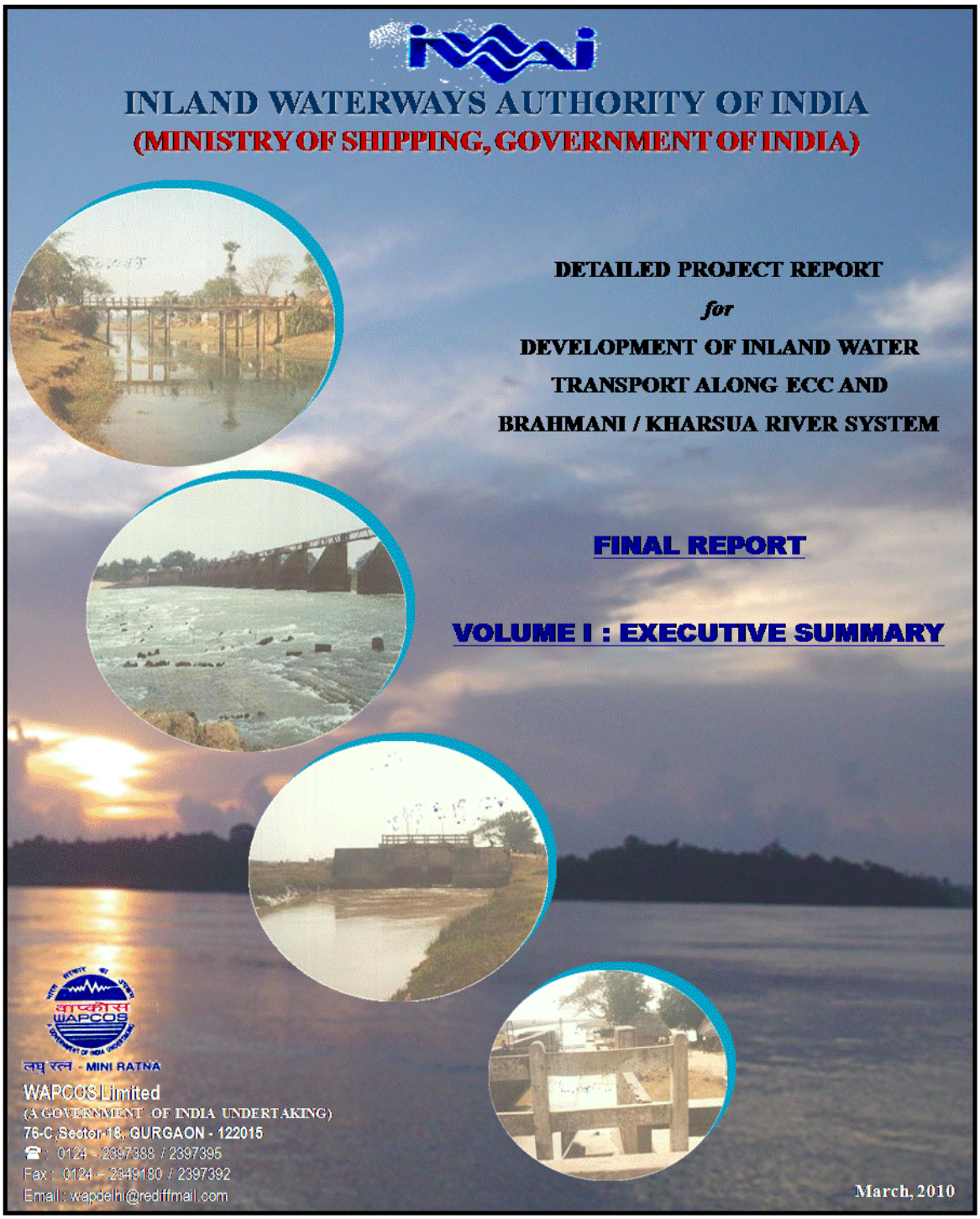
INLAND WATERWAYS AUTHORITY OF INDIA
(MINISTRY OF SHIPPING, GOVERNMENT OF INDIA)
DETAILED PROJECT REPORT
for
DEVELOPMENT OF INLAND WATER TRANSPORT ALONG ECC AND BRAHMANI / KHARSUA RIVER SYSTEM
FINAL REPORT
VOLUME I : EXECUTIVE SUMMARY
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March, 2010

# EXECUTIVE SUMMARY

## 1 INTRODUCTION

In order to give a boost to inter state movement of various products, a canal system was planned in the late 19th century. The canal system running between Paradip in the state of Orissa to Haldia in the state of West Bengal was looked upon as one of the greatest link in the total area from Paradip to Calcutta. The canal portion in Orissa was called Orissa Coast Canal and the portion in Bengal was named as Hijli tidal canal. The canal was opened to traffic during 1883 AD, but due to simultaneous development of railways and road network the canal system could not be utilised to the extent envisaged. Moreover, it is recorded that it was unable to pay for its own upkeep and maintenance and started silting up badly and slowly went out of use. Obvious reasons for this condition can be traced out to then newly created alternative mode of transport, infrastructure and technology available on IWT, which was basically old. Though certain stretches of this canal are still being used by people for movement of agricultural and other cargo by country boats, most part of the canal and its control structures are commonly found out of use and need upgradation /modification if the system is required to be put back in use. Presently the renamed East - Coast Canal (ECC) running between Paradip and Haldia consists of 120 km of natural river/creek portion between Paradip, Dhamra and Charbatia and 217 km of canal between Charbatia & Geonkhali including the intervening rivers and creeks.

The Brahmani/Kharasua/Mahanadi river system, which flows along the Talcher coal deposits and iron ore mines at Daiteri, can be made navigable round the year after taking proper regulatory measures.

## 2 THE WATERWAY

The waterway comprises the canal section and the river section. " The canal section" is the combination of the old Hijli Tidal Canal and the Orissa Coast Canal , together called the East Coast Canal (ECC). The ECC runs from Geonkhali on the right bank of the river Hooghly (approx. 34 nautical miles or 68 km downstream from Calcutta Port) to the Charbatia lock, where the canal joins to the river Matai and thereafter through the river section to the port of Paradip. The lengthwise distribution of the proposed waterway is given below:

| | |
|---|---|
| ➢ Geonkhali to Charbatia | 217 km |
| ➢ Charbatia to Dhamra | 39 km |
| ➢ Dhamra to Mangalgadi | 28 km |
| ➢ Mangalgadi to Paradip | 67 km |
| ➢ Talcher to Jokadia | 131 km |
| ➢ Jokadia to Mangalgadi | 106 km |
| **TOTAL** | **588 Km** |

The proposed waterway has been classified into the following three stretches as given below:

**(i) Stretch I : Talcher to Mangalgadi (237km)**

**(ii) Stretch II : Dhamra to Paradip (95km)**

**(iii) Stretch III : Dhamra to Geonkhali (256km)**

The stretches as defined above have been shown in **Figure No. 1 to 3** respectively.

A detailed topographic and hydrographic survey was carried out for the entire length of the waterway i.e. from Charbatia to Geonkahli in canal section and from Talcher to Paradip - Dhamra in river section.

The salient features of canal and river sections as revealed from the field surveys and investigations are given below : -

**Brahmani- Kharsua-Mahanadi river system :**

The Brahmani, Kharsua and Mahanadi river system mainly constitutes the river portion to be developed for proposed waterway and described in various sub-stretches as given below:

**Talcher to Jokadia**

River Brahamani from Talcher to Jokadia has a length of 131 kms and average slope of 35cm/km with maximum discharge of 9701 $m^3$ /s. The width varies from 137.5 to 2050m. It is a tropical alluvial river with braiding and meandering characteristics and bed and bank erosion. The lean season depth varies from 0.20 m to 0.6m.

**Jokadia to Singhpur**

The discharge flows d/s through the weir at Jokadia along the Kharsua river. Its width varies from 90m to 880m. From Jokadia to Singhpur for a distance of 60 kms the average slope is 16cm/km. This stretch is not influenced by the tidal effect and the present depth is dependent on the discharge from Jokadia weir. The lean season depth varies from 1.5m to 6m.

**Singhpur to Mangalagadi**

The waterway from Singhpur to Mangalagadi for a distance of 44km is a mixed zone influenced both by river discharge and the tides. The width varies from 100m to 800m and depth varies from 1.6m to 10m.

**Mangalgadi to Dhamra**

The waterway from Mangalgadi to Dhamra for a distance of 28 km follows the rivers Brahamani, Dhamra and influenced by tidal effect. The present depth varies from 2m to 12m and width from 350m to 1500m.

**Mangalgadi to Paradip**

The stretch of 67 km from Mangalgadi to Paradip passes through Hansua Nadi, Babar Creek, Nuna Nadi, Gobri Nadi, Ramchandi Galia Nadi, Kharnasi Nadi and Mahanadi river and shown in **Fig. 4**.

The entire stretch is tidal. The width of waterway varies from 16m to 20m in Babar Creek and 10m to 25m in Ramchandi Galia Nadi, whereas the average width is more than 45m in other nadis and rivers. The length of entire stretch is detailed below :

| S.No. | Name of Nadi / River | Length (in km) |
|---|---|---|
| 1 | Hansua Nadi | 13.5 |
| 2 | Babar Creek | 12 |
| 3 | Nuna Nadi | 13 |
| 4 | Gobri Nadi | 7 |
| 5 | Ramchandi Galia Nadi | 13 |
| 6 | Kharnasi Nadi | 3.5 |
| 7 | Mahanadi River | 5 |
| | **Total** | 67 km |

As regards depth in the internal route of Gobri Nadi etc, the depth becomes almost zero during low tides. However, during high tides, it becomes around 1m.

**Canal Section**

The East Coast Canal (ECC) connects the Rupnarayan river through a lock at Geonkhali in Distt. Midnapore, West Bengal, to river Matai through a lock at Charbatia in Bhadrak District, Orissa. The total distance from Geonkhali to Charbatia is 217 km of which 91 km is in the State of West Bengal and the rest in Orissa. The canal has a broadly N-S orientation and runs more or less parallel to and roughly 5 km from the east coast.

The construction of the canal started in 1880 and the canal was opened in 1885 for navigation. As the rivers in this part of West Bengal and Orissa follow easterly course and fall into the Bay of Bengal, the ECC crosses several rivers such as Haldi, Rasulpur, Subarnarekha, Panchapada, Budhabalanga. Crossing of all these rivers is done by means of `locks', one on each bank of the river to be crossed. These locks (on left and right banks of each river) are not always at exactly opposite points across the river but are located as per navigational and other considerations at the time of construction

In entire length of ECC,there are 62 no. of wooden and 31 no. of RCC bridges. Most of these bridges have clearances (Vertical and Horizontal) which are insufficient for all but the smallest boats. In many sections the canal is cut off completely by earthen bunds being built right across the water course. These bunds have been built as pedestrian - ways or kutcha roads across the canal perhaps by local enterprise and self help.

Since the canal remained out of use for a long time not only for navigation but also for irrigation, it has got silted up at many places. Despite this however, it does carry water at many sections & the depth varies from 0m to 1.5m & width varies from 10m to 25m.

## 3 TRAFFIC STUDIES

The proposed waterway passes through the major towns like Talcher, Paradip, Dhamra in the river section and Bhadrak, Balasore, Jaleswar and Haldia in the canal section. The river section of waterway is basically rich in minerals viz. coal, iron ore and industrial products such as Ferro-chrome, steel alloys, tyres, granites and forest products The canal section of waterway carries mainly agriculture production, handicrafts, textiles etc. Moreover, the waterway provide passage for movement of these cargo to consumer centers located along the coastline and to north/north– eastern through NW – 1 / NW – 2.

The likely commodities to use the proposed IWT mode are divided into the following groups :

i. Minerals : Coal, Iron Ore

ii. Agricultural products : Paddy, Rice, Straw, Animal fodder, Jute, Coconut and manure, consumables, fish products.

iii. Finished goods/Manufactured products : Fertiliser, cement, sugar, salt, building materials (sand, bricks, metals, tiles, Asbestos sheets and fabricated steel items), textiles etc.

The potential cargo movement in the entire stretch of waterway projected for next 25 years with a period interval of 5 years and starting with base year 2009 is summarized in the following tables:

## ORIGIN - DESTINATION OF CARGO MOVEMENT ( 2014-2019 ) IN 5 YEARS

| Sl. No. | Commodity | Quantity (in tonne) | Purpose/Agency | From | To |
|---|---|---|---|---|---|
| 1 | **Coal** | 2,000,000 | For Fertilizer Plant | Talcher | Paradip |
| | | 3,000,000 | Thermal Power Plant in U.P, Bihar | Talcher | Geonkhali |
| | | 5,000,000 | For Coastal Thermal Power Station onward dispatch by sea. | Talcher | Paradip |
| 2 | **Finished Goods** | 130,000 | For Marketing and Distribution by manufacturers | Balasore | Paradip |
| 3 | **Manufactured Products** | 800000 | Retailers | Balasore | Paradip |
| 4 | **Agricultural Products** | 140000 | Retailers | Dhamra | Geonkhali |
| **Total** | | **11,070,200** | **11.07mtpa** | | |

## ORIGIN - DESTINATION OF CARGO MOVEMENT (2019 - 2024) IN 10 YEARS

| Sl. No. | Commodity | Quantity (in tonne) | Purpose/Agency | From | To |
|---|---|---|---|---|---|
| 1 | **Coal** | 2,000,000 | For Fertilizer Plant | Talcher | Paradip |
| | | 3,000,000 | Thermal Power Plant in U.P, Bihar | Talcher | Geonkhali |
| | | 5,000,000 | For Coastal Thermal Power | Talcher | Paradip |
| | | 2,500,000 | Station onward dispatch by sea. | Talcher | Dhamra |
| 2 | **Finished Goods** | 160,000 | For Marketing and Distribution | Balasore | Paradip |
| 3 | **Manufactured Products** | 950,000 | Retailers | Balasore | Paradip |
| 4 | **Agricultural Products** | 150,000 | Retailers | Dhamra | Geonkhali |
| **Total** | | **13,750,000** | **13.75mtpa** | | |

## ORIGIN - DESTINATION OF CARGO MOVEMENT (2024 - 2029) IN 15 YEARS

| Sl. No. | Commodity | Quantity (in tonne) | Purpose/Agency | From | To |
|---|---|---|---|---|---|
| 1 | **Coal** | 2,000,000 | For Fertilizer Plant | Talcher | Paradip |
| | | 3,000,000 | Thermal Power Plant | Talcher | Geonkhali |
| | | 5,000,000 | For Coastal Thermal Power | Talcher | Paradip |
| | | 5,000,000 | Station onward dispatch by sea. | Talcher | Dhamra |
| 2 | **Finished Goods** | 1,830,000 | For Marketing and Distribution | Balasore | Paradip |
| 3 | **Manufactured Products** | 1,080,250 | Retailers | Balasore | Paradip |
| 4 | **Agricultural Products** | 170,000 | Retailers | Dhamra | Geonkhali |
| **Total** | | **18,080,000** | **18.08mtpa** | | |

## ORIGIN - DESTINATION OF CARGO MOVEMENT (2029 - 2034) IN 20 YEARS

| Sl. No. | Commodity | Quantity (in tonne) | Purpose/Agency | From | To |
|---|---|---|---|---|---|
| 1 | **Coal** | 2,000,000 | For Fertilizer Plant | Talcher | Paradip |
| | | 3,000,000 | Thermal Power Plant | Talcher | Geonkhali |
| | | 5,000,000 | For Coastal Thermal Power | Talcher | Paradip |
| | | 10,000,000 | Station onward dispatch by sea. | Talcher | Dhamra |
| 2 | **Finished Goods** | 2,100,000 | For Marketing and Distribution | Balasore | Paradip |
| 3 | **Manufactured Products** | 1,120,000 | Retailers | Balasore | Paradip |
| 4 | **Agricultural Products** | 200,000 | Retailers | Dhamra | Geonkhali |
| **Total** | | **23,430,000** | **23.43mtpa** | | |

**ORIGIN - DESTINATION OF CARGO MOVEMENT (2034 - 2039) IN 25 YEARS**

| S. No. | Commodity | Quantity (in tonne) | Purpose/Agency | From | To |
|---|---|---|---|---|---|
| 1 | **Coal** | 2,000,000 | For Fertilizer Plant | Talcher | Paradip |
| | | 3,000,000 | Thermal Power Plant | Talcher | Geonkhali |
| | | 5,000,000 | For Coastal Thermal Power | Talcher | Paradip |
| | | 10,000,000 | Station onward dispatch by sea. | Talcher | Dhamra |
| 2 | **Finished Goods** | 2,110,000 | For Marketing and Distribution | Balasore | Paradip |
| 3 | **Manufactured Products** | 1,120,000 | Retailers | Balasore | Paradip |
| 4 | **Agricultural Products** | 200,000 | Retailers | Dhamra | Geonkhali |
| **Total** | | **23,430,000** | **23.43mtpa** | | |

## 4 VESSEL DIMENSIONS PROPOSED

The design vessel size for two way navigation in canal portion and river portion has been worked out and given below:

| Parameters | River portion | Canal portion | |
|---|---|---|---|
| | **45m wide & 2.0m deep channel** | **Alternative I 32m wide & 2.0m deep channel** | **Alternative II 45m wide & 2.0m deep channel** |
| **Length** | 50m | 40m | 50m |
| **B** | 11.0m | 9.0m | 11.0m |
| **D** | 1.8m | 1.6m | 1.8m |
| **DWT** | 500t | 300t | 500t |

## 5 WATERWAY HYDRAULICS

The requirement of navigable depth of 2 m for a channel of 45m bed width in river portion and 32m/45m bed width in canal portion has been analyzed stretch wise.

**a) Stretch I : Talcher to Mangalgadi (237km)**

It is observed that discharge available in river Brahmani from Talcher to Jokadia works out to be 55 cumecs during lean season and discharge of 110 cumecs is required to ensure a navigable depth of 2 m in a channel of 45 m bed width. It is therefore proposed to provide a Nos. of barrages from Talcher to Jokadia to ensure 2m depth of water.

From Talcher to Jakodia, a total no. of 5 barrages have been proposed at the locations as given below.

| S.NO. | Name of Barrage | Distance from Samal barrage in km | Location (Name of Village/Town/District) |
|---|---|---|---|
| 1 | Barrage – 1 | 52 | Near Village Renthapat |
| 2 | Barrage – 2 | 78 | Near Village Indrajit |
| 3 | Barrage – 3 | 104 | Near Village Gobindapur |
| 4 | Barrage – 4 | 130 | Near Village Bartanda |
| 5 | Barrage – 5 | 148.5 | Near Village Matila |

The stretch from Jokadia to Singhpur for a distance of 60 km is non-tidal and water available depends on discharge passing through Jokadia weir.It has been found that a navigable depth of 2m would be maintained downstream of Jokadia.

The stretch from Singhpur to Mangalgadi for a distance of 42 km is a mixed zone influenced by river discharge and tidal effect. The navigable depth of 2 m is available for movement of barges by dredging the bed.

**b) Stretch II : Dhamra to Paradip (95 km)**

The stretch constitutes the waterway from Dhamra to Paradip. In this stretch, the navigable depth is available as it lies in natural creeks and tidal zones and intercepted by rivers and delta regions

**c) Stretch III : Dhamra to Geonkhali (256km)**

The ECC crosses several rivers such as Haldi, Rasulpur, Subarnarekha, Panchapada, Budhabalanga in its entire length and it has been proposed to provide a total no. of 23 locks to provide a passage for movement of barge from one level to other.

The navigable depth of 2 m can be maintained in canal by passing water from contributing river into the canal through locks and providing a bed slope of 1 in 5000 to the canal.

## 6 LAND ACQUISITION/RIGHT OF WAY

The land to be acquired to develop the proposed waterway has been determined for both alternatives and summarized below:

**a) Alternative I : 32 m Wide Canal**

It would be required to acquire land of 35 ha for terminals and 2018 ha to maintain section of canal for 32m bed width of canal.

**b) Alternative II : 45m Wide Canal**

It would be required to acquire land of 35 ha for terminals and 2344 ha to maintain section of canal for 45m bed width of canal.

## 7 ENGINEERING WORKS

There are various engineering works proposed to be carried out to make the waterway navigable for movement of barges and briefly described below:

### a) Dredging

In order to maintain the required slope, the dredging has been proposed in river and canal section of the waterway. The stretchwise quantity is summarized below.

| Sl. No. | Name of Stretch | Quantity of Dredging (in $Mm^3$) |
|---|---|---|
| 1 | Stretch I : Talcher to Mangalgadi | 4.22 |
| 2 | Stretch II : Dhamra to Paradip | 5.85 |
| 3 | Stretch III : Dhamra to Geonkhali | |
| a | Alternative I – 32m wide canal | 44.76 |
| b | Alternative II – 45m wide canal | 62.76 |

### b) Barrages

To maintain a navigable depth of 2m in between Talcher to Jokadia, total no. of 5 barrages with navigation lock have been proposed at the locations as already discussed.

### c) Raising of Bank

The construction of barrages would ensure the availability of water depth of 2 m for a distance of 26 km on its upstream side. It is proposed that the existing bank levels would be raised by 1.5 m above the required water level in order to store water on upstream side of barrage and to prevent submergence of land beyond existing banks. The quantity of filling required for raising left and right bank on upstream of barrages have been worked out as 23.815 $Mm^3$

**d) Protection measures**

On the basis of topographic and hydrographic survey, it is observed that there are various bends and curves in the river section of waterway. To prevent the banks from meandering action of river, it is therefore proposed to provide stone pitching on banks for a suitable distance in these bends and curves. The quantity of protection measures has been worked out as 0.804 $Mm^3$.

**e) Bridges**

It is observed that there are five bridges existing in stretch I from Talcher to Mangalgadi. As per the Classification of Inland Waterways in India, the minimum horizontal and vertical clearance required for structures across river is as given below:

| Class of Waterway | Minimum Horizontal Clearance between piers | Minimum Vertical Clearance above HTL/FSL |
|---|---|---|
| | (in m) | (in m) |
| III* | 50 | 7 |

* Class III waterway refers to navigable channel with minimum of 1.7m depth, 50m bottom width, 700m bend radius in river.

On the basis of salient details of these bridges (Refer Table 2.9),it is understood that the horizontal clearance between piers under these bridges varies from 33m to 52m and the requirement is to maintain 50m horizontal clearance for Class III waterway to enable movement of 500t barge. It is observed that there is no necessity to construct new bridges in place of exiting bridges where the length varies from 912m to 1420m and thus involves huge expenditure. It is therefore proposed to maintain these existing bridges with the condition that barge would pass cautiously through bridges with reduced speed.

It is observed that existing bridges across ECC lack either having minimum horizontal clearance or vertical clearance or both. It is therefore suggested to provide new foot bridges and road bridges in place of existing ones at these locations so that un-interrupted navigation of barges can take place.

**f) Navigation lock**

For movement of barges from high level to low level in river portion from Talcher to Jokadia, navigation locks have been proposed in the five barrages itself.

The ECC running between Charbatia to Geonkhali is intercepted by various rivers and it is observed that all the existing locks lack minimum clearance of 9m required for entry and exit of 300 tonne barge. It is therefore proposed to construct 23 nos. of new navigation locks in place of existing old ones, in the entire length of ECC so as to provide a mode of transportation of barges from one level to another.

**g) Pipe sluices**

In order to drain off storm water from adjoining catchment area along the entire length of ECC, pipe sluices in the form of non pressure NP2 RCC pipe of diameter 600mm with sump well, have been proposed at an interval of 500m throughout the entire length of ECC.

**h) Navigational Aids**

For safe navigation of barges round the clock, it is necessary to provide navigational aids in the developed waterway. A combination of country boats, buoy, lighted marks and shore beacons has been proposed in waterway as navigational aids for movement of barges round the clock. The estimated quantity of these navigational aids are given below :

| Sl.No. | Item Description | Unit | Quantity |
|---|---|---|---|
| 1 | Country boats | No. | 190 |
| 1. | FRP buoys | No. | 220 |
| 2. | Lighted marks | No. | 500 |
| 3. | Shore beacon | No. | 105 |

## 8 TERMINALS

The terminals are the gateway for the cargo and therefore should be strategically placed near high traffic concentration points in order to allow smooth and uninterrupted traffic between canal/river and hinterland. The following terminals have been proposed in different stretches :

**a. <u>River Section</u>** :

**i. Stretch I : Talcher to Mangalgadi**

Talcher terminal

Jenapur terminal

**ii. Stretch II : Dhamra to Paradip**

Dhamra terminal

Paradip termninal(Port facilities)

**b. <u>Canal Section</u> :**

**Stretch III : Dhamra to Geonkhali**

Balasore terminal

Nasirabad terminal

Geonkhali terminal

The salient features of theses terminals are briefly described below:

**Talcher :** The terminal at Talcher is proposed to load coal from the Talcher coal fields 10-15 km away. In the initial phase, operation to be carried out through feeder road traffic, but in the second phase conveyor systems are proposed to transport coal to the terminal.

**Jenapur:** The Jenapur terminal is specifically oriented to cater iron ores from Japur mines.

**Dhamra :** Only offshore loading facilities using ship's gear for coal and iron ore, is proposed. As a new Port is on the anvil same may be used for transshipment in future

**Paradip :** No new facilities to use the Port handling facilities in the initial operation. However, fully mechanical bulk handling facilities are proposed as the traffic increases. Additional facilities to handle the industrial cargo traffic in containers are also proposed.

**Balasore :** Probably the most important terminal on the canal is proposed to be equipped with both bulk and general cargo facilities.

**Nasirabad** : Feeder terminal for agro products and finished goods

**Geonkhali:** The terminating point of ECC and connecting terminal to carry cargo to the north/north eastern portion through NW -1.

## 9 ENVIRONMENTAL ASPECTS

Certain environment and environmental problems arise as a result of the development, exploitation and management of water resources projects.

Due to execution of the dredging activity, certain effects may occur to the water, however as it would be carried out at identified isolated locations, the resultant effect on river water quality will not be significant. In order to keep the environment free from pollution by dumping of dredged spoil, it is proposed that the spoil be disposed off in the low lying area adjoining the river course, without creating environmental degradation. A detailed environment study is being prepared by M/s CES Ltd., consultant to IWAI on environmental aspects.

The terminals are expected to handle materials like coal, iron ore, food grains, fertilizers, sand, bricks etc. Necessary care would be taken to minimize the adverse effect on the environment due to spillage/ handling of materials while loading/ unloading the same at terminal points. Effects on air and noise pollution shall be negligible. Overall, any significant negative impact on environment is not expected due to the implementation of IWT development in Kolkata - Paradip stretch of East Coast Canal integrated with Mahanadi - Brahmani river system. The advantages are:-

(1) Considerable reduction in vehicular traffic when major portion of road traffic is diverted to IWT.
(2) Savings in cost of fuel, and energy savings.
(3) More employment generation
(4) Development of tourism.

## 10 COST OF ENGINEERING WORKS

The Delhi Schedule of Rate, 2007 published by CPWD has been followed and escalated by 7% per annum to arrive at for year 2009 to arrive at the cost of the project. On the basis of survey & enquiries with land acquisition officer, the cost for land acquisition has been considered as Rs. 7.5 lakhs per hectare.

## 10.1 COST ESTIMATE FOR STRETCH I : TALCHER TO MANGALGADI

To arrive at the total cost for the year 2009, an escalation of 7% p.a. has been assumed w.r.t. base year 2007. Accordingly, a summary of cost involved in various above mentioned items for development of waterway in Stretch I from Talcher to Mangalgadi for the year 2007 and 2009 is given below:

| Sl. No. | Item Description | Cost for year 2007 (in lakhs) | Cost for year 2009 (in lakhs) |
|---|---|---|---|
| 1 | Land Acquisition | 90 | 103 |
| 2 | Dredging | 6543 | 7491 |
| 3 | Barrages with navigation lock | 139593 | 159820 |
| 4 | Raising banks | 21435 | 24541 |
| 5 | Protection measures | 3200 | 3664 |
| 6 | Fenders | 90 | 103 |
| 7 | Terminals | 3489 | 3995 |
| 8 | Navigation Aids | 865 | 990 |
| 9 | Facilities to local people for ferry service etc | 1000 | 1000 |
| | **Total** | **176305** | **201707** |

## 10.2 COST ESTIMATE FOR STRETCH II : DHAMRA TO PARADIP

To arrive at the total cost for the year 2009, an escalation of 7% p.a. has been assumed w.r.t. base year 2007. Accordingly, a summary of cost involved in various above mentioned items for development of waterway in Stretch II from Dhamra and Paradip for the year 2007 and 2009 is given below:

| Sl. No. | Item Description | Cost for year 2007 (in lakhs) | Cost for year 2009 (in lakhs) |
|---|---|---|---|
| 1 | Land Acquisition | 85 | 97 |
| 2 | Dredging | 9654 | 11053 |
| 3 | Protection measures | 203 | 232 |
| 4 | Terminals | 2788 | 3192 |
| 5 | Navigation Locks | 3918 | 4486 |
| 6 | Bridges | 1234 | 1413 |
| 7 | Navigation Aids | 108 | 124 |
| 8 | Facilities to local people for ferry service etc | 500 | 500 |
| | **Total** | **18490** | **21097** |

## 10.3 COST ESTIMATE FOR STRETCH III : DHAMRA TO GEONKHALI

The cost estimate has been worked out for the following two alternatives in developing the waterway from Dhamra to Geonkhali :

a. Alternative I : 32 m Wide Canal

b. Alternative II : 45 m Wide Canal

### 10.3.1 Cost estimate for Alternative I : 32m wide canal

To arrive at the total cost for the year 2009, an escalation of 7% p.a. has been assumed w.r.t. base year 2007. Accordingly, a summary of cost involved in various above mentioned items for development of waterway in Stretch III from Dhamra and Geonkhali for Alternative I : 32m wide canal for the year 2007 and 2009 is given below:

| Sl. No. | Item Description | Cost for year 2007 (in lakhs) | Cost for year 2009 (in lakhs) |
|---|---|---|---|
| 1 | Land Acquisition | 15225 | 17431 |
| 2 | Dredging | 111191 | 127303 |
| 3 | Navigation Locks | 31970 | 36602 |
| 4 | Pipe Sluices | 415 | 475 |
| 5 | Protection measures | 215 | 246 |
| 6 | Bridges | 9226 | 10563 |
| 7 | Terminals | 2700 | 3091 |
| 8 | Navigation Aids | 230 | 263 |
| 9 | Facilities to local people for ferry service etc | 1000 | 1000 |
| | **Total** | **172172** | **196974** |

In addition to cost mentioned in all the stretches , the cost for implementing EMP works has been determined as Rs. 1000 lakhs for base year 2007 as discussed in Chapter 9 and the same has been divided into two parts i.e. Rs.500 lakhs in cost estimate for Stretch I and Rs.500 lakhs in cost estimate for Stretch III.

Taking into account of all the three stretches, total cost involved in developing the entire waterway for 32m bed width in canal portion and 45m bed width in river portion is worked out to Rs. **4210Crore** as summarized below:

| Sl. No. | Item Description | Cost for year 2007 (in lakhs) | Cost for year 2009 (in lakhs) |
|---|---|---|---|
| 1 | Stretch I: Talcher to Mangalgadi | 176805 | 202279 |
| 2 | Stretch II : Dhamra to Paradip | 18490 | 21097 |
| 3 | Stretch III : Dhamra to Geonkhali | 172672 | 197547 |
| | **Total** | **365467** | **420923** |

**Say 4210Crore**

### 10.3.2 Cost estimate for Alternative II : 45m wide canal

To arrive at the total cost for the year 2009, an escalation of 7% p.a. has been assumed w.r.t. base year 2007. Accordingly, a summary of cost involved in various above mentioned items for development of waterway in Stretch III from Dhamra and Geonkhali for Alternative II : 45m wide canal for the year 2007 and 2009 is given below:

| Sl. No. | Item Description | Cost for year 2007 (in lakhs) | Cost for year 2009 (in lakhs) |
|---|---|---|---|
| 1 | Land Acquisition | 17670 | 20230 |
| 2 | Dredging | 156191 | 178823 |
| 3 | Navigation Locks | 45057 | 51586 |
| 4 | Pipe Sluices | 415 | 475 |
| 5 | Protection measures | 215 | 246 |
| 6 | Bridges | 13640 | 15616 |
| 7 | Terminals | 2700 | 3091 |
| 8 | Navigation Aids | 230 | 263 |
| 9 | Facilities to local people for ferry service etc | 1000 | 1000 |
| | **Total** | **237118** | **271330** |

In addition to cost mentioned in all the stretches , the cost for implementing EMP works has been determined as Rs. 1000 lakhs for base year 2007 as discussed in Chapter 9 and the same has been divided into two parts i.e. Rs.500 lakhs in cost estimate for Stretch I and Rs.500 lakhs in cost estimate for Stretch III.

Taking into account of all the three stretches, total cost involved in developing the entire waterway for 45m bed width in canal portion and 45m bed width in river portion is worked out to Rs. **4953 Crore** as summarized below:

| Sl. No. | Item Description | Cost for year 2007 (in lakhs) | Cost for year 2009 (in lakhs) |
|---|---|---|---|
| 1 | Stretch I : Talcher to Mangalgadi | 176805 | 202279 |
| 2 | Stretch II : Dhamra to Paradip | 18490 | 21097 |
| 3 | Stretch III : Dhamra to Geonkhali | 237618 | 271904 |
| | **Total** | **430413** | **495280** |

**Say 4953 Crore**

## 11 ECONOMIC AND FINANCIAL EVALUATION

Economic analysis attempts to measure the overall impact of the project on improving the economic welfare of the citizens of the country. The major benefits of the IWT stretch under consideration relates to the development of Talcher coalfields. Since the existing rail lines are choked, transportation of bulk commodity like coal is only possible through IWT. The waterways has enormous cargo potential for transportation of non-coking coal from Talcher through Brahmani-Kharsua river system to Paradip port for subsequent coastal transportation to thermal power plants. In addition these coals could be transported to Geonkhali using East Coast Canal and then further upstream to thermal power plants in the states of Bihar and Jharkhand. In addition benefits accrue due to setting up of cement plants due to fly ash availability from the thermal plants.

Taking into account the traffic projections carried out for the entire stretch of waterway and cost of development works associated, two options have been broadly identified for economic and financial analysis; one being the river portion consisting of stretch I (Talcher to Mangalgadi) and stretch II (Dhamra to Paradip) and the other being canal portion with Alternative I : 32m wide consisting of stretch III (Dhamra to Geonkhali). Finally, the economic and financial analysis have also been carried out for the combined river and canal portion. The results of EIRR for various options are given below :

| S.No. | Options | EIRR |
|---|---|---|
| 1. | River Portion | 31.76% |
| 2. | Canal Portion with Alternative I : 32m wide | 12.74% |
| 3. | River and canal with Alternative I : 32m wide | 26.09% |

For the development of present waterway involving heavy investments, it becomes very important to analyse the benefits of the owner i.e. IWT/Govt. and the users i.e. barge operator who would use such IWT facility when compared to road. The FIRR has therefore been evaluated for IWT/Government and Users/Barge operator. The results of FIRR for Government/IWAI for all the options are summarised as follows.

| S.No. | Weighted cost of capital | 3% | 6% | 12% |
|---|---|---|---|---|
| | Options | Levy charges (paise per Tonne - km) to earn an IRR equivalent to the weighted cost of capital | | |
| 1. | River Portion | 39 | 53 | 95 |
| 2. | Canal Portion with Alternative I : 32m wide | 224 | 271 | 399 |
| 3. | River and canal with Alternative I : 32m wide | 48 | 63 | 111 |

The results of FIRR for User/Barge Operator for all the options are summarized as follows :

| S. No. | Options | Levy Charge ( Rs. per Tonne - km) to earn an IRR of 12% |
|---|---|---|
| 1. | River Portion | 0.79 |
| 2. | Canal Portion with Alternative I : 32m wide | 1.14 |
| 3. | River & canal with Alternative I : 32m wide | 0.80 |

## 12 CONCLUSIONS AND RECOMMENDATIONS

The following conclusion are drawn from the above table as given below :

a. To earn an FIRR of 3% by Govt./IWT, the levy charges work out to be minimum as 39 Paise per Tonne - km for river portion and maximum as Rs. 2.24 per Tonne - km for canal portion with Alternative I : 32 m wide.

b. To earn an FIRR of 6% by Govt./IWT, the levy charges work out to be minimum as 53 Paise per Tonne - km for river portion and maximum as Rs. 2.71 per Tonne - km for canal portion with Alternative I : 32 m wide.

c. To earn an FIRR of 12% by Govt./IWT, the levy charges work out to be minimum as 95 Paise per Tonne - km for river portion and maximum as Rs. 3.99 per Tonne - km for canal portion with Alternative I : 32 m wide.

d. For user/barge operator, the cargo fare to be charged for earning 12% FIRR works out to be minimum as 79 paise per Tonne - km for river portion and maximum as Rs. 1.14 per Tonne - km for canal portion with Alternative I : 32 m wide.

e. Taking into view of highly favorable EIRR for Govt./IWAI and levy charges in the range of 79 paise to Rs. 1.14 per Tonne-km for all the Options to earn an IRR of 12% by barge operator, it is

concluded that the charges for using terminal and other infrastructural facilities may be absorbed so as to attract users to avail IWT facility.

f. Taking overview of all the activities associated with the development of proposed waterway, it is understood that the barge building facility is the activity that can be taken up under private sector participation/BOT/JV basis.

On the basis of conclusions discussed in previous para, it is understood and recommended that the river portion connecting Talcher to Dhamra and Paradip is economically viable and most attractive as it is commanding an EIRR of 31.76% thus contributing to valuable national upgradation. Moreover, the user/barge operator has sufficient scope to use the river portion of present waterway by charging 79 paise per Tonne - km in comparison to road. Taking into account the past experience of IWAI for not taking levy charges from barge operator in NW I and NW 2, it may be proposed that IWAI may not charge or charge on a nominal basis such as 5 paise per Tonne - km so as to attract the barge operator to use the proposed IWT facility.

**ANNEXURE - I**

## DETAILS OF DREDGING

| S.NO. | RIVER PORTION | DREDGING QUANTITY |
|---|---|---|
| 1 | Stretch I : Talcher to Mangalgadi | 4221356 $m^3$ |
| 2 | Stretch II : Dhamra to Paradip | 5850800 $m^3$ |
| | Total | 10072156 $m^3$<br>Say 10.07 million $m^3$ |
| | **CANAL PORTION** | |
| | Stretch III: Dhamra to Geonkhali | |
| 1 | Alternative I : 32m wide canal | 44768416 $m^3$<br>Say 44.77 million $m^3$ |
| 2 | Alternative II : 45m wide canal | 62768416 $m^3$<br>Say 62.77 million $m^3$ |
| | **Ground Total** | |
| | (River & Canal Portion with Alternative I) | 54840572 $m^3$<br>Say 54.84 million $m^3$ |
| | (River & Canal Portion with Alternative II) | 72840572 $m^3$<br>Say 72.84 million $m^3$ |

**ANNEXURE - II**

## DETAILS OF BRIDGES

| S.NO. | RIVER PORTION | TOTAL NO. OF BRIDGES | BRIDGES REQUIRING MODIFICATION |
|---|---|---|---|
| 1 | Stretch I : Talcher to Mangalgadi | 5 | - |
| 2 | Stretch II : Dhamra to Paradip | 8 | 7 |
| | Total | 13 | 7 |
| | **CANAL PORTION** | | |
| | Stretch III: Dhamra to Geonkhali | | |
| 1 | Alternative I : 32m wide canal | 93 | 93 |
| 2 | Alternative II : 45m wide canal | 93 | 93 |
| | **Grand Total** | | |
| | **(River & Canal Portion with Alternative I)** | **106** | **100** |
| | **(River & Canal Portion with Alternative II)** | **106** | **100** |

**ANNEXURE - III**

## DETAILS OF NEW NAVIGATION LOCKS

| S.NO. | RIVER PORTION | NEW LOCKS PROPOSED |
|---|---|---|
| 1 | Stretch I : Talcher to Mangalgadi | 5 |
| 2 | Stretch II : Dhamra to Paradip | 2 |
| | Total | 7 |
| | **CANAL PORTION** | |
| | Stretch III: Dhamra to Geonkhali | |
| 1 | Alternative I : 32m wide canal | 23 |
| 2 | Alternative II : 45m wide canal | 23 |
| | **Ground Total** | |
| | **(River & Canal Portion with Alternative I)** | 30 |
| | **(River & Canal Portion with Alternative II)** | **30** |

**ANNEXURE - IV**

## DETAILS OF TERMINALS

| S.NO. | RIVER PORTION | NUMBER OF TERMINALS | PLACES |
|---|---|---|---|
| 1 | Stretch I : Talcher to Mangalgadi | 2 | **Talcher Jenapur** |
| 2 | Stretch II : Dhamra to Paradip | 2 | **Dhamra Paradip** |
| | **CANAL PORTION** | | |
| 3 | Stretch III: Dhamra to Geonkhali | | |
| | Alternative I : 32m wide canal | 3 | **Balasore Nasirabad Geonkhali** |
| | Alternative II : 45m wide canal | 3 | **Balasore Nasirabad Geonkhali** |
| | **GRAND TOTAL** | 7 | |