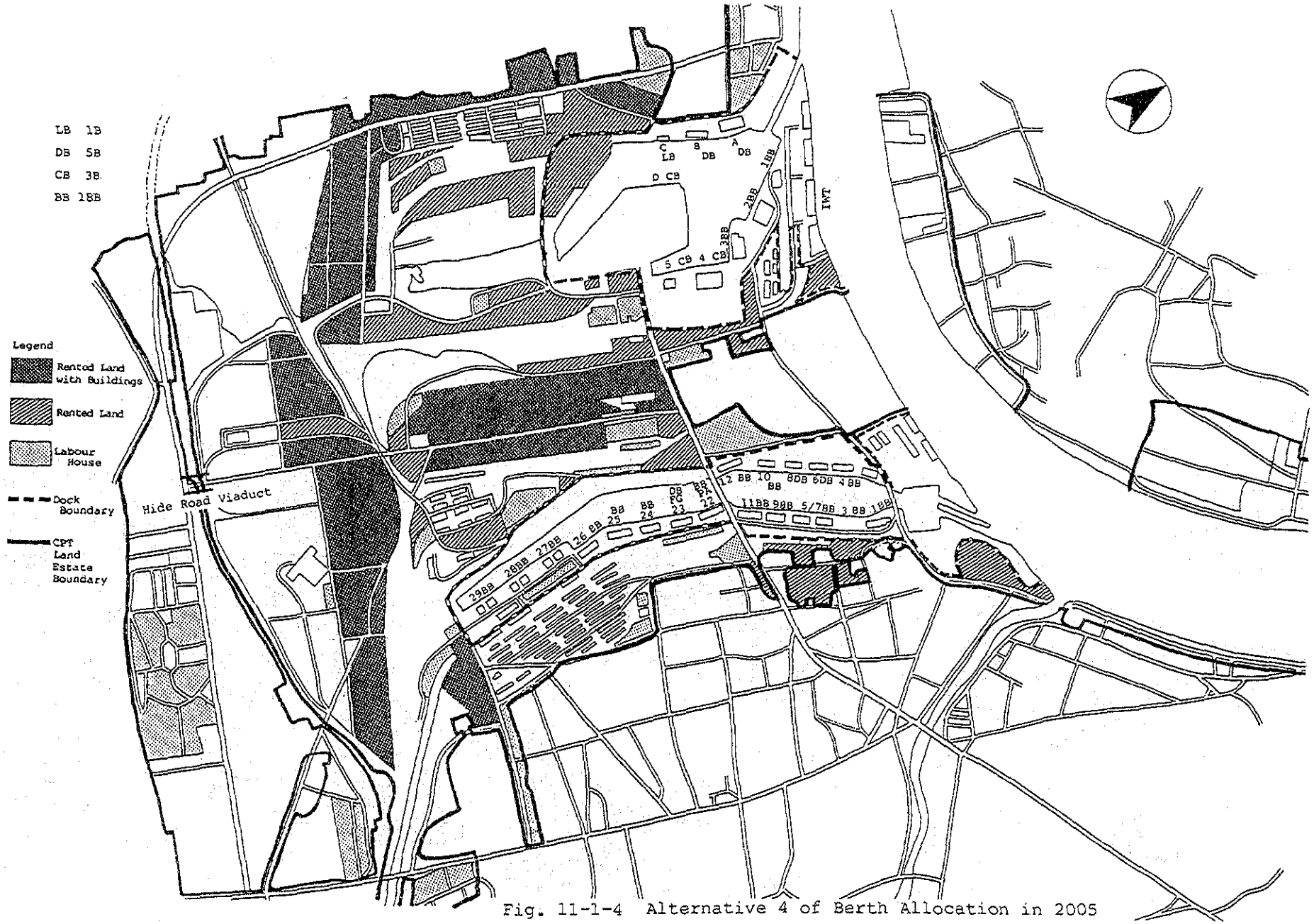


Fig. 11-1-4 Alternative 4 of Berth Allocation in 2005

	Merits	Demerits
Alternative 1	① On the back side of container berth in KPD2, sufficient land for container yard is available. ② It is easy to convert general cargo berths to container berths.	① One new berth must be constructed ② Container berths are allocated separately, and the operation control must be divided. ③ The location of container berths at KPD2 is the most inner side of KPD2, and container vessels must pass through 2 bridges and narrow water ways. ④ The width of the channel in front of 27-29 KPD is only 100m, but as the container berths have comparatively high productivity and the frequency of berthing becomes rather high, the width of the channel is rather narrow in comparison with the average vessel length over all. ⑤ The proportion of the vessels which use KPD will be more than that at NSD. ⑥ Some difficulty of connecting IWT and the container vessel terminal is likely. ⑦ The increase of traffic to the hinterland is projected.
Alternative 2	① It is easy to convert general cargo berths to container berths. ② It is easy to connect the IWT with the container vessel terminal. ③ Operation control is easy because container berths are concentrated in NSD.	① Same as 1 of alternative 1. ② Same as 7 of alternative 1. ③ The available area for the container yard is small. ④ In order to get a sufficient area for the container yard, the labour house at the back of the boundary wall must be removed.
Alternative 3	① Effect to decrease traffic load to hinterland is expected. ② Same as 1 of alternative 1. ③ Same as 2 of alternative 1. ④ Effective use of existing facilities.	① Same as 2 of alternative 1. ② Same as 3 of alternative 1. ③ Same as 4 of alternative 1. ④ Same as 5 of alternative 1. ⑤ Same as 6 of alternative 1.
Alternative 4	① Same as 1 of alternative 3. ② Same as 4 of alternative 3. ③ Same as 1 of alternative 2. ④ Same as 2 of alternative 2. ⑤ Same as 3 of alternative 2.	① Same as 3 of alternative 2. ② Same as 4 of alternative 2.

Taking into consideration the above merits and demerits, alternative 4 seems to be recommendable.

11-1-4 Cargo Handling System

The study in this section are carried out for general cargo (except bulk) and containers only.

The recommendable cargo handling systems ar so follows;

1) General cargo
   - o Combination system of the quay side crane, ship gear and mobile crane for the handling from/to ship
   - o To introduce the unit load system (such ad Pallet/Forklift) at apron, between apron and storage area.
   - o To introduce the mobile crane system at some open storage yard.

2) Containers
   - o To use ship gear for handling from/to ship
   - o To introduce rubber tyred transfer crane system at the terminal.

11-1-5 Required Scale or Cargo Handling Equipment

Required cargo handling equipment in future are planned depend on the recommendable cargo handling system and it is shown in Table. The table includes both of the Master Plan and Short-term Development Plan.

Table 11-1-1 List of Minor Handling Equipment at Calcutta

	Exist	For General Cargo						For Container						A.D.B. Planed	Total Procurement	
		1994 / 1995			2004 / 2005			1994 / 1995			2004 / 2005					
		Required	Procu (Initial)	Procu (Replace)	Required	Procu (Initial)	Procu (Replace)	Required	Procu (Initial)	Procu (Replace)	Required	Procu (Initial)	Procu (Replace)		94/95	04/05
Transfer crane(rubber)	0	0	0	0	0	0	0	12	9	0	12	0	0	3	9	0
Fork-lift 2.0 t	12	0	0	0	0	0	0	30	0	0	13	0	26	32	0	26
3.0 t	35	49	14	35	74	25	88	18	14	0	7	0	14	0	63	127
5.0 t	0	18	18	0	26	8	36	1	1	0	1	0	2	0	19	48
10.0 t	0	3	1	0	5	2	6	0	0	0	0	0	0	2	1	8
45.0 t	0	0	0	0	0	0	0	1	1	0	1	0	2	0	1	2
Mobile crane 6.0 t	27	23	0	0	14	0	14	0	0	0	0	0	0	0	0	14
10.0 t	12	12	0	4	15	3	12	0	0	0	0	0	0	0	4	15
16.0 t	0	5	5	0	10	5	0	0	0	0	0	0	0	0	5	5
30.0 t	4	5	1	2	10	5	4	0	0	0	0	0	0	0	3	8
45.0 t	0	2	2	0	3	1	0	0	0	0	0	0	0	0	2	1
Chassis	0	0	0	0	0	0	0	69	33	0	40	0	80	36	33	80
Tractor	0	0	0	0	0	0	0	25	8	0	20	0	40	17	8	40

Table 11-1-2 Replacement of Minor Handling Equipment (Calcutta)

Description	Capa.	Require at 94/95	Existing Equipment			No. of Replacement					Remarks
			No.	M.Y.	End Y.	90/91	91/92	92/93	93/94	94/95	
Fork-lift	3 t	65	3	1980	1985(89)	3					
			5	1981	1986(89)	5					
working life-time; 5 Y.			22	1982	1987(89)	22					
			5	1987	1992			5			
		total	35			30		5			35
		Initial Procu.	65-35- 2 = 28 ADB				10		18		28
											63 (Total Procurement)
Mobile crane	6 t	23	4	1974	1988						
			5	1980	1995						
working life-time; 15 Y.			1	1981	1996						No replacement
			10	1982	1997						
			1	1983	1998						
			6	1988	2001						
		total	27								
	10 t	12	1	1964	1979(89)	1					
			3	1987	1982(89)	3					
			2	1981	1998						
			3	1984	1999						
			1	1986	2001						
			2	1987	2002						
		total	12			4					4 (Total Procurement)
	30 t	5	2	1964	1979(89)	2					
			1	1982	1997						
			1	1985	2000						
		total	4			2					2
		Initial Procu.	5-4=1							1	1
											3 (Total Procurement)

11-1-6 Required Scale of Storage Facilities

(1) Classification of Commoditywise Cargoes by Storage Facility Type

We classified the commoditywise cargoes by storage facility type from the information obtained from CPT. We assumed that the classification pattern by storage facility type does not change in the future. Accordingly, the classification of commodity wise cargoes by storage facility type can be obtained as follows.

(at Present)

	Sheds Use	Yards Use	Container x 1000 tons
Import	864.7	1,032.3	218.0
Export	314.0	206.8	205.0
Total	1,178.7	1,239.1	423.0

(in 1994/95)

	Sheds Use	Yards Use	Container x 1000 tons
Import	729.2	1,050.8	580.0
Export	160.2	128.8	530.0
Total	889.4	1,179.6	1,110.0

(in 2004/05)

	Sheds Use	Yards Use	Container x 1000 tons
Import	1,059.3	1,415.7	599.0
Export	236.2	128.8	318.0
Total	1,295.5	1,544.5	917.0

(2) Allocation of Cargoes by Storage Facility Type to Districts of Ports

According to the berth allocation of general cargo berths to respective districts, the allocated cargoes to the respective districts are as follows.

(Unit: tons)

District		Sheds Use		Yards Use		Container	
		1995	2005	1995	2005	1995	2005
NSD	Import	115,105	176,550	165,916	235,950	580,000	599,500
	Export	25,295	39,367	20,337	21,467	530,000	317,500
	Total	140,432	215,917	186,253	257,417	1,110,000	917,000
West side of KPD1	Import	153,516	176,550	221,221	235,950		
	Export	33,726	39,367	27,116	21,467		
	Total	187,242	215,917	248,337	257,417		
East side of KPD1	Import	191,895	294,250	276,526	393,250		
	Export	42,157	65,611	33,895	35,778		
	Total	234,052	359,861	310,421	429,028		
KPD2	Import	268,653	411,950	387,137	550,550		
	Export	59,021	91,856	47,452	50,089		
	Total	327,674	503,806	434,589	600,639		

(3) Calculation Methodology of Required Area

The required area can be calculated by the following formula.

$$A = \frac{N \times C}{R \times w \times \alpha}$$

where

A : Required area of storage facilities

N : Cargo Volume

C : Peak rate

R : Average number of usage per year

$$\left(R = \frac{365}{da} \right.$$

$\left.\text{where da : Average dwell time} \right)$

w : Unit cargo weight per m^2

α : Available area rate

(4) Required Area for Respective Facilities

By taking the above-mentioned general cargoes and the required open storage yard area for dry bulk cargoes into consideration, the required area for respective facilities can be obtained as follows.

(Unit : m^2)

District	Sheds Use		Yards Use		Container Yard	
	1995	2005	1995	2005	1995	2005
NSD	8,933	13,725	10,470	14,626	1,923 slots	2,727 slots
West side of KPD1	(152) 11,914	(229) 13,725	(1,982) 13,959	(4,929) 14,629		
East Side of KPD1	14,893	22,875	17,450	24,378		
KPD2	20,849	32,025	26,955	34,128		
Total	56,589	82,346	73,486	87,758		

The obtained layout plans at respective district are as follows.

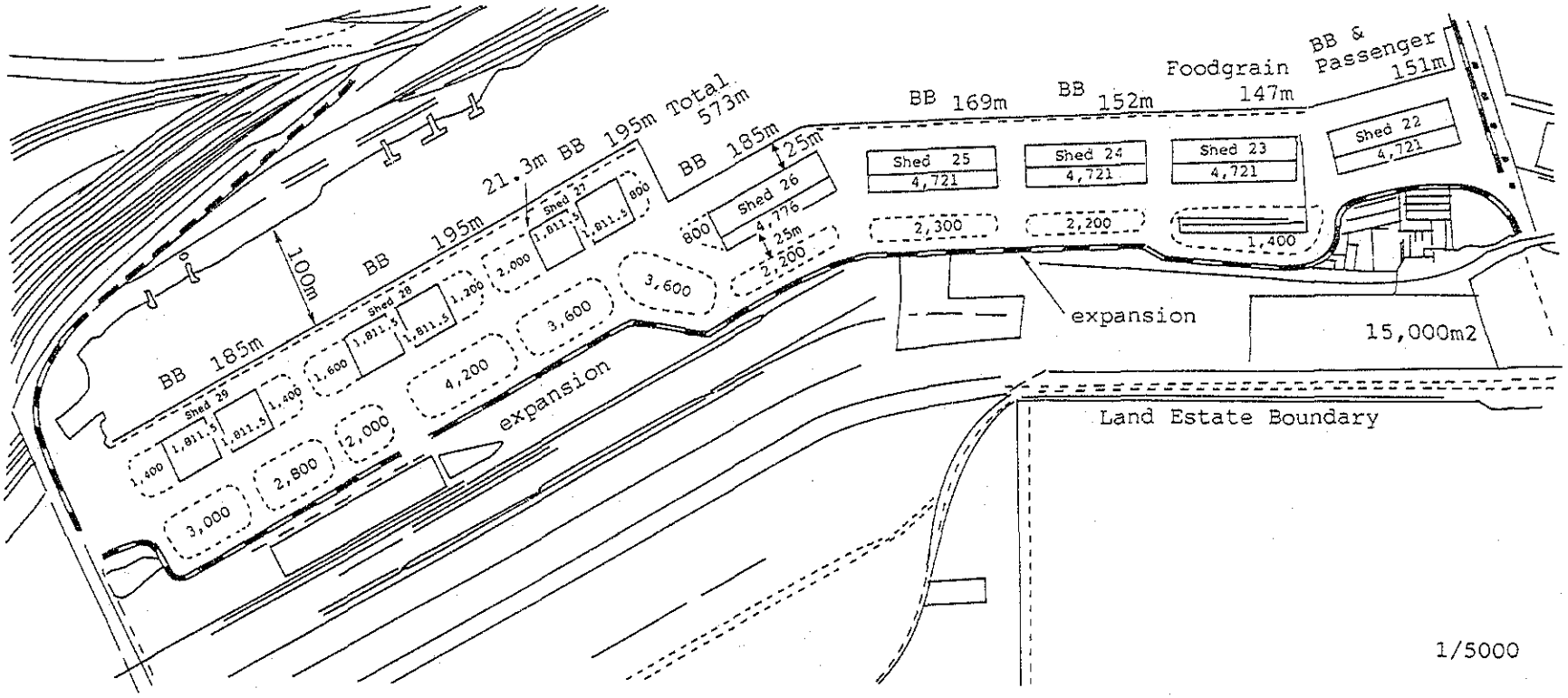


Fig. 11-1-5 Improvment Plan of KPD2 in 2004/05

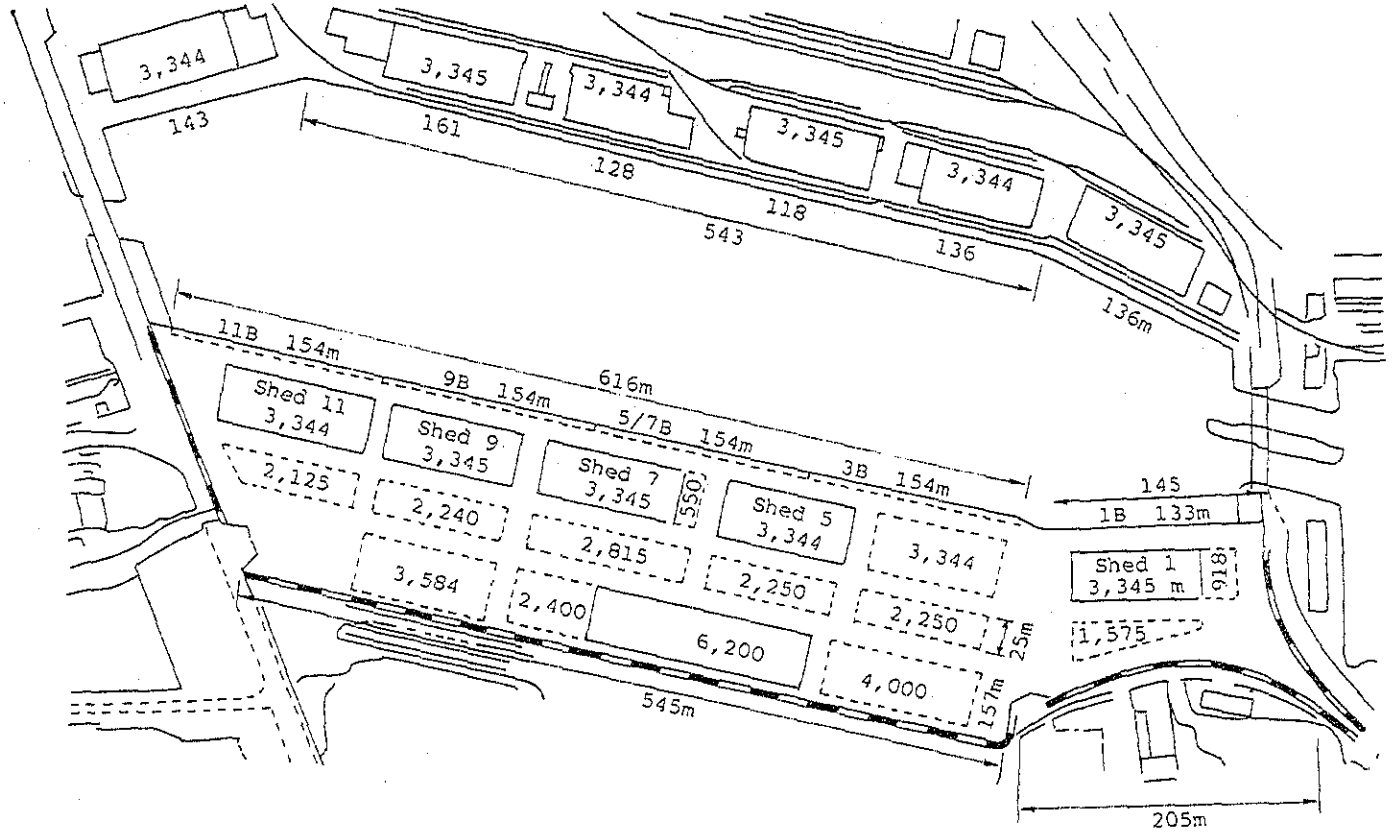


Fig. 11-1-6 Improvement Plan of East Side of KPD1 in 2004/05

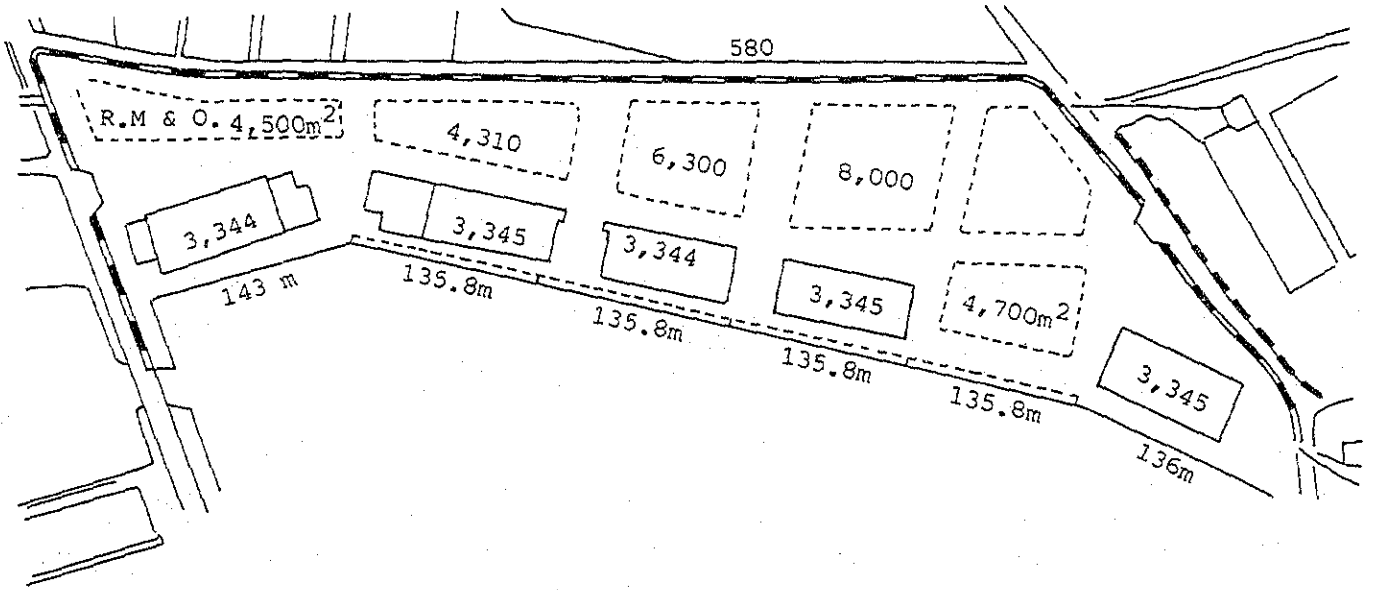


Fig. 11-1-7 Improvement Plan of West Side of KPD1 in 2004/05

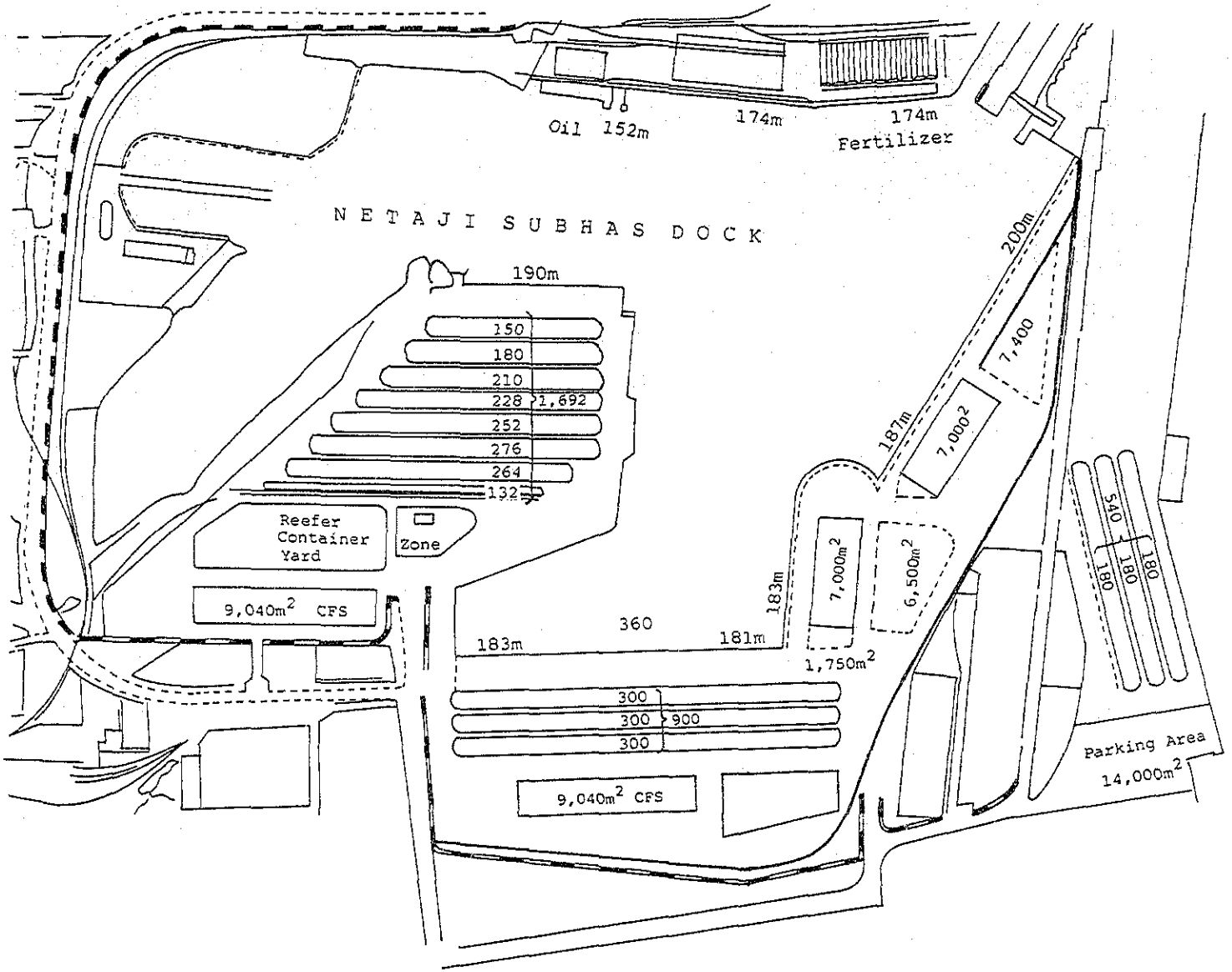


Fig. 11-1-8 Improvement Plan of NSD in 2005

11-1-7 Port Traffic Facilities

(1) Railway Systems

1) Premises

a) The required number of reception tracks, departure tracks and loading tracks are calculated on the assumption that the arrival rate of the rakes follows a poisson distribution and the service rate follows an exponential distribution.

b) Block rake loading terminal will be required at EJC yard.

c) To improve the railway operation most railway cargo will be shifted to the aforesaid loading terminal.

d) Requirement for the quay side tracks is expected to gradually decrease and those tracks would be eliminated mostly by 2005.

2) Facility Requirement up to 2005

a) Block rake loading terminal

The required number of reception tracks and loading tracks up to 2005 are as follows.

Total handling volume	:	500,000 tonnes
Full rake loading tracks	:	3 lines
Full rake reception tracks	:	1 lines

b) Container terminal

Total handling volume	:	14,100 TEUs
Loading/unloading tracks	:	3 lines (Full rake)
Reception/departure tracks	:	

c) Quay side tracks

Most quay side tracks would be eliminated.

(2) Road Systems

1) Premises

a) Traffic volume generated from each dock in 2005 are as follows shown in Fig. 11-1-9.

b) The numbers of queueing trucks during rush hour at KPD-1 and 2 are estimated on the assumption that the arrival rate of the exit gates follows a poisson distribution and the service rate follows an exponential distribution.

c) For the port related trucks two parking area shall be developed outside docks, one for KPD and one for NSD.

d) Second Hooghly River Bridge will be opened for traffic up to 1995.

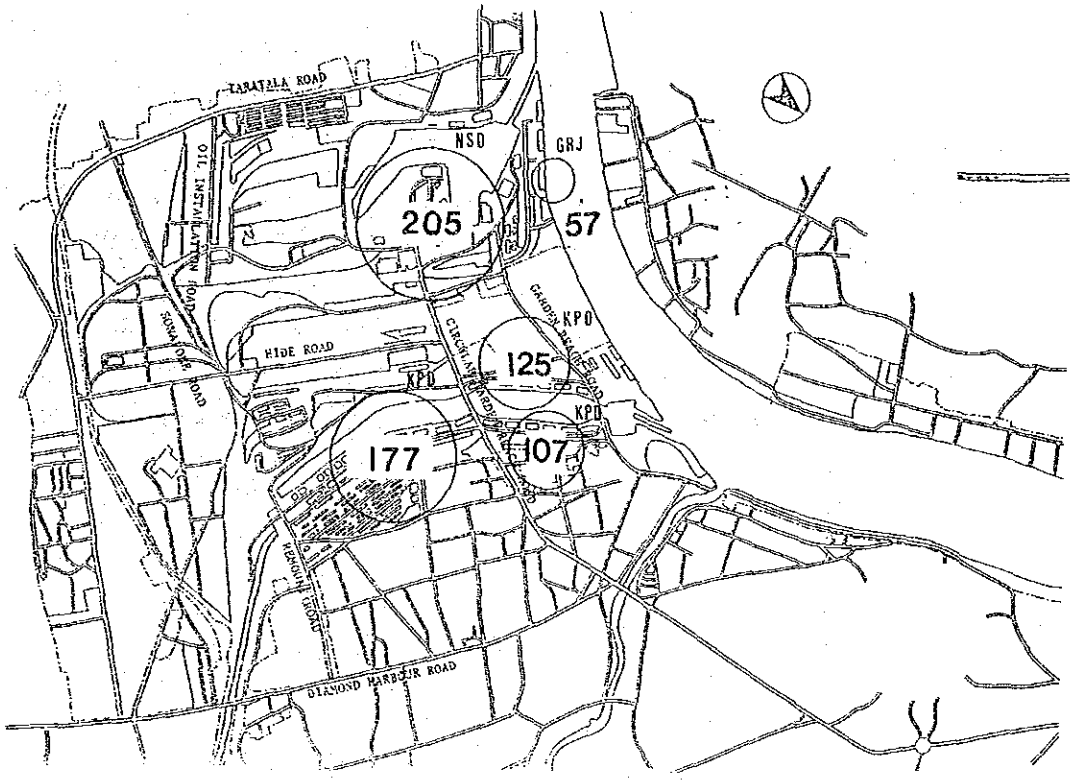


Fig. 11-1-9 Hourly Traffic Volume in 2005

2) Facility Requirements (ref. Fig. 11-1-10)

a) Major roads to be improved

In order to ease the congestion on the roads, especially on Circular Garden Reach Road, we propose following improvement.

Up to 1995 : New roads

1) Linkage between NSD (conversion of the C.G.R.R.) and Sonapore Road

2) Linkage between Sonapore Road and Remount Road

: Widening/improvement

1) Swing Bridge on Garden Reach Road

2) Hasting Bridge on Garden Reach Road

3) Sonapore Road and Hoboken Road

4) Hide Bridge

Up to 2005 : Widening/improvement

1) Katapukur Road
2) Eastern Boundary Road
3) Satya Doctor Road
4) Hide Road
5) Flyover bridge on Hoboken Road
6) Replacement of Bascule Bridge on Circular Garden Reach Road

b) Queueing space at the exist gates

In order to ease the congestion around the dock gates, we propose that each gate have two exits and queueing spaces for 5 - 10 tracks.

c) Parking facilities for trucks

The required parking spaces for port related trucks are as follows.

KPD : 22,500 m²

NSD : 14,000 m²

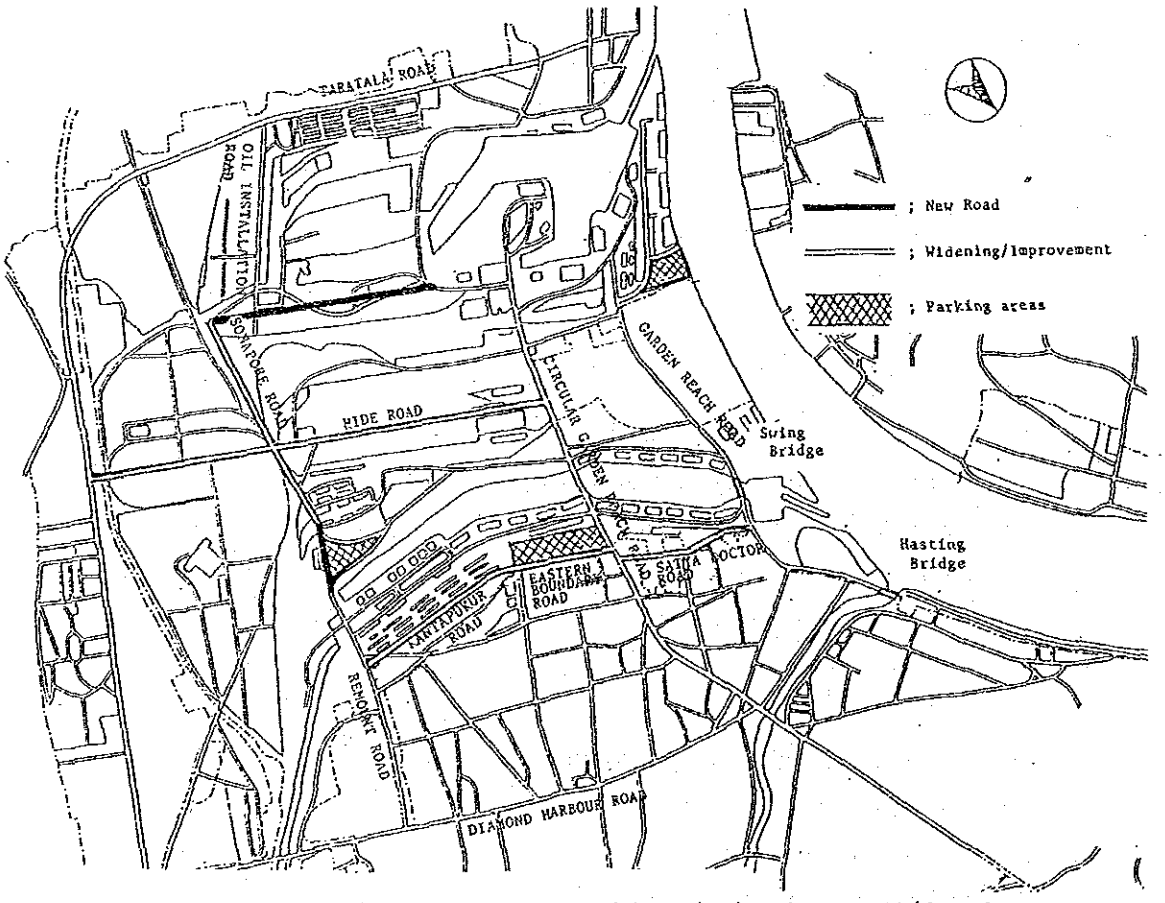


Fig. 11-1-10 Major roads and parking to be improved/developed

11-8 Proposed Land Use Plan

The required areas are summarized as follows.

① The area, which is now used for labour residences, at the back side of No. 4 and No.5 berths NSD must be required for container yards inside the dock boundary.

② The areas, which are now used for labour residences, at the back side of No. 27 and No. 28 berths, and No. 24 and No. 25 berths KPD2 must be required for storage area for general cargoes.

③ The areas at the east and west side of KPD1 inside the dock boundary inside the dock boundary will be used for port functions in the future.

④ The areas at the west side of KPD2 will not be required for port functions.

⑤ Three parts indicated by ① ② and ③ on the figure will be required for parking spaces.

⑥ The parts indicated by Ⅰ Ⅱ and Ⅲ on the figure will be required for present utilization.

⑦ The part indicated by Ⓐ on the figure, Dhobitalao Container Yard will be required for empty container pool.

⑧ The part indicated by Ⓑ on the figure will be rendered to city functions.

⑨ The part indicated by Ⓒ and Ⓓ on the figure will also be rendered to city functions.

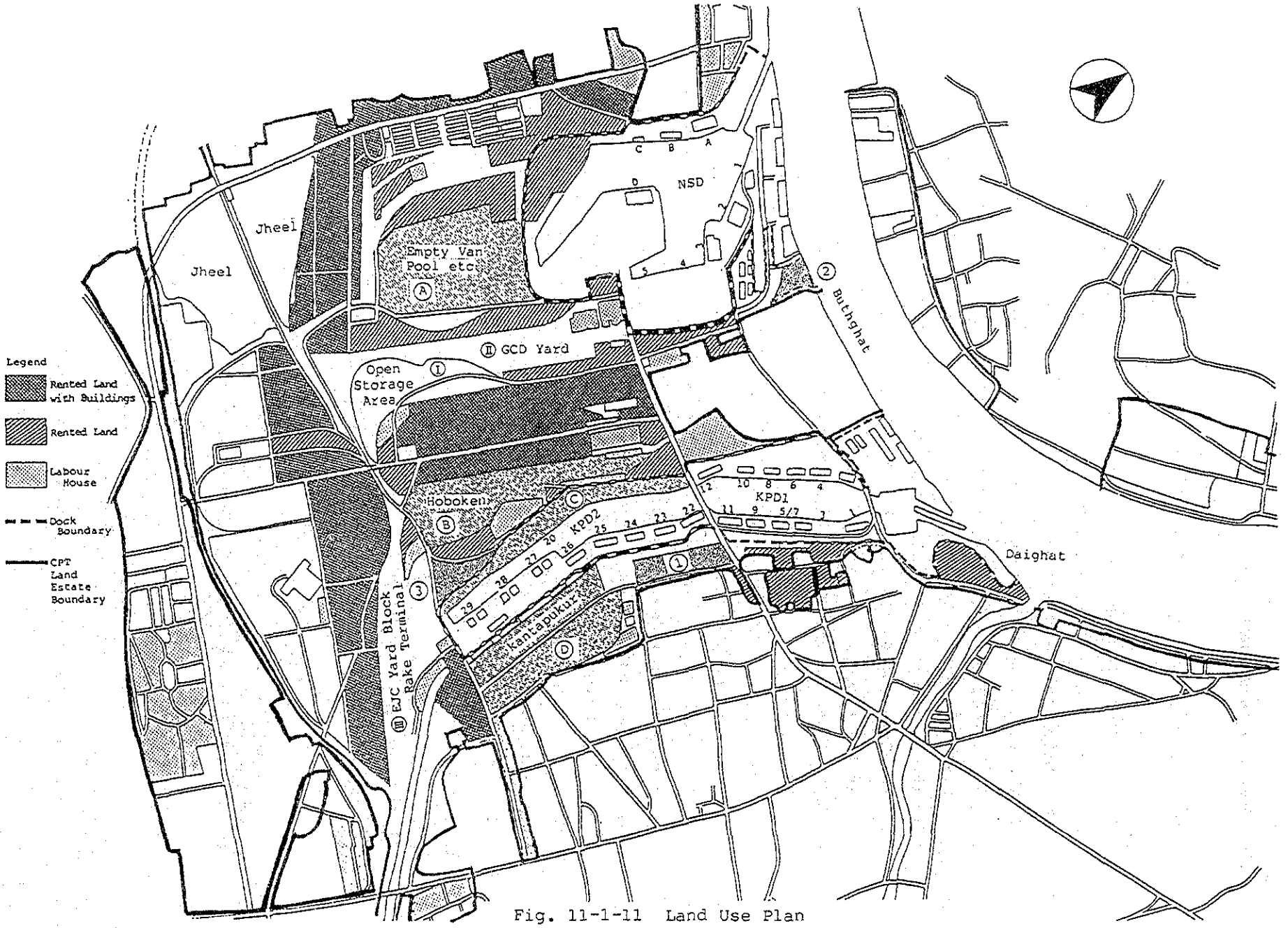


Fig. 11-1-11 Land Use Plan

11-2 Haldia Dock System

1. The accessible draft at Haldia is assumed based on th figures presented by the counterparts, i.e. 10.67 m in 2005 as against 8.6 m at present.

2. Berth Determination

The required number of berthing facilities by commodity in 2005 is determined as follows based on the conventional estimation method using berth occupancy criteria as well as a computer simulation using queuing theory.

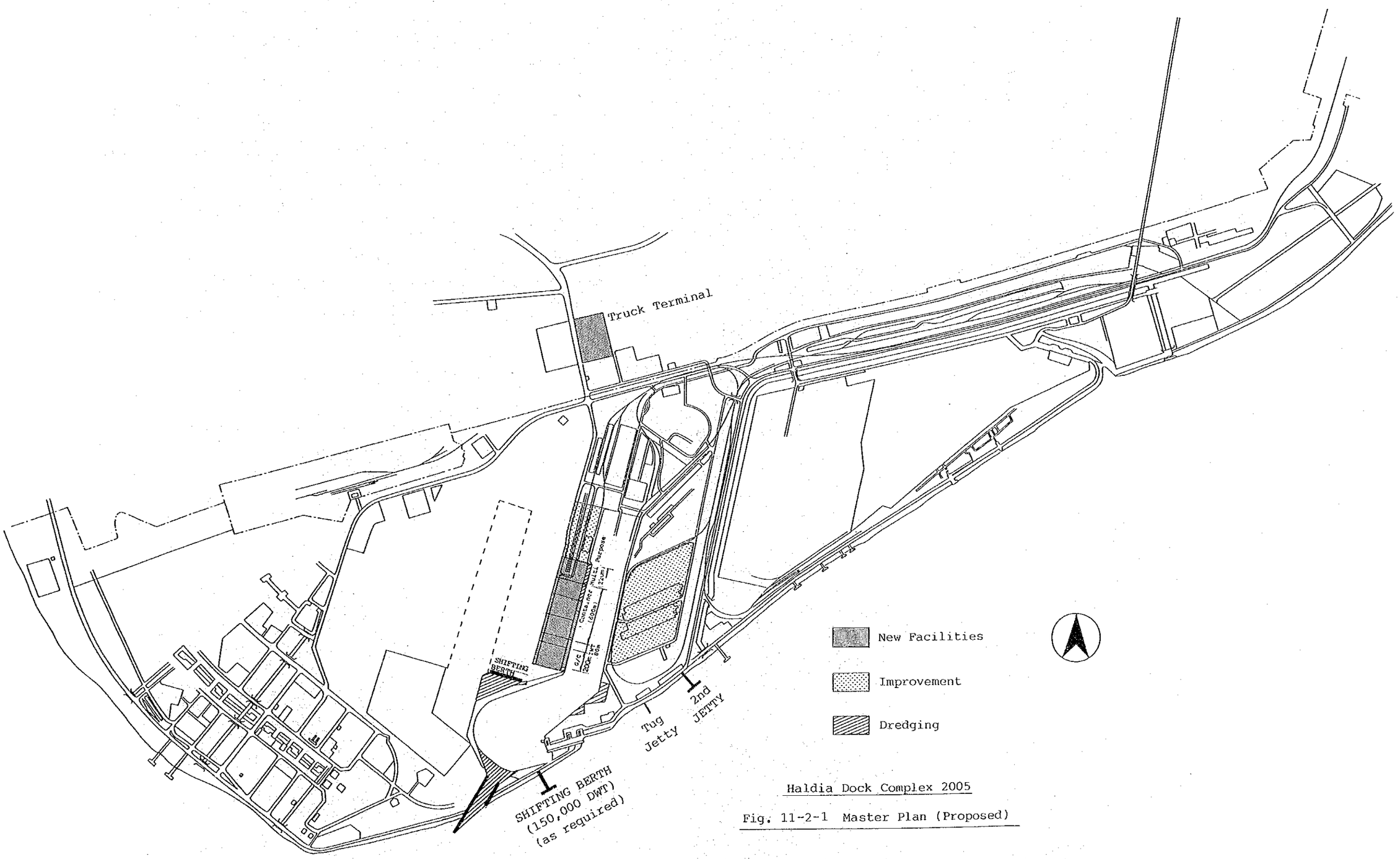
The layout is presented in Fig. 11-2-1.

Table 11-2-1

Commodity	Master Plan (Year of 2005)
P.O.L	1. restrengthening of the existing jetty (87,000 DWT) 2. construction of the 2nd oil jetty (150,000 DWT) 3. one shifting berth 4. increase of pumping rate
Coal	1. one coal berth with the effective handling rate of 610 TPH x 2 2. one converted coal berth with the effective handling rate of 480 TPH x 2
Fertiliser/ Raw material	1. one existing phosphate berth 2. 3-shift handling
Coking Coal	1. one mechanised c/coal berth converted from general cargo berth with the rated handling capacity of 700 TPH x 2
General cargo and Containers	1. two general cargo berths (one existing) 2. one multi-purpose berth 3. three container berths

Additionaly, the followings are also proposed;

1) Berthing facilities for working crafts both inside and outside the dock
2) Waiting berth to improve the lock productvity
3) Truck terminal



Haldia Dock Complex 2005

Fig. 11-2-1 Master Plan (Proposed)

3. Up to 2005, a 2nd lock entrance will be required. In addition, productivity improvement by upgrading tug fleet and berthing masters number, etc. will also be required.

4. Handling Equipment

a) Coal

At the coal berth, the losstime of the tippler will be reduced by 50% through of improved maintenance and crushing.

A Foulder Removal Equipment for coal will be provided at the ore berth.

After the above items are achieved, the port will have sufficient facilities to smoothly handle the forecast cargo volume (4,150,000t).

b) Coking Coal

The mechanisation of the existing general cargo berth is required to handle 1.8 million tonnes of coking coal. The required handling system is comprised of:

Unloader : Luffing crane with grab bucket 2 x 700 TPH
Belt Conveyer 1,400 TPH
Stacker/reclaimer 2 units
Stowage yard 150,000 m²

The layout is presented in Fig. 11-2-2.

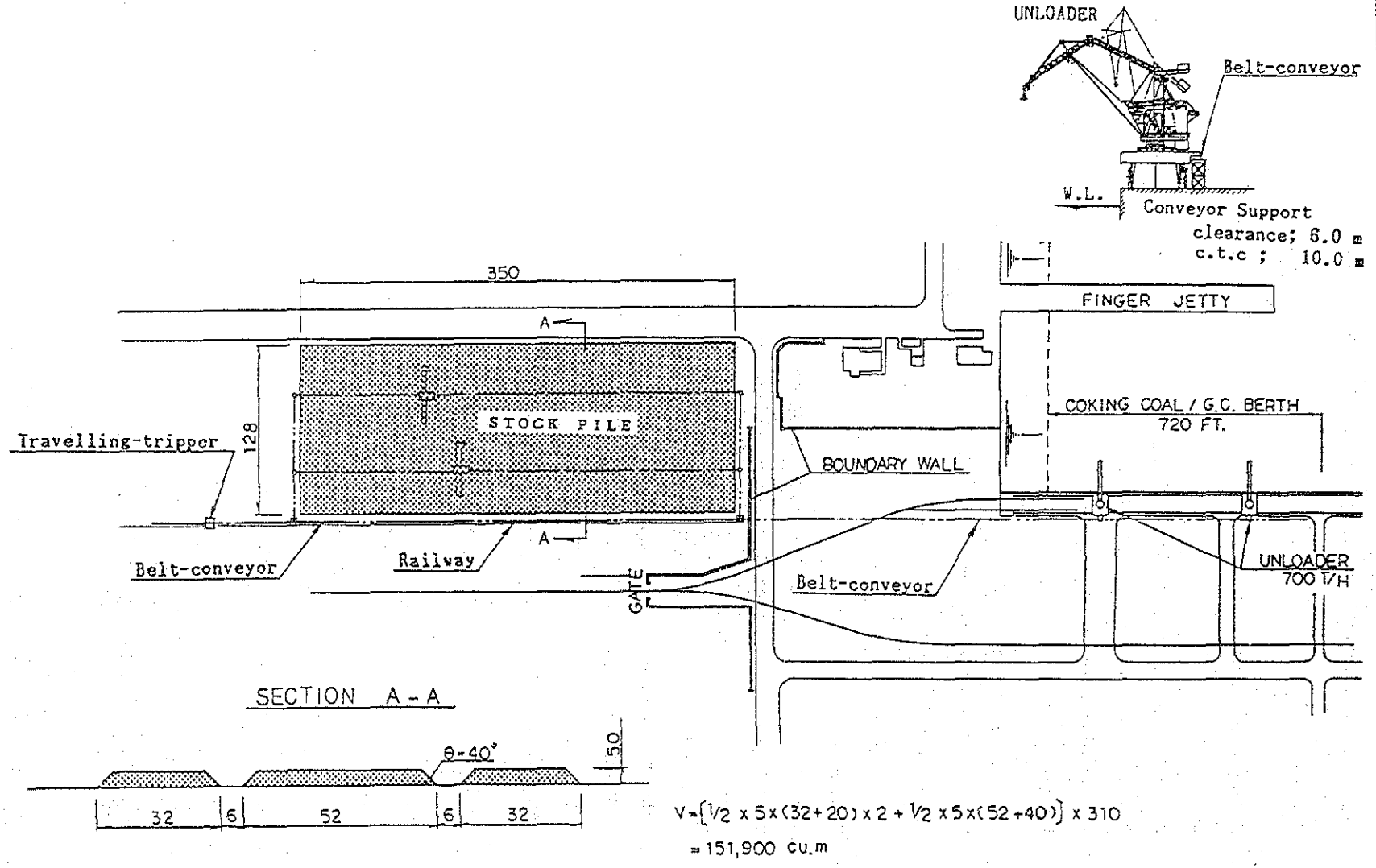


Fig. 11-2-2 Layout of Coking Coal Handling Plant

c) Container Terminal

Two quay cranes per berth are required.

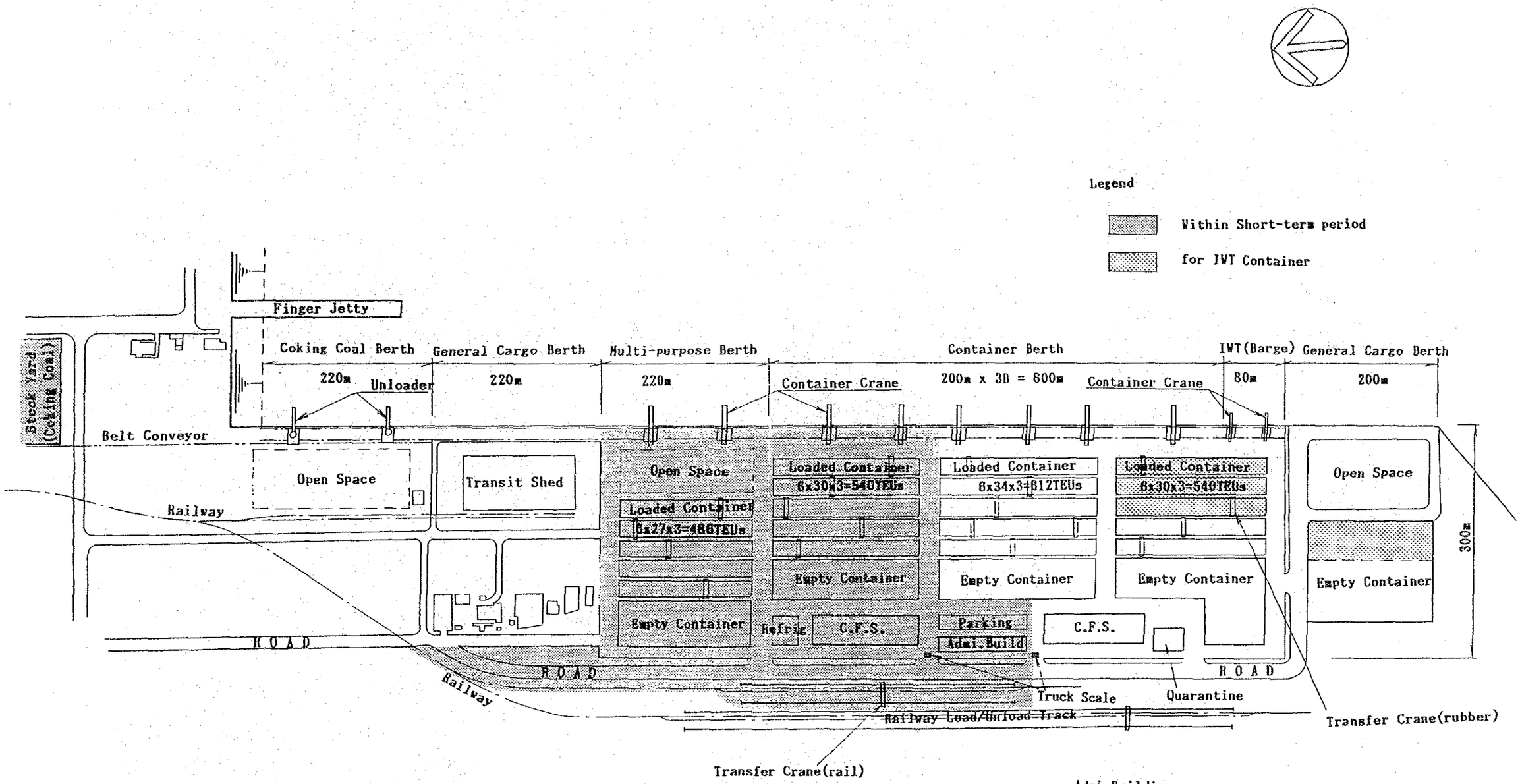
Among a variety of yard handling systems currently adopted in the world such as the transfer crane system (rail, rubber tyred), chassis system, straddle carrier system, forklift system, front loader system and others, the rubber tyred transfer crane (with tractor/trailers) system is recommended for Calcutta and Haldia.

The required scale of the equipment is presented in Table 11-2-2.

The layout of the container terminal is presented in Fig. 11-2-3.

Table 11-2-2

Equipment \ Year	1994/1995			2004/2005	
	Existing	Required	Procurement (Initial)	Required	Procurement (Initial)
Quay Crane	1	4	3	8	7
Transfer crane (rail)	1	1	0	3	2
Transfer crane (rubber)	0	9	9	16	7
Fork-lift					
2.0 t	0	16	16	31	15
3.0 t	8	9	1	17	8
5.0 t	0	1	1	5	4
10.0 t	0	0	0	0	0
45.0 t	0	1	1	1	0
Mobile crane					
10.0 t	3	0	0	0	0
16.0 t	0	0	0	0	0
30.0 t	0	0	0	0	0
Chassis	5	43	38	85	42
Tractor	4	20	16	37	17
Truck-scale	0	2	2	4	2



Admi.Building
1F; Maintenance shop & Cleaning
2F; Canteen
3F,4F; Office
5F; Operation control

Fig. 11-2-3 Layout Plan of Container Terminal at Haldia

5. Craft/Vessels

The required floating craft/vessels for Calcutta and Haldia Dock Systems in the future are planned as presented in Table 11-2-3. The table includes both of the Master Plan and Short-term Development Plan, so as to indicate the orderly timing of the procurement towards the future.

6. Port Traffic Facilities

(1) Railway System

1) Premises

a) The required number of reception tracks, departure tracks and loading tracks are calculated on the assumption that the arrival rate of the rakes follows a poisson distribution and the service rate follow an exponential distribution.

b) Container movement in Haldia is expected to increase after completion of the new ICDs expansion of Guwahati ICD.

c) Tippler efficiency will be improved by increasing the number of tipplers and/or reinforcing the capacity.

d) Mechanical loading facility for coking coal will be developed by 1995.

e) A direct link line will be developed between the coal departure tracks and the coking coal loading terminal.

(2) Facility Requirement

a) Container Terminal

The required number of reception tracks and loading tracks up to 2005 are as follows.

Total handling volume	:	69,500 TEUs
Reception Tracks	:	1 line
Loading/unloading Tracks	:	3 lines
Departure Tracks	:	2 lines

b) Coal Terminal

Total handling volume	:	4,150,000 tonnes
Reception Tracks	:	4 lines
Departure Tracks	:	7 lines

c) P.O.L.

Total handling volume	:	1,775,000 tonnes
Reception Tracks	:	5 lines
Departure Tracks	:	6 lines

d) Coking Coal

Total handling volume	:	1,800,000 tonnes
Loading Tracks	:	1 lines (Full rake)
Departure Tracks	:	4 lines

Table 11-2-3 Floating Equipment

Port	No.	Type of Vessel	Name	Built year	Main Dimensions L	B	D		Scrap H/P	Scrap S/T	Built H/P	Built S/T	Final	Remarks
	1	Dredger (River)	Mahaganga	'78	140.0	22.0	9.5	4,700 ㎥ 1,910ps×4						
	2	〃 〃	Mohana	'85	123.6	18.7	8.2	2,000 ㎥ 1,000ps						
	3	〃 〃	Churni	'81	111.4	18.0	7.3	1,700 ㎥ 1,352ps	X		0		0	Finally Large,Middle,Small three Dredgers
	4	〃 〃	Subarnarekha	'80	93.6	16.2	6.8	1,274 ㎥ 1,080ps	X	X	0	0	0	(5,000 3,000 1,760 ㎥)
	5	〃 (Port)	Ajay (Bucket)	'87	66.4	14.0	6.4	No Hopper 1,500ps	X					
C	6	〃 〃	Grab Dredg.No.1	'81	68.3	13.7	6.4	1,910ps	X					
	7	〃 〃	Grab Dredg.No.2	'87	68.3	13.7	6.4	1,910ps	X		0	0	0	750㎥
	8	Tug/Despatch	Nadia	'51	33.1	11.3	4.1	S.P 18t 1,153ps	X	X				→ Multi.
	9	〃	Sova	'63	73.8	12.2	3.98	20t 1,200ps	X					Average 66days Navi.per year
C	10	Tug boat (River)	Shaktiman	'84	33.0	9.0	4.5	22t 750ps×2					0	
	11	〃 〃	Stalwart	'73	30.7	9.8	4.3	10t 1,000ps	X					
C	12	〃 (Dock)	Champa	'64	28.9	8.2	3.8	10t 800ps	X	X	0	0	0	• 7 tugs are available usually
C	13	〃 〃	Chamoli	'65	28.9	8.2	3.8	10t 800ps	X	X	0	0	0	• (4 tugs within 11 tugs were not available
	14	〃 〃	Malati	'68	26.1	7.6	3.7	9.6t 775ps	X	X				at same time)
C	15	〃 〃	Dulap	'67	26.9	7.9	3.7	11.6t 950ps	X		0		0	
C	16	〃 〃	Tagar	'67	26.9	7.9	3.7	11.6t 950ps	X		0		0	
C	17	〃 〃	Hena	'67	27.4	7.9	3.7	11.6t 950ps	X		0		0	
C	18	〃 〃	Bakul	'68	27.4	7.9	3.7	11.6t 950ps	X		0		0	
C	19	〃 〃	Juin	'85	27.6	8.8	3.7	11.7t 950ps	X		0		0	
C	20	〃 〃	M.O.T.Tug-1	'87	28.4	8.2	3.1	950ps					0	
								12t 950ps	X		0		0	※ 1 1,500ps
														※ 1 750ps x 2
	21	Pilot Vessel	Saugor	'84	33.6	13.3	7.2	1,500ps	X	X				
	22	〃	Sandra	'84	33.6	13.3	7.2	1,500ps	X					
	23	River Survey Ve.	Haddia	'81	44.1	7.8	3.8	600ps	X	X				→ Multi. Alternately Work
	24	〃	Triveni	'85	60.1	10.8	6.2	1,200ps	X					
	25	River Survey Laun.	Ena	'60	20.4	4.8	2.2	120ps	X	X	0	0	0	
	26	〃	Lakshman	'60	20.4	4.8	2.2	120ps	X	X				
	27	〃	Bharat	'60	20.4	4.8	2.2	120ps	X	X				
	28	〃	Topsee	'60	20.4	4.8	2.2	120ps	X	X	0	0	0	based at Hugli point,Falta,Moyapur,Raj Raj,
	29	〃	Lava	'64	20.4	4.8	2.2	240ps					0	Akra & Fairfields.
	30	〃						160ps	X	X				
	31	〃	Kanchalya	'68	20.4	4.8	2.2	67ps	X		0		0	
	32	〃	Kalkeyee	'68	20.4	4.8	2.2	67ps	X		0		0	
	33	〃	Kopol	'70	17.8	4.9	1.9	218ps×2	X				0	
	34	Pil/Har/Dock Laun.	Parijat	'57	33.8	8.2	3.4	380ps	X	X	0	0	0	Transport officer & nec
	35	〃	Parul	'61	33.8	8.2	3.4	380ps	X	X	0	0	0	between shore point and ship
	36	〃	Keya	'63	18.4	5.9	1.8	90ps	X	X				
	37	〃	Kareb∫	'63	18.4	5.9	1.8	90ps	X	X				
	38	〃	Ketaki	'63	18.4	5.9	1.8	90ps	X	X	0	0	0	
	39	〃	Kahua	'72	18.4	5.9	1.8	90ps	X	X				
	40	〃	Nander	'72	18.4	5.9	1.8	93ps	X		0		0	
	41	〃	Madhabi	'72	18.4	5.9	1.8	93ps	X					
	42	〃	Mallika	'76	22.4	6.8	2.3	190ps					0	are stationed at Raj Raj
	43	〃	Srobana	'77	21.6	6.8	2.3	190ps					0	alternately
	44	〃	Sarmistha	'78	20.8	6.0	2.3	572ps					0	) voyage work for small
	45	〃	Sulopa	'79	20.8	6.0	2.3	572ps					0	) ships
	46	〃	Shilabati	'79	19.5	5.2	2.0	174ps					0	Transport personnel
	47	Lighting Launch	Jyoti	'58	28.9	5.0	3.6	360ps						→ Multi.
	48	〃	Dasarath	'88	30.4	8.0	3.7	368ps×2						
	49	Water Barge	Jaladhi	'81	39.4	9.4	3.8	100t water	X		0		0	
	50	〃	Baridhi	'83	39.4	9.4	3.8		X		0		0	
	51	Anchor Vessel	Deepak	'85	29.7	7.0	3.5		X					
	52	〃	Arjun	'87	37.1	8.8	4.4		X		0		0	Average 66days Navi.per year
	53	Light Vessel	Deepak	'66	20.7	7.0	3.8		X					
	54	〃	Pradip	'78	22.4	7.3	3.4		X					) No crew
	55	〃	Planet	'79	20.1	6.8	3.7		X	X				
	56	〃	Torch	'61	40.8	7.9	4.8		X	X				
	57	〃	Flame	'66	40.8	7.9	4.8		X	X				) with crews
	58	〃	Candle	'67	40.8	7.9	5.8		X	X				
	59	Research Vessel	Anusandhani	'82	43.9	9.9	4.8	1,800ps	X					→ Multi.
	60	Barge (Hopper)	No.3	'84	62.1	12.2	4.9	850ps×2	X	X				O/O/C since '87
	61	〃	No.4	'84	66.1	10.9	3.8	492 ㎥ 1,000ps	X	X				Private Co.
	62	〃	No.6	'86	65.1	10.9	3.8	710 ㎥ 1,000ps	X	X				
	63	〃	No.7	'87	87.1	11.6	4.9	701 ㎥ 1,780ps	X	X				
	64	House Boat	Blue-Wing	'52	24.7	6.3	1.8		X	X				
C	65	Multi-purpose ship									0	0	0	
C	66	〃									0	0	0	
H	67	〃									0	0	0	
C	68	Floating Crane	Atlas	'23	54.4	17.3	3.8	50t, 842ps,10 kt	X	X	0	0	0	50t
C	69	〃	Mahabahu	'63	33.2	14.6	3.5	60t, 1,100ps, 9.5kt	X	X	0		0	100t
	70	〃	Virbau	'63	46.0	14.9	3.8	30t, 777ps,10 kt	X	X				
H	71	〃	New ship								0	0	0	60t
C	72	General S.B.	New ship								0		0	
H	73	〃	New ship								0		0	
H	74	Dredger	Grab No.3	'87	66.8	11.8	4.9		X	X	0	0	0	780㎥
H	75	Tug boat	Ahalya 39.6	'72	39.6	9.7	4.9	S.P 24t 760ps×2	X		0		0	※
H	76	〃	Draupadi	'74	39.6	9.7	4.9	S.P 24t 760ps×2	X		0		0	※
H	77	〃	Kunti	'76	39.6	9.7	4.9	S.P 24t 760ps×2					0	
H	78	〃	Tara	'76	39.6	9.7	4.9	S.P 24t 760ps×2					0	
H	79	〃	Mandodari	'77	39.6	9.7	4.9	S.P 24t 760ps×2					0	
H	80	〃	New ship								0	0	0	•
H	81	〃	〃								0	0	0	•
H	82	〃	〃								0	0	0	• ※ 1 1,500ps
														※ 1 750ps x 2
H	83	Mooring boat	Satapa	'83	20.8	5.2	2.4		X					
H	84	〃	Jyan						X		0		0	
H	85	〃	No.1						X					
H	86	〃	No.2						X		0		0	

Chapter 12 Formulation of Short-term Development Plan

12-1 Calcutta Dock System (Including Budge Budge District)

12-1-1 Planning Premises

(1) Project Cargo Volume

①	Liquid Bulk Cargo	1,210 x 1000 tons
②	Dry Bulk Cargo	610
③	Container Cargo	1,110 (110 x 000 TEUs)
④	Other General Cargo	2,210

(2) Projected Vessel Size

		Vessel Size	Parcel Size
①	Liquid Bulk Carriers	10,300 DWT	6,405 tons
②	Dry Bulk Carriers	10,300	8,024
③	Container Vessels	8,900	3,885 (385 TEUs)
④	General Cargo Vessels	9,400	4,785

12-1-2 Alternative Formulation

By taking the improvement of cargo handling productivity into consideration, the alternatives of berth combination are as follows.

In 1994/95

	Container Berth			Dry Bulk Berth			General Cargo Berth			Lost Cost due to vessel waiting
Cargo Volume	x 1,000 tons 1,110			x 1,000 tons 610			x 1,000 tons 2,210			
No. of Vessel	(110 x 1,000 TEUs) 286			vessels 76			vessels 462			
λ	0.784			0.208			1.266			
	No. of B	Prod. TEUs/hour	$\overline{Wg}$ day	No. of B	Prod. tons/hour	$\overline{Wg}$ day	No. of B	Prod. tons/day	$\overline{Wg}$ day	
Alternative 1	4	15	0.02	4	1,150	0.6	18	492	0.6	304 △
2	4	10	0.13	4	"	"	18	"	"	324
3	4	15	0.02	3	"	3.2	19	"	0.3	357 } Long Waiting Time for Dry Bulk Carriers
4	4	10	0.13	3	"	"	19	"	"	377 }
5	3	15	0.1	4	"	0.6	19	"	"	195 ◎
6	3	10	0.7	4	"	"	19	"	"	295 ◎
7	2	15	0.9	4	"	"	20	"	0.14	279 △

Judging from the average waiting time, the above alternative 5 or 6 seems to be suitable.

For container cargoes, No. D berth NSD should be used. The other 2 necessary berths should be located in NSD or KPD2 by taking into consideration the availability of land use. The demand of IWT is some 20,200 TEUs and it seems to be less than the cargo volume which need to construct a independent IWT berth. Accordingly, the side of No. D berth of NSD shall be used for IWT containers.

The alternative of Short-term Development Plans are as follows.

ⓐ Alternative 1 (Fig. 12-1-1)

① Liquid Bulk Cargo	1B	1,925 tons/day	at C of NSD
② Dry Bulk Cargo	4B	1,150 tons/day	at A, B of NSD and 6 of KPD1 and 23 of KPD2
③ International Container Cargo	3B	10 - 15 TEUs/Hour	at D, 28 and 29 of KPD2
④ General Cargo	19B	492 tons/day	at other berths

ⓑ Alternative 2 (Fig. 12-1-2)

① Liquid Bulk Cargo	1B	1,925 tons/day	at C of NSD
② Dry Bulk Cargo	4B	1,150 tons/day	at A, B of NSD and 6 of KPD1 and 23 of KPD2
③ International Container Cargo	3B	10 - 15 TEUs/Hour	at D, 5 and 4 of NSD
④ General Cargo	19	492 tons/day	at other berths

As for the alternative Short-term Development Plans, alternative 2 is recommendable.

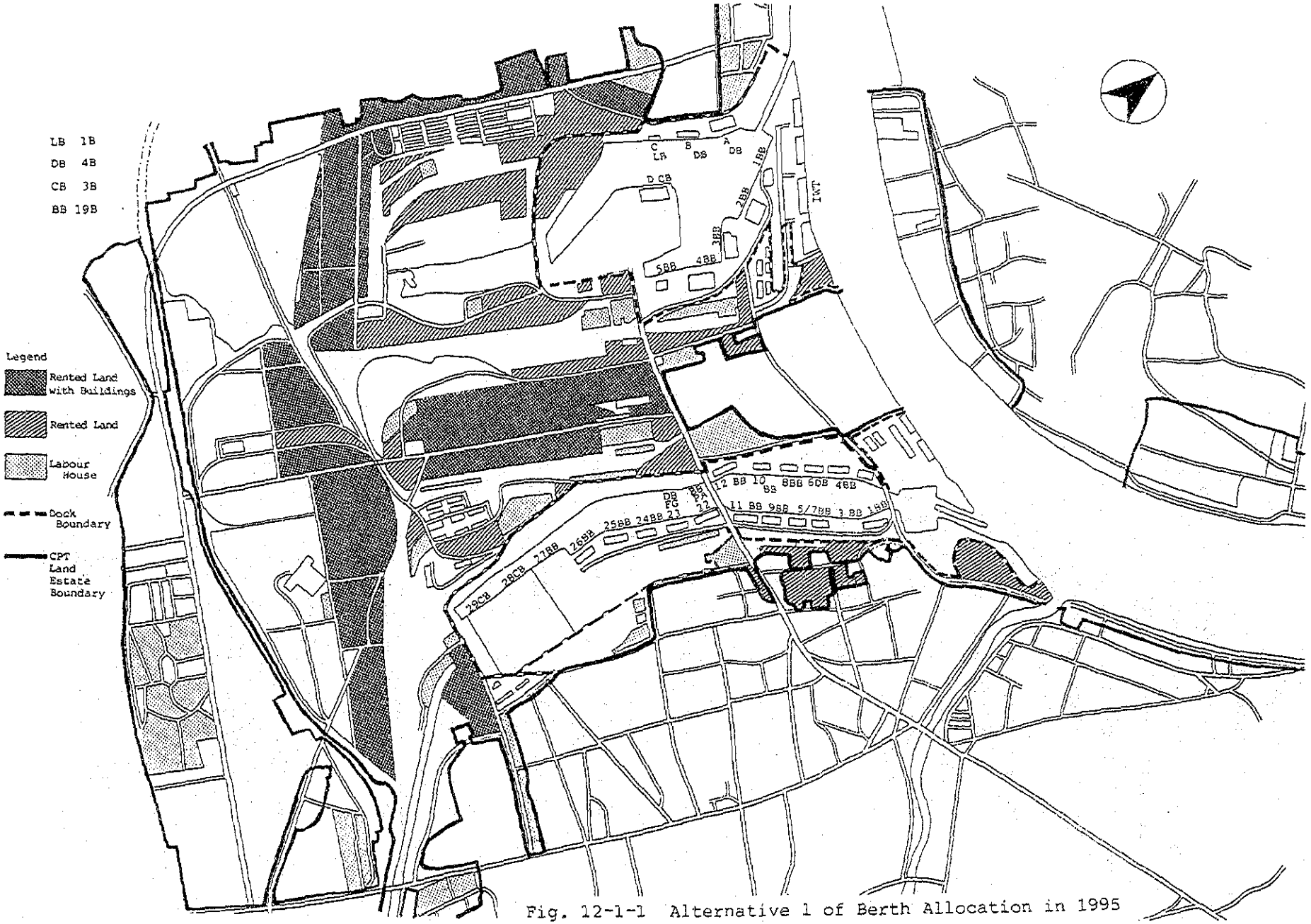


Fig. 12-1-1 Alternative 1 of Berth Allocation in 1995

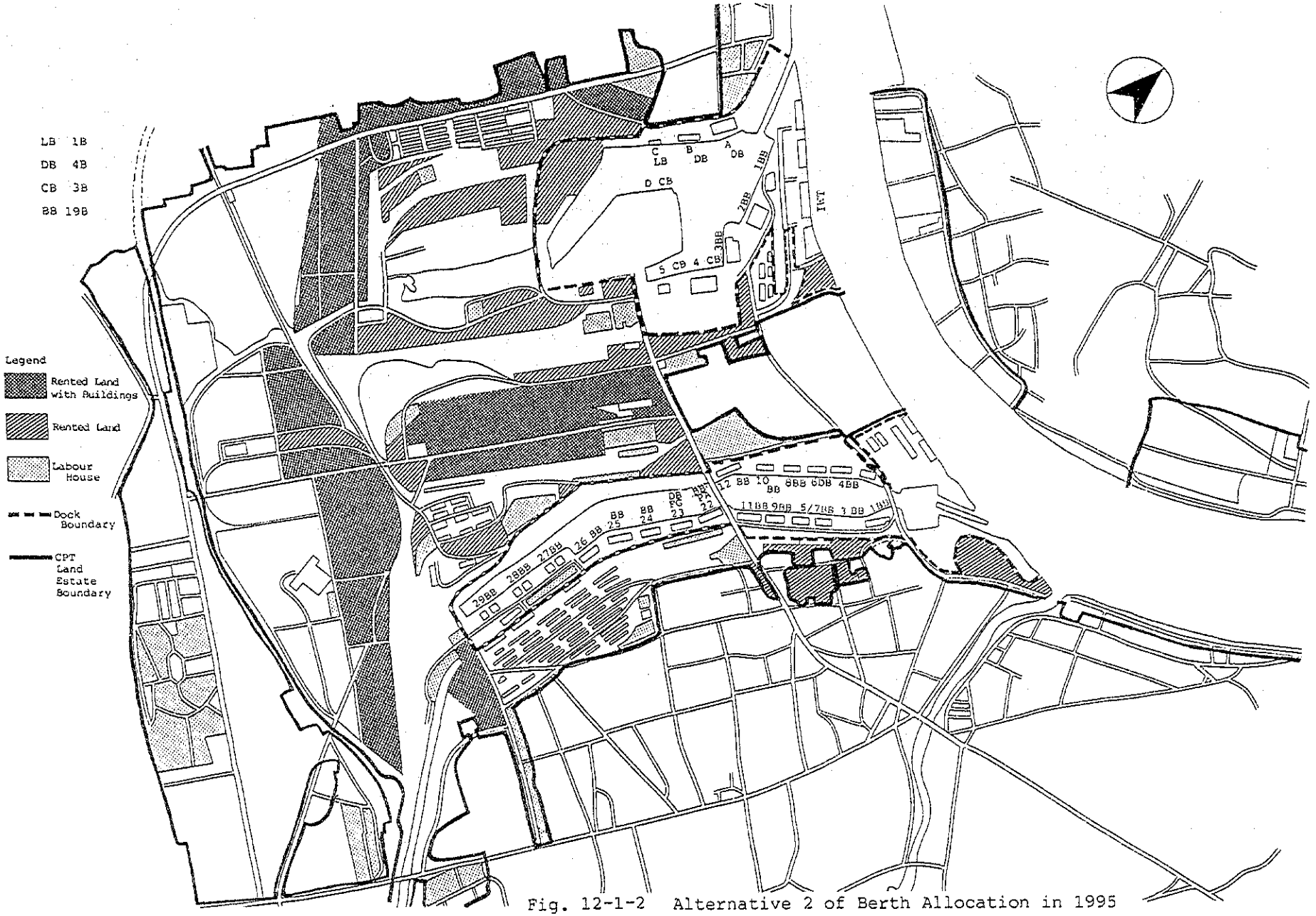


Fig. 12-1-2 Alternative 2 of Berth Allocation in 1995

12-1-3 Port Traffic Facilities

(1) Railway Systems

1) Premises

a) The required number of reception tracks, departure tracks and loading tracks are calculated on the assumption that the arrival rate of the rakes follows a poisson distribution and the service rate follows an exponential distribution.

b) Block rake loading terminal will be required at EJC yard.

c) Before developing the aforesaid loading terminal, operational problems in loading/unloading trucks and wagons and transportation in the Dock systems should be identified.

d) To improve the railway operation most railway cargo will be shifted to the aforesaid loading terminal.

e) Required for the quay side tracks is expected to gradually decrease and most quay side tracks except those at KPD-2 and NSD A, B would be eliminated.

2) Facility Requirement up to 1995

a) Block rake loading terminal

The required number of reception tracks and loading tracks up to 1995 are as follows.

Total handling volume	:	200,000 tonnes
Full rake loading tracks	:	2 lines
Full rake reception tracks	:	1 lines

b) Container terminal

Total handling volume	:	22,000 TEUs
Loading/unloading tracks	:	3 lines (Full rake)
Reception/departure tracks	:	

c) GCD yard

10 - 12 tracks would remain through 1995.

d) EJC yard

7 fully electrified reception tracks, 7 top electrified departure tracks, 3 sorting tracks and 2 tracks for loco movement

would remain through 1995.

e) Quay side tracks

Quay side tracks at KPD-2 and NSD A, B would remain through 1995.

f) Locomotives

At least 8 locomotives would be necessary.

It is recommended to replace four old locomotives with two of 5,000 ton capacity and two of smaller capacity for 9th Plan.

(2) Road Systems

1) Premises

a) Traffic volume generated from each dock in 1995 are as follows shown in Fig. 12-1-3.

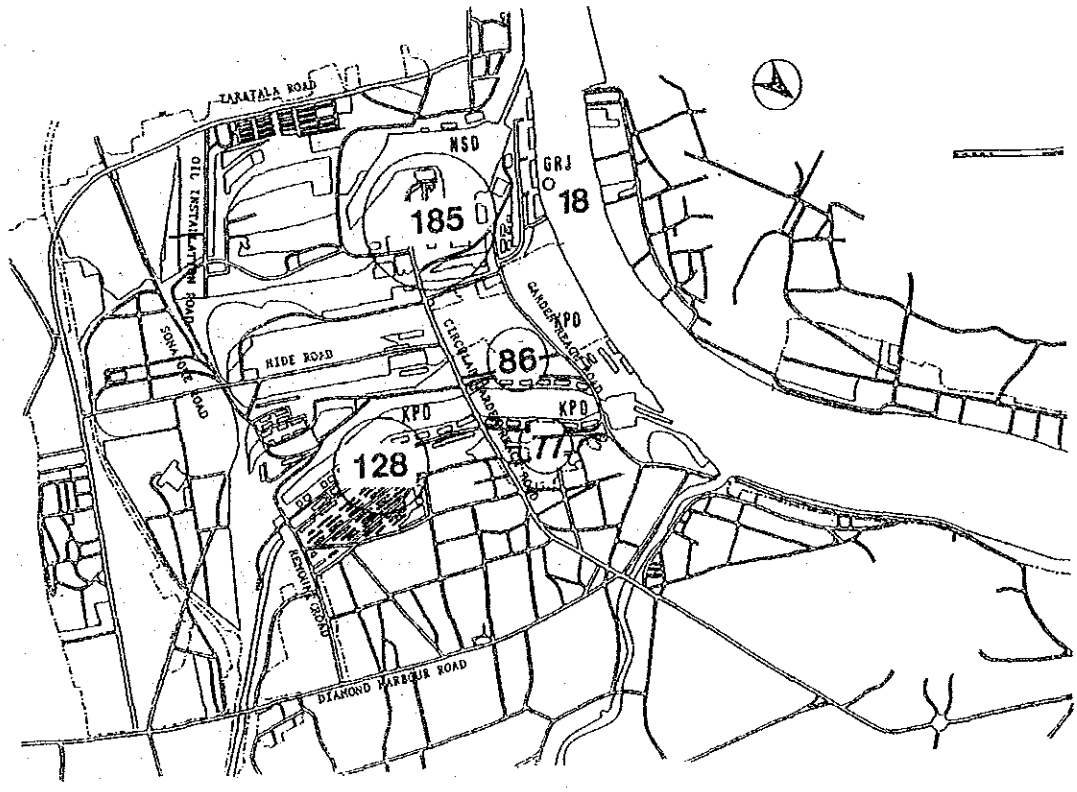


Fig. 12-1-3 Hourly Traffic Volume in 1995

b) The numbers of queueing trucks during rush hour at KPD-1 and 2 are estimated on the assumption that the arrival rate of the exit gates follows a poisson distribution and the service rate follows an

exponential distribution.

c) For the port related trucks two parking area shall be developed outside docks, one for KPD and one for NSD.

d) Second Hooghly River Bridge will be opened for traffic up to 1995.

2) Facility Requirements

a) Major roads to be improved

In order to ease the congestion on the roads, especially on Circular Garden Reach Road, we propose following improvement.

Up to 1995 : New roads

1) Linkage between NSD (conversion of the C.G.R.R.) and Sonapore Road

2) Linkage between Sonapore Road and Remount Road

: Widening/improvement

1) Swing Bridge on Garden Reach Road

2) Hasting Bridge on Garden Reach Road

3) Sonapore Road and Hoboken Road

4) Hide Bridge

b) Queueing space at the exist gates

In order to ease the congestion around the dock gates, we propose that each gate have two exits and queueing spaces for 5 - 10 tracks.

c) Parking facilities for trucks

The required parking spaces for port related trucks are as follows.

KPD : 15,000 m^2

NSD : 10,400 m^2

12-2 Haldia Dock System

1. The accessible draft at Haldia is assumed based on the figures presented by the counterparts, i.e. 9.3 m in 1995 as against 8.6 m at present.

2. Berth Determination

The required number of berthing facilities by commodity in 1995 is determined as follows based on the conventional estimation method using berth occupancy criteria as well as a computer simulation using queuing theory. The layout is presented in Fig. 12-2-1.

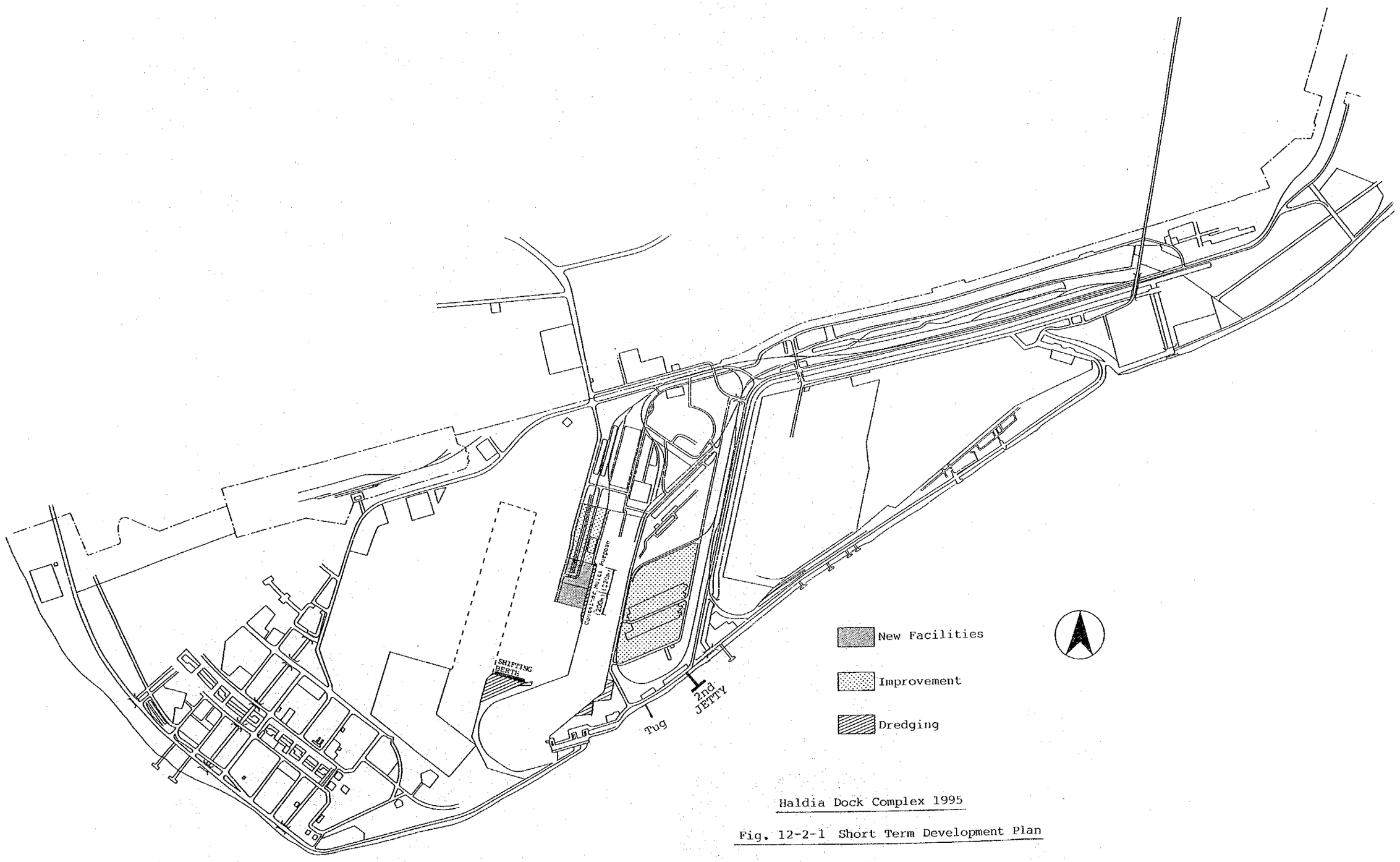
Table 12-2-1

Commodity	Short-term Plan (Year of 1995)
P.O.L	1. restreng thening of the existing jetty (87,000 DWT) 2. construction of the 2nd oil jetty (150,000 DWT) 3. increase of pumping rate
Coal	1. one coal berth with the effective handling rate of 610 TPH x 2 2. one converted coal berth with the effective handling rate of 480 TPH x 2
Fertiliser/ Raw material	1. one existing phosphate berth 2. 2-shift handling
Coking Coal	1. one mechanised c/coal berth converted from general cargo berth with the rated handling capacity of 700 TPH x 2
General cargo and Containers	1. one general cargo berth (existing) 2. one multi-purpose berth 3. one container berth

Additionally, the followings are also proposed;

1) Berthing facilities for working crafts inside and outside the dock

2) Waiting Berth to improve the lock productivity



Haldia Dock Complex 1995

Fig. 12-2-1 Short Term Development Plan

3. Lock Entrances

Up to 1995, a need for a 2nd lock entrance would emerge.

Otherwise, productivity improvement by upgrading tug fleet and berthing masters number, etc. as well as night navigation enabling calling/dispatch of vessels is imperative.

4. Handling Equipment

a) Coal

At the coal berth, the losstime of the tippler will be reduced by 50% through of improved maintenance and crushing.

A feeder and crusher for coal will be provided at the ore berth.

After the above items are achieved, the port will have sufficient facilities to smoothly handle the forecast cargo volume (4,150,000t).

b) Coking Coal

The mechanisation of the existing general cargo berth is required to handle 1.8 million tonnes of coking coal. The required handling system is comprised of:

Unloader : Luffing crane with grab bucket	2 x 700 TPH
Belt Conveyer	1,400 TPH
Starker/reclaimer	2 units
Stowage yard	150,000 m^2

The layout is presented in Fig. 11-2-2.

c) Container Terminal

Two quay cranes per berth are required.

Among a variety of yard handling systems currently adopted in the world such as the transfer crane system (rail, rubber tyred), chassis system, straddle carrier system, forklift system, front loader system and others, the rubber tyred transfer crane (with tractor/trailers) system is recommended for Calcutta and Haldia.

The required scale of the equipment is presented in Table 11-2-2.

The layout of the container terminal is presented in Fig. 11-2-3.

5. Craft/Vessels

Refer to Table 11-2-3.

6. Port Traffic Facilities

(1) Railway System

1) Premises

a) The required number of reception tracks, departure tracks and loading tracks are calculated on the assumption that the arrival rate of the rakes follows a poisson distribution and the service rate follow an exponential distribution.

b) Container movement in Haldia is expected to increase after completion of the new ICDs expansion of Guwahati ICD.

c) Tippler efficiency will be improved by increasing the number of tipplers and/or reinforcing the capacity.

d) Mechanical loading facility for coking coal will be developed by 1995.

e) A direct link line will be developed between the coal departure tracks and the coking coal loading terminal.

(2) Facility Requirement

a) Container Terminal

The required number of reception tracks and loading tracks up to 1995 are as follows.

Total handling volume	:	11,200 TEUs
Reception Tracks	:	1 line
Loading/unloading Tracks	:	1 line
Departure Tracks	:	1 line

b) Coal Terminal

Total handling volume	:	4,150,000 tonnes
Reception Tracks	:	4 lines
Departure Tracks	:	7 lines

c) P.O.L.

Total handling volume	:	1,280,000 tonnes
Reception Tracks	:	4 lines
Departure Tracks	:	5 lines

d) Coking Coal

Total handling volume	:	1,180,000 tonnes
Loading Tracks	:	1 line (Full rake)
Departure Tracks	:	4 lines

e) Locomotives

Al least 7 locomotives would be necessary.

It is recommended to place three locomotives of 5,000 ton capacity for coal rakes for 9th Plan.

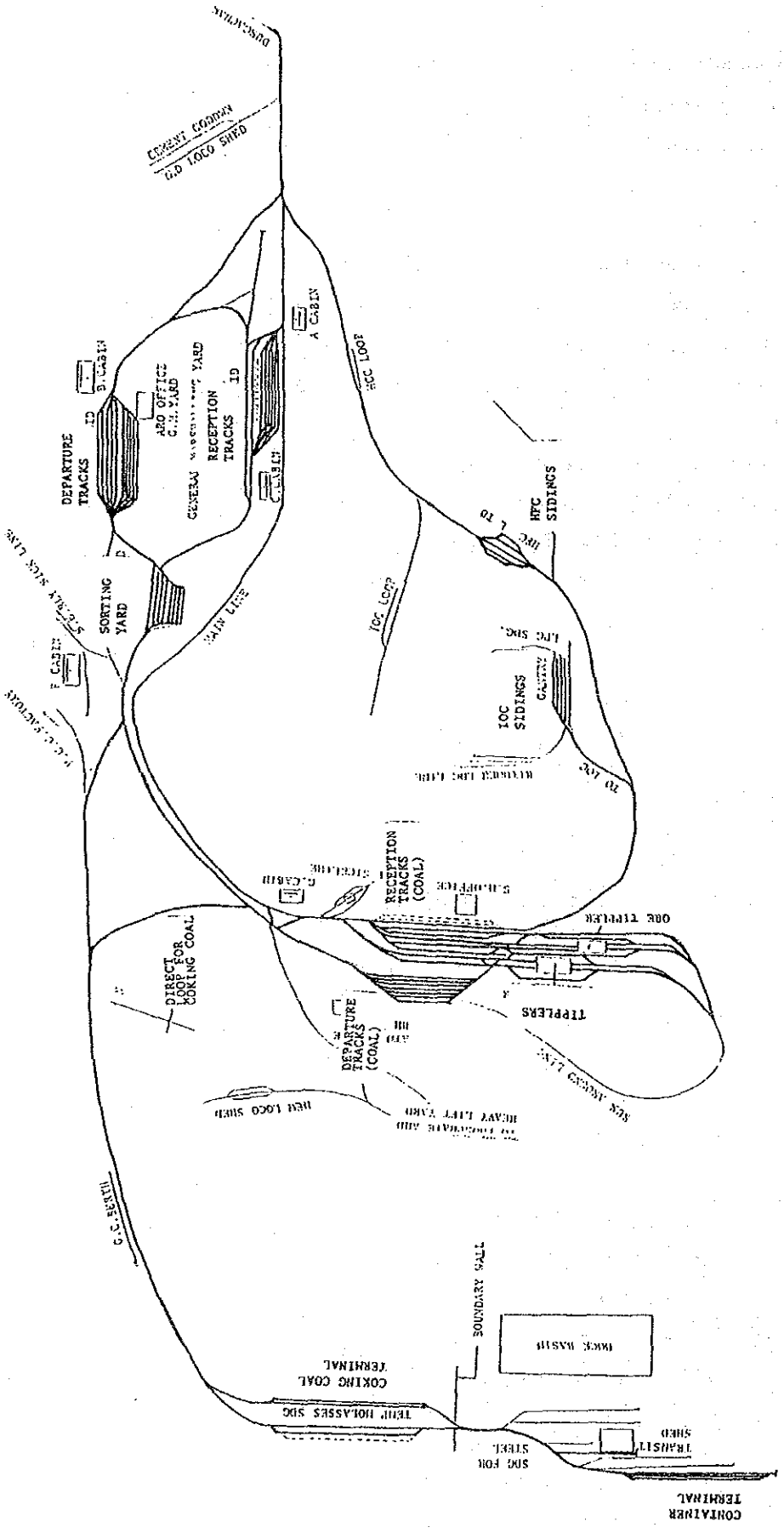


Fig. 12-2-2 General Plan of Haldia Railway System (1995)

Chapter 13 Preliminary Design and Cost Estimate

13-1 Design Condition

Main design conditions of the structures for the Development Plan are summarised as follows;

Design Conditions

Tidal Range	Calcutta H.W.L. + 4.88 m M.W.L. + 3.19 m L.W.L. + 1.68 m	Haldia H.W.L. + 5.01 m M.W.L. + 3.23 m L.W.L. + 1.34 m
Surcharges at Wharves	For Container For Others	3.0 t/m² 1.0 t/m²
Berthing Velocity	0.15 m/sec	
Seismic Coefficient	0.05	
Lifetime of Structures	30 years	

As for the structural type of quaywall, steel sheet pile, steel pipe pile and monolith concrete types are examined and compared from the viewpoint of soil conditions, local conditions such as availability of construction materials/equipment & labour-force and construction cost.

The conclusion is that the monolith concrete type is the most suitable.

13-2 Construction Schedule

The working schedules of various projects in the Master & Short-term Plan are shown in Table 13-1-1 & 13-1-2.

Table 13-1-1 Working Schedule (Master Plan)

Item NO.	Description	Q'ty / Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	F/S by JICA																		
2	E/S (D/D & Survey)																		
3	Tender for Const.																		
4 Calcutta	Replacement Swing B.	1 set																	
	Hasting Bridge	1 set																	
	Fly-over Bridge	1 set																	
	Replace. Bascule B.	1 set																	
	Road Works	L.S.																	
	Railway Works	L.S.																	
	Rehabili. Works	L.S.																	
	Cargo Handling Equip	L.S.																	
	Port Service Vessel	L.S.																	
5 Haldia	Container Berth	600 m																	
	Multi-purpose Berth	220 m																	
	General Cargo Berth	200 m																	
	Barge Berth	80 m																	
	Shifting Berth	1 set																	
	Tanker Shifting Buoy	1 set																	
	Yard Works	L.S.																	
	Parking Basin	L.S.																	
	Jetty in River	90 m																	
	Slipway,Workshop	L.S.																	
	Railway Works	L.S.																	
	Entrance Lock	L.S.																	
	Cargo Handling Equip	L.S.																	
	Port Service Vessel	L.S.																	
6	Navigation System	L.S.																	

Table 13-1-2 Working Schedule (Short-term Plan)

Item NO.	Description	Q'ty / Year	1988	1989	1990	1991	1992	1993	1994	1995
1	F/S by JICA									
2	E/S (D/D & Survey)									
3	Tender / Evaluation									
4 Calcutta	Replacement Swing Bridge	1 set								
	Hasting Bridge	1 set								
	New Roads	1,500 m								
	Widening Roads	650 m								
	Railway Works	L.S.								
	Pavement	580,000 m²								
	Fender System	L.S.								
	C.F.S.	9,040 m²								
	Cargo Handling Equipment	L.S.								
	Port Service Vessel	L.S.								
	Misc.Works	L.S.								
5 Haldia	Container Berth	200 m								
	Multi-purpose Berth	220 m								
	Yard Works	L.S.								
	Shifting Berth	L.S.								
	Parking Basin	L.S.								
	Slipway,Workshop	L.S.								
	Jetty in River	90 m								
	Railway Works	L.S.								
	Capital Dredging	350,000 m²								
	Cargo Handling Equipment	L.S.								
	Port Service Vessel	L.S.								
	Misc.Works	L.S.								
6	Navigation System	L.S.								

13-3 Construction Cost

Premises

Price ; Prices are expressed in Indian Rupees based on 1988 prices.

Exchange Rate ; The exchange rate is calculated as

$ 1.00 = Rs 13.50 = J ¥ 135.0

Duties & Taxes ; Customs duties on imported construction materials and equipment are not included in cost estimation. (Please refer to descriptions in next page showing in cases of assuming duties.)

Sales tax of 9 % in local currency is assumed.

Contingency ; A physical contingency of 10 % is assumed.

No price contingency is assumed.

Others ; To take advantage in the local conditions.

Short-term Plan

The construction cost of the Short-term Plan up to 1995 based on the above mentioned premises is 3,292.3 Million Rupees (approx. 244 Million US$). Details of main facilities to be developed are shown below,

Unit : Million Rs.

Calcutta Dock System		Amount	Note
Road Works including Bridges		55.3	Replacement & widening
Railway Works		80.9	Loading terminal, locomotives
Rehabilitation Works		306.4	Pavement in port areas etc.
Container Freight Station		29.6	At NSD No. 4 & 5
Cargo Handling Equipment		331.7	Transfer cranes, mobile cranes
Port Service Vessels		270.0	Tug-boats etc.
Sub-total		1,073.9	
Haldia Dock System			
Container Berth	200m	170.0	
Multi-purpose Berth	220m	187.0	
Yard Works		197.2	For container etc.
Railway Works		120.6	Yards, locomotives
Other Facilities		85.4	Jetties, workshop etc.
Capital Dredging		22.3	Basin & Berth front
Cargo Handling Equipment		358.3	Quay cranes etc.
Port Service Vessels		526.3	Dredgers, tug-boats etc.
Sub-total		1,667.1	

Channel Navigation System	172.5	Modernization of pilotage
Others (E/S & Contingency)	378.8	
Grand Total	3,292.3	

of which the local & foreign portions are;

Local portion Rs. 1,855.3 Million (56.4%)

Foreign portion Rs. 1,437.0 Million (43.6%)

The construction cost of Master Plan upto 2005 is

Rs. 7,881.2 Million

of which the local & foreign portions are;

Local portion Rs. 4,640.4 Million (58.9%)

Foreign portion Rs. 3,240.8 Million (41.1%)

Main facilities in this phase are additional 3 container berths at Haldia, cargo handling equipment & port service vessels at both ports etc.

Assuming 90% of customs duties on imported construction materials and equipment, except the floating equipment, construction cost will be estimated as follows;

Short-term Plan upto 1995 Rs. 3,610.2 Million

of which the local & foreign portions are;

Local portion Rs. 2,166.2 Million (60.0%)

Foreign portion Rs. 1,444.0 Million (40.0%)

Master Plan upto 2005 Rs. 8,972.2 Million

of which the local & foreign portions are;

Local portion Rs. 5,705.2 Million (63.6%)

Foreign portion Rs. 3,267.0 Million (36.4%)

* Remarks; All costs excluded items which are CPT's own expenses for minor equipment, belonging s to another authority's expenditures and on going projects such as by ADB & OECF, etc.

Chapter 14 Recommendations on Port Management and Operations

14-1 Realization of the Functional Allocation

Based on the analysis of the functional allocation between Calcutta and Haldia, It is recommended by the Team that a full-fledged container terminal should be established at Haldia in order to make Haldia more attractive for future container traffic.

The following points would be advisable from the viewpoint of the port management and operations so as to realize this recommendation;

1) to establish an autonomous operating unit which has entire responsibility for container handling operations throughout the Haldia Container Terminal (hereinafter referred as HCT),
2) to secure a reliable telecommunication system within the Haldia Dock System and between Haldia and Calcutta, and
3) to install a computer-based container handling system at HCT.

14-1-1 Autonomous Operating Unit

Establishment of an autonomous unit for the container handling operation would be advisable in order to realise the following points;

1) to maximize the utilization of the container terminal, and
2) to meet the port users' requirements which are particularly requested at Haldia.

Taking into consideration the huge amount of investment, establishment of an autonomous unit for container handling operation would be recommended in order to maximize the full utilization of the full-fledged HCT.

The functions of the container terminal which would be covered by HCT are summarized as follows;

1) Yard Operation : Yard Stacking, In-yard Movement, CFS Container Control
2) Gate Operation : Receiving/Delivery, Damage Check, Weight Check

3) Loading/Unloading Operation : Stowage Planning, Equipment Deployment

4) CFS Operation : Receiving/Delivery of LCL Cargo, Stuffing/Unstuffing

14-1-2 Reliable Telecommunication System

Establishment of a reliable telecommunication system should be taken into consideration as follows;

1) VHF system inside the terminal
2) Strengthening of internal telecommunication system in the Haldia Dock System, and
3) Exclusive telecommunication and data communication linkage between Haldia and Calcutta.

Strengthening of telecommunication system between Calcutta and Haldia should also be given high priority taking into consideration that Haldia has been developed as the satellite region for Calcutta in order to resolve the urban congestion of the city and the telecommunication system between the two cities is the lifeline of the further development of Haldia including the port development.

14-1-3 Computer System

The installation of a computer based container handling system at Haldia should be implemented during the Short Term development Plan including the period of running a trial.

The purposes of the installation of a computer based container handling system at HCT is not only to make efficient utilization of the terminal facilities but also to meet the port users' demand that an appropriate software required for container handling should be established at Haldia.

Taking such demand of port users into consideration, establishment of a data transmission office connected with the HCT by an on-line real time computer system in Calcutta Head Office would be recommended.

14-1-4 Concessions

It would be advisable to shift the present concessions to a TEUs per annum base instead of a per voyage base taking into consideration that the main calling frequency of container vessels at Haldia is by-monthly at present.

14-2 Others

(1) Standardization

The present format of the documents such as the Jetty Challan seems not to suit the smooth flow of port procedures. The UNLK (United Nations Layout Key) which is the standard form used for the design of trade related documents are widely used in the world and many trade documents including the Bill of Lading have been designed based on the UNLK.

The introduction of a computerised system requires the coding of various items, and it would be recommended to utilized the international standard codes.

(2) Tariff Structure

The development of containerisation has changed the traditional principle and a shipping company has become to be responsible to shippers for the delivery/receiving of containers at the points of the CY/CFS.

Taking into consideration the tendency above, it is preferable for the port to review the tariff structure for containers from the viewpoint of simplification of port procedures

Regarding the wharfage on containers at Calcutta Dock System, the wharfage on the box and on the containerized cargo are levyed sepalately at present. From the viewpoint of simplification of port procedures, the unit rate applicable to containers including both the wharfage on the box and the containerized cargo should also be examined.

(3) Establishment of Marketing Department

The purposes of establishment of the marketing department can be mentioned from the external and internal points of view.

From the external point of view, the purposes of th department are to collect the information of port users' requirements and to advertize them

the advantages of the port and to develop the new customers.

From the internal point of view, the department can function as an advisory organization to other departments from the viewpoint of convenience of port users based on the collected information of the customers requirements.

Chapter 15 Economic Analysis

15-1 Purpose and Methodology

The purpose of the economic analysis is to appraise the economic feasibility of the Short-term Plan from the viewpoint of the national economy. The economic internal rate of return (EIRR) based on cost-benefit analysis is used to appraise the feasibility of the project.

15-2 Benefits and Costs

A cost-benefit analysis is conducted on the difference between the "With" and "Without" investment cases.

15-2-1 Benefits

The following two items are identified as tangible benefits in this report.

1) Savings in Ships' Staying Costs

Investment in improved port facilities will reduce that staying time of ships (the waiting time for berth space and the time for loading and unloading cargo), and this cost reduction is identified as a major benefit of the project.

2) Saving in Time Costs

The reduction of ships' staying period due to the implementation of the project will bring about savings in interest as goods and funds will be turned over faster. This reduction is identified as the savings in time costs.

15-2-2 Costs

As for costs, construction costs, repair and maintenance and administration costs are estimated.

15-3 Economic Pricing

"Economic pricing" is used to examine the economic value of all costs and benefits to evaluate the project from the economic viewpoint. The market prices are changed to border prices using various conversion factors after excluding transfer items.

15-4 Results of Economic Analysis

15-4-1 Economic Internal Rate of Return (EIRR)

The EIRR of the Short-term Plan, using 30 years as the period of economic calculation, is estimated to be 18.88%.

Case	EIRR (%)
Base Case	18.88
Case A: Increase in Costs by 10%	16.79
Case B: Decrease in Benefits by 10%	16.58
Case C: Increase in Costs by 10% and Decrease in Benefits by 10%	14.67

15-4-2 Results

The Short-term Plan is judged to be feasible from the viewpoint of the national economy based upon the EIRR of the project as well as the uncountable benefits arising from the project.

Chapter 16 Financial Analysis

16-1 General Prerequisites of the Financial Analysis

(1) Project Life

Based on the same reasons as for the economic analysis, the project life for the financial analysis is determined as 30 years including 5 years of detailed design and construction and 25 yards of operation.

(2) Base Year

For the estimation, all costs, expenses and revenues analyzed here are indicated in prices as of 1988 when the price survey was conducted. Neither inflation of prices nor the increase of nominal salaries are considered during the project life.

(3) Traffic Volume

The traffic volume which can be handled through the proposed project, i.e. the "with case", is determined to reach the maximum volume in 1996/97, and the same volume will be handled continuously thereafter.

In the "without case", it is assumed that the cargo handling capacity will basically reach the limit at the beginning of the planning period, 1990/91.

(4) Costs and Expenses

The initial investment is estimated in Chapter 13 and the import duty for the proposed project is basically assumed to be nil for craft/vessels and 90% for other foreign procurements.

The facilities and equipment will be renewed based on their service lives.

The annual maintenance and repair costs for the facilities and equipment are calculated based on fixed proportions of the original construction or procurement costs.

The operation costs such as stores and consumables are calculated based on fixed proportions of the original construction or procurement costs.

The administration expenses are estimated as 20% of the total of the operation and the maintenance and repair expenses.

The annual depreciation costs of the proposed project are calculated by the straight line method.

16-2 Viability of the Project Itself

In order to examine the impact of various factors on the FIRR, the following conditions are set up.

(1) Import Duty

(a) Craft/Vessels	Nil
Others	90%
(b) Craft/Vessels and Container related materials/equipment	Nil
Others	90%
(c) All items	90%

(2) Personnel Cost

(a) to remain at the level of 1988/89. 15% of increase is added.

(b) manpower strength is reduced

(3) Tariff Increase

(a) No Increase

(b) 4% (Twice)

(c) 10% (Twice)

The calculation results are as follows:

Table 16-2-1 Impact of Manpower/Tariff/Duty on FIRR

(a) of 2) No reduction in personnel cost				(b) of 2) Reduction in personnel cost			
(a) of 3) Tariff increase 0%	1) Import Duty	(a) 0,90	12.14	(a) of 3)	1)	(a)	15.92
		(b) 0,0,90	12.99			(b)	17.01
		(c) 90,90	9.46			(c)	12.56
(b) of 3) Tariff increase 4% x 2	1) Import Duty	(a)	13.37	(b) of 3)	1)	(a)	17.12
		(b)	14.27			(b)	18.26
		(c)	10.53			(c)	13.58
(c) of 3) Tariff increase 10% x 2	1) Import Duty	(a)	15.21	(b) of 3)	1)	(a)	18.95
		(b)	16.19			(b)	20.18
		(c)	12.13			(c)	15.13

16-3 Financial Soundness of CPT

(1) Assumptions

1) Fund raising plan

(a) 10.5%

(b) 10.5% for domestic and 3% for foreign portions

2) Conversion of the existing loans

3) Personnel Cost

Same conditions used for calculation of the FIRR

(2) Results

Table 16-3-1 Comparison of Calculation Results

Case	Man Power	Average Interest Rate	Conversion	Accumulated DSR
1	No reduction	10.5 %	Done	1.22
2	Reduction	* 7.2 %	Not done	1.74
3	Reduction	10.5 %	Done	1.49

* Average interest rate of (b)-1)-(1) above

Both in Case 1 and Case 3, accumulated Debt Service Ratio indicate the difficulty of debt repayment and DSR of Case 2 shows the preferable level.

16-4 Sensitivity Analysis

Sensitivity analysis is made for the following 3 cases.

Case A : The project cost increases by 10 %

Case B : The revenue decrease by 10 %

Case C : The project cost increases and the revenue decreases by 10 % respectively

The FIRR is computed for each of the cases mentioned above and results are as follows:

Case A : 10.26 %

Case B : 10.10 %

Case C : 8.64 %

16-5 Conclusion

The calculation results of the FIRR indicate the feasibility of the proposed project itself but the debt repayment ability of CPT is critical.

Therefore, following points should be taken into account order to improve the projected financial situation of CPT, then the project can be regarded as feasible as a whole.

(1) It would be advisable for the Government of India to sanction CPT a concessional rate of loans as well as continuation of present moratorium.

(2) CPT should put forth it's best endeavors to reduce the present manpower strength including the redeployment of it's employees. The scale of rates should also be increased to the possible extent taking into account the trends of neighboring ports.

JICA