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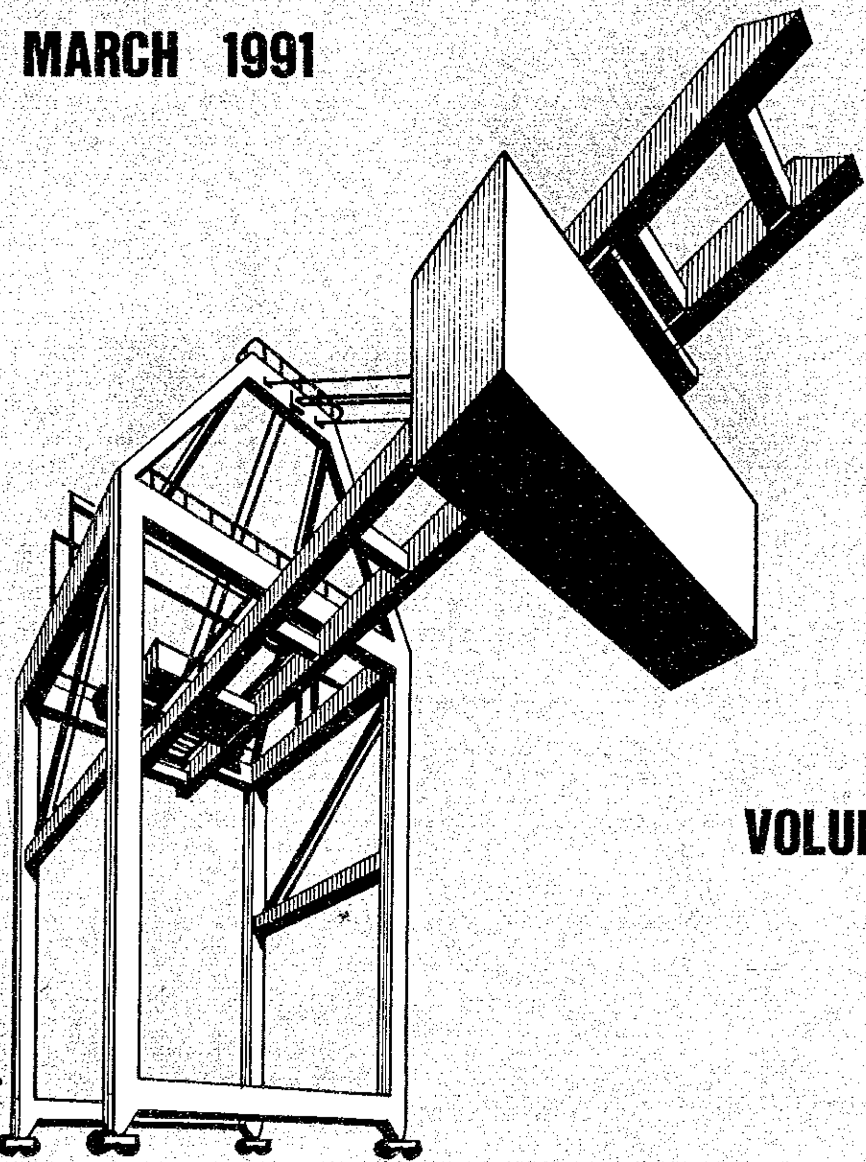
No. 62

FINAL REPORT

FEASIBILITY STUDY ON DEVELOPMENT PROJECT OF CONTAINER TERMINAL AT DHAKA-NARAYANGANJ PORT IN THE PEOPLE'S REPUBLIC OF BANGLADESH

MARCH 1991



VOLUME 1 SUMMARY

JAPAN INTERNATIONAL COOPERATION AGENCY

FINAL REPORT

FEASIBILITY STUDY ON DEVELOPMENT PROJECT OF CONTAINER TERMINAL AT DHAKA-NARAYANGANJ PORT IN THE PEOPLE'S REPUBLIC OF BANGLADESH

MARCH 1991

VOLUME 1 SUMMARY

PREFACE

In response to a request from the Government of the People's Republic of Bangladesh, the Japanese Government decided to conduct a feasibility study on Development Project of Container Terminal at Dhaka - Narayanganji Port and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to Bangladesh a study team headed by Mr. Yugo Otuki, and composed of members from the Overseas Coastal Area Development Institute of Japan and Nippon Koei Co., LTD. four times between November 1989 and December 1990.

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

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

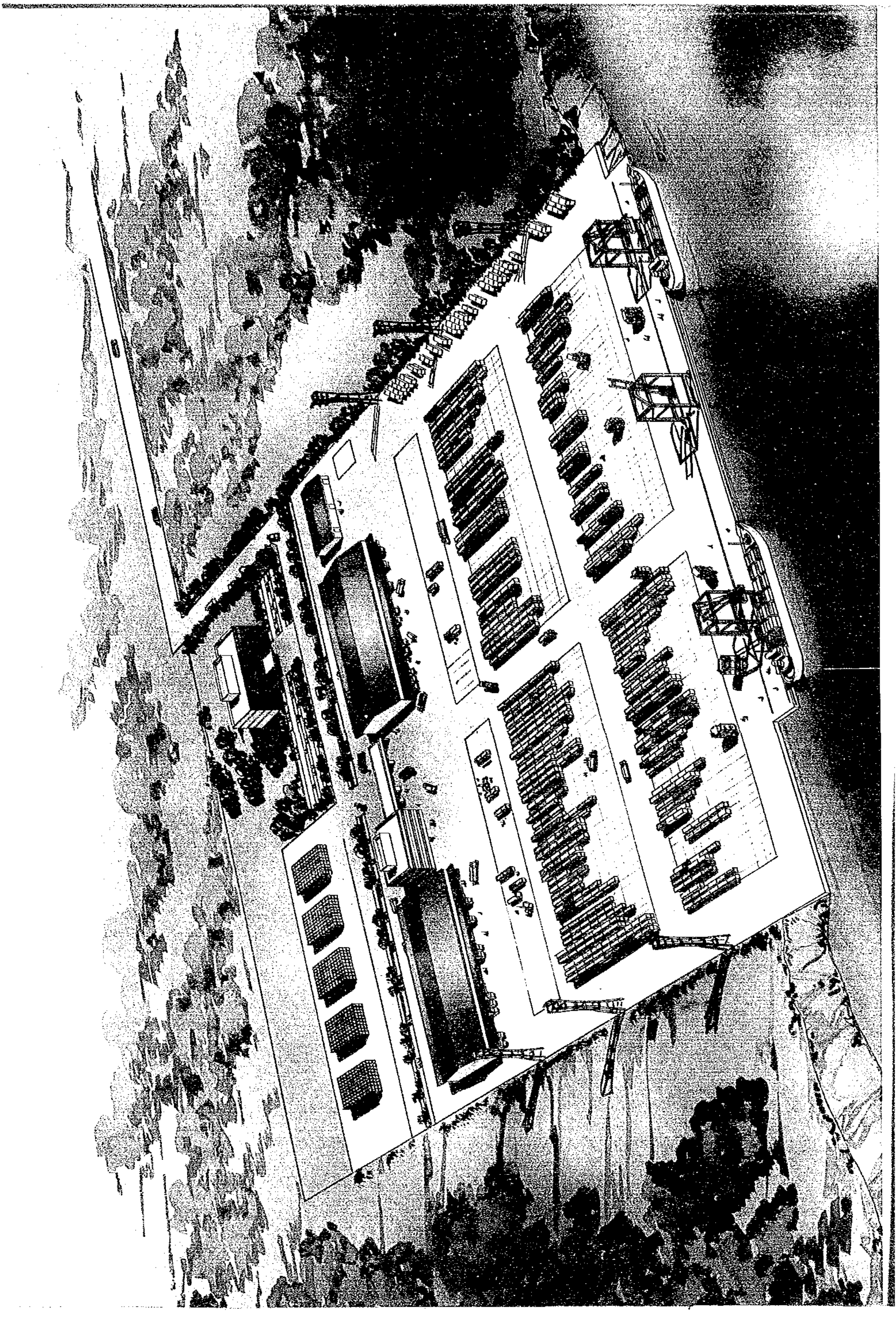
I wish to express my sincere appreciation to the officials concerned of the Government of Bangladesh for their close cooperation extended to the team.

March 1991

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency


BANGLADESH
INDIA
BURMA
DACCA
Calcutta
Chittagong
Shillong
MEGHALAYA
TRIPURA
Agartala
Comilla
Mymensingh
Khulna
Barisal
Jessore
Rangpur
Bogra
Pabna
Rajshahi
Sylhet
Dinajpur
English Bazar
Berhampore
Krishnanagar
Burdwan
Narayanganj
Faridpur
Noakhali
Chandpur
Gauhati
Goalpara
Cooch Behar
Cox's Bazar
Kushtia
Tangail
Patuakhali
MOUTHS OF THE GANGA (GANGES)
Continuation
on the same scale
88°
90°
92°



ABBREVIATION

ADB	Asian Development Bank
AH	Area of High Water Level
AL	Area of Low Water Level
AVE	Average
BIWTA	Bangladesh Inland Water Transport Authority
BIWTC	Bangladesh Inland Water Transport Authority
BR	Bangladesh Railway
BRTA	Bangladesh Road Transport Authority
BSC	Bangladesh Shipping Corporation
BWDB	Bangladesh Water Development Board
BWP	Bangladesh Meteorological Department
CFC	Conversion Factor for Consumption
CFS	Container Freight Station
CPA	Chittagong Port Authority
CT	Container Terminal
CY	Container Yard
C.B.R	California Bearing Ratio
C.D	Chart Datum
D.W.T.	Dead weight Ton
EIRR	Economic internal rate of return
FCL	Full Container Load
FFYP	Forth Five Year Plan
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Products
GVW	Gross Vehicle Weight
G.L	Ground Level
H.A.T	Highest Astronomical Tide
H.H.W.L	Highest High Water Level
H.W.L	High Water Level
ICD	Inland Container Depot
IWT	Inland Waterway Transport
LCL	Less Than Container Load
LOA	Length Over All
L.A.T	Lowest Astronomical Tide
L.W.L	Low Water Level

MPA	Mongla Port Authority
MT	Metric Ton
M.H.W.N	Mean High Water Neap
M.H.W.S	Mean High Water Level
M.L	Mean Level
M.L.W.N	Mean Low Water Neap
M.L.W.S	Mean Low Water Spring
P.C PILE	Prestressed Concrete Pile
P.W.D	Public Works Datum
RHD	Road and Highways Department
SCF	Standard Conversion Factor
SPT	Standard Penetration Test
TEU	Twenty Equivalent Unit

EXCHANGE RATE

US$ = TK 34.06 = ¥ 140.50

CONTENTS <SUMMARY>

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. Necessity of the Development of a Container Terminal at Dhaka Port

Since the start of container transport at Chittagong Port in 1976/77, there has been a steady increase in the volume of container cargos through the seaports, namely Chittagong and Mongla. Recently, the volume has increased sharply, showing an average growth rate of 33% per annum in the last five years, with around 91,000 TEUs being handled at the ports in 1988/89. Presently, most of the containers are handled at break-bulk berths at Chittagong Port without a specialized terminal for container handling. This causes serious congestion in container handling at the port. Insufficient inland transport systems for container cargos add to the congestion. Consequently, dwelling times of imported container cargos are excessively long, at around one month on average. In order to reduce the present congestion and cope with the further progress of containerization in the future, multipurpose berths with a spacious backyard of 18 hectares, intended to be used as a container terminal, are now under construction by the CPA and are scheduled to be completed in 1992. On the other hand, the MPA is also developing container handling capacity, including new berths, at Mongla Port within the spacious port premises owned by the MPA. Thus, at least, the seaports will have sufficient capacity to meet demands for container handling in the foreseeable future.

On the other hand, as for inland container transport, at present a large quantity of container cargo is destined for and originated from the Dhaka area and must be transported by ordinary trucks as loose cargos due to insufficient inland container transport infrastructure. Consequently, shippers and consignees cannot take full advantage of container transport for economic, swift, safe and convenient transport by carrying cargos in boxes as close as possible to their premises in bond without fear of damage and pilferage.

In order to resolve the present problems and to meet the large demand forecast for the future inland container transport, full-scale inland transport systems for containers need to be established along with the development of container terminals at the seaports. According to the cost analysis, the inland waterway system is recognized the most economical mode compared with the other modes: road and railway. Hence, great emphasis should be put on the development of the inland waterway system. As the first step of the development, a riverside container terminal in Dhaka Port needs to be established prior to preparation for container vessels. Thus, it is necessary to start the Development Project of a Container Terminal at Dhaka Port. In order to upgrade the level of service offered to customers through fair and healthy competition among the different transport modes, it seems desirable that other transport modes be developed.

The establishment of inland container transport systems, by which traders can take full advantage of container transport, is one of the preconditions for improving the investment atmosphere, especially for export-oriented industries such as the growing garment industry and electronics. Well-developed inland transport systems linked to favorable industrial zones would draw the attention of foreign investors and local entrepreneurs.

From the standpoint of regional development, establishment of an inland container terminal at Dhaka Port as a part of the port development would greatly contribute to regional development in and around the project site by developing industrial zones linked with the container terminal, generating massive employment opportunities.

2. Master Plan

The Master Plan is formulated with a target year of 2005. In that year, the number of containers handled at the seaports is forecast to reach 550 thousand TEUs considering the historical trend of container traffic and the forecast growth of socio-economic activities in Bangladesh. Approximately 75% of the total are assumed to be destined for or originate from the Dhaka area. Around 38% of the container flow between the seaports and the Dhaka area, i.e., 154 thousand TEUs, is assumed to be shared by inland waterways.

In order to accommodate 154 thousand TEUs containers, a new riverside container terminal with 13.7 hectares and three berths with a total length of 270 meters with three gantry cranes is required. As to the container-handling system, the straddle carrier system is proposed because of its operational flexibility and economical investment. The new container terminal is planned to be located on the south bank of the Buriganga River, namely the Pangaon site proposed through the site selection covering the riverbanks of the Buriganga, Sitalakhya and Megna rivers. A new 3.6-km-long access road is required to connect the new terminal and the Dhaka-Mawa Road. The total construction cost of the Master Plan is roughly estimated as 2,261 million Taka.

Taking account of the existing controlled water depth maintained by the BIWTA, new container vessels with shallow draft of 3.4 meters and 88 TEUs capacity are proposed, though investment in vessels is not included in this project.

3. Short-term Plan

(1) Container Terminal Development

The Short-term Plan is prepared as a first-stage plan with a target year of 1995 for the development of the container terminal in Dhaka Port within the framework of the Master Plan. In the target year, the number of containers to be handled at the new terminal is estimated as 69 thousand TEUs. Judging from the container number, a terminal area of around 8 hectares and two berths with a total length of 180 meters with two gantry cranes are required. A 3.6-km-long access road is also required. The total construction cost of the Short-term Plan is estimated as 1,580 million Taka.

(2) Economic Analysis

In the report, a comparison between the "Without Development" case and the "With Development" case was carried out. The purpose of the economic analysis is to investigate whether the Short-term plan is feasible or not from the viewpoint of the national economy. However, the analysis cannot actually take into consideration indirect benefits such as increased employment and income due to the port-related industrialization along with the development of the container terminal.

The economic rate of return (EIRR) is used to evaluate the measurable economic benefit compared to the economic cost. The benefit of this project is the saving on transportation costs of container cargo between Dhaka and Bangladesh's seaports. The resulting EIRR is 14.7%. The result of the economic analysis is that the EIRR exceeds the opportunity cost of capital in Bangladesh. So, the project is fully feasible from the viewpoint of the national economy.

(3) Financial Analysis

The resulting FIRR is 12.7% exceeding the weight average interest rate of funds for the project(11.5%). Consequently, this project is financially feasible. However, it is recommended that the interest rate on long-term loans from the government be kept lower than 11.5% in order to ensure the competitive position of inland waterway transport.

RECOMMENDATIONS

Based on the results of the study, the study team recommends that the Government of the People's Republic of Bangladesh implement the Development Project of a Container Terminal at Dhaka Port starting with the Short-term Plan with the target year of 1995 to cope with forecast demand for container transport between the seaports and the Dhaka area by inland waterways.

The contents of the project are summarized as follows:

1. Construction of a New Container Terminal

Project Site: Pangaon on the South Bank of the Buriganga River

Dimensions: Terminal Area: 8 Hectares
Berth Length: 180 Meters
Water Depth: 4 Meters below the LLWL

Cargo-handling Facilities: 2 Container Gantry Cranes
5 Straddle Carriers
2 Toplifters of 4.5 Ton Capacity
10 Forklifts of 3 Ton Capacity
2 Tractors
6 Trailers

Other Main Facilities: Container Freight Station
Repair Shop
Terminal Office
Marshaling Yard
Van Pool
Access Road: 3.6 Km (Port Road: 0.4 Km)

2. Land Acquisition

It is advisable that land for future expansion be acquired all at once at the first stage in order to ensure the expansion. In addition to the terminal area, a backup area needs to be prepared to support container-handling operations in the container terminal. Thus, the areas to be required in the first stage excluding the access road but including the port road are summarized as follows:

Terminal Area: 8 Hectares
Port Road: 0.7 Hectares
Area Reserved for Future Expansion: 6.7 Hectares
Backup Area: 3 Hectares

Total Area: 18.3 Hectares

The area for land acquisition including bank slope around the terminal area and excluding the jetty portion to be installed in the river and the access road is estimated as 20.2 hectares.

3. Participation of the Private Sector in Container Transport

Container transport by inland waterways will be confronted with severe competition from trucks and railways. Consequently, it is recommended that not only public but also private shipping companies take part in the operation of container vessels, in order to improve their services for users by competing with each other.

On the other hand, as far as the management and operations of the container terminal are concerned, it is desirable that more than one private company take part in carrying out the work, especially entire cargo-handling operations including planning and related documentation work. However, it may be difficult for the private sector to fulfill the work in the early stage. Consequently, it is recommended that the BIWTA manage and operate the terminal in the early stage and that the private sector take part in the work as soon as possible.

4. Simplification and Modernization of Procedures and Documentation

In order not only to develop trade in this country but also to establish efficient container transport operations, it is strongly recommended that the procedures and documentation required for container transport by inland waterways be simplified and modernized, in cooperation with all concerned organizations. Manuals for procedures should be prepared. It would be better to use a short-cut method by studying a modernized system in a foreign country and adopting it.

5. Preparation of New Building Vessels

It is essential to prepare the necessary number of new container feeder vessels proposed in this study at the time of commencement of the container terminal's operation, in order to realize the anticipated capability of the container terminal as well as to save on transportation costs.

In compliance with mentioned above circumstance, another study should be made in tune for the procurement of required number of vessels as outlined in this Report Chapter 10 of Part I and Chapter 4 of Part II.

6. Establishment of Training System

It is recommended that a training system be established for staff members and laborers in charge of container transport, in order to make up for the lack of expertise. Employment of foreign experts is also recommended.

Organization of the Study Team

The Study Team consist of nine experts. Their names and responsibilities are listed below.

Name	Responsibility
Yugo Otsuki	Leader, Overall Management and Port Planning
Takeo Shimazaki	Traffic System Planning
Tomoo Amano	Demand Forecast and Economic Analysis
Yoshio Yamauchi	Management and Operations, and Financial Analysis
Takahiro Kitaoka	Port Cargo Transport System
Katumi Naito	Construction Method and Cost Estimate
Mamoru Watabe	Design (Container Terminal)
Tadateru Michiura	Design (Container Handling Equipment and Container Ship)
Takao Nakano	Natural Condition (Soil Materials and Topographic Survey)

SUMMARY

1.1 OUTLINE OF BANGLADESH

1.1.1 Historical Background

The People's Republic of Bangladesh emerged as the 139th Nation of the World following a brief but bloody war of liberation with Pakistan on December 16, 1971.

The Bangladesh people have a long history of their lineage which is as follows:

Driven by the invading Aryans, a group of Dravidians settled in this land, which was followed by Aryan settlement. The Arab Muslims started arriving in the 9th century AD to be followed by the Persians, the Turks, Afghans and the Moghuls. Different races and nationalities from the neighboring areas came and settled in this region. Over the centuries, these diverse group of people mingled together to attain the present homogeneous cultural and ethnic entity.

1.1.2 Geographical Feature

Bangladesh is bounded by India on the north and west and by Myanmar and India on the east. In the south, the country has a long shoreline which opens onto the Bay of Bengal.

The area of the country is about 143,999 sq km (about 55,598 sq miles) with about 5.4 percent of the area occupied by rivers. The actual land area of this country is about 136,167 sq km.

The country has a tropical climate, which is classified into two distinct seasons: the dry season and the monsoon season. Annual rainfall varies from 1,100 mm to 3,500 mm with 80 percent of the total rainfall occurring during the monsoon season.

Bangladesh is predominantly a deltaic region, formed by alluvial sediments borne by 3 rivers: the Brahamaputra-Jamuna, the Padma (Ganges) and the Meghna.

With the exception of the Chittagong Hill Tracts, the Madhupur and the Barind Tract, the country is made up of low-lying alluvial plain.

These conditions sometimes lead to devastating floods, which damage the national economy of the country.

These floods recur once every three or five years.

1.1.3 Population

The population of Bangladesh was estimated at about 108 million people with a population density of 748 persons per sq km in 1988.

About 11.5 percent of the population was concentrated in the Dhaka district, which has the highest density in Bangladesh, with 1657 persons per sq km in 1988.

The population growth rates of Bangladesh as a whole and the Dhaka District between the census years of 1974 and 1981 were 2.35 percent and 4.0 percent per annum, respectively.

A projected population growth rate of 1.8 percent per year was considered for the Third Five-Year Plan (TFYP).

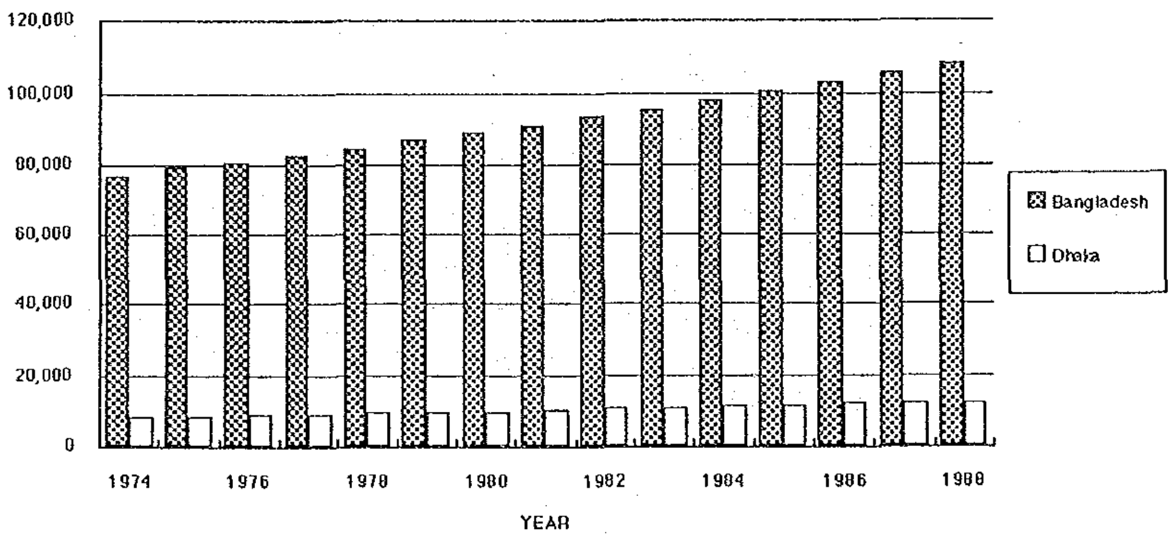


Fig. 1.1.1 Estimated Population

1.1.4 Economic Profile

1.1.4.1 Transition of GDP

The Gross Domestic Product of Bangladesh in 1987/88, at 1984/85 constant prices, reached 450,237 million Taka and its growth rate between 1976/77 and 1987/88 grew steadily at a rate of about 3.5 percent per annum.

The estimated GDP per capita in 1987/88, at 1984/85 constant prices, was about 4,277 Taka and its growth rate between 1976/77 and 1987/88 was about 1.37 percent per annum.

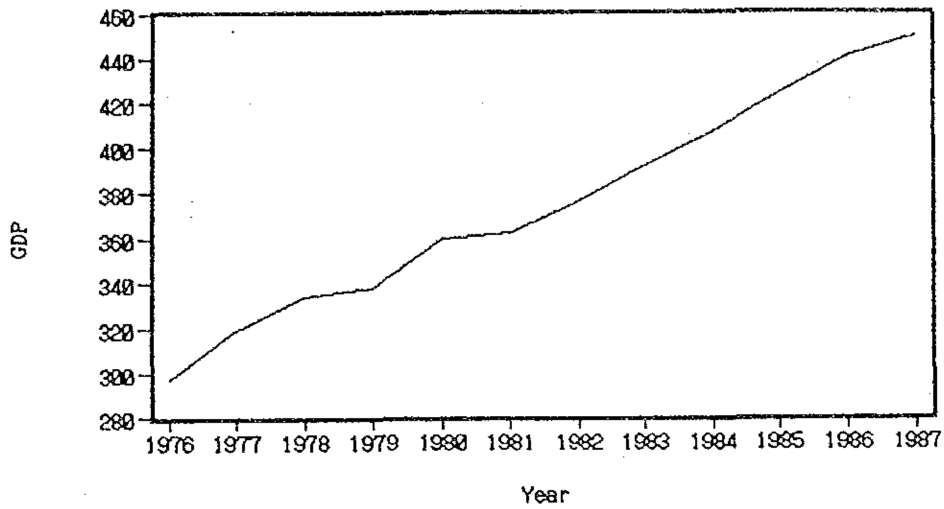


Fig. 1.1.2 Transition GDP

1.1.4.2 Foreign Trade

The major export goods of Bangladesh are Jute, Jute products, Tea, Naphtha/Molasses, Bunker Oil, Shrimps, Garments and Sundries. The major imports are Foodgrains, Cement, Pols, Sugar, Salt, Oilseeds and Sundries.

Regarding Bangladesh's balance of foreign trade, the total export value is about 45 percent of the total import value in 1987. Thus, the balance of foreign trade is in the red. (Refer to Table 1.9)

The total cargo throughput at Chittagong and Mongla Ports is tending upward. The total cargo throughput of these Port Authorities' facilities in 1988/89 has reached about 10,475 thousand tons, and the growth rate of the total cargo throughput between 1982/83 and 1988/89 was about 7.7 percent per annum.

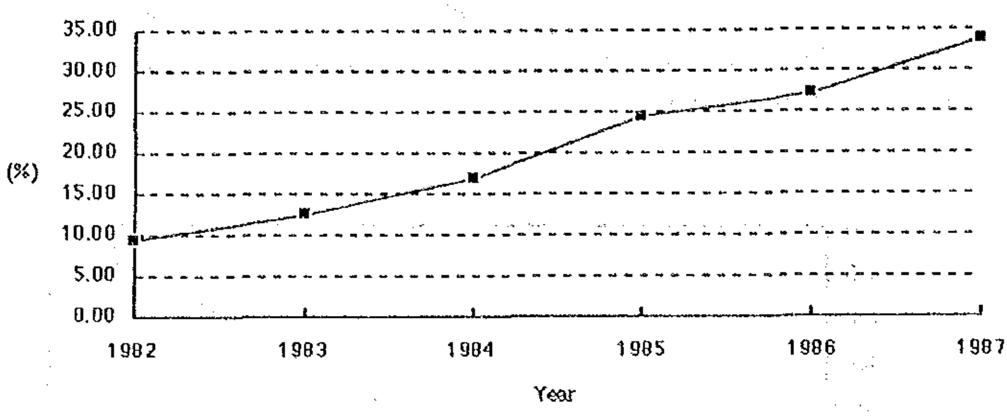


Fig. 1.1.3 Ratio of Containerization

The total container cargo throughput at the facilities of Chittagong and Mongla Port Authorities has reached approximately 797 thousand tons. The growth rate of the total container cargo throughput at these ports between 1982/83 and 1988/89 was about 42.5 percent per annum.

The ratio of containerization to total containerizable cargo throughput at Chittagong and Mongla ports increased from 6.04 percent in 1982/83 to 23.49 percent in 1987/88.

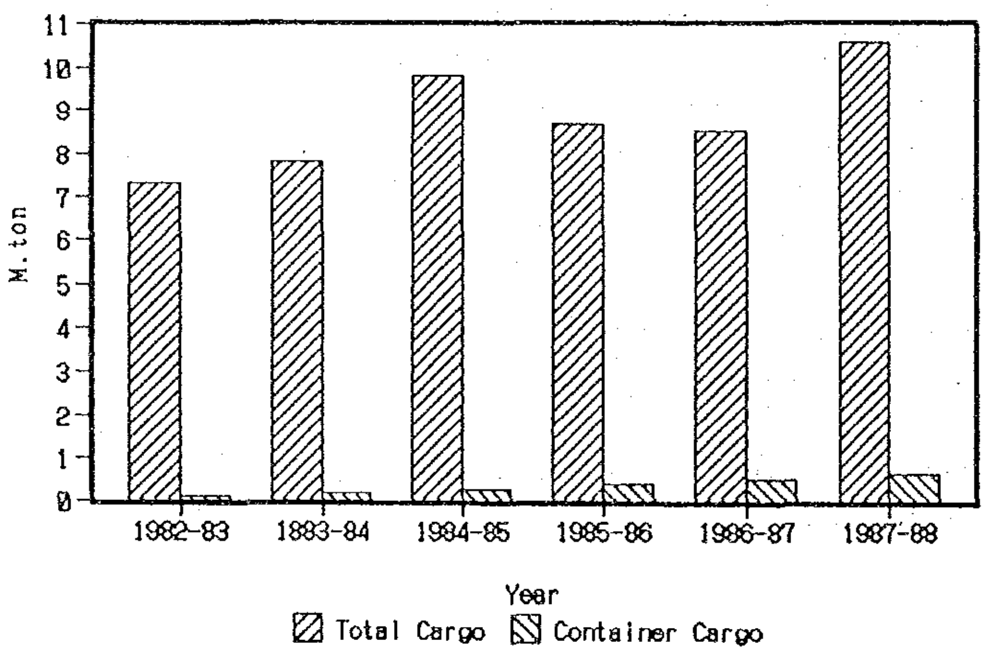


Fig. 1.1.4 Cargo Throughput at Chittagong and Mongla

1.1.5 Transport

Because Bangladesh's land is separated into many different parts by rivers meandering through the country's deltaic land and much of its industrial materials and consumer goods are imported, an efficient inland cargo transport system connected with the seaports, namely Chittagong and Mongla, is vital to the national economy. The two seaports and the river ports scattered through the country are connected by inland waterways, a great part of which are maintained by natural river flow. On the other hand, national highways connect principal cities such as Dhaka, Chittagong, Khulna and Rajshahi. Trucks must use ferries to cross large rivers such as the Jamuna. Aricha and Nagabari are important ferry ports connecting Dhaka and northwest part of Bengal. Railways also serve in inland transport, but are completely separated by the Jamuna, Padma and Lower Meghna rivers without any bridges for railways. Moreover, meter gauge is adopted in the east of the rivers and broad gauge is mainly adopted in the west part, resulting in there being quite different railway networks in one country. Double tracks are partly installed.

1.1.6 Development Plans in the Transport Sector

According to the Third Five-Year Plan (TFYP), the major targets of the plan in the transport sector are as follows:

- Construction of 1,288 km of paved roads, 15,244 meters of bridges including the Buriganga, Meghna and Gorai Bridges,
- Renewal of 925 km of railway tracks,
- Acquisition of 25 locomotives and 451 passenger carriages,
- Dredging of 23 million cubic meters of waterways,
- Development of container handling facilities at Chittagong and increasing loading/unloading capacity of the seaports by 6 lakh tons annually,
- Increase in shipping capacity by 2.86 lakh DWT,
- Development of major waterways by 161 km,
- Provision of launch landing stations in 150 places,
- Providing navigational aides to 483 km waterways.

Among the above targets, the Buriganga and Megna Bridges have already been completed. As to the development of container handling facilities at Chittagong Port, a multi-purpose terminal with berths of 450 meters long, mainly for container handling, is under construction and is partly in operation.

Besides the above targets, the project of Jamuna Bridge is now being studied. The multi-purpose terminal project at Mongla Port has also begun, though only pile-driving has been finished.

1.2 Natural Conditions

1.2.1 Ground Condition

(1) Topography

Physical Features and Topography

The proposed sites are located in the south eastern part of Dhaka city, along the river Buriganga and lower parts of the sites are subject to extensive flood every rainy season, The flood waters remain for a minimum of two months to a maximum of five months.

The site is in a fairly large area of lowland containing small areas of higher ground. There are long and irregular depressions at places where good paddy is raised.

During the monsoon specially from July to September the lowlying areas form a vast swamp and houses seem to float in water. In winter and summer the flood water recedes almost completely from the fields and the swamps blossom into green dry pastures and crop land.

(2) Geology

The Geological formations of the sites are partly new alluvial formation of moderate antiquity.

The sites may be divided broadly into the western alluvium, the alluvial area of the east, and the new alluvium of the south.

1.2.2 Meteorology

(1) Climate

The climate of the Dhaka area is characterized by high temperature and high humidity the climatic characteristies of the monsoon zones of Southeast Area. It is broadly divided into wet and dry seasons.

Generally, the wet seasons last from June to October, and the mean temperature is 29°C. The monthly average rainfall varies from 110 to 400mm, which is concentrated in the three-month period from June to August.

Located near the mouth of the Meghna River, which flows over 1,500Km and empties into the Bay of Bengal, the Dhaka area is inevitably stricken by floods is September when the wet season ends.

During the dry season, on the other hand, the weather is milder, with an average temperature of about 20°C, and the rainfall is less than 20mm during the November-February period.

(2) Wind

As to frequency of occurrence of Wind Direction, Winds blowing over the Dhaka area at a velocity of over 1m/sec account for 46.2% of the frequencies of wind occurrence observed. Throughout the year winds from three directions between south and east prevail, with the southerlies representing 37.5%, southeasterlies 22.4% and easterlies 10.1%.

Seasonwise, the south and southeast winds prevail during the wet season with a frequency of occurrence of 22.3% and 15.8%, respectively. In the dry season, winds occur with a 15.6% frequency, but the north-to-northwest winds are predominant.

As to frequency of Strong Winds, generally, winds with a velocity of 10m/sec or over, which may affect port activities, are referred to as strong winds.

Wind observation records of the Dhaka weather station, where observations are made eight times a day, do not indicate strong winds with a velocity of 10m/sec or over, winds with velocities of 5 to 9m/sec occur 41.6 times a year on average and their frequency of occurrence accounts for 3.1% of all winds of 1m/sec or more in velocity observed.

As to frequency of occurrence of maximum to end velocity, generally, maximum winds are generated by cyclones. In the Dhaka area, a wind velocity of 48.8m/sec (95knots) was observed.

(3) Rainfall

The mean annual rainfall in the Dhaka area is 2,060mm. In the wet season an average of about 400mm of rainfall in recorded in the June-August period.

The amount of precipitation in 1988 that brought about the worst floods in recent years was 2,411mm, or 1.2 times the average precipitation in ordinary years.

June shows 571mm of rainfall, or 1.4 times that in the corresponding month in ordinary years.

1.2.3 Rivers

(1) Speed of River Flow

The river width at the proposed container terminal site in Dhaka Port is about 300m, a width substantially equal to that of Demra. The water level at the site does not fluctuate very widely, For these reasons, it may safely be passumed that the river flow speed at the project site during floods is substantially equal to that observed at Demra.

The river flow speed tends of decrease with lowering water level and the correlation between flow speeds but water levels is somewhat erratic. However, the flow speed in Dhaka Port in average floods is estimated to be 0.6 to 0.80m/sec with a maximum of about 1.20m/sec.

(2) Datum Level

The datum level used for planning, design and construction of river and port structures is based on P.W.D.

(3) Flooding

Floods submerge large parts of the Study Area every year. Normally the inundation occurs between June and October. The area more than 50 percent of the Pangaon site is inundated for more than four and a half months (mid-June to November) in an average year.

The highest flood level in the last decade was recorded in 1988 when

Dhaka city was inundated for a while. The road level at the Pagla site, which is approximate +7.0m.P.W.D., was under water for 13 days in August 1988 and the Pangaon site was submerged in nearly all of the Study Area at that time.

1.2.4 Marine Conditions

(1) Coastal Waves

Waves reaching the sea areas of Chittagong located at latitudes 20°to 23°N. in the innermost part of the Bay of Bengal are generated by south to southwest winds sweeping over the bay.

Analysis of winds of 10m/sec or more in the Chittagong area indicated that nearly 75% of the winds were from south to southwest. These winds prevail for 13 days of the 3-year average with a frequency of occurrence (17 days).

Deep sea wave height is estimated at 2 to 2.5m judging from the fetch and distances to shores. Waves with a height of about 2m are estimated to reach the coast for 11 to 13 days on average between April and August.

(2) Waves during Cyclones

In most cases, cyclones, generated in the vicinity of latitudes 10° or 15°N. or almost in the center of the Bay of Bengal, skirt round the west of the bay, pass through its innermost part and turn into depressions after coming into contact with land.

These cyclones sweep over the sea for three or four days, but those generated near latitude 10°in the mouth of the bay are often gigantic, with a longer duration.

Estimation of cyclone-generated waves can only be made after in-depth analysis of the wind characteristics of cyclones. However, the height of deep-sea waves generated by cyclones as they reach the innermost part of the Bay of Bengal is assumed to attain levels of 8 to 10m.

(3) Tidal Currents

The highest current velocity is observed between Sandwip and Hatia along the navigable waterway leading from Chittagong to Dhaka. Captains of ships navigating in this area have reported that current velocity as visually measured ranged from 2 to 4m/sec depending on the tidal range.

1.3 Present Container Cargo Flow

1.3.1 Cargo Throughput at Chittagong and Mongla Ports

The cargo throughput at Chittagong port, excluding the quays of private companies, reached about 7,747 thousand tons in 1987/1988.

The growth rates of the total cargo and the container cargo at Chittagong port between 1979/80 and 1987/88 were about 2.8 percent and about 48 percent per annum, respectively.

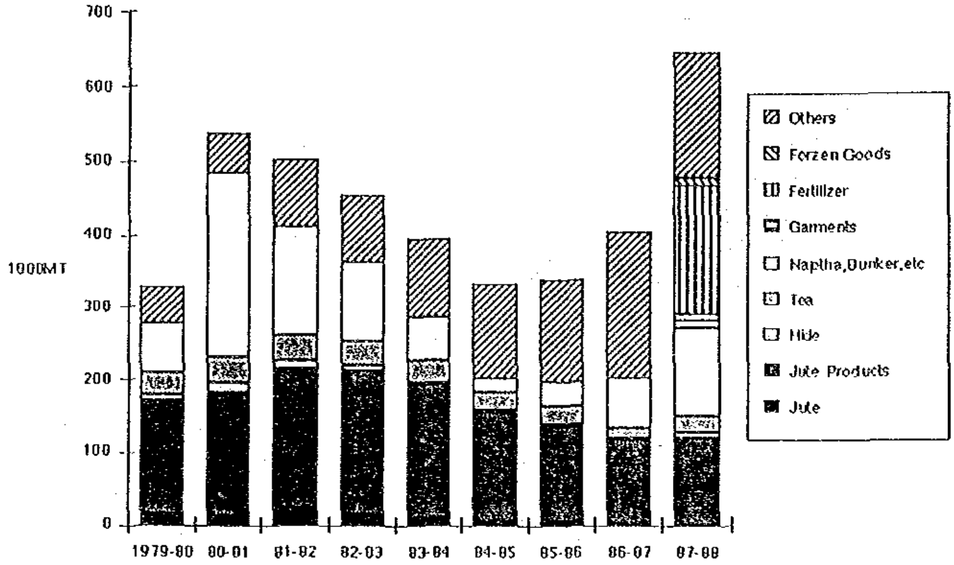


Fig. 1.3.1 Export Cargo Volume at Chittagong Port

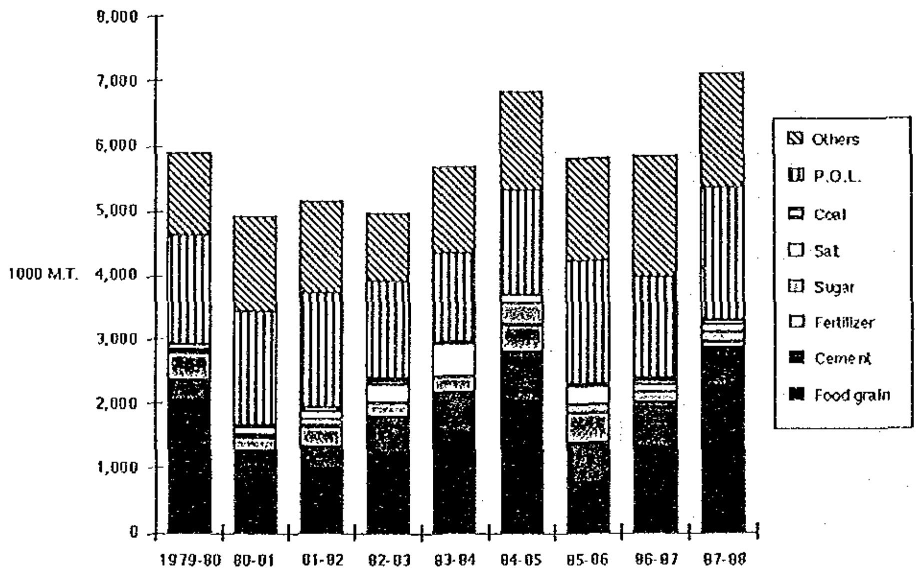


Fig. 1.3.2 Import Cargo Volume at Chittagong Port

The ratio of containerization to containerizable cargo is increasing rapidly, reaching about 32 percent at Chittagong port in 1987/1988.

The number of containers throughput at Chittagong port favorably increased from 1,364 TEU in 1979-80 to 77,522 TEU in 1988-89.

The ratio of the number of empty containers to the amount of containers at Chittagong port in 1987-88 was about 23 percent.

The average dwelling time of import cargo of FCL and LCL at the container yard of the CPA are about 28 days and 8 days, respectively. The average dwelling time of empty container boxes is about 30 days.

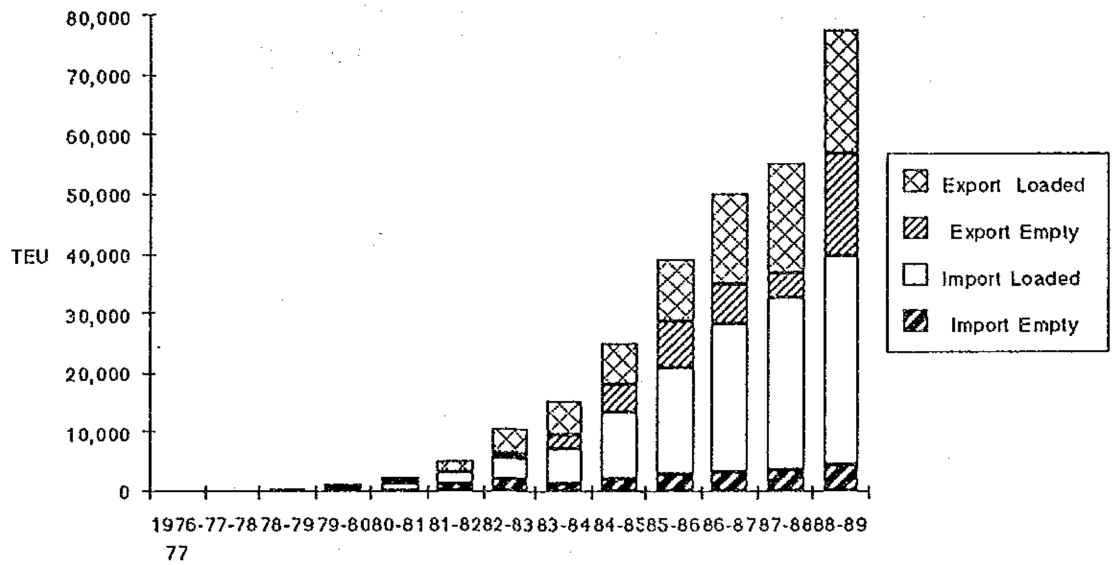


Fig. 1.3.3 Container Throughput at Chittagong Port

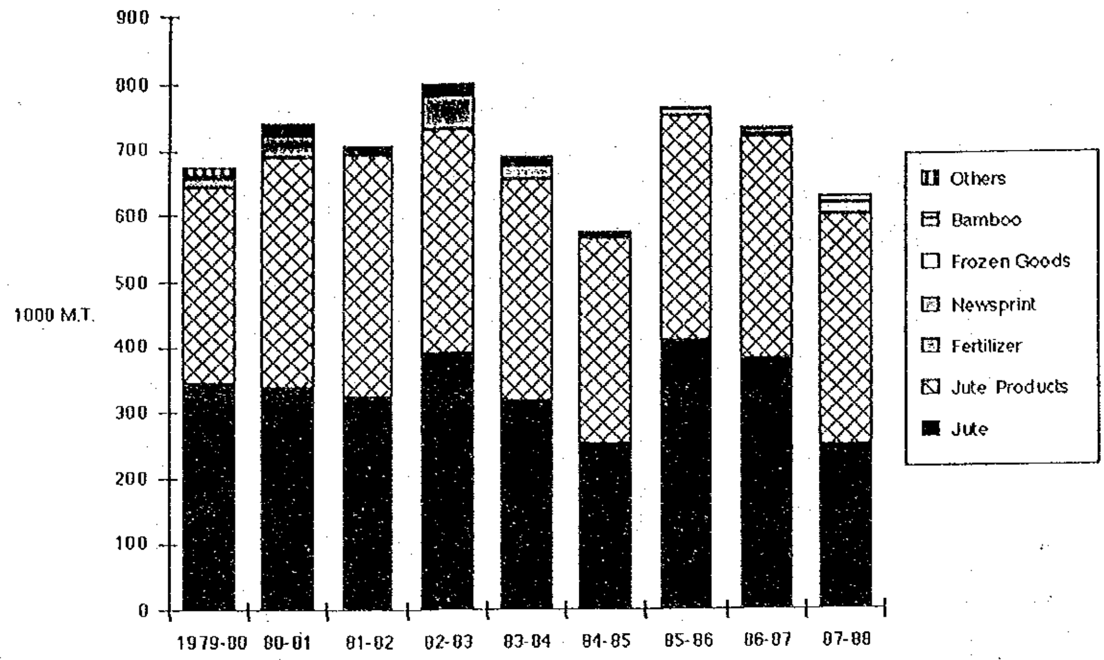


Fig. 1.3.4 Export Cargo Volume at Mongla Port

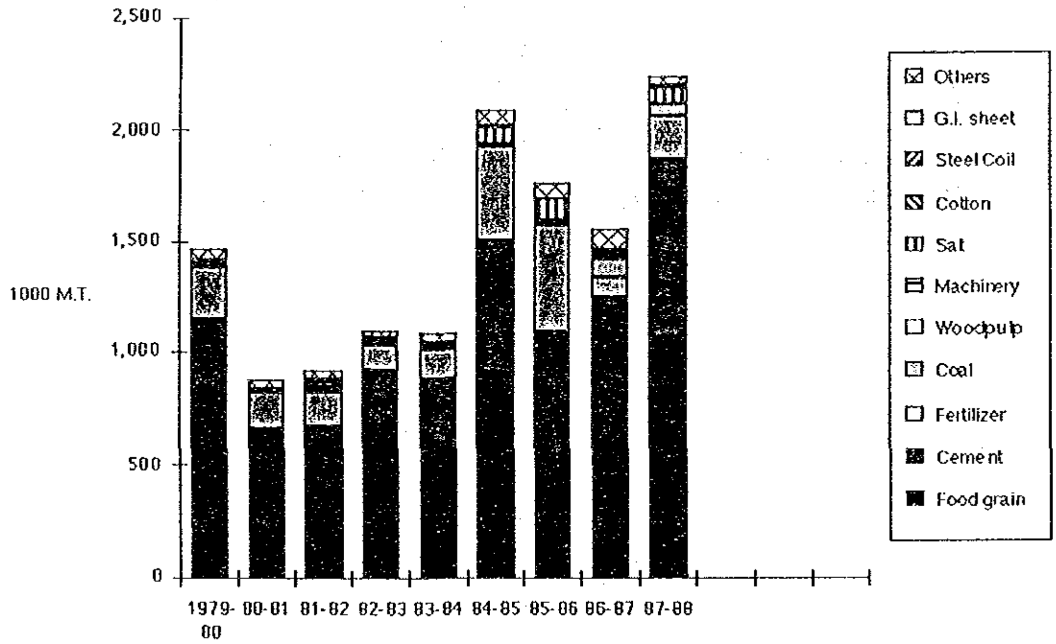


Fig. 1.3.5 Import Cargo Volume at Mongla Port

The total cargo and the container cargo throughput at the facilities of Mongla Port Authority(MPA) reached about 2,863 thousand tons and about 88 thousand tons, respectively, in 1987-88.

The average growth rates of the total cargo and container cargo throughput at Mongla port between 1983-84 and 1987-88 were about 12.7 percent per annum and about 44.2 percent per annum, respectively.

The ratio of containerization to the containerizable cargo at Mongla port in 1987/88 was about 21 percent. The average growth rate of the ratio of the containerization between 1983-84 and 1987-88 at Mongla port was about 20 percent.

The number of containers throughput at Mongla port in 1988-89 was about 11 thousand TEUs.

The grow rate of the number of TEUs throughput at Mongla port from 1983 to 1987 was about 33 percent per annum.

The ratio of the number of empty containers to the amount of containers at Mongla port in 1987-88 was about 52 percent.

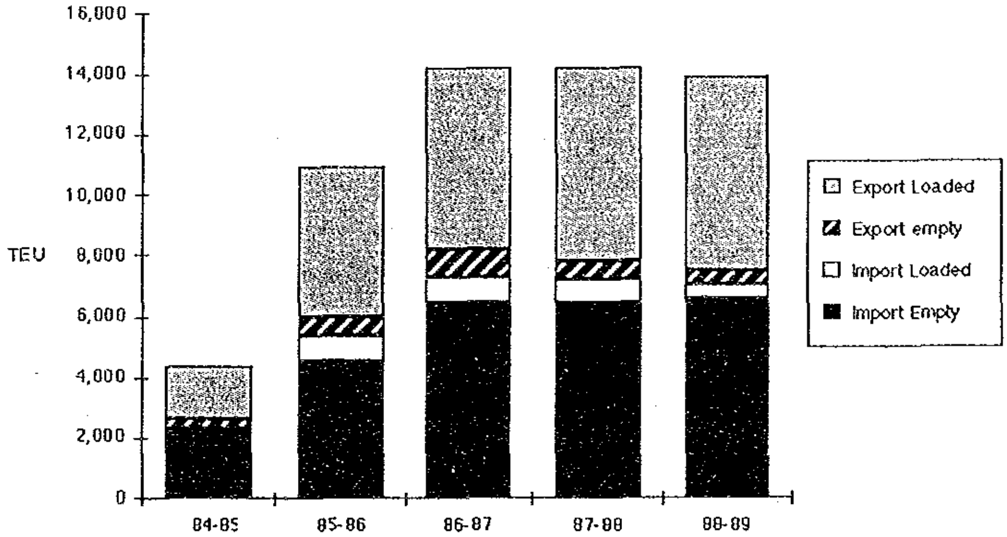


Fig. 1.3.6 Container Throughput at Mongla Port

1.3.2 Kamalapur Inland Container Depot (KICD)

The Kamalapur Inland Container Depot has been set up at Dhaka railway station in order to transport containers between Dhaka and Chittagong by railway.

The container throughput at KICD from January 1989 to October 1989 was 2,265 boxes, including empty containers.

The ratio of empty containers to total container throughput at ICD in the period mentioned above was about 40 percent.

Table 1.3.1 Container Throughput at Kamalapur ICD from January to October in 1989

(Unit:TEU)

	Loaded	Empty	Total
Receiving	503	583	1,086
Despatching	857	322	1,179
Total	1,360	905	2,265

Source: from Chittagong Port Authority

1.3.3 Container Cargo Movement in Bangladesh

The study team investigated the origin-destination (O/D) of break bulk cargo in order to gain an understanding of containerizable cargo movements in Bangladesh.

According to the Result of the O/D survey, about 93 and 65 percent of the container cargo for import and export routed coming to/from Dhaka are handled at Chittagong and Mongla ports.

The hinterland of Mongla Port is mainly the western region of Bangladesh. In Bangladesh, most of the container cargoes are either stuffed into or stripped from the container boxes at the container yard of the port authorities.

Customs clearance of most of the container cargoes is carried out at the container yard of the port authorities.

The most common transportation mode for break bulk cargo between Dhaka and Chittagong is road, which accounts for about 94 percent of the total volume of the transportation between the two ports. The next most-important mode of transportation is the railway, and the least used is the inland waterway, where the percentage is about 2.7 percent.

1.4 The Trend of Ocean Container Transportation

1.4.1 The Development of Container Transportation

(1) Brief History of Container Transportation

Ocean container transportation began in the early 20th century. In 1916, the trans-Altlantic trade was started by a American transport company. In 1921, the world's first container service was pioneered by the New York Central Railway Co. Within a few years, railway company in Europe adopted the container transportation system.

The pioneers of ocean transportation using container vessels were Sea-Land Service, Inc. and the Matoson Navigation Co., both of the U.S.A.

The containerization of liner service to/from Japan and Far East was started in 1968.

(2) Merit of Containerization

The greatest advantage of containerization is safe, quick and low-cost transportation of cargo. For shipping companies, containerization contributes to savings and rationalization of cargo handling charges in ports and easier land transport. Customers can save pacing costs, shorten the transit time of goods, prevent cargo damage and reduce the inventory cost of goods.

(3) Regulation of Containers

The size and type of container are regulated by the "Customs Convention on Containers, 1972" ISO rules, etc.

The standardization of container size is necessary in order to promote international containerization. The most common size of ocean freight container is 8 feet high, 8 feet wide and 20 or 40 feet long.

Depending on the materials, the containers are divided into three groups, namely Steel container, Aluminum container and Fiberglass Reinforced Plastic (FRP) container.

There are many type and kind of containers used to transport various kinds of cargoes. A suitable type and kind of container should be used to ensure safe transportation.

In order to carry cargoes safely, the strength of a container is an important factor. The ISO and the JIS regulate the strength of container.

(4) Container Vessels

In the beginning of the container transportation, RO-RO type container vessels were mainly used in short-distance trade. In the 1980th, major shipping lines deployed lift-on lift-off type full container vessel with cell guides.

In 1988, post-Panamax vessels were developed as 4th generation vessels. Now major shipping companies are mainly using 3rd generation vessels on trunk routes.

1.4.2 Present Situation of Shipping

(1) Shipping Service Network

Liner service on major trading routes is rapidly being containerized, using larger vessels. Currently the average size of container vessels serving the Far East/North America and Far East/Europe routes is 2,500 TEUs to 3,000 TEUs. However, still-larger container vessels will probably serve these routes in the near future, and the number of calling ports will decrease while other ports will served by feeder vessels.

Therefore, competition among container ports will become stronger. To cope with larger container vessels, larger facilities are being constructed in the neighboring countries of Bangladesh as well as in Europe and North America.

However, shallow channels and insufficient cargo volume obstruct large size vessels from calling at the ports of Bangladesh. Therefore, Bangladesh's container shipping service is limited to feeder services by small container vessels and by part-container vessels from Singapore or Colombo.

1.4.3 Trend of International Container Transport to the Bay of Bengal

Circumstances

Despite their positive activities on world-wide container routes, many container operators in the world have very limited performance in the Bay of Bengal route due to the small volume of container traffic. Therefore, container transport to/from this area has been covered by conventional chartered vessels with small container loading capacity or by feeder vessels from Singapore of Colombo. Some shipping companies have a strong interest in providing container service to Bangladesh on condition that the volume of containerized cargo to and from Bangladesh increases in the future.

1.5 Present Conditions of the Transport System between the Dhaka Area and the Seaports of Chittagong and Mongla

1.5.1 General Outline

The present transport network between Chittagong Port and the Dhaka/Narayanganj area is composed of three modes of transport: inland waterways, railways and roads. Container transport on this route has been made by rail, but there is no container transport by inland waterways and roads at present. Accordingly, future investment in the container transport system on this route should be distributed among these three transport modes.

The present transport network between Mongla Port and the Dhaka/Narayanganj area is composed of two modes of transport: inland waterways and roads. The railways in this country are divided into the east and west zones by the Jamuna River. Therefore, there is no connection between Mongla Port and the Dhaka/Narayanganj area, as well as no possibility of direct connection by rail between these two points in the near future. At present,there is no container transport on this route. But, according to the future investment plan, the transport system for carrying containers in this route will be distributed between inland waterways and roads.

1.5.2 Water-borne Transportation

(1) Seaports

There are two seaports, namely Chittagong and Mongla, in Bangladesh. Chittagong Port is situated on the right bank of the River Karnafuli, the port's jetties are located about 17 km from the confluence of the Karnafuli River and the Bay of Bengal. The CPA has thirteen continuous jetties (Nos.1-13), that can accommodate ocean-going vessels. They are marginal-type jetties along the riverside. Behind the jetties and inside the protected area, there are 13 transit sheds and 14 warehouses. Six sheds are used for C.F.S., five for imports and one for exports. The water depth along the jetties is 9.14 m. below the Chart Datum (C.D.). This defines the maximum permissible draft of vessels calling at the port and water depths of navigational channel from the confluence to the port are maintained by dredging to receive the vessels of the size considering tidal fluctuation. In the channel, there are three bars: the Outer Bar, the Inner Bar and the Upta Bar. They need to be dredged from time to time.

In addition to the thirteen jetties, a new multi-purpose terminal used mainly for handling containers is now under construction beside Jetty No.13. Berths of 450 m. long at the multi-purpose terminal have already been completed and opened. The terminal's backyard is still under construction and is scheduled to be completed by the end of 1991. The new terminal is expected to be fully operational in 1992.

In 1988/89, 403 vessels called at Chittagong Port to discharge and load around 78,000 TEUs containers. Small fully cellular container ships provide feeder service between the port and Singapore or Colombo. Their container carrying capacities are around 400 TEUs on average. Their maximum drafts are less than 8 meters. Partial container ships of sizes ranging between 1,000 D.W.T. and 15,000 D.W.T. are also used. Their container-carrying capacities are under 600 TEUs and on average around 400 TEUs. Conventional general cargo vessels are also used for container transportation. Besides Singapore and Colombo, these vessels call at other ports in India such as Calcutta, Madras and Cochin. Consequently, the number of containers discharged and loaded at Chittagong Port is less than the carrying capacities of full container ships or partial container ships at roughly 50% on average.

On the other hand, Mongla Port is situated on the left bank of the Pussur River. The port is one of the two seaports accommodating ocean-going vessels in Bangladesh and handles around one-fourth of the total amount of cargo loaded and unloaded at the seaports in this country. Compared with Chittagong Port, Mongla Port is characterized by the export of jute and jute goods, of which the volume exported through Mongla Port in 1988/89 accounted for 86% of the total. Except for jute and jute goods, non-bulk cargoes handled at Mongla Port are far less than that at Chittagong Port, accounting for less than 5% of the total non-bulk cargoes, excluding jute and jute goods, in 1988/89. Most cargoes handled at Mongla Port are bulk cargoes such as food grains, cement and fertilizer.

The Mongla Port Authority has five continuous jetties, namely Nos.5-9, whose total length is 914 m.. The water depths at the jetty front are maintained by dredging. The present water depths at the jetty front are in the range of 7 m.-8 m. below the C.D.. Truck-mounted shore cranes are installed on the apron. Behind the jetties, there is a spacious backyard enclosed by fences.

In addition to the above-mentioned existing facilities, a new multi-purpose terminal is now under construction beside Jetty No. 5. The terminal will have two jetties, namely Nos. 3 and 4, each 183 m. long, totaling 366 m.. Construction work for pile foundations with sufficient bearing capacity for future installation of shore cranes for heavy loads, mainly containers, is almost finished.

As for the access channel from the mouth of the Pussur River to Mongla Port, there are shallow parts such as the sandbar at the river mouth, the Sabur Beacon, the Southern Anchorage and the confluence downstream from the port. These shallow parts vary from around 4 m. to 6 m. below C.D. at present, defining the maximum permissible drafts of vessels passing through the channel. Although tidal fluctuation raises the maximum permissible drafts to 7 m.-8 m. at high tide, the MPA has a plan to dredge the shallow parts up to 9 m. below C.D. to improve navigational conditions through the channel by reducing waiting times. Part of the dredging project is about to get under way.

In 1988/1989, 148 vessels called at Mongla Port to discharge and load about 14,000 TEUs containers.

(2) Navigational Waterways

Navigational waterways in Bangladesh comprise inland waterways, mainly formed by rivers and coastal waterways in the Bay of Bengal. Navigational waterways relevant to this study are the routes between Dhaka and Narayanganj ports and the two seaports, Chittagong and Mongla. Classification and navigational distances of the main routes are as follows:

Route	Class	Water Depth	Distance
- Chittagong - Dhaka:	I	: 3.7 m. (12 feet):	307 km (191 miles)
- Mongla - Dhaka:	I	: 3.7 m. (12 feet):	304 km (189 miles)
- Chittagong - Mongla:	I	: 3.7 m. (12 feet):	369 km (230 miles)
- Dhaka - Narayanganj:	I	: 3.7 m. (12 feet):	34 km (21 miles)
- Mongla - Khulna:	I	: 3.7 m. (12 feet):	47 km (30 miles)
- Dhaka - Chandpur:	I	: 3.7 m. (12 feet):	68 km (42 miles)
- Dhaka - Barisal:	I	: 3.7 m. (12 feet):	168 km (104 miles)
- Mongla- Barisal:	I	: 3.7 m. (12 feet):	136 km (85 miles)

As for the coastal waterways, there are sandbars in front of the river mouths formed by materials deposited by the rivers and sand drift caused by sea waves hitting the coast. On the route between the ports of Chittagong and Dhaka, there is a coastal channel across such sandbars from Sandwip to South Hatia. According to the sounding record in 1986 by the BIWTA, the water depths vary from 2.1 m. to 3 m. (7 feet-10 feet) below C.D. through approximately 30 km. long, being maintained naturally without maintenance dredging. As the channel empties into the open sea, tidal fluctuation is much greater than in upland waterways. At Sandwip, the mean water levels fluctuate seasonally, because of the varying river flow, but the range of the fluctuation is small. According to the tide table of 1990 published by the BIWTA, the minimum mean water level is in February and the level is about 2.6 m. above the C.D.. Thus, at high tide above the mean water level, the water depth of the shallowest part in the channel is deeper than the following depth from the water surface:

2.1 m. below C.D.(sea bed) + 2.6 m. above C.D.(the mean water) = 4.7 m.

The duration of the high tide is around 6 hours, including ebb and flow. When vessels go to or come from the Lower Meghna River, flow and ebb are chosen accordingly. The duration of each ebb and flow period seems to be sufficient to allow them to pass through the channel.

After passing through the coastal channel, the inland waterway run through the Meghna River deep and wide enough for existing coasters. From the confluence of the Dhaleswari River with the Meghna River to the confluences of the Sitalakhya and Buriganga rivers with the Dhaleswari

River, there are some shallows which need to be dredged seasonally. Towards the upstream, the Buriganga and Sitalakhya rivers are stable and so suitable for river ports.

On the other hand, the route between the ports of Mongla and Dhaka runs through only inland waterways formed mainly by natural rivers and partly through canals such as the Mongla Ghasiakhali and the Ghabkhan canals. The inland navigational waterway from Mongla connects with the Meghna River at Ilsaghat. Though the waterway between Mongla and Ilsaghat is meandering, coasters and inland cargo vessels can navigate at night owing to navigational aids installed by the BIWTA. At the mouths of the canals and the confluence of the Gareshupura and the Meghna rivers near Ilsaghat, there are some shallows which need to be dredged from time to time. From Ilsaghat, the navigational route bound for the ports of Dhaka and Narayanganj is the same as the route from Chittagong Port.

The total volume of the maintenance dredging on the two main routes doesn't exceed 400,000 cub. m. per annum. The dredging is conducted by BIWTA's cutter suction dredgers.

(3) Management and Operating System of Shipping

The Ministry of Shipping regulates the operations and registration of vessels in Bangladesh. There are two public shipping corporations, one involved in international services and the other in inland and coastal services. The activities of the two corporations are strictly separated by law. The government's policy is to provide more incentives to the private sector to increase its participation in shipping.

(4) Voyage Times

1) Dhaka-Chittagong

The voyage time between Dhaka Port and Chittagong Port is on average 17-18 hours one way, but the loading/unloading times and waiting times at Dhaka Port are so long that on average 12-13 days are needed for one round trip.

2) Dhaka-Mongla

The voyage time between Dhaka Port and Mongla Port is on average 22-24 hours one way. The cargo handling time is 5-6 days and the round trip takes an average of 7-8 days.

(5) Freight Rates

The BIWTA fixes maximum and minimum fares and freight rates for inland water transport on behalf of the Government.

Maximum and minimum freight rates are fixed by the BIWTA according to the commodity.

(6) Future Projects

1) Chittagong Port

The CPA has made progress in upgrading the Multi-purpose Terminal by beginning work on a berthing facility 450m in length, which will be fully completed by December 1991 and begin full operations in 1992. In this berthing facility, two container feeder vessels 180m in length can berth simultaneously and an increasing amount of containerized cargoes will thus be handled in this terminal.

2) Mongla Port

Mongla Port has been facing problems because of the siltation caused by floods and cyclones. The MPA has the following projects for the dredging of the channels during the FFYP (Fourth Five Year Plan).

"Dredging work in the Pussur Channel" aims to ensure the safe passage of 8m draught ships through the Pussur Channel by capital dredging of 2,300,000m^3.

"Procurement of trailing suction dredger with self-propelled & self-discharging barges" proposes the procurement of a trailing suction dredger with two separate hopper barges of 2,000 tons capacity each to carry out routine dredging at the jetty front and in the shallow parts of the Pussur Channel.

3) Inland Waterways

The BIWTA has proposed a new investment plan for inclusion in the FFYP, amounting to Tk.8,346,517,000, which includes the construction of a container terminal, inland river ports, etc.

1.5.3 Railways

(1) General Outline of Bangladesh Railway

1) History

BR (Bangladesh Railway) is a government-owned and managed organization under the jurisdiction of the Ministry of Communications. The first section of 53.11km of broad-gauge track between Darsana and Jagati was opened on 15th November, 1862.

At present the BR is divided into two zones: the East Zone and the West zone. The East Zone lies to the east of the Jamuna River and comprises tracks with a one-meter gauge (1,000mm). The west zone lies to the west of the Jamuna River and comprises both broad (1,676mm) and one-meter-gauge tracks.

At the end of 1987, the BR had a total of 501 stations, comprising 2,745.65 route-kilometers of 923.53km of broad gauge and 1,822.12km of one-meter gauge. It owned a fleet of 291 locomotives, 1,791 loading vehicles and 16,247 of freight wagons. In 1987-88, it carried 53,003,000 passengers and 2,518,000 tons of freight, amounting to 5,025,182,000 passenger-kilometers and 678,267,000 ton-kilometers.

2) Organization

Presently, the Director-General, who holds concurrently the post of Secretary, Railway Division, Ministry of Communications, supervises the management and development of the BR. Under the Director-General, two General Managers control each of the two zones (East and West).

3) Present Situation

In the Third Five Year Plan, 1985-90, the Bangladesh Government points out the BR's unsound financial performance and proposes strategies for the development of the BR, laying more emphasis on improvement of the quality of service rather than expansion. The Mid-term Review of the Third Five Year Plan, 1985-90, published by the Planning Commission in February 1989, also points out the necessity of reducing costs through improvement of efficiency, better utilization of procductive assets and reduction in operating costs.

(2) Dhaka - Chittagong Rail Route

There is no direct rail connection between Mongla Port and Dhaka, because of the Jamuna River and the Rupsa Ferry. On the other hand, container cargo transport by rail between Chittagong Port and Dhaka has been in operation since 1988.

1) Facilities

On this rail route, the BR has one-meter gauge of 320.7km in length, consisting of double lines 122.00km in length and single lines 198.79km in length.

In the East Zone, the BR has 127 diesel electric locomotives for meter-gauge main line.

2) Operation

At present, 9 pairs of scheduled passenger and freight trains per day run on this route, besides 39 pairs of passenger and freight trains that run on a portion of this section.

3) Container Transport

The Kamalapur ICD (Inland Container Depot) was opened in 1987 by the BR as the first ICD in Bangladesh. It connects Chittagong Port and Dhaka directly by rail. Since 1987, this ICD has grown gradually, handling 3,043 TEU of containers in 1989. As the first ICD, the reslut of the Kamalapur ICD must be appraised.

① Journey time

The daily container service runs with a journey time of 16 hours and 30 minutes from Dhaka to Chittagong and 17 hours and 50 minutes from Chittagong to Dhaka.

② Freight rates

The freight rates of container transport between Chittagong Port and Kamalapur ICD are presented in the following Table.

Table 5.3.1 Freight Rates of Container Transport between Chittagong Port and Kamalapur ICD

	Freight rates(Tk.)
a. Chittagong Port to Kamalapur ICD	
up to 15 tons net	5,000
beyond 15 tons to 22 tons net	7,000
b. Kamalapur ICD to Chittagong Port	
up to 15 tons net	2,500
beyond 15 tons to 22 tons net	3,500
c. Kamalapur ICD to Chittagong Port	
empty	1,000

[Source] Chittagong Port Authority

(3) Future Expansion Plan

1) Dhaka - Chittagong Rail Route

The BR has a programme for constructing a double line 64km in length from Tongi to Bhairab Bazar for inclusion in the FFYP.

2) Kamalapur ICD

The Kamalapur ICD Project proposed by the ADB with construction costs of Tk.697,164,000 targets 76,800 TEUs to be transported by rail in 2006 between Dhaka and Chittagong.

1.5.4 Roads

(1) General Outline of Roads in Bangladesh

1) Road Network

The Roads and Highway Department, Ministry of Communications, is responsible for the construction and maintenance of national highways, the total length of which amounted to 2,831km in mid-1988.

2) Design Standard

While designing highway bridges and culverts in Bangladesh, the present standard of live loadings is AASHTO HS 20-44(MS 18), but many bridges and culverts remain under the old standard with a restriction of 10 tons GVW.

3) Vehicles

In 1988, there were 2,950 tractors and 1,150 trailers. But there is almost no transport of containers by tractors and trailers.

4) Motor Vehicle Law

Road transport in Bangladesh is regulated by "the Motor Vehicle Ordinance, 1983". Under the provisions of the Ordinance, motor vehicle rules are provided and prescribed in detail.

(2) Dhaka-Chittagong Highway

1) Summary

The Dhaka-Chittagong Highway, with a length of 248.2km, is the most important arterial road in Bangladesh, connecting these two major cities.

2) Present State

The Meghna Bridge opened in 1990. But the Daudkandi Ferry remains and many small bridges and culverts are under reconstruction, which makes container transport by road difficult.

3) Journey Time

The journey time by truck between Dhaka and Chittagong is on average 10 hours in the daytime and 11 hours at night, including waiting time for ferries and the drivers' rest time. It takes from 1.5 to 3 days for one round trip.

4) Freight Rates

The freight rates by truck from Chittagong to Dhaka are from Tk.4,000 to Tk.6,000 and those from Dhaka to Chittagong are from Tk.2,000 to Tk.3,200. Imbalance in the round trip cargo volume brings about the difference in freight rates.

5) Future Projects

① Road improvement project financed by ADB

The road improvement project on the Dhaka-Chittagong Highway financed by the ADB is on-going. This project comprises the improvement, the rehabilitation and the sealing of existing roads and does not comprise the widening or the construction of the new bypass nor the construction of the Daudkandi Bridge. This project is expected to be completed by October 1992 with construction costs of Tk.1,267,000,000.

② Meghna-Gumti Bridge

The Meghna-Gumti Bridge on the Dhaka-Chittagong Highway is expected to be constructed in the vicinity of the Daudkandi Ferry by March 1996 with Japanese assistance. The completion of the road improvement project financed by the ADB and the Meghna-Gumti Bridge will realize container transport by semi-trailer combinations on this highway.

(3) Dhaka-Mongla Roads

1) Summary

Bangladesh is divided by the Jamuna River into eastern and western parts. The hinterland of Mongla Port is the western part of the country. Because of these facts, road transport between Dhaka and Mongla is still underdeveloped compared with that on the Dhaka-Chittagong Highway.

2) Present State

The traffic volume on this route is lower compared with that of the Dhaka-Chittagong Highway. There are three ferries: Aricha, Kamarkhali and Rupsa ferries. The Gorai Bridge is now under construction and will be completed by June 1991, replacing the Kamarkhali Ferry. In the case of the Rupsa Ferry, there is no plan to construct a bridge.

3) Journey Time

The journey time by truck on this route depends on the waiting time for the Aricha Ferry. Normally, it takes 12-15 hours, but in adverse situations this becomes 1-2 days.

4) Freight Rates

The freight rates by truck are from Tk.3,900 to Tk.4,800.

5) Future Projects

① Road improvement projects financced by the ADB

In the some portions on the Dhaka-Mongla Road, road improvement projects financed by the ADB are on-going.

② Gorai Bridge

The Gorai Bridge, with a length of 630m, is under construction in the vicinity of the Kamarkhali Ferry with British assistance and will make the ferry redundant on its completion in June 1991.

1.6 Management and Operating Systems of Ports

1.6.1 The Outline of the Systems

Ports in Bangladesh are divided into two categories:inland river ports and seaports. Inland river ports and seaports are administered by the Bangladesh Inland Water Transport Authority(BIWTA) and specific port authorities, respectively. The BIWTA and the two port authorities are under the jurisdiction of the Ministry of Shipping.

The main functions of the BIWTA are river conservancy work, inland river navigation control and development and management of inland river ports. The main functions of the port authorities are seaport development and management. When they plan and develop their ports, the approval of the Planning Commission, The Ministry of Finance and the ERD (External Resources Division) as well as the Ministry of Shipping are required.

Cargo handling at inland river ports is carried out entirely by private companies. On the other hand, cargo handling, such as that involving cranes, straddle carriers, forklifts, etc. at seaports, is carried out by port authorities. However, unskilled laborers handling cargo at seaports are employed by private companies, the same as at inland river ports.

The BIWTA owns no commercial vessels such as passenger steamer and cargo vessels.

Within the port limits of both inland river ports and seaports, there are not only public jetties constructed and managed by the BIWTA and the port authorities but also many private jetties constructed and managed by private companies. Owners of private jetties are prohibited from handling cargo other than their own. The BIWTA and the port authorities have the power to permit erection of private jetties.

Kamalapur inland container depot is managed and operated by the Bangladesh Railway and the Chittagong Port Authority. The former provides the facilities, except cargo handling equipment, within the terminal and operates railway commercial services. The latter manages cargo handling equipment and carries out daily operational work such as cargo handling, documentation work, etc.

The revenues from the BIWTA's activities share less than 70% of its total revenues. The balance is covered by grants from the government. On the other hand, the financial situations of the port authorities are sound.

1.6.2 Customs Clearance for Containers

Containers themselves are different from ordinary cargo in light of their special use for transportation, so the Customs clearance of containers must be different from and more simple than that of ordinary cargo. As for cargo stuffed in containers, that is to say, containerized cargo, Customs clearance is almost the same as that of ordinary cargo.

However, it has been recognized that containerized cargo may obtain import/export Customs clearance without a strict actual inspection in the marine container terminal, but random inspection, in order to promote door-to-door transportation.

There is one convention called "CUSTOMS CONVENTION OF CONTAINERS, 1972". The convention, the international agreement aimed at developing and facilitating international carriage by container, was enacted by the Economic Commission for Europe (ECE) at Geneva on May 18, 1956, and amended in 1972.

1.7 Principal River Ports

There are seven principal river ports in Bangladesh: Dhaka, Narayanganj, Barisal, Chandpur, Baghabari and Bairab Bazar. The present conditions of these ports have been investigated, focusing on the potential for container traffic through these ports in the future. As to cargo movements through inland waterways in Bangladesh, much of the cargo originates from the seaports, Chittagong and Mongla, and is destined for the inland river ports, mainly Dhaka, Narayanganj and Khulna. In 1984/85, 78% of the total cargoes through the inland waterways originated from the seaports, and 90% of the cargoes were destined for the inland river ports. In the same year, 67% of the total cargoes were unloaded at the ports of Dhaka, Narayanganj and Khulna. In the same year, only around 10% of the total cargoes through inland waterway were transported between the river ports. Thus, the remaining 90% of the cargoes can be assumed to have been import and export cargoes delivered and collected through the inland waterways and the river ports.

In terms of foreign trade cargoes handled at Chittagong and Mongla ports, imports accounted for 86% of the total in 1988/89. Imported bulk cargoes are food grains, POL, cement, salt, sugar and coal, accounting for 77% of total imports. Imported non-bulk cargoes accounted for 23% of total imports. On the other hand, exports account for only 14% of total foreign trade cargoes in the same year. Major export cargoes are jute goods and jute, accounting for 50% of the total export cargoes. The volume of those cargoes, however, has decreased gradually in the last decade. Instead, there has been an increase in the volume of exported garments recently, along with the development of a garment industry mainly in and around the Dhaka area, though the volume is still small.

Thus, most major imports and exports are also listed as major commodities of cargoes transported through inland waterways. Food grains, POL, cement, fertilizer salt, jute goods and jute are the major commodities in inland waterway transport. In 1984/85, the cargo volume of the major commodities accounted for 86% of total cargo movement. Stones and sand are transported mainly between river ports in domestic trade.

As for non-bulk cargoes of foreign trade handled by seaports, there was a steady increase in the volume of the cargoes in the last decade, showing an annual growth rate of 3.7% on average. Imported non-bulk cargoes increased considerably, with an annual growth rate of 5.5%. On the other hand, exported non-bulk cargoes remained almost at a constant level, although the composition of commodities of the exported cargoes changed. Along with the increase in the volume of non-bulk foreign trade cargoes, there was a sharp increase in the percentage of containerization in the same period. Presently, one-fourth of the total non-bulk cargoes are already transported in containers by ocean-going vessels.

At present, except for jute and jute goods, most such non-bulk cargoes are transported by trucks as loose cargoes in inland transport whether they are carried in containers by ocean-going vessels or not.

1.8 Demand Forecast

The demand forecast consists of three parts: the estimate of the socio-economic indices, the estimate of the container throughput at seaports and the estimate of the container cargo volume and TEU to and from the Dhaka area.

1.8.1 Population and GDP in 2005

The future population of Bangladesh has been estimated by the Bangladesh Bureau of Statistics (B.B.S.).

In this study, the growth rate of the population between 1987 and 2000 is the same as that estimated by the B.B.S.. From 2000 to 2005, the annual population growth rate is assumed to be the same rate as the annual growth rate between 1995 and 2000.

From the result of the forecast, the population of Bangladesh in 2005 is estimated at about about 154.5 million.

Future GDP of Bangladesh is estimated using the past trend of GDP. The estimated GDP in 2005 is about TK 832 billion.

1.8.2 Container Throughput at Seaports in Bangladesh

The forecasdt of sea trade cargo in future is usede by two different approaches: macro-economic and micro-economic forecasting.

Macro-economic forecasting is a method of estimating cargo volume as a whole based on the correlation between the cargo volume and major economic indices.

Micro-economic forecasting is a method of estimating the cargo volume of each main commodity group individually. The total cargo is calculating by summing up these cargo volumes.

The steps involved in carrying out the forecast for container cargo throughput at sea ports are:

1) Estimating the volume of containerizable cargo for the planning period by macro-economic and micro-economic forecasting.
2) Estimating the trend of the ratio of containerization over the planning period by applying a logistic curve.
3) Estimating the container cargo throughput for the planning period at seaports by multiplying 1) by 2).
4) Estimating the container throughput for TEU and container boxes for the planning period at seaports.
5) Estimating the ratio of CL and LCL for the planning period at seaports.

From the result of the estimation, the number of loaded containers and the volume of container cargo for export and import in 2005 are as follows:

Number of loaded containers in 2005	for export:	97 thousand TEU.
	for import:	228 thousand TEU.
Volume of container cargo in 2005	for export:	1,091 thousand tons.
	for import:	2,973 thousand tons.

1.8.3 Container Cargo Volume Coming to and from the Dhaka Area

The ratio of the number of loaded container for import to and from the Dhaka area is estimated using the average of the ratio between the result of the O/D survey and the interviews at Chittagong Port Authority because the difference between the result of the O/D survey and the interview is very large.

From the result of the estimate, the ratio of the number of loaded containers for import to and from the Dhaka area is about 76 percent.

For export, the difference between the result of the O/D survey and the interview at CPA is not so large. So, in this study, the ratio in the result of the O/D survey, which is 65 percent, is adopted.

The container cargo volume coming to and from Dhaka area for export and import is estimated by multiplying the container cargo volume at seaports in Bangladesh by the ratio of number of loaded containers to and from the Dhaka area .

From the result of the estimation, the container cargo volumes coming to and from the Dhaka area for export and import in 2005 are as follows:

Container cargo volume in 2005 forexport: 709 thousand tons.
for import: 2,259 thousand tons.

1.9 Future Container Traffic

1.9.1 Methodology

On the future container traffic route between Dhaka and two seaports, Chittagong and Mongla ports, there will be three traffic modes: inland waterways, railways and roads. On the Dhaka-Mongla Route, only inland waterways will be able to transport containers before 2005. All the containers on this route, therefore, will be transported by inland waterway. But on the Dhaka-Chittagong Route, there will be three traffic modes for container traffic. The basic concept in estimating the traffic modal split is that it will be determined mainly by costs. Accordingly, the marginal costs for container transport are calculated for the three traffic modes. Marginal costs mean the necessary additional costs from now to transport the containers in the target year. These additional costs consist of the operating costs and future additional investment costs from now until the target year. Furthermore, the time factor is considered and converted into costs. Finally, the traffic modal split is estimated based on the concept that it will be basically determined in inverse proportion to marginal costs.

1.9.2 Estimation of Marginal Costs

Marginal costs for container transport consist of operating costs and additional investment costs. In calculating the operating costs, values for the traffic times and the transport capacities of three traffic modes are assumed. The operating costs per TEU for three traffic modes are then calculated. The additional investment costs are obtained by dividing the additional investments of each traffic mode by the number of containers to be handled by each traffic mode.

The calculated marginal costs are shown in Fig. 1.9.1.

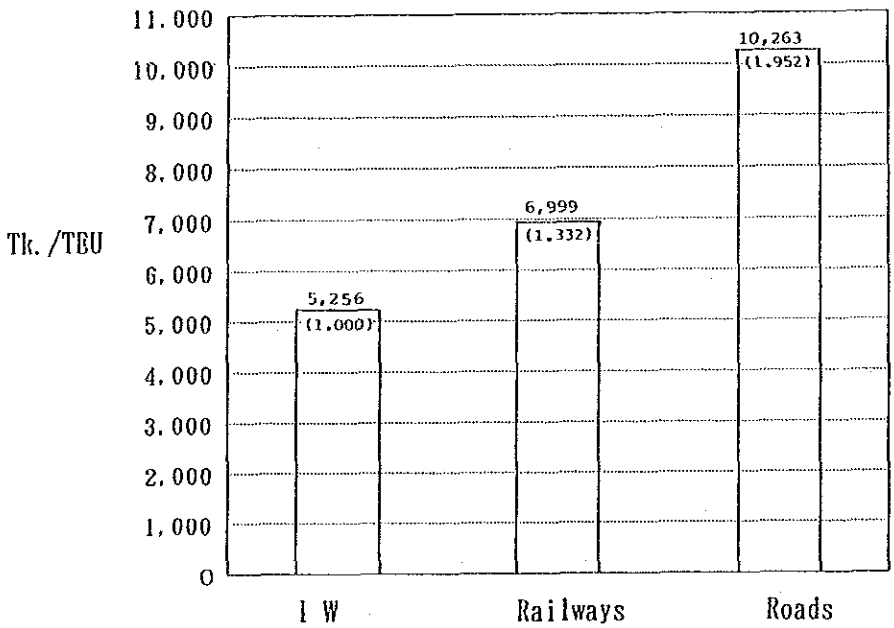


Fig. 1.9.1 Comparison of Marginal Costs by Traffic Mode in 2005

1.9.3 Estimation of Traffic Modal Split and Container Throughput

Using the time value obtained by dividing the weighted average costs of three traffic modes by the weighted average transport time, the time value costs are calculated for each traffic mode. Finally, the traffic modal split is estimated as the reciprocal ratio of the total cost, which is the sum of the marginal costs and half of the time value costs. Using the forecast container cargo volume and the estimated traffic modal split, the future container throughput at Dhaka in 2005 is estimated as shown in Table 1.9.1.

Table 1.9.1 Traffic Modal Split and Future Container Throughput at Dhaka in 2005

	Traffic modal split (%)	Container throughput (TEUs)		
		Import	Export	Total
Inland Waterway	38.2	76,828	76,828	153,656
Chittagong	(30.9)	(62,231)	(62,231)	(124,461)
Mongla	(7.3)	(14,597)	(14,597)	(29,195)
Railways	31.7	63,755	63,755	127,510
Roads	30.1	60,537	60,537	120,074
Total	100.0	201,120	201,120	402,240

1.9.4 Ratio of the Number of 20-Foot Containers to the total Number of Containers

For coming to and from the Dhaka area, the ratio of the number of 20-foot containers to the total number of containers is estimated using the actual data at Chittagong port by time series analysis.

From the result of the estimation, the ratio of the number of 20-foot containers is about 57.7 percent in 2005.

1.10 Future Water Transport System for Containers

1.10.1 Prospective Design of Container Vessels

As for domestic service, container vessels to be operated between Dhaka and either Chiattagong or Mongla has been studied from the point of view of conversion of existing vessels or building new ones.

In addition, international service container vessels, which will sail directly to Dhaka from either Singapore or Colombo, have been studied in line with the BIWTA's request. However, it appears that the marginal cost of container transportation on this route would be extremely high, while the transportation hours could be reduced compared with the combination work of the domestic service vessel and the middle size container feeder vessel operated between Singapore/Colombo and Chittagong/Mongla, because the size of vessels that can sail to Dhaka is limited.

Consequently, further study on the international route will continue in the future.

Conversion of Existing Vessels to Container Vessels

Three typical vessels suitable for carrying containers after conversion were chosen among the existing vessels, two from the bay-crossing coasters and one from the bay-crossing barges. Conversion of these vessels and also container transportation cost regarding one of the most economical vessels have been studied.

Due to the following reasons, however, it is not recommended that the existing vessels carry containers after conversion:

* These vessels are now old and their remaining working life is short.
* The number of containers that can be carried is not enough compared with new vessels.
* The number of days when vessels can operate is low because of unavoidable trouble.
* The transportation cost of containers will be higher than with new vessels due to low efficiency.
* It will be difficult to operate vessels on a tight schedule.
* Thus, to carry containers by a converted vessel is not economical compared with building new vessels and also is difficult to realize

the anticipated capability of the container terminal.

Building New Vessel

The maximum dimensions of a self-propelling vessel that can be sailed to the Dhaka area from chittagong or Mongla are thought to be as follows considering the natural condition of the waterways and the information obtained from the persons concerned:

Length overall	: 70.0 - 76.0m (230 - 250')
Breadth	: 12.1 - 13.6m (40 - 45')
Draft	: less than 3.66m (<12')

An open top type vessel with a lift on/lift off system has been designed. This is because, more containers can be accommodated on a lift on/lift off type vessel compared with a roll on/roll off-type one, and with an open top type vessel, the amount of work and time required for hatch cover handling are excluded and lashing work for the container can be minimized. For the above reasons, the rotation of vessels is high and congestion at the berth is mitigated. This means that vessels can be operated economically and efficiently, especially on short-distance trips such as shuttle service.

The vessel is also to be designed so as to have good seaworthiness and good maneuverarbility for the bay crossing and navigating narrow rivers.

Principal particulars of proposed vessels are as follows:

Length overall	68.00m (223' - 0")
Length p.p	63.00m (206' - 8")
Breadth mld.	13.00m (42' - 8")
Depth mld.	8.00m (26' - 3")
Draft mld.	3.40m (11' - 2")
Dead Weight	1,400t
Gross tonnage	1,700T
No. of Containers	88TEU
Service speed	10kts
Complement	12

Pusher/Tug - Barge System

Almost none of the following inherent merits of the pusher/tug-barge system are of practical relevance in domestic service container vessels' operation.

* To avoid idling main engine while the vessel is under cargo handling
* One pusher/tug can navigate along side more than one barge.

On the contrary, some of the demerits of the system such as difficulty of navigation, low propulsive efficiency and high investment are unavoidable in this project. Thus, this system has been excluded from this study.

As for building new ships in Bangladesh, joint projects with industrialized countries are recommended. That is, the first vessel should be designed and built in an industrialized country such as Japan, with engineers and workers of Bangladesh staying in the building yard to learn how to proceed with design and construction. Form the second vessel on, shipbuilding will take place in Bangladesh.

1.10.2 Management and Operating Systems of Container Vessels

Container waterway transport will be confronted with severe competition from trucks and railways. In order to compete with their services, it is necessary to establish an excellent service for users and an efficient management and operating system. Consequently, it is recommended that not only public but also private shipping companies should manage and operate container waterway services judging from inefficiency of public sector.

Technical, financial or operational tie-up between foreign shipping companies operating main or feeder services of international container trade should also be considered.

In order to hold a dominant position in inland container transport, it is recommended that safe night navigation should be established in waterway transport. Navigational aids or communication system between ports and vessels for safe night navigation of container vessels in inland rivers should be developed.

1.10.3 Responsibilities and Liabilities of Shipping Companies

The International Convention for the Unification of Certain Rules Relating to (Ocean) Bills of Lading, also known as "The Hague Rules" was effected and signed by many countries at Brussels in 1924.

According to the convention, the responsibilities and liabilities, the rights and immunities, the limitation of responsibilities, etc., of the ocean carriers were stipulated. It is the great principle that carriers are responsible an liable for loss or damage to carried goods during loading, stowage, navigation and discharge arising or resulting from commercial fault namely actual fault of their agent or servants but free from navigational fault in the management of the ship.

Generally speaking, the shipping company is responsible to shippers and consignees for the transportation of the cargo between the places mentioned on the Bill of Loading (B/L) as the place of receipt (or port of loading) and the place of delivery (or port of discharge).

1.10.4 Security of Transportation

In order to prevent criminal acts, a surveillance network along the main routes should be established by both customs and the police, and inland water transportation should be steadily conducted by reliable shipping companies.

Moreover, the useful facilities and systems should be improved by the BIWTA between Dhaka and chittagong or Mongla to ensure safer and more punctual navigation.

1.11 Master Plan for the Container Terminal Development

1.11.1 The Basic Concept of the Container Terminal Development

The purpose of the Master Plan with the target year of 2005 is to serve as a target and guideline for phase plans including the Short-term Plan with the target year of 1995. In formulating the Master Plan for a water-oriented container terminal at Dhaka Port, the following aspects concerning the development are recognized:

- Seaports of Chittagong and Mongla

Since the start of container transport at Chittagong Port in 1976/77, there has been a steady increase in the volume of container cargos through the seaports, namely Chittagong and Mongla. Recently, the volume has increased sharply, showing an average growth rate of 33% per annum in the last five years, with around 91,000 TEUs being handled at the ports in 1988/89. Presently, most of containers are handled at break-bulk berths at Chittagong Port without a specialized terminal for container handling. This causes serious congestion in container handling at the port. Insufficient inland transport systems for container cargos add to the congestion. Consequently, dwelling times of imported container cargoes are excessively long, at around one month on an average.

In order to reduce the present congestion and cope with the further progress of containerization in the future, multipurpose berths with a spacious backyard of 18 ha, intended to be used as a container terminal, are now under construction by the CPA and are scheduled to be completed in 1992. On the other hand, the MPA is also developing container handling capacity, including new berths, at Mongla Port within the spacious port premises owned by the MPA.

Thus, at least, the seaports will have sufficient capacity to meet demands for container handling in the foreseeable future, should an efficient management and operation system be developed, including improvement of necessary procedures such as customs clearance and training for personnel along with the development of the infra- and super-structures mentioned above.

- Transport System for Containers by Road

On the other hand, there are still no concrete plans for resolving the current problems with the inland transport systems for containers. Presently, a large quantity of container cargo is destined for and originates from the Dhaka area, being transported by trucks as loose cargos on the Dhaka-Chittagong highway. Usually, 20-ft. container cargos are carried by 2-3 trucks, due to limited loading capacities of the trucks and the small lot-sizes of cargoes. Consequently, shippers and consignees cannot take full advantage of container transportation for economic, swift, safe and convenient transportation by carrying cargoes in boxes as close as possible to their premises in bond.

Along the Dhaka-Chittagong highway, the Meghna Bridge was completed and the Meghna-Gumuti Bridge is expected to be completed by 1995. Furthermore, pavement and foundation of the existing highway are now being improved at the required stretches and will be completed by 1992. After the completion of the above construction work, infrastructures of the highway will be improved remarkably. However,this does not mean that full-scale container transport by trucks can start immediately thereafter. For a start, massive investment for numerous tractor-trailer units for container transport is necessary. Besides, an inland container depot equipped with at least a CFS in the Dhaka area needs to be prepared, taking account of the fact that local access roads to individual traders' premises are unsuitable for accommodating long and heavy units.

On the other hand, in terms of road communication between Dhaka and Mongla, the Jamuna Bridge is expected to connect the Dhaka area and northwest part of Bengal by land. The route via the new bridge, however, is over 500 km long, and too roundabout. Though there are alternative routes, these are disrupted by several large rivers where ferries are the only means of crossing. Accordingly, container transportation by trucks on the route is unlikely to be developed in the near future.

- Transport System for Containers by Railway

As for container transport by railway, the Kamalapur ICD was established by BR in 1987. Since the start of transport between Chittagong and Dhaka, the number of containers carried has increased gradually, but still remains within a few percent of the total volume through the seaports in spite of the recent sharp increase in the container traffic, registering around 2% in 1988/89. So far, it is rather difficult to say whether the current level of container transport by railway is fully successful. The cost of transporting containers by railway is much more attractive than by truck, nevertheless, traders seem likely to hesitate to make good use of the railways due to the fear of unpredictable journey times. Generally, valuable cargos are carried by containers, and accordingly, when selecting the means of transport from among several alternatives, the first priority is swiftness of transport and predictability of journey times, rather than slight differences of costs between the different means of transport compared with the values of cargoes themselves. Presently, containers are transported on railway wagons, joined to ordinary cargo trains which do not shuttle directly between Chittagong and Dhaka and are often forced to wait on sidings to allow passenger trains to pass by on the single-track lines. Using such a system to transport containers might be partly responsible for the above fear, though the service has been improved to some extent recently through the efforts of the BR. Notwithstanding this, the railway seems to have great potential in terms of development of container transport for the reason that the Kamalapur ICD could easily be expanded along with increased demand for use of the BR's premises at Kamalapur Station. The increase in demand might make operations of container unit trains viable, which could help remove the above fear. Needless to say, in order to start full-scale container transport, a large level of investment would be required along with the development of efficient operating and management systems from the standpoint of the customer's convenience.

- Inland Waterways and Principal River Ports

Presently, container transport by inland waterways does not exist. The principal river ports have no facilities to handle containers. The bearing capacities of the existing jetties are insufficient for heavy container loads as one unit, and there are no spacious backyards, which are indispensable to container handling. There is no concrete jetty nearby the proposed sites of a container terminal. Moreover, most of the existing coasters and cargo vessels currently in operation cannot accommodate container loading due to their narrow holds and the lack of the necessary fittings to fix container boxes. These vessels carry mainly bagged cargos such as food grains, cement and fertilizer which have large bulk density and are generally less valuable compared with container cargoes transported mainly by trucks as loose cargoes after being unstuffed from or before being stuffed into container boxes at seaports. Consequently, the cargoes transported by inland water are essentially unsuitable for container cargoes. Conversely, relating to the possibility of diversion of the above cargoes presently transported by land to the existing vessels, most vessels currently in operation are unsuitable for holding valuable cargoes due to insufficiency or nonexistence of outfitting in the holds, such as bottom ceilings, side sparring and ventilation which are indispensable in preventing damage to containers. Accordingly, it is rather difficult to imagine that container transport by inland waterways could be started using the existing system.

Nevertheless, the potential for container transport by inland waterway in Bangladesh draws strong attention. The seaports, Chittagong and Mongla and the Dhaka area as the major origin and destination of container cargoes are connected by Class I waterways, most of which are maintained by natural river flow without maintenance dredging. By using such natural waterways, establishing a riverside container terminal at Dhaka Port and preparing vessels specialized for container transport or modifying the existing vessels, an attractive container transport system by inland water, simple and less polluting, could be created.

- Fair and Healthy Competition between Different Transport Modes

Thus, regarding inland container transport, all the transport modes: road, railway and water, have potential in terms of establishing full-scale inland transport systems for containers in their respective ways to meet the large demand forecast for the future. In this study, emphasis is put on the container transport system by inland waterways, considering competitiveness vis-a-vis other transport modes. Though fair and healthy competition among the different transport modes might upgrade the level of service offered to customers, competition in and of itself should not be taken as an aim, taking account of the lack of the capacity of the existing inland container transport systems to meet future demand. The development of a full-scale container transport system of all transport modes seems necessary to meet demand as a whole.

- Improvement of Investment Atmosphere for Export-oriented Industries

The establishment of inland container transport systems, by which traders can take full advantage of container transport, is one of the preconditions for improving the investment atmosphere, especially for export-oriented industries such as the growing garment industry and the electronics and toy industries, which are also expected to grow. Well-developed inland transport systems linked to favorable industrial zones, such as a "Free Trade Zone", would draw the attention of foreign investors and local entrepreneurs.

- Regional Development by the Port Development

From the standpoint of regional development, establishment of an inland container terminal at Dhaka Port, as a part of the port development, would greatly contribute to regional development in and around the project site by developing industrial zones linked with the container terminal, generating massive employment opportunities, though a container transport system itself is a streamlined system that can be operated by fewer workers than existing systems.

- Potential of Establishing Container Terminals at the Principal River Ports

Regarding the potential of establishing container terminals at the principal river ports except for Dhaka and Narayanganj, there is hardly any possibility of doing so in the near future, considering the existing level of cargo traffic by inland water mentioned above. Taking into account that presently there is no actual container traffic by inland waterway and the financial resources for the new project are limited, only Dhaka Port should be focused on as a potential container port, at least at this stage, without distributing the limited amount of resources to several ports, which would making this project unjustifiable.

- Justifiability of Deepening Inland Waterway by Capital Dredging

The maximum permissible draft is determined based on the minimum water depth maintained naturally or guaranteed by maintenance dredging. Presently, a water depth of 3.7 m. (12 ft.) in the routes between the seaports and Dhaka Port is guaranteed by the BIWTA. Taking account of under keel clearance including trim, 3.5 m. (11 ft. 6 in.) is considered as the maximum draft to be designed in this study. As to the possibility of handling container ships with deeper drafts on the routes, the major obstacle is the shallowness in the waterway between Sandwip and Hatia. Apart from a shallow draft container ship to be designed specially in this study, the drafts of most small container feeder vessels in operation internationally, with carrying capacities of 150-400 TEUs, are in the range of 6-7 m.. Considering the under-keel clearance, a water depth of at least 8 m. is necessary to receive even the above small container vessels and for that, more than 14 million cub. m. need to be dredged only for capital dredging through the waterway over a 50 km. stretch. Moreover, subsequent maintenance dredging will also be necessary without any guarantee of maintaining the deepened channel against immediate siltation after floods and strong wave force in the monsoon season. Thus, such channel deepening should not be attempted.

1.11.2 *Container Flow at a Container Terminal*

(1) General

The conditions of container flow at a container terminal such as fluctuation of the number of container boxes dwelling at a marshaling yard and the volume of container cargos at a container freight station (hereinafter referred as CFS) depend mainly on the following factors:

- Number of containers handled at the terminal for the target year
- Arrival distribution of container ships
- *Cargo-handling productivity at the terminal*
- Arrival distribution of trucks that bring in container cargos
- Time spent for necessary procedures such as customs clearance

In the first stage of planning, the above factors are studied and necessary values are assumed in order to determine the required scales of the terminal facilities.

(2) Number of Containers Handled at a Container Terminal

The number of containers handled at a container terminal in Dhaka Port *is assumed according to the demand forecast and the modal split described* in Chapters 8 and 9, respectively. The numbers divided into imports and exports, and loaded and empty categories are summarized as follows:

Unit:Thousand TEUs

Year	Import			Export			Total		
	Loaded	Empty	Subtotal	Loaded	Empty	Subtotal	Loaded	Empty	Total
2005	66	11	77	24	53	77	90	64	154

(3) Arrival of Container Ships

It is known from experience that ships' arrivals at wharves for public use is conformable to a Poisson distribution. Using the arrival record of container ships at Chittagong Port in 1989, conformability to a Poisson distribution as to the record was verified.

In this study, referring to the actual distribution form for container ship arrival at the existing container ports including Chittagong Port, a Poisson distribution for a new container terminal at Dhaka Port is adopted.

(4) Cargo-handling Productivity of Container Gantry Cranes

It is said, based on experience, that average cargo-handling cycle time at leading container ports in the world is in the range of hourly 20-30 boxes. Actual productivity, however, fluctuates in every operation, and its distribution form is said, based on experience, to conform to a Erlan distribution of some degree. As to the actual operational record at Chittagong Port in 1989, the most conformable distribution form, namely a sixth degree Erlan distribution, was selected analytically. Referring to the result, the same degree of Erlan distribution with the average of hourly 20 TEUs for a new container terminal at Dhaka Port is adopted.

(5) Arrival of Trucks Loading Container Cargos

LCL cargos for export are brought into a container terminal as loose cargos by trucks. On the other hand, FCL cargos for export are delivered partly in container boxes by tractor-trailer units and partly as loose cargos by trucks, namely as CFS cargos. As for arrival distribution form of trucks and tractor-trailer units for exports, assuming random arrival on the safe side, a Poisson distribution is adopted in this study.

(6) Flow of Container Boxes and Cargos

After being unloaded from container ships by gantry cranes, container boxes are laid or stacked on a marshaling yard temporarily to wait for necessary procedures for import, including customs clearance. LCL cargos are unstuffed from container boxes and brought into a CFS to be sorted for consignees and then brought out as loose cargos by trucks. Import procedures for LCL cargoes are finished in the CFS. On the other hand, exported container cargos are brought into a container terminal by trucks or tractor-trailer units. Exported LCL and a part of FCL cargos are brought into the CFS, and after finishing export procedures, they are stuffed into container boxes and are brought out to a marshaling yard to wait to be shipped. FCL cargos excluding CFS cargos are stuffed into container boxes outside of the terminal, such as at a shipper's premise, and then are brought into and stacked on a marshaling yard of the terminal. Exported containers are then finally loaded into container ships.

Since the movement of container cargos and boxes mentioned above is too complex to be calculated analytically, computer simulation is conducted in this study so as to reveal the movement in the new container terminal with some accuracy.

1.11.3 Required Scale of Main Facilities of the Container Terminal

(1) General

Required scale of the main facilities are determined by using computer simulation and referring to experiential values such as peaking factors at leading container ports. When simulating container flow at the new container terminal in the target year of the Master Plan, the conditions described in Section 11.2 of Part I are adopted.

(2) Berths

Principal dimensions of a berth are determined to accommodate the container ships studied in Section 10.1 of Part I. Length per berth and water depth along a berth are determined to be 90 m. and 4 m. below The average LLW, respectively.

The optimum number of berths is determined by comparing alternative numbers and their respective costs comprising port costs and ship waiting costs. The ship waiting costs are computed using the computer simulation conducted through the period of the target year based on the conditions as described in Section 11.3.2 of Part I. Thus, three is selected as the optimum number of berths. The total berth length is 270 m.

(3) Marshaling Yard

Required number of containers stored at a marshaling yard is determined taking account of the fluctuating number of containers dwelling at the yard by using the computer simulation mentioned above. According to the result, the required number of containers stored at the marshaling yard is determined to be 2,380 TEUs that is the optimum number.

When determining required slot number of the marshaling yard to store the above containers, four alternative cargo-handling systems, namely straddle carrier system, transfer crane system, forklift system and chassis system, are considered to be compared.

(4) Container Freight Station

In order to determine required area and bay number, the result of the above simulation is also adopted. According to the result, the total number of bays on each side and the total area excluding office space are determined to be 49 and 7,740 sq. m., respectively. Taking account of a suitable size of one CFS building, two CFSs are arranged in the terminal.

(5) Apron

An apron where containers are loaded and unloaded onto or from container ships by gantry cranes is planned considering the installation of the cranes and efficient cargo-handling for relaying containers between the cranes and tractor-trailer units or straddle carriers. Taking account of comparatively narrow rail span of 10 m. as mentioned in Section 12.5, the minimum depth of the apron is estimated as around 35 m. though it differs slightly between different cargo-handling systems. Apron length is determined based on the lengths of the berths and the marshaling yard.

(6) Access Road

In order to connect the container terminal with the nearest major road, an access road needs to be planned. According to the result of the computer simulation, a two-lane access road will be sufficient to accommodate the above traffic volume. The width of the road's lanes and the total width of its paved part should be 3.25 m. and 6.5 m., respectively.

1.11.4 Layout of the Main Facilities of the Container Terminal

The main facilities of the container terminal, of which the required sizes are shown in Section 11.3 of Part I, are arranged. Then the required area as the main factor of the site selection is computed by different cargo-handling systems. The required area is in the range of 112,200 - 234,500 sq. m., and taking account of this range, site selection for this project is conducted.

1.11.5 Site Selection

For the site selection, potential project sites were looked for along riverbanks of the Buriganga, Sitalakhya and Megna rivers. According to detailed field surveys, Pangaon and Pagla sites were considered as alternative project sites to be assessed in detailed including cost estimation (see Fig. 1.11.1)

1.11.6 Alternative Development Plans of the Container Terminal

Considering the required scale of the container terminal and proposed suitable sites described in Section 11.3-Section 11.5 of Part I, alternative development plans of the container terminal with the target year of 2005 are proposed as follows (see Fig. 1.11.2 - Fig 1.11.6):

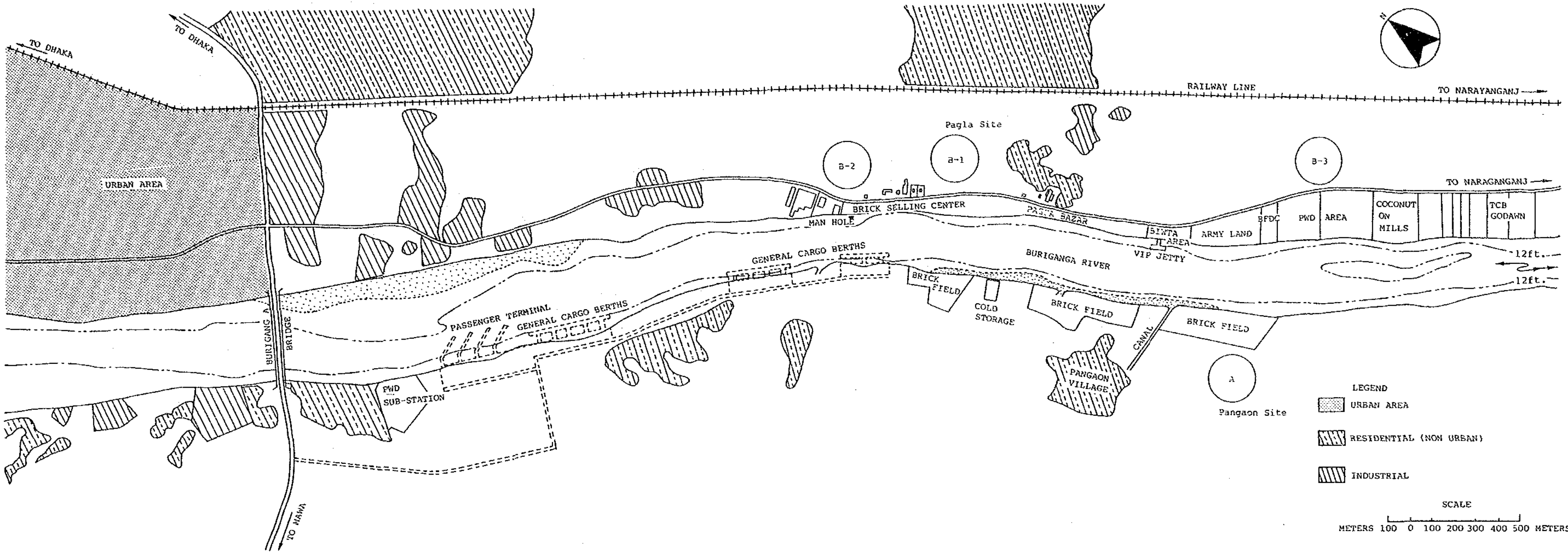


Fig. 1.11.1 Suitable Project Sites at Pangaon and Pagla

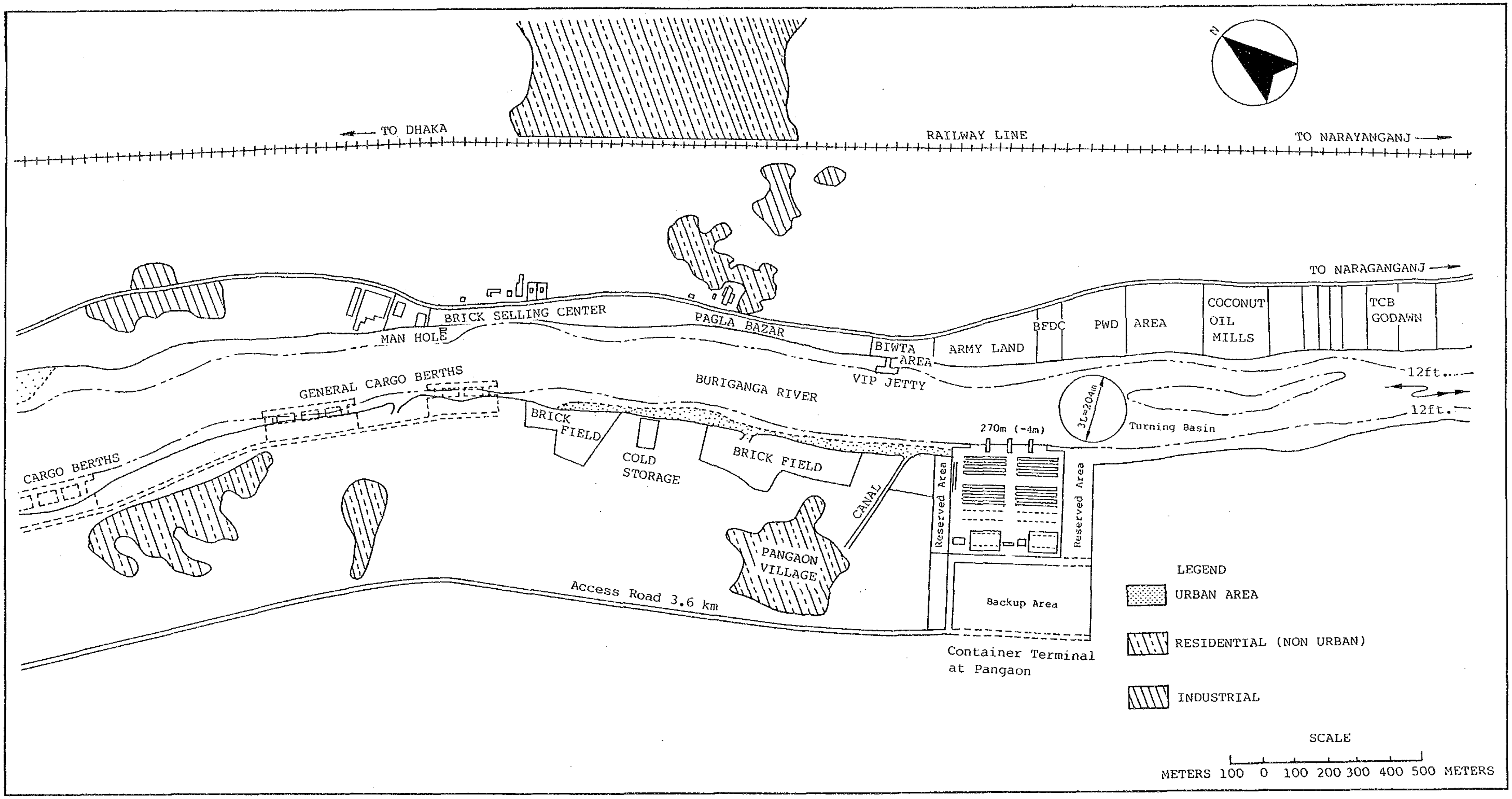


Fig. 1.11.2 Alternative Development Plan at Pangaon Site - Case 1

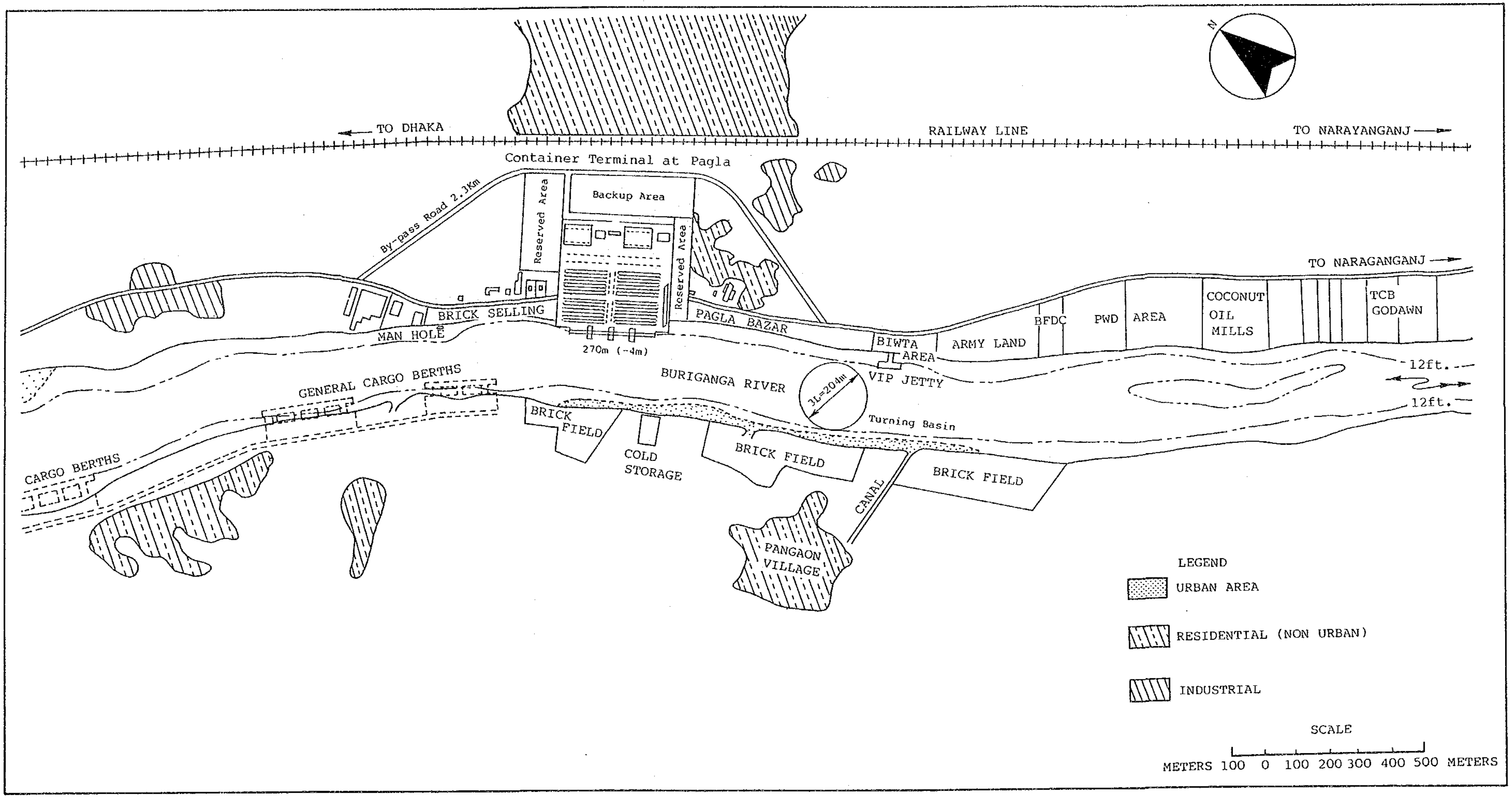


Fig. 1.11.3 Alternative Development plan at Pagla Site - Case 2

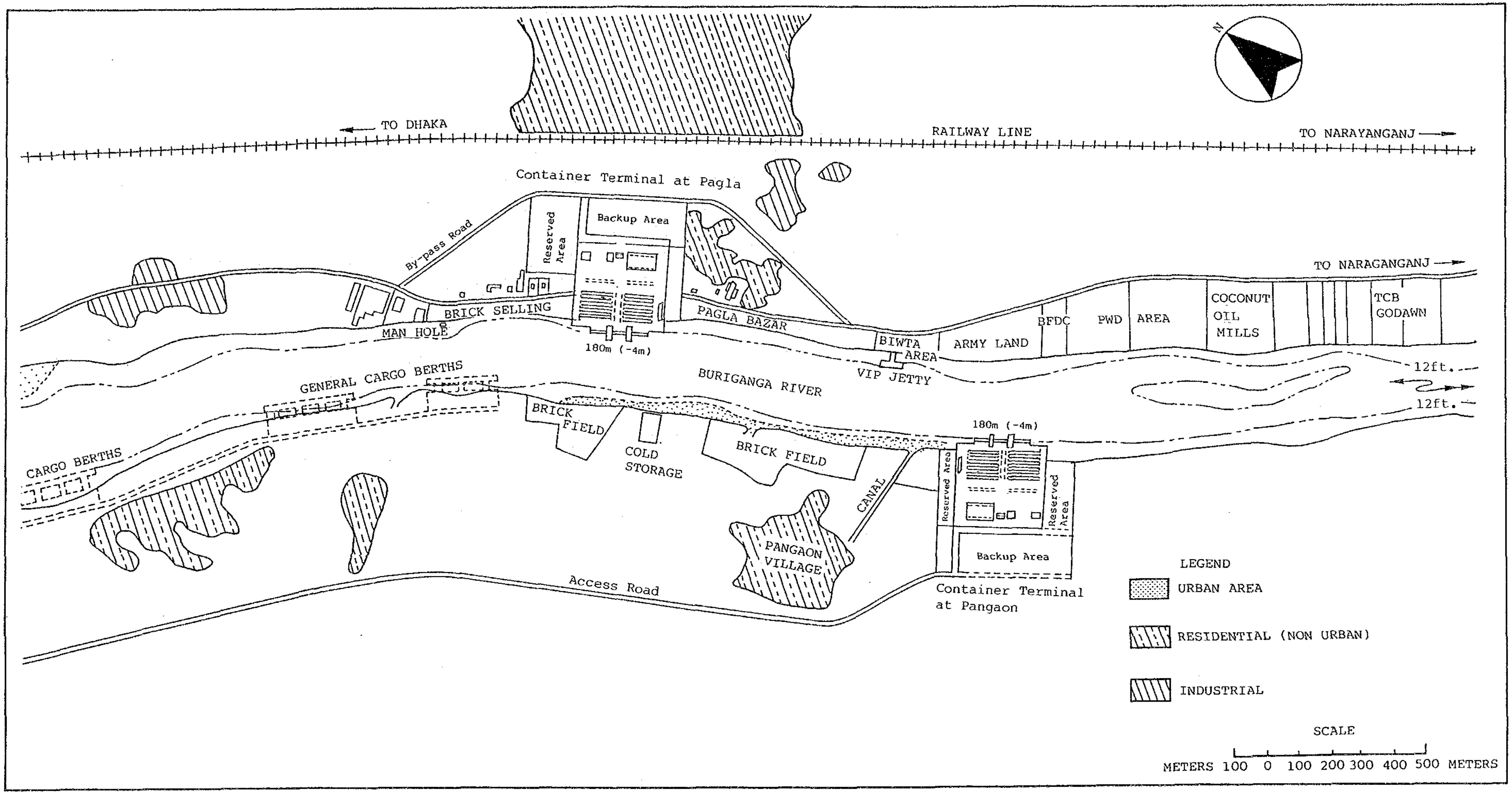


Fig. 1.11.4 Alternatie Development Plan at Pangaon and Pagla Site - Case 3

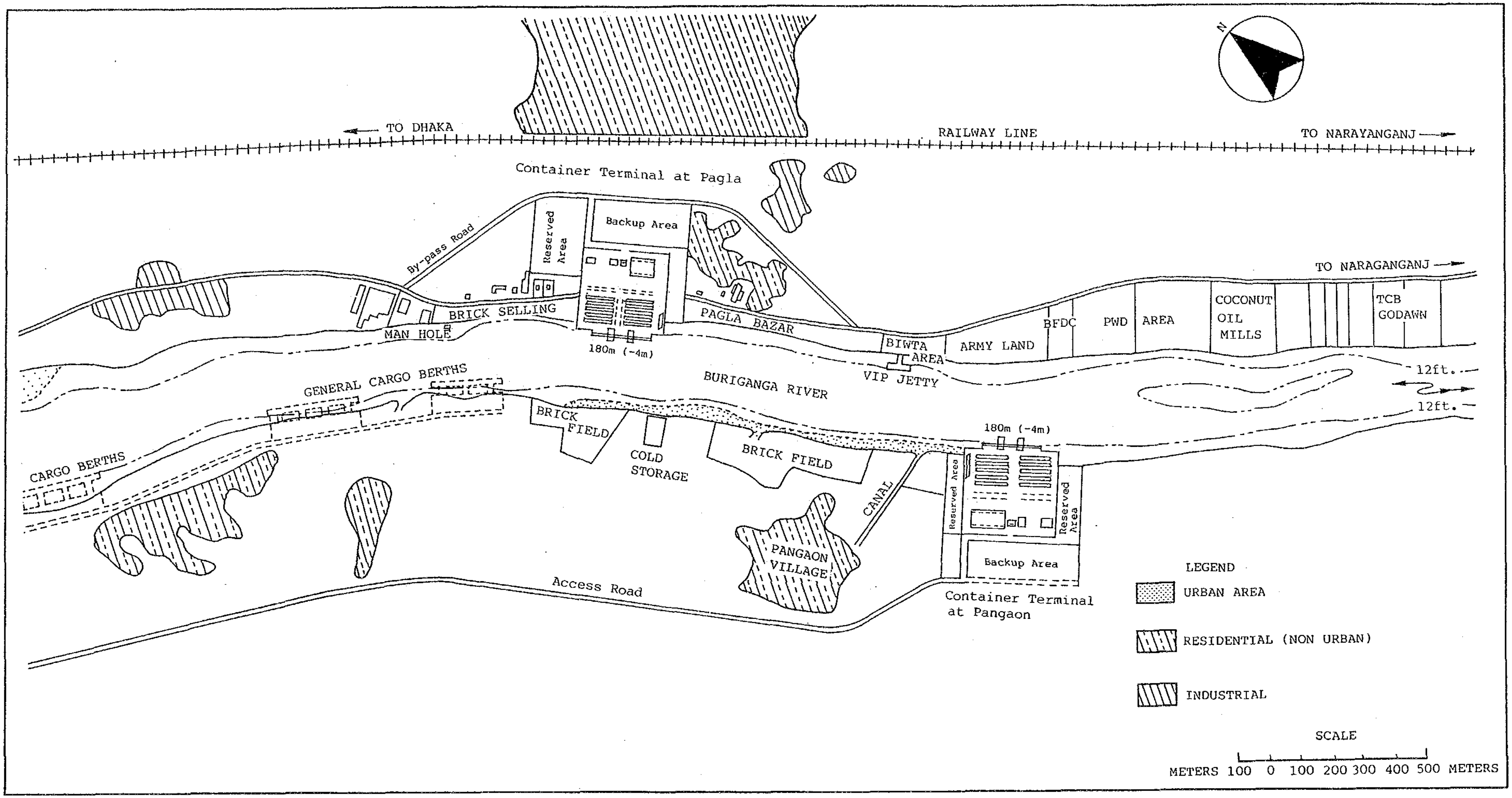


Fig.1.11.5 Alternatie Development Plan at Pangaon and Pagla Site - Case 4

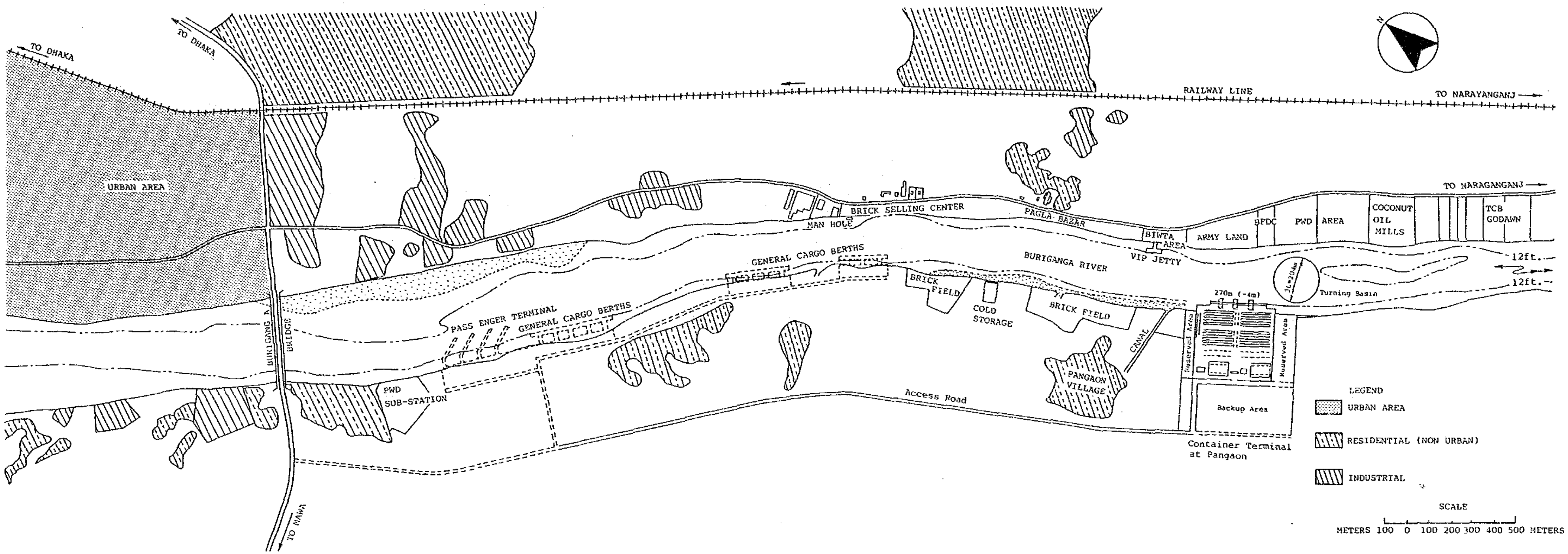


Fig. 1.11.6 Access Road Alignment of Case 1

	Project Site	Container No. Handled (TEUs per annum)	Remarks
- Case-1	Pangaon	154,000	
- Case-2	Pagla	154,000	
- Case-3	Pangaon	77,000	Simultaneous Development Plan
	Pagla	77,000	
		Total 154,000	
- Case-4	Pagla	69,000	The First Phase Plan
	Pangaon	85,000	The Second Phase Plan
		Total 154,000	

The alternative plans listed above are compared from the following points:

a. Land Acquisition

Considering the present land use described in Section 11.5.7 of Part I, land acquisition in Case-1 at the Pangaon site seems likely to be easier than in Case-2 at the Pagla site that is functioning as a selling center for construction materials such as bricks, sand and gravels delivered to the Dhaka city area, and therefore is used rather densely.

b. Basins

A basin needs to be located in a place capable of securing safety maneuvering and anchorage for container ships. In other words, if there are no proper basins near a container terminal planned at riverside, the plan should not be justified. In Case-1 at Pangaon site, a necessary turning basin can be allocate just adjacent to the site. Several basins for ships waiting for mooring at a container terminal can be also located in the comparatively spacious water area neighboring the site.

On the other hand, water area neighboring the Pagla site of Case-2 is insufficient for maneuvering a container ship with long LOA. When turning her, she is forced to back astern to the water area near the BIWTA's VIP Jetty. In this point, the Pangaon site of Case-1 has advantage than Case-2.

c. Access Road

In Case-1 at the Pangaon site, a new two-lane access road needs to be connected with the Dhaka-Mawa Road near Buriganga Bridge. A part of cost of the access road is allocated to the general berth project proposed by the previous JICA study team. As a result of the allocation, the remaining access road of around 3.6 km long is allocated to this project.

On the other hand, in Case-2 at the Pagla site, the existing Dhaka-Narayanganj Road runs through the site. However, a by-pass road needs to be constructed considering not to hinder various activities generated from a container terminal to be established newly and its future expansion. Thus, the by-pass road of around 2.3 km long is planed to be aligned.

d. Efficient Operation

Case-3 and Case-4 are plans to establish two container terminals each at both the Pagla and Pangaon sites for the purpose of developing both areas from the standpoint of regional development. However, in view of efficient container-handling operation at the terminals to be newly established, such separation of the terminals will cause serious inefficiency. In a case where a container ship berths at one terminal and there are still no containers having finished export procedures and being ready to be loaded onto the ship and there are such containers at the other terminal, the containers must be transferred to the relevant terminal, and otherwise, she must wait cargos or depart with half-loaded condition, resulting costly and inefficient container transport. Percentages of loaded containers for export transferred from one terminal to the other terminal to the total loaded containers for export are estimated as 46% and 48 % in Case-3 and Case-4, respectively. On the contrary, in Case-1 and Case-2, the above transfer don't occur. Moreover, investment costs of Case-3 and Case-4 are much higher than these of Case-1 and Case-2 due to their uneconomical separate plans (see Table 1.11.1). Thus, Case-3 and Case-4 should be avoided.

e. Phase Plan for Construction

As for Case-3, taking account of the first phase plan for this project to be implemented around 1995, required scale of a planned container terminal seems to be too small to divide into two terminals to be established simultaneously. In this stage, it is roughly estimated that only two berths as a total will be sufficient for the first phase plan. From the above, Case-3 should be avoided.

f. Container-handling Systems

The four cases, namely Cases 1, 2, 3 and 4, are further divided by four different container-handling systems as mentioned in Section 11.4 of Part I. of Part I Thus, sixteen cases as a total are compared each other as alternatives (see Table 1.11.1). Investment cost of chassis system is much higher than the other three cases, namely straddle carrier, transfer crane and forklift systems. There is no decisive difference in cost between the three cases. However, forklift system has fear to damage containers in cargo-handling operation as mentioned in Section 12.5 of Part I compared with straddle carrier and transfer crane systems. Thus, chassis and fork-lift systems are not advisable to be adopted for this project.

The comparison of the sixteen alternatives is summarized in Table 1.11.1.

Table 1.11.1 Comparison of the alternative Development Plans of the Container Terminal

Case No.	Container-handling System	Project Site	Terminal Area (sq.m)	Access Road (km)	Project Cost (Million TAKA): Infra- & Upper-Structures	ditto Taxes & Duties	Container Handling Equipment	ditto Taxes & Duties	Access Road	ditto Taxes & Duties	Sub-total: Project Cost	Sub-total: Taxes & Duties	Total	Cost Index	Remarks
1-1	Straddle Carrier	Pangaon	137,350	3.6	1,011	139	633	382	94	2	1,738	523	2,261	100	X
1-2	Transfer Crane	Pangaon	124,800	3.6	950	127	735	467	94	2	1,779	596	2,375	105	X
1-3	Forklift	Pangaon	190,600	3.6	1,217	176	582	262	94	2	1,893	440	2,333	103	
1-4	Chassis	Pangaon	247,100	3.6	1,334	179	2,039	151	94	2	3,467	332	3,799	168	
2-1	Straddle Carrier	Pagla	137,350	2.3	1,108	141	633	382	86	1	1,827	524	2,351	104	X
2-2	Transfer Crane	Pagla	124,800	2.3	1,039	129	735	467	86	1	1,860	597	2,457	109	X
2-3	Forklift	Pagla	190,600	2.3	1,345	178	582	262	86	1	2,013	441	2,454	109	
2-4	Chassis	Pagla	247,100	2.3	1,627	222	2,039	151	86	1	3,752	374	4,126	182	
3-1	Straddle Carrier	Total	171,800	5.9	1,335	165	806	472	179	3	2,320	640	2,960	131	
		(Pangaon)	85,900	3.6	637	82	403	236	94	2					
		(Pagla)	85,900	2.3	698	83	403	236	85	1					
3-2	Transfer Crane	Total	161,400	5.9	1,288	155	972	608	179	3	2,439	766	3,205	142	
		(Pangaon)	80,700	3.6	615	77	486	304	94	2					
		(Pagla)	80,700	2.3	673	78	486	304	85	1					
3-3	Forklift	Total	245,600	5.9	1,626	215	728	320	179	3	2,533	538	3,071	136	
		(Pangaon)	122,800	3.6	775	107	364	160	94	1					
		(Pagla)	122,800	2.3	851	108	364	160	85	2					
3-4	Chassis	Total	282,200	5.9	1,715	222	2,490	3,210	179	3	4,384	3,435	7,819	346	
		(Pangaon)	141,100	3.6	773	99	1,245	1,605	94	1					
		(Pagla)	141,100	2.3	942	123	1,245	1,605	85	2					
4-1	Straddle Carrier	Total	172,600	5.9	1,334	165	807	475	179	3	2,320	643	2,963	131	
		(Pagla)	80,000	2.3	678	80	378	213	94	1					
		(Pangaon)	92,600	3.6	656	85	429	262	85	2					
4-2	Transfer Crane	Total	157,600	5.9	1,272	154	916	567	179	3	2,367	724	3,091	137	
		(Pagla)	72,500	2.3	645	74	429	257	94	1					
		(Pangaon)	85,100	3.6	627	80	487	310	85	2					
4-3	Forklift	Total	252,800	5.9	1,648	220	747	333	179	3	2,574	556	3,130	138	
		(Pagla)	117,100	2.3	832	105	362	160	94	1					
		(Pangaon)	135,700	3.6	816	115	385	173	85	2					
4-4	Chassis	Total	293,900	5.9	1,742	227	2,491	3,211	179	3	4,412	3,441	7,853	347	
		(Pagla)	134,200	2.3	899	119	1,105	1,391	94	1					
		(Pangaon)	159,700	3.6	843	108	1,386	1,820	85	2					

According to the above comparison, the separate plans, namely Cases 3 and 4 are excluded. As for container-handling systems, chassis and forklift systems are also excluded. Thus, the following four cases are considered as suitable cases for this project and are further assessed from various points of views:

	Project Site	Container-handling System
1. Case 1-1:	Pangaon	Straddle Carrier
2. Case 1-2:	Pangaon	Transfer Crane
3. Case 2-1:	Pagla	Straddle Carrier
4. Case 2-2:	Pagla	Transfer Crane

As the alternative project sites, Pangaon and Pagla were compared in detail from various points of views (see Table 1.11.2). Land acquisition of the Pangaon site seems to be much easier than that of the Pagla site which has already been partly developed and built-up. As for basins essential to a riverside container terminal, a necessary turning basin can be allocated just adjacent to the Pangaon site in the comparatively spacious waters. On the contrary, turning basin cannot be allocated just adjacent to the Pagla site, and consequently container ships will be forced to back astern dangerously in the congested waterways to the broad waters away from the site. Furthermore, the Pangaon area left vacant has greater development potential than the Pagla area which has already been developed to a certain extent. Construction cost at the Pangaon site is estimated cheaper than that at the Pagla site. Thus, the Pangaon site has advantages and is selected as the optimum proposed project site.

As the alternative cargo-handling systems for the container terminal, straddle carrier system and transfer system were compared in detail from various points of views. The straddle carrier system has advantages over the transfer crane system in flexible operation owing to less number of container handling times. The straddle carrier system has already been adopted at the two seaports, therefore skill and technique of the system can be easily introduced to the planned new container terminal from the seaports. In this case, by applying similar procurement system adopted at the seaports, spare-parts of straddle carriers for the planned terminal may be procured conveniently. There is no decisive difference in cost between the two systems. Thus, the straddle carrier system has advantages over the transfer system, and is selected as the optimum cargo-handling system.

From the above comparison, Case 1-1 is selected as the optimum plan.

In order to support container-handling operation in the container terminal, backup area for warehouses, office space of shipping companies, shipping agencies and forwarders, etc. needs to be prepared adjacent to the container terminal. Though the area is expected to be used mainly for private sectors, land acquisition should be included in this project in order to avoid disorderly development and control land use around the container terminal. Thus, the project areas excluding the access road but including the port road for the Master Plan are summarized as follows (see Fig. 1.11.7):

- Terminal Area: 137,350 sq. m. (Van Pool: 12,600 sq. m.)
- Port Road: 8,695 sq. m.
- Backup Area: 37,280 sq. m.

- Total Area: 183,325 sq. m.

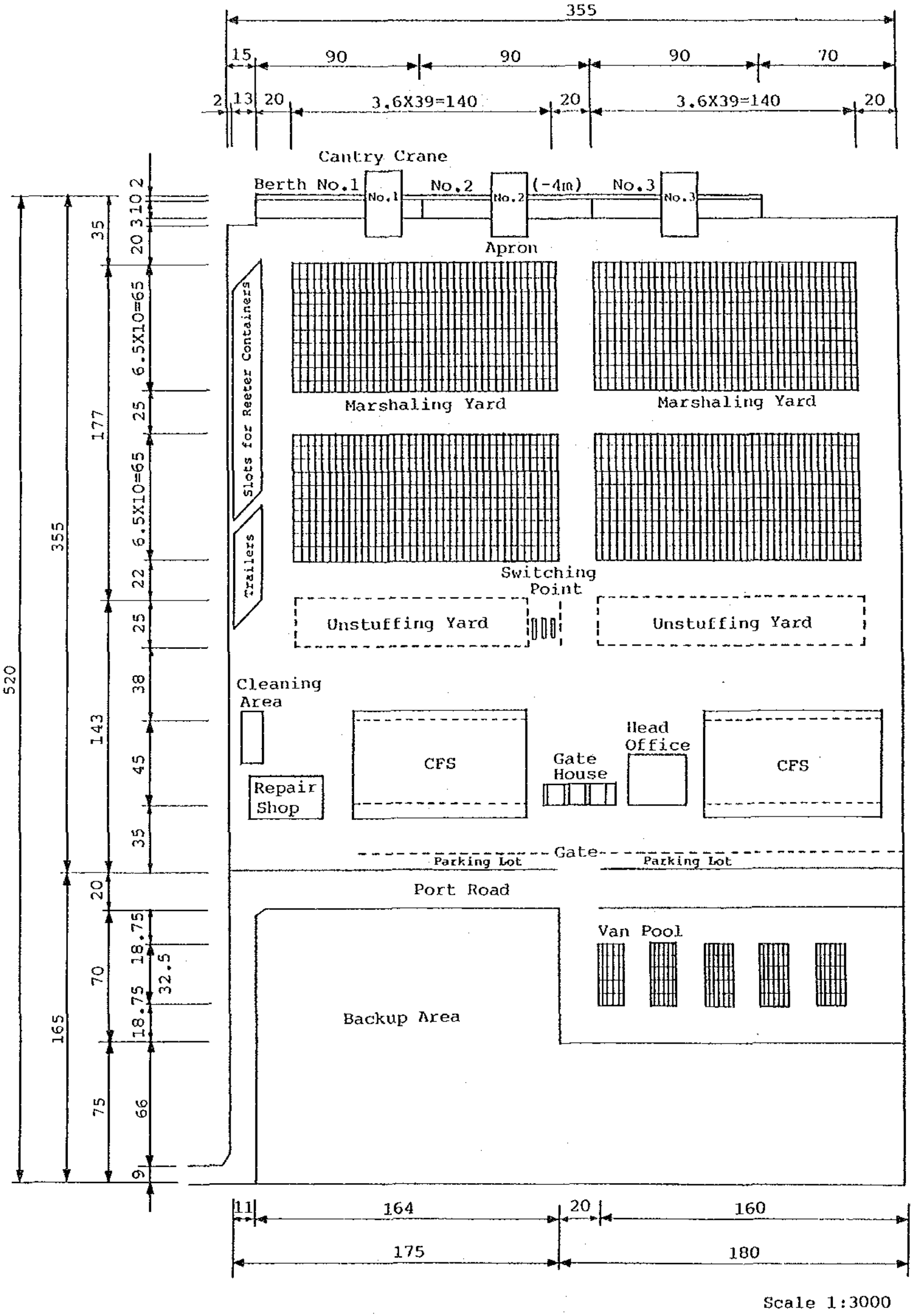


Fig. 1.11.7 Layout Plan of the Facilities of the Container Terminal for the Master Plan with the Target Year of 2005

Table 1.11.2 Comparison of the Alternative Project Sites for the Container Terminal

Project Site	Pangaon	Pagla
Case No.	Case 1-1 & Case 1-2	Case 2-1 & Case 2-2
Land Aquisition	Most part of the site is low-lying vacant land and its aquisition seems to be easier than at Pagla.	Backward area from Dhaka-Narayanganj road is low-lying and vacant, and waterfront area is used rather densely for a selling center for construction materials.
Basins	A necessary turning basin can be allocated just adjacent to the site.	When turning a container ship, she is forced to back astern to the water area near the BIWTA's VIP Jetty.
Potential for Future Development around the Project Site	Owing to the construction of Buriganga Bridge, the south bank of the Buriganga River presents great development potential and by constructing a local access road, the area can be developed greately.	Pagla site has been considerably developed, especially in waterfront area. The Dhaka-Narayanganj Railway Line might hinder future development in backward area.
Environmental Impact on the Areas Adjacent to the Terminal	The project site is sparsely-populated area and environmental impact on the areas adjacent to the terminal seems to be small by this project.	There is built-up area comprising residences and the Pagla Bazar in the east of the Pagla site. When establishing a containerterminal, a buffer zone will need to be made.
Cost Index	Case 1-1 (Straddle Carrier System): 100 Case 1-2 (Transfer Crane System): 105	Case 2-1 (Straddle Carrier System): 104 Case 2-2 (Transfer Crane System): 109

1.11.7 Land Use Plan in and around the Container Terminal

After determination of the optimal project site, it is necessary to prepare a land use plan in and around the selected site as part of the Master Plan in order to harmonize land use for massive container-handling and activities related to the handling with other uses such as for industrial, agricultural and urban activities. When preparing the land use plan, the following points should be considered:

- Reservation of land for future expansion of the container terminal,

- Preparation of space for the activities related to container-handling such as for warehouses, offices of shipping agencies and forwarders,

- Preparation of space for new industries generated from the establishment of the container terminal,

- Harmonization with the other land uses such as for existing industries, agriculture, housing and urban activities,

- Environmental consideration.

Proposed land use plan in and around the Pangaon site is shown in Fig. 1.11.8.

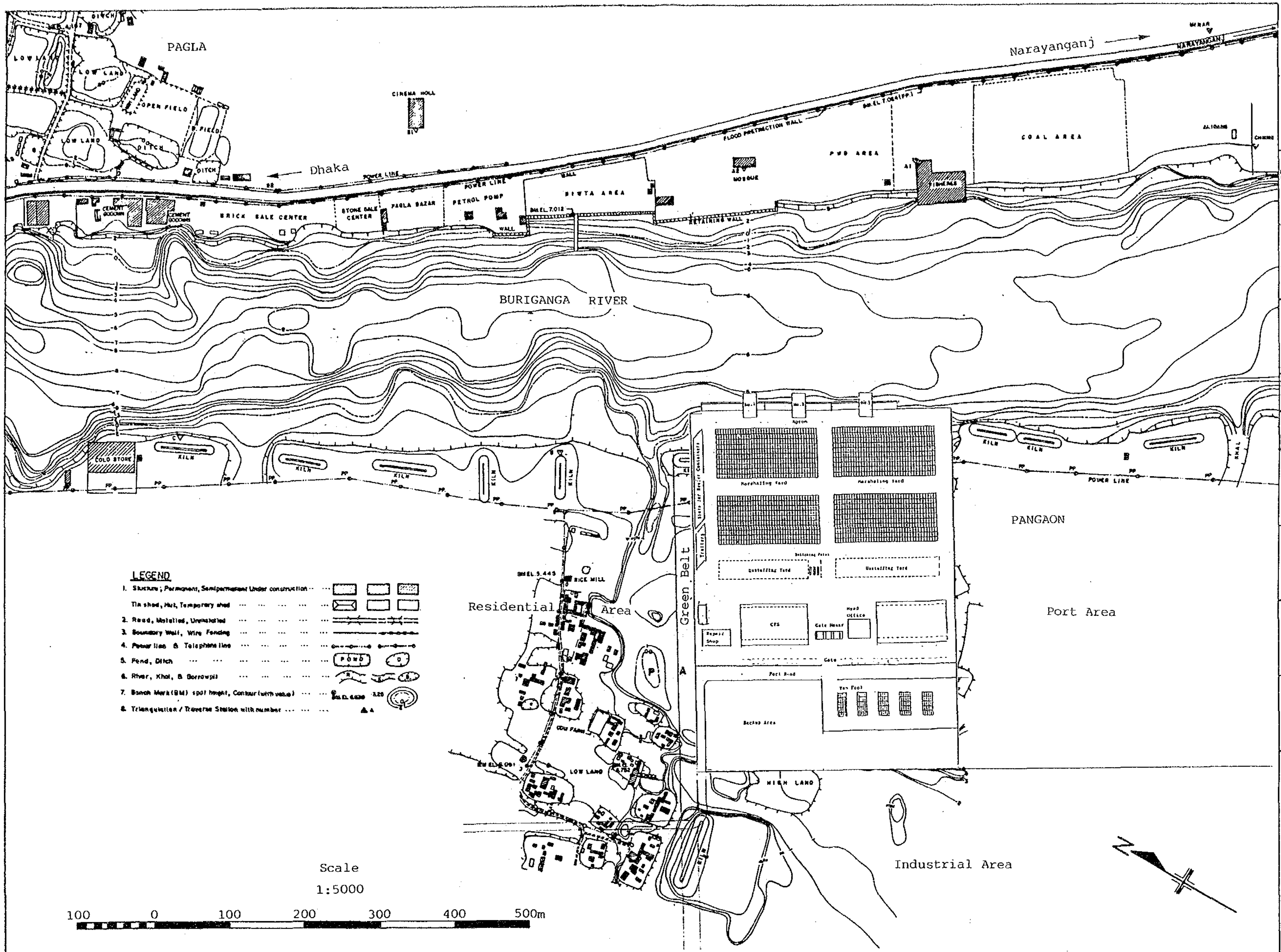


Fig. 1.11.8 Proposed Land Use Plan in and around the Project Site

1.12 Design of Construction and Cost Estimate

1.12.1 Design of Main Structures

(1) Design Conditions

For designing the major terminal facilities required for efficient operation of the proposed container terminal, which presupposes the berth length, design ship size, cargo-handling equipment and terminal operation system as determined in the Master Plan, in-depth analyses were made of the berthing speeds of ships, superimposed loads, design water level, apron crown height, existing ground level, design seismic coefficient, allowable stresses in major structural members, soil conditions and other pertinent design conditions.

(2) Structural Type of Whalf

In the Master Plan, three structural types considered fit for the proposed wharf, namely, gravity type, open type and pontoon type, were carefully analyzed and evaluated primarily in terms of relative case of construction, economical consideration, possible impacts on river flow and efficiency of cargo-handling operations.

In consequence, in the Master Plan the open-type wharf supported on Case-in-Site RC pipe piles was finally selected as the most desirable structural type for the new wharf.

(3) Container Yard

Careful evaluation of various pavement types has resulted in the choice of asphalt pavement in cooperating large quantities of brick chips for the container yard because of the advantages of this type of pavement, such as the case of obtaining the necessary materials and easier maintenance.

(4) CFS

A steel truss structure has been selected for the proposed CFS as a result of in depth analysis of the service conditions.

(5) Other Facilities

Detailed analysis of structural types and material requirement were undertaken with respect to the port administration building, repair shop, container gate, fences, port and access roads, drainage system and other necessary terminal facilities.

1.12.2 Container Handling Equipment

(1) Equipment between the vessel and the quay apron

The gantry crane mounted on rails with a capacity of 20 units of container per hour for domestic service vessel is proposed due to its high efficiency which means shorter a berth occupancy time of the vessel for cargo handling and safety in operation, although the investment cost is high compared with the mobile crane.

The highly efficiently and safety operations are the most important function in order to realize the anticipated capacity of the container terminal and to avoid congestion at the berth.

(2) Equipment between the quay apron and the yard

The straddle carrier system is proposed because of its operational flexibility and the economical investment on this project, after the following four typical container terminal systems were analyzed.

- straddle carrier system (S.C.)
- transfer crane system (T.C.)
- forklift system
- chassis system

A comparison of each system regarding each element are as follows.

Table 1.12.1 Comparison Table of Each System

	S.C.	T.C.	Forklift	Chassis
Required marshalling yard area	medium	small	rather large	huge
Do, Index on the project	38	31	64	100
Cost of investment	low	medium	low	high
Balance to the capacity of gantry crane	excellent	good	good	good
Efficiency of works	medium	medium	low	high
Flexibility of works	high	low	medium	high
Damage ratio of containers	low	low	high	very low
Maintenance fee & repair time	high	medium	high	low
Application of automation	medium	easy	medium	medium

N.B. S.C.: Straddle carrier system
T.C.: Transfer crane system

1.12.3 Construction Plan and Cost Estimate

The two places, Pangaon and Pagla, of the proposed container terminal are further divided by four different container handling systems as mentioned straddle carrier, transfer crane, forklift and chassis. Consequently, Pangaon site for the container terminal with straddle carrier system has been selected for the Master Plan and the Short-Term Plan. The rough cost for the Master Plan is as follows;

- infrastructure & upper structure: 1,150 million Taka (included Tax 139 million Taka)
- container handling equipment: 1,015 million Taka (included Tax 382 million Taka)
- access road: 96 million Taka (included Tax 2 million Taka)

Total 2,261 million Taka (included Tax 523 million Taka) the rough cost for the Short-Term Plan is as follows;

- infrastructure & upper structure:	896 million Taka (included Tax 86 million Taka)
- container handling equipment:	629 million Taka (included Tax 234 million Taka)
- *access road*	*55 million Taka*
Total	1,580 million Taka (included Tax 320 million Taka)

On the other hand, the main construction projects in the long-term as well as the short-term development plan will consist of the following works; preparations, temporary work, land reclamation, constructing mooring facilities. marshalling yard, container freight station, and access road., etc.

Figure 1.12.2 shows the operation flow for these construction items.

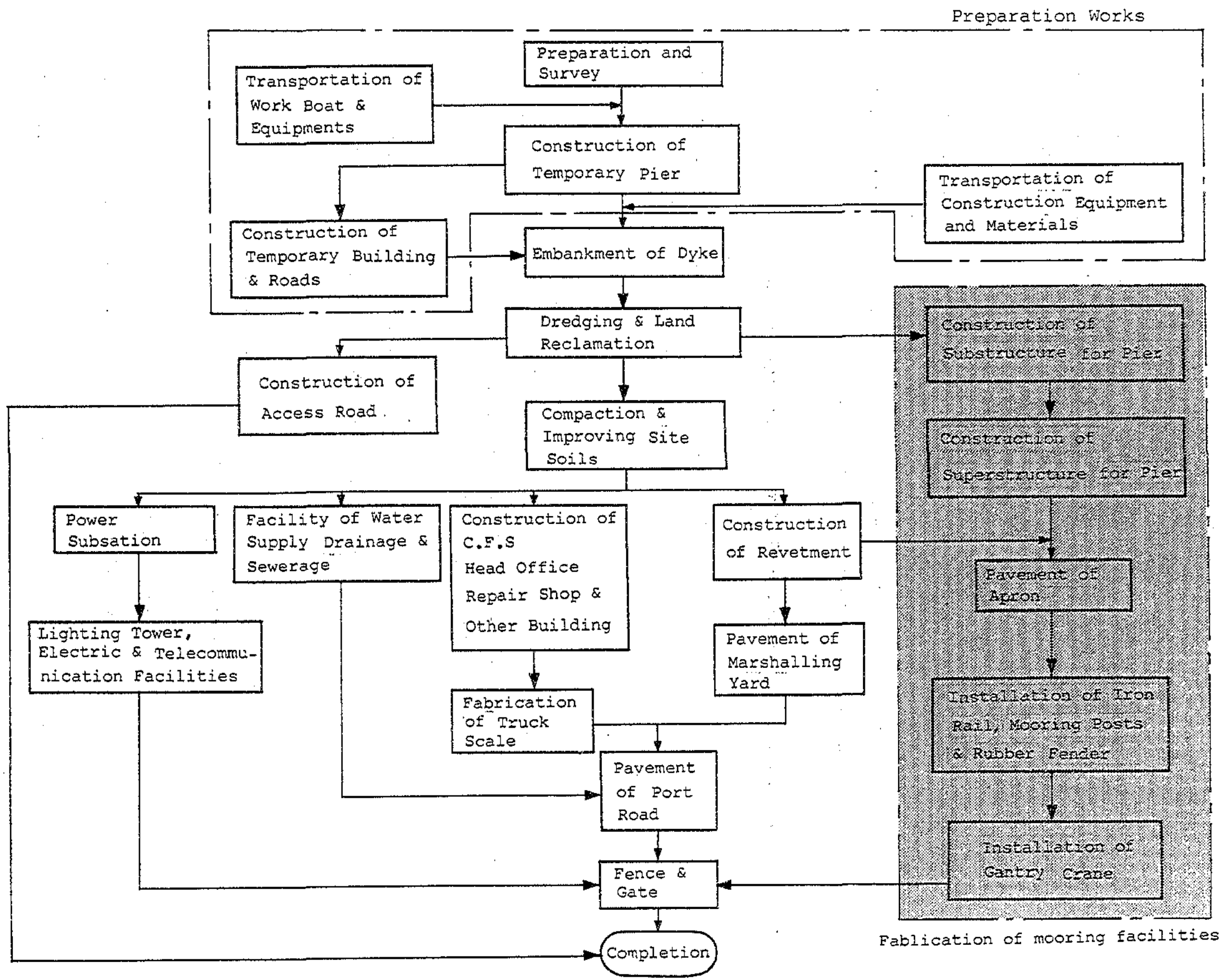


Fig. 1.12.2 Operation Flow for Construction