INLAND WATERWAYS AUTHORITY OF INDIA

DEVELOPMENT OF WATERWAY STRETCH BETWEEN PEDAGANJAM TO ENNORE SOUTH OF NORTH BUCKINGHAM CANAL IN NATIONAL WATERWAY - 4

PROJECT FEASIBILITY REPORT

वाप्कोस लिमिटेड
WAPCOS LIMITED
(भारत सरकार का उपक्रम - जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय)
(A Government of India Undertaking - Ministry of Water Resources, River Development & Ganga Rejuvenation)

Flat No: 2C, II[nd] floor, Jai Durga Apartment,
38/2, First Avenue, Ashok Nagar, Chennai-600 083.
Tel.: 24710477 / Tel Fax: 044-24714424
E-mail: chennai@wapcos.gov.in

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1.0 INTRODUCTION

Government of India had declared Six National Waterways (National Waterway-1 to National Waterway-6) for Inland water borne transport. These waterways include river stretches of Ganga and Bhagirathi (NW-1, Haldia to Allahabad), Brahmaputra (NW-2, Sadiya to Dubri), Kerala Backwater canals (NW-3, Kollam to Kottapuram), Krishna-Godavari delta (NW-4, Pondicherry to Kakinada and Bhadrachalam to Rajmundry), Mahanadi – Brahmani - Matai delta (NW-5) and Barak (NW-6, Lakhipur to Bhanga).

These waterways can be developed for navigation of shipping to provide an efficient network of inland water transportation in India. An optimal mix of Road, Rail and Inland waterway transport leads to provide an efficient transport infrastructure that is flexible and cost-effective. Although India has inland waterways with a navigable length of 14,544 km, only 40 percent of this length is currently used for navigation by mechanized vessels.

The Kakinada-Puducherry stretch of Canals and the Kaluvelly Tank, Bhadrachalam - Rajahmundry stretch of River Godavari and Wazirabad - Vijayawada stretch of River Krishna (1095 km) was declared as National Waterway-4 during November 2008. The detailed project report for development of navigation in Kakinada - Puducherry canal along with rivers Godavari and Krishna was prepared by WAPCOS during 2010.

National Waterway No. 4 (NW-4):

The total distance of National Waterway-4 covering Kakinada-Puducherry stretch of Canals and the Kaluvelly Tank, Bhadrachalam - Rajahmundry stretch of River Godavari and Wazirabad-Vijayawada stretch of River Krishna is about 1095 km.

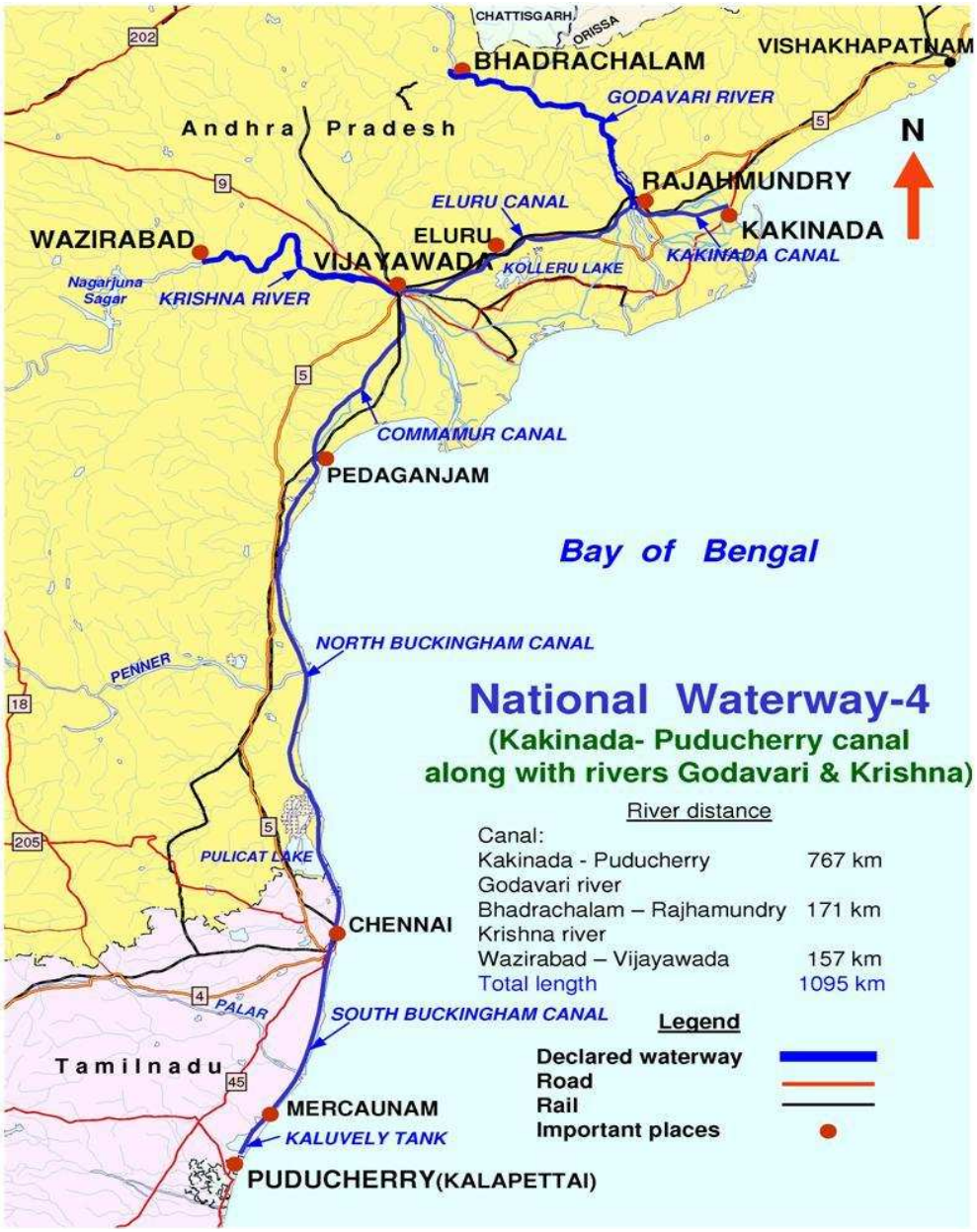


Fig.1: NW-4 Kakinada Puducherry Stretch

2.0 BACKGROUND

IWAI is proposing to develop NBC (North Buckingham Canal) from Ennore Sea mouth to Pedaganjam for about 300 km the initial stage. The second stage for developing irrigation canals i.e., Commamur Canal, Eluru Canal and Kakinada Canal for 302 Km shall be initiated after receiving the assurance from State Government that they shall be supplying adequate water in these canals. In the

final stage, the development of river portion i.e. Krishna and Godavari shall be considered only after completion of construction works of dams and navigational locks across these two Rivers.

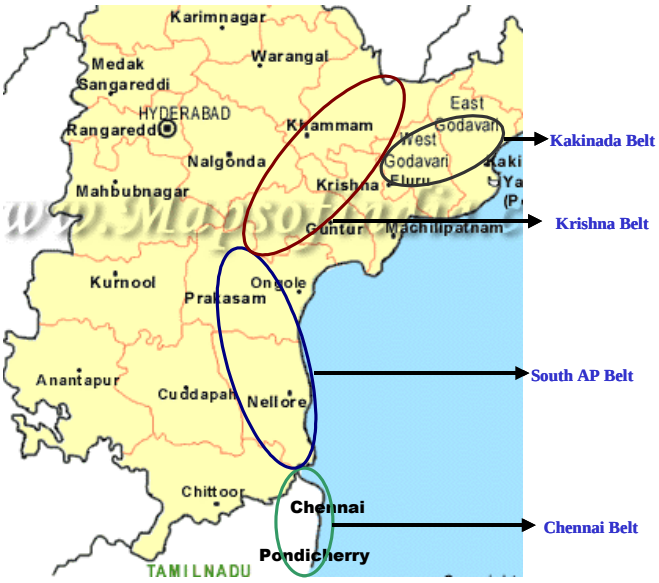
Need for the Project

The Union Government has decided to take up the development of stretch of approx 300 Km stretch of the National Waterway-4 (NW-4) between Padaganjam to Ennore South for development of navigation. The main components of the project includes dredging and excavation to develop the navigational channel, construction of four terminals, review of the existing bridges / Foot bridges and installation of navigational aids.

Major Cargo Belts

The hinterland of Kakinada - Puducherry Inland waterway has been divided into four major cargo belts viz. Kakinada belt, Krishna belt, South AP belt (Padaganjam to Ennore), and Chennai belt. The location of various cargo belts in the hinterland are shown in Figure **2.**.

Figure 2. Profile of Hinterland-Cargo Belts



3.0 PROJECT DESCRIPTION

Buckingham canal

The Buckingham canal is a tidal canal. It was constructed during 19th century along the Coromandal Coast. The main purpose of the canal was to have a lock-in-canal with extensive provision for passing upland discharge so as to retain a surface water level in the canal approximately upto the highest prevailing tide to facilitate inland navigation. The flood gates/locks were provided in various sea mouths to prevent silting caused by daily variation of tides. Locks serve another purpose of creation of impounding facility to retain high water level in the canal between low tides and also during the periods when sea bars are closed. After various stages of improvements and construction of lock chambers, and surplus escapes for drainage, the canal carries only Salt Water. The canal has been divided into two parts:

- North Buckingham Canal
- South Buckingham Canal

The Canal has been re- classified by W.R.O., P.W.D., Govt. of Tamil Nadu as North, Central and South Buckingham Canal for administrative convenience.

North Buckingham Canal

The North Buckingham Canal runs for a distance of 316 km starting from Ramperu Lock and ends at Central Station of Chennai, from where the South Buckingham canal starts .The South Buckingham Canal runs for a distance of 110km and ends at Kovalam lock.

North Buckingham canal has a bed width ranging from 15 m to 30 m. Sea water being the main source of water for the entire Buckingham canal, the North Buckingham Canal has sea connections at several places and sea water enters into the canal during high tides. At present the condition of North Buckingham Canal is such that it remains almost dry. The banks have been eroded. There are

many saltpans all along the canal. During March to July every year, the canal remains totally dry as revealed from the discussions with A.P. Govt. and T.N Govt. authorities. There are following confluences of rivers along the North Buckingham Canal:

1. River Paleru Confluence
2. River Manneru confluence
3. River Musi confluence
4. River Pennar confluence.

The range of the tide is about 0.7 to 1.0 m. The location map of the Stretch between Pedaganjam to Ennore South is shown in **Figure 3**.

The following districts are located in North Buckingham canal as given below:

S. No.	District
1	Nellore
2	Tiruvallur

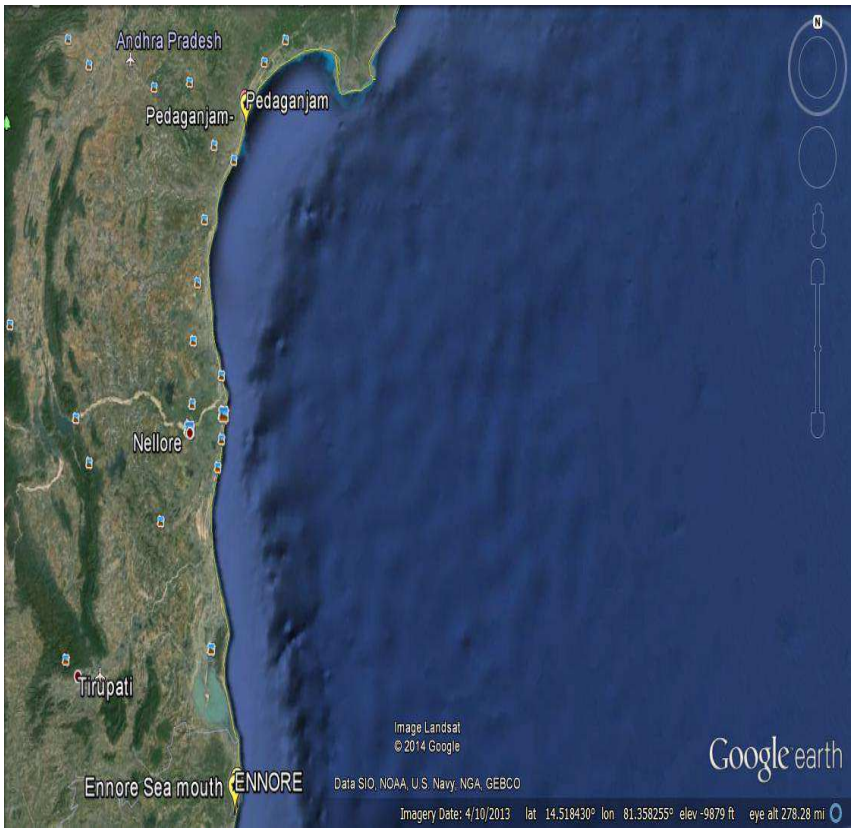


Fig.3: Location Map of the Stretch between Pedaganjam to Ennore South

4.0 PLANNING AND PROPOSED INFRASTRUCTURE

4.1 Terminals

Terminals are the centers of receipt, export, storage, distribution of cargo and embarkation of passengers. Terminals form the hub of connection at transit through various means and modes of transportation. They are the shelters where vessels can berth and load or unload cargo and get its supplies. With development of waterway transport many small and big cities at the same time have grown into political, cultural, economic and trade centres. Many such important towns have developed on the Kakinada-Puducherry Canal route.

In order to meet the need of rapid economic development in the country and also in view of congestion faced in other modes of transport like road and railway, the capacity of inland water transportation has to be increased / created and many terminals along the route have to be built. At present ferry services are operated at many places, for which ghats alongwith temples have been constructed along the banks of canals and rivers. Existing wharves are of marginal type and are mainly for convenience crossing the rivers or canals from one town on one bank to other town opposite the bank of rivers and canals.

Lack of terminal and handling facilities and infrastructure has limited the expansion of inland water transportation rate and full utilization of canals along the waterways and fleets operating thereat. Construction of terminals requires a substantial amount of revenue, either of government or of private companies through BOOT route. Huge investments involved in development of terminals reinforce the need of proper selection of location of terminals.

Inland terminals should be strategically placed in such a way that it serves dual purpose. Enough traffic passes through the terminals and associated hinterland also develops side by side.

The facilities provided at the terminals should meet the traffic demand and should be utilized to the maximum extent possible. As the resources are scarce, the investment made should be economically viable.

Planning for inland terminals and other associated development works should take into account changes in pattern of trade, future expansions, increase in size of vessels etc. Terminals development works while being implemented should ensure proper rehabilitation (R & R) of people displaced by the project.

Influencing factors for Selection of Terminal locations

Basic Conditions

This para deals with the various aspects of the cargo transfer, handling and storage and in consequence planning of terminals in the waterway.

The terminals when judiciously located would go a long way in making the waterway operation a success. Thus terminals are to be located near high traffic concentration points which will enable cargo owners to use IWT in preference to rail/road modes. Terminals are the hubs for inter-modal transfer of cargo and act as interface between the waterway and the hinterland. Accordingly, the main aspects requiring careful consideration for efficient traffic management and thereby effecting in the increased traffic capacity of the entire system are,

- Site condition
- Water area planning
- Navigational aids
- Berths

- Cargo handling systems
- Sufficiency of land provision

Site Conditions

The location of the inland terminal in general depends on many factors, of which the basic criteria are :

- Terminal to be hub in cargo generation and consumption hinterland.
- River front characteristics to be conducive
- Land area availability behind waterfront at terminal

For planning an IWT terminal, inputs on following aspects are needed and the same have been obtained as available.

1. Meteorological conditions
2. Canal/river characteristics
3. Geomorphology of the site
4. Geo-technical conditions
5. Land area requirement and availability
6. Availability of construction material

Construction material availability

Construction of terminal structures are required to be carried out using the locally available materials only. Transportation of these materials would not pose any difficulty. Lack of road infrastructure at certain locations may exist, but waterways can be used to carry these material, in smaller crafts. Therefore, no problem on this account is foreseen. The construction material is available in abundance in the close environs of the waterway.

Proposed Terminal Locations

The following location has been proposed for the Terminals along the North Buckingham Canal from Pedaganjam to Ennore.

- Kottapatnam
- Maipadu
- Durgarajupatnam
- Ennore (South)

Cargo Traffic at Proposed Terminals

The cargo movement features and traffic at the terminals are given below:

Kottapatnam Terminal:

Kottapatnam is a small town situated along Commamur Canal, and is chosen as a terminal from the abundance of forests, the likely traffic of forest products to be moved from Kottapatnam and to be destined to Bhadrachalam upstream. Besides it rice and food grains, granite can be major cargo to be loaded form this terminal and the same can be unloaded at Maipadu, Durgarajapatnam and Chennai downstream.

The traffic projections at Kottapatnam is shown in Table 1.

Table 1: Traffic Projections (in Million Tonne)

Year	Traffic							
	2014-15	**2017-18**	**2022-23**	**2027-28**	**2032-33**	**2037-38**	**2042-43**	**2047-48**
Loading at Kottapatnam	0.131	0.204	0.307	0.438	0.510	0.597	0.699	0.820
Unloading at Kottapatnam	0.140	0.218	0.326	0.463	0.533	0.614	0.708	0.817
Total traffic in Million tonne	**0.271**	**0.422**	**0.633**	**0.901**	**1.043**	**1.210**	**1.406**	**1.637**

This terminal is near Ongole and Kottapatnam Bridge. An alternative site was also identified. The following are the findings of the visit:

Alternative I: At Chainage 284 km (Approx.) and in left bank between 178 km and 179 as per State Govt. records.

- The site is in Southern side of Kottapatnam Bridge
- Land required approx. 300 m x 100 m

Advantages

- High water line available on bank
- Connected to Ongole Kottapatnam Beach road
- Only 50 m away from existing bridge
- Some part of land i.e. survey nos. 1217 and 1913 is already in possession of A.P. Govt., whereas adjacent portion i.e. survey no. 1958 is given on lease for 30 years called DK Temporary Patta land

Problems Envisaged

- Salt water farming using underground bore wells is being carried out all along Buckingham canal and required to be relocated, if the terminal comes up in the land.
- Salt Commissioner's permission is required to acquire the land.

Alternative II – In right bank of Canal on Chainage 284 km

Advantages

- High water line available on bank
- Barren land of Govt. available

Problems Envisaged

- Salt water farming from underground borewell is being carried out all along Buckingham canal and required to be relocated
- Salt Commissioner's permission is required to acquire land.

Disadvantages/Problems

- No accessibility by road
- A new road is required to be constructed
- Ships coming from Commamur Canal will face difficulty in manoeuvering if situated on right bank as other terminals selected are mainly on left bank.

The selected location for Kottapatnam Terminal is Alternative – I.

Maipadu Terminal:

Maipadu at the South Andhra Pradesh along Commamur Canal is another terminal location suggested because of its proximity to heavily industrialized cities of Nellore and Ongole. The traffic to be handled originating from Maipadu is less than the traffic terminating there at. Fish and marine products are the major products to have potential of IWT traffic. Besides rice, food grains are other major cargo to be transported downstream. These can be unloaded at Chennai, a metropolitan city for local assumption and for export purposes. The upstream cargo of salt and fertilizers can move from Chennai and can be unloaded at Maipadu. The traffic projections at Maipadu is given in Table 2.

Table 2: Traffic Projections (in Million Tonne)

Year	Traffic							
	2014-15	**2017-1**	**2022-23**	**2027-28**	**2032-33**	**2037-38**	**2042-43**	**2047-48**
Loading at Maipadu	0.011	0.017	0.027	0.039	0.039	0.046	0.053	0.061
Unloading at Maipadu	0.038	0.059	0.086	0.118	0.132	0.148	0.166	0.187
Total traffic	**0.049**	**0.077**	**0.113**	**0.157**	**0.177**	**0.200**	**0.227**	**0.258**

in Million tonne								

The site is located near the bridge abutting the Maipadu Beach. The Buckingham Canal runs along the sea at this location. Two alternatives were seen.

Area of land required – 30000 m^2

Alternative I – Near the bridge abutting the beach on right bank 2 km from Maipadu village

Advantages

- Adequate waterfront available
- Nearness to road. A pucca road of 3 m wide exists near the selected site.

Disadvantage/Problem

- Land occupied by aqua-farm hatcheries on patta land (Govt. of A.P. has given to private people on lease)
- Cost of land – Too high, because of aqua-farms and structures thereof.
- Falling in CRZ

Alternative II : Near village road survey no. 220

Advantages

- Adequate waterfront available
- Near to Kutcha road survey no. 220
- Barren land available, but on Patta land

Disadvantages/Problems

- Land occupied by aqua-farm hatcheries on patta land

The selected location for Maipadu Terminal is Alternative – II.

Durgarajupatnam Terminal

Durgarajupatnam has been selected for locating the IWT terminal, owing to its vicinity to Krishnapattnam near Nellore. A new port at Krishnapattnam is under consideration. A new Captive Thermal Power Station is coming up in Krishnapattnam. Coal is a major cargo identified to be moved from Bhadrachalam and to be unloaded at Durgarajupatnam besides other location en-route. Rice is another major commodity identified to be moved from Vijayawada and surroundings to Durgarajupattnam besides other locations en-route. Rice is another major commodity identified to be moved from Vijayawada and surroundings to Durgarajupattnam. Fertilisers can also be unloaded at Durgarajupatnam from Kakinada. Upstream cargo of salt can be unloaded at this terminal coming from Chennai. The traffic projections at Durgarajupatnam is given in Table3.

Table 3: Traffic Projections (in Million Tonne)

Year	Traffic							
	2014-15	**2017-18**	**2022-23**	**2027-28**	**2032-33**	**2037-38**	**2042-43**	**2047-48**
Loading at Durgarajupatnam	0.011	0.017	0.027	0.039	0.045	0.053	0.061	0.071
Unloading at Durgarajupatnam	0.038	0.059	0.086	0.118	0.132	0.148	0.166	0.187
Total traffic in Million tonne	**0.049**	**0.076**	**0.113**	**0.157**	**0.177**	**0.201**	**0.227**	**0.258**

This site falls under Wakadu Mandal in Nellore District. The terminal was sited at ½ km from Durgarajupatnam on left bank of Buckingham canal. Two alternatives were seen and the following are the findings from site observation.

Land area required – 300 m x 100 m

Alternative I – Near Marine Police Station and Tsunami rehabilitation colony by ACT, Geneva on left side of R&B road

Advantage

- Adequate and stable water front available
- Well connected with road
- Two plots (Patta lands) no. 676 and 678 can be acquired as these are vacant
- Can be expanded as there are vacant lands available

Disadvantage/problem

- A temple temporarily constructed on plot 676 needs to be demolished.

Alternative II – On right side of R&B road ending at Buckingham canal near Marine Police Station

Advantage

- Adequate and stable waterfront available
- Well connected with road
- Three plots (Patta lands) no. 210,211 and 606 need to be acquired, but they are vacant.

Disadvantage

- Cannot be expanded in future, as Tsunami rehabilitation colony constructed by ATC, Geneva is existing beyond these plots.

The selected location for Durgarajupatnam Terminal is Alternative – I.

Ennore Terminal

Ennore is a big sea port and shippers have shown willingness to shift to IWT mode of transportation owing to it being near sea if a terminal is proposed here. Hence, the IWT terminal is proposed at Ennore. Fertilisers are identified as major cargo to be loaded from this terminal because of Manali fertilizers located at Ennore and to be unloaded at Kottapatnam, Maipadu, Durgarajupatnam,

Vijayawada, Muktiyala, Eluru, Rajahmundry and Kakinada. The traffic projections at Ennore is given in Table 4.

Table 4: Traffic Projections (in Million Tonne)

Year	Traffic							
	2014-15	**2017-18**	**2022-23**	**2027-28**	**2032-33**	**2037-38**	**2042-43**	**2047-48**
Loading at Ennore	0.176	0.251	0.367	0.518	0.620	0.743	0.891	1.069
Unloading at Ennore	0.574	1.007	1.544	2.221	2.557	2.946	3.397	3.920
Total traffic in Million tonne	**0.750**	**1.258**	**1.911**	**2.739**	**3.177**	**3.689**	**4.288**	**4.989**

The terminal is selected because of its proximity to the industrial city of Chennai. Ennore is having many industrial units including a Thermal Power Station. It has a very big port called “Ennore Port Ltd.” Two alternative locations were identified and the following are the findings from site visit:

Land area required 300 m x 125 m

Alternative I – South of Ennore South Lock near Kattukuppam village

Advantage

- Adequate waterfront available (water depth 0.65 to 1.0 m)
- Stable bank available
- No obstruction viz., power line, electric line etc. at the site in heavy industrial area
- Well connected to road (KH Road) and rail
- Electricity can be bought from T.N.E.B.

Disadvantage

- The site is at present occupied totally by fishermen – There are pucca/permanent houses in Kattukuppam village.
- The fishermen colony needs to be rehabilitated which is a complex issue.

- The effluent from nearby industries of Ennore is released into the canal, hence fishermen have kept sand bags at Ennore South Lock to control effluents and survive the fish.

Alternative II :Next to Ennore creek bridge no. 44 around 200 m away from bridge on K.H. Road.

Advantage

- Adequate water front available, water depth =1.0 m
- Stable bank available
- No obstruction of power line, electric line at the site
- Situated on K.H. Road in the vicinity of Ennore Creek Rail Bridge
- Adequate barren land available with salt office
- Problem of effluent release into creek is minimal at the site.

Disadvantage/Problem

- Land to be acquired from Salt Department
- Barren land is at present available of size 300 m x 100 m

The selected location for Ennore Terminal is Alternative – II.

Electricity and Water requirement for all Terminals

The electricity and water requirement is described for all the terminals.

The power required for the terminal is as follows:

Sl. No.	Item Description	KW Required
1	Lighting for offices, yards / storages area(covered & open),jetty etc.	200
2	Service equipment, any supplementary cranes etc., water supply pumps from storage	200
	Total	**400**

A provision for 400 kW is to be allocated. Incoming supply voltage from State Electricity Board can be 3.3 kV or 440 Volts depending on the available state supply point voltage. The power supply can be partly supplemented by 100 kW D.G. set for terminal operations in the event of stoppage of city supply. Main incoming supply of 3.3kV or 440 Volts will be reduced as required for through station.

As regards water supply, the river/canal source is to be used. The daily requirement is 10000 lt. per day with 50% to be potable water using water treatment methods. Disposal of used and drainage water is to made to the flowing river at suitable designated point. The water supply system will have an underground storage of 10000 lt. and overhead tank of 5000 lt. Water supply can be drawn from river or municipal supply as would suit conditions.

4.2 Navigational Aids

The proposed estimated quantity of navigational aids viz., lighted marks and shore beacons required on the banks of the stretch of North Buckingham canal is given below:

Sl.No.	Item Description	Unit	Quantity
1.	Lighted Marks	No.	655
2.	Shore beacon	No.	50

4.3 Bridges

As per the Classification of Inland Waterways in India, the minimum horizontal and vertical clearance required for structures across canal is given below

Class of Waterway	Minimum Horizontal Clearance between piers	Minimum Vertical Clearance above HTL/FSL

	(in m)	(in m)
II*	**30**	**5**

* Class II waterway refers to navigable channel with minimum of 1.8m depth, 30m bottom width, 500m bend radius in canal portion.

The width of waterway required for two-way navigation is determined as 32.4 m for movement of 300 t barge in the stretch of North Buckingham canal. It is observed that 18 nos. of bridges as tabulated below do not satisfy the minimum clearance required and therefore needs to be replaced with new bridges at these locations and the same is shown in **Table- 5.**

Table- 5 Details of Bridges

Sl. No	Chainage (in km)	Name of Bridge	Type of Bridge	Length (in m)	Vertical Clearance (w.r.t F.S.L /H.T.L in m)	Horizontal Clearance (between Piers in m)	Bridges requiring Modification
1	17.800	Pallepalem	RCC	30.0	4.4	10	Yes
2	25.600	Kottapatnam	RCC	25	5.2	13.2	No
3	33.600	Itanukkala	RCC	30.0	5.0	10	Yes
4	35.900	Gavandlapalem	Bamboo Bridge	20.0	5.0	10	Yes
5	42.700	Palleru	Wooden Bridge	25.0	5.0	12	No
6	44.000	Kesavapalem	RCC Foot Bridge	54.0	4.0	17.5	Yes
7	46.400	Pallepalem	RCC	30.0	3.5	20	Yes

Sl. No	Chainage (in km)	Name of Bridge	Type of Bridge	Length (in m)	Vertical Clearance (w.r.t F.S.L /H.T.L in m)	Horizontal Clearance (between Piers in m)	Bridges requiring Modification
8	55.700	Pallepalem	Broken RCC	38.0	3.4	5	Yes
9	73.000	Ramayapatnam	RCC	37.5	6.5	11	No
10	76.050	Arularadipalem	RCC	42.0	4.4	11	Yes
11	77.200	Mundevadipalem	RCC Foot Bridge	42.0	(Broken and Not in use)		No
12	84.200	Kotachattnam	RCC	45.0	6.2	11	No
13	108.500	Iskapalle	RCC	28.5	5.6	10	Yes
14	119.600	Ramachandrapuram	RCC	26.0	4.4	10	Yes
15	137.000	Maipadu	Foot Bridge	29.5	4.4	12.1	Yes
16	137.200	Maipadu	RCC Foot Bridge	28.2	4.4	12.5	Yes
17	144.200	Venkannapalem	RCC Jetty	47.0	6.0	12	No
18	145.600	Patavenkatapalem	RCC Jetty	47.0	3.0	7.5	Yes
19	146.000	Mutiayalalapu	RCC Jetty	47.0	6.0	12	No
20	149.600	Yenatipalem	RCC Bridge (Broken)	23.7	1.5	8	Yes
21	150.500	Papattapalem	RCC Foot Bridge	35.0	6.0	10	Yes
22	150.800	Nadiamapattapalem	RCC	28.0	6.5	25	No
23	155.600	Anantapuram	RCC	25.0	5.0	15	No
24	158.400	Nalatur	RCC	25.5	4.5	16	Yes
25	166.800	Mathukuru	RCC	26.0	3.7	10	Yes
26	189.200	Siddhavaram	RCC	22.5	4.8	12	No

Sl. No	Chainage (in km)	Name of Bridge	Type of Bridge	Length (in m)	Vertical Clearance (w.r.t F.S.L /H.T.L in m)	Horizontal Clearance (between Piers in m)	Bridges requiring Modification
27	195.200	Majarapatireddipalem	RCC Jetty Bridge	45.0	6.0	12.5	No
28	196.800	Tupidipalem	RCC Bridge	24.0	6.1	16	No
29	212.800	Monapalem	RCC	27.5	5.7	11.5	No
30	235.300	Sriharikota	RCC	39.5	3.2	12.4	Yes
31	292.000	Kupam Railway Bridge	Iron Girder Railway	25.0	5	20	No
32	292.800	Kupam Road Bridge	RCC	25.0	5	20	No
33	293.600	Ennore Bridge	RCC	25.0	5	20	No
34	296.500	Ennore Bridge (new)	RCC	45.0	4.8	11	No
35	296.700	Ennore Railway Bridge	Iron Girder Bridge	45.0	5.1	11	No
Total Number of bridges requiring modification							**18**

As per Class-II waterway, the total number of Bridges requiring modification is 18 Nos.

4.4 Navigational Lock:

The details of existing 23 no. locks falling in the stretch of North Buckingham canal are given below in **Table - 6**. It is proposed to provide a channel width of 32 m and 300 ton barge would ply in the stretch of North Buckingham Canal. The dimensions of these locks are not suitable for safe passage of 300 ton barge. Hence, it is therefore proposed to provide 23 nos. new locks in place of existing ones for safe passage of 300 ton barges.

Table 6: Details of existing navigational locks in North Buckingham Canal Stretch

Sl.No.	Chainage (km)	Name of Lock	Sill Level (in m)	FSL (in m)	Size of Lock Chamber (in m)	Width at entrance (in m)
1	0	Ramperu Lock	-1.665	2.385	38.1 x 6.1	6.1
2	12	Gundlakamma Lock	-2.155	2.205	38.1 x 6.1	6.1
3	18	Mudigondi Lock	-2.135	2.685	38.1 x 6.1	6.1
4	39.6	Tatepuram Lock (Musi)	-1.557	2.805	38.1 x 6.1	6.1
5	42.6	Palleru Lock	-1.945	2.175	38.1 x 6.1	6.1
6	55.1	Pallepalem lock (N)	-2.250	3.605	38.1 x 6.1	6.1
7	57.5	Manneru lock (S)	-2.250	2.905	41.175 x 6.1	6.1
8	70.6	Elikeru Lock (N)			Destroyed/Missing	
9	70.7	Elikeru lock (S)			Destroyed/Missing	
10	100	Chippaleru Lock (N)	-1.828	1.985	38.1 x 6.1	6.1
11	100.5	Chippaleru Lock (S)	-1.828	1.985	38.1 x 6.1	6.1
12	114.8	Pyderu Lock (N)	-1.615	2.555	38.1 x 6.1	6.1
13	115.2	Pyderu Lock (S)	-1.828	2.625	38.1 x 6.1	6.1
14	128.4	Pennar Lock (N)			38.1 x 6.1	6.1
15	130.2	Pennar Lock (S)			38.1 x 6.1	6.1
16	164.7	Kandaleru Lock (N)			38.1 x 6.1	6.1
17	168.5	Kandaleru Lock (S)			38.1 x 6.1	6.1
18	191.8	Swarnamukhi Lock			38.1 x 6.1	6.1
19	208.4	Pumbli Lock			38.1 x 6.1	6.1
20	270.5	Coromandal Lock	-2.13		39.0 x 5.5 (abandoned)	5.50

Sl.No.	Chainage (km)	Name of Lock	Sill Level (in m)	FSL (in m)	Size of Lock Chamber (in m)	Width at entrance (in m)
21	282.6	Chintamani Lock	-2.13		39.0 x 5.50 (abandoned)	5.50
22	295.8	Ennore Lock (N)	-2.14		39.0 x 5.50	6.1
23	297.8	Ennore Lock (S)	-2.14		39.0 x 5.50	6.1

The salient features for a typical proposed new Navigational lock are as follows:

- No. of lock chamber : 2
- Length of lock chamber : 50 m
- Width of lock chamber : 15m
- Type of superstructure : RCC counterfort
- Height of wall : 7.5m
- Width of out lock walls : 1.0 m
- Width of inner lock walls : 2.0 m
- Type of foundation : Pile Foundation
- Type of Lock Gates : Mitre Gate
- No. of Gates : 8
- Size of Gates : 6m x 15 m
- Length of guide wall : 10m on both banks
- Bed protection : Stone pitching

Hence, it is therefore proposed to provide 23 nos. of new navigational locks in place of existing ones for safe passage of 300 ton barges.

4.5 **Dredging:**

The quantity of dredging required for North Buckingham canal for 32m bed and depth 1.8m from 0km to 297km has been worked out and are given below in **Table - 7**.

Table- 7 Dredging Quantity

Sl. No.	Location		Chainage (in km)		Quantity of Dredging (in m^3)
	From	To	From	To	
1	Ramperu lock,Peddaganjam	Gundlakamma lock	0.00	12.00	704865
2	Gundlakamma lock	Mudigundi lock	12.00	18.00	367459
3	Mudigundi lock	Musi lock	18.00	40.00	1461947
4	Musi lock	Palleru lock	40.00	43.00	84714
5	Palleru lock	Manneru lock (N)	43.00	55.00	430134
6	Manneru lock (N)	Manneru lock (S)	55.00	58.00	97226
7	Manneru lock (S)	Elikeru lock (N)	58.00	71.00	474699
8	Elikeru lock (N)	Chippaleru lock (N)	71.00	100.00	1724998
9	Chippaleru lock (N)	Ryderu lock (N)	101.00	115.00	117222
10	Ryderu lock (N)	Pennar lock (N)	115.00	128.00	620179
11	Pennar lock (N)	Kandaleru lock (N)	130.00	165.00	1513181
12	Kandaleru lock (N)	Swarnamukhi lock	168.00	192.00	1444928
13	Swarnamukhi lock	Pambali Lock	192.00	208.00	496272
14	Pambali Lock	Coromandal Lock	208.00	270.00	2172057
15	Coromandal Lock	Chintamani Lock	271.00	283.00	399097

16	Chintamani Lock	Ennore Lock (N)	283.00	295.00	552429
17	Ennore Lock (N)	Ennore Lock (S)	295.00	297.00	101414
				Total	**12762821**
				Say,	**12.80 MCM**

4.6 **Raising of Banks:**

The quantity of filling required for North Buckingham canal for 32m bed from 0km to 297km has been worked out and are given below in **Table - 8**.

Table - 8 : Details of Filling Quantity

Sl. No.	**Location**		**Chainage (in km)**		**Quantity of Filling (in m^3)**
	From	**To**	**From**	**To**	
1	Ramperu lock,Peddaganjam	Gundlakamma lock	0.00	12.00	0
2	Gundlakamma lock	Mudigundi lock	12.00	18.00	0
3	Mudigundi lock	Musi lock	18.00	40.00	51800
4	Musi lock	Palleru lock	40.00	43.00	16490
5	Palleru lock	Manneru lock (N)	43.00	55.00	98195
6	Manneru lock (N)	Manneru lock (S)	55.00	58.00	34335
7	Manneru lock (S)	Elikeru lock (N)	58.00	71.00	198015
8	Elikeru lock (N)	Chippaleru lock (N)	71.00	100.00	398335
9	Chippaleru lock (N)	Ryderu lock (N)	101.00	115.00	457805
10	Ryderu lock (N)	Pennar lock (N)	115.00	128.00	12145
11	Pennar lock (N)	Kandaleru lock (N)	130.00	165.00	1002220

Sl. No.	Location		Chainage (in km)		Quantity of Filling (in m^3)
12	Kandaleru lock (N)	Swarnamukhi lock	168.00	192.00	325945
13	Swarnamukhi lock	Pambali Lock	192.00	208.00	655309
14	Pambali Lock	Coromandal Lock	208.00	270.00	2151186
15	Coromandal Lock	Chintamani Lock	271.00	283.00	520405
16	Chintamani Lock	Ennore Lock (N)	283.00	295.00	340235
17	Ennore Lock (N)	Ennore Lock (S)	295.00	297.00	14500
				Total	**6276920**
				Say,	**6.28 MCM**

5.0 Land Details

The land area to be acquired for 100m wide corridor of Buckingham Canal is given in Table 9:

Table 9: Area to be acquired in North Buckingham Canal (Andhra Pradesh Stretch – 258 km)

S. No.	Chainage	Area to be acquired	Location
1	0-2	5	Peddaganjam
2	2-7	12.5	
3	7-12	11	
4	12-17	12.5	
5	17-22	10	
6	22-27	10	
7	27-32	10	

S. No.	Chainage	Area to be acquired	Location
8	32-37	7.5	
9	37-42	7.5	
10	42-47	10	
11	47-52	0	
12	52-57	0	
13	57-62	0	
14	62-67	0	
15	67-72	0	
16	72-77	0	
17	77-82	0	
18	82-87	0	
19	87-92	0	
20	92-97	0	
21	97-102	0	
22	102-107	0	
23	107-112	0	
24	112-117	0	
25	117-122	0	
26	122-127	0	
27	127-132	5	
28	132-137	10	
29	137-142	7.5	
30	142-147	7.5	
31	147-152	0	
32	152-157	0	
33	157-162	0	
34	162-167	0	
35	167-172	0	

S. No.	Chainage	Area to be acquired	Location
36	172-177	0	
	TOTAL	126	
37	178.5-316	3.9	Tada
	TOTAL	**129.9**	

Area to be acquired in North/South Buckingham Canal

(Tamil Nadu Stretch)

S. No.	Chainage (km)	Area to be acquired (ha)
North Buckingham Canal		
1	Chainage 2.74-16.35	
	Patta Land	4.256
	Poramboke Land	13.264
	Encroachment Area	5.156
2	Chainage 18.4-58	
	Poramboke Land	52.95
	TOTAL	**75.626**

6.0 COST ESTIMATE

The cost for development of Stretch between Padaganjam to Ennore South of North Buckinham Canal of National Waterway-4 shall be Rs.35313.15 Lakhs. The breakup details are given in Table 10.

Table 10: Details of cost breakup

S.No	Name of work	Qty	Cost (Rs.)	Total Amount (Rs. In Lakhs)
1	Land Acquisition	205.52 Hectare	25,00,000.00	5138.15
2.	Dredging	12.80Mcum	200.00	25600.00
3.	Navigational Locks	23 Nos.	13,90,000.00	319.00
4.	Bridges	18 Nos.	40,00,000.00	720.00
5.	Terminals	4 Nos.	8,34,00,000.00	3336.00
6.	Navigational Aids	200 Nos.	1,00,000.00	200.00
		TOTAL	**Rs. In Lakhs**	**35313.15**